



# BIOEM 2016

5-10 June 2016, Het Pand, Ghent, Belgium

The Joint Annual Meeting of  
The Bioelectromagnetics Society and the  
European BioElectromagnetics Association  
co-organized with the European COST EMF-MED Action BM1309

## *Technical Program and General Information*



## European BioElectromagnetics Association Council

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Executive Secretary	Micaela Liberti	Italy
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Engineering/Physical Sciences	Marta Parazzini	Italy
At Large	Wout Joseph	Belgium
At Large	John Tattersall	United Kingdom
At Large	Mats-Olof Mattsson	Austria
At Large	Mirjana Moser	Switzerland

## The Bioelectromagnetics Society - Officers and Board of Directors

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## Local Organizing Committee



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Co-chairs  
Belgium



Wout Joseph  
Co-chairs  
Belgium



Suleyman  
Dasdag  
Turkey



Niels Kuster  
Switzerland



Richard  
Nuccitelli  
United States



Andrew Wood  
Australia



Isabelle Van der  
Elstraeten  
Belgium

### From the Co-chairs of the Local Organizing Committee

On behalf of the BioEM2016 Local Organizing Committee, I welcome you to Ghent, Belgium, for the Annual Joint Meeting of the Bioelectromagnetics Society (BEMS) and the European BioElectromagnetics Association (EBEA). This time the BioEM conference is co-organized with the European COST Action BMI309 (EMF-MED: European network for innovative uses of EMFs in biomedical applications). I thank the two societies and the COST Action for the support and help with the organisation.

The conference is held in “het Pand” in Ghent. The city of Ghent is a compact, authentic city where the past and present co-exist in perfect balance. Ghent is one of the most beautiful historic cities in Europe and was given several pretty names: historic heart of Flanders, a city of all times, medieval Manhattan, Europe’s best kept secret.

Het Pand in Gent is a former Dominican cloister located in the beautiful medieval centre of Ghent and will offer you the opportunity to participate in the premier bioelectromagnetics meeting in an unforgettable environment. The conference centre is located in walking distance from most of the hotels.

On Tuesday the banquet will be held in the Old Fish Market (“Oude Vismijn”). This beautiful building with its baroque facade from 1689 stands near to the old Gravensteen on the Saint Veerle square. You will be arriving at the banquet after a guided historic round-trip on the beautiful waterways of Ghent.

We are very grateful for the generous support of our sponsors, listed both on the meeting website and at the end of this booklet.

Welcome to Ghent! I look forward to seeing you throughout the week. And I wish you an interesting conference with a lot of networking moments and of course a lot of fun.

Luc Martens  
Chair, Local Organizing Committee

## Technical Program Committee



Francesca  
Apollonio  
Co-chair  
Italy



Heidi  
Danker-Hopfe  
Co-chair  
Germany



Niels Kuster  
Switzerland



Luc Martens  
Belgium



Mirjana Moser  
Switzerland



Joachim Schüz  
France



Thomas Vernier  
United States

### From the Co-chairs of the Technical Program Committee

Dear Colleague,

It is a great pleasure to welcome you to Ghent for the Joint Annual Meeting of the Bioelectromagnetics Society (BEMS) and European Bioelectromagnetics Association (EBEA), BioEM2016. The Annual Meeting provides a unique opportunity for researchers, experts, and students to meet and interact, to discuss and share knowledge, to enjoy and appreciate all the potentialities of the bioelectromagnetic field.

This year for the first time the BioEM conference has been co-organized with the European COST Action BMI309 (EMF-MED: European network for innovative uses of EMFs in biomedical applications) witnessing the interesting perspectives of medical applications of electromagnetic fields.

We are happy that the invited program came out on the basis of the proposals of our scientific community that is confirmed to be of great vitality providing interesting and new ideas. The Technical Program Committee worked with a good harmony as a unique team finalizing a meeting that consists of five Plenary Sessions, one for each day, and three Tutorials Sessions. Three workshops have been proposed and organized within the framework of the Meeting, by members of the societies.

The plenary sessions ('A safe evolution for Wireless Power Transfer'; 'Characterization and manipulation of cells with E fields'; 'Can we induce adaptive response with EM stimulation'; 'Need of a breakthrough in clinical application of hyperthermia'; 'New avenues of epidemiological research') will cover most of the key issues of bioelectromagnetics, with the aid of some of the most distinguished speakers in each area.

The three tutorials are intended to develop basic knowledge on regulatory aspects, to give an overview on measurements issues and to provide insights on the rational basis for clinical applications.

More than 300 papers from 36 different countries all over the world were submitted, and after reviewing the abstracts, the Technical Program Committee assigned them into 14 oral Platform Sessions and two Poster Sessions, preceded by Flash Student Poster presentations. A strong participation of students (about 50 submitted abstracts) demonstrates the ability of our Societies to attract young researchers and it gives hope for a continuous renewal of our community.

As usual the abstract review process has been given extreme attention with the aim of keeping high the quality of the meeting. The BEMS Board, the EBEA Council, COST representatives and other scientists from our community have acted as reviewers; each submitted abstract was scored by at least three referees.

BioEM2016 will host a tight number of awards and recognitions. We will start with the prestigious d'Arsonval Award from BEMS, which will be presented this year to Prof. Kenneth Foster, in recognition of his outstanding achievements in various fields of bioelectromagnetics.

BioEM2016 continues the tradition of the Chiabrera Lecture for Excellence in Bioelectromagnetics, an

honor bestowed on an outstanding young researcher by EBEA. Finally, the traditional awards of the students, the last day of the meeting, are increased by a new one: the Arthur Pilla Young Scientist Award, which will be awarded to the best presentation by a young scientist at the annual BioEM Meeting.

This meeting would not have been possible without the contribution of many individuals. We thank for the strong efforts and dedication the members of the Technical Program Committee, the referees who diligently reviewed and scored all the submitted abstracts, as well as Jeffrey Carson and Astrid Chamson-Reig from Lawson Health Research Institute in Canada who have supported us with hard work and constant contributions, which have been essential for the final result.

Furthermore our personal thanks go to Luc Martens and the Local Organizing Committee, to Nam Kim, BEMS President and to Eric van Rongen, EBEA President.

On behalf of the Technical Program Committee, we conclude thanking you for your participation and support to BioEM2016 conference and we hope that you will appreciate our work and enjoy the meeting!

Francesca Apollonio and Heidi Danker-Hopfe  
Co-Chairs, Technical Program Committee, BioEM2016

# Technical Program Review Committee



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United States



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Apollonio  
Italy



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United States



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United States



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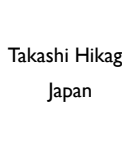
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Japan



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Sarah Loughran  
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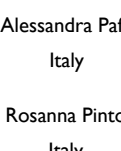
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Rosanna Pinto  
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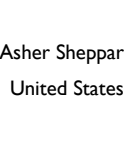
Andrei  
Pakhomov  
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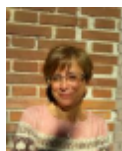
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Stefania Romeo  
Italy



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Myrtil Simko  
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John Tattersall  
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Shoogo Ueno  
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Eric Van Rongen  
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Marthinus  
Van Wyk  
South Africa



Thomas Vernier  
United States



Jonna Wilen  
Sweden



Andrew Wood  
Australia



Olga Zeni  
Italy

## Schedule at a Glance

NO PHOTOS ARE ALLOWED DURING THESE PRESENTATIONS

### Thursday, June 2, 2016

Time	Session	Name	Location
08:00 - 12:00	ICES1	TC95/Subcommittee 1: Techniques, Procedures, Instrumentation and Computation	Zaal Rector Vermeylen
13:00 - 17:00	ICES2	TC95/Subcommittee 2: Terminology, Units of Measurements and Hazard Communication	Zaal Rector Vermeylen
17:30 - 19:00	ICES3	AdCom	Zaal Rector Vermeylen

### Friday, June 3, 2016

Time	Session	Name	Location
09:00 - 15:30	ICES4	TC95/Subcommittee 3: Safety Levels with Respect to Human Exposure to Electromagnetic Fields, 0 - 3 kHz and TC95/Subcommittee 4: Safety Levels with Respect to Human Exposure to Electromagnetic Fields, 3 kHz – 300 GHz	Zaal Rector Vermeylen
16:00 - 17:00	ICES5	TC95/Subcommittee 5: Safety Levels with Respect to Electro-Explosive Devices	Zaal Rector Vermeylen
17:00 - 19:00	ICES6	COMAR	Zaal Rector Vermeylen

### Saturday, June 4, 2016

Time	Session	Name	Location
09:30 - 11:30	ICES7	TC95/Subcommittee 6: EMF Modeling and Dosimetry	Zaal Rector Vermeylen
12:30 - 16:00	ICES8	ICES TC95 Main Committee	Zaal Rector Vermeylen

### Sunday, June 5, 2016

<b>Time</b>	<b>Session</b>	<b>Name</b>	<b>Location</b>
09:00 - 14:00	M1	BEMS Board Meeting	Persconferentiezaal
09:30 - 11:30	ICES9	IEEE ICES open house	Zaal Rector Vermeylen
13:00 - 17:30	MMF	MMF Workshop - EMF Exposure Limits and Compliance Assessment of Future Wireless Devices Above 6 GHz	Zaal Rector Vermeylen
14:00 - 18:00	M2	EBEA Council Meeting	Zaal Rector Gillis
18:30 - 20:30		Welcome Reception	Refter
20:30 - 00:30		Student Ice Breaker	Wasbar

### Monday, June 6, 2016

<b>Time</b>	<b>Session</b>	<b>Name</b>	<b>Location</b>
08:30 - 09:00	OC	Welcome - Introduction	Refter
09:00 - 10:00	PI	Plenary I: A "safe" evolution for Wireless Power Transfer: the EM compliance of systems and devices	Refter
10:00 - 10:30		Coffee Break	Kapittelzaal
10:30 - 12:30	S1	Molecular and cellular responses to RF exposure	Refter
10:30 - 12:30	S2	Instrumentation, measurements and protocols	Zaal Rector Vermeylen
12:30 - 13:30		Lunch	Kapittelzaal
13:30 - 14:30	FA	Student Flash Poster Session A	Refter
14:30 - 16:00	PA	Poster Session A	Kloostergang & Novicengang
16:00 - 16:30		Coffee Break	Kapittelzaal
16:30 - 18:10	S3	Pulsed electric fields: theoretical and experimental modelling	Refter
16:30 - 18:10	S4	In vivo exposure	Zaal Rector Vermeylen



**Tuesday, June 7, 2016**

<b>Time</b>	<b>Session</b>	<b>Name</b>	<b>Location</b>
08:30 - 09:30	T1	Tutorial 1: Standards development activities of the IEEE International Committee on Electromagnetic Safety	Refter
08:30 - 09:30	T2	Tutorial 2: How to conduct personal radiofrequency electromagnetic field measurement surveys	Zaal Rector Vermeylen
09:30 - 10:15	P2	Plenary 2: Characterization and manipulation of cells with E fields	Refter
10:15 - 10:45		Coffee Break	Kapittelzaal
10:45 - 11:45	DA	The d'Arsonval Lecture	Refter
11:45 - 12:45	FB	Student Flash Poster Session B	Refter
12:45 - 14:00		Lunch	Kapittelzaal
12:45 - 14:00	M3	EBEA General Assembly	Refter
14:00 - 15:30	PB	Poster Session B	Kloostergang & Novicengang
15:30 - 16:00		Coffee Break	Kapittelzaal
16:00 - 17:40	S5	Human studies: ELF and RF	Refter
16:00 - 17:40	S6	Electromagnetic interference on implanted devices	Zaal Rector Vermeylen
18:00 - 19:15		Boats to the Conference Banquet	Waterways of Ghent
19:15 -		Conference Banquet	Oude Vismijn

**Wednesday, June 8, 2016**

<b>Time</b>	<b>Session</b>	<b>Name</b>	<b>Location</b>
08:00 - 09:00	HT	Hot Topic Plenary - The US NTP Study: A Real Game Changer or Just Another Study?	Refter

09:00 - 10:00	P3	Plenary 3: Can we induce adaptive response with EM stimulation? The new frontier of immune system and EM field interaction	Refter
10:00 - 10:30		Coffee Break	Kapittelzaal
10:30 - 11:00	CL	Chiabrera Lecture	Refter
11:00 - 12:40	S7	Computational models for medical applications	Zaal Rector Vermeylen
11:00 - 12:40	S8	Epidemiology studies	Refter
12:45 - 14:00		Lunch	Kapittelzaal
12:45 - 14:00	M4	BEMS Business Meeting	Refter
14:00 - 18:00		Free Afternoon	
14:30 - 16:30	MCM	MCM meeting COST Action BMI309: European network for innovative uses of EMFs in biomedical applications (EMF-MED)	Refter

**Thursday, June 9, 2016**

<b>Time</b>	<b>Session</b>	<b>Name</b>	<b>Location</b>
08:30 - 09:30	T3	Tutorial 3: "The Erice-EBEA School framework" Neuroprotective effects of EM fields: from preclinical to clinical studies	Refter
08:30 - 09:30	W1	Workshop 1: Spatial averaging: towards a better basis for standard procedures	Zaal Rector Vermeylen
09:30 - 10:30	P4	Plenary 4: Need of a breakthrough in clinical application of hyperthermia: shared knowledge, gaps and challenges	Refter
10:30 - 11:00		Coffee Break	Kapittelzaal
11:00 - 12:40	S09	Pulsed electric fields: from cells to animals	Refter
11:00 - 12:40	S10	Measurements for safety assessment	Zaal Rector Vermeylen

12:45 - 14:00		Lunch	Kapittelzaal
12:45 - 14:00	M5	BEMS-EBEA Merger Meeting	Refter
14:00 - 15:20	SI1	Innovative perspectives for medical applications	Zaal Rector Vermeylen
14:00 - 15:20	SI2	Public Policy and Safety assessment	Refter
15:30 - 16:00		Coffee Break	Kapittelzaal
16:00 - 18:00	W2	Workshop 2: Short workshop on implementation of the EMF Directive	Zaal Rector Vermeylen
16:00 - 18:00	W3	Workshop 3: Single cell electromagnetic exposure and analysis: experimental considerations, coupling of optical imaging techniques, and biological outcomes	Refter

### Friday, June 10, 2016

Time	Session	Name	Location
08:30 - 10:10	SI3	Computational dosimetry	Refter
08:30 - 10:10	SI4	In vitro exposure: static and ELF	Zaal Rector Vermeylen
10:15 - 10:45		Coffee Break	Kapittelzaal
10:45 - 12:15	P5	Plenary 5: New avenues of epidemiological research –added value or old challenges, or both?	Refter
12:15 - 13:15	SA	Student Awards	Refter
12:15 - 13:15	SA	Arthur Pilla Young Scientist Award	Refter
13:15 - 13:30	CC	Closing Ceremony	Refter
14:00 - 18:00	M5	BEMS Board Meeting	Persconferentiezaal
14:00 - 18:00	M6	EBEA Council Meeting	Zaal Rector Gillis

## General Information

### **THE CONFERENCE VENUE**

BioEM2016 will take place at Culture and Convention Center Het Pand, a former Dominican monastery located at Onderbergen 1, in the historic city center of Ghent. The city offers a unique combination of a glorious past with a lively present and invites you to discover its many monuments and museums. Here beats the young heart of a sparkling city full of culture, arts, events and, most certainly just as important, countless cosy pubs and original restaurants. June is one of the warmer months with average temperatures between 13°C (55°F) and 19°C (67°F). All meeting rooms at the venue have complimentary Wi-Fi service.

### **REGISTRATION AND INFORMATION DESK**

When you enter the conference venue through the main entrance, the Registration and Information Desk will be located to the right (see Ground Maps). Please follow the directions.

On Sunday, June 5th, the Registration Desk will be open from 11 a.m. From Monday, June 6th till Friday, June 10th, the Registration Desk will be open from 8 a.m. until the end of the last meeting session.

### **CONFERENCE BADGE**

Badges must be worn at all times during the meeting and during all social events (registered guests as well). Please present a printed version of your ticket (sent to you upon registration) at the Registration Desk to receive your badge and conference bag.

### **CONFERENCE LUNCH AND COFFEE BREAKS**

A sandwich/pasta/salad buffet will be provided on Monday, June 6th, on Tuesday, June 7th, on Wednesday, June 8th, and on Thursday, June 9th in the Kapittelzaal and adjacent garden. Coffee breaks will take place in the same location.

### **SOCIAL EVENTS**

#### **WELCOME FUNCTION**

Sunday, June 5th, 6:30 p.m. at the conference venue (Room: Refter). Expected end time: approximately 8:30 p.m.

#### **STUDENT ICE BREAKER**

Sunday, June 5th, 8:30 p.m. till 0:30 a.m. at the Wasbar (Nederkouter 109), a short walk from the conference venue. We will meet at the conference venue Registration Desk at 8:15 p.m. and then walk in group to the Wasbar.

#### **CONFERENCE BANQUET**

Join us Tuesday, June 7th, 6:15 p.m. at the quay at the Graslei (Gent-Watertoerist) for a guided historic round-trip on the beautiful waterways of Ghent. As it is only a short distance from the conference

venue, we will gather at the Registration Desk at 6:00 p.m. and walk in group to the quay.

The boats are on a tight schedule, so please make sure to be at the quay no later than 6:15 p.m.

The boats will take us to the Oude Vismijn (Sint-Veerleplein, access through the gate next to the bridge) where we will disembark at 7:15 p.m. for a reception and the conference banquet, followed by an after party with DJ.

## TRAVELLING TO GHENT

### REACHING GHENT BY AIR

- **Brussels Airport (BRU)** is one of the major international airports in Europe and is served by most major carriers. Upon landing at this airport, it can take longer than usual to get your luggage because of extra security checks. When you fly back home from Brussels Airport, you need to be 3 hours in advance at the airport as everyone is checked before entering the building. Ghent is only 45 minutes from Brussels Airport, where flights arrive from and depart to more than 70 destinations. There are two direct trains per hour between the airport railway station (Brussel-Nationaal-Luchthaven) and the railway station Gent-Sint-Pieters. In the airport, follow the signs to the railway station, which is below ground level. Buy a ticket for Gent-Sint-Pieters station at the counter in the train station of the airport or online at [www.belgianrail.be/en/](http://www.belgianrail.be/en/).
- **Brussels South Charleroi Airport (CRL)** is 70 minutes from Ghent and is served primarily by low-cost carriers. There is a bus connection from the airport to the Brussel-Zuid (Bruxelles-Midi) railway station every 30 minutes. You can find the timetable on [www.brussels-city-shuttle.com/en/timetable](http://www.brussels-city-shuttle.com/en/timetable). From there, frequent train connections to Gent-Sint-Pieters station are available.
- **Amsterdam Airport Schiphol (AMS)** is the main international airport of the Netherlands. From there, the fastest rail connection to Ghent takes two hours by high-speed train Thalys. You will need to reserve your train seat in advance on the website of NS International or on [b-europe.com](http://b-europe.com). You will take the Thalys to Antwerp Central Station and then switch to a train to Ghent. In the Thalys ticket, travel to all Belgian train stations is included. You can also take trains to Ghent for which no reservation is needed. That will take more than 3 hours.
- **Paris Charles De Gaulle (CDG)** is one of the major international airports of France. From there, the fastest rail connection to Ghent takes two hours and fifteen minutes by high-speed train (TGV, Thalys). You will need to reserve your train seat in advance on the website of [b-europe.com](http://b-europe.com). You will take the TGV or Thalys to Brussel-Zuid (Bruxelles-Midi) Station and then switch to a train to Ghent. In the TGV or Thalys ticket, travel to all Belgian train stations is included.

### REACHING GHENT BY HIGH-SPEED TRAIN FROM PARIS, LONDON, AMSTERDAM

The closest international railway station for high-speed trains is the Brussel-Zuid (Bruxelles-Midi) railway station (arrival of Thalys, TGV, Eurostar, ICE). Regular connections by train to the railway station Gent-Sint-Pieters are available. Train schedules are available at [b-europe.com](http://b-europe.com). Tickets must be booked in advance.

## REACHING THE CONFERENCE VENUE BY PUBLIC TRANSPORT IN GHENT

You can take (in the city center or at Gent-Sint-Pieters station) Tram 1 or Tram 22 and stop at "Korenmarkt". To reach the conference venue, you have to cross the Sint-Michiels Bridge and you will find 'Het Pand' right behind the Sint-Michiels Church on your left-hand side. Google Maps has transit schedules for buses and trams if you need to plan a route from your hotel to the venue. Single tickets cost €3 and are valid for a single journey of up to 60 minutes. One or three day passes may be more convenient and offer more value for money. Tickets and day passes can be purchased from the driver, up front from a vending machine (cash only), or up front at a point of sale.

## REACHING THE CONFERENCE VENUE BY CAR

When you reach Ghent by car, enter the city from the E40 or the E17 motorway. Follow the parking route (P-route) to Parking P7, Sint-Michiels Parking. This parking is located only 50 meters away from 'Het Pand'. You can take the exit Onderbergen and find yourself in the Wilderoosstraat, opposite to 'Het Pand'.

## ORAL AND POSTER PRESENTATION GUIDELINES

Please find below some potentially useful material to assist you in preparing a presentation for BioEM2016.

Papers are to be presented in two basic formats: Oral and Poster Presentations. Below you will find specific information concerning these two formats.

If for any reason you find yourself unable to personally present your paper, please try to arrange for someone else to present it. **If nobody is available to present your work, you must notify the TPC Chairs well ahead of time (at [tpc@bioem2016.org](mailto:tpc@bioem2016.org)). If the presentation does not take place, without having previously notified the TPC, the corresponding abstract will be removed from the online abstract book.**

## NO PHOTOS ARE ALLOWED DURING THESE PRESENTATIONS

### Oral Presentations

All oral presentations have been allocated a 20-minute time slot. These 20-minutes must include the presentation, questions, and transitioning to the next speaker. It is recommended that speakers plan on a 15-minute presentation to allow for 5 minutes of questions. It is important to strictly adhere to this schedule as most oral presentations are scheduled in parallel sessions. Arrive at least 10 minutes early prior to the start of the session and introduce yourself to the chair while familiarizing yourself with the audiovisual equipment and session chair guidelines.

Each meeting room will be equipped with a personal computer to accommodate PowerPoint and PDF presentation formats. Technical support will be present in each meeting room to ensure flawless execution. Authors must load their presentations onto the designated computer at the conference venue during the break before their session. Presenters will not be allowed to connect their own computer to the projection system. Presentations can be loaded via USB flash memory stick. Authors are urged to try to minimize any potential problems by taking advantage of redundancy whenever possible: save and bring presentations in multiple formats (PowerPoint and Adobe pdf), store presentations in more than one media, and keep the media on your person during travel.

The best student oral presentation(s) will be awarded.

## Student Poster Presentations with Flash Presentation

Poster sessions are an important part of the BioEM2016 conference and a method for immediate and effective communication between all those interested in specific subjects, actions or programs. Posters should be carefully designed and prepared to ensure their full impact.

The poster presenters are kindly requested to follow the instructions below:

- Two poster sessions, i.e., A on Monday, June 6th at 2:30 p.m., and B on Tuesday, June 7th at 2:00 p.m., are planned.
- **All student posters** will also be presented as **poster flash presentation**. The two poster flash sessions will take place on Monday, June 6th in room Refter from 1:30 p.m. to 2:30 p.m. (FA), and on Tuesday, June 7th in room Refter from 11:45 a.m. to 12:45 p.m. (FB).
- Please ensure that you plan your communication carefully. The language is English. Each presenter will have **2 minutes** time to present **4 slides maximum** for the flash presentation (discussions will follow afterwards at your poster). Please introduce yourself in the beginning of your presentation and point out the main findings of your work. Hence your presentation should not include new material that is not shown on your poster.
- The Chairs will call up the next presenter after the 2 min are over and you have to leave the podium.
- Please upload your presentation at the computer available at the Registration Desk on Monday, June 6th before 12:30 p.m. for the FA session, and on Tuesday June 7th before 10:45 a.m. for the FB session either in PowerPoint (.pptx) or PDF format, since all flash poster presentations will be uploaded beforehand on the same computer. The presenters will not be allowed to use their USB memory sticks or laptops during the session.

The best student poster(s) will be awarded.

## Poster Presentations

The poster presentations will be held in **Kloostergang & Novicengang** (see Ground Maps). Poster boards will be available for each author to attach their posters to. Authors are limited to use the **A0 portrait format**. A mounting system for the poster will be provided. The boards will be numbered to correspond with poster numbers in the Program and student posters will be clearly identified. The organizers are not liable for any poster materials.

**Authors should be present at their stations for the duration of their assigned session to discuss their work and answer questions, as there will be a flux of attendees.**

**Mounting:** Posters can be mounted anytime beginning on Sunday afternoon. Each board will be marked with the poster number, as indicated in the final program. A poster mounting system will be provided.

**Removal:** Posters must be removed no later than Friday, June 10th, 12:00 p.m. (noon).

## CONFERENCE ORGANIZERS

### **iMinds - Ghent University**

Local organization

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### **Lawson Health Research Institute Website and Meeting Support**

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# Technical Program

**Thursday June 2, 2016**

**Session: ICES1**

**TC95/Subcommittee 1: Techniques, Procedures, Instrumentation and Computation**

**Thursday June 2, 2016 • 08:00 - 12:00**

**Zaal Rector Vermeylen**

**Session: ICES2**

**TC95/Subcommittee 2: Terminology, Units of Measurements and Hazard Communication**

**Thursday June 2, 2016 • 13:00 - 17:00**

**Zaal Rector Vermeylen**

**Session: ICES3**

**AdCom**

**Thursday June 2, 2016 • 17:30 - 19:00**

**Zaal Rector Vermeylen**

**Friday June 3, 2016**

**Session: ICES4**

**TC95/Subcommittee 3: Safety Levels with Respect to Human Exposure to Electromagnetic Fields, 0 - 3 kHz and TC95/Subcommittee 4: Safety Levels with Respect to Human Exposure to Electromagnetic Fields, 3 kHz – 300 GHz**

**Friday June 3, 2016 • 09:00 - 15:30**

**Zaal Rector Vermeylen**

**Session: ICES5**

**TC95/Subcommittee 5: Safety Levels with Respect to Electro-Explosive Devices**

**Friday June 3, 2016 • 16:00 - 17:00**

**Zaal Rector Vermeylen**

**Session: ICES6**

**COMAR**

**Friday June 3, 2016 • 17:00 - 19:00**

**Zaal Rector Vermeylen**

**Saturday June 4, 2016**

**Session: ICES7**  
**TC95/Subcommittee 6: EMF Modeling and Dosimetry**  
**Saturday June 4, 2016 • 09:30 - 11:30**  
**Zaal Rector Vermeylen**

**Session: ICES8**  
**ICES TC95 Main Committee**  
**Saturday June 4, 2016 • 12:30 - 16:00**  
**Zaal Rector Vermeylen**

## Sunday June 5, 2016

**Session: M1**  
**BEMS Board Meeting**  
Sunday June 5, 2016 • 09:00 - 14:00  
Persconferentiezaal

**Session: ICES9**  
**IEEE ICES open house**  
Sunday June 5, 2016 • 09:30 - 11:30  
Zaal Rector Vermeylen

### **ICES9-I [09:30]**

#### **ICES open house - EMF safety standards: What's in the future?**

C. K. Chou<sup>1</sup>

<sup>1</sup>*International Committee on Electromagnetic Safety, Institute of Electrical and Electronics Engineers Standards Association, Piscataway, NJ, USA, 08854*

The IEEE ICES develops standards for the safe use of electromagnetic energy in the frequency range of 0 Hz to 300 GHz. This open house provides an opportunity for you to hear and speak with the ICES leaders and Committee members to learn about our activities and projects—projects with which you can become involved and contribute your expertise in developing science based exposure and assessment standards related to a safe exposure to electromagnetic fields. There will be brief presentations at the beginning of the open house from each of the subcommittee chairs followed by informal questions and answers. You will learn of the benefits of being a member and we welcome your participation in moving ICES standards forward.

**Session: MMF**  
**MMF Workshop - EMF Exposure Limits and Compliance Assessment of Future Wireless Devices Above 6 GHz**  
Sunday June 5, 2016 • 13:00 - 17:30  
Zaal Rector Vermeylen  
Chair: Kenneth Foster

**Session: M2**  
**EBEA Council Meeting**  
Sunday June 5, 2016 • 14:00 - 18:00  
Zaal Rector Gillis

**Welcome Reception**  
Sunday June 5, 2016 • 18:30 - 20:30  
Refter

**Student Ice Breaker**  
Sunday June 5, 2016 • 20:30 - 00:30  
Wasbar

**Monday June 6, 2016**

**Session: OC**  
**Welcome - Introduction**  
**Monday June 6, 2016 • 08:30 - 09:00**  
**Refter**  
**Chairs: Luc Martens, Francesca Apollonio & Heidi Danker-Hopfe**

**Session: P I**  
**Plenary I: A "safe" evolution for Wireless Power Transfer: the EM compliance of systems and devices**  
**Monday June 6, 2016 • 09:00 - 10:00**  
**Refter**  
**Chairs: Teruo Onishi & Nam Kim**

**PI-I [09:00]**

**Exposure assessment and dosimetry of WPT systems**

Akimasa Hirata<sup>1</sup>

<sup>1</sup>*Department of Computer Science and Engineering, Nagoya Institute of Technology, Nagoya, Japan, 466-8555*



**Biographical sketch**

Akimasa Hirata received the Ph.D. degrees in communications engineering from Osaka University, Suita, Japan, in 2000. In 2001, he joined Osaka University as an Assistant Professor. In 2004, he moved to Nagoya Institute of Technology where he is Full Professor. His research interests are in computational modeling of electromagnetics and thermodynamics in biological tissue. He has published more than 150 papers in established journals and 160 conference papers/abstracts.

Dr. Hirata is a Chair of Subcommittee of EMF Dosimetry Modeling of IEEE ICES (2014-) and a member of Main Commission of ICNIRP (2016-). He serves an editorial board member of Physics in Medicine and Biology (2010-) and was an Associate Editor of IEEE Transactions on Biomedical Engineering (from 2006 to 2012).

Dr. Hirata won several awards including Prizes for Science and Technology (Research Category 2011, Public Understanding Promotion Category 2014) by the Commendation for Science and Technology by the Minister of Education, Culture, Sports, Science and Technology, Japan, and IEEE EMC-S Technical Achievement Award (2015). He is a Fellow of Institute of Physics.

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**Five relevant publications**

T. Sunohara, A. Hirata, I. Laakso, V. DeSantis, and T. Onishi, "Evaluation of nonuniform field exposures with coupling factors," Physics in Medicine and Biology, vol.60, pp.8129-8140, 2015.

T. Sunohara, A. Hirata, I. Laakso, and T. Onishi, "Analysis of in-situ electric field and specific absorption rate in human models for wireless power transfer system with induction coupling," Physics in Medicine and Biology, vol.59, pp.3721-3735, 2014.

I. Laakso and A. Hirata, "Evaluation of induced electric field and compliance procedure for wireless power transfer system in an electrical vehicle," Physics in Medicine and Biology, vol.58, pp.7583-7593, 2013.

A. Hirata, T. Ito, and I. Laakso, "Confirmation of quasi-static approximation in SAR evaluation for wireless power transfer system," Physics in Medicine and Biology, vol.58, no.17, pp.N241-249, 2013.

I. Laakso, S. Tsuchida, A. Hirata, and Y. Kamimura, "Evaluation of SAR in a human body model due to wireless power transmission in the 10 MHz band," *Physics in Medicine and Biology*, vol.57, pp.4991-5002, Jul. 2012.

### **Abstract**

Transmitted power in wireless power transfer (WPT) system is much larger than that used in wireless communications. Attention is needed on the human safety and compliance for non-uniform fields leaked from such systems. The frequency bands for WPT systems based on magnetic coupling or resonance are mainly from 80 kHz to 10 MHz, and their applications are highly variable including charging for electric vehicles and home appliances. In this presentation, computational methods are briefly explained for assessing the induced field strength in the human body for WPT systems. Contribution of external electric field to induced field strength is smaller than that caused by the magnetic field in most cases. Quasi-static electromagnetic methods are shown to be enough for most applications operating below 10-30 MHz, together with experimental validation. The induced electric field and specific absorption rate (SAR) are computed in different human body models (genders, ages, etc). Compliance procedures are also reviewed for conforming the international guidelines/standards.

## **PI-2 [09:30]**

### **WPT Compliance testing methodologies**

Mark Douglas<sup>1</sup>

<sup>1</sup>*IT'IS Foundation, Zurich, Switzerland, 8004*



### **Biographical sketch**

Dr. Douglas is a Project Leader at the Foundation for Research on Information Technologies in Society (IT'IS Foundation) and co-chair of ICES TC95 SC1. His work includes the development of instrumentation and procedures to assess exposure from electromagnetic sources. These sources include wireless power transmitters, household appliances, mobile telephones and millimeter wave devices. His research work in electromagnetic dosimetry has resulted in 5 patents and over 80 papers for scientific conferences and peer reviewed journals.

Mark received the B.Eng degree from the University of Victoria, Victoria, British Columbia, Canada in 1990, the M.Sc. degree from the University of Calgary, Calgary, Alberta, Canada in 1993, and the Ph.D. degree from the University of Victoria in 1998, all in electrical engineering. Prior to working at the IT'IS Foundation, he led research projects at Ericsson and Motorola.

### **Abstract**

Electromagnetic dosimetry has a strong scientific foundation at radio frequencies where mobile communication devices operate (especially 700 MHz to 6 GHz), but several knowledge gaps exist for the frequency range of interest for wireless power transfer (WPT) systems (100 kHz to 10 MHz). Moreover, the incident fields may exceed the reference levels at close distances to a WPT system, requiring the accurate assessment of the induced fields in the body. Most WPT designs are based on inductive coupling between transmit and receive coils in which the magnetic field between them causes eddy currents in the body. The induced electric field, current density and SAR are sensitive to parameters such as the coil currents, the coil design, and the distance, orientation, and posture of the exposed person. For the rigorous and routine evaluation of compliance with exposure limits, several knowledge gaps need to be filled. These include the development of high-resolution human models with improved modeling of the nervous system, computationally-efficient full-wave numerical solvers, the extension of the available set of human models to include at-risk segments of the population, tools to change their posture, shape and mass, and the inclusion of medical implants. This presentation will address these gaps with the aim of developing a product compliance standard with emphasis on measurement reproducibility, validation, conservative exposure assessment covering a large majority of people and including at-risk segments of the population.

**Coffee Break**  
**Monday June 6, 2016 • 10:00 - 10:30**  
**Kapittelzaal**

**Session: S1**  
**Molecular and cellular responses to RF exposure**  
**Monday June 6, 2016 • 10:30 - 12:30**  
**Rafter**  
**Chairs: Lluis M. Mir & Isabelle Lagroye**

**Session: S2**  
**Instrumentation, measurements and protocols**  
**Monday June 6, 2016 • 10:30 - 12:30**  
**Zaal Rector Vermeylen**  
**Chairs: Andrew Wood & Gernot Schmid**

**SI-1 [10:30]**  
**STUDENT PAPER**

**Effects of radiofrequency fields on living cells at a molecular level using the real-time Bioluminescence Resonance Energy Transfer technique (BRET)**

Hermanus Ruigrok<sup>1</sup>, Bertrand Goudeau<sup>3</sup>, Annabelle Hurtier<sup>1</sup>, Emmanuelle Poque-Haro<sup>1</sup>, Florence Poulletier De Gannes<sup>1</sup>, Isabelle Lagroye<sup>1</sup>, Neso Sojic<sup>3</sup>, Stéphane Arbault<sup>3</sup>, Philippe Leveque<sup>2</sup>, Bernard Veyret<sup>1</sup> & Yann Percherancier<sup>1</sup>

<sup>1</sup>IMS Laboratory UMR 5218, Bordeaux university, Talence, France, 33405

<sup>2</sup>XLIM UMR 7252, CNRS, Limoge, France, 87060

<sup>3</sup>ISM Laboratory NSysA team, Bordeaux university, Pessac, France, 33600

**Keywords: In vitro, RF/Microwaves, Completed (unpublished)**

**Presented by: Hermanus Ruigrok**

While heating of living tissue by radiofrequency fields (RF) is well characterized, the existence of specific effects, remains controversial. We studied the activation of TRPV1 by following the recruitment of calmodulin (CaM) on TRPV1, under RF exposure, using the BRET technique. Cells expressing the TRPV1-Luc and YFP-CaM probes were exposed to several signals at 1800 MHz at a SAR of 6 or 1.5 W/kg. In a typical experiment using the GSM signal at 6 W/kg, there was an expected rise in BRET signal due to RF-induced temperature elevation, but the BRET signal remained stable when temperature kept constant, showing no evidence of a specific RF effect on TRPV1 activation. The same results were obtained for the other RF signals at both SAR levels.

**S2-1 [10:30]**

**Sensitivity of magnetic resonance thermal imaging for mmWave exposure assessment**

Cem M. Deniz<sup>1, 2, 3, 4</sup>, William S. Slovinsky<sup>5</sup>, Daniel K. Sodickson<sup>1, 2, 3</sup>, Marvin Ziskin<sup>5</sup> & Leor Alon<sup>1, 2, 3, 4</sup>

<sup>1</sup>Department of Radiology, New York University School of Medicine, New York, NY, USA, 10016

<sup>2</sup>Center for Advanced Imaging Innovation and Research (CAI2R), New York University School of Medicine, New York, NY, USA, 10016

<sup>3</sup>NYU WIRELESS, New York University Tandon School of Engineering, Brooklyn, NY, USA, 11201

<sup>4</sup>RF Test Labs, Inc., New York, NY, USA, 10021

<sup>5</sup>Center of Biomedical Physics, Temple University, Philadelphia, PA, USA, 19140

**Keywords: Dosimetry (measurements), RF/Microwaves, Work in Progress**

**Presented by: Cem M. Deniz**

The energy from millimeter wave (mmW) is deposited predominantly at the surface of phantoms/tissues. Recently, it has been shown that magnetic resonance (MR) thermal imaging can be used to quantify the mmW energy deposited inside a phantom and a human calf [1]. In this work, we investigated the effect of exposure length on temperature measurement accuracy by defining measurement ranges as multiples of two minutes while keeping the output power of the antenna unchanged. Our results suggest that MR thermal imaging is sensitive to detect small changes within the phantom and capture time course of heating throughout mmW exposure.

## SI-2 [10:50]

### **Chemical study of the effects of UltraWide Band and Narrow Band signals on membranes**

Marie Breton<sup>1</sup>, Alexandre Catrain<sup>2</sup>, Rene Vezinet<sup>2</sup> & Lluís M. Mir<sup>1</sup>

<sup>1</sup>Laboratory of Vectorology and Anticancer Therapies UMR 8203, Gustave Roussy, Villejuif, France, 94805

<sup>2</sup>CEA, DAM, Gramat, France, 46500

**Keywords: Electrochemistry, RF/Microwaves, Completed (unpublished)**

**Presented by: Marie Breton**

The aim of this study is to evaluate the impact of high amplitude ElectroMagnetic (EM) pulses on cell membranes and to determine thresholds of exposure. We used giant unilamellar vesicles (GUVs) as cell models. GUVs have been exposed to two types of EM pulses: Ultra-Wide Band (UWB) and Narrow Band (NB). NB pulses do not seem to induce a lipid oxidation. However, bipolar UWB pulses induced an oxidation of the GUVs lipids. Monopolar UWB pulses also induced an oxidation of the GUVs lipids with a threshold in voltage. The study requires to be continued on cells. Indeed, the accumulation of oxidized lipids in membranes can impact the cell physiology and play a key role in many diseases.

## SI-3 [11:10]

### **Mobile phone signal exposure triggers hormesis-like effect in $Atm^{+/+}$ and $Atm^{-/-}$ MEFs to maintain genome integrity**

Chuan Sun<sup>1</sup>, Xiaoxia Wei<sup>1</sup>, Guangdi Chen<sup>1</sup> & Zhengping Xu<sup>1</sup>

<sup>1</sup>Bioelectromagnetics Laboratory, Zhejiang University School of Medicine, Hangzhou, China, 310058

**Keywords: In vitro, RF/Microwaves, Completed (unpublished)**

**Presented by: Zhengping Xu**

We investigated the effects of 1,800 MHz RF-EMF on genomic integrity in ataxia telangiectasia mutated (ATM), a chief guardian of genome stability, sufficient ( $Atm^{+/+}$ ) or deficient ( $Atm^{-/-}$ ) mouse embryonic fibroblasts (MEFs). In  $Atm^{+/+}$  MEFs, RF-EMF at an average specific absorption rate (SAR) of 4.0 W/kg induced significant DNA single-strand breaks (SSBs) at 1-hour exposure, and activated SSB repair mechanism, resulting in reduced DNA damage which is lower than the background level at

## S2-2 [10:50]

### **Automated average electric field measurements for improved reproducibility of compliance verification measurements**

Peter Fritschi<sup>1</sup>, Emre Atsan<sup>1</sup>, Manuel Haag<sup>1</sup>, Roger Jegerlehner<sup>1</sup>, Martin Lengacher<sup>1</sup>, Damiano Scanferla<sup>1</sup>, Erich Zimmermann<sup>1</sup> & Hugo Lehmann<sup>1</sup>

<sup>1</sup>Innovation, Swisscom Ltd., CH-3050 Bern, Switzerland

**Keywords: Standards, RF/Microwaves, Work in Progress**

**Presented by: Hugo Lehmann**

To increase reproducibility of compliance verification measurements for mobile phone base stations in Switzerland we propose the use of automated average electric field measurements.

## S2-3 [11:10]

### **Protocol and Methods for RF Exposure Evaluation of Portable Wireless Charging Systems**

Giorgi Bit-Babik<sup>1</sup> & Antonio Faraone<sup>1</sup>

<sup>1</sup>Chief Technology Office, Motorola Solutions, Inc., Fort Lauderdale, Florida, USA

**Keywords: Standards, RF/Microwaves, Completed (unpublished)**

**Presented by: Antonio Faraone**

A protocol to evaluate RF exposure from portable, stationary, and wearable Wireless Power Transfer (WPT) systems operating between 4 MHz and 30 MHz is presented. Experimental and computational evaluations are performed in free-space as well as with suitable body phantoms. Existing instrumentation enable accurate measurements in free-space as well as in body simulating liquids. Should use conditions be not practical for experimental tests, computational models may be employed and validated by comparing computed



36-hour exposure. In Atm<sup>-/-</sup> MEFs, the same RF-EMF induced similar kinetics of both SSBs and double-strand breaks (DSBs). The observed phenomenon is similar to the hormesis of a toxic substance at low dose.

#### SI-4 [11:30]

##### **Decrease in burst activity of neuronal networks under exposure to RF as a function of SAR for the CW and GSM-1800 signals**

Corinne El Khoueiry<sup>1</sup>, Francesca Camera<sup>5</sup>, Rosa Orlacchio<sup>4</sup>, Rémy Renom<sup>1</sup>, André Garenne<sup>2, 3</sup>, Florence Poullietier De Gannes<sup>1</sup>, Emmanuelle Poque-Haro<sup>1</sup>, Isabelle Lagroye<sup>1, 6</sup>, Bernard Veyret<sup>1, 6</sup> & Noëlle Lewis<sup>1</sup>

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<sup>2</sup>UMR 5293, Institut des Maladies Neurodegeneratives, Bordeaux, France, 33000

<sup>3</sup>CNRS, UMR 5293, Institut des Maladies Neurodegeneratives, Bordeaux, France, 33000

<sup>4</sup>IETR, Rennes, France, 35700

<sup>5</sup>La Sapienza University, Rome, Italy, 00184

<sup>6</sup>Bioelectromagnetics Laboratory, Bordeaux, France, 33000

**Keywords: In vitro, RF/Microwaves, Completed (published)**

**Presented by: El Khoueiry Corinne**

We had shown previously an alteration of the spontaneous electrical activity of neuronal networks under RF exposure. The present work aimed at assessing the dose response relationship for this effect, following 15 min of RF exposure (GSM or CW; 0.01-9.2 W/kg) of neuronal cultures from rat embryonic cortexes (17-28 days in vitro). The second objective was to identify a potential differential response elicited by pulsed (GSM) and non-pulsed (CW) RF. Both signals elicited a clear decrease in burst rate with SAR. At low SAR levels, the amplitude of the effect was greater with GSM. Further work is ongoing to elucidate the mechanism of the effect, be it thermal and/or “nonthermal”.

#### SI-5 [11:50]

##### **STUDENT PAPER**

##### **Inhibition of Tumor Proliferation and Decrease in Cancer Stem Cell population by RF EMF amplitude-modulated at tumor-specific frequencies is mediated by T-type voltage gated calcium channels**

near field and/or SAR distributions versus those in reference experiments to perform conclusive exposure evaluations. The proposed protocol is currently under consideration for inclusion in an upcoming IEC standard.

#### S2-4 [11:30]

##### **Magnetic Fields from High-Voltage Overhead Powerlines - A Method to Calculate Annual Averages and its Validation by Measurements**

Alfred Bürgi<sup>1</sup>, Sanjay Sagar<sup>2, 3</sup>, Benjamin Struchen<sup>2, 3</sup>, Martin Roosli<sup>2, 3</sup> & Stefan Joss<sup>4</sup>

<sup>1</sup>ARIAS umwelt.forschung.beratung, Bern, Switzerland, CH-3011

<sup>2</sup>Department of Epidemiology and Public Health, Swiss Tropical and Public Health Institute, Basel, Switzerland, CH-4051

<sup>3</sup>University of Basel, Basel, Switzerland, CH-4051

<sup>4</sup>Federal Office for the Environment FOEN, Bern, Switzerland, CH-3003

**Keywords: Epidemiology, ELF/ILF, Completed (unpublished)**

**Presented by: Alfred Bürgi**

A model for calculating long term exposure to extremely low frequency (ELF) magnetic fields (MF) from high-voltage overhead powerlines is presented, as well as its validation by measurements. In the first step, a computer model was developed and possible data sources were evaluated. In the second step, the model was applied to a 31 km long section of a line with two 220 kV systems and exposure maps for the length of the section were calculated. At the final step, a measurement campaign was conducted to determine lateral magnetic field profiles at two locations and compare the model results to the measurements.

#### S2-5 [11:50]

##### **Measurements of Dielectric Properties of Materials with High Water Content at Millimeter Waves using a Reverberation Chamber**

Abdou Khadir Fall<sup>1</sup>, Christophe Lemoine<sup>1</sup>, Philippe Besnier<sup>1</sup>, Maxim Zhadobov<sup>2</sup>, Ronan Sauleau<sup>2</sup> & Yves Le

Hugo Jimenez<sup>1, 2</sup>, Jacquelyn Zimmerman<sup>3</sup>, Sambad Sharma<sup>1, 2</sup>, Kounosuke Watabe<sup>1, 2</sup>, Minghui Wang<sup>1, 2</sup>, Michael Pennison<sup>1, 2</sup>, Niels Kuster<sup>4</sup>, Frederico Costa<sup>5</sup>, Alexandre Barbault<sup>6, 7</sup>, Dwayne Godwin<sup>7</sup>, Carl Blackman<sup>1, 2</sup> & Boris Pasche<sup>1, 2</sup>

<sup>1</sup>Cancer Biology, Wake Forest Baptist Medical Center, Winston-Salem, North Carolina, USA, 27103

<sup>2</sup>Comprehensive Cancer Center, Wake Forest Baptist Medical Center, Winston-Salem, North Carolina, USA, 27103

<sup>3</sup>Medicine, The Johns Hopkins Hospital, Baltimore, Maryland, USA

<sup>4</sup>IT'IS Foundation, Zurich, Switzerland

<sup>5</sup>Hospital Sirio Libanes, Sao Paulo, Brazil

<sup>6</sup>TheraBionic, Ettlingen, Germany

<sup>7</sup>Neurobiology and Anatomy, Wake Forest University, Winston-Salem, North Carolina, USA, 27103

**Keywords:** *In vitro*, RF/Microwaves, Work in Progress  
**Presented by:** Hugo Jimenez

Experimental and clinical evidence suggests that administration of low level radiofrequency electromagnetic fields, amplitude-modulated (AM RF EMF) at specific frequencies ranging from 400 Hz to 21 kHz, elicits therapeutic responses in patients with cancer. Here we show that the anti-proliferative response elicited from tumor-specific AM RF EMF is mediated by T-type voltage gated calcium channels.

## SI-6 [12:10]

### 8-oxoG DNA glycosylase-I inhibition sensitizes Neuro-2a cells to oxidative DNA base damage induced by 900 MHz radiofrequency electromagnetic radiation

Chuan Liu<sup>1</sup>, Lei Zhang<sup>1</sup>, Zheng-Ping Yu<sup>1</sup> & Zhou Zhou<sup>1</sup>

<sup>1</sup>Department of Occupational Health, Third Military Medical University, Chongqing, China, 400038

**Keywords:** *In vitro*, RF/Microwaves, Completed (published)

**Presented by:** Zhou Zhou

This study was to provide information about the *in vitro* putative genotoxicity during Neuro-2a cells exposure to RF-EMFs. Exposure to 900 MHz RF-EMFs with insufficient energy could induce oxidative DNA base damage in Neuro-2a cells. These increases were concomitant with similar increases in the generation of ROS. Without OGG1 siRNA, 2 W/kg RF-EMFs induced oxidative DNA base damage in Neuro-2a cells. Interestingly, with OGG1 siRNA, RF-EMFs could cause DNA base

Dréan<sup>3</sup>

<sup>1</sup>Institute of Electronics and Telecommunications of Rennes (IETR), UMR CNRS 6164, INSA of Rennes, Rennes, France, 35708

<sup>2</sup>Institute of Electronics and Telecommunications of Rennes (IETR), UMR CNRS 6164, University of Rennes 1, Rennes, France, 35042

<sup>3</sup>Transcription, Environment and Cancer Group, Institute of Research in Environmental and Occupational Health (IRSET), INSERM U1085, University of Rennes 1, Rennes, France, 35042

**Keywords:** Dosimetry (measurements), RF/Microwaves, Completed (unpublished)  
**Presented by:** Abdou Khadir Fall

This study aims at introducing a method for determining the dielectric properties of lossy materials with high water contents in a millimetre-wave reverberation chamber. Such materials with high water content, e.g. biological tissues can be described by a Debye model. The proposed method consists in fitting the theoretical average absorption cross section to the experiment data resulting from the average absorption cross section measurements. By applying this method on a 4% agar phantom in the 50-65 GHz frequency range, the difference between the measured real and imaginary parts and the reference value of the agar phantom is 4.3% and 8%, respectively

## S2-6 [12:10]

### Boundary Proximity Effect near the Flat Phantom Surface and Extrapolation of Point SAR Values in That Region

Yoon-Myoung Gimm<sup>1</sup>, Kang-Seok Yoon<sup>2</sup>, Dohwan Kwon<sup>3</sup>, Sungoo Kim<sup>3</sup>, Sanghyun Park<sup>3</sup>, Samyoung Chung<sup>4</sup>, Kihwea Kim<sup>4</sup> & Judong Jang<sup>4</sup>

<sup>1</sup>School of Electronics and Electrical Engineering, Dankook University, Yongin-si, Korea, 16890

<sup>2</sup>EMF Safety Inc., Yongin-si, Korea, 16890

<sup>3</sup>EPIK Co.,Ltd, Gwacheon-si, Korea, 13821

<sup>4</sup>Radio Environment Safety Division, Ministry of Science, ICT and Future Planning, Jeollanam-do, Korea, 58217

**Keywords:** Dosimetry (measurements), RF/Microwaves, Work in Progress  
**Presented by:** Yoon-Myoung Gimm

In SAR measurement at 5 GHz band where Wi-Fi repeaters are operated, the field amplitude is very steep in the phantom medium, and it is proposed that the probe diameter is as small as 3 mm, and

damage in Neuro-2a cells as low as 1 W/kg.

the maximum distance for the extrapolation from the nearest measurement point to the phantom surface shall be 2.5 mm. Although they are good requirements for the probe and the first measurement distance from the phantom surface to avoid the boundary proximity effect, small sized sensing probes may not have sufficient sensitivities in the very weak field in most of the volume to be estimated in 5 GHz band. It is demonstrated in this presentation that larger diameter probes can be used in the flat phantom for the measurement of SAR in 5 GHz band.

**Lunch**  
**Monday June 6, 2016 • 12:30 - 13:30**  
**Kapittelzaal**

**Session: FA**  
**Student Flash Poster Session A**  
**Monday June 6, 2016 • 13:30 - 14:30**  
**Refter**  
**Chairs: Niels Kuster & Meike Mevissen**

**FA-1 [13:33]**

**WITHDRAWN**

**FA-2 [13:36]**

**STUDENT PAPER**

**Influence of current flow and cell line on successful electroporation of cells**

Ahmed El Mahmoudi<sup>1, 3</sup>, Andreas Ritter<sup>1, 3</sup>, Anne Esser<sup>2</sup>, Katharina Kolvenbach<sup>2</sup>, Ulf Peter Neumann<sup>2</sup> & Martin Baumann<sup>3</sup>

<sup>1</sup>Department of Diagnostic and Interventional Radiology, Aachen, Germany, 52074

<sup>2</sup>Department of General, Visceral and Transplantation Surgery, Aachen, Germany, 52074

<sup>3</sup>Applied Medical Engineering (AME), Helmholtz Institute, Aachen, Germany, 52074

**Keywords: Clinical (therapy), Pulsed, Completed (unpublished)**

Electroporation is a technique used in molecular biology to increase the permeability of the cell membrane by applying pulsed electric fields. This effect is also used in cancer therapy (IRE, Electrochemotherapy). For a better understanding of the effects described above, the development of an in vitro model for the medical application of IRE has started, upon this study is based. The results of the cell suspension experiments point out significant differences between the four tested cell lines. The combination of an electric field in addition to a current flux is necessary for successful EP treatments (ECT, IRE).

**FA-3 [13:39]**

**STUDENT PAPER**

**Study on the analytic methods of EMF effect radiated by the commercial wireless power charging device**

Jun-Seok Kang<sup>1</sup>, Seungwoo Lee<sup>1</sup>, Byeong-Nam Kang<sup>1</sup> & Nam Kim<sup>1</sup>

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**Keywords:** *Dosimetry (computational), ELF/ILF, Work in Progress*

In this paper, we analyzed the evaluation of EMF effect about the commercial wireless power charging device. The coils used in this study is A10 model released by wireless power consortium, and input current is 1 A to the operating frequency of 125 kHz during the simulation. As the results, calculated SAR is much lower than the EMF safety standards, but calculated magnetic field strength radiated by coils is significantly exceed the EMF safety standards. These results are similar to the results from other papers that evaluated EMF effect about the wireless power transfer system in the low frequency band, so we need to discuss suitability of international standards for the SAR and the magnetic field strength.

#### **FA-4 [13:42]**

**WITHDRAWN**

#### **FA-5 [13:45]**

**STUDENT PAPER**

##### **Implementation of European Directive 2013/35/EU in Power Substations: Numerical Determination of Compliance Distances to Conductors Concerning Magnetic Field Exposure**

Pia Schneeweiss<sup>1, 2</sup> & Gernot Schmid<sup>1</sup>

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<sup>2</sup>Vienna University of Technology, Vienna, Austria, 1040

**Keywords:** *Dosimetry (computational), ELF/ILF, Work in Progress*

In view of the implementation of the European directive 2013/35/EU compliance distances to power line conductor arrangements would be of practical value, in order to provide guidelines for workers close to such installations or to implement appropriate access restrictions wherever necessary. In this paper we report results from numerical computations using high resolution anatomical body models exposed to power line conductor installations at different distances and orientations with respect to different body parts. These results will then be used as a basis for the derivation of reliable compliance distances.

#### **FA-6 [13:48]**

**STUDENT PAPER**

##### **Effect of chronic exposure to low frequency magnetic fields in germ cells of mice**

Gloria Lévano<sup>1</sup>, Martha Valdivia<sup>1</sup> & Victor Cruz<sup>2</sup>

<sup>1</sup>Genetic, San Marcos University, Lima, Peru, Lima 01

<sup>2</sup>Telecommunication, San Marcos University, Lima, Peru, Lima 01

**Keywords:** *In vivo, Static, Completed (unpublished)*

The objective of this study was to evaluate the effect of low-frequency magnetic fields ,715  $\mu$ T and 60 Hz in the spermatogonial stem cells (SSC) from mice and early adulthood. Six groups were studied: group I: Mice 4 dpp without exposure to magnetic fields, group II: Mice of 4 days postpartum (dpp) exposed 10 days, group III : mice 4 dpp exposed 10 days ,group IV: mice without exposed to magnetic fields. Group III and IV were evaluated at 73 dpp, group V: mice of 35 dpp sham exposed . Group VI: mice of 35 days exposed for 35 days. Group V and VI were evaluated on 70 dpp. After SSC isolation the concentration, viability and the percentage of positive cells DBA, were evaluated .

**FA-7 [13:51]  
STUDENT PAPER**

**ExpoM: Exposure Measurement Platform Enabling ELF Magnetic Field and RF Electromagnetic Field Strength Measurements**

Marco Zahner<sup>1</sup>, Jürg Fröhlich<sup>2</sup> & Juerg Leuthold<sup>1</sup>

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<sup>2</sup>*Fields at Work GmbH, Zurich, Switzerland, 8006*

**Keywords: Dosimetry (measurements), ELF/LF, Work in Progress**

Spectrally resolved magnetic field measurements in combination with localized tracking is a challenge to this day. For this purpose we have introduced a magnetometer module (ExpoM-ELF) designed for the assessment of personal exposure to Extremely Low Frequency (ELF) magnetic fields from DC up to 100 kHz. The combination of the ExpoM-ELF with the ExpoM-RF - an RF-EMF exposure meter allows for the assessment of the most relevant exposure sources over a very wide range of the frequency spectrum.

**FA-8 [13:54]  
STUDENT PAPER**

**Super-resolution microscopy reveals microtubule buckling and breaking following nanosecond pulsed electric field exposure in U87 human glioblastoma cells**

Lynn Carr<sup>1</sup>, Sylvia M. Bardet<sup>1</sup>, Malak Soueid<sup>1</sup>, Delia Arnaud-Cormos<sup>1</sup>, Philippe Leveque<sup>1</sup> & Rodney P. O'Connor<sup>1</sup>

<sup>1</sup>*Xlim Research Institute, University of Limoges, Limoges, France, 87060*

**Keywords: In vitro, Pulsed, Work in Progress**

Nanosecond pulsed electric field (nsPEF) exposure causes apoptosis in cancer cells via a currently unknown mechanism. We used live-cell, super-resolution microscopy to show that 100, 10 ns, 44 kV/cm pulses, applied at 10 Hz to U87 tubulin-mEmerald glioblastoma cells, resulted in the buckling of microtubules followed by their breakage and depolymerization. Microtubule depolymerization is a key event in apoptosis execution, making the effect we report on the microtubule network a candidate for the mechanism behind nsPEF induced apoptosis.

**FA-9 [13:57]  
WITHDRAWN**

**FA-10 [14:00]  
STUDENT PAPER**

**Studies on genotoxicity of intermediate frequency magnetic fields in rat primary astrocytes**

Mikko Herrala<sup>1</sup>, Jonne Naarala<sup>1</sup> & Jukka Juutilainen<sup>1</sup>

<sup>1</sup>*Department of Environmental and Biological Sciences, University of Eastern Finland, Kuopio, Finland*

**Keywords: In vitro, IF, Work in Progress**

In this study rat primary astrocytes were used to study genotoxic effects of 7.5 kHz magnetic field exposure at 30 or 300  $\mu$ T by measuring DNA damage using the single cell gel electrophoresis (Comet) assay and flow cytometric micronucleus scoring. Results will be reported in the BioEM 2016 meeting.

**FA-11 [14:03]  
STUDENT PAPER**

**TETRA specific long-term exposure of neuronal in vitro networks**

Tim Köhler<sup>1</sup>, Maximilian Wölfel<sup>2</sup>, Ulrich Bochtler<sup>2</sup> & Christiane Thielemann<sup>1</sup>

<sup>1</sup>*Biomems lab, University of Applied Sciences Aschaffenburg, Aschaffenburg, Germany, 63743*

<sup>2</sup>*Laboratory for EMC, University of Applied Sciences Aschaffenburg, Aschaffenburg, Germany, 63743*

**Keywords:** *In vitro, RF/Microwaves, Work in Progress*

For long the health of human brain is an issue in biological radiation research. Compared to long-standing mobile communication standards like GSM, terrestrial trunked radio (TETRA) has hardly been addressed in literature. TETRA is a digital radio communication standard especially used by occupational groups such as police forces, fire brigade and ambulances. It is of particular importance to investigate the new frequencies on their potential health risks. In this work we study, whether TETRA-specific long-term exposure affects electrophysiology of neuronal networks. Our results show that the TETRA-specific long-term exposure does not affect burst rate (BR) of cortical rat neurons, compared to control and sham group.

## **FA-12 [14:06]**

### **STUDENT PAPER**

#### **Mobile phone radiation exposure: oxidative stress induced cytomorphic changes in hippocampus and consequential effect on contextual fear memory**

Kumari Singh<sup>1</sup>, Rohit Gautam<sup>1</sup>, Jayprakash Nirala<sup>1</sup> & Paulraj Rajamani<sup>1</sup>

<sup>1</sup>*school of environmental sciences, Jawaharlal Nehru University, New Delhi, India, 110067*

**Keywords:** *In vivo, RF/Microwaves, Work in Progress*

Over the past few decades there is an exponential growth in the number of mobile phone subscriptions worldwide. There are also several reports on ill health effect of chronic exposure to radiofrequency radiation. Present study was aimed to evaluate the effect of chronic exposure to 3G mobile phone radiation on brain in general and hippocampus in specific. We tried to find out that whether radiation exposure leads to oxidative stress mediated neuronal damage in hippocampus and is there any functional consequences of it in terms of memory impairment. Radiation exposure may also lead to increase in basal stress hormone level which in turn may have a role in neuronal damage and consequential memory impairment.

## **FA-13 [14:09]**

### **WITHDRAWN**

## **FA-14 [14:12]**

### **STUDENT PAPER**

#### **Induction of Autophagy in Hypothalamus and Striatum after Exposure of 835MHz Radiofrequency Electromagnetic Field**

Dahyeon Yu<sup>1</sup>, Ju-Hwan Kim<sup>1</sup>, Hye-Ryoung Lee<sup>1</sup>, Jin-Koo Lee<sup>1</sup> & Hakrim Kim<sup>1</sup>

<sup>1</sup>*Department of Pharmacology, College of Medicine, Dankook University, Cheonan, Korea, 31116*

**Keywords:** *In vivo, RF/Microwaves, Completed (unpublished)*

The data from gene expression analysis, biochemical studies and imaging by transmission electron microscopy showed that autophagy can be induced in striatum and hypothalamus after exposure of 835MHz RF-EMF exposure at SAR of 4.0W/kg for 5h/day for 12 weeks to C57BL/6 mice.

## **FA-15 [14:15]**

### **STUDENT PAPER**

#### **An Analytical Solution for Forward Problem of Magneto-Acousto-Electrical Tomography**

Elyar Ghalichi<sup>1</sup> & Nevzat Gencer<sup>1</sup>

<sup>1</sup>Electrical and Electronics Engineering, METU, ANKARA, Turkey, 06800

**Keywords: Mechanistic/Theoretical, Ultrasound, Work in Progress**

In this study, an analytic method (Separation of variables method) of solving the forward problem of Magneto-Acousto-Electrical Tomography (MAET) is investigated for 2D concentric circles. The electric potential is separated to azimuthal and radial components. Since the electric potential is complex valued in the domain, complex exponential eigenfunctions are used to represent the azimuthal component of it. The results are compared to numerical results calculated by COMSOL Multiphysics. The relative errors of electric potential's magnitude between these two solutions are obtained. These errors are calculated for all nodes of finite element method's mesh. Out of 521744 nodes, only seven have an error greater than five percent.

## **FA-16 [14:18]**

### **STUDENT PAPER**

#### **Additional Methodologies of Categorizing INTEROCC Subjects that were exposed to RF Telecommunication & Transmitter Antenna Sources**

Taichi Murata<sup>1, 2</sup>, Javier Vila<sup>3, 4, 5</sup> & Elisabeth Cardis<sup>3, 4, 5</sup>

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<sup>3</sup>ISGlobal, Centre for Research on Environmental Epidemiology (CREAL), Barcelona, Spain

<sup>4</sup>Universitat Pompeu Fabra (UPF), Barcelona, Spain

<sup>5</sup>CIBER Epidemiología y Salud Pública (CIBERESP), Madrid, Spain

**Keywords: Occupational, RF/Microwaves, Work in Progress**

The main goal of this study was to categorize exposure scenarios for INTEROCC subjects in the military who worked with both telecommunication antennas and transmitters in order to eventually model their RF electric field exposures. Methodologies used to create telecommunication, transmitter, and Super Scenarios will be explained in detail. Outcomes of the creation of source-exposure scenarios will enable us to proceed to the next steps of convening an expert judgment panel to determine distances that the INTEROCC subject worked from the antenna sources and discovering levels of RF electric field by scenario that military personnel were exposed to when using both telecommunication antenna and transmitter sources.

## **FA-17 [14:21]**

### **STUDENT PAPER**

#### **Consumer Awareness Framework – A Risk Mitigation Architecture of EMF**

Rojalin Pradhan<sup>1</sup>, Jack Rowley<sup>3</sup> & Dr. Mahim Sagar<sup>2</sup>

<sup>1</sup>Bharti School of Telecommunication Technology and Management, Indian Institute of Technology Delhi, New Delhi, India, 110016

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<sup>3</sup>GSM Association, Hong Kong, Hong Kong

**Keywords: Standards, RF/Microwaves, Completed (unpublished)**

Aware consumer, informed choice are the two premises for a fast absorption of telecom technology. This framework is developed on the above premise. This consumer awareness framework represents the basic need of the hour because there are risks associated with the use of any technology. This framework will have high social impact for all the stakeholders of the telecom industry (Regulator, Operator, Government, and Consumer). This framework identifies the key factors, their linkages and hierarchy in developing the framework of consumer awareness of Radio Signal.

**Session: PA**  
**Poster Session A**  
**Monday June 6, 2016 • 14:30 - 16:00**  
**Kloostergang & Novicengang**  
**Chairs: Heidi Danker-Hopfe & Francesca Apollonio**

**Coffee Break**  
**Monday June 6, 2016 • 16:00 - 16:30**  
**Kapittelzaal**

**Session: S3**  
**Pulsed electric fields: theoretical and experimental modelling**  
**Monday June 6, 2016 • 16:30 - 18:10**  
**Rafter**  
**Chairs: Andrei Pakhomov & P. Thomas Vernier**

**Session: S4**  
**In vivo exposure: ELF, IF, RF**  
**Monday June 6, 2016 • 16:30 - 18:10**  
**Zaal Rector Vermeylen**  
**Chairs: Rene De Seze & James Lin**

### **S3-1 [16:30]**

#### **Enhancement of nsPEF ablation in 3D cell culture models by electrosensitization**

Claudia Muratori<sup>1</sup>, Andrei Pakhomov<sup>1</sup>, Shu Xiao<sup>1</sup> & Olga Pakhomova<sup>1</sup>

<sup>1</sup>Frank Reidy Research Center for Bioelectrics, Old Dominion University, Norfolk, VA, USA, 23508

**Keywords: Electroporation, Pulsed, Completed (published)**

**Presented by: Olga Pakhomova**

In this study we demonstrated benefits of split-dose PEF exposure in the 3D cell culture. An area affected by PEF was visualized and its enlargement was quantified. In both types of 3D cultures split-dose treatments increased cell death up to 3 fold as compared to single dose exposures. The results suggest that engaging electrosensitization may assist in vivo cancer ablation by reducing the voltage required for ablation thus enabling wider electrode positioning without losing the ablation efficiency.

### **S3-2 [16:50]**

#### **A new methodology for the geometric characterization of an electropore**

Paolo Marracino<sup>1</sup>, Federica Castellani<sup>2,3</sup>, P. Thomas Vernier<sup>2</sup>, Micaela Liberti<sup>1</sup> & Francesca Apollonio<sup>1</sup>

### **S4-1 [16:30]**

#### **Assessment of extremely low frequency electromagnetic field (50 Hz) exposure on epigenetic modifications in mice. Preliminary results from the CLeMAN project**

Denis Habauzit<sup>1</sup>, Catherine Martin<sup>1</sup>, Florence Poulletier De Gannes<sup>2</sup>, Emmanuelle Poque-Haro<sup>2</sup>, Annabelle Hurtier<sup>2</sup>, Isabelle Lagroye<sup>2</sup> & Yves Le Dréan<sup>1</sup>

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<sup>2</sup>BioEM Team, University of Bordeaux, Talence, France

**Keywords: In vivo, ELF/IF, Work in Progress**

**Presented by: Denis Habauzit**

50 Hz magnetic fields have been classified as possible human carcinogen for childhood leukaemia, but no in vivo or in vitro studies support this classification. In this ongoing project, we are studying possible epigenetic changes, such as histone post-translational modifications or DNA methylation, in the bone marrow of mice exposed 8 h/d, 5d/wk at 1000  $\mu$ T. A high-content microscopy screening was performed for the detection of rare epigenetic events at the single cell level.

### **S4-2 [16:50]**

#### **Does exposure to radiofrequency fields in early life have an effect on behaviour?**

Kerry A. Broom<sup>1</sup>, Jutta Jarvinen<sup>1</sup> & Zenon Sienkiewicz<sup>1</sup>

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**Keywords: Electroporation, Pulsed, Completed (unpublished)**

**Presented by: Paolo Marracino**

We present here a new method for characterizing the radius of electropores in molecular dynamics simulations of phospholipid bilayers. The geometric evaluation of electropores is important to fully understand the mechanisms of electroporation and the rigorous characterization of molecular transport. The algorithm we have developed represents the pore as a one-sheet hyperboloid from which the pore radius is extracted. The method can be generalized and is robust and applicable to a wide range of model porated bilayer systems.

### S3-3 [17:10]

#### **Improving predictions: Insertion of molecular scale interactions into cell electroporation models**

Zachary Levine<sup>1, 2</sup>, Thiruvallur Gowrishankar<sup>3</sup>, Kyle Smith<sup>3</sup>, Reuben Son<sup>3</sup>, P. Thomas Vernier<sup>4</sup> & James Weaver<sup>3</sup>

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<sup>2</sup>(present) Department of Physics, Department of Chemistry and Biochemistry, Materials Research Laboratory, University of California Santa Barbara, Santa Barbara, CA, USA, 93106

<sup>3</sup>Harvard-MIT Division of Health Sciences and Technology, Massachusetts Institute of Technology, Cambridge, MA, USA, 01720

<sup>4</sup>Frank Reidy Center for Bioelectrics, Old Dominion University, Norfolk, VA, USA, 23508

**Keywords: Electroporation, Pulsed, Work in Progress**  
**Presented by: Thomas Vernier**

In spite of significant progress in understanding non-thermal responses of cells to very large electric fields, major problems remain. Cell-level models with representations of aqueous media and different cell/organelle membranes and molecular dynamics (MD) with atomic/molecular scale descriptions

**Keywords: In vivo, RF/Microwaves, Work in Progress**  
**Presented by: Kerry A. Broom**

In this study, C57BL/6J mice were exposed to 1800 MHz fields from gestation through to weaning. Following exposures, long-term home-cage behaviour was investigated. Following assessments of learning and memory at 15 and 30 weeks, brain tissues were examined using immunohistochemistry. Exposure had subtle effects on behaviour and on acquisition of a water maze task at 30 weeks. Immunohistochemistry also suggests that exposure may impact microglial activation and neuronal activation, and may have an effect on levels of Synaptophysin. This research should be informative of possible risks to human health from radiofrequency fields.

### S4-3 [17:10]

#### **Behavioral effects of long-term exposure to IF magnetic fields**

Kumari Kajal<sup>1</sup>, Henna Koivisto<sup>2</sup>, Matti Viluksela<sup>1</sup>, Jonne Naarala<sup>1</sup>, Heikki Tanila<sup>2</sup> & Jukka Juutilainen<sup>1</sup>

<sup>1</sup>Department of Environmental Sciences, University of Eastern Finland, Kuopio, Finland

<sup>2</sup>A. I. Virtanen Institute, University of Eastern Finland, Kuopio, Finland, 70150

**Keywords: Behavioural, IF, Completed (unpublished)**  
**Presented by: Kumari Kajal**

Exposure of mice to 7.5 kHz magnetic fields at 12 or 120  $\mu$ T did not alter body weight, spontaneous activity, motor coordination, endurance or level of anxiety. Slightly impaired learning in the Morris swim task and statistically significant impairment in inhibitory avoidance learning suggest possible negative effect on memory consolidation. The exposure did not increase astroglial activation in the hippocampus.

address these problems. Here we present on-going work that shows the first use of MD to obtain basic EP (electroporation) parameters used in cell-level models. Specifically, the parameter allowing description of pore expansion/contraction can be obtained from cell experiments or from MD, and the two values are within a factor of 3. This points the way to major improvements in cell EP modeling.

### **S3-4 [17:30] STUDENT PAPER**

#### **Validity of molecular simulations of lipid bilayers in electric fields --- the model makes a difference!**

Federica Castellani<sup>1, 2</sup> & P. Thomas Vernier<sup>2</sup>

<sup>1</sup>*Biomedical Engineering Institute, Old Dominion University, Norfolk, Virginia, USA, 23508*

<sup>2</sup>*Frank Reidy Research Center for Bioelectrics, Old Dominion University, Norfolk, Virginia, USA, 23508*

**Keywords:** *Electroporation, Pulsed, Work in Progress*  
**Presented by:** *Federica Castellani*

The force field is one of the primary determinants of the behavior of ions, molecules, lipids, and proteins in molecular dynamics simulations of lipid bilayers. To better understand how the physical and mechanical properties of the constituents of molecular models and the interactions between them are influenced by the force field, we compared simulations using the GROMOS-OPLS and CHARMM36 force fields. We report results from three aqueous phospholipid bilayer systems: one containing only lipids and water and two containing also chloride ions and either a monovalent cation (potassium) or a bivalent cation (calcium).

### **S3-5 [17:50]**

#### **Numerical modeling of intracellular adrenal chromaffin cell responses to high intensity 5 ns electric pulses**

Josette Zaklit<sup>1</sup>, Gale Craviso<sup>2</sup>, Normand Leblanc<sup>2</sup>, Robert Terhune<sup>1</sup> & Indira Chatterjee<sup>1</sup>

<sup>1</sup>*Department of Electrical and Biomedical Engineering, University of Nevada, Reno, Nevada, USA, 89557*

<sup>2</sup>*Department of Pharmacology, University of Nevada School of Medicine, Reno, Nevada, USA, 89557*

**Keywords:** *Electroporation, Pulsed, Work in Progress*  
**Presented by:** *Indira Chatterjee*

### **S4-4 [17:30]**

#### **Neuroinflammation after GSM-900 or UMTS-1960 exposure**

Florence Poulletier De Gannes<sup>1</sup>, Emmanuelle Poque-Haro<sup>1</sup>, Rémy Renom<sup>1</sup>, Annabelle Hurtier<sup>1</sup>, Marion Jany<sup>1</sup>, Julie Enderlin<sup>1</sup>, Gilles Ruffie<sup>1, 3</sup>, Yann Percherancier<sup>1</sup>, Bernard Veyret<sup>1, 2</sup> & Isabelle Lagroye<sup>1, 2</sup>

<sup>1</sup>*University of Bordeaux, IMS Laboratory UMR 5218 CNRS Bioelectronics group, Talence, France, 33405*

<sup>2</sup>*École Pratique des Hautes Études, Bioelectromagnetics laboratory, Talence, France*

<sup>3</sup>*IMS Transfert-A2M, IMS Laboratory ENSCBP, Pessac, France*

**Keywords:** *In vivo, RF/Microwaves, Completed (unpublished)*

**Presented by:** *Florence Poulletier De Gannes*

There are some doubts related to neuroinflammation following exposure to wireless communication signals. Our work aims at providing answers to this open question. Rats were repeatedly exposed to two types of mobile phone signals (GSM- 900 and UMTS), 2 hrs/day, 5 days/week, for 4 weeks at Brain Averaged SAR of 0, 0.5, 5, and 15 W/kg. A global view of neuroinflammation was obtained using a set of markers.

### **S4-5 [17:50]**

#### **High-frequency stimulation of the hippocampus decreases epileptic activity in mice: preliminary results**

Julien Modolo<sup>1, 2</sup>, Pascal Benquet<sup>1</sup>, Gabriel Dieuset<sup>1</sup> & Fabrice Wendling<sup>1, 2</sup>

<sup>1</sup>*Laboratoire Traitement du Signal et de l'Image, Université de Rennes 1, Rennes, France, 35042*

<sup>2</sup>*Institut National de la Santé et de la Recherche Médicale, Rennes, France*

**Keywords:** *In vivo, ELFILF, Work in Progress*  
**Presented by:** *Julien Modolo*

Exposing adrenal chromaffin cells to a 5 ns electric pulse requires a twofold or greater electric field (E-field) amplitude to cause  $\text{Ca}^{2+}$  release from internal stores than to stimulate  $\text{Ca}^{2+}$  influx. To examine why intracellular responses require a higher field amplitude, a 2D cell model was constructed to assess pore formation in  $\text{Ca}^{2+}$ -storing organelle membranes. The modeling results suggest that E-field values as low as  $\sim 3$  MV/m cause pores to form within intracellular membranes, thus contrasting with experimental findings. A parametric study was designed to optimize E-field and cytoplasm conductivity in the cell model for which modeling and experimental results give comparable field threshold values for intracellular  $\text{Ca}^{2+}$  release.

**OBJECTIVE:** Explore the potential effect of high-frequency stimulation for reducing hyperexcitability of hippocampal tissue in epileptic mice (kainate model, mesial temporal lobe epilepsy). **METHODS:** Electrical stimulation at 1 kHz was delivered in the hippocampus during 14 blocks of stimulation (1 minute each) every 5 minutes. Intracranial EEG was measured 1 hour before, during stimulation, and 1 hour after. **RESULTS:** The number and duration of epileptic markers (hippocampal paroxysmal discharges) was significantly reduced. **CONCLUSIONS:** Electrical stimulation of the hippocampus in the kilohertz range has the potential to normalize pathological hyperexcitability in epilepsy.

**Tuesday June 7, 2016**

**Session: T1**  
**Tutorial 1: Standards development activities of the IEEE International Committee on Electromagnetic Safety**  
**Tuesday June 7, 2016 • 08:30 - 09:30**  
**Refter**

**T1-I [08:30]**

**Standards development activities of the IEEE International Committee on Electromagnetic Safety**

C. K. Chou<sup>1</sup>

<sup>1</sup>*TC95 Chairman, International Committee on Electromagnetic Safety, Institute of Electrical and Electronics Engineers Standards Association, Piscataway, NJ, USA, 08854*

The IEEE International Committee on Electromagnetic Safety (ICES) develops standards for the safe use of electromagnetic energy in the range of 0 Hz to 300 GHz. ICES consists of two technical committees. Technical Committee (TC) 95 develops standards for human exposure to electric, magnetic and electromagnetic fields based on established adverse effects with appropriate safety margins included. TC34 deals with methods for the assessment of human exposure to such fields, and develops compliance assessment standards for products that emit electromagnetic energy. In this presentation, standardization activities of ICES are updated. ICES welcomes participation of new members with an interest in developing science-based standards.

**Session: T2**  
**Tutorial 2: How to conduct personal radiofrequency electromagnetic field measurement surveys**  
**Tuesday June 7, 2016 • 08:30 - 09:30**  
**Zaal Rector Vermeylen**

**T2-I [08:30]**

**Radiofrequency electromagnetic fields (RF-EMF): how to characterize exposure?**

Marloes Eeftens<sup>1</sup>

<sup>1</sup>*Departement of Epidemiology and Public Health, Swiss Tropical and Public Health Institute, Basel, Switzerland, 4051*

Many epidemiological studies into RF-EMF and health effects have so far relied on self-reported cumulative call time, number of calls or years of mobile phone ownership. Such questionnaire-based exposure assessment clearly provides easy, yet crude estimates of exposure to RF-EMF. With the development of portable measurement devices for radiofrequency electromagnetic fields, a number of possibilities have emerged to characterize exposure in an objective and quantitative way, in real-time. The subject that is studied can be a person (personal measurements), a specific place (spot measurements) or an environment that is considered to be of public interest (microenvironmental survey). Yet, these study designs bring along their own advantages and challenges when conducting, analyzing and interpreting the measurements. The real-time nature of the data allows us to gather a richness of measurement data within a relatively short time. Several challenges relate to technical and practical limitations of conducting any measurement study, whether it is environmental or personal. During this tutorial, we consider several of those issues: cross-talk, imperfect isotropy, body shielding, sources close to the body, selection bias and more, and guided by examples from the research practice, we will provide tools to help make careful considerations during the study design process.

## T2-2 [09:00]

### Personal RF-EMF exposure of adolescents and adults: first results from Slovenia

Peter Gajsek<sup>1</sup>

<sup>1</sup>Institute of Nonionizing Radiation (INIS), Ljubljana, Slovenia

Although RF exposure surveys have been carried out in the general environment using recently developed personal measurement devices (exposure meters), comprehensive measurement of exposure with a true population based sampling frame and a common protocol across number of countries has never been conducted. This has limited the generalisability of survey results and hampered attempts to estimate population-level exposures. In the framework of the EU FP7 funded international multi-center research project GERoNiMO (Generalised EMF Research using Novel Methods) assessment of RF EMF exposures following a common measurement protocol in the general population in a number of representative European countries (Switzerland, Slovenia, Spain, Denmark, Italy, Netherlands) is carried out. Personal surveys have also tended to assess cumulative exposure from all RF sources. First results of the measurements from 50 adolescents and 50 parents in Slovenia will be presented. In addition, the results of average personal RF-EMF exposure and average personal RF-EMF exposure by different activities and technologies will be compared and correlate with the results already collected by other countries.

#### Session: P2

#### Plenary 2: Characterization and manipulation of cells with E fields

Tuesday June 7, 2016 • 09:30 - 10:15

Refter

Chairs: Myles Capstick & Azadeh Peyman

## P2-1 [09:30]

### Characterization and manipulation of cells with E fields

Peter Gascoyne<sup>1</sup>

<sup>1</sup>President, Applied Electrofluidic Systems, LLC, USA



#### **Biographical sketch**

Peter Gascoyne is currently President of Advanced Electrofluidic Systems, LLC, a small company specializing in the development of clinically-oriented instruments based on the application of microfluidic and AC electrokinetic principles. He was formerly a research director at the University of Texas M.D. Anderson Cancer Center in Houston, Texas, for almost 30 years. His research into cell biophysical and morphological properties of cells led to the discovery of correlations between cell membrane morphology and cell cancer transformation and his studies on dielectrophoresis contributed to the development of electrokinetic methods for the isolation of cancer from normal cells. His present collaborations with The University of Texas M.D. Anderson Cancer Center and with Baylor College of Medicine Microbiome Center extend these cell isolation methodologies to blood biopsies aimed at individualized cancer therapy and to the isolation and analysis of organisms that comprise the human microbiome, respectively.

#### **Abstract**

In recent years, AC electrokinetic methods have been applied for the characterization and isolation of many different cells types ranging from yeasts and bacteria to mammalian cells. This talk reviews the bases for the dielectric properties of different cell types and how an understanding of these properties can be exploited through appropriate instrumentation to achieve the isolation of cells. Current examples of the isolation of rare circulating tumor cells in different types of cancers, the isolation of low concentrations of bacteria for

the detection of bacteremia, and the study of the different microorganism subtypes that comprise the human microbiome in specific niches will be shown.

**Coffee Break**  
**Tuesday June 7, 2016 • 10:15 - 10:45**  
**Kapittelzaal**

**Session: DA**  
**The d'Arsonval Lecture**  
**Tuesday June 7, 2016 • 10:45 - 11:45**  
**Rafter**  
**Chairs: Nam Kim & Marthinus Van Wyk**

**DA-1 [10:45]**

**Accomplishments and Challenges of Bioelectromagnetics from a 45 Year Perspective in the Field**

Kenneth Foster<sup>1</sup>

<sup>1</sup>*School of Engineering and Applied Science, University of Pennsylvania, Philadelphia, PA, USA, 19104*

**Session: FB**  
**Student Flash Poster Session B**  
**Tuesday June 7, 2016 • 11:45 - 12:45**  
**Rafter**  
**Chairs: Niels Kuster & Meike Mevissen**

**FB-1 [11:48]**

**WITHDRAWN**

**FB-2 [11:51]**  
**STUDENT PAPER**

**An ex vivo study on the shrinkage occurring in bovine liver during microwave thermal ablation: carbonized vs coagulated tissue**

Laura Farina<sup>1</sup>, Claudio Amabile<sup>2</sup>, Vanni Lopresto<sup>3</sup>, Rosanna Pinto<sup>3</sup>, Marta Cavagnaro<sup>1</sup>, Simone Cassarino<sup>2</sup>, Nevio Tosoratti<sup>2</sup> & S. Nahum Goldberg<sup>4,5</sup>

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**Keywords: Clinical (therapy), RF/Microwaves, Completed (unpublished)**

Microwave Thermal Ablation is an interstitial technique using electromagnetic field at microwave frequencies, usually 915 MHz or 2.45 GHz, to treat tumors. The deployed energy induces a temperature increase (above 55-60°C) in the target tissue leading to an irreversible thermal damage. Characterization of the physical and structural changes occurring in tissues at high temperatures is essential to optimize the treatment's outcomes. A shrinkage of the tissue was observed and a preliminary study performed. This work aims at deepening the comprehension of this phenomenon, proposing two novel set ups for the characterization of

the tissue contraction in correlation with the physical status of the ablated tissue, i.e. to its temperature.

### **FB-3 [11:54] STUDENT PAPER**

#### **Analysis of EMF health effect according to the shielding structure type for IW wireless power charging device**

Jong-Chan Kim<sup>1</sup>, Seungwoo Lee<sup>1</sup>, Domin Choi<sup>1</sup> & Nam Kim<sup>1</sup>

<sup>1</sup>*College of Electrical Computer Engineering, Chungbuk National University, Cheongju-si, Chungbuk, Korea, 28644*

**Keywords: Dosimetry (computational), ELF/ILF, Work in Progress**

In this paper, we implemented EMF health effect of a low power wireless charging device, which is currently being commercialization, and it is based on the A10 coil model of Qi standard. In addition, by using magnetic material and conductive material, we propose a magnetic shielding structure to solve the leakage magnetic field problem which can radiate from the use of wireless charging device, and proceeded analysis of leakage magnetic field and specific absorption rate in accordance with the structure change. As the computer simulation result, we verified that the proposed structure could reduce leakage magnetic field radiation and SAR value by using each proposed shielding structures.

### **FB-4 [11:57] STUDENT PAPER**

#### **Numerical thermal dosimetry in human head based on TLM method**

Oualid Makhoul<sup>1</sup>, Marylene Cueille<sup>1</sup> & Jean-Lou Dubard<sup>1</sup>

<sup>1</sup>*LEAT, UMR-CNRS 7248, University of Nice Sophia-Antipolis, Sophia antipolis, France, 06903*

**Keywords: Dosimetry (computational), RF/Microwaves, Work in Progress**

To control the temperature rise in biological tissues exposed to the electromagnetic waves, the thermal aspect must be taken into account by solving the bio-heat equation. In this paper, a new numerical scheme based on the TLM method, particularly suitable to highly heterogeneous environments, is applied for computing thermal distribution in a human head exposed to plane wave at 900 MHz. The model was proven to be unconditionally stable which allows using a larger time step than the one involved with FDTD or other TLM models. The numerical results are compared with those simulated with CST.

### **FB-5 [12:00] STUDENT PAPER**

#### **Stochastic Sensitivity in Thermal Dosimetry for the Homogeneous Human Brain Model\***

Anna Šušnjara<sup>1</sup>, Mario Cvetkovic<sup>1</sup>, Dragan Poljak<sup>1</sup>, Sebastien Lallechere<sup>2</sup> & Khalil El Khamlichi Drissi<sup>2</sup>

<sup>1</sup>*University of Split, Split, Croatia*

<sup>2</sup>*Blaise Pascal University, Clermont-Ferrand, France*

**Keywords: Dosimetry (computational), RF/Microwaves, Work in Progress**

The sensitivity analysis of thermal parameters in the homogeneous human brain model is presented, investigating their influence on thermal rise, as a direct consequence of the high frequency exposure. The novelty presented is the combination of modern Stochastic Collocation method with the thermal part of the existing deterministic electromagnetic-thermal model. The sensitivity analysis excludes the less important parameters and can be used as a prior step of more complex experimental or computational models. In addition, obtained confidence margins give more precise estimate if temperature elevation reaches the prescribed limits or not. \*This work was undertaken within the framework of COST Action BM1309 (COST EMF-MED).

## **FB-6 [12:03] STUDENT PAPER**

### **Personal Exposimeter for Radio Frequency Exposure Assessment in the 60-GHz Band**

Reza Aminzadeh<sup>1</sup>, Arno Thielens<sup>1</sup>, Haolin Li<sup>1</sup>, Carole Leduc<sup>2</sup>, Maxim Zhadobov<sup>2</sup>, Guy Torfs<sup>1</sup>, Johan Bauwelinck<sup>1</sup>, Luc Martens<sup>1</sup> & Wout Joseph<sup>1</sup>

<sup>1</sup>*Department of Information Technology, Ghent University / iMinds, Ghent, Belgium, 9050*

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**Keywords: Dosimetry (measurements), RF/Microwaves, Completed (unpublished)**

For the first time a personal Exposimeter (PE) is presented for radiation assessment in the 60-GHz band. Numerical simulations are used to design the PE and its uncertainty is assessed using on-body calibration measurements at 61 GHz. The PE consisting of three nodes (antennas) with vertical-horizontal-horizontal (VHH) polarization has a 50% prediction interval of 1.3 dB which is 3.1 dB lower than a single node experiment. The proposed PE has a 19.7 dB smaller uncertainty compared to the currently available exposimeters at lower frequencies. A 95 % confidence interval of 6.6 dB is measured on the response of the proposed PE.

## **FB-7 [12:06] STUDENT PAPER**

### **Effects of nsPEF on Viability and E6/E7 Viral Gene Expression in HPV-16 Integrated Cervical Carcinoma in Vitro**

Hollie Ryan<sup>1, 3</sup>, Loree Heller<sup>2, 3</sup> & Stephen J. Beebe<sup>3</sup>

<sup>1</sup>*Biomedical Engineering Institute, Old Dominion University, Norfolk, Virginia, USA, 23529*

<sup>2</sup>*College of Health Sciences, Old Dominion University, Norfolk, Virginia, USA, 23529*

<sup>3</sup>*Frank Reidy Research Center for Bioelectrics, Old Dominion University, Norfolk, Virginia, USA, 23508*

**Keywords: Dosimetry (measurements), All Frequencies, Work in Progress**

Nanosecond pulsed electric fields (nsPEFs) are non-thermal, ultra-short pulses with high voltage electric field intensity (kV/cm) and high power (MW). NsPEFs have been studied as potential infection and disease therapies, but not after viral integration. In this study, effects of nsPEFs on HPV-16 infected cervical cancer cell line CaSki were examined for viability and expression of viral oncogenes E6 and E7. Results showed exposure led to transient enhanced viability at fewer pulses and dose- and time-dependent decreases in viability, and caused no changes in viral gene expression, possibly implicating cell repair and cell death mechanisms of cellular metabolism in response to nsPEF exposure rather than direct effects on gene transcription.

## **FB-8 [12:09] STUDENT PAPER**

### **Diversity of monopolar and bipolar nanosecond pulsed electric signals action on the metallo-enzyme superoxide dismutase (SOD): a modelling approach**

Elena della Valle<sup>1</sup>, Paolo Marracino<sup>1</sup>, Olga Pakhomova<sup>2</sup>, Micaela Liberti<sup>1</sup> & Francesca Apollonio<sup>1</sup>

<sup>1</sup>*Department of Information Engineering, Electronics and Telecommunications, Sapienza University of Rome, Rome, Italy, 00184*

<sup>2</sup>*Frank Reidy Research Center for Bioelectrics, Old Dominion University, Norfolk, Virginia, USA, 23508*

**Keywords: Electroporation, Pulsed, Completed (unpublished)**

Recent papers showed that when dealing with nanosecond pulsed electric fields (nsPEFs), bipolar pulses proved far less effective at membrane permeabilization and at cell killing than monopolar ones, contrary to what happens in the microsecond range. The mechanism at the basis of such selective response of cells is not fully elucidated; one hypothesis worthwhile to test is a direct action of nsPEFs on intracellular enzyme reactions. The goal of this study is to investigate possible enzyme response due to the application of nsPEF



monopolar and bipolar of intensity of  $10^8$  V/m and duration of 100 ns on the superoxide dismutase (SOD,Cu-Zn) enzyme, by means of a molecular dynamic (MD) modelling approach.

#### **FB-9 [12:12]**

#### **WITHDRAWN**

#### **FB-10 [12:15]**

#### **STUDENT PAPER**

#### **The behaviour of the neuroblastoma cell line during *in vitro* wound healing with the application of PEMF and PRFE**

Mehmet Gumusay<sup>1</sup>, Adnan Kaya<sup>1</sup>, Suna Saygili<sup>2</sup>, Isil Aydemir<sup>2</sup> & Ibrahim Tuglu<sup>2</sup>

<sup>1</sup>*Biomedical Technologies, Izmir Katip Celebi University, Izmir, Turkey, 35620*

<sup>2</sup>*Department of Histology, Celal Bayar University, Manisa, Turkey*

**Keywords: *In vitro*, Static, Completed (unpublished)**

The effects of extremely low frequency pulsed electromagnetic field (PEMF) and pulsed radiofrequency energy (PRFE) on wound healing *in vitro* were examined. Mouse neuroblastoma cell line, NA2B were investigated by its neurite extension behaviour under the application of electromagnetic fields. Wound model was performed with needle of ppd syringe in shape of (+). Cultured cells were exposed to the PEMF (75 Hz frequency, square waveform and magnetic field of 1 mT for up to 5 h) and PRFE (27.12 MHz carrier frequency square waveform) systems for 5. The wound healing was investigated by closure of the wound by the cell proliferation with neurite inhibition using inverted microscope image.

#### **FB-11 [12:18]**

#### **STUDENT PAPER**

#### **Effects of radiofrequency electromagnetic fields emitted by Terrestrial Trunked Radio (TETRA) handheld devices on event related potentials**

Torsten Eggert<sup>1</sup>, Hans Dorn<sup>1</sup>, Cornelia Sauter<sup>1</sup>, Gernot Schmid<sup>2</sup>, Thomas Bolz<sup>3, 4</sup>, Alexander Marasanov<sup>1</sup>, Marie-Luise Hansen<sup>1</sup>, Anita Peter<sup>1</sup> & Heidi Danker-Hopfe<sup>1</sup>

<sup>1</sup>*Charité - University Medicine Berlin, Competence Centre of Sleep Medicine, Berlin, Germany, 12200*

<sup>2</sup>*Seibersdorf Laboratories, Seibersdorf, Austria, 2444*

<sup>3</sup>*Institute of Mobile and Satellite Communication Technology GmbH, Kamp-Lintfort, Germany, 47475*

<sup>4</sup>*RF-Frontend GmbH, Kamp-Lintfort, Germany, 47475*

**Keywords: *Human, RF/Microwaves, Completed (unpublished)***

In a comprehensive study acute effects of Terrestrial Trunked Radio (TETRA) exposure on the central nervous system were investigated. In this placebo-controlled randomized double-blind cross-over study TETRA signals simulating exposure from a handheld device were applied during sleep, the resting state and while under cognitive demand. Aim of this contribution is to present the results of electrophysiological activities and behavioral measurements obtained during a choice reaction time task and an auditory 3-stimulus oddball paradigm. To sum up, none of the investigated auditory event related potentials differed significantly with exposure. Thus, the present analysis reveals no evidence for any health-related effects of RF-EMF exposure.

#### **FB-12 [12:21]**

#### **STUDENT PAPER**

#### **Characterization of Cell Electroporation by Confocal Raman Spectroscopy**

Antoine Azan<sup>1</sup>, Valérie Untereiner<sup>2,3</sup>, Caterina Merla<sup>1</sup>, Cyril Gobinet<sup>3</sup>, Olivier Piot<sup>3</sup> & Lluís M. Mir<sup>1</sup>

<sup>1</sup>Vectorology and Anticancer Therapies, UMR8203, CNRS, Univ. Paris-Sud, Gustave Roussy, Université Paris-Saclay, Villejuif, France, 94805

<sup>2</sup>Plateforme imagerie cellulaire et tissulaire, Université de Reims Champagne-Ardennes, Reims, France, 51100

<sup>3</sup>MEDyC, UMR7369, CNRS, Université de Reims Champagne-Ardennes, Reims, France, 51100

**Keywords:** *In vitro*, Pulsed, Work in Progress

In this study, we report the first experimental characterization of cell electropermeabilization by confocal Raman spectroscopy. This non-invasive and label-free optical technique provides access to the molecular composition of the samples. Raman signatures of control and pulsed living human adipose-derived mesenchymal stem cells were acquired at several regions of interest and spectral bands. Depending on the region of interest investigated, critical Raman peaks specific to cell electropermeabilization were identified. It provides new information at a molecular level on this bio-electromagnetic interaction.

### FB-13 [12:24]

#### STUDENT PAPER

#### **Pulsed Electromagnetic Fields increase proliferative response of chondrocytes and induce changes in growth alignment by optimizing field parameters**

Irene Garcia<sup>1</sup>, Nazario Felix-Gonzalez<sup>1</sup> & Ceferino Maestu<sup>1</sup>

<sup>1</sup>Bioelectromagnetics, Biomedical Technology Centre, Pozuelo de Alarcón, Spain, 28223

**Keywords:** *In vitro*, Pulsed, Completed (unpublished)

Arthritis involves hundreds of musculoskeletal disorders, such as Rheumatoid Arthritis (RA) and Osteoarthritis (OA). Pulsed electromagnetic fields (PEMFs) are a recent modality which offers beneficial effects in tissue regeneration, inflammation decrease or in pain relief. This study seeks to identify the optimal parameters which do not impair cell viability and enhance cell proliferation, in order to set up an alternative therapy to certain musculoskeletal disorders.

### FB-14 [12:27]

#### STUDENT PAPER

#### **An *in vitro* cost-effective test bench for cardiac implants, reproducing human exposure to electric fields 50/60 Hz**

Cihan Gercek<sup>1</sup>, Djilali Kourtiche<sup>1</sup>, Pierre Schmitt<sup>1</sup>, Isabelle Magne<sup>2</sup>, Martine Souques<sup>3</sup>, Patrice Roth<sup>1</sup> & Mustapha Nadi<sup>1</sup>

<sup>1</sup>Nanomaterials, Electronics and Living Systems Department, Institut Jean Lamour (UMR 7198), CNRS, Nancy, France, 54000

<sup>2</sup>R&D, EDF, Moret sur Loing, France, 77818

<sup>3</sup>SEM, EDF, Levallois-Perret, France, 92300

**Keywords:** *In vitro*, ELF/ELF, Completed (unpublished)

Regulations regarding EMF related occupational risks are based on the European Directive 2013/35/EU. It sets the minimum requirements for the protection of workers exposed to these fields, and defines workers bearing implants as workers at particular risk. For these workers two standards proposed methods to assess the risk (EN 50527-1 and EN 50527-2). These methods include numerical or experimental *in-vitro* approaches. This study designs an *in vitro* cost-effective test bench for active cardiac implants, reproducing the human exposure to electric fields of 50/60Hz, by combining two approaches (numerical and *in vitro*).

### FB-15 [12:30]

#### STUDENT PAPER

#### **The impact of millimeter waves on the enzymatic activity of succinate dehydrogenase**

Vincent Van Eeghem<sup>1</sup>, Katty Goossens<sup>2</sup>, Gokarna Pandey<sup>1</sup>, Guoqiang He<sup>1</sup>, Cathleen De Tandt<sup>1</sup>, Benyameen Keelson<sup>1</sup>,

Ronnie Willaert<sup>2</sup> & Johan Stiens<sup>1</sup>

<sup>1</sup>Department of Electronics and Informatics (ETRO), Laboratory for micro- and photon electronics (LAMI), Vrije Universiteit Brussel, Brussels, Belgium

<sup>2</sup>Department of Bioengineering Sciences, IJRG NanoBiotechnology & NanoMedicine (SBB), Vrije Universiteit Brussel, Brussels, Belgium

**Keywords:** *In vitro*, RF/Microwaves, Work in Progress

Although micro- and millimeter waves become more important in our daily life, an unambiguous biophysical explanation for the interaction mechanism with biological matter is still lacking. At the molecular level, structural features such as conjugated molecules and metal ions in proteins could play an essential role in the interaction with non-ionizing electromagnetic (EM) waves. Moreover, transfer of charges in biochemical reactions could be disturbed significantly by these EM waves. Taking these aspects into account, the enzymatic activity of succinate dehydrogenase was evaluated after exposure to low-intensity millimeter waves. The results showed a time-dependent reduction of the enzyme activity, which didn't reverse after exposure.

### **FB-16 [12:33] STUDENT PAPER**

#### **Effects of long-term exposure to intermediate frequency magnetic fields on fertility in mice**

Kumari Kajal<sup>1</sup>, Mikko Herrala<sup>1</sup>, Heikki Tanila<sup>2</sup>, Matti Viluksela<sup>1</sup>, Jonne Naarala<sup>1</sup> & Jukka Juutilainen<sup>1</sup>

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**Keywords:** *In vivo*, IF, Work in Progress

Groups of 20 male C57BL/6J mice were exposed continuously for 5 weeks to 7.5 kHz magnetic fields at 12 or 120  $\mu$ T. Sperm from cauda epididymis was analysed for motility, total sperm counts, and morphology. Testicular spermatid head were counted. No differences in body and reproductive tissue weights or testis sperm counts were seen between the three groups. Other results will be reported in the BioEM 2016 meeting.

### **FB-17 [12:36] STUDENT PAPER**

#### **The long-term exposure of 835 MHz radiofrequency radiation causes a hypoglycemia in SMP-30 KO mice**

Hye-Ryoung Lee<sup>1</sup>, Dahyeon Yu<sup>1</sup>, Ju-Hwan Kim<sup>1</sup>, Hakrim Kim<sup>1</sup> & Jin-Koo Lee<sup>1</sup>

<sup>1</sup>Department of Pharmacology, Dankook University, Cheonan, Korea, 31116

**Keywords:** *In vivo*, RF/Microwaves, Work in Progress

Long-term exposure of 835 MHz RFR induced hypoglycemia and AMPK signaling may be activating to modulate glucose homeostasis in RFR exposed aging mice.

**Lunch**  
**Tuesday June 7, 2016 • 12:45 - 14:00**  
**Kapittelzaal**

**Session: M3**  
**EBEA General Assembly**  
**Tuesday June 7, 2016 • 12:45 - 14:00**  
**Refter**

**Session: PB**  
**Poster Session B**  
**Tuesday June 7, 2016 • 14:00 - 15:30**  
**Kloostergang & Novicengang**  
**Chairs: Heidi Danker-Hopfe & Francesca Apollonio**

**Coffee Break**  
**Tuesday June 7, 2016 • 15:30 - 16:00**  
**Kapittelzaal**

**Session: S5**  
**Human studies: ELF and RF**  
**Tuesday June 7, 2016 • 16:00 - 17:40**  
**Rafter**  
**Chairs: Alexandre Legros & Sarah Loughran**

**Session: S6**  
**Electromagnetic interference on implanted devices**  
**Tuesday June 7, 2016 • 16:00 - 17:40**  
**Zaal Rector Vermeylen**  
**Chairs: Marthinus Van Wyk & Wout Joseph**

**S5-1 [16:00]**  
**STUDENT PAPER**

**Pulse modulated radiofrequency exposure influences cognitive performance**

Adam Verrender<sup>1, 2</sup>, Sarah Loughran<sup>1, 2, 3</sup>, Anna Dalecki<sup>2, 3</sup>, Ray McKenzie<sup>1</sup> & Rodney Croft<sup>1, 2, 3</sup>

<sup>1</sup>Australian Centre for Electromagnetic Bioeffects Research, Wollongong, Australia

<sup>2</sup>Centre for Health Initiatives, Illawarra Health & Medical Research Institute, University of Wollongong, Wollongong, Australia

<sup>3</sup>Population Health Research on Electromagnetic Energy, Monash University, Melbourne, Australia

**Keywords: Human, RF/Microwaves, Completed (unpublished)**

**Presented by: Adam Verrender**

Consistent evidence shows that exposure to PM-RF affects the brains electrical activity. However, the functional consequence of this change remains unclear, as several studies which have assessed aspects of cognitive and behavioural functioning have produced contradictory, but mostly null results. Using an improved methodology, the present study found an effect of PM-RF exposure on reaction time and response bias in a working memory task. It is possible that the methodological improvements employed in the present study increased sensitivity, and thus the ability to detect potential effects.

**S6-1 [16:00]**

**Numerical Per-Patient MRI RF Exposure Estimation via Morphing**

Manuel Murbach<sup>1</sup>, Esra Neufeld<sup>1</sup>, Bryn Lloyd<sup>1</sup> & Niels Kuster<sup>1, 2</sup>

<sup>1</sup>ITIS Foundation, Zurich, Switzerland

<sup>2</sup>Swiss Federal Institute of Technology (ETH), Zurich, Switzerland

**Keywords: Dosimetry (computational), RF/Microwaves, Work in Progress**  
**Presented by: Manuel Murbach**

Current safety standards for exposure to radiofrequency fields in magnetic resonance imaging are conservative and intended to protect the entire patient population. Limits set on whole-body averaged specific absorption rate take into account the patient's weight, which allows robust but only very rudimentary per-patient exposure estimation. The introduction of additional metrics will further increase the accuracy of local exposure estimations. In this study, we explore the benefits of patient mapping to anatomical models and morphing-based variants, with comparisons to truly personalized approaches via patient registration.

## **S5-2 [16:20] STUDENT PAPER**

### **Idiopathic environmental intolerance attributed to electromagnetic fields (IEI-EMF) and sleep disruption: Melatonin Assessment in saliva and urine**

Soafara Andrianome<sup>1, 2</sup>, Laurent Hugueville<sup>3</sup>, Rene De Seze<sup>1, 2</sup>, Maité Hanot-Roy<sup>1, 2</sup>, Kelly Blazy<sup>1, 2</sup>, Christelle Gamez<sup>1, 2</sup> & Brahim Selmaoui<sup>1, 2</sup>

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<sup>3</sup>Centre MEG-EEG, CRICM et CENIR, Centre National de la Recherche Scientifique, Paris, France

**Keywords: Clinical (diagnostics), All Frequencies, Review, Commentary, Recommendation, Evaluation**  
**Presented by: Soafara Andrianome**

Sleep disruption is frequently reported by people with idiopathic environmental intolerance attributed to electromagnetic fields or IEI-EMF. The physiopathology of this association is not clear. We aimed to evaluate whether melatonin level was affected in IEI-EMFs patients. Melatonin levels in saliva and urine were quantified by immunoassay techniques in a session without intentional exposure to EMF. Sleep quality was assessed by questionnaires. Significant differences in PSQI and ESS scores between compared groups were observed. Likewise, a higher proportion of pathological sleep for ESS was found in IEI-EMF group. Results indicate that melatonin is not associated with different sleep troubles reported by IEI-MFs patients.

## **S5-3 [16:40]**

### **Magnetophospenes in humans exposed to ELF MF up to 50 mT, a threshold study**

Alexandre Legros<sup>1, 2, 3, 4</sup>, Julien Modolo<sup>1, 2, 3</sup>, Michael Corbacio<sup>1</sup>, Daniel Goulet<sup>5</sup>, Michel Plante<sup>5</sup>, Martine Souques<sup>6</sup>, François Deschamps<sup>7</sup>, Genevieve Ostiguy<sup>5</sup>, Jacques Lambrozo<sup>6</sup> & Alex Thomas<sup>1, 2, 3</sup>

<sup>1</sup>Human Threshold Research Group, Lawson Health Research Institute, London, ON, Canada

<sup>2</sup>Department of Medical Biophysics, Western University, London, ON, Canada

<sup>3</sup>Department of Medical Imaging, Western University, London, ON, Canada

## **S6-2 [16:20] STUDENT PAPER**

### **RF-induced heating of patients with partially implanted implant lead: effect of feed geometry and patient dimensions**

Elena Lucano<sup>1, 2</sup>, Micaela Liberti<sup>2</sup>, Tom Lloyd<sup>3</sup>, Francesca Apollonio<sup>2</sup>, Steve Wedan<sup>3</sup>, Wolfgang Kainz<sup>1</sup> & Leonardo M. Angelone<sup>1</sup>

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<sup>3</sup>Imricor Medical Systems, Burnsville, MN, USA, 55337

**Keywords: Dosimetry (computational), RF/Microwaves, Completed (unpublished)**  
**Presented by: Elena Lucano**

During an MRI procedure radiofrequency (RF)-induced heating can occur on a partially or fully implanted lead because of the coupling of the catheter with the RF field. In commercial 1.5T MRI scanners used in clinical applications, the position of feed excitation and orientation of the polarization with respect to the patient are often unknown. The data analysis in this study shows that source position, field orientation, and patient dimension strongly affect local SAR at the tip of a partially implanted catheter, suggesting that such information needs to be taken into account when evaluating safety of partially implanted catheters.

## **S6-3 [16:40] STUDENT PAPER**

### **Computable Anatomical Phantoms for MRI Safety Evaluation of Patients with Implants**

Aiping Yao<sup>1, 2</sup>, Earl Zastrow<sup>1, 2</sup>, Eugenia Cabot<sup>1</sup>, Bryn Lloyd<sup>1</sup>, Wolfgang Kainz<sup>3</sup> & Niels Kuster<sup>1, 2</sup>

<sup>1</sup>IT'IS Foundation, Zurich, Switzerland, CH-8004

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**Keywords: Dosimetry (computational),**

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<sup>7</sup>Service Environnement Réseaux, RTE, Paris, France

**Keywords: Behavioural, ELF/LF, Completed (unpublished)**

**Presented by: Alexandre Legros**

Although magnetophosphenes perception is the most reliable reported effect on acute human neurophysiological responses to extremely low frequency (ELF) magnetic field (MF) exposure, current knowledge is based on small sample size, non-replicated experiments. In this study, we established MF levels triggering magnetophosphenes at 20, 50, 60 and 100 Hz in humans. Magnetophosphenes perception and EEG were collected in 55 magnetic flux density conditions randomly delivered in each frequency group (2 experiments, total n=145). Results indicate that threshold values 1) need to be reported as a function of dB/dt instead of flux density, and 2) are frequency-dependent (higher sensitivity to lower frequencies). No clear trend was found in EEG data.

## **S5-4 [17:00]**

### **A proposed method to study the effect of time-varying electric and magnetic stimulations on the vestibular function**

Sebastien Villard<sup>1, 2</sup>, Alicia Allen<sup>1, 3</sup>, Michael Corbacio<sup>1, 2</sup>, Daniel Goulet<sup>4</sup>, Michel Plante<sup>4</sup>, Martine Souques<sup>5</sup>, François Deschamps<sup>6</sup>, Genevieve Ostiguy<sup>4</sup>, Jacques Lambrozo<sup>5</sup>, Michel Guerraz<sup>7</sup>, Alex Thomas<sup>1, 8</sup> & Alexandre Legros<sup>1, 2, 3, 8</sup>

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<sup>7</sup>Laboratoire de Psychologie et Neurocognition, Université de Chambéry, Chambéry, France

<sup>8</sup>Medical Imaging, University of Western Ontario, London, Ontario, Canada

**Keywords: Behavioural, ELF/ILF, Work in Progress**

**Presented by: Sebastien Villard**

## **RF/Microwaves, Completed (unpublished)**

**Presented by: Aiping Yao**

The Virtual Population phantoms have been proven to be an essential tool for investigations of EM absorption in the human body, including RF safety evaluation of implant during MRI. Four phantoms of ViP 1.0 and 3.0 were compared from a dosimetrical point of view. We evaluated 1) the body-average and local absorption and 2) the total dissipated lead tip power (TDLTP) of six implant routings under diverse exposure conditions. The observed difference in TDLTP, evaluated for limited implant topologies, is less than 1dB. We found the whole-body SAR to be similar, but local SAR differs significantly in the spine region (>5dB). In general, usage of ViP 3.0 will reduce the anatomical phantom related uncertainties that are difficult to quantify.

## **S6-4 [17:00]**

### **STUDENT PAPER**

#### **Factors determining susceptibility of cardiovascular implantable electronic devices with bipolar leads to ELF-EMF**

Dominik Stunder<sup>1</sup>, Andreas Napp<sup>2</sup>, Christian Schikowsky<sup>1</sup>, Matthias Zink<sup>2</sup>, Kai Jagielski<sup>1</sup>, Thomas Kraus<sup>1</sup> & Tobias Seckler<sup>1</sup>

<sup>1</sup>Research Center for Bioelectromagnetic Interaction (femu), RWTH Aachen University, Aachen, Germany, 52074

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**Keywords: In vivo, ELF/ILF, Completed (published)**

**Presented by: Dominik Stunder**

The risk of electromagnetic interference (EMI) of cardiovascular implantable devices is an important question. Factors determining susceptibility to ELF-EMF are only known for devices with unipolar leads although today 99% of the implanted leads are bipolar. We conducted an in vivo study to determine interference thresholds of devices in 50 Hz-EMF and subsequently regression analyses to identify influencing factors for EMI of bipolar

Extremely low-frequency (ELF <300Hz) magnetic fields (MF) acute effects in humans are still mostly described as visual flickering perception called magnetophosphenes. Yet, postural control modulations in the presence of MF suggest the interaction between magnetic induction and vestibular sensory organs. This work propose to investigate the impact of 100  $\mu$ T MF at 20, 60, 90, 120, and 160 Hz on the vestibular function by analyzing center of pressure (COP) displacement modulations and subjective visual vertical (SVV) measurements. The sensitivity of both COP and SVV to galvanic vestibular stimulation (GVS) will be used as positive control to evaluate the impact of transcranial alternating current stimulation (tACS) and ELF MF.

### **S5-5 [17:20]**

#### **Acute impact of extremely low frequency (< 300 Hz) magnetic fields up to 100 mT on human standing balance**

Alicia Allen<sup>1,4</sup>, Sebastien Villard<sup>1,2</sup>, Michael Corbacio<sup>1,2</sup>, Daniel Goulet<sup>5</sup>, Michel Plante<sup>5</sup>, Martine Souques<sup>6</sup>, François Deschamps<sup>7</sup>, Genevieve Ostiguy<sup>5</sup>, Jacques Lambrozo<sup>6</sup>, Michel Guerraz<sup>8</sup>, Alex Thomas<sup>1,3</sup> & Alexandre Legros<sup>1,2,3,4</sup>

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<sup>8</sup>Laboratoire de psychologie et neurocognition, Université de Chambéry, Chambéry, France

**Keywords: Human, ELF/ILF, Work in Progress**

**Presented by: Sebastien Villard**

Studies have found that extremely low-frequency (ELF, <300Hz) magnetic fields (MF) can modulate standing balance, however acute balance effects of high flux densities in this frequency range have not been systematically investigated yet. This pilot study explores acute human standing balance responses to magnetic induction and to alternating currents (AC) directly applied with skin electrodes. The

devices. Factors identified as highly significant were device sensitivity, lead's tip orientation, position, and tip-to-ring spacing. The influence of lead's tip orientation and position were previously unknown and now gives new options for the implantation procedure to minimize the patients' risk of EMI.

### **S6-5 [17:20]**

#### **STUDENT PAPER**

#### **Study on the Interference of Cardiovascular Implantable Electronic Devices (CIED) Exposed to Magnetic Fields up to 200 kHz**

Kai Jagielski<sup>1</sup>, Tobias Seckler<sup>1</sup>, Thomas Kraus<sup>1</sup> & Dominik Stunder<sup>1</sup>

<sup>1</sup>Research Center for Bioelectromagnetic Interaction (femu), RWTH Aachen University, Aachen, Germany, 52074

**Keywords: In vitro, IF, Completed (published)**

**Presented by: Kai Jagielski**

This study assessed the effect of homogeneous and inhomogeneous magnetic fields up to 200 kHz with arbitrary waveforms on CIEDs by measuring the induced interference voltage and comparing it to the performance limits of ISO 14117. The measuring system with four different "off the shelf" CIED leads was placed in an adipose or leptosome torso phantom with different saline solutions which allowed four realistic implantation sites and seven different implantation angles of the lead tip. Exceedance of the performance limits was measured in the worst case at 7  $\mu$ T<sub>rms</sub> and 100 kHz within the ICNIRP reference levels for general public. For validation of the data an in vivo study is suggested.

study uses direct current (DC) stimulation, or galvanic vestibular stimulation (GVS), as a positive control. The center of pressure displacement was collected and analyzed using validated sway characteristics. This work aims to explore MF exposure thresholds for inducing acute standing balance modulations at various ELFs.

**Boats to the Conference Banquet**  
**Tuesday June 7, 2016 • 18:00 - 19:15**  
**Waterways of Ghent**

**Conference Banquet**  
**Tuesday June 7, 2016 • 19:15 -**  
**Oude Vismijn**



## Wednesday June 8, 2016

Session: HT

Hot Topic Plenary - The US NTP Study: A Real Game Changer or Just Another Study?

Wednesday June 8, 2016 • 08:00 - 09:00

Refter

Chairs: Nam Kim & Eric Van Rongen

### HT-1 [08:00]

#### Rational & Summary of Exposure and Dosimetry

Myles Capstick<sup>1</sup> & Niels Kuster<sup>1</sup>

<sup>1</sup>*IT'IS & ETH, Zurich, Switzerland*

### HT-2 [08:10]

#### Preliminary Findings

Michael Wyde<sup>1</sup>

<sup>1</sup>*NIEHS, USA*

### HT-3 [08:30]

#### Plenary Discussions

Michael Wyde<sup>1</sup>, Myles Capstick<sup>2</sup> & Niels Kuster<sup>2</sup>

<sup>1</sup>*NIEHS, USA*

<sup>2</sup>*IT'IS & ETH, Zurich, Switzerland*

### Session: P3

## Plenary 3: Can we induce adaptive response with EM stimulation? The new frontier of immune system and EM field interaction

Wednesday June 8, 2016 • 09:00 - 10:00

Referee

Chairs: Myrtil Simko & Richard Nuccitelli

### P3-1 [09:00]

#### Immune system and EMF, state of the art and new routes to explore

Claudio Pioli<sup>1</sup>

<sup>1</sup>Laboratory of Biomedical Technologies, ENEA, Rome, Italy, 00123



#### Biographical sketch

Dr Claudio Pioli is a senior scientist at the ENEA, Division of Health Technologies (Rome, Italy) where he leads the Group of Immunology. He is an invited professor at the University of Rome Tor Vergata, where he teaches Molecular Immunology and is also a member of the PhD program in Immunology and Applied Biotechnologies.

For several years, he has been studying mechanisms of immune-regulation focusing his attention on lymphocyte differentiation and functions. He has investigated the effects on the immune system of the exposure to ionizing and non ionizing radiations. Using several in vitro and in vivo models, the effects of EMF on immune functions were extensively investigated in adulthood and during development.

#### Abstract

In recent years, the interest on the effects of EMF on the immune system increased, not only focused on potentially health-threatening issues but also raising the possibility to favorably modulate immune responses. Recent progresses in immunology revealed how complex the interactions of the immune cells between them and with cells of other systems are. To address its task, i.e. protection of the organism from invading pathogens, the immune system must carry out effective not harmful responses, i.e. not only to eradicate the pathogens, but also be “respectful” with the organism and tolerate irrelevant antigens, while dealing with environmental cues. Xenobiotics (pollutants, medicines, ionizing radiations ...) are known to affect immune responses. Yet, other factors, including diet, pro/prebiotics, life style and other medicines may positively modulate immune functions. Many studies investigated the potentially detrimental effects of EMF on the immune system often reaching contradictory conclusions. Interestingly, modulating effects of cell functions by EMF envisage the possibility to regulate immune parameters using EMF; a research topic deserving further investigation. Besides, the last decades also faced a tremendous progress in our understanding of the immune system. However, not always boundary disciplines studying the effects of xenobiotics on the immune system took advantage of this increased knowledge. An analysis of what could be investigated to assess the effects of EMF on immune functions, stressing unmet issues, will be discussed.

### P3-2 [09:30]

#### The challenge of immunoelectrochemotherapy

Lluis M. Mir<sup>1</sup>

<sup>1</sup>Vectorology and Anticancer Therapies, UMR 8203, CNRS, Univ. Paris-Sud, Gustave Roussy, Université Paris-Saclay, Villejuif, France, 94805

#### Biographical sketch

Lluis M. Mir, WG2 leader of the COST action EMF-MED (BM1309), former President of the EBEA (June 2012



– June 2014), did his graduate work at the Ecole Normale Supérieure (Paris) and obtained his D.Sc. at Univ. of Toulouse in 1983. CNRS researcher, he is the Director of the Lab. of Vectorology and Anticancer Therapies (UMR 8203 CNRS-Université Paris-Sud at Gustave Roussy, Villejuif, France). In 2011 he founded the European Associated Laboratory for the applications of Electric pulses in Biology And Medicine (LEA EBAM) that he co-directs with Pr. D. Miklavcic.

He has coordinated research projects at French and European levels, published 203 scientific articles and 21 book chapters (H index=60, Web of Science), delivered 542 presentations at international meetings and 92 invited lectures at institutions all over the world, deposited 22 first applications of patents resulting in several families of patents under exploitation, and won several awards, including the URSI-France 2012 medal and Frank Reidy award in Bioelectrics in 2015.

### **Abstract**

The delivery of short intense electric pulses that permeabilize cell membranes is used not only in vitro, but also in vivo, to transfer antitumor drugs to cancer tissues (electrochemotherapy) or to transfer nucleic acids to healthy and malignant tissues (nucleic acids electrotransfer, electrogenetherapy). In vivo, electric pulses do not impact only the cells “individually”, causing their electropermeabilization. They also act on the tissues “collectively”, causing transient vascular locks or acting as immunological adjuvants. These tissue reactions will be discussed: in particular, the promising alliance of electrochemotherapy and immunotherapy that has already been evidenced in preclinical studies. Indeed, electrochemotherapy is a highly efficient and safe anticancer treatment, but local when given alone. Its clinical applications are developing in the EU (about 3000 patients treated in the EU last year). Optimized combinations of electrochemotherapy with immunotherapy agents must therefore be sought since they should result in systemic treatment of the cancer.

\*:The promising alliance of electrochemotherapy and immunotherapy. Calvet C.Y. and Mir L.M., Cancer Metastasis Reviews 2016, March 18, DOI: 10.1007/s10555-016-9615-3 (OA).

This study was conducted in the scope of COST BM 1309 EMF-MED and of LEA EBAM (European Laboratory of Pulsed Electric Fields Applications in Biology and Medicine).

**Coffee Break**  
**Wednesday June 8, 2016 • 10:00 - 10:30**  
**Kapittelzaal**

**Session: CL**  
**Chiabrera Lecture**  
**Wednesday June 8, 2016 • 10:30 - 11:00**  
**Refter**  
**Chairs: Eric Van Rongen & Florence Poulletier De Gannes**

### **CL-I [10:30]**

#### **Sleepless in Bioelectromagnetics: Unravelling the Effects of Radiofrequency Electromagnetic Fields on the Brain**

Sarah Loughran<sup>1</sup>

<sup>1</sup>IHMRI, University of Wollongong, Wollongong, Australia

### Session: S7

#### Computational models for medical applications

Wednesday June 8, 2016 • 11:00 - 12:40

Zaal Rector Vermeylen

Chairs: Micaela Liberti & Marta Parazzini

#### S7-1 [11:00]

##### Large-Scale Multi Neuronal Simulation within an Anatomical Head Model for Transcranial Alternative Current Stimulation (tACS) Investigations

Antonino Mario Cassara<sup>1</sup>, Esra Neufeld<sup>1</sup>, Manuel Guidon<sup>2</sup>, Wolfgang Kainz<sup>3</sup> & Niels Kuster<sup>1,4</sup>

<sup>1</sup>*IT'IS Foundation for Research on Information Technologies in Society, Zurich, Switzerland*

<sup>2</sup>*Zurich MedTech, Zurich, Switzerland*

<sup>3</sup>*U.S. FDA, CDRH, Office of Science and Engineering Laboratories, Division of Biomedical Physics, USA*

<sup>4</sup>*Swiss Federal Institute of Technology (ETHZ), Zurich, Switzerland*

**Keywords:** Dosimetry (computational), ELF/ILF, Completed (unpublished)

**Presented by:** Antonino Mario Cassara

To gain understanding and predict sensitivity to neurostimulation in tACS experiments, we performed EM simulations in a high-resolution anatomical head model combined with neuronal simulations based on reconstructed neurons placed in the cortex. Maps of E-field thresholds and spiking onset time for a biphasic stimulus permit the definitions of classes and locations of stimulation behavior. Simulation results are in qualitative agreement with fMRI data and provide mechanistic insight into the relationship between applied field and excitation properties of pyramidal neurons. The developed approach can flexibly handle arbitrary electrode montages, stimuli, and anatomical and neuronal models.

#### S7-2 [11:20]

##### Investigation of Electric and Magnetic Stimulation Time Constants Through Neuronal Dynamics Functionalized Anatomical Models

Esra Neufeld<sup>1</sup>, Antonino Mario Cassara<sup>1</sup>, Hazael Montanaro<sup>1,2</sup>, Wolfgang Kainz<sup>3</sup> & Niels Kuster<sup>1,2</sup>

<sup>1</sup>*IT'IS Foundation for Research on Information Technologies in Society, Zurich, Switzerland*

### Session: S8

#### Epidemiology studies

Wednesday June 8, 2016 • 11:00 - 12:40

Refter

Chairs: Martin Roosli & Eric Van Rongen

#### S8-1 [11:00]

##### STUDENT PAPER

##### Personal RF-EMF exposure in Switzerland: Differences in exposure between adolescents, parents, young adults and community types

Benjamin Struchen<sup>1</sup>, Katharina Roser<sup>1</sup>, Benjamin Schwob<sup>1</sup>, Noemi Meier<sup>1</sup>, Jonas Fischer<sup>1</sup>, Marloes Eeftens<sup>1</sup> & Martin Roosli<sup>1</sup>

<sup>1</sup>*Departement of Epidemiology and Public Health, Swiss Tropical and Public Health Institute, Basel, Switzerland, 4051*

**Keywords:** Epidemiology, RF/Microwaves, Work in Progress

**Presented by:** Benjamin Struchen

In the Swiss canton of Zurich personal measurements in 43 adolescents and 42 parents and 30 young adults yielded an average personal RF-EMF exposure of 0.18 V/m for Total exposure, 0.10 V/m for Uplink exposure, 0.11 V/m for Downlink exposure, 0.07 V/m for Broadcasting, 0.04 V/m for DECT and 0.04 V/m for WLAN exposure. The exposure of young adults was higher than in the other groups with mean Total, Uplink and Downlink exposure of 0.22 V/m, 0.13 V/m and 0.15 V/m compared to 0.16 V/m, 0.10 V/m, 10 V/m for parents and 0.16 V/m, 0.09 V/m, 0.08 V/m for adolescents, respectively. These clear exposure differences can largely be explained by differences in behaviour and smartphone use.

#### S8-2 [11:20]

##### ELF-MF occupational exposure and hematolymphopoietic cancers - an analysis of the Swiss National Cohort

Anke Huss<sup>1,2</sup>, Adrian Spoerri<sup>2</sup>, Matthias Egger<sup>2</sup>, Hans Kromhout<sup>1</sup> & Roel Vermeulen<sup>1</sup>

<sup>1</sup>*IRAS, University of Utrecht, Utrecht, the Netherlands, 3584 CM*

<sup>2</sup>*ISPM, University of Bern, Bern, Switzerland, 3012*

<sup>2</sup>Swiss Federal Institute of Technology (ETHZ) , Zurich, Switzerland

<sup>3</sup>U.S. FDA, CDRH, Office of Science and Engineering Laboratories, Division of Biomedical Physics, USA

**Keywords: Dosimetry (computational), ELF/ILF, Completed (published)**

**Presented by: Esra Neufeld**

Coupled EM-neuronal dynamics modeling of electric or magnetic stimulation of different nerves in functionalized anatomical human models is used to elucidate factors affecting stimulation time constants. These time constants are important for low frequency exposure safety assessment and are subject of controversies. We conclude that they are affected by spatial exposure extent, anatomy-related field inhomogeneity, short pulse duration dynamics, pulse duration range, and the method by which time-constants are determined from strength-duration relationships. The experimentally observed behavior can be reproduced with coupled EM-neuronal dynamics modeling in functionalized anatomical models.

### **S7-3 [11:40]**

**“Patient semi-specific” dosimetry for electromagnetic stimulation applied to regenerative treatments**

Francesca Camera<sup>1</sup>, Fioravante Capone<sup>2</sup>, Stefania Setti<sup>3</sup>, Roberta Fusco<sup>3</sup>, Ruggero Cadossi<sup>3</sup>, Francesca Apollonio<sup>1</sup>, Vincenzo Di Lazzaro<sup>2</sup> & Micaela Liberti<sup>1</sup>

<sup>1</sup>Department of Information Engineering, Electronics and Telecommunications, "La Sapienza" University of Rome, Rome, Italy, 00184

<sup>2</sup>Institute of Neurology, Campus Biomedico University, Rome, Italy

<sup>3</sup>IGEA, Clinical Biophysics, Carpi, Italy

**Keywords: Dosimetry (computational), Pulsed, Completed (unpublished)**

**Presented by: Micaela Liberti**

Specific pulsed electromagnetic field (PEMF) have been shown to be effective in producing changes in the excitability of human cerebral cortex and to have neuroprotective potential on animal models of brain ischemia and on in-vitro studies. For this reason, the interest of validating the PEMF stimulation as non-invasive, safe and effective tool to promote recovery in acute ischemic stroke patients is spreading. In such a context, an accurate dosimetry that can be patient semi-specific and, so, describe the electrical quantities induced in each

**Keywords: Epidemiology, ELF/ILF, Completed (unpublished)**

**Presented by: Anke Huss**

We evaluated occupational exposure to ELF magnetic fields and mortality from different types of hematolymphopoietic cancers, using the Swiss National Cohort. We evaluated 18 years of mortality data and exposure to ELF magnetic fields for occupations at censuses 1990 and 2000. We compared 4.3 million workers with either high or medium vs. low exposure to ELF magnetic fields using the Swiss National Cohort.

### **S8-3 [11:40]**

**In-utero Exposure to High Magnetic Fields and the Risk of Attention-Deficit/Hyperactivity Disorder in Offspring: A prospective cohort study with up to 18 years of follow-up**

De-Kun Li<sup>1</sup>, Hong Chen<sup>1</sup>, Jeannette Ferber<sup>1</sup> & Roxana Odouli<sup>1</sup>

<sup>1</sup>Division of Research, Kaiser Permanente, Oakland, California, USA, 94612

**Keywords: Epidemiology, ELF/ILF, Work in Progress**

**Presented by: De-Kun Li**

In this prospectively cohort study of more than 1,482 mother-child pairs, pregnant women were asked to carry an EMDEX meter to measure their magnetic field (MF) exposure during pregnancy. Their offspring were followed for any diagnosis of attention-deficit/hyperactivity disorder (ADHD). Maternal exposure to high MF level during pregnancy is associated with an increased risk of ADHD in offspring. The association was noticeably stronger in female than in male offspring.

treatment, is clearly a powerful tool to understand brain magnetic stimulation and the related interaction mechanisms with biological tissues.

#### **S7-4 [12:00]**

##### **Assessment of the Electric field distribution induced by deep Transcranial Magnetic Stimulation for the treatment of depressive disorders**

Serena Fiocchi<sup>1</sup>, Ilaria Liorni<sup>1</sup>, Paolo Ravazzani<sup>1</sup> & Marta Parazzini<sup>1</sup>

<sup>1</sup>*Istituto di Elettronica e di Ingegneria dell'Informazione e delle Telecomunicazioni IEIIT, CNR Consiglio Nazionale delle Ricerche-IEIIT, Milan, Italy, 20133*

**Keywords: Dosimetry (computational), ELF/LF, Completed (published)**

**Presented by: Marta Parazzini**

In the last few years, deep transcranial magnetic stimulation (dTMS) has been used for the treatment of depressive disorders. To facilitate its clinical application, particular shapes of coils (Hesed coils) were designed. Given their increasing demand and the lack of studies which accurately characterize their use, this paper aims to provide a picture of the distribution of the induced electric field in four realistic human models of different ages and gender. In detail, the electric field distributions were calculated by using numerical techniques in the brain structures potentially involved in the progression of the disease and were quantified both in terms of amplitude levels and focusing power of the distribution.

#### **S7-5 [12:20]**

##### **Stochastic Collocation Method Applied to Transcranial Magnetic Stimulation Analysis\***

Mario Cvetkovic<sup>1</sup>, Anna Šušnjara<sup>1</sup>, Dragan Poljak<sup>1</sup>, Sebastien Lallechere<sup>2</sup> & Khalil El Khamlichi Drissi<sup>2</sup>

<sup>1</sup>*University of Split, Split, Croatia*

<sup>2</sup>*Blaise Pascal University, Clermont-Ferrand, France*

**Keywords: Dosimetry (computational), ELF/ILF, Work in Progress**

**Presented by: Mario Cvetkovic**

This work examines the influence of the brain tissue parameters' uncertainty and the coil positioning variations within the framework of Transcranial Magnetic Stimulation (TMS). A combination of deterministic modeling and the

#### **S8-4 [12:00]**

##### **A prospective cohort analysis of cell phone use and behavioral problems in children**

Madhuri Sudan<sup>1</sup>, Jorn Olsen<sup>2</sup>, Onyebuchi Arah<sup>1</sup>, Carsten Obel<sup>2</sup> & Leeka Kheifets<sup>1</sup>

<sup>1</sup>*Department of Epidemiology, UCLA, Los Angeles, California, USA, 90095*

<sup>2</sup>*Dept of Environmentl & Occupational Medicine, Aarhus Universitet, Aarhus, Denmark,*

**Keywords: Behavioural, RF/Microwaves, Completed (unpublished)**

**Presented by: Madhuri Sudan**

We previously reported associations between cell phone use and behavioral problems in children in the Danish National Birth Cohort using cross-sectional data. To overcome the limitations of cross-sectional analysis, we re-examine these associations with prospectively collected data. Based on maternal reports, prenatal and postnatal cell phone use was assessed at age 7 years, and behavioral problems were assessed at 7 and 11 years of age with the Strengths and Difficulties Questionnaire. Here we will present results of the prospective (longitudinal) analysis.

#### **S8-5 [12:20]**

##### **Personal exposure of children to ELF magnetic fields in France: results of the EXPERS study**

Isabelle Magne<sup>1</sup>, Martine Souques<sup>2</sup>, Isabelle Bureau<sup>3</sup>, Anne Duburcq<sup>3</sup>, Emmanuel Remy<sup>4</sup> & Jacques Lambrozo<sup>2</sup>

<sup>1</sup>*Electrical Equipment Laboratory Department, EDF R&D, Moret sur Loing, France*

<sup>2</sup>*Medical Studies Department, EDF, Levallois-Perret, France*

<sup>3</sup>*Cemka-Eval, Bourg la Reine, France*

<sup>4</sup>*Industrial Risk Management Department, EDF R&D, Chatou, France*

**Keywords: Epidemiology, ELF/ILF, Completed (unpublished)**

**Presented by: Isabelle Magne**

stochastic theoretical basis was used in the assessment of the parameter uncertainties effects on the induced electric field and the related electric current density in the homogeneous human brain model. The non-intrusive Stochastic Collocation (SC) technique, by means of which the input parameter uncertainties are taken into account, enables the assessment of the corresponding confidence margins in the set of output parameters.\*This work was undertaken within the framework of COST Action BMI309 (COST EMF-MED).

The assessment of the exposure to ELF magnetic fields remains an important question in the context of epidemiological studies. We present here the results of the first study characterizing the personal exposure of children at a national scale. Descriptive statistical analyses were used to identify variables correlated with the exposure. The distribution of personal exposure was compared to the distribution of exposure during sleep.

**Lunch**  
**Wednesday June 8, 2016 • 12:45 - 14:00**  
**Kapittelzaal**

**Session: M4**  
**BEMS Business Meeting**  
**Wednesday June 8, 2016 • 12:45 - 14:00**  
**Refter**

**Free Afternoon**  
**Wednesday June 8, 2016 • 14:00 - 18:00**

**Session: MCM**  
**MCM meeting COST Action BMI309: European network for innovative uses of EMFs in biomedical applications (EMF-MED)**  
**Wednesday June 8, 2016 • 14:30 - 16:30**  
**Refter**

Thursday June 9, 2016

**Session: T3**

**Tutorial 3: “The Erice-EBEA School framework” - Neuroprotective effects of EM fields: from preclinical to clinical studies**

**Thursday June 9, 2016 • 08:30 - 09:30**

**Refter**

**Chair: Ferdinando Bersani**

**Session: W1**

**Workshop 1: Spatial averaging: towards a better basis for standard procedures**

**Thursday June 9, 2016 • 08:30 - 09:30**

**Zaal Rector Vermeylen**

**Chairs: Martin Gledhill & Steve Iskra**

**T3-1 [08:30]**

**The Erice-EBEA School: an unique opportunity to learn Bioelectromagnetics**

Ferdinando Bersani<sup>1</sup>

<sup>1</sup>*University of Bologna, Bologna, Italy*

The School of Bioelectromagnetism “A. Chiabrera” was founded in 2003 under the request of EBEA and ICEmB (Italian “Interuniversity Centre for the Study of the interaction between EMF and Biological Systems”), and was established as permanent School at the E. Majorana Foundation and Centre for Scientific Culture, in Erice (Sicily). The main task of the Courses is to train young researchers (often called students”) in the different aspects and topics of Bioelectromagnetics, but it’s not only restricted to them, but also to everyone involved in scientific and social aspects of our discipline (biologists, physicists, engineers, doctors, environmental experts etc.). The history of the School will be shortly outlined and, in particular, the main outcomes from last Course held in April 2016 will be presented.

**T3-2 [08:45]**

**Neuroprotective effects of EM fields: from preclinical to clinical studies**

Ruggero Cadossi<sup>1</sup>

<sup>1</sup>*IGEA, Carpi, Italy*

Therapy as a science: the long journey from early observations of biological effects of EM fields to randomised clinical trials. The agonist activity of EM fields for the A<sub>2A</sub> adenosine receptor provides the scientific background to explain the neuroprotective effects observed in cells cultured in hypoxic conditions and the rational base for use in patients

**W1-1 [08:30]**

**Workshop - Spatial averaging: towards a better basis for standard procedures**

Steve Iskra<sup>1, 2</sup> & Martin Gledhill<sup>3</sup>

<sup>1</sup>*Telstra, Melbourne, Australia*

<sup>2</sup>*Bioelectromagnetics Laboratory, Swinburne University of Technology, Melbourne, Australia*

<sup>3</sup>*EMF Services, Clyde, New Zealand, 9391*

**Keywords: Dosimetry (measurements),**

**RF/Microwaves, Work in Progress**

**Presented by: Martin Gledhill**

Spatial averaging of radiofrequency fields is intended to provide a practical means to determine whether exposures to non-uniform fields comply with references levels, and hence fundamental limits on SAR. A variety of spatial averaging schemes has been proposed over the years, but it is not clear whether they guarantee compliance with both whole-body and localised limits on specific absorption rate. This workshop will provide an overview of current averaging schemes, the extent to which they do (or don't) meet their objectives, discuss desirable features of averaging schemes and identify what work needs to be done to define an ideal scheme.



during the acute phase of stroke.

**Session: P4**  
**Plenary 4: Need of a breakthrough in clinical application of hyperthermia: shared knowledge, gaps and challenges**  
**Thursday June 9, 2016 • 09:30 - 10:30**  
**Rafter**  
**Chairs: Gerard van Rhoon & Mirjana Moser**

#### **P4-I [09:30]**

### **Hyperthermic Radiation Oncology 2020: Evidence, Care, Cure, Visions**

Stephan Bodis<sup>1</sup>

<sup>1</sup>Radiation Oncology Center, Kantonsspital Aarau-Baden, Baden, Switzerland



#### **Biographical sketch**

Born in 1958 in Basel, Switzerland, he received his medical education at University of Fribourg and the Medical School of the University of Basel (1978-1984).

His residencies in Internal Medicine were at the Canton Hospital Baden (1985 – 1987) and University Hospital Zurich (1987 – 1989), followed by a Clinical and Research Fellowship in the Departments of Hematology/Oncology and Molecular Pharmacology, Institute Gustave Roussy, Villejuif, Paris, France (1989-1991). He worked as a resident and obtained US Board Certification in Radiation Oncology at the Joint Center for Radiation Therapy, Harvard Medical School, Boston, MA, USA (1991 – 1995), undertaking a Research Fellowship at the Dana Farber Cancer Institute and the Massachusetts Institute of Technology Cancer Research Center in addition.

Stephan Bodis served briefly as an attending physician in Radiation Oncology at Brigham and Women's Hospital in Boston before returning to Switzerland as an attending physician in the department of Radiation Oncology at University Hospital Zurich. Currently, Stephan Bodis is the Director of the Radiation Oncology Centers Aarau-Baden (2003 – present). He is also an Associate Physician in the Department of Radiation Oncology at the University Hospital Zurich (2012 – present).

In 1998 he was appointed Assistant Professor at the University of Zurich Medical School and was promoted to Full Professor in 2012.

Stephan Bodis' work concerns clinical aspects of molecular radiobiology, the application of photon and proton radiotherapy and the combination of hyperthermia with radiotherapy in the treatment of various cancers. He is a member of numerous national and international cancer organisations and international cancer congress organisations (e.g. Wolfsberg Meeting Series).

#### **Abstract**

Hyperthermic oncology has been practiced for over 50 years. Despite thousands of patients treated, despite high quality academic departments, despite vigorous QA, and despite peer-review publications in high impact journals, Hyperthermic radiation oncology is still not widely accepted internationally as routine evidence-based (EB) therapy. Too many improvements are still pending or have just recently been implemented into patient treatment concepts

**Technology:** Hyperthermia (HT) hard-and software technology missed the jump into the 21<sup>st</sup> century compared with other medical technologies (e.g. diagnostic radiology, radiation oncology).

**Quality assurance (QA):** Inter-institutional national and international differences for QA are still huge. Lack of certification for HT oncology units might be one reason. National quality assurance recommendations for HT miss the iron grip of the national radiation protection authorities known to all RT departments. And

there is still too little systematic and practical information available regarding optimal heating dose-intensity.

**Thermal dose and dosimetry:** The choice of an optimal heating dose-intensity reflects back to the in vitro and in vivo thermoradiobiological studies. Efforts to be made to optimize the thermal dose and intensity based on clinical conditions which could be different from those in controlled laboratory conditions. These should address the optimal temperature, HT-RT sequence, HT frequency and the RT time-dose-fractionation schedules when used along with HT.

**Workflow:** HT patients still lack seamless integration in the departmental workflow (scheduling, imaging, planning, coordination with radiotherapy)

**EB in HT oncology:** Too little by too few institutes...was dormant until now, despite thousands of carefully treated patients. There have been published phase III randomized studies, however these are limited and restricted to a few academic sites. Well designed randomized phase II and III clinical trials, especially in de novo cancer patients treated with curative intent, should help to better evaluate the clinical efficacy of HT, use survival and not only local control as a primary endpoint, evaluate long term toxicities of thermoradiotherapy / thermochemoradiotherapy. The assumption that a therapy offering “no harm and potential benefit (HT)” is automatically better than a therapy with “possible harm and potential benefit (RT or CT)” is shortsighted.

**Clinical trials:** There is a lack of high quality, innovative, single institution phase I studies and of prospective, multicenter randomized phase III studies for specific curative indications with long term follow-up.

Preliminary results from our Swiss Clinical Hyperthermia Network and the Swiss Hyperthermia Research Network will be presented and discussed. There are better and more data available in many outstanding institutions worldwide.

Hyperthermic radiation oncology could become a major treatment discipline if step by step integration is undertaken for timely technology, seamless workflow, stringent QA, multidisciplinary decision-making processes, EB guidelines for institutional treatment indications and increased patient numbers included in curative phase III treatment protocols with survival as endpoint. This all needs to be carefully coordinated, communicated, planned, implemented and published.

And last but not least: Think and plan with cool networks but not with heated egos.

**Coffee Break**  
**Thursday June 9, 2016 • 10:30 - 11:00**  
**Kapittelzaal**

**Session: S09**  
**Pulsed electric fields: from cells to animals**  
**Thursday June 9, 2016 • 11:00 - 12:40**  
**Rafter**  
**Chairs: Olga Pakhomova & Damijan Miklavcic**

**Session: S10**  
**Measurements for safety assessment**  
**Thursday June 9, 2016 • 11:00 - 12:40**  
**Zaal Rector Vermeylen**  
**Chairs: Luc Martens & Philip Chadwick**

**S09-1 [11:00]**

**Optimizing Nano-Pulse Electro-Signaling parameters to activate immunogenic apoptosis and inhibit metastasis**

Richard Nuccitelli<sup>1</sup>, Zachary Mallon<sup>1</sup>, Amanda McDaniel<sup>1</sup>, Myra Perez<sup>1</sup>, Mark Kreis<sup>1</sup>, Brian Athos<sup>1</sup>, Dave Danitz<sup>1</sup>, Darrin Uecker<sup>1</sup> & Pamela Nuccitelli<sup>1</sup>

<sup>1</sup>Research and Development, Pulse Biosciences Inc., Burlingame, CA, USA, 94010

**S10-1 [11:00]**

**STUDENT PAPER**

**Personal exposure from mobile phone base stations in Australia and Belgium**

Chhavi Bhatt<sup>1</sup>, Arno Thielens<sup>2</sup>, Mary Redmayne<sup>1</sup>, Michael Abramson<sup>1</sup>, Baki Billah<sup>1</sup>, Malcolm Sim<sup>1</sup>, Roel Vermeulen<sup>3, 4, 5</sup>, Luc Martens<sup>2</sup>, Wout Joseph<sup>2</sup> & Geza Benke<sup>1</sup>

<sup>1</sup>Centre for Population Health Research on Electromagnetic

**Keywords: Electroporation, Pulsed, Work in Progress**  
**Presented by: Richard Nuccitelli**

We have been developing a non-thermal nanoelectroablation therapy for treating tumors and unwanted skin lesions. Effective immunogenic apoptosis stimulation of cells in a cuvette peaks at 10 J/ml in all three cell types studied which corresponds to 15 pulses at 25 kV/cm. We have also demonstrated that Nano-Pulsed Electro-Signaling (NPES) ablation of a single melanoma tumor inhibits melanoma metastasis in a mouse syngeneic model system as compared to mice in which the tumor was surgically removed.

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<sup>3</sup>Institute for Risk Assessment Sciences (IRAS), Utrecht University, Utrecht, the Netherlands, 3584

<sup>4</sup>Julius Centre for Health Sciences and Primary Care, University Medical Center, Utrecht, the Netherlands

<sup>5</sup>Department of Epidemiology and Public Health, Imperial College, London, United Kingdom

**Keywords: Epidemiology, RF/Microwaves, Completed (unpublished)**

**Presented by: Chhavi Bhatt**

We employed an on-body calibrated personal distributed exposimeter to assess micro-environmental personal exposure to mobile phone base stations GSM 900 MHz downlink in Australia and Belgium. The study revealed that the personal exposure levels measured in Australian microenvironments were generally lower than those in the Belgian microenvironments. The personal exposures across urban microenvironments were higher than those in the rural and suburban microenvironments. Likewise, the exposure levels across the outdoor microenvironments were much higher than those across the indoor microenvironments. A majority of the second measurements in the same site provided highly varied exposures.

## **S09-2 [11:20]**

**Potential differential effects of single high intensity 6 ns electric pulses on macroscopic inward and outward ionic currents recorded in whole-cell patch clamped bovine chromaffin cells**

Lisha Yang<sup>1</sup>, Gale Craviso<sup>1</sup>, Robert Terhune<sup>2</sup>, P. Thomas Vernier<sup>3</sup>, Indira Chatterjee<sup>2</sup> & Normand Leblanc<sup>1</sup>

<sup>1</sup>Department of Pharmacology, University of Nevada School of Medicine, Reno, NV, USA, 89557

<sup>2</sup>Department of Electrical and Biomedical Engineering, University of Nevada, Reno, NV, USA, 89557

<sup>3</sup>Frank Reidy Research Center for Bioelectrics, Old Dominion University, Norfolk, VA, USA, 23508

**Keywords: Electroporation, Pulsed, Work in Progress**  
**Presented by: Thomas Vernier**

Previous studies from our group have shown that exposing adrenal chromaffin cells to a single 5 ns, 5 MV/m pulse causes activation of voltage-gated Ca<sup>2+</sup>

## **S10-2 [11:20]** **STUDENT PAPER**

**Development of a drone-based measurement system for 3D radiofrequency exposure assessment**

Sam Aerts<sup>1</sup>, Matthias Van Den Bossche<sup>1</sup>, Arno Thielens<sup>1</sup>, Luc Martens<sup>1</sup> & Wout Joseph<sup>1</sup>

<sup>1</sup>Department of Information Technology, Ghent, Belgium, 9050

**Keywords: Dosimetry (measurements), RF/Microwaves, Completed (published)**

**Presented by: Sam Aerts**

A significant drawback for current measurement-based modelling of exposure to radiofrequency (RF) electromagnetic fields (EMF) is its inherent two-dimensional-only application. Therefore, we developed a measurement system, composed of a hexacopter carrying RF measurement nodes, that will enable researchers to accurately measure 3D exposure patterns in

channels,  $\text{Ca}^{2+}$  influx and rise in intracellular  $\text{Ca}^{2+}$  level that stimulates catecholamine release. In this study, we examined whether a similar pulse can directly influence ionic currents in whole-cell voltage clamped bovine chromaffin cells. Our results show that single 6 ns pulses inhibited voltage-gated  $\text{Na}^+$  current by  $\sim 10\%$  while exerting no effect on other voltage-dependent cation currents. These short pulses appear to inhibit  $\text{Na}^+$  currents by reducing maximal conductance.

### **S09-3 [11:40]**

#### **Diverse susceptibility to nsPEF ablation across multiple cell types**

Andrei Pakhomov<sup>1</sup>, Chantelle Labib<sup>1</sup>, Elena Gianulis<sup>1</sup>, Gintautas Saulis<sup>2</sup>, Vitalij Novickij<sup>3</sup> & Olga Pakhomova<sup>1</sup>

<sup>1</sup>Frank Reidy Research Center for Bioelectrics, Old Dominion University, Norfolk, Afghanistan, 23508

<sup>2</sup>Department of Biology, Vytautas Magnus University, Kaunas, Lithuania

<sup>3</sup>Magnetic Field Institute, Vilnius Gediminas Technical University, Vilnius, Lithuania

**Keywords: Electroporation, Pulsed, Completed (unpublished)**

**Presented by: Andrei Pakhomov**

We established that different cell types exhibited up to 80-fold different susceptibility to injury by nanosecond pulsed electric field (nsPEF). For the first time, we used adherent cells (to eliminate confounding effects of cell detachment and re-attachment), and used the same growth medium and serum (to eliminate confounding effects of the medium composition). Our data indicate that nanoelectroablation is not equally effective against all types of solid tumors, but rather certain tumors are more susceptible to nsPEF and can be better targets than others.

outdoor or large indoor environments. Here, we introduce the measurement system as well as an application consisting of outdoor measurements as a function of height (up to 60m) of RF radiation from mobile phone base stations in the 900MHz band used by Global System for Mobile Communications technology (GSM900).

### **S10-3 [11:40]**

#### **Personal exposure to magnetic fields and transient effects on wellbeing amongst staff routinely working with MRI in healthcare settings in the UK.**

Eva Batistatou<sup>1</sup>, Stephen Keevil<sup>2</sup>, Anna Molter<sup>3</sup>, Penny Gowland<sup>4</sup>, Stuart Crozier<sup>5</sup>, Martie van Tongeren<sup>6</sup>,

Kristel Schaap<sup>7</sup>, Hans Kromhout<sup>7</sup> & Frank De Vocht<sup>8</sup>

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<sup>8</sup>Social and Community Medicine, University of Bristol, Bristol, United Kingdom, BS8 2PS

**Keywords: Occupational, Static, Completed (published)**

**Presented by: Frank De Vocht**

In this presentation, we describe personal exposure to static and time-varying magnetic fields from MRI of radiographers and other staff in clinical settings in the UK, and evaluate whether and how this exposure is associated with transient effects on wellbeing.

**S09-4 [12:00]**  
**STUDENT PAPER**

**Electrical manipulation of mesenchymal stem cells calcium oscillations with microsecond pulsed electric fields**

Hanna Hanna<sup>1</sup>, Franck Andre<sup>1</sup> & Lluís M. Mir<sup>1</sup>

<sup>1</sup>Vectorology and Anticancer Therapies, UMR 8203, CNRS, Univ. Paris-Sud, Gustave Roussy, Université Paris-Saclay, 94805 Villejuif, France

**Keywords: Electroporation, Pulsed, Completed (unpublished)**

**Presented by: Hanna Hanna**

Human mesenchymal stem cells (hMSC) are a promising tool for regenerative medicine. These cells present spontaneous calcium oscillations. In our study, we used one single 100  $\mu$ s pulse in order to control these oscillations. The results demonstrate that, according to the electric field amplitude, we are able to induce a calcium peak with properties close to those of calcium spontaneous oscillations, or, on the contrary, to inhibit calcium oscillations for a long time compared to the pulses duration. This study shows that it is possible therefore to control calcium oscillations in hMSC, hence modulating their characters or differentiation properties. Viability tests showed that the cells remain viable under the electric pulse conditions.

**S09-5 [12:20]**

**Gene Electrotransfer for Effective Delivery of Plasmid DNA to the Skin In Vivo**

Richard Heller<sup>1</sup>, Amy Donate<sup>1</sup>, Siqi Guo<sup>1</sup>, Chelsea Edelblute<sup>1</sup> & Anna Bulysheva<sup>1</sup>

<sup>1</sup>Center for Bioelectrics, Old Dominion University, Norfolk, Virginia, USA, 23505

**Keywords: Electroporation, Pulsed, Work in Progress**

**Presented by: Richard Heller**

Gene electrotransfer (GET) of skin is a simple minimally invasive approach. While there has been some success in delivering plasmid DNA using GET to the skin, there are limitations to this approach. In this current study, we have evaluated the addition of externally applied thermal energy to GET protocols to enhance delivery.

**S10-4 [12:00]**

**In situ measurements of RF electromagnetic field exposure of general public in France in 2014**

Emmanuelle Conil<sup>1</sup>

<sup>1</sup>ANFR, Maisons-Alfort, France, 94700

**Keywords: Dosimetry (measurements), RF/Microwaves, Other**

**Presented by: Emmanuelle Conil**

This report focuses on the analysis of the 2955 measurements performed in France in 2014 as part of national monitoring of public exposure to electromagnetic waves. Many environments are represented : indoor/outdoor, rural/urban, home/public area/street... All results are under regulatory limits established by the French decree number 2002-775 based on the ICNIRP limits. A large majority (82%) of the exposure levels are under 1V/m. When a comprehensive assessment has been performed (ie.for case B of ANFR protocol), the strongest service contributing to the exposure has been identified. In most cases (57%), mobile services are the strongest service contributing to the level of measured exposure.

**S10-5 [12:20]**

**Measurements of residential intermediate frequency exposures due to home appliances**

Blaz Valic<sup>1</sup> & Peter Gajsek<sup>1</sup>

<sup>1</sup>Institute of Non-Ionizing Radiation, Ljubljana, Slovenia, 1000

**Keywords: Dosimetry (measurements), IF, Completed (unpublished)**

**Presented by: Blaz Valic**

The exposure of the population in the intermediate frequencies (IF) is increasing. A part of the GERoNiMO project was an assessment of the IF exposure at homes in three EU countries. From 87 measured appliances 21 of them had the exposure quotient above 0, whereas for 66 of them the exposure quotient was 0. The important contributors in the IF range are induction hob and (C)FL. For the measured induction hobs the highest value at the distance of 20 cm from the appliance was 62 percent of the ICNIRP 2010 exposure. At 50 cm the maximum value was 12 percent of the ICNIRP 2010 exposure. For the CFL the values are

similar: at 20 cm the maximum exposure was 51 percent of the ICNIRP 2010 and it drops to 20 percent at 50 cm.

**Lunch**  
**Thursday June 9, 2016 • 12:45 - 14:00**  
**Kapittelzaal**

**Session: M5**  
**BEMS-EBEA Merger Meeting**  
**Thursday June 9, 2016 • 12:45 - 14:00**  
**Refter**

**Session: S11**  
**Innovative perspectives for medical applications**  
**Thursday June 9, 2016 • 14:00 - 15:20**  
**Zaal Rector Vermeylen**  
**Chairs: Antonio Sarolic & Theodoros Samaras**

**Session: S12**  
**Public Policy and Safety assessment**  
**Thursday June 9, 2016 • 14:00 - 15:20**  
**Refter**  
**Chairs: Eric Van Rongen & John Bolte**

#### **S11-I [14:00]**

##### **Electrochemotherapy by pulsed electromagnetic field treatment *in vivo***

Damijan Miklavcic<sup>1</sup>, Simona Kranjc<sup>2</sup>, Matej Kranjc<sup>1</sup>, Janez Scancar<sup>3</sup>, Jure Jelenc<sup>4</sup> & Gregor Serša<sup>2</sup>

<sup>1</sup>Faculty of Electrical Engineering, University of Ljubljana, Ljubljana, Slovenia, 1000

<sup>2</sup>Department of Experimental Oncology, Institute of Oncology Ljubljana, Ljubljana, Slovenia, 1000

<sup>3</sup>Jozef Stefan Institute, Ljubljana, Slovenia, 1000

<sup>4</sup>Iskra Medical LLC, Ljubljana, Slovenia, 1000

**Keywords: Electroporation, Pulsed, Completed (published)**

**Presented by: Damijan Miklavcic**

Contactless electroporation by pulsed electromagnetic fields could represent an interesting approach for drug and gene delivery into cells. Our results show that pulsed electromagnetic fields at magnetic field below of 1 T was sufficient to achieve similar effects as observed in pulsed electric fields using electrodes. i.e. membrane permeabilization of tumor cells, thus, improved delivery and cellular uptake of small molecules, such as drug (e.g. cisplatin) in solid tumors was enabled.

#### **S12-I [14:00]**

##### **Is there evidence of biological effects from WLAN and comparable electromagnetic fields in everyday exposure situations?**

**Systematic review of experimental studies**  
Frank Gollnick<sup>1</sup>, Lambert Bodewein<sup>1</sup>, David Graefrath<sup>1</sup>, Kai Jagielski<sup>1</sup>, Thomas Kraus<sup>1</sup> & Sarah Driessen<sup>1</sup>

<sup>1</sup>Research Center for Bioelectromagnetic Interaction (femu), RWTH Aachen University, Aachen, Germany

**Keywords: Public Health Policy, RF/Microwaves, Work in Progress**

**Presented by: Frank Gollnick**

We reviewed the evidence of experimental studies for biological or health effects by everyday exposure to RF fields of WLAN devices or exposures comparable to such RF fields. From 225 potentially eligible references, 65 relevant studies using exposures below, at, or slightly above the exposure limits were included. Just over half of those 44 studies of it using exposures below or at the limits showed an effect. The large majority of these 44 studies had medium or strong methodical weaknesses. More detailed evaluations are ongoing. So far no substantial evidence of health implications is derived from the results, but the mostly poor study quality impairs the informative value of the present available scientific database.

## **SI1-2 [14:20] STUDENT PAPER**

### **Image-Based Modeling of Superparamagnetic Iron-Oxide Nanoparticle Hyperthermia Therapy**

Hazael Montanaro<sup>1, 2</sup>, Esra Neufeld<sup>1</sup>, Myles Capstick<sup>1</sup> & Niels Kuster<sup>1, 2</sup>

<sup>1</sup>IT'IS Foundation for Research on Information Technologies in Society, Zurich, Switzerland

<sup>2</sup>Swiss Federal Institute of Technology (ETHZ), Zurich, Switzerland

**Keywords: Clinical (therapy), ELFILF, Completed (unpublished)**

**Presented by: Hazael Montanaro**

SPIONs have been used as MRI contrast agents. When coated and functionalized, they can specifically target cancer cells. In combination with alternating magnetic fields, SPIONs can be used to administer enhanced and targeted hyperthermic cancer treatment. A treatment planning platform featuring image-based personalized anatomical model generation, EM and thermal modeling, effect quantification, and field optimization has been extended to include nanoparticle-field interaction and enhanced energy deposition with image-data information about particle density distributions. The impact of particle density, distribution sharpness and width, and perfusion vs. heat diffusion was investigated.

## **SI1-3 [14:40]**

### **A full-wave numerical study to investigate the possibility of using microwaves for image-monitored ablation treatments**

Gennaro G. Bellizzi<sup>1, 2</sup>, Marta Cavagnaro<sup>3</sup>, Lorenzo Crocco<sup>1</sup>, Vanni Lopresto<sup>4</sup> & Rosa Scapaticci<sup>1</sup>

<sup>1</sup>IREA, National Council of Research of Italy, Naples, Italy

<sup>2</sup>DIIES, Mediterranea University of Reggio Calabria, Reggio Calabria, Italy

<sup>3</sup>DIEET, Sapienza University of Rome, Rome, Italy

<sup>4</sup>ENEA, Division of Health Protection Technologies, Rome, Italy

**Keywords: Clinical (diagnostics), RF/Microwaves, Work in Progress**

## **SI2-2 [14:20] STUDENT PAPER**

### **Changing precautionary messages to change their effect? An experimental study testing how message consistency and information about the effectiveness of the precautions influence recipients' health concerns**

Christoph Boehmert<sup>1, 2</sup>, Peter Wiedemann<sup>3</sup> & Rodney Croft<sup>2, 4</sup>

<sup>1</sup>Department of Science Communication, Karlsruhe Institute of Technology, Karlsruhe, Germany

<sup>2</sup>Australian Centre for Electromagnetic Bioeffects Research, ACEBR, Wollongong, Australia

<sup>3</sup>Science Forum EMF, Berlin, Germany

<sup>4</sup>Centre for Health Initiatives, Illawarra Health & Medical Research Institute, University of Wollongong, Wollongong, Australia

**Keywords: Public Health Policy, RF/Microwaves, Completed (unpublished)**

**Presented by: Christoph Boehmert**

The communication of precautionary measures to reduce RF EMF exposure from mobile phones has repeatedly been shown to increase people's concern about potential health effects from RF EMFs. We tested if further information regarding the precautionary messages can decrease this level of health concerns. Specifically, we tried to improve the message's consistency and the (perceived) effectiveness of the precautionary measures. An experimental design was employed. While consistency did not affect risk perception, information about the measures' effectiveness resulted in higher risk perceptions, contrary to our assumptions.

## **SI2-3 [14:40]**

### **The interdisciplinary Swiss expert group on electromagnetic fields and non-ionising radiation (BERENIS) – results and conclusions after 18 months of work**

Stefan Dongus<sup>1</sup>, Peter Achermann<sup>2</sup>, Jürg Fröhlich<sup>3</sup>, Jürg Kesselring<sup>4</sup>, Meike Mevissen<sup>5</sup>, David Schuermann<sup>6</sup>, Edith Steiner<sup>7</sup> & Martin Roosli<sup>1</sup>

<sup>1</sup>Environmental Exposures and Health Unit, Swiss Tropical and Public Health Institute, Basel, Switzerland, 4002

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<sup>3</sup>Fields at Work GmbH, Zurich, Switzerland, 8006

<sup>4</sup>Rehabilitation Centre, Clinics of Valens, Valens, Switzerland,

**Presented by: Lorenzo Crocco**

Microwave ablation is a cancer treatment based on local heating of tumor cells to induce coagulative necrosis. The effectiveness of this technique would improve significantly if paired with a system for the real-time monitoring of the evolving dimension and shape of the thermally ablated area. This work explores the possibility of using microwave imaging as a non-invasive methodology to monitor the overall treatment evolution, by tracking variations of the electromagnetic properties of ablated tissue and surrounding regions. In particular, a preliminary feasibility study based on full-wave numerical simulations is herein presented.

#### **S11-4 [15:00]**

##### **New focusing strategy for improved design of hyperthermia array applicators**

Domenica Iero<sup>1</sup>, Maarten Paulides<sup>2</sup>, Lorenzo Crocco<sup>3</sup>, Tomas Drizdal<sup>2</sup>, Tommaso Isernia<sup>1, 3</sup> & Gerard van Rhoon<sup>2</sup>

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<sup>2</sup>Department of Radiation Oncology, Hyperthermia Unit, Erasmus MC Cancer Institute, Rotterdam, the Netherlands

<sup>3</sup>IREA Istituto per il Rilevamento Elettromagnetico dell'Ambiente, CNR National Research Council of Italy, Napoli, Italy

**Keywords: Clinical (therapy), RF/Microwaves, Work in Progress**

**Presented by: Domenica Iero**

The complexity of human body anatomy, physiology and thermal regulation set challenges in hyperthermia (HT) therapy which can only be tackled by performing an adaptive treatment policy specific at the individual patient. Due to those challenges multi antenna phased array systems are

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<sup>7</sup>Ärztinnen und Ärzte für Umweltschutz, Basel, Switzerland, 4019

**Keywords: Public Health Policy, All Frequencies, Work in Progress**

**Presented by: Stefan Dongus**

In 2014, the interdisciplinary Swiss expert group on electromagnetic fields and non-ionising radiation (BERENIS) started continuously assessing newly published human experimental and epidemiological studies, mammalian in vivo and in vitro studies, as well as exposure and dosimetry studies. Based on defined criteria, BERENIS identifies the most relevant publications with regard to health risk assessment. Studies (in vivo and in vitro) presenting underlying mechanisms besides descriptive findings are considered high priority. The evaluations of these publications are published in quarterly newsletters. This abstract presents the results and conclusions after 18 months of BERENIS work, with a particular focus on the assessed studies.

#### **S12-4 [15:00]**

##### **Realistic output power levels of multi-technology radio base stations and the implication on RF EMF exposure compliance assessments**

Paramananda Joshi<sup>1</sup>, Björn Thors<sup>1</sup>, Davide Colombi<sup>1</sup>, Christer Tornevik<sup>1</sup> & Lars-Eric Larsson<sup>2</sup>

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<sup>2</sup>TeliaSonera, Stockholm, Sweden, 123 86

**Keywords: Dosimetry (measurements), RF/Microwaves, Completed (unpublished)**

**Presented by: Paramananda Joshi**

Realistic output power levels of multi-technology radio base station (RBS) sites have been obtained via a network-based study conducted in Sweden by considering combinations of 2G, 3G, and 4G radio access technologies. For a case with all three technologies combined, mean, median, and 95th percentile output power values of the RBSs during real operations have been found to be 23.7%, 23.3%, and 28.8%, respectively, of the maximum possible output power. For the combined case, the ICNIRP limit compliance distance in front of an RBS antenna, when fed with the 95th percentile output



usually designed in such a way to prevent or reduce the impact of treatment limiting hot spots. In this contribution Optimal Constrained Power Focusing (OCPF) technique is exploited to define the phase and amplitude settings of the HYPERcollar3D excitations. OCPF has showed a good ability in shaping the power deposition in healthy tissues while providing a comprehensive coverage of the target region, in 10 patients affected by Head & Neck tumors.

power value obtained from the network data, has been found to be reduced by 62% compared with that obtained using the maximum possible combined power value.

**Coffee Break**  
**Thursday June 9, 2016 • 15:30 - 16:00**  
**Kapittelzaal**

**Session: W2**  
**Workshop 2: Short workshop on implementation of the EMF Directive**  
**Thursday June 9, 2016 • 16:00 - 18:00**  
**Zaal Rector Vermeylen**  
**Chairs: Philip Chadwick & Georg Neubauer**

#### **W2-1 [16:00]**

#### **The Occupational EMF Exposure Directive 2013/35/EU; an interactive workshop for discussion of implementation and compliance issues**

Philip Chadwick<sup>1</sup>, Georg Neubauer<sup>2</sup>, Carolina Calderon<sup>3</sup> & Wout Joseph<sup>4</sup>

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**Keywords: Occupational, All Frequencies, Other**

**Presented by: Georg Neubauer**

This abstract is for the Discussion Workshop. It addresses the European Directive on workers' exposure to electromagnetic fields (2013/35/EU) which will be being implemented at the time of the BioEM2016 meeting. It addresses the implementation, and standardisation frameworks that have been developed around the Directive as well as some of its practical implications and consequences. The intention is for interested people to be able to discuss these issues in conjunction with a number of short scene-setting presentations from the authors and others.

**Session: W3**

**Workshop 3: Single cell electromagnetic exposure and analysis: experimental considerations, coupling of optical imaging techniques, and biological outcomes**  
**Thursday June 9, 2016 • 16:00 - 18:00**

**Refter**

**Chairs: Caterina Merla & Rafael Davalos**

**W3-1 [16:00]**

**Disseminating the OPTIC BIOEM MSCA-IF Project: the SICEAN workshop at BioEM 2016 meeting**

Caterina Merla<sup>1</sup> & Lluís M. Mir<sup>1</sup>

<sup>1</sup>*Vectorology and Anticancer Therapies, UMR 8203, CNRS, Univ. Paris-Sud, Gustave Roussy, Université Paris-Saclay, Villejuif, France, 94805*

**Keywords: Mechanistic/Theoretical, All Frequencies, Concept**

**Presented by: Caterina Merla**

In the OPTIC BIOEM MSCA-IF project, a fast CARS microscope will be integrated with a wide band electromagnetic field exposure setup to study in vitro the role of membrane lipid reactions in the electropermeabilization phenomenon. This innovative CARS analysis will be supported by mass spectroscopy measurements, and by simulated electric field and pore density distributions on the bio-samples. This last step is an attempt to correlate sample areas presenting the highest CARS signal intensity with the correspondent E field and pore density distributions. Within the framework of the OPTIC BIOEM action the SICEAN workshop entitled “Single Cell Electromagnetic exposure and Analysis” has been organized at next the BioEM 2016 Meeting.

**W3-2 [16:10]**

**Microchambers for cell exposure: from the design to applications**

Agnese Denzi<sup>1</sup>, Maura Casciola<sup>1, 2</sup>, Paolo Marracino<sup>1</sup>, Caterina Merla<sup>3, 4</sup>, James C. M. Hwang<sup>5</sup>, Xuanhong Cheng<sup>5</sup>, Francesca Apollonio<sup>1</sup> & Micaela Liberti<sup>1</sup>

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<sup>4</sup>*Vectorology and Antitumor Therapies, UMR 8203, CNRS, Univ. Paris-Sud, Université Paris-Saclay, Gustave Roussy, Villejuif, France, 94805*

<sup>5</sup>*Lehigh University, Bethlehem, USA, 18015*

**Keywords: In vitro, Pulsed, Completed (unpublished)**

**Presented by: Agnese Denzi**

In the last decades, the advances in the micro and nano fabrication techniques have led to the development of microdevices that have improved the possibility of analysis at cell level. These devices can be used in different applications (cell detection and identification, manipulation, cell treatments). The requisites, that are necessary to achieve, are different for various applications and represent the starting point of the project. The numerical multiphysics models can be very advantageous to analyze the performances of such devices and to predict their operation.

**W3-3 [16:30]**

**Electroporation of adhered brain endothelial cells on chip toward controlled transcellular**

## **permeabilization of the blood-brain barrier**

Mohammad Bonakdar<sup>1</sup>, Elisa Wasson<sup>1</sup> & Rafael Davalos<sup>1, 2, 3</sup>

<sup>1</sup>Department of Mechanical Engineering, Virginia Tech University, Blacksburg, Virginia, USA, 24061

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<sup>3</sup>Virginia Tech - Wake Forest University, Blacksburg, Virginia, USA, 24061

**Keywords: Electroporation, Pulsed, Completed (published)**

**Presented by: Rafael V Davalos**

The blood-brain barrier (BBB) is a restrictive layer of cells found in the capillaries of the brain, which separates the central nervous system from the peripheral circulatory system. Many drugs that show promise in vitro, fail in vivo because the BBB prevents them from reaching brain tissue. Therefore, not only is it important to develop novel methods of treatment, but also in vitro testing platforms that better represent in vivo conditions. We are currently developing a microengineered model of the BBB to explore the utility of permeabilizing the BBB using pulsed electric fields.

## **W3-4 [16:50]**

### **Study of the transmembrane voltage induced by short electric pulses on cells membranes: overcome and remaining challenges**

Aude Silve<sup>1</sup>, Ralf Straessner<sup>1</sup>, Martin Sack<sup>1</sup>, Lars Wegner<sup>1</sup> & Wolfgang Frey<sup>1</sup>

<sup>1</sup>Institute for Pulsed Power and Microwave Technology, Karlsruhe Institute of Technology, Eggenstein-Leopoldshafen, Germany, 76344

**Keywords: Electroporation, Pulsed, Work in Progress**

**Presented by: Aude Silve**

Measurement of the transmembrane voltage induced on cell membranes by external pulsed electric fields is an experimental challenge which can be addressed by using voltage sensitive dyes such as ANNINE-6. In order to use this approach, it is necessary to design a setup for exposing single cells with a well-defined external field. Moreover, since the studied phenomenon has fast kinetics, it is necessary to couple a fluorescence acquisition setup with a time resolution in the nanosecond range. Experimental challenges related to the setup will be presented. In addition, the presentation will highlight the challenges that persist especially as regards to the interpretation of the results.

## **W3-5 [17:10]**

### **Non-invasive and Label-Free Optical Spectroscopy Techniques to Investigate the Interaction between Intense Pulsed Electric Fields and Biological Samples**

Antoine Azan<sup>1</sup>, Michaël Scherman<sup>2</sup>, Aude Silve<sup>3</sup>, Valérie Untereiner<sup>4, 5</sup>, Caterina Merla<sup>1</sup>, Nelly Dorval<sup>2</sup>, Brigitte Attal-Trétout<sup>2</sup>, Olivier Piot<sup>4</sup> & Lluís M. Mir<sup>1</sup>

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<sup>3</sup>Institute for Pulsed Power and Microwave Technology, Karlsruhe Institute of Technology, Karlsruhe, Germany, 76229

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<sup>5</sup>Plateforme d'Imagerie Cellulaire et Tissulaire, CNRS, Reims, France, 51100

**Keywords: In vitro, Pulsed, Work in Progress**

**Presented by: Antoine Azan**

This study reports an experimental characterization of biological samples exposed to intense pulsed electric fields by Confocal Raman Spectroscopy (CRS) and Coherent Antistokes Raman Scattering (CARS) spectroscopy. CRS was used to investigate the molecular composition of biological samples, while CARS spectroscopy was tuned to probe vibrational bands of interfacial water around biological samples. The Raman

spectra and CARS spectra of pulsed sample and control samples were compared. Raman signature results showed strong modification of the molecular composition between the two groups (control vs pulsed), while CARS spectra results indicated a destabilization of the interfacial water due to pulsed electric fields.

### **W3-6 [17:30]**

#### **STUDENT PAPER**

##### **Thermal imaging with Rhodamine B in cells exposed to electromagnetic radiation**

David Moreau<sup>1</sup>, Claire Lefort<sup>1</sup>, Ryan Burke<sup>1</sup>, Philippe Leveque<sup>1</sup> & Rodney P. O'Connor<sup>1</sup>

<sup>1</sup>*XLIM Research Institute, Limoges, France, 87060*

**Keywords:** *Dosimetry (measurements), Pulsed, Completed (published)*

**Presented by:** *David Moreau*

During the exposure of biological cells to electromagnetic fields, whether it is infrared laser light or nanosecond pulsed electric fields, thermal effects should be considered. In this work, an optical method is presented to quantify the local temperature changes at the cellular level induced by the exposure to these stimuli. Rhodamine B, a fluorescent dye whose quantum yield is temperature dependent, was used to perform these experiments and to demonstrate a local increase of temperature due to either infrared laser light or nanosecond pulsed electric fields exposure.

Friday June 10, 2016

**Session: S13**

**Computational dosimetry**  
Friday June 10, 2016 • 08:30 - 10:10  
Refter

**Chairs: Niels Kuster & Mats-Olof Mattsson**

**S13-1 [08:30]**

**Realistic physics-based posing of anatomical models for safety evaluations and computational life science in various configurations**

Bryn Lloyd<sup>1</sup>, Emilio Cherubini<sup>3</sup>, Nicolas Chavannes<sup>4</sup> & Niels Kuster<sup>1, 2</sup>

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<sup>2</sup>ETH Zürich, Zürich, Switzerland, 8092

<sup>3</sup>SPEAG, Zürich, Switzerland, 8004

<sup>4</sup>Zurich MedTech ZMT, Zürich, Switzerland, 8004

**Keywords: Dosimetry (computational), All Frequencies, Completed (unpublished)**

**Presented by: Bryn Lloyd**

Safety assessments often require the computational phantom to have a realistic, application dependent posture. We present a new technique for posing anatomical models, which achieves several goals: improved realism of soft tissue deformation, no artifacts like ripping or tearing of tissues and a simpler procedure to make models posable. This new approach has been implemented in the software package Sim4Life V2.2 and is demonstrated on the Virtual Population V3.0 models, which contain millions of triangles enclosing approx. 300 important tissues.

**S13-2 [08:50]**

**Modelling of ELF-current flow through the human body**

**Session: S14**

**In vitro exposure: static and ELF**  
Friday June 10, 2016 • 08:30 - 10:10  
Zaal Rector Vermeylen

**Chairs: Carmela Marino & Dariusz Leszczynski**

**S14-1 [08:30]**

**Exposure of neuronal cells to 50-Hz magnetic fields triggers epigenetic microRNA-34b/c impairment independently of the oxidative stress**

Barbara Benassi<sup>1</sup>, Caterina Merla<sup>1, 2</sup>, Vanni Lopresto<sup>1</sup>, Rosanna Pinto<sup>1</sup>, Claudia Cirotti<sup>3</sup>, Giuseppe Filomeni<sup>3, 4</sup>, Carmela Marino<sup>1</sup> & Claudia Consales<sup>1</sup>

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<sup>4</sup>Cell Stress and Survival Unit, Danish Cancer Society Research Center, Copenhagen, Denmark, 2100

**Keywords: In vitro, ELF/IF, Work in Progress**

**Presented by: Barbara Benassi**

Epigenetic regulation by microRNAs has been implicated in neuronal response to stress and environmental stimuli eventually leading to neurodegeneration. We here investigate the involvement of miR-34b/c cluster in neurons exposed to magnetic fields (MF) at the frequency of 50 Hz, and its relationship with the redox imbalance elicited by the exposure challenge. Our findings demonstrate that the 50-Hz MF drives miR-34b/c impairment by affecting their transcription level, and triggers synuclein up-regulation. Moreover, miR deregulation does not depend on the oxidative stress elicited by the MF challenge, it might be rather involved in the oxidative imbalance induced by MF exposure, likely through epigenetic regulation of mitochondria targets

**S14-2 [08:50]**

**Exposure of 7 T static magnetic fields to rat MSCs constructs and influences on**

Stefan Cecil<sup>1</sup>, Gernot Schmid<sup>1</sup>, Michael Koch<sup>2</sup> & Michael Bartonek<sup>2</sup>

<sup>1</sup>EMC&Optics, Seibersdorf Laboratories, Seibersdorf, Austria, 2444

<sup>2</sup>Eaton Industries Austria GmbH, Schrems, Austria, 3943

**Keywords: Dosimetry (computational), ELF/LF, Work in Progress**

**Presented by: Stefan Cecil**

The aim of this ongoing project is the evaluation of the current flow through the human heart at frequencies > 1kHz and the comparison to the threshold for ventricular fibrillation. In this first part of the project a model of the human skin for numerical simulations of the current flow through the human heart was developed.

### S13-3 [09:10]

**Calculation of the exclusion zones for workers and the public at radio base station antennas. A comparison between the covel NF-Huygens approach and the Vector-Point-Source method**

Karsten Menzel<sup>1</sup>

<sup>1</sup>Owner, EMFfx Consulting & Simulation, Willich, Germany

**Keywords: Dosimetry (computational), RF/Microwaves, Completed (unpublished)**

**Presented by: Karsten Menzel**

Based on ICNIRP-guidelines the compliance distances for the public and workers have been calculated each year at thousands of radio antennas worldwide by means of the Vector-Point-Source method. This method results in an underestimation of the field situation at planar antennas beside the boresight (up to a factor 6) and also at multi-band antennas in the upper bands in boresight (up to 60%). The new NF-Huygens method that is based on the near field measurements of the antenna manufacturers, allows a more accurate determination of compliance distances. The field modelling of antennas improved by the NF-Huygens

**expressions of biological markers and in vivo bone formation**

Sachiko Yamaguchi-Sekino<sup>1</sup>, Kira Tsutomu<sup>2</sup>, Masaki Sekino<sup>3</sup> & Manabu Akahane<sup>4</sup>

<sup>1</sup>National Institute of Occupational Safety and Health, Japan, Kawasaki, Japan, 2148585

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<sup>3</sup>Graduate School of Engineering, The University of Tokyo, Tokyo, Japan, 1138654

<sup>4</sup>Department of Public Health, Nara Medical University, Kashihara, Japan, 6340813

**Keywords: In vitro, Static, Completed (unpublished)**

**Presented by: Sachiko Yamaguchi-Sekino**

In the present study, exposure of rat MSCs construct (TCP combined with mesenchymal stem cells) to 7 T SMFs from MRI system was carried out. Influences on expressions of biological markers and in vivo bone formation were examined. From the results of expression on biological markers and in vivo bone formation, no obvious adverse health effects were detected by 7 T exposure (3 hours/day for 8 days) to rat MSCs. These results would be useful as a safety information for MRI system users.

### S14-3 [09:10]

**Extremely low frequency pulsed electromagnetic fields protect primary human osteoblasts from oxidative stress by upregulating endogenous antioxidants**

Sabrina Ehnert<sup>1</sup>, Johannes Birk<sup>1</sup>, Patrick Ziegler<sup>1</sup>,

Christina Stacke<sup>2</sup>, Anne-Kristin Fentz<sup>2</sup>, Steffen

Schröter<sup>1</sup>, Andreas K Nussler<sup>1</sup> & Karsten Falldorf<sup>2</sup>

<sup>1</sup>Siegfried Weller Institute for Trauma Research, Eberhard Karls Universität Tübingen, Tübingen, Germany, 72076

<sup>2</sup>Sachtleben GmbH, Hamburg, Germany, 20251

**Keywords: In vitro, ELF/LF, Completed (unpublished)**

**Presented by: Sabrina Ehnert**

We recently identified a specific extremely low-frequency pulsed electromagnetic field (ELF-PEMF) that supports osteoblasts function, e.g. alkaline phosphatase (AP) activity or matrix mineralization. This process was found to be ERK1/2-dependent being associated with cellular oxidative stress. Therefore, in this study we investigated the influence of this ELF-PEMF program on oxidative stress responses in primary human osteoblasts. Our results show that the particular ELF-PEMF protects primary human osteoblasts

method can help to enhance the acceptance of numeric field calculations for compliance assessment at radio base station sites.

### **S13-4 [09:30]**

#### **Assessment of work exposure from electric fields in high voltage switchyards against the EU directive**

Yngve Hamnerius<sup>1</sup>, Tomas Nilsson<sup>2</sup> & Edward Friman<sup>3</sup>

<sup>1</sup>Dept. of Signals & Systems, Chalmers University of Technology, Gothenburg, Sweden, SE41296

<sup>2</sup>Torptronics Engineering AB, Genevad, Sweden, SE31240

<sup>3</sup>Svenska Kraftnät, Sundbyberg, Sweden, SE17224

**Keywords: Dosimetry (computational), ELF/ILF, Work in Progress**

**Presented by: Yngve Hamnerius**

The exposure to electric fields in high voltage switchyards does often exceed the action levels in the EU Directive 2013/35/EU. In order to assess if the workplace fulfils the exposure limit values, a simulation of the induced electric field strength inside the body have to be done. In order to simulate the electric field exposure, the sources (phase conductors) as well as all conducting objects, ground plane and free space have to be included in the computational volume. This large volume can't be calculated directly with the desired resolution. By using a two step simulation it is possible to assess the exposure limit.

from oxidative stress via upregulation of the endogenous antioxidant SOD2, CAT or GPX and GSR. Thus, ELF-PEMF treatments might represent an interesting adjunct to conventional therapy supporting bone formation during fracture healing.

### **S14-4 [09:30]**

#### **Uniformity of extremely low frequency electromagnetic field accelerates the proliferation of various human cells**

YeoJun Yoon<sup>1</sup>, SangHyeon Im<sup>2</sup>, Gwan Soo Park<sup>2</sup>, Hae June Lee<sup>2</sup> & Kiwon Song<sup>1</sup>

<sup>1</sup>Department of Biochemistry, Yonsei University, Seoul, Korea, 03722

<sup>2</sup>Department of Electrical Engineering, Pusan National University, Pusan, Korea, 46269

**Keywords: In vitro, ELF/ILF, Work in Progress**

**Presented by: Kiwon Song**

Previously, we showed that the uniformity of 60 Hz electromagnetic field (EMF) could be a key factor for the cellular effect by comparing the influence of gradient and uniform ELF-EMF on human cells. In this study, we further investigated the effect of the uniform EMF of a 60 Hz EMF at 6 mT on both cancerous HeLa and normal fibroblast IMR90 cells by using two different uniform EMF generators. Consistently, uniform ELF-EMF exposures from two different generators promoted cell proliferation in HeLa and IMR90 cells. The accelerating effect of EMF on cell proliferation was higher when the finer uniform EMF generator was used. This observation suggests that the uniformity of EMF is a major factor to accelerate the proliferation of human cells.

**Coffee Break**  
**Friday June 10, 2016 • 10:15 - 10:45**  
**Kapittelzaal**

**Session: P5**  
**Plenary 5: New avenues of epidemiological research – added value or old challenges, or both?**  
**Friday June 10, 2016 • 10:45 - 12:15**  
**Referee**  
**Chairs: Gunnhild Oftedal & Anke Huss**

**P5-1 [10:45]**

**The COSMOS study, a European Prospective cohort on Mobile Phone use and Health: first glances at the data and future perspectives**

Mireille Toledano<sup>1</sup>

<sup>1</sup>MRC-PHE Centre for Environment and Health, Department of Epidemiology and Biostatistics, Imperial College London, London, UK, W2 1PG



**Biographical sketch**

Dr Toledano is a senior lecturer in epidemiology at Imperial College London, an investigator of the MRC-PHE Centre for Environment and Health, and Vice-Chair of ISEE-Europe, specialising in environmental and spatial epidemiology. Much of her work to date has focused on early life environmental exposures such as water disinfection by-products, air pollution/noise, and waste incineration and reproductive outcomes, including collaborative projects with various birth cohorts across Europe, assessing exposure at individual level through questionnaire data, biomarkers, and global metabolomic profiling. She also has over 10 year's expertise in the field of spatial epidemiology and the use of routinely collected data and geographical information systems (GIS) for small area health studies. She has a special interest in the field of non-ionizing radiation epidemiology, and currently leads large cohort studies following the health of adults (UK-arm of COSMOS) and children (SCAMP) in

relation to long term exposure to electromagnetic fields from mobile phones and other wireless devices. Her experience also includes working on national studies of adult cancers near overhead power lines and childhood cancers in proximity to mobile phone base stations.

**Abstract**

The COSMOS study currently includes 300,000 adult mobile phone users across Europe. COSMOS has been designed to overcome some of the shortcomings of previous studies including the prospective assessment of exposure and disease, the use of objective information on mobile phone use from network operator traffic records, and the prospective assessment of health-related behaviors and symptoms avoiding problems with (differential) recall bias, and cross-sectional health analyses. The COSMOS study currently has on average 5 years of follow-up allowing for the first risk analyses on selected endpoints. This talk will present an overview of the COSMOS project focusing on its design, the complexities of exposure assessment in particular the use of network operator traffic records, and first glances of the phone use and symptoms analysis.

**P5-2 [11:15]**

**GERoNiMO - Generalised EMF Research using Novel Methods – an integrated approach: from research to risk assessment and support to risk management**

Elisabeth Cardis<sup>1, 2, 3</sup>

<sup>1</sup>ISGlobal, Barcelona, Spain

<sup>2</sup>Universitat Pompeu Fabra (UPF), Barcelona, Spain

<sup>3</sup>CIBER Epidemiología y Salud Pública (CIBERESP), Madrid, Spain





### **Biographical sketch**

Elisabeth Cardis Research Professor and Head of the Radiation Programme at the Centre for Research in Environmental Health (CREAL), Barcelona, an ISGlobal allied centre where she has worked since 2008, and former head of the Radiation Group at IARC, where she worked for over 20 years. Her non-ionising radiation work includes the coordination of GERoNiMO, CREST, INTERPHONE, INTEROCC, and MOBI-Kids, and being WP leader and member of the Steering Committee of the EU-funded EMF-Net and EFHRAN projects and the ANSES ACCEDERA project. She has coordinated numerous EU projects in the Quality of Life, Environment, EURATOM and INCO programmes. She has over 200 indexed publications and has been member of the ICNIRP Standing Committee in Epidemiology, the international advisory committee of the WHO International EMF Project, the Rapid Response Team of EMF-Net, the steering committee of the Swiss National Non-Ionising Radiation Programme and the Spanish CCARS (Scientific Advisory Committee on Radiofrequency and Health) and the French ANSES Working Group on RF, as well as an adviser to the Catalan Parliament. She is a member of the EBEA (European Bioelectromagnetics Association), and is an affiliated researcher of the Israeli Non-Ionizing Radiation Information Center and the McLaughlin Centre for Population Health (Ottawa, Canada).

### **Abstract**

The EU population is increasingly exposed to new physical and chemical agents in the environment, some of which may be detrimental to public health. Of these, electromagnetic fields (EMF) are one of the most ubiquitous, with new EMF technologies and novel applications being actively developed and commercialised. To address pertinent questions on EMF and health, GERoNiMO is using an integrated approach building upon existing European resources (epidemiological studies, exposure assessment techniques, mechanistic and animal models, expert networks), using, where appropriate, novel methods, to better understand potential mechanisms underlying possible health effects of EMF, characterise population levels of exposure, and further the state of knowledge on EMF and health.

GERoNiMO, an EC funded project including 19 partners from 11 countries, focuses on radiofrequency fields (RF) – as understanding of possible health effects is insufficient and a large proportion of the general population is exposed, with commercial applications continuing to grow – and intermediate frequencies (IF) – as applications are increasing and information on potential health effects is sparse.

The main objectives of the project are to: i) evaluate possible health effects (cognitive and behavioural development, cancer risk, and reproductive effects) of exposure to RF and IF in children and adults; ii) better understand mechanisms of biological effects (behavioural and reproductive effects, cancer, ageing, and Alzheimer's disease) related to RF and IF; iii) collect better data on population exposure and improve health risk assessment for RF and IF; and iv) underpin policy development in Europe on RF and IF (including non-technological means of reducing exposure and best practices in risk communication to support EU policy makers).

### **P5-3 [11:45]**

#### **Mobile phone use, radiofrequency electromagnetic fields exposure, and children's cognitive, behavioural, and non-specific symptoms - the example of the Swiss HERMES study within the GERoNiMO project**

Martin Roosli<sup>1</sup>

<sup>1</sup>Departement of Epidemiology and Public Health, Swiss Tropical and Public Health Institute, Basel, Switzerland, 4051

### **Biographical sketch**

Martin Rööslı is Professor at the Swiss Tropical- and Public Health Institute in Basel and leads the Environmental Exposures and Health Unit. He has a background in atmospheric physics and a PhD in environmental epidemiology. His research focuses on various environmental topics.

He conducted several epidemiological studies on personal exposure measurements and health effects of electromagnetic fields including occupational studies in railway workers as well as population based studies



dealing with cancer, neurodegenerative diseases and non-specific symptoms of ill health. He is a member in various national and international commissions on environmental health research including ICNIRP, BERENIS and the Scientific Council of the IARC. He has published numerous scientific papers, reviews and book chapters.

**Abstract**

Mobile phone uses has become an integral part of adolescents' life and currently various studies within and outside the EU project GERoNiMO address potential effects on behavior, symptoms or cognition. The challenge for this research is to differentiate between potential biophysical effects from mobile phone radiation and effects from the wireless device use itself due to non-radiation related factors such as nocturnal mobile phone use. Using the Swiss HERMES study as an example, new approaches in exposure assessment and cumulative dose calculations are presented and applied to epidemiological analyses on symptoms, behavior and cognitive

functions. HERMES is a prospective cohort study consisting of 439 adolescents followed one year. A subgroup of 234 adolescents provided access to operator recorded mobile phone use data and 90 adolescents took part in personal RF-EMF measurements for 72 hours.

**Session: SA**  
**Student Awards**  
**Friday June 10, 2016 • 12:15 - 12:45**  
**Rafter**  
**Chairs: Marthinus Van Wyk & Florence Poulletier De Gannes**

**Session: SA**  
**Arthur Pilla Young Scientist Award**  
**Friday June 10, 2016 • 12:45 - 13:15**  
**Rafter**  
**Chairs: Marthinus Van Wyk & Florence Poulletier De Gannes**

**Session: CC**  
**Closing Ceremony**  
**Friday June 10, 2016 • 13:15 - 13:30**  
**Rafter**  
**Chairs: Luc Martens, Nam Kim & Eric Van Rongen**

**Session: M6**  
**BEMS Board Meeting**  
**Friday June 10, 2016 • 14:00 - 18:00**  
**Persconferentie**

**Session: M7**  
**EBEA Council Meeting**  
**Friday June 10, 2016 • 14:00 - 18:00**  
**Zaal Rector Gillis**

**Session: PA**  
**Poster Session A**  
**Monday June 6, 2016 • 14:30 - 16:00**  
**Kloostergang & Novicengang**  
**Chairs: Heidi Danker-Hopfe & Francesca Apollonio**

**PA-1 [14:30]**

**Ecological study of honeybees and snails before and after construction of 345kV High Voltage Transmission Line (HVTL) in Korea**

Seung-Cheol Hong<sup>1</sup>, M.D Rajitha Kawshalya<sup>1</sup>, Yun Jin Lee<sup>1</sup>, Byungjun Han<sup>2</sup> & Taeho Lee<sup>2</sup>

<sup>1</sup>Dept of Occupational Health & Safety Engineering, Inje University, 197 Inje-ro, Korea, 50834

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**Keywords: Behavioural, ELF/ILF, Work in Progress**

**Presented by: Seung-Cheol Hong**

So far, most of the Korean research works have been focused on electromagnetic field (EMF) effects on humans' health and behavior. However there have been very few reported studies on invertebrates' animals such as insects and mollusca. In this work we report on the EMF effect on honeybees and snails for the first time in Korea. Effects of radio frequency electromagnetic field on bees have been reported before in some countries but not in Korea. The purpose of this study is to investigate EMF effects on honeybees and snails. In the first part of our work we study on an ecological system before the construction of a HVTL as an ongoing project.

**PA-3 [14:30]**

**Preliminary study of bio behavioral changes of honeybees (*Apis mellifera*) before the construction of 345kV high voltage transmission line**

M.D Rajitha Kawshalya<sup>1</sup>, Yun Jin Lee<sup>1</sup>, Byungjun Han<sup>2</sup>, Taeho Lee<sup>2</sup> & Seung-Cheol Hong<sup>1</sup>

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**Keywords: Behavioural, ELF/ILF, Work in Progress**

**Presented by: Seung-Cheol Hong**

Commercial apiculture is slowly growing livelihood in sejong area. Residents of area are aware about the importance of honeybees for the eco system and their role in pollination. We have chosen honeybee farm near the proposed 345kV high voltage transmission line (HVTL) in sejong area to carry out this preliminary study to observe the bio behavioral changes on honeybees due to the impact of surroundings. We measure the current environment factors and video monitored to study the behavior of honeybees. This study we are observing the bio behavioral changes of bees before and after construction of high voltage transmission line. As an ongoing project now we are at the preliminary stage of this research.

**PA-5 [14:30]**

**Behavioral alterations in mice due to low-intensity microwaves with amplitude modulation in the EEG frequency band**

Vincent Van Eeghem<sup>1</sup>, Anissa El Arfani<sup>2</sup>, Arta Anthoula<sup>1</sup>, Ali Pourkazemi<sup>1</sup>, Ilse Smolders<sup>2</sup> & Johan Stiens<sup>1</sup>

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**Keywords: Behavioural, RF/Microwaves, Work in Progress**

**Presented by: Vincent Van Eeghem**

Since the introduction of microwave applications in our daily life, neurological complaints and changes in the electroencephalogram (EEG) spectrum were associated with microwave exposure. To which extent microwaves affect the brain function remains unclear. In this exploratory study, mice were exposed for 6 days to low-intensity 10 GHz microwaves with an amplitude modulation (AM) of 2 or 8 Hz. These modulation frequencies correspond to brain waves in the EEG spectrum of mice. Immediately after exposure, 8 Hz AM showed a reduced locomotor activity which faded out on the long term. For a modulation of 2 Hz, no significant changes in locomotor activity were observed. In all cases, no anxiety nor depressive-like behavior was seen.

## **PA-7 [14:30]**

### **Inflammation system and immunological characterization of Patients Suffering From Electrohypersensitivity**

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**Keywords: Clinical (diagnostics), All Frequencies, Work in Progress**

**Presented by: Soafara Andrianome**

Electrohypersensitivity (EHS) is characterized by a variety of atypical symptoms attributed to EMF exposure. Diagnostic markers are lacking and research of these biomarkers could greatly help understanding this syndrome. The present study aimed to look to the pattern of some selected biological markers of immunological system in EHS individuals. In this regard, we compared levels of immunoglobulin A, neopterin and C Reactive Protein between patient with EHS and their matched control group. In our study, we failed to show a strong marker from immunological system despite a difference in participants according to the EHS duration for neopterin (difference between subgroups between short-term and long term affected participants).

## **PA-9 [14:30]**

### **Hemodynamic patterns before and after exposure to RF EMF AM at HCC frequencies in patients with advanced hepatocellular carcinoma (HCC) under earth's constant ambient magnetic field and under additional 10 – 200 Gauss static magnetic-field**

Frederico Costa<sup>1</sup>, Antonio Iemma<sup>2</sup>, Said Rabbani<sup>3</sup>, Tan Chen<sup>1</sup>, Tatiana Zanesco<sup>1</sup>, Brenda Gumz<sup>1</sup>, Edison Parise<sup>1, 4</sup>, Giovanni Cerri<sup>1</sup>, Marcos Menezes<sup>1</sup>, Carl Blackman<sup>5</sup>, Hugo Jimenez<sup>5</sup>, Alexandre Barbault<sup>6</sup> & Boris Pasche<sup>5</sup>

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**Keywords: Clinical (diagnostics), RF/Microwaves, Work in Progress**

**Presented by: Frederico Costa**

This study tested if an additional constant magnetic field with strength of 10 to 200 Gauss (10-200 G) can alter the hemodynamic system pattern in patients diagnosed with HCC and healthy individuals. 10-200 G

fields were generated by a MRI 3.0T not in operation. With 20 individual exposed to ambient constant earth magnetic field and 10-200 G, we observed a significant change in the hemodynamic system when patients with HCC are exposed to 10-200 G, but such a change was not observed in healthy controls. The exposure to HCC-specific frequencies overcame the effects of 10-200 G in patients with HCC. These findings provide new data to understand the biological effects of HCC-specific AM RF EMF in patients with HCC.

### **PA-11 [14:30]**

#### **Realization of breast cancer detection system for self-diagnosis**

Woo-Geun Kang<sup>1</sup>, Soon-Ik Jeon<sup>2</sup>, Hyuk-Je Kim<sup>2</sup>, Hyung-Do Choi<sup>2</sup> & Jeong-Ki Paek<sup>1</sup>

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**Keywords: Clinical (diagnostics), RF/Microwaves, Work in Progress**

**Presented by: Woo-Geun Kang**

The early detection of breast cancer is very important for higher survival rate. For such purpose, a simple detection system for self-diagnosis would be necessary. Our previous study showed that this kind of simple system, which can detect the existence of breast cancer, works well and even the small size of tumor phantom can be detected [1]. In this study, we realized a breast cancer detection system for self-diagnosis, and its performance was tested. The size of the sensor module was reduced using a proper material for the wall of the sensor module and absorber outside the wall of the sensor module. Further study is required for miniaturization of the whole system, including the development of a chip for the transceiver module.

### **PA-13 [14:30]**

#### **STUDENT PAPER**

#### **Influence of current flow and cell line on successful electroporation of cells**

Ahmed El Mahmoudi<sup>1, 3</sup>, Andreas Ritter<sup>1, 3</sup>, Anne Esser<sup>2</sup>, Katharina Kolvenbach<sup>2</sup>, Ulf Peter Neumann<sup>2</sup> & Martin Baumann<sup>3</sup>

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**Keywords: Clinical (therapy), Pulsed, Completed (unpublished)**

**Presented by: Ahmed El Mahmoudi**

Electroporation is a technique used in molecular biology to increase the permeability of the cell membrane by applying pulsed electric fields. This effect is also used in cancer therapy (IRE, Electrochemotherapy). For a better understanding of the effects described above, the development of an in vitro model for the medical application of IRE has started, upon this study is based. The results of the cell suspension experiments point out significant differences between the four tested cell lines. The combination of an electric field in addition to a current flux is necessary for successful EP treatments (ECT, IRE).

### **PA-15 [14:30]**

#### **Electromagnetic Stimulation of Injured Tendon Monitored by High Definition Digital Ultrasound**

Richard Parker<sup>1</sup>, Ali Meghroufel<sup>1</sup> & Marko Markov<sup>2</sup>

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<sup>2</sup>Research International, Williamsville, New York, USA, 14221

**Keywords: Clinical (therapy), ELF/LF, Completed (unpublished)**

**Presented by: Richard Parker**

Electromagnetic field therapy applied signals that are very similar to the body's own natural signals attempting to accelerate the healing process. For visual monitoring, we employ advanced mathematical techniques to analyze the observational ultrasound signal such that the underlying structure of living tissue is found and displayed, thus permitting a daily high definition evaluation of living tissue changes.

#### **PA-17 [14:30]**

##### **Finding ways for more confined heating during deep hyperthermia**

Gerard van Rhoon<sup>1</sup>, Martine Franckena<sup>1</sup> & Maarten Paulides<sup>1</sup>

<sup>1</sup>*Dept. Radiation Oncology, Hyperthermia Unit, Erasmus MC Cancer Institute, Rotterdam, the Netherlands, 3075 EA*

**Keywords: Clinical (therapy), RF/Microwaves, Work in Progress**

**Presented by: Gerard van Rhoon**

Confining hyperthermia treatment to the tumor has a great potential to improve therapeutic outcome and reduce toxicity. Combining advanced high antenna element electromagnetic systems with fast real-time hyperthermia treatment planning guidance and non-invasive thermometry by MR imaging has the potential to deliver highly focused deep heating at elevated tumor temperatures. Based on existing thermal dose effect relationships, this may result in improved treatment with shorter treatment duration, hence at lower costs. These are important arguments to develop the required hyperthermia system and push boundaries to a next level.

#### **PA-19 [14:30]**

##### **Influence of therapy magnetoelectric field modalities on clinically significant bacterial and fungal strains**

Lyubina Vesselinova<sup>1</sup>, Daniela Pencheva<sup>2</sup>, Maria Pavlova<sup>3</sup>, Todor Kantardjiev<sup>3</sup>, Petia Genova-Kalu<sup>3</sup>, Rayna Bryaskova<sup>4</sup> & Julian Raynov<sup>5</sup>

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**Keywords: Clinical (therapy), All Frequencies, Work in Progress**

**Presented by: Lyubina Vesselinova**

An experimental work on microbial and mycological agents with clinical significance in magnetic fields conditions is presenting. The work aims to investigate the possible restrictions of magnetotherapy by immunocompromised patients.

#### **PA-21 [14:30]**

##### **Drug delivery mediated by magnetic fields: first experiments and design of a magnetic exposure system**

Elena della Valle<sup>1</sup>, Martina Molinaro<sup>1</sup>, Stefania Petralito<sup>2</sup>, Patrizia Paolicelli<sup>2</sup>, Martina Nardoni<sup>2</sup>, Maria Antonietta Casadei<sup>2</sup>, Maria Cristina Annesini<sup>5</sup>, Caterina Merla<sup>3, 4</sup>, Rosanna Pinto<sup>4</sup>, Micaela Liberti<sup>1</sup> & Francesca Apollonio<sup>1</sup>

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**Keywords:** Dosimetry (computational), IF, Completed (unpublished)

**Presented by:** Elena della Valle

Liposomal drug delivery system is a novel technique used for the treatment of cancer, inflammation and chronic diseases. It allows having a controlled release of drugs encapsulated by the application of an external (electric, magnetic, thermal) stimulus. In this work an experimental activity is reported concerning the application of magnetic low fields ( $\sim \mu\text{T}$ ) on magnetoliposomes (MLs) for drug delivery purpose. Moreover a theoretical analysis and a numeric modelling approach have been used for the design of a new exposure system that could be able to generate intensities of the order of mT in a frequency range up to 50 kHz.

## PA-23 [14:30]

### On some integral approaches in electromagnetic dosimetry\*

Dragan Poljak<sup>1</sup>, Mario Cvetkovic<sup>1</sup>, Andres Peratta<sup>2</sup>, Cristina Peratta<sup>2</sup>, Hrvoje Dodig<sup>3</sup> & Akimasa Hirata<sup>4</sup>

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<sup>4</sup>Nagoya Institute of Technology, Nagoya, Japan

**Keywords:** Dosimetry (computational), All Frequencies, Review, Commentary, Recommendation, Evaluation

**Presented by:** Dragan Poljak

The paper reviews some integral methods for electromagnetics dosimetry; Laplace equation/subdomain boundary element method (BEM) - LF exposure scenarios, surface integral equation (SIE)/Method of Moments (MoM) - the brain exposure to HF radiation, tensor volume integral equation (VIE) - the whole body exposed to HF radiation, and Stratton-Chu integral formulation+vector Helmholtz equation/hybrid BEM/finite element method (FEM) scheme for the eye exposure to HF radiation. Some illustrative numerical results for induced current density, electric field and specific absorption rate (SAR), are presented in the paper.\*This work was undertaken within the framework of COST Action BM1309 (COST EMF-MED) and ICES TC 95SC6.

## PA-25 [14:30]

### STUDENT PAPER

### Study on the analytic methods of EMF effect radiated by the commercial wireless power charging device

Jun-Seok Kang<sup>1</sup>, Seungwoo Lee<sup>1</sup>, Byeong-Nam Kang<sup>1</sup> & Nam Kim<sup>1</sup>

<sup>1</sup>College of Electrical and Computer Engineering, Chungbuk National University, Cheongju-si, Chungbuk, Korea, 28644

**Keywords:** Dosimetry (computational), ELF/IF, Work in Progress

**Presented by:** Jun-Seok Kang

In this paper, we analyzed the evaluation of EMF effect about the commercial wireless power charging device. The coils used in this study is A10 model released by wireless power consortium, and input current is 1 A to the operating frequency of 125 kHz during the simulation. As the results, calculated SAR is much lower than the EMF safety standards, but calculated magnetic field strength radiated by coils is significantly exceed the EMF safety standards. These results are similar to the results from other papers that evaluated EMF effect about the wireless power transfer system in the low frequency band, so we need to discuss suitability of international standards for the SAR and the magnetic field strength.

## PA-27 [14:30]

### Statistical analysis of the SAR in the infant's brain by considering the dielectric change

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<sup>1</sup>China Academy of Telecommunication Research, Beijing, China, 100191

**Keywords:** *Dosimetry (computational), RF/Microwaves, Work in Progress*

**Presented by:** *Tongning Wu*

In the work, we focused on estimating the infant's brain SAR variation due to the possible fluctuation of the dielectric properties at 2.5 GHz using the surrogate model method. The sparse Generalized Polynomial Chaos Expansions method was applied to construct the surrogate model. The entire procedures, quality of the models and the dosimetric results were shown.

## **PA-29 [14:30]**

### **Specific Absorption Rate induced by anti-theft store protection gate**

Belinda Lima Herrero<sup>1</sup>, Mohammed Serhir<sup>1</sup> & Dominique Picard<sup>1</sup>

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**Keywords:** *Dosimetry (computational), RF/Microwaves, Completed (unpublished)*

**Presented by:** *Dominique Picard*

Supermarkets and shops use anti-theft store protection gates to avoid the theft of their products. These devices consist generally in two parallel porticoes containing one or several vertical loop antennas. The customers of the supermarket pass between both porticoes and it results from it an exposure of the customers to the magnetic field radiated by antennas. The study evaluates numerically this exposure in the case of a pair of three loops antenna porticoes.

## **PA-31 [14:30]**

### **Study of the exposure of 1 year-old infant to 3G femtocell using Polynomial Chaos theory**

Ilaria Liorni<sup>1</sup>, Marta Parazzini<sup>1</sup>, Serena Fiocchi<sup>1</sup>, Nadege Varsier<sup>2</sup>, Abdelhamid Hadjem<sup>2</sup>, Paolo Ravazzani<sup>1</sup> & Joe Wiart<sup>3</sup>

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**Keywords:** *Dosimetry (computational), RF/Microwaves, Completed (published)*

**Presented by:** *Marta Parazzini*

Wireless communication systems are spreadly used, even though the concern about the exposure to Radio-Frequency electromagnetic fields (RF-EMF). Also children are increasingly exposed to RF-EMF generated by novel devices. Therefore, an assessment of children's exposure to these sources in real scenarios is needed. In this study an analysis of a 1-year-old child exposure to a 3G femtocell emitting in downlink mode has been carried out. In order to estimate the variability of the exposure due to the position of this device with respect to the baby, stochastic dosimetry, based on the Polynomial Chaos (PC) theory, has been used to build surrogate models of the SAR induced in the child at a low computational cost.

## **PA-33 [14:30]**

### **Dosimetry of exposure of human to ultra-high voltage power lines**

Mai Lu<sup>1</sup> & Shoogo Ueno<sup>2</sup>

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**Keywords:** *Dosimetry (computational), ELF/LF, Work in Progress*



**Presented by: Shoogo Ueno**

In this work a realistic human body exposed to the extremely low frequency (ELF) electromagnetic field generated by the three-wire, three-phase ultra-high-voltage (UHV) power lines with AC-750 kV is presented. The induced magnetic flux density and electric fields in body tissues were obtained by impedance method and the results were compared with the ICNIRP guidelines. The obtained values of magnetic fields were well below the ICNIRP Reference Level. While the induced electric fields in both CNS and body tissues exceeds the ICNIRP Basic Restriction. It suggests a potential health risks may be imposed to humans standing erect under the UHV power lines.

### **PA-35 [14:30]**

#### **Method for conservatively deriving measurable limits from electric field induced in the human body by external 50 Hz electric or magnetic fields**

Isabelle Magne<sup>1</sup> & François Deschamps<sup>2</sup>

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<sup>2</sup>Development & Engineering Division, RTE, Paris La Défense, France

**Keywords: Dosimetry (computational), ELF/IF, Completed (unpublished)**

**Presented by: Isabelle Magne**

Exposure limits are defined in the ELF range in terms of induced electric field in the human body. Dosimetry calculations are needed because this parameter is not directly measurable. Such calculations are influenced by many parameters. From a review of published papers, we propose a method for conservatively deriving measurable levels of electric and magnetic fields equivalent to the basic restrictions.

### **PA-37 [14:30]**

#### **Electric field distribution in anatomical head model including stroke lesion, during transcranial Direct Current Stimulation**

Zoi Manoli<sup>1,2</sup>, Marta Parazzini<sup>3</sup>, Theodoros Samaras<sup>1</sup> & Paolo Ravazzani<sup>3</sup>

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**Keywords: Dosimetry (computational), ELF/IF, Work in Progress**

**Presented by: Theodoros Samaras**

In this study we present a model of an anatomically detailed human head including the pathological condition of a stroke lesion, undergoing transcranial direct current stimulation (tDCS). Different phases of stroke (acute, chronic) and stroke lesion volume (10cm<sup>3</sup>-50cm<sup>3</sup>) are investigated, in order to estimate computationally the electric field distributions inside the resulting models. The electrodes were placed over the lesion area according to the 10/20 EEG international system. The affected volume and the maximum electric field in two brain tissues of interest are estimated to quantify the efficiency and the focusing ability of the anodal tDCS in the affected hemisphere.

### **PA-39 [14:30]**

#### **Relationship between power density of external field and temperature elevation in a simplified head model for dipole and patch antennas**

Ryota Morimoto<sup>1</sup>, Yota Hashimoto<sup>1</sup>, Ilkka Laakso<sup>1</sup>, Akimasa Hirata<sup>1</sup>, Kei Satoh<sup>2</sup> & Teruo Onishi<sup>2</sup>

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**Keywords: Dosimetry (computational), RF/Microwaves, Completed (unpublished)**

**Presented by: Akimasa Hirata**

In this study, the relationship between power density and temperature elevation is investigated in a simplified head model from 3 to 30 GHz. The motivation for this investigation is that the power density is used as a surrogate of the thermal effect at frequencies > 3 GHz (IEEE) and > 10 GHz, its effectiveness has not been well investigated. Patch and dipole antennas are considered to discuss the variability for different field distributions.

#### **PA-41 [14:30]**

##### **AIMDs exposed in multi-channel transmit coils: Worst-case assessment of the total dissipated lead-tip power**

Manuel Murbach<sup>1</sup>, Esra Neufeld<sup>1</sup>, Earl Zastrow<sup>1, 4</sup>, Juan Córcoles<sup>2</sup>, Eugenia Cabot<sup>1</sup>, Wolfgang Kainz<sup>3</sup> & Niels Kuster<sup>1, 4</sup>

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**Keywords: Dosimetry (computational), RF/Microwaves, Completed (unpublished)**

**Presented by: Manuel Murbach**

Magnetic resonance imaging is used more and more frequently to scan patients with active implanted medical devices (AIMD). In this study, we investigated the absolute and realistically constrained worst-case radiofrequency (RF) induced total dissipated lead-tip power of AIMDs that feature elongated conductive wires – such as those used in pacemakers, deep-brain stimulators, and spinal cord stimulators – when exposed to multi-transmit (pTx) body coils. Compared to traditional quadrature excitations, the increase in the degrees of freedom in the pTx coils can result in considerably larger RF-induced total dissipated lead-tip power.

#### **PA-43 [14:30]**

##### **Optimized numerical modeling of low voltage/high current conductors with respect to magnetic field exposure scenarios**

Cristian Romitan<sup>1, 2</sup> & Gernot Schmid<sup>1</sup>

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<sup>2</sup>University of Applied Sciences, Vienna, Austria, 1200

**Keywords: Dosimetry (computational), ELF/ELF, Work in Progress**

**Presented by: Gernot Schmid**

The numerical assessment of the in situ electric field strength  $E_i$  in body parts next to conductors carrying high electric currents, is sensitive to the particular current distribution inside the conductor. In case of conductors with non-circular cross sections modeled as an assembly of discrete line currents, care must be taken in order to get a realistic (smooth) magnetic field distribution close to the conductor surface. In the present work, discrete line current models have been systematically investigated in order to develop an optimized representation of a high current conductor with rectangular cross section. The developed conductor model was then used to assess  $E_i$  in a hand model close to the conductor surface.

#### **PA-45 [14:30]**

##### **STUDENT PAPER**

##### **Implementation of European Directive 2013/35/EU in power substations: Numerical determination of compliance distances to conductors concerning magnetic field exposure**

Pia Schneeweiss<sup>1, 2</sup> & Gernot Schmid<sup>1</sup>

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<sup>2</sup>Vienna University of Technology, Vienna, Austria, 1040

**Keywords:** Dosimetry (computational), ELF/LF, Work in Progress

**Presented by:** Pia Schneeweiss

In view of the implementation of the European directive 2013/35/EU compliance distances to power line conductor arrangements would be of practical value, in order to provide guidelines for workers close to such installations or to implement appropriate access restrictions wherever necessary. In this paper we report results from numerical computations using high resolution anatomical body models exposed to power line conductor installations at different distances and orientations with respect to different body parts. These results will then be used as a basis for the derivation of reliable compliance distances.

## PA-47 [14:30]

### Theoretical analysis of transmembrane potential of cells exposed to nanosecond pulsed electric field

Guoshan Yang<sup>1</sup>, Hongmei Zhou<sup>1</sup> & Wei Lu<sup>1</sup>

<sup>1</sup>Department of Health Physics, Beijing Institute of Radiation Medicine, Beijing, China, 100850

**Keywords:** Dosimetry (computational), Pulsed, Completed (published)

**Presented by:** Guoshan Yang

This study aimed at studying the influence of nanosecond pulsed electric field (nsPEF) on the transmembrane potentials both of the cellular and organelle membranes. The results showed that: (1) from  $10^5$  to  $10^7$  Hz, the electric field induced larger transmembrane potential on the organelle membrane than on the cellular membrane. (2) The ratio between the transmembrane potential on the organelle membrane and the cellular membrane increased with shorter nsPEF, but the field amplitude should be stronger to make the transmembrane potential reach the threshold of electroporation. (3) Transmembrane potentials calculated with the consideration of dispersion phenomenon in high-frequency fields were larger than those without.

## PA-49 [14:30]

### Induced electric field in users of bone conduction hearing prosthesis exposed to low frequency electromagnetic fields

Patryk Zradziński<sup>1</sup>, Jolanta Karpowicz<sup>1</sup>, Krzysztof Gryz<sup>1</sup> & Wiesław Leszko<sup>1</sup>

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**Keywords:** Dosimetry (computational), ELF/ILF, Work in Progress

**Presented by:** Patryk Zradziński

Bone Anchored Hearing Aid (BAHA) implants are a kind of hearing prosthesis. The direct biophysical effects in the user of such an implant exposed to a non-uniform low frequency magnetic field were evaluated by numerical simulations focused on the electric field induced in a virtual phantom. The results of numerical simulations revealed hazards (induced electric field) in BAHA users up to several times higher than in healthy people (without implants).

## PA-51 [14:30]

### Influence of anatomical segmentation accuracy for whole body SAR computations evaluated on three different voxel-models based on the Visible Human Project (VHP) data set

Richard Überbacher<sup>1</sup> & Stefan Cecil<sup>1</sup>

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**Keywords:** *Dosimetry (computational), RF/Microwaves, Work in Progress*  
**Presented by:** *Richard Überbacher*

In this work we compare the influence of the anatomical segmentation accuracy of human models for whole body SAR computations. For this purpose three body models (Brooks AFB, ITIS and Austin-TX) segmented in a different way but basing all on the same data set of the Visible Human Project (VHP) were analyzed. To get comparable results the voxel size was defined as a uniform grid with 2 millimeter steps. For the computations the mainly used frequencies for mobile communications were investigated, i.e. the range from GSM900MHz up to LTE2600MHz. For the numerical EMF dosimetry this work may lead to more knowledge about uncertainty deriving from different accuracies of anatomical segmentation techniques.

### **PA-53 [14:30]**

#### **The method of electromagnetic field reduction in HF welder surroundings – case study**

Pawel Bienkowski<sup>1</sup>, Rafal Jablonski<sup>2</sup>, Hubert Trzaska<sup>1</sup> & Bartlomiej Zubrzak<sup>1</sup>

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**Keywords:** *Dosimetry (measurements), RF/Microwaves, Work in Progress*

**Presented by:** *Pawel Bienkowski*

Electromagnetic field (EMF) in high frequency (HF) welding is one of the inherent and least desirable factors. It's caused by energy used for generating heat in welded material and radiated mostly from welder platens and HF circuits. Electromagnetic field levels in welder surroundings can be significant from the point of view of labor safety (both in force in Poland and also related to soon coming into force EU Directive 013/35/EU). Work presents the actual case of HF welder installation, that did not meet the EMF exposure requirements and the results of EMF level reduction using shielding method.

### **PA-55 [14:30]**

#### **Determination of RF exposure in typical everyday scenarios**

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**Keywords:** *Dosimetry (measurements), RF/Microwaves, Completed (unpublished)*

**Presented by:** *Christian Bornkessel*

6-min time averaged RF exposure measurements to terminal devices (mobile phones, WLAN and DECT devices) and fixed transmitters (base stations and broadcast transmitters) on 30 different points in seven everyday scenarios were performed. The highest exposure was 0.46 % of the power density reference level and was dominated by a microcell antenna. An own head operated mobile phone during an active call dominates the individual exposure in all scenarios. Therefore, a good base station coverage is the most effective measure in minimising the individual exposure.

### **PA-57 [14:30]**

#### **A study on the occupational exposure to EMF caused by the arc welding machine**

Heejun Chae<sup>1</sup>, Sangbong Jeon<sup>2</sup>, Daehyo Jeong<sup>1</sup> & Junoh An<sup>1</sup>

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**Keywords:** *Dosimetry (measurements), ELF/IF, Work in Progress*

**Presented by:** *Heejun Chae*

Extremely-low frequency electromagnetic fields caused by Arc welding machine and welding cable are

conducted by using an ELF meter. The maximum magnetic flux density for the TIG welding machine is 34.03  $\mu$ T, which is obtained in the frequency band of 723 Hz. The measured value is significantly high level approaching to the 98.4 % of the ICNIRP occupational reference level.

#### **PA-59 [14:30]**

##### **Preliminary SAR measurement in a liquid phantom for compliance of wireless power transfer systems in IF band**

Jerdvisanop Chakarothai<sup>1</sup>, Satoshi Shimoyama<sup>1, 2</sup>, Kanako Wake<sup>1</sup>, Lira Hamada<sup>1</sup>, Katsumi Fujii<sup>1</sup>, Takuji Arima<sup>1, 2</sup>, Soichi Watanabe<sup>1</sup> & Toru Uno<sup>2</sup>

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**Keywords:** *Dosimetry (measurements), IF, Work in Progress*

**Presented by:** *Jerdvisanop Chakarothai*

Wireless power transfer (WPT) systems produce high electromagnetic (EM) near-fields. There are public concerns about hazards due to EM exposure from WPT systems. In the near future, various types of WPT systems will be launched into the market. Therefore, it is of mandatory to check compliance of each WPT product with EM safety standards. In this study, we constructed a system for measuring induced electric field strength and specific absorption rate (SAR), in a human-equivalent liquid phantom in the vicinity of a WPT system. Using our measurement system, we obtain induced electric field strength and determine SAR in order to check compliance of our fabricated WPT system with ICNIRP guidelines.

#### **PA-61 [14:30]**

##### **Indoor RF exposure assessment in urban area conducted by personal RF exposimeter**

Ivan Gresits<sup>1</sup>, Peter Necz<sup>1</sup>, Noemi Nagy<sup>1</sup> & György Thuroczy<sup>1</sup>

<sup>1</sup>Department of Non-Ionising Radiation, National Public Health Center, Budapest, Hungary, 1221

**Keywords:** *Dosimetry (measurements), RF/Microwaves, Completed (unpublished)*

**Presented by:** *Ivan Gresits*

The aim of this study was to measure the indoor microenvironmental level of RF exposure and individual personal exposure in urban area. Our main hypothesis was that the RF components of indoor exposure emitted by household wireless devices (e.g. DECT, WiFi, Bluetooth etc.) is already higher than the exposure from downlink frequency bands of mobile base stations. The total recorded electric field strengths of measured data were several times below the public exposure limits recommended by the EU, but the level of total RF exposure averaged over 24h from indoor household wireless devices is still less than the total exposure emitted by other sources from outdoor area.

#### **PA-63 [14:30]**

##### **Novel measurement of interference voltage in cellular band using an electro-optic converter for active implantable medical device EMI assessment**

Takashi Hikage<sup>1</sup>, Toshio Nojima<sup>1</sup>, Iyama Takahiro<sup>2</sup> & Teruo Onishi<sup>2</sup>

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**Keywords:** *Dosimetry (measurements), RF/Microwaves, Work in Progress*

**Presented by:** *Takashi Hikage*

We developed a novel voltage sensor for active implantable medical devices (implantable-cardiac pacemakers / ICDs) EMI assessment by applying a miniaturized direct modulated Electrical to Optical (EO) converter equipped in a pacemaker mock-up. The developed sensor can be placed in the liquid phantom and can

measure induced RF interference voltage without disturbing electromagnetic fields emitted from tested RF device. In this paper, measurement of frequency characteristics of induced interference voltage in cellular band is demonstrated.

### **PA-65 [14:30]**

#### **Exposure to extremely low frequency magnetic field on child-care centers near underground transmission lines in Seoul, Korea**

Taeho Lee<sup>1</sup>, Byungjun Han<sup>1</sup> & Joonsig Jung<sup>2</sup>

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**Keywords:** *Dosimetry (measurements), ELF/LF, Completed (published)*

**Presented by:** *Taeho Lee*

In Korea, the health risk controversy on extremely low frequency magnetic field is expanded from overhead transmission lines to underground transmission lines. This study aimed to measure and analyze the exposure to ELF magnetic field on child-care centers near underground transmission lines in Seoul, Korea.

### **PA-67 [14:30]**

#### **Influence of the urban characteristics on the spatial structure of electric field radiated by BTS antennas**

Thomas Lemaire<sup>1</sup>, Joe Wiart<sup>2</sup> & Philippe De Doncker<sup>1</sup>

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**Keywords:** *Dosimetry (measurements), RF/Microwaves, Work in Progress*

**Presented by:** *Thomas Lemaire*

The spatial structure of the electric field emitted by base stations in the Brussels Region (Belgium) is measured, and studied using the variogram. A relationship between the variogram shape and the base station antenna density in each measurement area is shown.

### **PA-69 [14:30]**

#### **Test field diversification method for the safety assessment of RF-induced heating of medical implants during MRI at 64 MHz**

Elena Lucano<sup>1, 2, 4</sup>, Aiping Yao<sup>1, 3</sup>, Earl Zastrow<sup>1, 3</sup>, Wolfgang Kainz<sup>4</sup>, Micaela Liberti<sup>2</sup> & Niels Kuster<sup>1, 3</sup>

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<sup>4</sup>CDRH, Office of Science and Engineering Laboratories, FDA, Silver Spring, USA, 20993

**Keywords:** *Dosimetry (measurements), RF/Microwaves, Completed (unpublished)*

**Presented by:** *Elena Lucano*

Elongated conductive structures may pick up radiofrequency-energy during magnetic resonance exposure, and locally deposit it in tissue near the implant electrodes. Current experimental assessment strategy is limited to only a small set of implant exposure conditions. In this work, we outline a method where exposure conditions of the implants can be diversified. We apply this method to three generic implants and the resulting heating is measured by the total dissipated power at the lead tip. We found a dynamic range for the total dissipated power at the lead tip of more than 30 dB from 1480 distinct exposure conditions. Once proven practical, the proposed method may improve the safety assessment of medical implants.

## PA-71 [14:30]

### **Experimental assessment about electromagnetic fields measurements in IoT environments**

Silvia de Miguel-Bilbao<sup>1</sup>, M. Dolores Marcos<sup>2</sup> & Victoria Ramos González<sup>1</sup>

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**Keywords:** *Dosimetry (measurements), RF/Microwaves, Work in Progress*

**Presented by:** *Victoria Ramos*

This work analyzes the electromagnetic (EM) environments through the assessment of exposure levels from systems based on Internet of Things (IoT). Currently there is no so much information about the EM radiation emitted by these systems and few studies have been performed. The results of these studies confirm that exposure levels are lower than thresholds established in the current standards. However, local high peaks of the emitted signals have been observed in the proximity of some radiofrequency devices.

## PA-73 [14:30]

### **Near-field exposure measurement of patch antennas considered in the upper frequency in the SHF band**

Teruo Onishi<sup>1</sup>, Kei Satoh<sup>1</sup> & Akimasa Hirata<sup>2</sup>

<sup>1</sup>Research Laboratories, NTT DOCOMO, INC., Yokosuka, Japan, 239-8536

<sup>2</sup>Department of Computer Science and Engineering, Nagoya Institute of Technology, Nagoya, Japan, 466-8555

**Keywords:** *Dosimetry (measurements), RF/Microwaves, Work in Progress*

**Presented by:** *Teruo Onishi*

Recently research and development as well as standardization on the 5<sup>th</sup> mobile communication system (5G) have been actively conducted all over the world. Frequency bands above 6 GHz are considered for 5G in addition to those used for current mobile systems. From exposure assessment point of view, the power density should be used above 6 GHz as a measurement index. The power density can be obtained by measuring the electric field in the far-field. However, exposure assessment methods focusing on near-field exposure should be investigated. In this study, a conventional probe such a Waveguide probe, which has been used for near-field to far-field transformation, is investigated to measure the electric field close to the antenna.

## PA-75 [14:30]

### **SAR estimation procedure for base station antennas based on two-dimensional scan measurements**

Iyama Takahiro<sup>1</sup>, Teruo Onishi<sup>1</sup>, Yoshiaki Tarusawa<sup>1</sup>, Lira Hamada<sup>2</sup> & Soichi Watanabe<sup>2</sup>

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**Keywords:** *Dosimetry (measurements), RF/Microwaves, Work in Progress*

**Presented by:** *Takahiro Iyama*

The Specific Absorption Rate (SAR) measurement procedure is mainly used for mobile devices such as handsets, and the applicability of such a procedure to base station antennas is evaluated in IEC62232. We propose a combination procedure that measures the two-dimensional SAR distribution around the surface of the bottom of a phantom and the one-dimensional exponential decay of the SAR distribution in the direction of the phantom depth to obtain a SAR estimation. The proposed procedure is more efficient and reduces the measurement time. We confirmed that the difference in the 10 g SAR and the total loss is within approximately 30%. An example is also shown where the proposed procedure is applied to SAR

measurement of a base station antenna.

### **PA-77 [14:30]**

#### **Co-exposure to extremely low-frequency electromagnetic fields and sound pressure in industrial environments: Temporal measurements near power transformers**

Arno Thielens<sup>2</sup>, Aaron Pozzolo<sup>1, 2</sup>, Luc Dekoninck<sup>2</sup>, Leen Verloock<sup>2</sup>, Jos Knockaert<sup>1</sup>, Dick Botteldooren<sup>2</sup>, Luc Martens<sup>2</sup> & Wout Joseph<sup>2</sup>

<sup>1</sup>IMOSYDE, Ghent University, Kortrijk, Belgium, 8500

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**Keywords:** *Dosimetry (measurements), ELF/LF, Work in Progress*

**Presented by:** *Arno Thielens*

Co-exposure to high levels of extremely low-frequency (ELF) electromagnetic (EM) fields and high sound pressure (SP) levels can occur in industrial environments. Legislation requires measurements of both ELF EM fields and SP levels in these environments. Therefore, a simultaneous assessment would mean a gain in efficiency. As a first case study, ELF EM and SP exposure is measured near power transformers using temporal measurements. The magnetic flux density at 50 Hz and SP at 100 Hz are highly correlated ( $r^2=0.76$ ,  $p<0.05$ ). Consequently, a linear conversion with a relatively small relative error (8.5%) can be made. Currently, measurements are being carried out to test the sensitivity of this model.

### **PA-79 [14:30]**

#### **Continuous magnetic field measurements around HV overhead power lines**

Blaz Valic<sup>1</sup> & Peter Gajsek<sup>1</sup>

<sup>1</sup>Institute of Non-Ionizing Radiation, Ljubljana, Slovenia, 1000

**Keywords:** *Dosimetry (measurements), ELF/LF, Completed (unpublished)*

**Presented by:** *Blaz Valic*

In the vicinity of HV overhead power lines the public is exposed to magnetic field. To determine the average exposures continuous measurements of ELF magnetic field was done. Results show that the average exposures are much lower than the maximum values. The overhead power lines are typically loaded between 20 in 40 percent of its nominal load. For most of the measured locations the contribution of HV overhead power lines to the magnetic field inside the building was small and comparable or lower than the contribution of other sources, as for example home appliances and domestic installation. Therefore the influence of the HV power lines on the magnetic field in the buildings at the distances of more than 60m can in practice be neglected.

### **PA-81 [14:30]**

#### **Compliance assessment of baby phones in the frequency range of 446 MHz to 2450 MHz**

Gunter Vermeeren<sup>1</sup>, Leen Verloock<sup>1</sup>, Wout Joseph<sup>1</sup> & Luc Martens<sup>1</sup>

<sup>1</sup>iMinds / Ghent University, Department of Information Technology, Ghent, Belgium, B-9050

**Keywords:** *Dosimetry (measurements), RF/Microwaves, Completed (unpublished)*

**Presented by:** *Gunter Vermeeren*

We assessed the compliance with International Commission on Non-Ionizing Radiation Protection (ICNIRP) guidelines of nine commercially available baby units of a baby phone communicating in the frequency range of 446 MHz to 2450 MHz under realistic worst-case exposure conditions. All devices were compliant with ICNIRP guidelines: the root-mean-squared electric field value closest to the ICNIRP reference level over all investigated devices was 1.51 V/m, which is 19.4 times below the ICNIRP reference level at 466 MHz; the peak spatial SAR in 10 g of tissue was 0.37 W/kg in muscle simulating tissue, which is 5.4 times below the



basic restriction of 2 W/kg as specified by ICNIRP.

### **PA-83 [14:30] STUDENT PAPER**

#### **ExpoM: exposure measurement platform enabling ELF magnetic field and RF electromagnetic field strength measurements**

Marco Zahner<sup>1</sup>, Jürg Fröhlich<sup>2</sup> & Juerg Leuthold<sup>1</sup>

<sup>1</sup>*Institute of Electromagnetic Fields (IEF), ETH Zurich, Zurich, Switzerland, 8092*

<sup>2</sup>*Fields at Work GmbH, Zurich, Switzerland, 8006*

**Keywords: Dosimetry (measurements), ELF/LF, Work in Progress**

**Presented by: Marco Zahner**

Spectrally resolved magnetic field measurements in combination with localized tracking is a challenge to this day. For this purpose we have introduced a magnetometer module (ExpoM-ELF) designed for the assessment of personal exposure to Extremely Low Frequency (ELF) magnetic fields from DC up to 100 kHz. The combination of the ExpoM-ELF with the ExpoM-RF - an RF-EMF exposure meter allows for the assessment of the most relevant exposure sources over a very wide range of the frequency spectrum.

### **PA-85 [14:30]**

#### **IRE efficiency for clinical ablation of hepatic tumors. Calibration of a mathematical model from medical imaging and clinical data**

Olivier Gallinato<sup>1, 2</sup>, François Cornelis<sup>3</sup>, Olivier Seror<sup>4</sup> & Clair Poinard<sup>1, 2</sup>

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**Keywords: Electroporation, Pulsed, Work in Progress**

**Presented by: Olivier Gallinato**

Numerical simulations are proposed for clinical procedure of tumor ablation using the promising technique of irreversible electroporation. The mathematical model is calibrated from medical imaging and clinical data. The study provides preliminary works towards a clinical evaluation of IRE efficiency.

### **PA-87 [14:30]**

#### **Electrochemotherapy with optical navigation for improved accuracy of treatment plan execution**

Bor Kos<sup>1</sup>, Aleš Grošelj<sup>2</sup>, Maja Cemazar<sup>3</sup>, Jure Urbančič<sup>2</sup>, Masa Bosnjak<sup>3</sup>, Biserka Veberič<sup>2</sup>, Primož Strojan<sup>4</sup>, Damijan Miklavcic<sup>1</sup> & Gregor Serša<sup>3</sup>

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**Keywords: Electroporation, Pulsed, Completed (published)**

**Presented by: Bor Kos**

Electroporation-based treatments are a highly effective local treatment option for a variety of tumors. Deep seated tumors in the head and neck region are often difficult to access with standard fixed-geometry electrodes, therefore the use of single needle variable-geometry electrodes can be favorable. We present a

method for coupling optical navigation and numerical treatment planning for better control of electroporation treatment realization.

### **PA-89 [14:30]**

#### **Transmembrane voltage and small molecule transport after 6 ns electropermeabilization**

Esin B Sözer<sup>1</sup>, C. Florencia Pocetti<sup>2, 3</sup> & P. Thomas Vernier<sup>1</sup>

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<sup>3</sup>Consejo Nacional de Investigaciones Científicas y Técnicas, Buenos Aires, Argentina

**Keywords: Electroporation, Pulsed, Work in Progress**

**Presented by: Esin Sozer**

Extending our analysis of YO-PRO-1 transport into cells after a single 6 ns, 20 MV/m electric pulse, we studied multiple pulses (1 Hz and 1 kHz repetition rates) and transport of other fluorescent cationic and anionic dyes of similar size. We also monitored membrane potential with FluoVolt, generating evidence for the dependence of small molecule transport on post-pulse transmembrane voltage, which returns to pre-pulse levels in 25 s for all cases. After 25 s, fluorescence varies both in localization and in intensity depending on pulse number and repetition rate. This evidence for rapid cellular responses to electric pulse perturbation suggests that models for transport of small molecules after electropermeabilization must be revised.

### **PA-91 [14:30]**

#### **Cohort study of mobile phone use and neurocognitive and behavioural outcomes in adolescents**

Irene Chang<sup>1</sup>, Charlotte Fleming<sup>1</sup>, Iroise Dumontheil<sup>2</sup>, Michael Thomas<sup>2</sup>, Martin Roosli<sup>3</sup>, Paul Elliott<sup>1</sup> & Mireille Toledano<sup>1</sup>

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<sup>3</sup>Department of Epidemiology and Public Health, Swiss Tropical and Public Health Institute, Basel, Switzerland, 40002

**Keywords: Epidemiology, RF/Microwaves, Work in Progress**

**Presented by: Mireille Toledano**

The Study of Cognition, Adolescents and Mobile Phones (SCAMP) is a three-year prospective cohort study which will follow several thousand secondary school pupils across London, UK. It aims to investigate whether children's use of mobile phones and other wireless devices influences their neurocognitive/behavioural development and will be the largest study in the world to date to address this research question.

### **PA-93 [14:30]**

#### **RF-EMF exposure and non-Hodgkin lymphoma. Is there any connection?**

Jesus Gonzalez-Rubio<sup>1</sup>, Alberto Nájera<sup>1</sup> & Enrique Arribas<sup>2</sup>

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**Keywords: Epidemiology, RF/Microwaves, Completed (unpublished)**

**Presented by: Jesus Gonzalez-Rubio**

This paper presents an epidemiological study to research the spatial relationship between RF-EMF generated by mobile phone base stations and non-Hodgkin lymphoma in the city of Albacete (Spain). For this purpose,

we performed a lattice map of personal RF-EMF exposure from exterior mobile phone base stations, covering the entire 110 administrative regions in the city of Albacete (Spain). We used a personal exposimeter, Satimo EME Spy 140 model, performing measurements every 4 seconds. The exposimeter was located inside the plastic basket of a bicycle, whose versatility permitted the access to all the zones of the city.

#### **PA-95 [14:30]**

##### **In-vitro, and epidemiological evidence on the relative toxicity from modulated radio frequency radiation for glioma risk**

L. Lloyd Morgan<sup>1</sup>, Anthony B. Miller<sup>2</sup>, Devra Davis<sup>3</sup>, Igor Belyaev<sup>4, 5</sup>, Michael Carlberg<sup>6</sup> & Lennart Hardell<sup>6</sup>

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<sup>6</sup>University Hospital, Örebro, Sweden, SE-701 85

**Keywords: Epidemiology, RF/Microwaves, Work in Progress**

**Presented by: L. Lloyd Morgan**

In 2011, radio frequency radiation (RFR) was classified as a possible human carcinogen (Group 2B) based on epidemiological studies showing increased brain cancer risks [1]. Since that time, the epidemiological evidence for brain cancer has become even stronger suggesting classification of RF as a probable human carcinogen, Group 2A [2] or even Group 1, a human carcinogen [3]. Experimental studies have also suggested several molecular biological and cellular mechanisms which provide a basis for carcinogenicity [4]. Consistent with findings that UMTS signal may be more effective at inhibiting DNA repair [5, 6], risk of glioma is larger from UMTS compared to GSM signal [7].

#### **PA-97 [14:30]**

##### **Effects of Radio Frequency Radiation emitted from Cell Phone on levels of reactive oxygen species with special reference to male Reproductive health: A Systematic Review**

Ravindra Nath<sup>1</sup>, Rajeev Singh<sup>2</sup> & Radhey Shyam Sharma<sup>1</sup>

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**Keywords: Epidemiology, RF/Microwaves, Work in Progress**

**Presented by: Dr. Ravindra Nath**

Mobile phone has become a crucial and multipurpose useful device among people of all strata. The RFR emitted from cell phone and Impact of these RFR on reactive oxygen species has been demonstrated by various animal and in-vitro studies. The excessive production of ROS due to RFR can damage gonadal tissue and also may adversely influence production of androgens. Both in-vitro and in-vivo studies have shown that exposure to RFR induced generation of ROS, which results in reduction in testicular size, weight, sperm count, sperm motility and quality of spermatozoa. Hence RFR exposure emitted from cell phone are adversely influencing the male reproductive health.

#### **PA-99 [14:30]**

##### **Effect of Radio Frequency Radiation (RFR) emitted from Cell Phone and Cell Phone Towers**

Radhey Shyam Sharma<sup>1</sup>, Ravindra Nath<sup>1</sup> & Rajeev Singh<sup>2</sup>

<sup>1</sup>Division of Reproductive Biology and Maternal Health, Indian Council of Medical Research, New Delhi, India, 110029

<sup>2</sup>Department of Environmental Studies, Satyawati College, University of Delhi, Delhi, India, 110052

**Keywords: Epidemiology, RF/Microwaves, Review, Commentary, Recommendation, Evaluation**

**Presented by: Dr. Radhey Shyam Sharma**

The widespread use of mobile phone has resulted in increased human exposure to radiofrequency radiation (RFR). Following the enormous increase in the use of cell phone around the world, the health concerns are being raised. Though no conclusive data available so far indicating the adverse health effects of these radiation but growing body of scientific evidences indicates biological effects of RFR. The studies conducted in India clearly establish biological effects of RFR. But it is not clear how much time these biological changes will take in resulting adverse health effects. To address this issue, a multidisciplinary prospective cohort study has been initiated in India.

### **PA-101 [14:30]**

#### **Clusters detection of childhood acute leukaemia and their association with the high voltage network in the metropolitan area of Guadalajara, Jalisco**

Leonardo Soto<sup>1</sup>

<sup>1</sup>Information Technology&Epidemiology, Hospital de Pediatría IMSS Jalisco, Guadalajara, Mexico, 45030

**Keywords: Epidemiology, ELF/ILF, Work in Progress**

**Presented by: Leonardo Soto**

Acute Leukaemia is the most common cancer in childhood. Analysing the spatial distribution of AL may generate the identification of risk factors. We aimed to evaluate incidence rates of AL, spatial distribution and detection of cancer clusters in the metropolitan area of Guadalajara, Jalisco, Mexico. We included children under 15 years of age diagnosed with AL during the period 2010-2015 in the metropolitan area of Guadalajara. The DBSCAN demonstrated three clusters all located in the municipality of Guadalajara. A total of 269 new cases of AL were registered, 227 (84%) acute lymphoblastic leukaemia (ALL) and 42 (16%) with acute myeloblastic leukaemia.

### **PA-103 [14:30]**

#### **Human exposure to a 60 Hz, 50,000 $\mu$ T magnetic field and biological indicators of stress**

Martine Souques<sup>1</sup>, Michael Corbacio<sup>2</sup>, Sebastien Villard<sup>2, 3</sup>, Jacques Lambrozo<sup>1</sup> & Alexandre Legros<sup>2, 3, 4</sup>

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**Keywords: Human, ELF/ILF, Completed (unpublished)**

**Presented by: Martine Souques**

Previous studies conducted on human volunteers investigating blood parameters with exposure to power-line frequency magnetic fields (MF) have not exceeded 1,000  $\mu$ T. This experimental pilot work tested 5 volunteers sitting in a system exposing their entire head to a 60 Hz, 50,000  $\mu$ T MF for 10 minutes. EEG activity was recorded and blood samples of cortisol and Thyroid Stimulating Hormone (TSH) were collected before, during and after the exposure. There were no noticeable differences in the blood parameters and EEG alpha activity due to MF exposure. There were no reported adverse effects from participating in the study. This work reports the highest power-frequency magnetic flux density applied to humans to study blood parameter changes.

### **PA-105 [14:30]**

#### **Stimulation frequency dependency of current perception threshold in Japanese**

Yoshitsugu Kamimura<sup>1</sup>, Madoka Yamazaki<sup>2</sup>, Setsu Nakatani-Enomoto<sup>2</sup>, Kanako Wake<sup>3</sup> & Yoshikazu Ugawa<sup>2</sup>

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**Keywords: Human, IF, Completed (unpublished)**

**Presented by: Yoshitsugu Kamimura**

We recently studied effects of age or gender on the current perception threshold in Japans normal subjects. Comparisons of our new results with those described in EHC137 suggests that the present threshold measurement method may be more strictly or correctly shows the real threshold as compared previous method. The frequency dependency shown here very well corresponded to the theoretically expected frequency dependency of nerve responses based on the myelinated fiber model.

## **PA-107 [14:30]**

### **Review of human experimental RF EMF studies published in the period 2011 – 2015**

Gunnhild Oftedal<sup>1</sup>, Sarah Loughran<sup>2</sup>, G. James Rubin<sup>3</sup>, Giuseppe Curcio<sup>4</sup>, Brahim Selmaoui<sup>5</sup> & Rene De Seze<sup>6</sup>

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**Keywords: Human, RF/Microwaves, Work in Progress**

**Presented by: Gunnhild Oftedal**

In the ongoing task of the World Health Organization (WHO) to develop Environment Health Criteria (EHC) for radio frequency (RF) electromagnetic fields (EMF), literature published after 1991 will be included. This presentation focus on studies that have been published in the period 2011 – 2015. Studies that complied with the predefined inclusion criteria include outcomes related to cognitive performance, brain electrical activity, brain metabolism and blood flow, symptoms, well-being and exposure detection, cardiovascular and autonomic nervous systems and temperature. For most endpoints only a few studies suggested a possible effect of exposure, while for electrical brain activity, effects were suggested in most studies.

## **PA-109 [14:30]**

### **The effects of short-term GSM and UMTS base station signal exposure on cognitive performance of Malaysians**

Hasliza A. Rahim<sup>1</sup>, Mohd Fareq Abd Malek<sup>2</sup>, Khadizah Husna<sup>3</sup>, Hafizi Omar<sup>4</sup> & M. A. Humayun<sup>1</sup>

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**Keywords: Human, RF/Microwaves, Completed (unpublished)**

**Presented by: Hasliza A. Rahim**

The main objective of this research is to investigate whether short-term exposure at 1 V/m to the typical Global System for Mobile Communication (GSM) and Universal Mobile Telecommunications System (UMTS) affects cognitive performance and physiological parameters (body temperature, blood pressure and heart rate) of Malaysian children or not.

### **PA-111 [14:30]**

#### **Detection thresholds for static electric fields from high-voltage direct current (HVDC) transmission lines in human subjects**

Kristina Schmiechen<sup>1</sup>, Sarah Driessen<sup>1</sup>, Thomas Kraus<sup>1</sup>, Marius Stoffels<sup>2</sup>, Artur Mühlbeier<sup>2</sup>, Thomas Krampert<sup>2</sup> & Dominik Stunder<sup>1</sup>

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<sup>2</sup>Institute for High Voltage Technology, RWTH Aachen University, Aachen, Germany

**Keywords: Human, Static, Work in Progress**

**Presented by: Kristina Schmiechen**

With the introduction of high voltage direct current (HVDC) power lines in Germany, humans will be increasingly exposed to static electric fields. The aim of this study is to examine the ability of human beings to perceive the presence of those fields. An exposure chamber has been built for this purpose. Two-hundred participants will be exposed to DC fields up to 50 kV/m or hybrid fields (AC up to 30 kV/m), in combination with ion currents. Sensory thresholds for the detection of electric fields will be assessed in two psychophysical experiments. These thresholds will serve as reference in determining limit values for static electric fields.

### **PA-113 [14:30]**

#### **Microwave soil disinfestation: a way to sustainable development**

Bruno Bisceglia<sup>1</sup> & Simona Valbonesi<sup>2</sup>

<sup>1</sup>Department of Industrial Engineering, University of Salerno, Fisciano (SA), Italy

<sup>2</sup>Consorzio Elettra 2000, Roma, Italy, 80100

**Keywords: Human, RF/Microwaves, Work in Progress**

**Presented by: Bruno Bisceglia**

Microwave and radiofrequency electromagnetic fields can play a great role in improving sustainability of food processing. Electromagnetic fields can also be used in soil disinfestation as a non polluting method instead of conventional methods based on fumigation. This technology ensures effective soil disinfestation without polluting the groundwater. Low power MW fields can also be used in facilitate germination and growth rate of seeds ensuring more abundant crops in poor areas.

### **PA-115 [14:30]**

#### **Exposure of scaffolds to Extremely Low Frequency Magnetic Field. Numeric simulation**

Bruno Bisceglia<sup>1</sup>, Matteo Lodi<sup>2</sup>, Alessandro Fanti<sup>2</sup> & Giuseppe Mazzarella<sup>2</sup>

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<sup>2</sup>Department of Electronic Engineering, University of Cagliari, Cagliari, Italy, 09046

**Keywords: In vitro, ELF/ILF, Work in Progress**

**Presented by: Bruno Bisceglia**

In orthopedic practice the use of biophysical stimulation from exposure to magnetic field for bone regeneration lead to good results, as for the treatment of non-unite fracture, osteotomies, osteoporosis and bone remodelling. The scaffold is a functional object capable of reproducing physical and chemical phenomena which are necessary to repair and regenerate bone. Our work focuses on the study and the analysis of the use of superparamagnetic scaffold as instrument for magnetic targeting.

### **PA-117 [14:30]**

#### **Genotoxic effects of intermediate frequency magnetic field on blood leukocytes in vitro**

Annamária Brech<sup>1</sup>, Györgyi Kubinyi<sup>1</sup>, Erzsebet Szaladjak<sup>1</sup>, Zsuzsanna Nemeth<sup>1</sup>, Jozsef Bakos<sup>1</sup> & György Thuroczy<sup>1</sup>

<sup>1</sup>Department of Non-Ionising Radiation, National Public Health Center, Budapest, Hungary, 1221

**Keywords:** *In vitro*, IF, Completed (unpublished)

**Presented by:** Annamária Brech

In contrast of radiofrequency and power frequency fields very little research on biological effects of exposure to intermediate frequency (IF) magnetic field has been presented so far. The aim of this experiment was to evaluate possible genotoxic effects of exposure to 123.9 kHz IF magnetic field on dog blood leukocytes. The applied magnetic field strength was 630 A/m at 123.9 kHz frequency, with exposure durations of 1, 2, 3, 4, 5, 20 and 24h. For the assessment of genotoxicity we used alkaline Comet assay. We found significant effect on DNA damage following 3 and 20 h exposure to IF magnetic field.

**PA-119 [14:30]**

**STUDENT PAPER**

**Super-resolution microscopy reveals microtubule buckling and breaking following nanosecond pulsed electric field exposure in U87 human glioblastoma cells**

Lynn Carr<sup>1</sup>, Sylvia M. Bardet<sup>1</sup>, Malak Soueid<sup>1</sup>, Delia Arnaud-Cormos<sup>1</sup>, Philippe Leveque<sup>1</sup> & Rodney P. O'Connor<sup>1</sup>

<sup>1</sup>Xlim Research Institute, University of Limoges, Limoges, France, 87060

**Keywords:** *In vitro*, Pulsed, Work in Progress

**Presented by:** Lynn Carr

Nanosecond pulsed electric field (nsPEF) exposure causes apoptosis in cancer cells via a currently unknown mechanism. We used live-cell, super-resolution microscopy to show that 100, 10 ns, 44 kV/cm pulses, applied at 10 Hz to U87 tubulin-mEmerald glioblastoma cells, resulted in the buckling of microtubules followed by their breakage and depolymerization. Microtubule depolymerization is a key event in apoptosis execution, making the effect we report on the microtubule network a candidate for the mechanism behind nsPEF induced apoptosis.

**PA-121 [14:30]**

**WITHDRAWN**

**PA-123 [14:30]**

**Effects of low-frequency pulsed electromagnetic fields on 3T3 fibroblast proliferation for in vitro wound healing using Helmholtz Coil system**

Mehmet Gumusay<sup>1</sup>, Adnan Kaya<sup>1</sup>, Ozan Karaman<sup>1</sup> & Afra Demirci<sup>1</sup>

<sup>1</sup>Biomedical Technologies, Izmir Katip Celebi University, Izmir, Turkey, 35620

**Keywords:** *In vitro*, Pulsed, Completed (unpublished)

**Presented by:** Adnan Kaya

Pulsed electromagnetic fields (PEMF) have been shown to accelerate wound healing. However, the mechanism of action is still unclear. The present study examined the effect of PEMF on in vitro wound healing model developed by 3T3 mouse fibroblasts of exposure to a 75 Hz frequency, square waveform and magnetic field of 1 mT for up to 5 h. The migration rates of 3T3 fibroblasts were estimated by capturing images at 0, 12, 24, 48 and 72 hours' time points. The cell proliferation at similar time points as migration assay was determined by using methylthiotetrazole (MTT) assay. The results of migration and proliferation assay showed that PEMF applied group had significantly greater proliferation and migration compared to control group.

**PA-125 [14:30]**  
**STUDENT PAPER**

**Studies on genotoxicity of intermediate frequency magnetic fields in rat primary astrocytes**

Mikko Herrala<sup>1</sup>, Jonne Naarala<sup>1</sup> & Jukka Juutilainen<sup>1</sup>

<sup>1</sup>*Department of Environmental and Biological Sciences, University of Eastern Finland, Kuopio, Finland*

**Keywords:** *In vitro, IF, Work in Progress*

**Presented by:** *Mikko Herrala*

In this study rat primary astrocytes were used to study genotoxic effects of 7.5 kHz magnetic field exposure at 30 or 300  $\mu$ T by measuring DNA damage using the single cell gel electrophoresis (Comet) assay and flow cytometric micronucleus scoring. Results will be reported in the BioEM 2016 meeting.

**PA-127 [14:30]**

**Pulsed electric fields anti-proliferation effects at tumor specific frequencies: experimental data and modelling approach**

Frederic Bellossi<sup>1</sup>, Gerard Dubost<sup>2</sup>, Anthony Holland<sup>3</sup> & James Bare<sup>4</sup>

<sup>1</sup>*Private, Bordeaux, France*

<sup>2</sup>*Emeritus Professor of Physics, University of Rennes I, Rennes, France*

<sup>3</sup>*Associate Professor, Skidmore College, New-York, USA*

<sup>4</sup>*DC, Private, Albuquerque, NM, USA*

**Keywords:** *In vitro, Pulsed, Work in Progress*

**Presented by:** *Frederic Bellossi*

RF EMFs show anti-proliferation effects upon cancer cells using specific frequencies within the low and intermediate range, i.e. below 400kHz. Limited understanding of the mechanisms of these effects exists so far and only a few models have been proposed. Apoptosis induction during cell mitosis is identified as one reason of their actions<sup>[1]</sup>. The Large Band Antenna Radiation (LBAR) model considers different complementary actions of EMFs on cancer cells and allows to correlate specific active frequencies with different cancer cell lines<sup>[2],[3]</sup>. First experiments are carried out to further assess the validity of the LBAR model and provide data to upgrade it as relevant. Preliminary results are presented at the BioEM2016 Conference.

**PA-129 [14:30]**  
**STUDENT PAPER**

**TETRA specific long-term exposure of neuronal in vitro networks**

Tim Köhler<sup>1</sup>, Maximilian Wölfel<sup>2</sup>, Ulrich Bochtler<sup>2</sup> & Christiane Thielemann<sup>1</sup>

<sup>1</sup>*Biomems lab, University of Applied Sciences Aschaffenburg, Aschaffenburg, Germany, 63743*

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**Keywords:** *In vitro, RF/Microwaves, Work in Progress*

**Presented by:** *Tim Köhler*

For long the health of human brain is an issue in biological radiation research. Compared to long-standing mobile communication standards like GSM, terrestrial trunked radio (TETRA) has hardly been addressed in literature. TETRA is a digital radio communication standard especially used by occupational groups such as police forces, fire brigade and ambulances. It is of particular importance to investigate the new frequencies on their potential health risks. In this work we study, whether TETRA-specific long-term exposure affects electrophysiology of neuronal networks. Our results show that the TETRA-specific long-term exposure does not affect burst rate (BR) of cortical rat neurons, compared to control and sham group.



### PA-131 [14:30]

#### **Magnetic field stimulation effects on the production of PHB by methylotrophic strain**

Carlos Eduardo Molina Guerrero<sup>1</sup>, Angelica Hernandez Rayas<sup>2</sup>, Iveth Jimenez<sup>1</sup>, Concepción García-Castañeda<sup>1</sup>, Teodoro Cordova-Fraga<sup>2</sup> & Guadalupe de la Rosa<sup>1</sup>

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**Keywords:** *In vitro*, Pulsed, Work in Progress

**Presented by:** Angelica Hernandez Rayas

The possibility of increase the production of PHB using magnetic field will permit a possible reduction of cost production of this polymer, which is a big impediment for its production in great scale.

### PA-133 [14:30]

#### **The effects of 2100 MHz UMTS modulated mobile phone radiation on estrogen metabolism in MCF-7 and HGF-1 cells in vitro**

Elcin Ozgur<sup>1</sup>, Kahraman Ateş<sup>2</sup>, Recai Ogur<sup>3</sup>, Goknur Guler<sup>1</sup> & Nesrin Seyhan<sup>1</sup>

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<sup>3</sup>Department of Public Health, Gülhane Military Medical Academy, Ankara, Turkey

**Keywords:** *In vitro*, RF/Microwaves, Completed (unpublished)

**Presented by:** Elcin Ozgur

This study was aimed to analyze the in vitro effects of 2100 MHz (Universal Mobile Telecommunications System) UMTS modulated mobile phone like radiation on the enzymes of estrogen metabolism.

### PA-135 [14:30]

#### **Quality matter: Systematic analysis of endpoints related to “cellular life” in vitro data of radiofrequency electromagnetic field exposure**

Myrtill Simko<sup>1</sup>, Daniel Remondini<sup>2</sup>, Olga Zeni<sup>3</sup> & Maria Rosaria Scarfi<sup>3</sup>

<sup>1</sup>Department Health and Environment, AIT Austrian Institute of Technology, Tulln, Austria, 3430

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<sup>3</sup>Institute for Electromagnetic Sensing of Environment, CNR, Napoli, Italy, 80124

**Keywords:** *In vitro*, RF/Microwaves, Completed (unpublished)

**Presented by:** Myrtill Simko

The presented analysis allows a global point of view on the state of the art of RF-EMF “cellular life” in vitro effects, highlighting the need of more stringent quality procedures for the exposure conditions.

### PA-137 [14:30]

#### **Genotoxic effects of exposure to intermediate frequency magnetic field combined with ionizing radiation in H295R tumor cell line in vitro: investigations of possible adaptive response against ionizing radiation**

Erzsebet Szaladjak<sup>1</sup>, Györgyi Kubinyi<sup>1</sup>, Annamária Brech<sup>1</sup>, Zsuzsanna Nemeth<sup>1</sup>, Jozsef Bakos<sup>1</sup> & György Thuroczy<sup>1</sup>

<sup>1</sup>Department of Non-Ionising Radiation, National Public Health Center, Budapest, Hungary, 1221

**Keywords:** *In vitro*, IF, Completed (unpublished)

**Presented by:** Erzsebet Szaladjak

The aim of this study was to examine on the H295R tumor cell line, whether a 20 hours exposition to a

250.8 kHz intermediate frequency (IF) magnetic field (MF) has any effects on DNA, or could IF MF exposure induce adaptive response (AR) if performed before a 1.5 Gy X-ray irradiation (XR). Our results indicate that there was a significant effect of IF MF exposure compared to the control group. The number of DNA strand breaks was significantly decreased in IF MF pre-exposed cells after they were subsequently treated with 1.5 Gy XR. Hence non-ionizing IF MF induced AR to ionizing XR. A very important question is, whether the reduced XR-induced DNA damage caused by IF MF results a reduced effectiveness of radiotherapy or not.

#### **PA-139 [14:30]**

##### **The effect of electromagnetic waves with extremely high frequencies and low intensity on human albumin solution**

Poghos Vardevanyan<sup>1</sup>, Vitali Kalantaryan<sup>2</sup>, Mariam Shahinyan<sup>1</sup>, Marina Parsadanyan<sup>1</sup> & Mareta Mikaelyan<sup>1</sup>

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**Keywords:** *In vitro, RF/Microwaves, Completed (unpublished)*

**Presented by:** *Vitali Kalantaryan*

The effect of electromagnetic waves with extremely high frequencies (EMW EHF) and low intensity on human albumin solutions has been investigated. It has been shown that the effect of EMW EHF on albumin solution causes some conformational changes in albumin structure. This fact is obvious from fluorescence spectroscopy method based on maximal fluorescence intensities and emission wavelengths.

#### **PA-141 [14:30]**

##### **Interaction of netropsin with double-stranded nucleic acids irradiated with non ionizing athermal millimeter electromagnetic waves**

Vitali Kalantaryan<sup>1</sup>, Radik Martirosyan<sup>1</sup>, Babayan Yura<sup>2</sup> & Sergey Hakobyan<sup>3</sup>

<sup>1</sup>*Microwave Radiophysics, Yerevan State University, Yerevan, Armenia, 0025*

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**Keywords:** *In vitro, RF/Microwaves, Work in Progress*

**Presented by:** *Vitali Kalantaryan*

The our studies show that binding constant (K) of netropsin with irradiated DNAs changes: almost by one order for B-form DNA and is tripled in case of A-form DNA. The changes of enthalpy ( $\Delta H$ ) and entropy ( $\Delta S$ ) for binding process were calculated by Van't Hoff analysis, from the dependence of K on the temperature. As a result of irradiation with resonant frequencies, the absolute values of  $\Delta H$  and  $\Delta S$  increase. The increase in the thermodynamic binding parameters (K,  $\Delta H$ ,  $\Delta S$ ) at complexing of anticancer drug netropsin in vitro with irradiated double-stranded nucleic acids indicates of prospects of development of the complex millimeter therapy with anticancer drug for clinical oncology in the treatment of malignancies.

#### **PA-143 [14:30]**

##### **The low power electromagnetic millimeter waves influence on the cellular indicators of leucopoiesis**

Vitali Kalantaryan<sup>1</sup>, Radik Martirosyan<sup>1</sup>, Tsovinar Adamyan<sup>2</sup> & Emma Gevorkyan<sup>2</sup>

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**Keywords:** *In vivo, RF/Microwaves, Work in Progress*

**Presented by:** *Vitali Kalantaryan*

On the base of our experimental results and the literature data we conclude that the low intensity millimeter

waves elevate the functional state of the blood cells, the functional potential of the leukocytes, preparing the cells to resist against other agents.

#### **PA-145 [14:30]**

##### **A reverberation chamber for animal exposure at millimeter waves**

Abdou Khadir Fall<sup>1</sup>, Christophe Lemoine<sup>1</sup>, Philippe Besnier<sup>1</sup>, Maxim Zhadobov<sup>2</sup>, Ronan Sauleau<sup>2</sup>, Frederic Percevault<sup>3</sup>, François Ferrière<sup>3</sup> & Yves Le Dréan<sup>3</sup>

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**Keywords:** *In vivo*, RF/Microwaves, Work in Progress

**Presented by:** Abdou Khadir Fall

A mode stirred reverberation chamber (RC) is designed to conduct *in vivo* studies in the 60-GHz band. This exposure system has suitable features for experiments on animals. An interface, for temperature measurements using an infrared (IR) camera, is designed in the chamber wall in order to measure the specific absorption rate and/or the power density inside the chamber.

#### **PA-147 [14:30]**

##### **Long term and excessive use of 900 MHz radiofrequency radiation alter microRNA expression in brain**

Suleyman Dasdag<sup>1</sup>, Zulkuf Akdag<sup>2</sup>, Mehmet Emin Erdal<sup>3</sup>, Nurten Erdal<sup>4</sup>, Ozlem Izci<sup>3</sup>, Mustafa Ertan Ay<sup>3</sup>, Senay Gorucu<sup>3</sup>, Bahar Tasdelen<sup>5</sup> & Korkut Yegin<sup>6</sup>

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**Keywords:** *In vivo*, RF/Microwaves, Completed (published)

**Presented by:** Suleyman Dasdag

Wireless technological equipment has led to a dramatic increase in electromagnetic pollution and man-made sources have by far exceeded those of natural origin.

#### **PA-149 [14:30]**

##### **Effect of 2.1 GHz radiofrequency radiation on healing of mandibular fractures**

Mustafa Durgun<sup>1</sup>, Suleyman Dasdag<sup>2</sup>, Serkan Erbatur<sup>3</sup>, Korkut Yegin<sup>4</sup>, Suna Ogucu-Durgun<sup>5</sup>, Cosar Uzun<sup>6</sup>, Golge Ogucu<sup>7</sup>, Ulas Alabalik<sup>8</sup> & Zulkuf Akdag<sup>9</sup>

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**Keywords: Clinical (therapy), RF/Microwaves, Completed (published)**

**Presented by: Suleyman Dasdag**

The healing of a fracture is a complex biological process that comprises several overlapping steps and is managed by a number of mechanisms. Maxillofacial injury occurs in approximately 5%33% of patients which have experienced severe traumas.

## **PA-151 [14:30]**

### **Does prolonged radiofrequency radiation emitted from Wi-Fi devices induce DNA damage in various tissues of rats?**

Zulkuf Akdag<sup>1</sup>, Suleyman Dasdag<sup>2</sup>, Fazile Canturk<sup>3</sup>, Derya Karabulut<sup>4</sup>, Yusuf Caner<sup>3</sup> & Nur Adalier<sup>5</sup>

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**Keywords: In vivo, RF/Microwaves, Completed (published)**

**Presented by: Suleyman Dasdag**

Wireless internet (Wi-Fi) providers have become essential in our daily lives, as wireless technology is evolving at a dizzying pace. Although there are different frequency generators, one of the most commonly used Wi-Fi devices are 2.4 GHz frequency generators.

## **PA-153 [14:30]**

### **Harmonic motion microwave doppler imaging using scanning antennas**

Azadeh Kamali Tafreshi<sup>1</sup>, Can Baris Top<sup>2</sup>, Umit Irgin<sup>2</sup> & Nevzat Gencer<sup>1</sup>

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**Keywords: In vivo, RF/Microwaves, Work in Progress**

**Presented by: Azadeh Kamali Tafreshi**

Harmonic Motion Microwave Doppler Imaging (HMMDI) had been proposed to image the breast tissues based on their dielectric and elastic properties. In this study, an experimental system is designed and its performance is investigated on an inhomogeneous breast tissue mimicking phantom. The phantom has three different sized tumor phantom inclusions inside the fat phantom. A local vibration is induced in the phantom using a focused ultrasound transducer. Meanwhile, the microwave waves are transmitted to the phantom and the back scattered microwave signal is sensed using the antenna. The tumor phantom of 4.5 mm diameter and 4 mm height, 25 mm inside the fat phantom is detected using the HMMDI system.

## **PA-155 [14:30]**

### **Alteration of synaptic vesicles in hypothalamus and striatum after exposure of 835MHz radiofrequency electromagnetic field**

Ju-Hwan Kim<sup>1</sup>, Yang Hoon Huh<sup>2</sup>, Dahyeon Yu<sup>1</sup>, Hye-Ryoung Lee<sup>1</sup>, Hyung-Gun Kim<sup>1</sup>, Yoon-Myoung Gimm<sup>3</sup> & Hakrim Kim<sup>1</sup>

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**Keywords:** *In vivo*, RF/Microwaves, Work in Progress

**Presented by:** Hye-Ryoung Lee

In the present study, we hypothesize that synaptic vesicles at axon terminals are affected by chronic exposure of RF-EMF exposure. Therefore, we apply 835MHz RF-EMF, SAR of 4.0W/kg for 5 hours per day for 4 weeks and 12 weeks to C57BL/6 mice. The number and size of synaptic vesicles are significantly decreased in RF exposed group. This result suggest that 835 MHz RF exposure could affect the neurotransmission through altered profiles of synaptic vesicles in neuron.

## **PA-157 [14:30]**

### **Are magnetic fields able to induce or promote genomic instability? Preliminary results from the CLeMAN project**

Isabelle Lagroye<sup>1</sup>, Yves Le Dréan<sup>2</sup>, Florence Poullietier De Gannes<sup>1</sup>, Denis Habauzit<sup>2</sup>, Emmanuelle Poque-Haro<sup>1</sup>, Annabelle Hurtier<sup>1</sup>, Catherine Martin<sup>2</sup>, Rémy Renom<sup>1</sup> & Bernard Veyret<sup>1</sup>

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**Keywords:** *In vivo*, ELF/LF, Work in Progress

**Presented by:** Isabelle Lagroye

Genomic instability, evaluated as the presence of DNA damage, was investigated in the bone marrow of BDF1 mice exposed to 50 Hz magnetic fields, 8 h/d, 5d/wk and up to 8 weeks of age at 1000  $\mu$ T, beginning at conception. The effect of magnetic fields was also investigated in mice with induced genomic instability and/or treated with the genotoxic agent MethylNitroUrea. Bone marrow was taken from mice from five to six litters. Preliminary data suggest no statistically significant difference within the groups and further experiments are on-going to increase the sample size.

## **PA-159 [14:30]**

### **Weak magnetic field manipulation disrupts regenerative outgrowth in Planaria**

Jacob Morton<sup>1</sup>, Jordon Czajka<sup>1</sup>, Julian Cyrus<sup>2</sup>, Frank Barnes<sup>2</sup> & Wendy Beane<sup>1</sup>

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**Keywords:** *In vivo*, Static, Work in Progress

**Presented by:** Frank Barnes

Weak magnetic fields (MF) have been shown to affect the rate of cellular proliferation, while planarian flatworms require proliferation for regenerative outgrowth (blastema formation). Our data shows exposing planarian regenerates to 200 $\mu$ T MF causes significant decreases in blastema size, as compared to controls exposed to 45 $\mu$ T (earth-normal). Our data indicates exposure is required early during regeneration and likely depends on reactive oxygen species (ROS)—as direct ROS inhibition phenocopies 200 $\mu$ T exposure. Since MF variations can change the combined nuclear and electron spin states in radical molecules and radical pair recombination rates, these data suggest MF affect stem cell proliferation *in vivo* via changes in ROS production.

## **PA-161 [14:30]**

### **STUDENT PAPER**

#### **Effect of chronic exposure to low frequency magnetic fields in germ cells of mice**

Gloria Lévano<sup>1</sup>, Martha Valdivia<sup>1</sup> & Victor Cruz<sup>2</sup>

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**Keywords:** *In vivo*, *Static*, *Completed (unpublished)*

**Presented by:** Gloria Lévano

The objective of this study was to evaluate the effect of low-frequency magnetic fields, 715  $\mu$ T and 60 Hz in the spermatogonial stem cells (SSC) from mice and early adulthood. Six groups were studied: group I: Mice 4 dpp without exposure to magnetic fields, group II: Mice of 4 days postpartum (dpp) exposed 10 days, group III: mice 4 dpp exposed 10 days, group IV: mice without exposed to magnetic fields. Group III and IV were evaluated at 73 dpp, group V: mice of 35 dpp sham exposed. Group VI: mice of 35 days exposed for 35 days. Group V and VI were evaluated on 70 dpp. After SSC isolation the concentration, viability and the percentage of positive cells DBA, were evaluated.

## PA-163 [14:30]

### Possible mechanism of spermatogenic germ cell apoptosis induced by extremely low frequency magnetic fields

Sungman Park<sup>1</sup>, Young-Jin Kim<sup>1</sup>, Min Soo Kim<sup>1</sup>, Sang-Kon Lee<sup>2</sup>, Nam Kim<sup>3</sup>, Yoon-Myoung Gimm<sup>4</sup> & Yoon-Won Kim<sup>1</sup>

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<sup>4</sup>Department of Electronics and Electrical Engineering, Dankook University, Yong-In, Korea, 16891

**Keywords:** *In vivo*, *ELF/ILF*, *Completed (published)*

**Presented by:** Yoon-Won Kim

The male mice and rat were used for this study to explore the biological effective dose of 60 Hz MF. In mice, the apoptotic cells in testicular tubules were increase at the exposure to 60 Hz MF of 20 mT for 20 week. Number of sperm and sperm motility were declined at the exposure to 100 mT. Differently with mice, testis weight, sperm motility and abnormality of sperm were not affected by the exposure in rat. Testicular germ cell death was significant increase at the continuous exposure to 60 Hz MF of 50 mT for 20 weeks in rat. The induced current in rat exposed with 60 Hz MF is about 3 times of that in mouse. This result suggests that, at least, the induced current is not the unique fact to the apoptosis of testicular germ cell by 60 Hz MF.

## PA-165 [14:30]

### Effects of exposure to the LTE RF signal on mice immune system

Emmanuelle Poque-Haro<sup>1</sup>, Florence Poulletier De Gannes<sup>1</sup>, Annabelle Hurtier<sup>1</sup>, Gilles Ruffie<sup>1,2</sup>, Yann Percherancier<sup>1</sup>, Bernard Veyret<sup>1,3</sup> & Isabelle Lagroye<sup>1,3</sup>

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**Keywords:** *In vivo*, *RF/Microwaves*, *Work in Progress*

**Presented by:** Isabelle Lagroye

We conducted a study on the immune system of free-moving mice, exposed in a reverberating chamber to a TLE signal at 3.5 GHz. No effects could be seen on the splenocytes phenotype and mitogen-induced lymphocytes proliferation. Data on cytokine production by the splenocytes under activation need to be completed before a firm conclusion can be made.

## PA-167 [14:30]

### **Chronic exposure effect of low level microwave radiation on growth related enzymes of rat**

Paulraj Rajamani<sup>1</sup>, Rohit Gautam<sup>1</sup>, Kumari Vandana<sup>1</sup> & Jitendra Behari<sup>2</sup>

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**Keywords:** *In vivo, RF/Microwaves, Completed (published)*

**Presented by:** Paulraj Rajamani

Wistar rats were exposed different microwave frequencies. A significant decrease in PKC activity and increased ODC activity as well as DNA strand breaks was observed as compared control group. It is inferred that prolonged exposure to these radiation causes significant alteration in growth related enzymes of brain tissue, suggesting a transductive coupling to the cytoplasm which may affect the behavioral pattern as well as learning and memory functions in developing rat.

## PA-169 [14:30]

### **STUDENT PAPER**

### **Mobile phone radiation exposure: oxidative stress induced cytomorphic changes in hippocampus and consequential effect on contextual fear memory**

Kumari Singh<sup>1</sup>, Rohit Gautam<sup>1</sup>, Jayprakash Nirala<sup>1</sup> & Paulraj Rajamani<sup>1</sup>

<sup>1</sup>school of environmental sciences, Jawaharlal Nehru University, New Delhi, India, 110067

**Keywords:** *In vivo, RF/Microwaves, Work in Progress*

**Presented by:** Kumari Singh

Over the past few decades there is an exponential growth in the number of mobile phone subscriptions worldwide. There are also several reports on ill health effect of chronic exposure to radiofrequency radiation. Present study was aimed to evaluate the effect of chronic exposure to 3G mobile phone radiation on brain in general and hippocampus in specific. We tried to find out that whether radiation exposure leads to oxidative stress mediated neuronal damage in hippocampus and is there any functional consequences of it in terms of memory impairment. Radiation exposure may also lead to increase in basal stress hormone level which in turn may have a role in neuronal damage and consequential memory impairment.

## PA-171 [14:30]

### **WITHDRAWN**

## PA-173 [14:30]

### **Associations of 5-HT<sub>1A</sub> gene polymorphisms with cognitive alterations after electromagnetic radiation**

Lifeng Wang<sup>1</sup>, Haijuan Li<sup>1</sup> & Xiangjun Hu<sup>1</sup>

<sup>1</sup>Laboratory of Experimental Pathology, Beijing Institute of Radiation Medicine, Beijing, China, 100850

**Keywords:** *In vivo*, RF/Microwaves, Completed (unpublished)

**Presented by:** Lifeng Wang

5-HT system regulates the brain development, cognition and emotion. Genetic polymorphisms lead to individual differences. In this study, we evaluated whether the single nucleotide polymorphisms (SNP) of 5-HT receptors were associated with the alterations of cognitive function after EMR. Two SNPs were screened in rat 5-HT<sub>1A/2A/2C</sub>R promoter region, including 5-HT<sub>1A</sub>R -215 T>C (rs198585630) and 5-HT<sub>2A</sub>R 74\_75 ins G. 5-HT<sub>1A</sub>R rs198585630 genotypes in rats were TT, TC and CC. Transcriptional activity of 5-HT<sub>1A</sub>R promoter including C allele was higher than that including T allele. C allele was more susceptible to 30 mW/cm<sup>2</sup> microwave with a stronger transcriptional activation.

## PA-175 [14:30]

### **STUDENT PAPER**

### **Induction of autophagy in hypothalamus and striatum after exposure of 835MHz radiofrequency electromagnetic field**

Dahyeon Yu<sup>1</sup>, Ju-Hwan Kim<sup>1</sup>, Hye-Ryoung Lee<sup>1</sup>, Jin-Koo Lee<sup>1</sup> & Hakrim Kim<sup>1</sup>

<sup>1</sup>Department of Pharmacology, College of Medicine, Dankook University, Cheonan, Korea, 31116

**Keywords:** *In vivo*, RF/Microwaves, Completed (unpublished)

**Presented by:** Dahyeon Yu

The data from gene expression analysis, biochemical studies and imaging by transmission electron microscopy showed that autophagy can be induced in striatum and hypothalamus after exposure of 835MHz RF-EMF exposure at SAR of 4.0W/kg for 5h/day for 12 weeks to C57BL/6 mice.

## PA-177 [14:30]

### **3D finite element simulation of electric properties of biological cells at radio frequencies**

Sebastian Boehmelt<sup>1</sup>, Michael Dudzinski<sup>1</sup>, Nils Kielian<sup>1</sup>, Marco Rozgic<sup>1</sup>, Lars-Ole Fichte<sup>1</sup> & Marcus Stiemer<sup>1</sup>

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**Keywords:** *Mechanistic/Theoretical*, RF/Microwaves, Work in Progress

**Presented by:** Sebastian Boehmelt

A three-dimensional finite element simulation of the electric properties of biological cells suspended in an electrolyte and exposed to an ambient electric field in the range of radio frequencies is presented. To cope with the different length scales of the cell and its membrane, a novel domain decomposition method combined with an interpolation process between the boundaries of subdomains is introduced. After careful validation, the numerical algorithms are applied to systematically study the dependence of a cell's electric properties, such as, e.g., polarization, transmembrane potential, or SAR, on the cellular geometry and on the frequency. The varied parameters characterize the cell's shape, orientation, and membrane thickness.

## PA-179 [14:30]

### **Nerve response to electrical stimulation with repetitive subthreshold monophasic rectangular pulses – simulation study based on SENN nerve model**



Zlatko Zivkovic<sup>1</sup>, Antonio Sarolic<sup>1</sup> & Vedran Deletis<sup>2</sup>

<sup>1</sup>FESB, University of Split, Split, Croatia

<sup>2</sup> Department of Intraoperative Neurophysiology, Mount Sinai Health System-Roosevelt Hospital, New York, NY, USA

**Keywords:** *Mechanistic/Theoretical, IF, Work in Progress*

**Presented by:** *Zlatko Zivkovic*

The study deals with nerve response to a long train of repetitive, rectangular monophasic pulses. The threshold current for repetitive stimuli was calculated and compared to the threshold current for single pulse excitation having the same phase duration, as well as to the rheobase current, for a wide range of phase durations and repetition frequencies. The study was carried out using the SENN (Spatially Extended Nonlinear Node) nerve model. The results indicate that nerve excitation by repetitive monophasic stimuli can be efficient even for subthreshold high-frequency pulses. This result is potentially interesting for both medical application protocols and human exposure studies.

## **PA-181 [14:30] STUDENT PAPER**

### **An analytical solution for forward problem of Magneto-Acousto-Electrical Tomography**

Elyar Ghalichi<sup>1</sup> & Nevzat Gencer<sup>1</sup>

<sup>1</sup>Electrical and Electronics Engineering, METU, ANKARA, Turkey, 06800

**Keywords:** *Mechanistic/Theoretical, Ultrasound, Work in Progress*

**Presented by:** *Elyar Ghalichi*

In this study, an analytic method (Separation of variables method) of solving the forward problem of Magneto-Acousto-Electrical Tomography (MAET) is investigated for 2D concentric circles. The electric potential is separated to azimuthal and radial components. Since the electric potential is complex valued in the domain, complex exponential eigenfunctions are used to represent the azimuthal component of it. The results are compared to numerical results calculated by COMSOL Multiphysics. The relative errors of electric potential's magnitude between these two solutions are obtained. These errors are calculated for all nodes of finite element method's mesh. Out of 521744 nodes, only seven have an error greater than five percent.

## **PA-183 [14:30]**

### **Stimulation strategies for tinnitus suppression in a neuron model**

Alessandra Paffi<sup>1</sup>, Francesca Camera<sup>1</sup>, Chiara Carocci<sup>1</sup>, Francesca Apollonio<sup>1</sup> & Micaela Liberti<sup>1</sup>

<sup>1</sup>Department of Information Engineering, Electronics and Telecommunications (DIET), Sapienza University of Rome, Rome, Italy, 00184

**Keywords:** *Mechanistic/Theoretical, ELF/IF, Completed (unpublished)*

**Presented by:** *Micaela Liberti*

Tinnitus is a debilitating perception of sound in the absence of external auditory stimuli that may have a peripheral origin in the cochlea. Experimental studies evidenced that an electrical stimulation of peripheral auditory fibers could alleviate symptoms but the underlying mechanisms are still unknown. In this work we use a stochastic neuron model, mimicking an auditory fiber affected by tinnitus, to check the effects, in terms of firing reduction, of different kinds of electric stimulations, i.e. continuous wave signals and Gaussian white noise. Results show a cooperative effect of signal and noise in suppressing tinnitus.

## **PA-185 [14:30]**

### **A numerical study on the resolution limit of Magneto-Acousto-Electrical Tomography using Magnetic Field Measurements**

Reyhan Zengin<sup>1, 2</sup> & Nevzat Gencer<sup>1</sup>

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<sup>2</sup>Electrical and Electronics Engineering Dept., Selcuk University, Konya, Turkey, 42075

**Keywords: Mechanistic/Theoretical, Ultrasound, Work in Progress**

**Presented by: Reyhan Zengin**

In this study, resolution limit of the magnetic field measurement method of Magneto-Acousto-Electrical Tomography is investigated. This method is based on electrical current induction using ultrasound together with an applied static magnetic field. The magnetic field intensity generated due to induced currents is measured using a nearby coil. 2D numerical geometry with a 16-element linear phased array (LPA) ultrasonic transducer (1 MHz) and a conductive body with two tumorous tissues is modeled in 4 T. Two tumorous tissues are placed at a distance of 1 mm away from each other. The pick-up voltages are on the order of nanovolts. Two tumorous tissues can be distinguished if the distance between each tumorous tissue is more than 1 mm distance.

### **PA-187 [14:30]**

#### **Prevalence of sensory symptoms associated with electromagnetic fields exposure from ultra high field magnetic resonance scanners**

Mahsa Fatahi<sup>1</sup>, Liliana Ramona Demenescu<sup>2</sup>, Amirmohammad Fattahi<sup>3</sup> & Oliver Speck<sup>1, 2</sup>

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<sup>3</sup>Department of Mechanical Engineering, Imperial College, London, United Kingdom

**Keywords: Occupational, Static, Work in Progress**

**Presented by: Mahsa Fatahi**

Ultra-high field magnetic resonance imaging (UHF MRI) ( $B_0 \geq 7$  Tesla) has shown a very good safety record for 10 years<sup>1,2</sup>, however the systems are not yet approved for clinical use. One prerequisite to pave the way for transferring 7T to clinical use is to assure that the risk is minimal for both subjects and workers. This survey study attempts to delineate prevalence of sensory symptoms and perception of safety of healthy individuals working with human 7 Tesla magnetic resonance imaging scanners.

### **PA-189 [14:30]**

#### **Occupational exposure assessment using induced current density based on the waveform of a welding current pulse**

Sangbong Jeon<sup>1</sup>, Heejun Chae<sup>2</sup>, Daesung Han<sup>3</sup>, Ae-kyoung Lee<sup>1</sup> & Jonghwa Kwon<sup>1</sup>

<sup>1</sup>Radio Technology Research Department, ETRI, Daejeon, Korea, 34129

<sup>2</sup>Institute for Future Radio Engineering, Seoul, Korea, 03175

<sup>3</sup>Daejeon Polytechnic School, Daejeon, Korea, 35306

**Keywords: Occupational, ELF/ILF, Work in Progress**

**Presented by: Ae-kyoung Lee**

In this paper, we were measured the waveform of welding current pulse in time domain, and then the amplitude and phase components of the welding current were established using Fast Fourier Transformation (FFT) analysis of the measured data. The assessment is performed using the induced current density was calculated from welding current for occupational exposure.

### **PA-191 [14:30]**

#### **Numerical dosimetry for the characterization of human exposure to the stray fields emitted by**

### **a wireless power transfer system prototype**

Rosanna Pinto<sup>1</sup>, Antonino Genovese<sup>2</sup>, Sergio Mancini<sup>1</sup>, Caterina Merla<sup>1</sup> & Vanni Lopresto<sup>1</sup>

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<sup>2</sup>*Production, Conversion and Use of Energy Division, ENEA, Rome, Italy, 00123*

**Keywords:** Occupational, IF, Work in Progress

**Presented by:** Rosanna Pinto

Wireless Power Transfer (WPT) technology is one of the most promising application for charging the batteries of electric vehicles. The exposure assessment of human body to the stray electromagnetic fields emitted by WPT devices is a critical issue which can limit the spreading of this technology in everyday life. In this paper, a dosimetric study has been carried out to evaluate the electric (E) field induced both in a homogeneous ellipsoid phantom and in an anatomical model exposed to a model of a WPT system prototype, which was experimentally characterized. Preliminary results showed that the 99<sup>th</sup> percentile value of the E-field, induced in the homogeneous phantom, is compliant with ICNIRP 2010 basic restrictions.

### **PA-193 [14:30]**

#### **Survey of health complaint and middle-term exposure assessments of magnetic fields among 1.5 T MRI system operators**

Sachiko Yamaguchi-Sekino<sup>1</sup>, Shinya Imai<sup>2</sup>, Humio Maeyatsu<sup>3</sup> & Takeo Hlkichi<sup>4</sup>

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**Keywords:** Occupational, Static, Completed (unpublished)

**Presented by:** Sachiko Yamaguchi-Sekino

The survey of health complaints and middle-term occupational exposure assessments of magnetic fields were carried out among 1.5 T MRI system operators. Exposure level (a summary of one-hour averaging of B in a day: mT/day) was significantly higher (approx. 36 times higher) in the MRI-operation days compared with no-operation days and were also elevated significantly in accordance with the increase of MRI system operation. Health complaints such as tiredness and headache were increased significantly in MRI-operation days while the relationship between the health complaints and the average number of MR operation in day was not observed. These results would provide useful information for epidemiology studies related to MRI system operators.

### **PA-195 [14:30]**

#### **Occupational exposure assessment to extremely low frequency magnetic fields in healthcare facilities**

Vanni Lopresto<sup>1</sup>, Rosanna Pinto<sup>1</sup>, Vittorio Cannata<sup>2</sup>, Chiara Orlandi<sup>2</sup>, Annapaola Santoro<sup>2</sup>, Salvatore Zaffina<sup>2</sup> & Vincenzo Camisa<sup>2</sup>

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**Keywords:** Occupational, ELF/ILF, Work in Progress

**Presented by:** Vanni Lopresto

Assessment of occupational exposure to extremely low frequency-magnetic fields (ELF-MFs) is a critical issue for interpreting the outcomes of epidemiological studies carried out in this field. The identification of homogeneous groups of workers, together with the complete characterization of the exposure scenario and discrimination between occupational and environmental exposure represent relevant items of this matter. In this work, the ELF-MF exposure assessment of different groups of workers, employed in a large pediatric

hospital in Rome, Italy, will be carried out by means individual radiometric measurements and environmental measurements in specific working scenarios.

## **PA-197 [14:30] STUDENT PAPER**

### **Additional Methodologies of Categorizing INTEROCC Subjects that were exposed to RF Telecommunication & Transmitter Antenna Sources**

Taichi Murata<sup>1, 2, 3</sup>, Javier Vila<sup>3, 4, 5</sup> & Elisabeth Cardis<sup>3, 4, 5</sup>

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**Keywords: Occupational, RF/Microwaves, Work in Progress**

**Presented by: Taichi Murata**

The main goal of this study was to categorize exposure scenarios for INTEROCC subjects in the military who worked with both telecommunication antennas and transmitters in order to eventually model their RF electric field exposures. Methodologies used to create telecommunication, transmitter, and Super Scenarios will be explained in detail. Outcomes of the creation of source-exposure scenarios will enable us to proceed to the next steps of convening an expert judgment panel to determine distances that the INTEROCC subject worked from the antenna sources and discovering levels of RF electric field by scenario that military personnel were exposed to when using both telecommunication antenna and transmitter sources.

## **PA-199 [14:30]**

### **Workers exposition near electromagnetic forming process: an experimental and simulation study**

Méline Bouldi<sup>1</sup>, Philippe Demaret<sup>1</sup> & Gerard Fleury<sup>1</sup>

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**Keywords: Occupational, ELF/ILF, Work in Progress**

**Presented by: BOULDI Méline**

Electromagnetic forming is an industrial process using pulsed magnetic field for shaping conductive material. With reference to the European Directive 2013/35/UE, evaluating the electromagnetic safety of workers seems overriding. Experiments and simulations were combined to determine the interaction between the source and working environment. An experimental map of the radiated field was obtained for an input signal with frequency components lower than 10 kHz. Electromagnetic simulations of the system were validated thanks to experimental measurements. The electric field in an equivalent body tissue cylinder was then calculated and compared to the limit values defined in the Directive. Locations at risk were finally determined.

## **PA-201 [14:30]**

### **Experimental study on the role of touch contact properties for the perception threshold of contact current**

Jolanta Karpowicz<sup>1</sup>, Krzysztof Gryz<sup>1</sup> & Patryk Zradziński<sup>1</sup>

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**Keywords: Occupational, IF, Completed (unpublished)**

**Presented by: Jolanta Karpowicz**

International guidelines (IEEE, ICNIRP, directive 2013/35/EU) have set out exposure limits for contact currents, as far as the indirect effects of exposure are considered. The aim was to analyse what parameters of contact through touching an object determine the contact currents perception threshold (CC-PT). In tests with a group of adult healthy males, no significant difference was found in touch CC-PT from the kind of skin contact with active electrodes (skin: dry or covered by electro conductive gel; contact: continuous or non-continuous when tapping the electrode) from the size of the active electrode (4-14 mm diameter) at low frequency. In the radiofrequency experiments, CC-PT was found to be proportional to the electrode size.

### **PA-203 [14:30]**

#### **Experimental assessment of vector characteristic of the influence of static magnetic fields on workers moving near the magnet of magnetic resonance scanners**

Jolanta Karpowicz<sup>1</sup>

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**Keywords: Occupational, Static, Completed (unpublished)**

**Presented by: Jolanta Karpowicz**

Recently, the assessment of workers' exposure static magnetic fields (SMF) was focused on the level and dynamic changes of exposure while moving near to magnets of magnetic resonance (MRI) scanners. However, there is now much discussion, triggered by the publication of ICNIRP guidelines on movement-related hazards caused by the influence of SMF, which suggests that such assessment may be not sufficient. The presented work focused on the use of vector characteristics (3D) of SMF influences on workers moving near MRI magnets in order to improve the understanding of the SMF influence on workers, and possible interaction mechanisms involved in the reported symptoms of exposure.

### **PA-205 [14:30]**

#### **An expert model for the practical transposition of European Directive 2013/35/EU on requirements for workers' exposure to electromagnetic fields into the occupational safety and health policy in Poland**

Jolanta Karpowicz<sup>1</sup>, Marek Zmyślony<sup>2</sup>, Jarosław Kieliszek<sup>3</sup>, Paweł Bienkowski<sup>5</sup>, Roman Kubacki<sup>6</sup>, Krzysztof Gryz<sup>1</sup>, Halina Aniołczyk<sup>2</sup>, Alicja Bortkiewicz<sup>2</sup>, Zygmunt Grabarczyk<sup>1</sup>, Piotr Politański<sup>2</sup>, Elżbieta Sobiczewska<sup>3</sup>, Jacek Starzyński<sup>4</sup>, Hubert Trzaska<sup>5</sup>, Ryszard Wiaderkiewicz<sup>7</sup>, Stanisław Wincenciak<sup>4</sup> & Patryk Zradziński<sup>1</sup>

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<sup>7</sup>Medical University of Silesia, Katowice, Poland, PL: 40-055

**Keywords: Public Health Policy, All Frequencies, Review, Commentary, Recommendation, Evaluation**

**Presented by: Jolanta Karpowicz**

The model for the practical transposition of European Directive 2013/35/EU into labour law in Poland, as drawn up by a group of experts on occupational electromagnetic hazards is discussed. The main principles for transposing the requirements of European Directive 2013/35/EU (D2013/35/EU) on workers' exposure to electromagnetic fields (EMF) have been entered to the system of occupational safety and health (OSH) policy that is currently binding in Poland. Experience from its practical function was incorporated into the

suggested new electromagnetic OSH policy.

### **PA-207 [14:30]**

**WITHDRAWN**

### **PA-209 [14:30]**

#### **Experiences from Finnish situation report bulletins on the research of extremely low-frequency electric and magnetic fields**

Leena Korpinen<sup>1</sup> & Mika Penttilä<sup>2</sup>

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<sup>2</sup>*Fingrid Oyj, Helsinki, Finland*

**Keywords: Public Health Policy, ELF/ELF, Completed (unpublished)**

**Presented by: Leena Korpinen**

The annual number of publications on health issues of electromagnetic fields is quite large, and staying up to date can be time consuming. The aim of the paper is to describe the experiences from Finnish situation report bulletins on the research of extremely low-frequency electric and magnetic fields. The first report was published six years ago in 2009. The situation report bulletin has received a good amount of positive feedback and it will continue to be published in 2016.

### **PA-211 [14:30]**

#### **Introduction to national policy for surrounding area of overhead transmission lines in Korea**

Byeongyoon Lee<sup>1</sup>, Sung Ho Myung<sup>1</sup>, Yeungyu Cho<sup>1</sup>, Taeho Lee<sup>2</sup> & Byungjun Han<sup>2</sup>

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**Keywords: Public Health Policy, ELF/ELF, Completed (published)**

**Presented by: Byeongyoon Lee**

The construction of power facilities such as transmission lines and substations has been one of the serious social problems in Korea as other countries. This is because of the over-concerns about possible adverse human health effects of power frequency magnetic fields generated by electric power facilities and decrease in asset value. Korean government decided to solve this problem by law in order to facilitate stable demand and supply of electric power and to contribute to the development of national economy and local community. In this paper, the national policy for surrounding area of overhead transmission lines in Korea is introduced.

### **PA-213 [14:30]**

#### **Influence of power-transmission-lines on car accidents**

Joel Niederhauser<sup>1</sup>, Roman Schmied<sup>2</sup>, Mathias Baudenbacher<sup>3</sup>, Christian Schindler<sup>4</sup> & Martin Roosli<sup>4</sup>

<sup>1</sup>*Bioelectromagnetics, InnoClever GmbH, Liestal, Switzerland, 4410*

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<sup>3</sup>*Accident Statistics, Federal Roads Office (FEDRO), Ittingen, Switzerland, 3063*

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**Keywords: Public Health Policy, ELF/ELF, Work in Progress**

**Presented by: Joel J Niederhauser**

In 1896 Jaques-Arsène d'Arsonval observed that plunging the head into an alternating magnetic field (110V, 30 A, 42 Hz) gave birth to syncope in some persons. We have previously reported about nationwide analysis of

unusual person damage accidents on Swiss motorways identified 9 unusual accident hot-spots. We found that exposure to power-line crossing on the 2.5 km road segment before approaching these hot-spot accident locations was higher compared to matched control settings. We analyzed magnetic field exposure before the two most prominent hot-spots and found that the locations coincide with published power grid bottlenecks and with the locations of the longest magnetic field exposure measured on motorways in each canton.

## **PA-215 [14:30] STUDENT PAPER**

### **Consumer awareness framework – A risk mitigation architecture of EMF**

Rojalin Pradhan<sup>1</sup>, Jack Rowley<sup>3</sup> & Dr. Mahim Sagar<sup>2</sup>

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<sup>2</sup>*Department of Management Studies, Indian Institute of Technology Delhi, New Delhi, India, 110016*

<sup>3</sup>*GSM Association, Hong Kong, Hong Kong*

**Keywords: Standards, RF/Microwaves, Completed (unpublished)**

**Presented by: Rojalin Pradhan**

Aware consumer, informed choice are the two premises for a fast absorption of telecom technology. This framework is developed on the above premise. This consumer awareness framework represents the basic need of the hour because there are risks associated with the use of any technology. This framework will have high social impact for all the stakeholders of the telecom industry (Regulator, Operator, Government, and Consumer). This framework identifies the key factors, their linkages and hierarchy in developing the framework of consumer awareness of Radio Signal.

## **PA-217 [14:30]**

### **Review on the scientific basics of the international technical specification IEC TS 60479 on limiting electrical hazards for human beings and livestock**

Dagmar Dechent<sup>1</sup>, Sarah Driessen<sup>1</sup>, Thomas Kraus<sup>1</sup> & Dominik Stunder<sup>1</sup>

<sup>1</sup>*Research Center for Bioelectromagnetic Interaction (femu), RWTH Aachen University, Aachen, Germany, 52074*

**Keywords: Standards, ELF/ILF, Review, Commentary, Recommendation, Evaluation**

**Presented by: Dagmar Dechent**

A review of the scientific literature serving as the basis for the technical specification IEC TS 60479 on the effects of electric current on human beings and livestock is provided. The identified literature in the references of all parts of the specification was published in the period between 1934 and 1993. Fundamental pathophysiological studies on ventricular fibrillation and body impedance were conducted mainly on corpses and animals. In future determinations of limit values for other frequency ranges, exposure durations, current shapes and applications, the limitations of the available in vivo data should be kept in mind and complemented by simulation studies and additional research.

## **PA-219 [14:30]**

### **A study on changes in perception of the general public through the risk communication activities on the EMF safety**

Dong Geun Choi<sup>1</sup>, Hae Gyeong<sup>1</sup>, Je Hwan Ryu<sup>1</sup> & Eun Mi Lee<sup>1</sup>

<sup>1</sup>*National Radio Research Agency of Ministry of Science, ICT and Future Planning, Naju, Korea*

**Keywords: Public Health Policy, RF/Microwaves, Work in Progress**

**Presented by: Dong Geun Choi**

In this paper, risk communication programs which are the EMF safety education and forum for the general

publics are performed by the RRA in Korea. The education program was conducted for the vulnerable children and the housewives, and the forum program was conducted for the EMF experts, stakeholders, and consumers. We provided the interesting curriculums such as making of a radio detector for children, and performed bilateral communication between the experts and stakeholders. These programs play a key role of understanding of EMF informations and RCs, and make a turning-point of specified EMF perception. As the results of survey conducted before and after programs, significant changes of EMF risk perception are shown.

## **PA-221 [14:30]**

### **Design of electric field measurement system with isotropic probe for ambient RF exposure assessment**

DukSoo Kwon<sup>1</sup>, Sang il Kwak<sup>1</sup>, Jonghwa Kwon<sup>1</sup> & Hyung-Do Choi<sup>1</sup>

<sup>1</sup>Radio Technology Research Department, ETRI, Daejeon, Korea, 34129

**Keywords:** *Dosimetry (computational), RF/Microwaves, Work in Progress*

**Presented by:** *DukSoo Kwon*

An electric field measurement system with an isotropic probe that has omni-directional radiation characteristics is proposed. To detect the electric field coming from radio frequency (RF) sources, the proposed measurement system covers 819 MHz to 2660 MHz. Design procedure is presented to verify the validity of the proposed system. The proposed measurement system can provide estimating hazard assessment of RF electromagnetic field (EMF) exposure.



**Session: PB**  
**Poster Session B**  
**Tuesday June 7, 2016 • 14:00 - 15:30**  
**Kloostergang & Novicengang**  
**Chairs: Heidi Danker-Hopfe & Francesca Apollonio**

**PB-2 [14:00]**

**Assessment of Electromagnetic field (EMF) emission levels by the 22.9kV distribution line in Korea**

Yun Jin Lee<sup>1</sup>, M.D Rajitha Kawshalya<sup>1</sup> & Seung-Cheol Hong<sup>1</sup>

<sup>1</sup>*Dept of Occupational Health & Safety Engineering, Inje University, 197 Inje-ro, Korea, 50834*

**Keywords: Behavioural, ELF/ILF, Work in Progress**

**Presented by: Seung-Cheol Hong**

To implement large-scale housing development projects in South Korea, an environmental impact assessment (EIA) should be conducted to ensure the environmental rights of residents. Measuring the EMF emission level is a part of EIA. EMF measurements are usually carried out near 154kV, 345kV, and 765kV high voltage transmission lines (HVTL) but 22.9kV distribution lines are not considered. This 22.9kV distribution line is going to build near residential areas. According to the Korea Environmental Institute guide, the EMF emission level must not exceed 2 ~ 4mG. In this work we report the EMF emission levels of 22.9kV distribution lines at various distances from the lines. In South Korea this is the first time such a study is being conducted.

**PB-4 [14:00]**

**Electromagnetic hypersensitivity study on Malaysian Children**

Hasliza A. Rahim<sup>2</sup>, Khadizah Husna<sup>3</sup>, Mohd Fareq Abd Malek<sup>1</sup>, M. A. Humayun<sup>2</sup> & Muhammad Solihin<sup>3</sup>

<sup>1</sup>*The University of Wollongong in Dubai (UOWD), Dubai, United Arab Emirates*

<sup>2</sup>*Bioelectromagnetic Research Group, University Malaysia Perlis, Arau, Malaysia, 2600*

<sup>3</sup>*Faculty of Engineering and Information Science, The University of Wollongong in Dubai (UOWD), Dubai, United Arab Emirates*

**Keywords: Behavioural, RF/Microwaves, Completed (unpublished)**

**Presented by: Hasliza A. Rahim**

EMF perception and the Well-being resulted from our experiments performed under SHAM, 850 MHz, 1800 MHz and 2600 MHz exposure conditions has been presented in this paper. The single blinded approach has been used during the experiments. From the outcome of this experiment it has been revealed there is no significant effect on the Malaysian children.

**PB-6 [14:00]**

**Primary immune system modulation through low field ELF, results in neutrophils, chicken and horses**

Jan Cuppen<sup>1, 2</sup>

<sup>1</sup>*Neiding BV, Veldhoven, the Netherlands, 5508HB*

<sup>2</sup>*Eindhoven University of Technology, Eindhoven, the Netherlands, 5600MB*

**Keywords: Clinical (therapy), ELF/ILF, Completed (published)**

**Presented by: Jan Cuppen**

Application of ELF immune stimulation in 50 farms indicated that health and productivity improvements were only obtained when either infection pressure was high or environmental conditions were adverse. A confirmation test was done with 22 wire frame cages for 22 chickens each in the midst of 22.000 commercial chickens. No statistically significant differences in growth, mortality, feed consumption were observed, nor

any positive trend. Laboratory experiments with human neutrophils demonstrated a significant increase in nettosis for the stimulus. Exploring the effects on animals with clear disease, pilot experiments with 20 horses with summer eczema (an allergic reaction to for which no cure exists) showed strong improvements in all horses.

## **PB-8 [14:00] STUDENT PAPER**

### **An ex vivo study on the shrinkage occurring in bovine liver during microwave thermal ablation: carbonized vs coagulated tissue**

Laura Farina<sup>1</sup>, Claudio Amabile<sup>2</sup>, Vanni Lopresto<sup>3</sup>, Rosanna Pinto<sup>3</sup>, Marta Cavagnaro<sup>1</sup>, Simone Cassarino<sup>2</sup>, Nevio Tosoratti<sup>2</sup> & S. Nahum Goldberg<sup>4, 5</sup>

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**Keywords: Clinical (therapy), RF/Microwaves, Completed (unpublished)**

**Presented by: Laura Farina**

Microwave Thermal Ablation is an interstitial technique using electromagnetic field at microwave frequencies, usually 915 MHz or 2.45 GHz, to treat tumors. The deployed energy induces a temperature increase (above 55-60°C) in the target tissue leading to an irreversible thermal damage. Characterization of the physical and structural changes occurring in tissues at high temperatures is essential to optimize the treatment's outcomes. A shrinkage of the tissue was observed and a preliminary study performed. This work aims at deepening the comprehension of this phenomenon, proposing two novel set ups for the characterization of the tissue contraction in correlation with the physical status of the ablated tissue, i.e. to its temperature.

## **PB-10 [14:00]**

### **Effects of low frequencies magnetic field and gadolinium in protein expression and DNA integrity of embryonic kidney cells (HEK-293T line)**

Luis Fernando Gomez<sup>1</sup>, Teodoro Cordova-Fraga<sup>2</sup> & Gloria Barbosa-Sabanero<sup>3</sup>

<sup>1</sup>Department of chemistry, electronics and biomedical engineering, Universidad de Guanajuato, Leon, Mexico, 37150

<sup>2</sup>Department of Physical Engineering, Universidad de Guanajuato, Leon, Mexico, 37150

<sup>3</sup>Department of Medical Sciences, Universidad de Guanajuato, Leon, Mexico, 37000

**Keywords: Clinical (therapy), ELF/IF, Completed (unpublished)**

**Presented by: Teodoro Cordova-Fraga**

The low frequency magnetic fields (LF-MF) and MRI contrast agents based on Gadolinium (Gd) had been applied to different cell types. However, the results of the stimulation with LF-MF on cellular systems are controversial. While some studies indicate that the LF-MF stimulates cell proliferation, others show the opposite. On the other hand, some studies consider Gd as a nephrotoxic agent while others consider it harmless. In this study it was analyzed qualitative and quantitative changes at proteins expression and DNA integrity in human renal cells in culture after stimulation with LF-MF with or without Gd.

## **PB-12 [14:00]**

### **Deep transcranial magnetic stimulation using the semi-Halo coil**

Mai Lu<sup>1</sup> & Shoogo Ueno<sup>2</sup>

<sup>1</sup>Key Lab. of Opt-Electronic Technology and Intelligent Control of Ministry of Education, Lanzhou Jiaotong University, Lanzhou,

China, 730070

<sup>2</sup>Department of Applied Quantum Physics, Graduate School of Engineering, Kyushu University, Fukuoka, Japan, 812-8581

**Keywords:** *Clinical (therapy), Pulsed, Work in Progress*

**Presented by:** *Shoogo Ueno*

Direct stimulation of deeper brain tissues by transcranial magnetic stimulation (dTMS) plays an important role in the study of reward and motivation mechanism. This study presents numerical simulation of dTMS by considering the semi-Halo coil (sHalo) working with a circular coil. Three-dimensional distributions of the induced magnetic field and electric field in realistic head model were obtained by impedance method, and the results were compared with the normal Halo-circular assembly coil (HCA coil). It was found the potential disadvantage of wide distribution of the electric field under the perimeter of the HCA coil can be alleviate by employing the sHalo coil.

#### **PB-14 [14:00]**

##### **Assessment of the human body effect in the transmission of a handheld wireless microphone**

Eugenia Cabot<sup>1</sup>, Ivica Stevanovic<sup>1</sup>, Heinrich Sidler<sup>1</sup>, Niels Kuster<sup>1</sup> & Myles Capstick<sup>1</sup>

<sup>1</sup>IT'IS Foundation, Zurich, Switzerland, 8004

**Keywords:** *Dosimetry (computational), RF/Microwaves, Completed (unpublished)*

**Presented by:** *Myles Capstick*

The goal of this study was to quantify the degradation in wireless microphone transmission performance at higher frequencies compared to performance in the currently allocated ultra high frequency band, with particular reference to how the radiation pattern from wireless microphones in the presence of a human body changes as the transmission frequency increases. To achieve this objective, a numerical study of a handheld wireless microphone with three human models was performed in the frequency range of 235 MHz to 6 GHz.

#### **PB-16 [14:00]**

##### **EMF safety and thermal aspects in a pacemaker equipped with a wireless power transfer system**

Tommaso Campi<sup>1</sup>, Silvano Cruciani<sup>1</sup>, Valerio De Santis<sup>1</sup> & Mauro Feliziani<sup>1</sup>

<sup>1</sup>Department of Industrial and Information Engineering and Economics, University of L'Aquila, Italy, Italy, 67100

**Keywords:** *Dosimetry (computational), IF, Completed (published)*

**Presented by:** *Valerio De Santis*

A Wireless Power Transfer system based on magnetic resonant coupling has been applied to a pacemaker for recharge its battery. Three different configurations of secondary coil have been investigated placing it inside the titanium case of the pacemaker, on the top surface of the case, or being part of the top surface case. For each examined configuration, the EMF safety and thermal aspects have been investigated by numerical and experimental techniques. The obtained results demonstrated the feasibility of the proposed solutions highlighting their advantages and disadvantages.

#### **PB-18 [14:00]**

##### **Exposure assessment of the pulsed magnetic field produced by welding guns in view of the recent literature evidence**

Aldo Canova<sup>1</sup>, Fabio Freschi<sup>1, 2</sup>, Luca Giaccone<sup>1</sup> & Maurizio Repetto<sup>1, 2</sup>

<sup>1</sup>Dipartimento Energia, Politecnico di Torino, Torino, Italy

<sup>2</sup>School of Information Technology and Electrical Engineering, The University of Queensland, Brisbane, QLD, Australia

**Keywords:** *Dosimetry (computational), Pulsed, Work in Progress*

**Presented by: Luca Giaccone**

This paper focuses on the compliance of resistance spot welding (RSW) guns with safety standards and the recent literature on human exposure to electromagnetic fields. Averaging techniques are taken into account and the compliance is checked with and without filtering the results by the so called 99th percentile approach proposed by the International Commission on Non Ionising Radiation Protection (INCIRP) registering a huge difference in the final results. Moreover, since the nature of the magnetic field is pulsed, the most suitable methodologies found in standards and the literature have been tested. It is observed a good agreement of all these approaches for the case study under analysis.

## **PB-20 [14:00]**

### **ELFSTAT Project: Assessment of infant exposure to extremely low frequency magnetic fields (ELF-MF, 40-800 Hz) and possible impact on health of new technologies**

Ilaria Liorni<sup>1</sup>, Serena Fiocchi<sup>1</sup>, Marta Parazzini<sup>1</sup>, Laurent Le Brusquet<sup>2</sup>, Martin Roosli<sup>3, 4</sup>, Benjamin Struchen<sup>3, 4</sup> & Paolo Ravazzani<sup>1</sup>

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<sup>3</sup>*Epidemiology and Public Health, Swiss Tropical and Public Health Institute, Basel, Switzerland*

<sup>4</sup>*University of Basel, Basel, Switzerland*

**Keywords: Human, ELF/IF, Work in Progress**

**Presented by: Marta Parazzini**

ELFSTAT Project started in November 2015 and is funded by the French ANSES (2015-2018, Grant agreement n. 2015/1/202). The main purpose of ELFSTAT is to characterize children's exposure to low frequency magnetic fields (MF, from 40 to 800 Hz) in real exposure scenarios using stochastic approaches. Both the global exposure at personal level and tissue dosimetry due to far- and near-field sources will be investigated. Finally, prediction of the impact of new technologies (e.g. smart grids, electric vehicles) on children's exposure will be carry out, enlarging the frequency range to the intermediate frequencies (IF).

## **PB-22 [14:00]**

### **Regional personalized electrodes to select transcranial electric stimulation target: a computational study of the electric field distribution**

Serena Fiocchi<sup>1</sup>, Ilaria Liorni<sup>1</sup>, Andrea Cancelli<sup>2</sup>, Carlo Cottone<sup>2</sup>, Paolo Ravazzani<sup>1</sup>, Franca Tecchio<sup>2</sup> & Marta Parazzini<sup>1</sup>

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**Keywords: Dosimetry (computational), ELF/IF, Completed (unpublished)**

**Presented by: Marta Parazzini**

Recently, a procedure to personalize the electrode to stimulate specific cortical regions by transcranial electric stimulations (tES) has been proposed. Results of these studies documented that the cortical excitability was differently modulated depending on where the personalized electrode was positioned, thus refining previous evidences that it is possible to focus the effects of tES by properly shaping and positioning the electrodes to target a region of interest of the cerebral cortex. This study aims to assess, through computational modelling techniques, the distribution of the electric field (E) induced by tES via the regional personalized (RePE) and the non-personalized (ReNPE) electrode.

## **PB-24 [14:00]**

### **Systematic numerical analysis of occupational partial body exposure by inhomogeneous magnetic fields confirms compliance assessment with respect to exposure limit values for sensory effects according to European directive 2013/35/EU**

Rene Hirtl<sup>1, 2</sup> & Gernot Schmid<sup>1</sup>

<sup>1</sup>*EMC & Optics, Seibersdorf Laboratories, Seibersdorf, Austria, 2444*

<sup>2</sup>*Institute of Electrodynamics, Technical University of Vienna, Vienna, Austria, 1040*

**Keywords:** *Dosimetry (computational), ELF/LF, Completed (unpublished)*

**Presented by:** *Rene Hirtl*

According to 2013/35/EU, exposure limit values (ELV) are met if external electric or magnetic fields are below corresponding low and high action levels (AL) for head, trunk and limb exposure. For validation numerical computations with magnetic field exposure on human body models are conducted. Applying magnetic fields according to low AL to the head and high AL to trunk and limbs at the same time, results in slightly increased ELV in central nerve system, dependent on field direction, slope and position of the transition from low to high magnetic fields. However, violation of corresponding exposure limit values could only be detected for certain situations at 16  $\frac{2}{3}$  Hz, as a result of the comparably high ratio between high AL and low AL.

## **PB-26 [14:00]**

### **Mobile phone exposure of a family inside elevator cabin: Comparison between an adult and a child user**

Ioanna Karatsi<sup>1</sup> & Stavros Koulouridis<sup>1, 2</sup>

<sup>1</sup>*School of Electrical and Computer Engineering, University of Patras, Patras, Greece, 26504*

<sup>2</sup>*Group of electrical engineering - Paris, UMR 8507 CNRS, Centravlesupelec, UPMC, UPSud, Paris, France, 91192*

**Keywords:** *Dosimetry (computational), RF/Microwaves, Work in Progress*

**Presented by:** *Stavros Koulouridis*

Detailed comparison dosimetry study for a four-member family inside an elevator between an adult and a child mobile phone user, is carried out. Numerically accurate models from the Virtual Population of a 7th month pregnant woman, an adult male (Duke), an 8 years old boy (Dizzy) and a 5 years old girl (Roberta) are utilized. Mobile phone is modelled in three talk positions, vertical, tilt and cheek. It is found that, almost all SAR values are higher for the three no phone users when the 5 years old child is on phone as compared to the adult phone user. Roberta herself has most of SAR values lowered when she is alone as compared to being with the other family members.

## **PB-28 [14:00]**

### **STUDENT PAPER**

### **Analysis of EMF health effect according to the shielding structure type for IW wireless power charging device**

Jong-Chan Kim<sup>1</sup>, Seungwoo Lee<sup>1</sup>, Domin Choi<sup>1</sup> & Nam Kim<sup>1</sup>

<sup>1</sup>*College of Electrical Computer Engineering, Chungbuk National University, Cheongju-si, Chungbuk, Korea, 28644*

**Keywords:** *Dosimetry (computational), ELF/LF, Work in Progress*

**Presented by:** *Jong-Chan Kim*

In this paper, we implemented EMF health effect of a low power wireless charging device, which is currently being commercialization, and it is based on the A10 coil model of Qi standard. In addition, by using magnetic material and conductive material, we propose a magnetic shielding structure to solve the leakage magnetic field problem which can radiate from the use of wireless charging device, and proceeded analysis of leakage magnetic field and specific absorption rate in accordance with the structure change. As the computer

simulation result, we verified that the proposed structure could reduce leakage magnetic field radiation and SAR value by using each proposed shielding structures.

### **PB-30 [14:00]**

#### **Estimation of dielectric values for skin and other tissues in the Terahertz range**

Alireza Lajevardipour<sup>1</sup>, Andrew Wood<sup>1</sup>, Steve Iskra<sup>1</sup> & Robert McIntosh<sup>1</sup>

<sup>1</sup>Bioelectromagnetics Laboratory, Swinburne University of Technology, Melbourne, Australia, Vic 3122

**Keywords:** *Dosimetry (computational), THz, Work in Progress*

**Presented by:** *Alireza Lajevardipour*

In order to accurately estimate the energy absorption pattern in skin and other tissues in the THz and Far IR regions, values of dielectric parameters  $\epsilon$  and  $\sigma$  are required. We present an approach, which is a combination of using literature values of related parameters and modelling of Debye and Lorentz absorption, of estimating these parameters, for use in electromagnetic solver applications.

### **PB-32 [14:00]**

#### **Impact of the vague partial body SAR definition in the MRI safety standard IEC 60601-2-33 on actual patient exposure**

Elena Lucano<sup>1, 2</sup>, Manuel Murbach<sup>3</sup>, Wolfgang Kainz<sup>1</sup> & Maria Iacono<sup>1</sup>

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<sup>3</sup>IT'IS Foundation, Zurich, Switzerland, 8004

**Keywords:** *Dosimetry (computational), RF/Microwaves, Work in Progress*

**Presented by:** *Elena Lucano*

MR safety standard IEC-60601-2-33 has published limits on the maximum allowed radio-frequency (RF) power to be absorbed by the patient. The standard reports that the RF power is controlled by either the whole body averaged SAR (WbSAR), the head averaged SAR (hSAR), or the partial body averaged SAR (PbSAR). However the standard leaves the PbSAR calculation open to different interpretations. Results showed variation of WbSAR up to 38% and 43%, at 64 and 128 MHz respectively, when considering different PbSAR limits. The study suggests a revision of the PbSAR limit as defined in IEC 60601-2-33 to exclude inconsistencies and incorrect estimations of the effective power being delivered to the patient.

### **PB-34 [14:00]**

#### **STUDENT PAPER**

#### **Numerical thermal dosimetry in human head based on TLM method**

Oualid Makhoul<sup>1</sup>, Marylene Cueille<sup>1</sup> & Jean-Lou Dubard<sup>1</sup>

<sup>1</sup>LEAT, UMR-CNRS 7248, University of Nice Sophia-Antipolis, Sophia antipolis, France, 06903

**Keywords:** *Dosimetry (computational), RF/Microwaves, Work in Progress*

**Presented by:** *Oualid Makhoul*

To control the temperature rise in biological tissues exposed to the electromagnetic waves, the thermal aspect must be taken into account by solving the bio-heat equation. In this paper, a new numerical scheme based on the TLM method, particularly suitable to highly heterogeneous environments, is applied for computing thermal distribution in a human head exposed to plane wave at 900 MHz. The model was proven to be unconditionally stable which allows using a larger time step than the one involved with FDTD or other TLM models. The numerical results are compared with those simulated with CST.

## **PB-36 [14:00]**

### **EM setups for real time optical imaging under electromagnetic exposures**

Caterina Merla<sup>1,2</sup>, Micaela Liberti<sup>3</sup>, Antoine Azan<sup>1</sup>, Paolo Marracino<sup>3</sup>, Francesca Apollonio<sup>3</sup> & Lluís M. Mir<sup>1</sup>

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**Keywords:** *Dosimetry (computational), Pulsed, Work in Progress*

**Presented by:** *Caterina Merla*

In the framework of the European project OPTIC BIOEM (UE MSCA-IF), an optical imaging technique based on CARS is going to be used as a way to experimentally explore basic bioelectromagnetic interactions at single cell level. A new experimental configuration has been developed combining a wide field CARS microscope with a wide-band electromagnetic micro-device capable of simultaneously exposing several cells to various electromagnetic waveforms. The numerical analyses conducted on three different micro devices possibly suitable to be integrated into the CARS microscope are presented. Simulated micro devices show a good matching up to few GHz allowing pulses of hundreds of ps to be delivered undistorted to the biological solution.

## **PB-38 [14:00]**

### **SAR calculations in anatomically realistic human models of various female body types exposed to RF far-fields from 10 Mhz to 8 GHz**

Tomoaki Nagaoka<sup>1</sup> & Soichi Watanabe<sup>1</sup>

<sup>1</sup>*Electromagnetic Compatibility Laboratory, National Institute of Information and Communications Technology, Koganei, Japan, 184-8795*

**Keywords:** *Dosimetry (computational), RF/Microwaves, Work in Progress*

**Presented by:** *Tomoaki Nagaoka*

We developed voxel-based anatomical models of different female body types (slim, mildly obese, and severely obese) by deforming a Japanese female model (HANAKO). By the finite-difference time-domain (FDTD) method, we calculated the whole-body-averaged specific absorption rates (WBA-SARs) in the developed models and HANAKO exposed to vertically and horizontally polarized EM waves ranging from 10 MHz to 8 GHz, and compared the WBA-SARs between the models.

## **PB-40 [14:00]**

### **Quasi-static simulation technique for the heterogeneous structure of voxel human body**

SangWook Park<sup>1</sup> & Minhyuk Kim<sup>2</sup>

<sup>1</sup>*EMI/EMC R&D Center, Korea Automotive Technology Institute, Cheonan, Korea, 330-912*

<sup>2</sup>*Electrical and Computer Engineering, Seoul National University, Seoul, Korea, 08826*

**Keywords:** *Dosimetry (computational), Static, Work in Progress*

**Presented by:** *SangWook Park*

We proposed new numerical approach to simulate the complex, heterogeneous structure of the voxel human body, which can consider both incident electric and magnetic fields significantly reducing the simulation time of a low-frequency analysis. The electromagnetic field in and around the dielectric sphere is calculated from the some antennas excitation to validate our method. The method has successfully shown the possibility of analyzing near-field problems under low frequencies.

## **PB-42 [14:00]**

### **Exposure due to phone calls of other users in train scenario**

David Plets<sup>1</sup>, Wout Joseph<sup>1</sup> & Luc Martens<sup>1</sup>

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**Keywords:** *Dosimetry (computational), RF/Microwaves, Completed (published)*

**Presented by:** *David Plets*

The contribution of radio-frequent radiation originating from other people's devices to the total own whole-body absorption is assessed in a simulation study. In a Global System for Mobile Communications (GSM) macrocell connection scenario, the uplink of 15 other users can cause up to 15% of the total absorption when calling yourself and up to 100% when not calling yourself, while in a Universal Mobile Telecommunications System (UMTS) femtocell connection scenario, the contribution of the uplink of other users is negligible. When calling yourself, median total whole-body Specific Absorption Rates are reduced by a factor of about 400,000 when deploying a UMTS femtocell base station instead of relying on the GSM macrocell.

## **PB-44 [14:00]**

### **Current distribution around lesions due to apical periodontitis by applying 500-kHz current across electrodes**

Hiroo Tarao<sup>1</sup>, Hiromichi Yumoto<sup>2</sup>, Toshihiko Tominaga<sup>3</sup>, Masatake Akutagawa<sup>2</sup>, Takahiro Emoto<sup>2</sup>, Toshitaka Ikehara<sup>4</sup> & Yohsuke Kinouchi<sup>2</sup>

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**Keywords:** *Dosimetry (computational), IF, Work in Progress*

**Presented by:** *Hiroo Tarao*

In the present paper, to find a way to apply currents effectively against the alveolar bone around lesions, we demonstrated calculations of current distribution in a simple tooth model to which two electrodes are attached.

## **PB-46 [14:00]**

### **STUDENT PAPER**

#### **Stochastic sensitivity in thermal dosimetry for the homogeneous human brain model\***

Anna Šušnjara<sup>1</sup>, Mario Cvetkovic<sup>1</sup>, Dragan Poljak<sup>1</sup>, Sebastien Lallechere<sup>2</sup> & Khalil El Khamlichi Drissi<sup>2</sup>

<sup>1</sup>*University of Split, Split, Croatia*

<sup>2</sup>*Blaise Pascal University, Clermont-Ferrand, France*

**Keywords:** *Dosimetry (computational), RF/Microwaves, Work in Progress*

**Presented by:** *Anna Šušnjara*

The sensitivity analysis of thermal parameters in the homogeneous human brain model is presented, investigating their influence on thermal rise, as a direct consequence of the high frequency exposure. The novelty presented is the combination of modern Stochastic Collocation method with the thermal part of the existing deterministic electromagnetic-thermal model. The sensitivity analysis excludes the less important parameters and can be used as a prior step of more complex experimental or computational models. In addition, obtained confidence margins give more precise estimate if temperature elevation reaches the prescribed limits or not. \*This work was undertaken within the framework of COST Action BM1309 (COST EMF-MED).



**PB-48 [14:00]**  
**STUDENT PAPER**

**Personal exposimeter for radio frequency exposure assessment in the 60-GHz band**

Reza Aminzadeh<sup>1</sup>, Arno Thielens<sup>1</sup>, Haolin Li<sup>1</sup>, Carole Leduc<sup>2</sup>, Maxim Zhadobov<sup>2</sup>, Guy Torfs<sup>1</sup>, Johan Bauwelinck<sup>1</sup>, Luc Martens<sup>1</sup> & Wout Joseph<sup>1</sup>

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**Keywords:** *Dosimetry (measurements), RF/Microwaves, Completed (unpublished)*

**Presented by:** *Reza Aminzadeh*

For the first time a personal Exposimeter (PE) is presented for radiation assessment in the 60-GHz band. Numerical simulations are used to design the PE and its uncertainty is assessed using on-body calibration measurements at 61 GHz. The PE consisting of three nodes (antennas) with vertical-horizontal-horizontal (VHH) polarization has a 50% prediction interval of 1.3 dB which is 3.1 dB lower than a single node experiment. The proposed PE has a 19.7 dB smaller uncertainty compared to the currently available exposimeters at lower frequencies. A 95 % confidence interval of 6.6 dB is measured on the response of the proposed PE.

**PB-50 [14:00]**

**Electromagnetic field meters checking for labor safety and environment protection purposes**

Pawel Bienkowski<sup>1</sup>, Antonio Sarolic<sup>2</sup> & Hubert Trzaska<sup>1</sup>

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<sup>2</sup>University of Split, Split, Croatia

**Keywords:** *Dosimetry (measurements), RF/Microwaves, Completed (published)*

**Presented by:** *Pawel Bienkowski*

The electromagnetic field (EMF) measurements for labor safety or environment protection purposes are done in conditions different from the laboratory ones. This may lead to many types of a meter failures and errors. In order to allow a meter checking during the measurements, several solutions of the meter testers are proposed. The newest of them allow a validation of almost any type of meter while any type of an EMF source is of concern.

**PB-52 [14:00]**

**Effects on seedlings of pre-sowing treated tomato seeds with static magnetic field**

Achilles Boursianis<sup>1</sup>, Athanasios Koukounaras<sup>2</sup>, Stefanos Kostas<sup>2</sup>, Argyris Theopoulos<sup>1</sup> & Theodoros Samaras<sup>1</sup>

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**Keywords:** *Dosimetry (measurements), Static, Work in Progress*

**Presented by:** *Achilles Boursianis*

Pre-sowing treatment of seeds with static magnetic field has been reported in the literature as a means of enhancing plant development. In the present work we have designed and constructed a setup for exposing vegetable seeds of tomato to static magnetic field (SMF). The results have shown that tomato seedlings significantly benefit from the pre-sowing treatment with magnetic flux density of 45 mT. The time of treatment that leads to improved growth is 90 min.

## **PB-54 [14:00]**

### **Occupational exposure to (ultra) high static magnetic field during research activities around 7 T and 3 T MRI scanners**

Mahsa Fatahi<sup>1</sup>, Jolanta Karpowicz<sup>2</sup>, Krzysztof Gryz<sup>2</sup> & Oliver Speck<sup>1</sup>

<sup>1</sup>Department of Biomedical Magnetic Resonance, Otto-von-Guericke University Magdeburg, Magdeburg, Germany

<sup>2</sup>Central Institute for Labour Protection - National Res. Inst. (CIOP-PIB), Warszawa, Poland

**Keywords: Dosimetry (measurements), Static, Work in Progress**

**Presented by: Mahsa Fatahi**

Assessment of static magnetic field exposure of high and ultra high MRI was carried out for MRI research staff (N=5) using the exposimetric recordings during different pre-defined motions around the 3 T and 7 T MRI scanners. Different motions were chosen in the way to represent typical, as well as the worst case exposure scenarios. According to the results, the recorded exposure to SMF and motion-induced time varying fields are highly variable between individuals, Exposures to SMF was approximately 2 times higher near 7 T MRI compared to 3 T. However dB/dt was much lower near 7 T scanner than 3 T

## **PB-56 [14:00]**

### **Human simulant liquid recipe at 150 MHz for SAR measurement**

Yoon-Myoung Gimm<sup>1</sup>, Jin-Jeong Kim<sup>2</sup>, Samyoung Chung<sup>3</sup>, Kihwea Kim<sup>3</sup> & Judong Jang<sup>3</sup>

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<sup>2</sup>EMF Safety Inc., Yongin-si, Korea, 16890

<sup>3</sup>Radio Environment Safety Division, Ministry of Science, ICT and Future Planning, Joellanam-do, Korea, 58217

**Keywords: Dosimetry (measurements), RF/Microwaves, Completed (unpublished)**

**Presented by: Yoon-Myoung Gimm**

Recipes of human simulant liquids for SAR measurement at 150 MHz were formulated for head and body. The measured dielectric constants (real part) and conductivities (imaginary part) are within  $\pm 10\%$  specified in IEC 62209 or IEEE Std 1528.

## **PB-58 [14:00]**

### **ELF magnetic field in electrical urban transportation vehicles**

Krzysztof Gryz<sup>1</sup>, Jolanta Karpowicz<sup>1</sup>, Wieslaw Leszko<sup>1</sup> & Patryk Zradziński<sup>1</sup>

<sup>1</sup>Laboratory of Electromagnetic Hazards, Central Institute for Labour Protection - National Research Institute, Warszawa, Poland, 00-701

**Keywords: Dosimetry (measurements), ELF/LF, Work in Progress**

**Presented by: Krzysztof Gryz**

The supplying systems of electrical vehicles of urban public transportation (metro, trams, trolleys, buses), which is composed from outside power lines and inside driving installations and engines, produce extremely low frequency (ELF) electromagnetic field (EMF) exposure. The root-mean-square (RMS) values of magnetic flux density B in the passenger sections and worker cabins were recorded by data-loggers (66 recordings of 10-40 minutes duration). The recorded values of B do not exceed 28  $\mu\text{T}$  (the highest near to DC/AC power inverters or AC supplying cables in the passenger section) and are compliant with exposure limits for workers (Directive 2013/35/EU) and general public (ICNIRP, 2010; Council Recommendation 519/1999).

## **PB-60 [14:00]**

### **A comparison of the RF-EMF according to whether installation of base stations within a Kindergarten**

Taewook Hwang<sup>1</sup>

<sup>1</sup>Radio Environment Business Department, Korea Communications Agency, Naju, Korea, 520833

**Keywords:** *Dosimetry (measurements), RF/Microwaves, Completed (unpublished)*

**Presented by:** *Taewook Hwang*

Most of measurement levels in kindergarten of South Korea are very lower than ICNIRP guidelines of human exposure for EMF. There is still a slightly difference in the measurement data of group, the base station was installed on the roof of a kindergarten building, and the other group, the difference value was approximately within maximum 0.01 V/m. The reason for this is many base stations were installed nearby kindergarten. So, although the base stations not installed in kindergarten, the RF-EMF level can be high. Therefore, we are not guaranteed that the RF-EMF of group, the base station was installed on the roof of a kindergarten building, is higher than that other group.

## **PB-62 [14:00]**

### **The applicability of the fast SAR test techniques for conformity test**

Kihwea Kim<sup>1</sup>, Judong Jang<sup>1</sup>, Jongil Lee<sup>1</sup>, Jaewoong Kim<sup>1</sup> & Samyoung Chung<sup>1</sup>

<sup>1</sup>National Radio Research Agency, Naju, Korea, 58217

**Keywords:** *Dosimetry (measurements), RF/Microwaves, Other*

**Presented by:** *Kihwea Kim*

This study is to investigate the feasibility and/or supplementary of the fast SAR test facilities for the conformity test to evaluate the specific absorption rate for mobile devices, which are assessed by normal robot test facilities. From the inter-lab comparison tests among test labs in Korea, the measurement results for the mobile devices under test are obtained. Thereafter, the error range of the test results obtained from the fast SAR assessment is investigated and analysed by comparing them with the test results of the SAM and flat phantom.

## **PB-64 [14:00]**

### **Transmitted power of mobile phones in 3G networks of Seoul, Korea**

Ae-kyoung Lee<sup>1</sup> & Jonghwa Kwon<sup>1</sup>

<sup>1</sup>Radio Technology Research Department, ETRI, Daejeon, Korea, 34129

**Keywords:** *Dosimetry (measurements), RF/Microwaves, Work in Progress*

**Presented by:** *Ae-kyoung Lee*

Power data transmitted from mobile phones operating in Wideband Code Division Multiple Access (WCDMA) were collected in Seoul. They are related with electromagnetic absorption in the human head in the uplink frequency range of the WCDMA technology. At present, two operators provide WCDMA services in Korea. The measurements were performed in voice call mode while driving along side streets. From the results, the power data were almost the same between different commercial phones connected to one network but a marked difference in Tx power level was shown for the different two operators.

## **PB-66 [14:00]**

### **Measurements of liquid complex permittivity using handheld instrumentation**

Caterina Merla<sup>1</sup>, Alessandra Paffi<sup>2</sup>, Simone Orcioni<sup>3</sup>, Rosanna Pinto<sup>1</sup>, Francesca Apollonio<sup>2</sup> & Micaela Liberti<sup>2</sup>

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<sup>3</sup>Dipartimento di Ingegneria dell'Informazione, Università Politecnica delle Marche, Ancona, Italy, 60121

**Keywords:** *Dosimetry (measurements), RF/Microwaves, Completed (unpublished)*

**Presented by: Micaela Liberti**

In this work a versatile and low-cost procedure for complex permittivity measurements of liquids was presented, based on handheld instrumentation and home-made software for data acquisition and post-processing. Results show that the proposed setup provides accurate measurements of complex permittivity with errors below 3% if compared to reference standards. Thanks to versatility, portability and low-cost, the proposed setup and procedure are suitable for on-site measurements in different application contexts, from quality food monitoring and control to medical applications.

## **PB-68 [14:00]**

### **Statistical analysis of nondetects considerations in personal exposition to RF-EMF measurements**

Alberto Nájera<sup>1</sup>, Jesus Gonzalez-Rubio<sup>1</sup> & Enrique Arribas<sup>2</sup>

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<sup>2</sup>Applied Physics Department, University of Castilla-La Mancha, Albacete, Spain, 02001

**Keywords: Dosimetry (measurements), RF/Microwaves, Completed (unpublished)**

**Presented by: Alberto Nájera**

Several studies have characterized personal exposition to RF-EMF using personal exposimeters. Data analysis involving nondetects is the main challenge. However, recent exposimeters have considerably reduced its detection limit to 0.005 V/m. For this reason, we suggest reconsidering statistical analysis of nondetects based on the comparison of four different approaches: regression on order statistics (ROS), without considering nondetects, dividing nondetect values by 2 and a naïve approach. Considering nondetects could bias mean values calculation. We suggest that nondetects should be neglected to show a more realistic physical situation of mean or median exposition values, that is, a description based on measurement when signal is detected.

## **PB-70 [14:00]**

### **Specific Absorption Rate of two commercial microcellular antennas**

Dominique Picard<sup>1</sup>

<sup>1</sup>EMG - GEEPS, CentraleSupélec, Gif sur Yvette, France, 91192

**Keywords: Dosimetry (measurements), RF/Microwaves, Completed (unpublished)**

**Presented by: Dominique Picard**

In underground parkings or subway for example, microcellular or indoor antennas allow the acces to mobile telephony networks. People or maintenance technician can be near these antennas and consequently can be exposed to their radiated electromagnetic field. The EN50383 standard describes the valuation method of the exposure due to the microcellular base station antennas: the exposure is evaluated by means of the SAR induced in a flat phantom. The measured SAR level depends upon the antenna. This study compares the SAR values obtained for two antennas, a directive antenna and a ceiling antenna, related to the frequency and the distance between the antenna and the phantom.

## **PB-72 [14:00]**

### **STUDENT PAPER**

### **Effects of nsPEF on viability and E6/E7 viral gene expression in HPV-16 integrated cervical carcinoma in vitro**

Hollie Ryan<sup>1, 3</sup>, Loree Heller<sup>2, 3</sup> & Stephen J. Beebe<sup>3</sup>

<sup>1</sup>Biomedical Engineering Institute, Old Dominion University, Norfolk, Virginia, USA, 23529

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<sup>3</sup>Frank Reidy Research Center for Bioelectrics, Old Dominion University, Norfolk, Virginia, USA, 23508

**Keywords:** Dosimetry (measurements), All Frequencies, Work in Progress

**Presented by:** Hollie Ryan

Nanosecond pulsed electric fields (nsPEFs) are non-thermal, ultra-short pulses with high voltage electric field intensity (kV/cm) and high power (MW). nsPEFs have been studied as potential infection and disease therapies, but not after viral integration. In this study, effects of nsPEFs on HPV-16 infected cervical cancer cell line CaSki were examined for viability and expression of viral oncogenes E6 and E7. Results showed exposure led to transient enhanced viability at fewer pulses and dose- and time-dependent decreases in viability, and caused no changes in viral gene expression, possibly implicating cell repair and cell death mechanisms of cellular metabolism in response to nsPEF exposure rather than direct effects on gene transcription.

## **PB-74 [14:00]**

### **Measurement of conductivities of skin tissues in intermediate frequency band**

Kanako Wake<sup>1</sup>, Kensuke Sasaki<sup>1</sup> & Soichi Watanabe<sup>1</sup>

<sup>1</sup>Electromagnetic Compatibility Laboratory, National Institute of Information and Communications Technology, Tokyo, Japan, 184-8795

**Keywords:** Dosimetry (measurements), IF, Work in Progress

**Presented by:** Kensuke Sasaki

Novel data of the conductivity for the tissues composing skin was evaluated in intermediate frequency (IF) band by in vitro experiment. Porcine skin was fractionated into dermis, subcutaneous tissue (SCT), and the conductivities of fractionated samples are measured with parallel plate method. Although the conductivity of the dermis and SCT were constant from 10 kHz to 1 MHz, that of the epidermis and bulk tissue increase with increasing the frequency. It was found that the conductivity of bulk skin is not determined by that of the dermis but by that of the epidermis in the IF region.

## **PB-76 [14:00]**

### **Measurement of dielectric properties of biological tissues at millimeter-wave frequencies; Comprehensive comparison of methodologies using a coaxial probe**

Kensuke Sasaki<sup>1</sup>, Atsuhiko Nishikata<sup>2</sup>, Soichi Watanabe<sup>1</sup> & Osamu Fujiwara<sup>1, 3</sup>

<sup>1</sup>Electromagnetic Compatibility Lab., National Institute of Information and Communications Technology, Koganei, Japan, 184-8795

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<sup>3</sup>Nagoya Institute of Technology, Nagoya, Japan, 466-8555

**Keywords:** Dosimetry (measurements), RF/Microwaves, Work in Progress

**Presented by:** Kensuke Sasaki

The use of a coaxial probe is effective for the measurement of the dielectric properties of biological tissues. Many researchers have proposed several methodologies using the probe. In this study, we present a comprehensive comparison of measurement methodologies using a coaxial probe for the measurement of dielectric properties at millimeter-wave frequencies.

## **PB-78 [14:00]**

### **Electric field measurement close to antennas at the upper frequency of the SHF band using an electro-optical probe**

Kei Satoh<sup>1</sup> & Teruo Onishi<sup>1</sup>

<sup>1</sup>Research Laboratories, NTT DOCOMO, INC., Yokosuka, Japan, 239-8536

**Keywords:** *Dosimetry (measurements), RF/Microwaves, Work in Progress*

**Presented by:** *Kei Satoh*

5G (Fifth Generation) is a new-generation cellular system targeting commercial deployment in 2020. Since 5G requires more frequency bands to achieve ultra-high-speed communications, technical verification has been conducted above 6 GHz. However, there is no clear method for evaluating the electromagnetic exposure above 6 GHz. We present the first study comparing electro-optic (EO) and waveguide (WG) probes for use in an electric field distribution measurement method in the vicinity of super high frequency (SHF) band antennas. The results based on EO probe measurements are closer to calculated results than those using the WG probe, which indicates that the EO probe is more effective in measuring the electric field strength of SHF antennas.

## **PB-80 [14:00]**

### **Experimental estimation of SAR enhancement due to two parallel implanted metal plates under near-field exposure conditions**

Naoki Tanaka<sup>1</sup>, Takashi Hikage<sup>1</sup>, Toshio Nojima<sup>1</sup>, Tomoaki Nagaoka<sup>2</sup> & Soichi Watanabe<sup>2</sup>

<sup>1</sup>*Graduate school of Information Science and Technology, Hokkaido University, Sapporo, Japan*

<sup>2</sup>*National Institute of Information and Communications Technology, Tokyo, Japan*

**Keywords:** *Dosimetry (measurements), RF/Microwaves, Work in Progress*

**Presented by:** *Naoki Tanaka*

This paper introduced experimental evaluations for local SAR enhancement for a human head with two metal implants aligned in parallel. To investigate the impact of the two metal implants, temperature distribution measurements using solid phantoms were conducted. In the measured distributions, temperature rise due to the metallic plates was clearly observed in the gap of two metal plates region.

## **PB-82 [14:00]**

### **A novel flexible measurement system from DC up to 10 MHz for an accurate and fast magnetic field assessment**

Richard Überbacher<sup>1</sup>, Otmar Putz<sup>1</sup> & Gernot Schmid<sup>1</sup>

<sup>1</sup>*EMC & Optics, Seibersdorf Laboratories, A-2444 Seibersdorf, Austria*

**Keywords:** *Dosimetry (measurements), Static, Work in Progress*

**Presented by:** *Richard Überbacher*

In this work we present a novel flexible measurement system for the assessment of localized magnetic field exposure (i.e. welding processes) that covers fully the frequency range from DC up to 10 MHz. The system was evaluated in a large measurement campaign on different welding workplaces.

## **PB-84 [14:00]**

### **STUDENT PAPER**

### **Diversity of monopolar and bipolar nanosecond pulsed electric signals action on the metallo-enzyme superoxide dismutase (SOD): a modelling approach**

Elena della Valle<sup>1</sup>, Paolo Marracino<sup>1</sup>, Olga Pakhomova<sup>2</sup>, Micaela Liberti<sup>1</sup> & Francesca Apollonio<sup>1</sup>

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**Keywords:** *Electroporation, Pulsed, Completed (unpublished)*

**Presented by:** *Elena della Valle*

Recent papers showed that when dealing with nanosecond pulsed electric fields (nsPEFs), bipolar pulses

proved far less effective at membrane permeabilization and at cell killing than monopolar ones, contrary to what happens in the microsecond range. The mechanism at the basis of such selective response of cells is not fully elucidated; one hypothesis worthwhile to test is a direct action of nsPEFs on intracellular enzyme reactions. The goal of this study is to investigate possible enzyme response due to the application of nsPEF monopolar and bipolar of intensity of  $10^8$  V/m and duration of 100 ns on the superoxide dismutase (SOD,Cu-Zn) enzyme, by means of a molecular dynamic (MD) modelling approach.

### **PB-86 [14:00]**

#### **Microdosimetry for pulsed E fields in a realistic models of cells and endoplasmic reticulum**

Agnese Denzi<sup>1</sup>, Hanna Hanna<sup>2</sup>, Franck Andre<sup>2</sup>, Lluís M. Mir<sup>2</sup>, Francesca Apollonio<sup>1</sup> & Micaela Liberti<sup>1</sup>

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**Keywords: Electroporation, Pulsed, Completed (unpublished)**

**Presented by: Agnese Denzi**

The electroporation phenomenon, which consists in an increase in the membrane permeability to molecules and drugs, has become a promising technique for different clinical applications (e.g. cancer treatment). Microsecond pulsed electric fields ( $\mu$ sPEFs) with amplitude in the range of tens of kV/m are used to permeabilize the cell plasma membrane whereas nanosecond pulsed electric fields with amplitude of MV/m also cell internal structures, such as the endoplasmic reticulum. In this work, a numerical realistic model of cell and its reticulum has been realized to demonstrate the use of  $\mu$ sPEFs also for the permeabilization of this internal structure, comparing this result with experimental ones and obtaining a good agreement between them.

### **PB-88 [14:00]**

#### **Why extend the traditional electroporation (EP) model?**

James Weaver<sup>1</sup>, Reuben Son<sup>1</sup>, Kyle Smith<sup>1</sup> & Thiruvallur Gowrishankar<sup>1</sup>

<sup>1</sup>*Harvard-MIT Division of Health Sciences and Technology, Massachusetts Institute of Technology, Cambridge, Massachusetts, USA, 02139*

**Keywords: Electroporation, Pulsed, Work in Progress**

**Presented by: James Weaver**

The Sözer, Pocetti and Vernier BioEM2016 Abstract<sup>1</sup> describes provocative experimental results that stimulated this BioEM2016 Abstract, viz. “[Our] results reveal limitations in current models of electroporation, which do not include rapid, active, cellular responses to electric-pulse-induced damage.” We propose a cell electroporation (EP) model with transient pores (TPs) dominant during a pulse, and a few long-lived pores (LLPs) that dominate after a pulse.<sup>2</sup> The number of LLPs may depend on pulse duration, fewer for shorter pulses. A few LLPs may therefore restore most of the cell membrane resting potential in a few seconds, allowing electrodiffusion of small molecules through LLPs (a rapid, active cell response).

### **PB-90 [14:00]**

#### **Systematic review of the exposure assessment and epidemiology of high-frequency voltage transients**

Frank De Vocht<sup>1</sup> & Robert G Olsen<sup>2</sup>

<sup>1</sup>*Social and Community Medicine, University of Bristol, Bristol, United Kingdom, BS8 2PS*

<sup>2</sup>*School of Electrical Engineering and Computer Science, Washington State University, Pullman, WA, USA*

**Keywords: Epidemiology, RF/Microwaves, Review, Commentary, Recommendation, Evaluation**  
**Presented by: Frank De Vocht**

This work describes the results of a systematic review of the peer-reviewed and grey literature concerning the exposure assessment and epidemiology of high-frequency voltage transients, or dirty electricity (DE).

### **PB-92 [14:00]**

#### **Self-reported mobile phone use patterns and semen quality parameters among men from a fertility clinic**

Ryan Lewis<sup>1</sup>, John Meeker<sup>2</sup>, Lidia Mínguez-Alarcón<sup>3</sup>, Gabor Mezei<sup>4</sup> & Russ Hauser<sup>3, 5, 6</sup>

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<sup>6</sup>Vincent Memorial Obstetrics and Gynecology Service, Massachusetts General Hospital, Boston, Massachusetts, USA, 02114

**Keywords: Epidemiology, RF/Microwaves, Completed (unpublished)**

**Presented by: Gabor Mezei**

We explored the potential relationship between mobile phone use patterns and sperm concentration, motility, and morphology among 153 men (contributing 350 semen samples) from a fertility clinic in Boston, MA. Mixed-effects models with random subject effects were used to account for correlated data within participants. Overall, we found no evidence for a relationship between mobile phone use patterns and markers of testicular function.

### **PB-94 [14:00]**

#### **Magnetic fields (MF) exposure during pregnancy and the risk of miscarriage: a cohort study of pregnant women**

De-Kun Li<sup>1</sup>, Hong Chen<sup>1</sup>, Jeannette Ferber<sup>1</sup> & Roxana Odouli<sup>1</sup>

<sup>1</sup>Division of Research, Kaiser Permanente, Oakland, California, USA, 94612

**Keywords: Epidemiology, ELF/ELF, Completed (unpublished)**

**Presented by: De-Kun Li**

We conducted epidemiological study in a cohort of 1,054 pregnant women to examine their personal magnetic field (MF) level in relation to the risk of miscarriage. All participants were asked to wear an EMDEX Lite meter for 24 hours to measure MF. We observed that high MF exposure level during pregnancy is associated with increased risk of miscarriage. This finding further supports previously reported associations. Accurate measurement of MF exposure is likely vital for studies examining EMF health effects.

### **PB-96 [14:00]**

#### **Personal exposure of adults to ELF magnetic fields in France: preliminary results of the EXPERS study**

Isabelle Magne<sup>1</sup>, Martine Souques<sup>2</sup>, Isabelle Bureau<sup>3</sup>, Anne Duburcq<sup>3</sup>, Emmanuel Remy<sup>4</sup> & Jacques Lambrozo<sup>2</sup>

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**Keywords: Epidemiology, ELFILF, Work in Progress**  
**Presented by: Isabelle Magne**

The assessment of the exposure to ELF magnetic fields remains an important question in the context of epidemiological studies. We present here the results of the first study characterizing personal exposure of adults at a national scale. Descriptive statistical analyses were used to identify variables correlated with the exposure.

#### **PB-98 [14:00]**

##### **Evaluation of electromagnetic radiation impact for personnel working in magnetic resonance tomography environment**

Arvydas Martinkenas<sup>1</sup>, Edita Jauniute<sup>1</sup>, Lina Mazrimaite<sup>1</sup> & Julius Berneckis<sup>1</sup>

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**Keywords: Epidemiology, ELFILF, Work in Progress**

**Presented by: Arvydas Martinkenas**

Radiology personnel are working full-time with increased density of high magnetic fields. Using 'Spectran NF-5035' meter collected data it was observed that variable magnetic field in work environment is constant and its average vary up to 48 kHz; magnetic field intensity is up to 850 pT. Despite that, when MRI is the mode of operation, it was captured that intensification of variable magnetic field exceeds and the average peak values grow up to 1000 pT. Due to the SF-36 questionnaire analysis, we found that MRT working environment has affection on personnel due to increased pain in the body, decreased viability and partly affection of debilitating mental work, however physical functioning and general physical condition is quite optimal.

#### **PB-100 [14:00]**

##### **Establishment of a cohort of RTE retirees professionally exposed to 50 Hz Magnetic field**

Martine Souques<sup>1</sup>, Anne Duburcq<sup>2</sup>, Carole Babin<sup>3</sup> & Jacques Lambrozo<sup>1</sup>

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**Keywords: Epidemiology, ELFILF, Work in Progress**

**Presented by: Martine Souques**

A number of possible adverse effects related to ELF magnetic field exposure of adults have been studied in many areas of human health. A historical cohort of 50 Hz magnetic field exposed workers is to be constituted. The health status of the subjects will be monitored and followed up using three indicators: long-term illness statements, age at death, and cause of death after retirement. The exposure will be assessed on the basis of the job title and will take into account the duration in the exposed jobs. The analysis will look especially at neurodegenerative diseases, cardiovascular diseases and cancers. To date, 1658 subjects could be included, including 1342 with a full career history. The inclusions of subjects are still ongoing.

#### **PB-102 [14:00]**

##### **Hints of media: An experimental study of effect of media warnings about health hazards of MP use on self-report symptoms**

Lei Zhang<sup>1</sup>, Feizhou Zheng<sup>1</sup>, Peng Gao<sup>1</sup>, Zhou Zhou<sup>1</sup> & Zheng-Ping Yu<sup>1</sup>

<sup>1</sup>Department of Occupational Health, Third Military Medical University, Chongqing, China, 400038

**Keywords: Epidemiology, RF/Microwaves, Completed (unpublished)**

**Presented by: Lei Zhang**

The present study is to investigate the effects of media warnings about the health hazards of MP use on self-reported symptoms. After completing baseline questionnaires, the 703 undergraduate students participants were randomly assigned to a video treatment group (watching a video about the health hazards of MP use) or a control group. Then, they completed another set of questionnaires containing self-reported physical symptoms and BDI. Participants in the video group reported significantly more frequent headache, fatigue, memory loss, inattention and higher level of depression. Additionally, the prevalence of memory loss and inattention were significantly higher in participants with higher level of depression who watched the video.

#### **PB-104 [14:00]**

##### **Effects of 1950 MHz W-CDMA-like signal on human spermatozoa**

Setsu Nakatani-Enomoto<sup>1</sup>, Miho Okutsu<sup>2</sup>, Satoshi Suzuki<sup>2</sup>, Ryota Suganuma<sup>2</sup>, Stefan Groiss<sup>3</sup>, Suguru Kadowaki<sup>1</sup>, Hiroyuki Enomoto<sup>1</sup>, Keiya Fujimori<sup>2</sup> & Yoshikazu Ugawa<sup>1</sup>

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**Keywords: Human, Static, Completed (unpublished)**

**Presented by: Setsu Nakatani-Enomoto**

We analyzed the effects of exposure to 1950 MHz Wideband Code Division Multiple Access (W-CDMA)-like EMW for 1 hour on human spermatozoa with specific absorption rates of either 2.0 or 6.0 W/kg. Healthy subjects aged 20 to 44 years old participated in this study. The computer-assisted sperm analyzer system was used to evaluate total sperm count, sperm motility parameters, and sperm kinetic variables. We also measured the percentage of 8-hydroxy-2'-deoxyguanosine (8-OHdG) positive spermatozoa with flow cytometry to evaluate damage to DNA. No significant differences were observed between the EMW exposure and the sham exposure conditions in any studied parameters.

#### **PB-106 [14:00]**

##### **EMF application to agro-food processing. EMF for a green economy**

Bruno Bisceglia<sup>1</sup> & Simona Valbonesi<sup>2</sup>

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<sup>2</sup>Consorzio Elettra 2000, Roma, Italy, 80100

**Keywords: Human, RF/Microwaves, Work in Progress**

**Presented by: Bruno Bisceglia**

The proposed work focuses on a scientific analysis on the possible use of electromagnetic fields in a green chemistry and green economy scenario. At present two challenges are open: the use of electromagnetic fields for soil disinfection and disinfestation and to improve agricultural productivity. The use of microwave electromagnetic fields in the near future could be a viable alternative to the use of chemicals for soil disinfestation.

#### **PB-108 [14:00]**

##### **Testing the replicability of the effect of 14 Hz pulse modulated RF-EMF on EEG power in healthy adults: A pilot study**

Anna Dalecki<sup>1, 2</sup>, Sarah Loughran<sup>1, 2, 3</sup> & Rodney Croft<sup>1, 2, 3</sup>

<sup>1</sup>Population Health Research on Electromagnetic Energy, Monash University, Melbourne, Australia

<sup>2</sup>Centre for Health Initiatives, Illawarra Health & Medical Research Institute, University of Wollongong, Wollongong, Australia

<sup>3</sup>Australian Centre for Electromagnetic Bioeffects Research, Wollongong, Australia

**Keywords:** Human, RF/Microwaves, Work in Progress

**Presented by:** Anna Dalecki

It has been reported that the effects of radio-frequency electromagnetic fields (RF-EMF) on waking EEG are modulation-dependant. Specifically, Hinrikus et al., (2008) reported that in an intermittent (1-minute RF ON, 1-minute RF OFF) exposure protocol, increases in alpha and beta power occurred in the first 30 seconds, but not second 30 seconds of the 1-minute RF-EMF exposures (with no such change observed in corresponding 30-second segments of a 1-minute unexposed baseline or sham exposure condition). This abstract presents pilot data collected as part of a larger study aiming to independently replicate the results reported by Hinrikus et al., (2008) employing a design with several methodological improvements.

## **PB-110 [14:00]**

### **STUDENT PAPER**

#### **Effects of radiofrequency electromagnetic fields emitted by Terrestrial Trunked Radio (TETRA) handheld devices on event related potentials**

Torsten Eggert<sup>1</sup>, Hans Dorn<sup>1</sup>, Cornelia Sauter<sup>1</sup>, Gernot Schmid<sup>2</sup>, Thomas Bolz<sup>3, 4</sup>, Alexander Marasanov<sup>1</sup>, Marie-Luise Hansen<sup>1</sup>, Anita Peter<sup>1</sup> & Heidi Danker-Hopfe<sup>1</sup>

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**Keywords:** Human, RF/Microwaves, Completed (unpublished)

**Presented by:** Torsten Eggert

In a comprehensive study acute effects of Terrestrial Trunked Radio (TETRA) exposure on the central nervous system were investigated. In this placebo-controlled randomized double-blind cross-over study TETRA signals simulating exposure from a handheld device were applied during sleep, the resting state and while under cognitive demand. Aim of this contribution is to present the results of electrophysiological activities and behavioral measurements obtained during a choice reaction time task and an auditory 3-stimulus oddball paradigm. To sum up, none of the investigated auditory event related potentials differed significantly with exposure. Thus, the present analysis reveals no evidence for any health-related effects of RF-EMF exposure.

## **PB-112 [14:00]**

#### **Effects of radiofrequency electromagnetic fields on brain function in waking and sleep: are they age and/or gender specific?**

Blanka Pophof<sup>1</sup> & Heidi Danker-Hopfe<sup>2</sup>

<sup>1</sup>Federal Office for Radiation Protection, Oberschleissheim, Germany, 85764

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**Keywords:** Human, RF/Microwaves, Work in Progress

**Presented by:** Blanka Pophof

Since 2003, The German Federal Office for Radiation Protection funded several projects on effects of radiofrequency electromagnetic fields on brain function. The most consistent findings (mainly from young healthy volunteers) were subtle effects on the sleep EEG, which, however, usually are not reflected at the level of sleep stages. Effects seen in the resting state EEG do not have measurable implications at the behavioral level. The effects observed so far do not pose a health risk. To evaluate the influence of gender and age, further projects investigating aged females and males are ongoing.

## **PB-114 [14:00]**

### **Exposure triggered health questionnaires by linking real-time RF-EMF measurements to a smartphone application**

Luuk van Wel<sup>1</sup>, Anke Huss<sup>1</sup>, Philipp Bachmann<sup>2</sup>, Marco Zahner<sup>2, 3</sup>, Hans Kromhout<sup>1</sup>, Jürg Fröhlich<sup>2</sup> & Roel Vermeulen<sup>1</sup>

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<sup>3</sup>*Institute of Electromagnetic Fields, ETH Zurich, Zurich, Switzerland*

**Keywords: Human, RF/Microwaves, Completed (unpublished)**

**Presented by: Anke Huss**

We developed a smartphone app prompting health status related questions, when triggered by pre-set exposure events detected in real-time by an exposimeter. A feasibility study was performed. Participants were asked to install the application on their smartphone and to carry a RF exposimeter for 48 hours. We obtained complete data of 33 out of 46 participants. Main trigger reason was tenfold relative increase in field strength, (61%) followed by control conditions (28%). Asking real-time exposure triggered questions using a smartphone app is feasible and has the potential to be applied to other types of exposure. Response rates were about 75% having limited influence on daily activities of participants.

## **PB-116 [14:00]**

### **STUDENT PAPER**

#### **Characterization of cell electropermeabilization by confocal Raman spectroscopy**

Antoine Azan<sup>1</sup>, Valérie Untereiner<sup>2, 3</sup>, Caterina Merla<sup>1</sup>, Cyril Gobinet<sup>3</sup>, Olivier Piot<sup>3</sup> & Lluis M. Mir<sup>1</sup>

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**Keywords: In vitro, Pulsed, Work in Progress**

**Presented by: Antoine Azan**

In this study, we report the first experimental characterization of cell electropermeabilization by confocal Raman spectroscopy. This non-invasive and label-free optical technique provides access to the molecular composition of the samples. Raman signatures of control and pulsed living human adipose-derived mesenchymal stem cells were acquired at several regions of interest and spectral bands. Depending on the region of interest investigated, critical Raman peaks specific to cell electropermeabilization were identified. It provides new information at a molecular level on this bio-electromagnetic interaction.

## **PB-118 [14:00]**

### **Characterization of 50-Hz magnetic field exposure response of mice Neuronal Primary Cultures**

Claudia Consales<sup>1</sup>, Rosanna Pinto<sup>1</sup>, Vanni Lopresto<sup>1</sup>, Caterina Merla<sup>1, 4</sup>, Giuseppe Filomeni<sup>2, 3</sup>, Carmela Marino<sup>1</sup> & Barbara Benassi<sup>1</sup>

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**Keywords: In vitro, ELFILF, Work in Progress**

**Presented by: Claudia Consales**

In a previous paper from our laboratory [1] we demonstrated that 50-Hz magnetic field (MF), exposure sensitizes neuroblastoma dopaminergic cell lines SH-SY5Y to the action of the neurotoxin 1-methyl-4-phenylpyridinium (MPP+), a drug which induces a Parkinson phenotype when injected in vivo. To examine possible effects of the same experimental conditions on brain cells, we are exploring mice cortex primary cultures (E15,5 wild type) response to 50-Hz MF exposure, considering, also in this case, its combination with MPP+ administration. In order to dissect the possible pathways involved in this response, we are also investigating the effect of 50-Hz MF on neuronal primary cultures from PARP-1 knockout embryos.

**PB-120 [14:00]  
STUDENT PAPER**

**Pulsed Electromagnetic Fields increase proliferative response of chondrocytes and induce changes in growth alignment by optimizing field parameters**

Irene Garcia<sup>1</sup>, Nazario Felix-Gonzalez<sup>1</sup> & Ceferino Maestu<sup>1</sup>

<sup>1</sup>*Bioelectromagnetics, Biomedical Technology Centre, Pozuelo de Alarcón, Spain, 28223*

**Keywords:** *In vitro, Pulsed, Completed (unpublished)*

**Presented by:** Irene Garcia

Arthritis involves hundreds of musculoskeletal disorders, such as Rheumatoid Arthritis (RA) and Osteoarthritis (OA). Pulsed electromagnetic fields (PEMFs) are a recent modality which offers beneficial effects in tissue regeneration, inflammation decrease or in pain relief. This study seeks to identify the optimal parameters which do not impair cell viability and enhance cell proliferation, in order to set up an alternative therapy to certain musculoskeletal disorders.

**PB-122 [14:00]  
STUDENT PAPER**

**An *in vitro* cost-effective test bench for cardiac implants, reproducing human exposure to electric fields 50/60 Hz**

Cihan Gercek<sup>1</sup>, Djilali Kourtiche<sup>1</sup>, Pierre Schmitt<sup>1</sup>, Isabelle Magne<sup>2</sup>, Martine Souques<sup>3</sup>, Patrice Roth<sup>1</sup> & Mustapha Nadi<sup>1</sup>

<sup>1</sup>*Nanomaterials, Electronics and Living Systems Department, Institut Jean Lamour (UMR 7198), CNRS, Nancy, France, 54000*

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**Keywords:** *In vitro, ELFILF, Completed (unpublished)*

**Presented by:** Cihan Gercek

Regulations regarding EMF related occupational risks are based on the European Directive 2013/35/EU. It sets the minimum requirements for the protection of workers exposed to these fields, and defines workers bearing implants as workers at particular risk. For these workers two standards proposed methods to assess the risk (EN 50527-1 and EN 50527-2). These methods include numerical or experimental *in-vitro* approaches. This study designs an *in vitro* cost-effective test bench for active cardiac implants, reproducing the human exposure to electric fields of 50/60Hz, by combining two approaches (numerical and *in vitro*).

**PB-124 [14:00]  
STUDENT PAPER**

**The behaviour of the neuroblastoma cell line during *in vitro* wound healing with the application of PEMF and PRFE**

Mehmet Gumusay<sup>1</sup>, Adnan Kaya<sup>1</sup>, Suna Saygili<sup>2</sup>, Isil Aydemir<sup>2</sup> & Ibrahim Tuglu<sup>2</sup>

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**Keywords:** *In vitro*, *Static*, *Completed (unpublished)*

**Presented by:** Mehmet Gumusay

The effects of extremely low frequency pulsed electromagnetic field (PEMF) and pulsed radiofrequency energy (PRFE) on wound healing *in vitro* were examined. Mouse neuroblastoma cell line, NA2B were investigated by its neurite extension behaviour under the application of electromagnetic fields. Wound model was performed with needle of ppd syringe in shape of (+). Cultured cells were exposed to the PEMF (75 Hz frequency, square waveform and magnetic field of 1 mT for up to 5 h) and PRFE (27.12 MHz carrier frequency square waveform) systems for 5. The wound healing was investigated by closure of the wound by the cell proliferation with neurite inhibition using inverted microscope image.

## **PB-126 [14:00]**

### **Effects of 385 nm ultra violet A light irradiation on cultured RAW264.7 cells**

Toshitaka Ikehara<sup>1</sup>, Mutsumi Nakahashi<sup>2</sup>, Takahiro Emoto<sup>4</sup>, Masatake Akutagawa<sup>4</sup>, Koichiro Tsuchiya<sup>3</sup>, Akira Takahashi<sup>2</sup> & Yohsuke Kinouchi<sup>4</sup>

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**Keywords:** *In vitro*, *All Frequencies*, *Work in Progress*

**Presented by:** Toshitaka Ikehara

We tested effects of 385 nm light irradiation on RAW 264.7 cells. The Irradiation didn't affect the cell viability, but ROS (reactive oxygen species) in cells and medium were increased after the irradiation. This ROS was mainly singlet oxygen was indicated by a fluorescent probe and an electron paramagnetic resonance (EPR) spectrometer. The cellular ROS was rapidly increased in low glutathione(GSH) cells earlier than control. EPR spectrum obtained after irradiation to a solution containing DMPO (5,5'-dimethyl-1-pyrroline N-oxide) consisted of DMPO-glutathionyl and DMPO-hydroxyl radical adducts. These results suggest that the ROS induced by the irradiation is mainly singlet oxygen, and cellular GSH plays as a scavenger of cellular ROS.

## **PB-128 [14:00]**

### **What is the primary target of the action millimeter waves on biological objects?**

Vitali Kalantaryan<sup>1</sup>, Radik Martirosyan<sup>1</sup>, Yura Babayan<sup>2</sup> & Hamlet Badalyan<sup>3</sup>

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<sup>2</sup>Physics and Electrotecnics, National University of Architecture and Construction of Armenia, Yerevan, Armenia, 0009

<sup>3</sup>General Physics, Yerevan State University, Yerevan, Armenia, 0025

**Keywords:** *In vitro*, *RF/Microwaves*, *Completed (unpublished)*

**Presented by:** Vitali Kalantaryan

It has been experimentally shown that the low-intensity electromagnetic fields (EMFs) do not act directly on DNA molecules, and the influence takes place through a mediated influence of the EMFs on the water, stimulating structural change of the water shell surrounding the DNA. Thereby, we may conclude that the primary targets of the influence of the electromagnetic fields on the DNA water solutions are the water molecules.

### **PB-130 [14:00]**

#### **Thermostability of the Mitoxantrone-tumor DNA complexes irradiated by low power electromagnetic waves**

Vitali Kalantaryan<sup>1</sup>, Radik Martirosyan<sup>1</sup>, Sergey Hakobyan<sup>2</sup> & Ruzanna Khazaryan<sup>3</sup>

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**Keywords:** *In vitro, RF/Microwaves, Completed (unpublished)*

**Presented by:** *Vitali Kalantaryan*

Thermostability of mitoxantrone (MTX) complexes with DNA of sarcoma 45 (tDNA) and healthy rat liver (hDNA) earlier irradiated by resonant and non-resonant frequencies of oscillations of water structures has been studied. It is shown that due to irradiation of DNA complexes by resonant frequencies, dehydration of nucleotides and Na<sup>+</sup> ions, present in solution, occurs. As a result of this fact at relatively low concentrations of MTX, when 100 base pairs of DNA corresponds to one of MTX molecules the thermostability of complexes decreases, moreover, the change is more pronounced (~0.8<sup>0</sup>C) at complex-formation with tDNA. The results of the work may be applied for treatment of new schemes of anti-tumor preparations in clinics.

### **PB-132 [14:00]**

#### **Effect of 1950 MHz radiofrequency fields exposure on the biology of human neural stem cells**

Hee-Jin Kim<sup>1</sup>, Jeong-Yub Kim<sup>1, 2</sup>, Nam Kim<sup>3</sup> & Myung-Jin Park<sup>1</sup>

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<sup>3</sup>*Chungbuk National University, Cheongju, Korea, 362-763*

**Keywords:** *In vitro, RF/Microwaves, Work in Progress*

**Presented by:** *Nam Kim*

In the present study, we examined the effect of 1950 MHz radiofrequency fields (RF) radiation on the biology of human neural stem cells. Our results demonstrate that RF exposure significantly reduced the proliferation, decreased the expression of stem cell factor, nestin and increased cell migration factor, N-cadherin in these cells.

### **PB-134 [14:00]**

#### **Effects of long-term exposure to 0.3 THz in HCE-T cells derived from human eye**

Shin Koyama<sup>1</sup>, Eijiro Narita<sup>1</sup>, Yoko Shimizu<sup>1</sup>, Takeo Shiina<sup>2</sup>, Masao Taki<sup>2</sup>, Naoki Shinohara<sup>1</sup> & Junji Miyakoshi<sup>1</sup>

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**Keywords:** *In vitro, THz, Completed (unpublished)*

**Presented by:** *Shin Koyama*

The cellular effects of long-term exposure to 0.3 terahertz (THz) in human corneal epithelial (HCE-T) cells were investigated. There was no statistically significant increase in the micronucleus (MN) frequencies of the cells exposed to 0.3 THz compared with sham-exposed controls and incubator controls. The morphological change of the cells also seemed no significant difference among the above three treatments. In heat shock protein (Hsp) expression, there was also no significant difference among the above three treatments. These results indicate that the exposure to 0.3 THz would be considered to have no or very little effect on the MN formation, morphological change, and Hsp expression on HCE-T cells.

### **PB-136 [14:00]**

#### **Investigation of DNA damage in rat primary neurons exposed to the GSM-1800 signal**

Isabelle Lagroye<sup>1, 2</sup>, Rémy Renom<sup>2</sup>, Florence Poulletier De Gannes<sup>2</sup>, Emmanuelle Poque-Haro<sup>2</sup>, Corinne El Khoueiry<sup>2</sup> & Bernard Veyret<sup>1, 2</sup>

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**Keywords:** *In vitro*, RF/Microwaves, Work in Progress

**Presented by:** Isabelle Lagroye

In vitro experiments were designed to investigate DNA damage in rat primary neurons exposed to the GSM-1800 signal. Interaction with known chemicals was also tested.

### **PB-138 [14:00]**

#### **Effects of high-intensity static magnetic fields on an *in vitro* plant system for the production of biopharmaceuticals in aerospace environment**

Vanni Lopresto<sup>1</sup>, Maria Elena Villani<sup>2</sup>, Angiola Desiderio<sup>2</sup>, Silvia Massa<sup>2</sup>, Rosanna Pinto<sup>1</sup> & Eugenio Benvenuto<sup>2</sup>

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**Keywords:** *In vitro*, Static, Work in Progress

**Presented by:** Vanni Lopresto

The human stay in space for long periods is closely linked to the possibility of cultivating plants on board, both for food purposes and as a source of bioactive molecule. However, the response of plant systems to extreme growing conditions in space aircrafts is still poorly investigated. Hereby we describe a study on effects of the exposure to high-intensity static magnetic field, which could be experienced in the spacecraft habitat in presence of active magnetic shielding systems. To this aim, an analysis of the proteomic profiles of tomato roots, used as biofactories for the production of biopharmaceutical molecules, is presented.

### **PB-140 [14:00]**

#### **Extremely low-frequency electromagnetic fields promote *in vitro* neuronal differentiation and neurite outgrowth of embryonic neural stem cells via up-regulating TRPC1**

Qin-Long Ma<sup>1</sup>, Chun-Hai Chen<sup>1</sup>, Lei Zhang<sup>1</sup>, Zhou Zhou<sup>1</sup> & Zheng-Ping Yu<sup>1</sup>

<sup>1</sup>Department of Occupational Health, Third Military Medical University, Chongqing, China, 400038

**Keywords:** *In vitro*, ELFILF, Completed (unpublished)

**Presented by:** Zheng-Ping Yu

We studied the potential effects of ELF-EMFs on eNSCs. The eNSC proliferation and maintenance were significantly enhanced after ELF-EMF exposure. ELF-EMF exposure increased the ratio of differentiated neurons and promoted the neurite outgrowth of eNSC-derived neurons. In addition, the expression of the proneural genes, NeuroD and Ngn1, was increased after ELF-EMF exposure. Moreover, the expression of TRPC1 was significantly up-regulated accompanied by increased the peak amplitude of intracellular calcium level induced by ELF-EMF. Silencing TRPC1 expression eliminated the up-regulation of the proneural genes and the promotion of neuronal differentiation and neurite outgrowth induced by ELF-EMF.

### **PB-142 [14:00]**

#### **Genotoxic effects of ultraviolet (UV) radiation on human 3D skin model *in vitro***

Zsuzsanna Nemeth<sup>1</sup>, Györgyi Kubinyi<sup>1</sup>, Annamária Brech<sup>1</sup>, Erzsebet Szaladjak<sup>1</sup>, Jozsef Bakos<sup>1</sup>, Zsolt Forgács<sup>2</sup>, Brahim



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**Keywords:** *In vitro*, *Optical*, *Work in Progress*

**Presented by:** *Zsuzsanna Nemeth*

The aim of this experiment was to examine whether the UVA or UVB exposure with two doses each has genotoxic effect on human reconstructed skin in vitro. The DNA damage was detected by comet assay. In this preliminary study we managed to show the direct damaging effect of the UVB radiation on the DNA, but UVA exposure did not have any significant effect. This experiment was done as a preliminary study for the project named “Cellular response to co-exposure of radiofrequency (RF) and solar ultraviolet (UV) radiation in human in vitro skin model (SKIN-RF)”

## **PB-144 [14:00]**

### **Spatially localized intracellular calcium concentration increases stimulated by nanosecond electric pulses in adrenal chromaffin cells**

Nina Semenova<sup>1</sup>, Gale Craviso<sup>2</sup> & P. Thomas Vernier<sup>1</sup>

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**Keywords:** *In vitro*, *Pulsed*, *Work in Progress*

**Presented by:** *Nina Semenova*

The effects of nanosecond electric pulses (nsEP) on calcium homeostasis in adrenal chromaffin cells were studied using confocal microscopy. Application of a single 6 ns duration nsEP causes spatially heterogeneous increases in intracellular calcium concentration ( $[Ca^{2+}]_i$ ). Z-stacks of confocal images were recorded before and after the application of nsEP to build three-dimensional models of the spatial and temporal localization of calcium concentration changes in the cell, which will allow us to better understand the cellular response to the applied electric field.

## **PB-146 [14:00]**

### **STUDENT PAPER**

### **The impact of millimeter waves on the enzymatic activity of succinate dehydrogenase**

Vincent Van Eeghem<sup>1</sup>, Katty Goossens<sup>2</sup>, Gokarna Pandey<sup>1</sup>, Guoqiang He<sup>1</sup>, Cathleen De Tandt<sup>1</sup>, Benyameen Keelson<sup>1</sup>, Ronnie Willaert<sup>2</sup> & Johan Stiens<sup>1</sup>

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**Keywords:** *In vitro*, *RF/Microwaves*, *Work in Progress*

**Presented by:** *Vincent Van Eeghem*

Although micro- and millimeter waves become more important in our daily life, an unambiguous biophysical explanation for the interaction mechanism with biological matter is still lacking. At the molecular level, structural features such as conjugated molecules and metal ions in proteins could play an essential role in the interaction with non-ionizing electromagnetic (EM) waves. Moreover, transfer of charges in biochemical reactions could be disturbed significantly by these EM waves. Taking these aspects into account, the enzymatic activity of succinate dehydrogenase was evaluated after exposure to low-intensity millimeter waves. The results showed a time-dependent reduction of the enzyme activity, which didn't reverse after

exposure.

### **PB-148 [14:00]**

#### **Effects of Whole Body Exposure of 915 MHz RFID on polyamine metabolism in Rat**

Young Hwan Ahn<sup>1</sup>, Hye Sun Kim<sup>1</sup>, Man Jeung Paik<sup>2</sup>, Yun-Sil Lee<sup>3</sup>, Hyung-Do Choi<sup>4</sup>, Jonghwa Kwon<sup>4</sup>, Jeong-Ki Park<sup>5</sup> & Nam Kim<sup>5</sup>

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<sup>3</sup>Ewha Woman's University, Seoul, Korea,

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<sup>5</sup>Department of Radio Sciences and Engineering, Chungbuk National University, Cheongju, Korea,

**Keywords: In vivo, RF/Microwaves, Completed (published)**

**Presented by: Young Hwan Ahn**

As a part of an investigation on potential risks of RFID to human health, we studied whether exposure to 915 MHz RFID in rats affects on polyamine metabolism in rat. We suggest that subchronic exposure to the 915 MHz RFID at SAR of 2 W/kg may induce a metabolic disturbance of polyamine.

### **PB-150 [14:00]**

**WITHDRAWN**

### **PB-152 [14:00]**

#### **Short term but daily long term effect of 900 MHz, 1800 MHz and 2100 MHz Radiofrequency Radiation on Sperm Morphology**

Veysi Akpolat<sup>1</sup>, Suleyman Dasdag<sup>2</sup>, Zulkuf Akdag<sup>1</sup>, Umut Cirit<sup>3</sup>, Cafer-Tayyar Selcuk<sup>4</sup>, Cemal Akcay<sup>4</sup>, Ugur Seker<sup>3</sup>, Ferit Ozmen<sup>3</sup> & Dogan Kurt<sup>5</sup>

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**Keywords: In vivo, RF/Microwaves, Completed (unpublished)**

**Presented by: Suleyman Dasdag**

Potential adverse effect of radiofrequency radiation (RF) emitted from mobile phone exposure on male fertility were extensively investigated by many of researchers since the mobile phones was an indispensable part of our daily life. Many of the studies indicated the adverse effect of RF on testes and seminal parameters, including motility, concentration and morphology.

### **PB-154 [14:00]**

#### **Effect of extremely low frequency magnetic field on response of irrinotecan in glioblastoma: A preliminary observation**

Havva Bektas<sup>1</sup>, Mehmet Taspinar<sup>2</sup>, Veysel Yuksek<sup>3</sup> & Suleyman Dasdag<sup>4</sup>

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**Keywords: Clinical (therapy), ELF/ILF, Completed (unpublished)**

**Presented by: Suleyman Dasdag**

Glioblastoma (GBM) is one of most deadly brain tumors, which still has not a definitive treatment. Therefore, more performance is necessary to contribute the treatment of the disease.

## **PB-156 [14:00]**

### **Do 2100 MHz radiofrequency radiation emitted from mobile phones alter space between brain cells? A preliminary electron microscopical study**

Suleyman Dasdag<sup>1</sup>, Zulkuf Akdag<sup>2</sup>, Veysi Akpolat<sup>2</sup> & Engin Devenci<sup>3</sup>

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**Keywords: In vivo, RF/Microwaves, Completed (unpublished)**

**Presented by: Suleyman Dasdag**

Recently researchers indicated that the space between brain cells may increase during sleep, allowing the brain to flush out toxins that build up during waking hours. This new research finding motivated us to investigate the effect of radiofrequency radiation (RF) on the space between brain cells. This study is first phase of a long term study.

## **PB-158 [14:00]**

### **The biological impact of RF EMF amplitude-modulated at tumor-specific frequencies on Human Xenograft Tumors**

Hugo Jimenez<sup>1, 2</sup>, Jacquelyn Zimmerman<sup>3</sup>, Sambad Sharma<sup>1, 2</sup>, Ralph D'Agostino<sup>2, 4</sup>, Debra Fuller<sup>5</sup>, Youngkyoo Jung<sup>5</sup>, Akiva Mintz<sup>5</sup>, Kounosuke Watabe<sup>1, 2</sup>, David Caudell<sup>6, 7</sup>, Barry DeYoung<sup>6</sup>, Niels Kuster<sup>8</sup>, Frederico Costa<sup>9</sup>, Alexandre Barbault<sup>10</sup>, Carl Blackman<sup>1, 2</sup> & Boris Pasche<sup>1, 2</sup>

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<sup>8</sup>IT'IS Foundation, Zurich, Switzerland

<sup>9</sup>Centro de Oncologia, Hospital Sirio Libanes, Sao Paulo, Brazil

<sup>10</sup>TheraBionic GmbH, Ettlingen, Germany

**Keywords: In vivo, RF/Microwaves, Work in Progress**

**Presented by: Hugo Jimenez**

Here we describe the impact tumor-specific AM RF EMF had on cell cycle arrest in Huh-7 cells. Additionally, we state tumor-specific AM RF EMF did not inhibit growth in tumors of mouse origin.

## **PB-160 [14:00]**

### **STUDENT PAPER**

### **Effects of long-term exposure to intermediate frequency magnetic fields on fertility in mice**

Kumari Kajal<sup>1</sup>, Mikko Herrala<sup>1</sup>, Heikki Tanila<sup>2</sup>, Matti Viluksela<sup>1</sup>, Jonne Naarala<sup>1</sup> & Jukka Juutilainen<sup>1</sup>

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**Keywords:** *In vivo*, *IF*, *Work in Progress*

**Presented by:** Kumari Kajal

Groups of 20 male C57BL/6j mice were exposed continuously for 5 weeks to 7.5 kHz magnetic fields at 12 or 120  $\mu$ T. Sperm from cauda epididymis was analysed for motility, total sperm counts, and morphology. Testicular spermatid head were counted. No differences in body and reproductive tissue weights or testis sperm counts were seen between the three groups. Other results will be reported in the BioEM 2016 meeting.

## **PB-162 [14:00]**

### **STUDENT PAPER**

#### **The long-term exposure of 835 MHz radiofrequency radiation causes a hypoglycemia in SMP-30 KO mice**

Hye-Ryoung Lee<sup>1</sup>, Dahyeon Yu<sup>1</sup>, Ju-Hwan Kim<sup>1</sup>, Hakrim Kim<sup>1</sup> & Jin-Koo Lee<sup>1</sup>

<sup>1</sup>Department of Pharmacology, Dankook University, Cheonan, Korea, 31116

**Keywords:** *In vivo*, *RF/Microwaves*, *Work in Progress*

**Presented by:** Hye-Ryoung Lee

Long-term exposure of 835 MHz RFR induced hypoglycemia and AMPK signaling may be activating to modulate glucose homeostasis in RFR exposed aging mice.

## **PB-164 [14:00]**

#### **Microarray analysis of hippocampal gene expression in chronic exposure to a 1.95 GHz mobile phone signal**

Hae-June Lee<sup>1</sup>, Jonghwa Kwon<sup>2</sup>, Jeong-Ki Park<sup>3</sup>, Nam Kim<sup>4</sup> & Yun-Sil Lee<sup>5</sup>

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<sup>4</sup>School of Electrical and Computer Engineering, Chungbuk National University, Cheongju, Korea, 361763

<sup>5</sup>Graduate School of Pharmaceutical Sciences, Ewha Womans University, Seoul, Korea, 120750

**Keywords:** *In vivo*, *RF/Microwaves*, *Work in Progress*

**Presented by:** Hae-June Lee

To access biological effect of radiofrequency electromagnetic fields on brain, we analyzed gene expression profiles of hippocampus obtained from young and aged female C57BL/6 mice exposed to a 1.95 GHz EMF at a specific absorption rate (SAR) of 5 W/kg or sham condition for 8 months. We found chronic RF-EMF alters hippocampal transcriptome in young and aged mice.

## **PB-166 [14:00]**

#### **Frequency dependent thermal effects of over 6 GHz radio frequency electromagnetic fields exposure in vivo**

Shin Ohtani<sup>1</sup>, Akira Ushiyama<sup>2</sup>, Machiko Maeda<sup>1</sup>, Kenji Hattori<sup>1</sup>, Naoki Kunugita<sup>2</sup>, Jianqing Wang<sup>3</sup> & Kazuyuki Ishii<sup>1</sup>

<sup>1</sup>Department of Hygienic Chemistry, Meiji Pharmaceutical University, Kiyose, Japan, 204-8588

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**Keywords:** *In vivo*, *RF/Microwaves*, *Work in Progress*

**Presented by: Shin Ohtani**

To investigate the thermal effects of 10-GHz RF-EMF exposure, core temperature and gene expression of stress markers were analyzed during and following exposure for 3 days (6 h/day). As results, at WBA-SAR of 4 W/kg, the increase of core temperature was not observed, but some Hsp and Hsf genes were significantly upregulated in the cerebellum and skin. Comparison among 2.14-, 6-, and 10-GHz indicated that 10-GHz exposure showed quite different effects from 2.14- and 6-GHz exposure. Although the core temperature and transcriptional changes in the brain were less affected, the transcriptional changes in the skin were more affected. At 0.4 W/kg, there were no significant changes in the core temperature and these gene expression.

## **PB-168 [14:00]**

### **Duration- and dose-dependent apoptosis of testicular germ cells induced by the exposure to 60 Hz magnetic fields**

Sungman Park<sup>1</sup>, Min Soo Kim<sup>1</sup>, Young-Jin Kim<sup>1</sup>, Sang-Kon Lee<sup>2</sup>, Kyung-Chan Choi<sup>3</sup>, Nam Kim<sup>4</sup>, Yoon-Myoung Gimm<sup>5</sup> & Yoon-Won Kim<sup>1</sup>

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<sup>5</sup>Department of Electronics and Electrical Engineering, Dankook University, Yong-In, Korea, 16891

**Keywords: In vivo, ELF/LF, Completed (published)**

**Presented by: Yoon-Won Kim**

The 6-week-old BALB/c male mice were divided at random depending on the study design. For dose-dependent exposure, male mice were exposed to 60 Hz MF at 2, 20, or 200 mT for 8 weeks. For the duration experiment, male mice were continuously exposed to a 60 Hz of 100 mT for 2, 4, 6, or 8 weeks. The percentage of seminiferous tubules with apoptotic cells increase in a dose-dependent manner. The seminiferous tubule diameter in testes decreased in the exposed groups. The apoptotic cells in testicular tubules were duration-dependent increased at exposed groups of 100 mT, and a significant difference appeared from 6 weeks.

## **PB-170 [14:00]**

### **Small-animal setups for investigation of radiofrequency exposure using microscopic and magnetic resonance imaging**

Maarten Paulides<sup>1</sup>, Rob Mestrom<sup>3</sup>, Elles Raaijmakers<sup>1,3</sup>, Pierre Agnass<sup>1,2,3</sup>, Timo tenHagen<sup>2</sup> & Gerard van Rhoon<sup>1</sup>

<sup>1</sup>Radiation Oncology, Erasmus University Medical Center, Rotterdam, the Netherlands

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<sup>3</sup>Electrical Engineering, Eindhoven University of Technology, Eindhoven, the Netherlands

**Keywords: In vivo, RF/Microwaves, Work in Progress**

**Presented by: Maarten Paulides**

The impact of radiofrequency (RF) electromagnetic waves on humans is being studied intensively to better understand the desired and undesired effects. Aimed at a thorough investigation of RF-based local heating, we developed exposure setups for small-animal investigation. These devices are specifically designed to allow concurrent intravital microscopy and MRI for studying the transient impact of local heating on anatomy and physiology. In this work, we present the designs and show the potential of the two approaches by numerical and experimental investigations for scenarios mimicking local heating in the head and neck and liver region.

## **PB-172 [14:00]**

### **Development of the *in vivo* exposure apparatus to explore the possibilities of health effects due to 85kHz intermediate frequency magnetic field**

Yukihisa Suzuki<sup>1</sup>, Keiji Wada<sup>1</sup>, Kazuki Matsubara<sup>1</sup>, Tatsuya Terai<sup>1</sup>, Hajime Yoshino<sup>1</sup>, Akira Ushiyama<sup>2, 3</sup>, Shin Ohtani<sup>3</sup>, Kenji Hattori<sup>3</sup> & Kazuyuki Ishii<sup>3</sup>

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**Keywords:** *In vivo*, *IF*, *Work in Progress*

**Presented by:** Yukihisa Suzuki

We have developed the exposure system for 85 kHz time varying magnetic field to explore the possibility of health effects caused by this frequency band. When the current of 30Arms is applied to the solenoidal coil, effective value of alternating magnetic flux density 6.5 mT is obtained. Numerical dosimetry is performed to estimate induced electric field with anatomical mouse model. It is found that, induced electric field of 7.8V/m, that is whole body average, will be achieved by this exposure system.

## **PB-174 [14:00]**

### **High frequency electromagnetic field assisted therapy of breast cancer by ferromagnetic nanoparticles conjugated with glucose in rats**

Lubomir Traikov<sup>1</sup>, Ivan Antonov<sup>1</sup>, Achilleas Gerou<sup>1</sup>, Nicoll-Ellen Kafozoff<sup>1</sup>, Radka Hadjiolova<sup>2</sup>, Gabriela Atanasova<sup>3</sup> & Nikolai Atanasov<sup>3</sup>

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<sup>3</sup>Dept. Wireless Communication and Broadcasting, College of Telecommunications, Sofia, Bulgaria, 1565

**Keywords:** *In vivo*, *RF/Microwaves*, *Completed (published)*

**Presented by:** Lubomir Traikov

Ferromagnetic-nanoparticles offer many potential benefits for therapy by making specific drugs more efficacious and by decreasing their adverse side-effects. The basic idea of our study is use of glucose-conjugate Fe-MNP(Glc-Fe-MNPs) for targeting and more accurate focusing in order to increase the effect of high-frequency electromagnetic fields induced hyperthermia in solid breast tumors. Tumors demonstrate high metabolic activity for glucose in comparison with other cells. Assisted RF-EMF hyperthermia induced by glucose conjugated magnetic nanoparticles in high-frequency oscillating magnetic fields is a promising form of heat delivery in which thermal energy is supplied at the nanoscale to the tumor.

## **PB-176 [14:00]**

### **Effects of weak neuroprosthetic stimulation on signaling transduction of the amputated thermo-nociceptive neurons**

Aassunta Virtuoso<sup>1</sup>, Stephanie Venteo<sup>4</sup>, Celia Herrera-Rincon<sup>2</sup>, Patrick Carroll<sup>4</sup>, Michele Papa<sup>1</sup> & Fivos Panetsos<sup>3, 5</sup>

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**Keywords:** *In vivo*, *ELF/IF*, *Completed (unpublished)*

**Presented by:** Fivos Panetsos

Sensory nerve amputation induces severe anatomical and functional changes along the affected pathway. Electrical stimulation applied to the transected nerve prevent sensory deprivation-related changes in the central nervous system. Here we study how chronic electrical stimulation interacts with the signaling mechanisms at the level of peripheral ganglia. As an amputation model we used the irreversible transection of the infraorbital nerve of the rat. We show that the functional status of thermo-nociceptive neurons is modified by a 4-weeks application of artificial stimulation.

### **PB-178 [14:00]**

#### **External electric and magnetic fields as a signaling mechanism for biological systems**

Frank Barnes<sup>1</sup> & Ben Greenebaum<sup>2</sup>

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<sup>2</sup>Department of Physics, University of Wisconsin-Parkside, Kenosha, Wisconsin, USA, 53141-2000

**Keywords:** *Mechanistic/Theoretical, All Frequencies, Work in Progress*

**Presented by:** *Frank Barnes*

It has been shown that weak magnetic fields can modify radical concentrations, and both inhibit and accelerate the growth of some cancer cells. The timing of the application of these fields is important. It is proposed that externally applied magnetic and electric fields should be considered as possible methods for signaling biological systems.

### **PB-180 [14:00]**

#### **Electrodynamics of magnetic pulse machines: generation of EM fields and biological effects**

Fatiha Bougrioua<sup>1</sup>, Robert Bouzerar<sup>1,2</sup>, Issyan Tekaya<sup>1,2</sup>, Mohammed Hamzaoui<sup>3</sup>, Valéry Bourny<sup>3,4</sup>, Alexandre Rabdane<sup>1</sup>, Denis Jouaffre<sup>5</sup>, Matthieu Morel<sup>5</sup> & Dominique Haye<sup>5</sup>

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**Keywords:** *Mechanistic/Theoretical, Pulsed, Work in Progress*

**Presented by:** *Fatiha Bougrioua*

We are investigating the time varying electric and magnetic fields generated by magnetic pulse technologies (MP) and their potential effects on biological systems. A first theoretical model based on electrical analogues is proposed to characterize the coupling between EM field and biological systems.

### **PB-182 [14:00]**

#### **Polarization response of macromolecular structures to ultra-short electric pulses based on a continuous-wavelet analysis**

Guglielmo d'Inzeo<sup>1</sup>, Alessandra Paffi<sup>1</sup> & Paolo Marracino<sup>1</sup>

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**Keywords:** *Mechanistic/Theoretical, Pulsed, Work in Progress*

**Presented by:** *Guglielmo d'Inzeo*

In this work we use the continuous wavelet transform (c-WT) technique to study the polarization response of a protein in solution. The analysis allows us to capture the essential details of the fast polarization process induced by an external ultra-short pulsed electric field, surpassing the principal limitations of the classical

time-frequency analysis.

### **PB-184 [14:00]**

#### **Application method of AMC reflector for SAR reduction of 5GHz wireless LAN router**

Seungwoo Lee<sup>1</sup> & Nam Kim<sup>1</sup>

<sup>1</sup>*College of Electrical and Computer Engineering, Chungbuk National University, Cheongju-si, Korea, 28644*

**Keywords: Mechanistic/Theoretical, RF/Microwaves, Completed (unpublished)**

**Presented by: Seungwoo Lee**

In this paper, we present a new type of reflector which consists of periodically arrayed AMC structures. The aimed frequency band is 5 GHz for wifi service. Other investigators have used various methods to verify proposed AMC structures. However, direct analysis of the characteristics of AMC structures is difficult because AMC structures are one of the methods to embody the metamaterial characteristic. Therefore, AMC structures are generally being applied as absorbers, filters, reflectors, spacers, or secondary devices for improving the performance of antennas. Their characteristics of transmission or reflection are being analyzed by simulation or measurement.

### **PB-186 [14:00]**

#### **Electric field effects on protein unfolding thermodynamics**

Paolo Marracino<sup>1</sup>, Francesca Apollonio<sup>1</sup>, Micaela Liberti<sup>1</sup> & Andrea Amadei<sup>2</sup>

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**Keywords: Mechanistic/Theoretical, Pulsed, Completed (published)**

**Presented by: Paolo Marracino**

Here we present the application of a recently developed theoretical-computational approach to model the protein unfolding thermodynamics response to intense electric fields. Application to two different proteins indicates a well-defined field interval for a significant unfolding-refolding equilibrium.

### **PB-188 [14:00]**

#### **Grouping approaches for EMF risk assessment – How to treat inconsistencies in the bio-effects literature and get meaningful answers**

Mats-Olof Mattsson<sup>1, 2</sup> & Myrtil Simko<sup>1, 2</sup>

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**Keywords: Mechanistic/Theoretical, All Frequencies, Work in Progress**

**Presented by: Mats-Olof Mattsson**

Our on-going work includes development and validation of “grouping” approaches to classification and quality assessment of published in vivo and in vitro studies on effects of exposure to various types of EMF, enabling selection of studies for further risk assessment based on quality and usefulness. In the present study, we focus on EMF exposures due to the use of millimeter and THz waves, and the LTE standard for wireless communication.

### **PB-190 [14:00]**

**WITHDRAWN**



## **PB-192 [14:00]**

### **Research on the activation of the Nrf2-Keap1 signaling pathway by active fraction of KFL protect neural cells injury induced by microwave exposure**

Ruiyun Peng<sup>1</sup> & Shaohua Hu<sup>2</sup>

<sup>1</sup>Dept of Exper Pathol, Institute of Radiation Medicine, Beijing, China, 100850

<sup>2</sup>Dept of Check, Hospital of PLA 96164 Troop, Jinhua, China, 321000

**Keywords: Mechanistic/Theoretical, RF/Microwaves, Completed (unpublished)**

**Presented by: Ruiyun Peng**

Here we assessed the real-time calcium levels change of primary hippocampal neurons and PC12 cells during pulsed microwave exposure using Fluo 4 and genetically encoded calcium indicator. And we demonstrated that KFL could protect cognitive defect and oxidative stress caused by HPM by modulation of ROS formation and antioxidant enzymes. Our data also suggested that some electrophilic compounds contained in KFL protect neuron via Nrf2-Keap1 signaling pathway. The project lays the foundation for using Nrf2-Keap1 pathway as preventive and therapeutic target for treatment of microwave-induced brain injury.

## **PB-194 [14:00]**

### **Towards microvolume dielectric spectroscopy of proteins verified by molecular modelling**

Milan Příhoda<sup>1</sup>, Jiří Pruša<sup>1</sup>, Daniel Havelka<sup>1</sup>, Ondrej Krivosudský<sup>1</sup>, Ondřej Kučera<sup>1</sup> & Michal Cifra<sup>1</sup>

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**Keywords: Mechanistic/Theoretical, RF/Microwaves, Work in Progress**

**Presented by: Michal Cifra**

To study the dynamics and electrical properties of proteins, we have designed and fabricated grounded coplanar waveguide-based chip for microvolume (few hundred microliters) dielectric spectroscopy of liquids in 1-50 GHz band and implemented a method for the prediction of the complex permittivity of biomolecule solution from molecular dynamics simulation.

## **PB-196 [14:00]**

### **Large Bandwidth Antenna Radiation (LBAR) induces inside cumulative pressure and membrane surface tension of cancer cells**

Gerard Dubost<sup>1</sup>, James Bare<sup>2</sup>, Frederic Bellossi<sup>3</sup> & Anthony Holland<sup>4</sup>

<sup>1</sup>Emeritus Professor of Physics, University of Rennes 1, Rennes, France

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**Keywords: Mechanistic/Theoretical, Pulsed, Work in Progress**

**Presented by: Frederic Bellossi**

We use a radio frequency excited plasma antenna enclosed in a glass tube to destroy cancer cells. The confined plasma antenna, filled with helium gas, is fed by a 27.12MHz carrier signal that is over-modulated with rectangular pulses of a chosen modulation frequency  $f$ . We have named the model related to the induced biological process mechanisms as Large Bandwidth Antenna Radiation (LBAR) model. The modulation frequency  $f$ , based on cancer cell size, ranges from 100kHz to 400kHz. Combined to the energy cumulated into the cell due to the field radiation, it can contribute to cancer cells destruction. The LBAR model introduces a possible new method of cancer treatment that can radically change the existing cancer treatment paradigm.

## **PB-198 [14:00]**

### **Electromagnetic field (EMF) exposure assessment at a bar induction heating line according to the German “DGUV Regulation 15” and the EU directive 2013/35/EU**

Carsten Alteköster<sup>1</sup>, Claudine Neumann<sup>1</sup> & Marc Wittlich<sup>1</sup>

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**Keywords: Occupational, ELF/ILF, Work in Progress**

**Presented by: Carsten Alteköster**

The “DGUV Regulation 15” (former BGV B11) represents the reliable fundament for the assessment of EMF exposure to employees in Germany. However, the question is which consequences the transposition of the Directive 2013/35/EU will have compared to the current situation. This work describes the evaluation of the magnetic fields in the surrounding of a bar heating line according to the DGUV R15. Some places had to be marked as a hazardous area and protective measures to reduce the EMF exposure had to be taken. Additionally, the data are also discussed with reference to the limits for occupational environments as defined by the EU directive and numerical simulations are carried out with the aim to verify whether the basic values are met.

## **PB-200 [14:00]**

### **An evaluation of electromagnetic hazards near the 27 MHz rod antenna of a radio communication unit, using in-situ and in-silico measurements of the limb current**

Jolanta Karpowicz<sup>1</sup>, Patryk Zradziński<sup>1</sup>, Jarosław Kieliszek<sup>2</sup>, Krzysztof Gryz<sup>1</sup>, Jaromir Sobiech<sup>2</sup> & Wiesław Leszko<sup>1</sup>

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**Keywords: Occupational, RF/Microwaves, Completed (unpublished)**

**Presented by: Jolanta Karpowicz**

The aim was to evaluate correlations between biophysical effects of electromagnetic field exposure in humans (induced limb current) and: (1) parameters of affecting inhomogeneous electric field, (2) body anthropometric properties. Strong, positive, statistically significant correlations were found between limb current and body volume index (body height multiplied by mass), mass and height of exposed persons ( $r > 0.7$ ;  $p < 0.001$ ). Exposed person's body volume and exposure evaluation by electric field in front of the chest were not analysed in other studies regarding limb currents and need further studies to improve electromagnetic hazards evaluation practice, as well as dimensions of “reference measurement probe”.

## **PB-202 [14:00]**

### **Wide-band experimental evaluation of contact current perception threshold**

Jolanta Karpowicz<sup>1</sup>, Patryk Zradziński<sup>1</sup> & Krzysztof Gryz<sup>1</sup>

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**Keywords: Occupational, IF, Completed (unpublished)**

**Presented by: Jolanta Karpowicz**

Limits for contact currents were set out because of the indirect effects of exposure to electromagnetic field. The aim of the study was to analyse what relative level of the contact currents exceeds perception threshold. It was found that female's sensitivity tends to be higher (lower perception threshold). At frequencies  $< 15$  kHz, the contact current perception threshold is significantly lower than the relevant limits set out by the directive 2013/35/EU and its dependence on the touch contact area was not found. Contrary to this, at frequencies  $> 30$  kHz, the contact current perception threshold is significantly higher than the limits and is higher at larger electrode.

## **PB-204 [14:00]**

### **Exposure assessment at a low frequency inductive heating unit - a case study**

Claudine Neumann<sup>1</sup>, Carsten Alteköster<sup>1</sup> & Marc Wittlich<sup>1</sup>

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**Keywords: Occupational, ELF/ILF, Work in Progress**

**Presented by: Claudine Neumann**

Occupational safety and health efforts regarding the exposure against electromagnetic fields have been boosted by the new EC directive 2013/35/EC since its release. Consequently, national regulations have to be synchronized to the new legal standards by the member states. Nevertheless, national regulations like the DGUV Regulation 15 (former BGV B11) in Germany remain valuable aggregations of knowledge and experience. This work describes the determination of exposure areas using the DGUV R 15 at a low-frequency inductive heating unit. Measurements and evaluations clearly revealed some parts of the working area as hazardous environment. Consequently, immediate protective measures to avoid impermissible exposure of employees are required.

## **PB-206 [14:00]**

### **Critical review of a time domain assessment method for magnetic fields recently proposed by the European Commission for implementing directive 2013/35/EU**

Gernot Schmid<sup>1</sup> & Rene Hirtl<sup>1</sup>

<sup>1</sup>*EMC & Optics, Seibersdorf Laboratories, Seibersdorf, Austria, A-2444*

**Keywords: Occupational, ELF/ILF, Completed (unpublished)**

**Presented by: Gernot Schmid**

A time domain assessment (TDA) method for magnetic field exposure, recently proposed by the European Commission in the non-binding guide for practical implementation of the “workers directive” 2013/35/EU was critically reviewed. It could be demonstrated that the TDA method is not consistent with the underlying exposure assessment principles of the directive. We therefore recommend to remove this method from the non-binding guide as soon as possible.

## **PB-208 [14:00]**

### **Implementing the European EMF Directive - the Dutch experience**

Rianne Stam<sup>1</sup> & John Bolte<sup>1</sup>

<sup>1</sup>*Sustainability, Environment and Health, National Institute for Public Health and the Environment (RIVM), Bilthoven, the Netherlands, 3720 BA*

**Keywords: Occupational, All Frequencies, Completed (unpublished)**

**Presented by: Rianne Stam**

Summary: European Directive 2013/35/EU sets rules and limits for worker exposure to EMF. The Directive is implemented in the Netherlands with minimal changes. Stakeholders were consulted in a national meeting. To prepare employers for their task in EMF risk assessment and prevention, a concise national guide, brochures on special topics and specialized web pages were developed.

## **PB-210 [14:00]**

### **Implementation of the EMF Directive 2013/35/EU in Germany**

Ljiljana Udovicic<sup>1</sup>, Hannelore Neuschulz<sup>1</sup>, Georg Hilpert<sup>2</sup> & Erik Romanus<sup>1</sup>

<sup>1</sup>*Federal Institute for Occupational Safety and Health (BAuA), Dortmund, Germany*

<sup>2</sup>German Federal Ministry of Labour and Social Affairs (BMAS), Bonn, Germany

**Keywords:** Occupational, All Frequencies, Other

**Presented by:** Ljiljana Udovicic

**Summary** The European Directive 2013/35/EU, which came into force in June 2013, shall be implemented in the national law of all European member states by July 2016. The Directive is going to be implemented into German national legislation by the Occupational Safety and Health Ordinance on Electromagnetic Fields (EMF Ordinance). Subsequently, in order to improve the comprehensibility and usability of the EMF Ordinance, the Technical Rules will be developed.

## **PB-212 [14:00]**

### **An external ionizing radiating source as a morbidity aggravating co-factor by mixed low-intensity non-ionizing professional conditions in physiotherapy**

Lyubina Vesselinova<sup>1</sup>

<sup>1</sup>MMDER/Clinic of Physical and Rehabilitation Medicine, Military Medical Academy, Sofia, Bulgaria, 1336

**Keywords:** Occupational, All Frequencies, Completed (unpublished)

**Presented by:** Lyubina Vesselinova

There are presented the results from a recent complex morbidity study in 30 physiotherapy facilities. The morbidity aggravation dependence on an X-ray source in vicinity are studied, evidenced and presented at first in this paper.

## **PB-214 [14:00]**

### **Relaunch EMF-Portal 2016: Redesign, Consolidation and Modernization of the IT infrastructure making the EMF-Portal ready for the Future**

Lambert Bodewein<sup>1</sup>, Dagmar Dechent<sup>1</sup>, Sarah Driessen<sup>1</sup>, Tanja Emonds<sup>1</sup>, Frank Gollnick<sup>1</sup>, Thomas Kraus<sup>1</sup>, Anne-Kathrin Petri<sup>1</sup> & David Graefrath<sup>1</sup>

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**Keywords:** Public Health Policy, All Frequencies, Other

**Presented by:** Lambert Bodewein

The EMF-Portal ([www.emf-portal.org](http://www.emf-portal.org)) of the RWTH Aachen University summarizes systematically scientific research data on the effects of electromagnetic fields (EMF). All information is made available in English, German and Japanese. The EMF-Portal is the world's most comprehensive free EMF literature database. It has been growing for more than 10 years during which time various features such as a glossary, a data base of field sources and a further language have been added. This has so far led to a well-functioning system of several customized offers while lacking sustainability and modernity for future demands. A modernization of the IT infrastructure and relaunch of the website with a new professional design have recently been completed.

## **PB-216 [14:00]**

### **Scientific literature database on the electrophysiological effects of electric current: A valuable expansion of the EMF-Portal**

Tanja Emonds<sup>1</sup>, Sarah Driessen<sup>1</sup>, David Graefrath<sup>1</sup>, Thomas Kraus<sup>1</sup> & Dagmar Dechent<sup>1</sup>

<sup>1</sup>Research Center for Bioelectromagnetic Interaction (femu), RWTH Aachen University, Aachen, Germany, 52074

**Keywords:** Public Health Policy, All Frequencies, Other

**Presented by:** Tanja Emonds

The EMF-Portal now provides an overview on the current state of knowledge on electrical injuries, their

sequels, the mechanisms of action and electrophysiological as well as therapeutic effects of electrical current. This section of the literature database contains ca. 2680 studies (as of Feb 2016). All studies are classified into individual study types and the main exposure parameters are extracted. Four study types are equipped with further details and keywords. The EMF-Portal can be an important and indispensable basis for the systematic analyses and evaluation of the effects of EMF as well as electric current and a properly based risk assessment.

## **PB-218 [14:00]**

### **50Hz EMF and public health policy: The involvement of the Belgian BioElectroMagnetics Group**

Maryse Ledent<sup>1</sup>, Annemarie Maes<sup>2</sup>, Maurits De Ridder<sup>3</sup>, Veronique Beauvois<sup>4</sup>, Gabrielle Scantamburlo<sup>1</sup> & Luc Verschaeve<sup>2</sup>

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**Keywords: Public Health Policy, ELF/ILF, Other**

**Presented by: Maryse Ledent**

The BBEMG website ([www.bbemg.be](http://www.bbemg.be)) aims to present the results of the research teams of the Belgian BioElectroMagnetics Group, to inform about electric and magnetic fields and their potential health effects, and to become a centre of documentation and education able to provide understandable and correct information regarding 50 Hz electric and magnetic fields to the general public, physicians, scientists, public officials... This paper is focusing on the involvement of the BBEMG through its website in the Belgian public policy, its identified goals and how it is implemented and evaluated. Challenges will also be analysed.

## **PB-220 [14:00]**

### **Health and biological effects of static electric fields on humans and vertebrates: A systematic review**

Anne-Kathrin Petri<sup>1</sup>, David Graefrath<sup>1</sup>, Dagmar Dechent<sup>1</sup>, Thomas Kraus<sup>1</sup> & Sarah Driessen<sup>1</sup>

<sup>1</sup>*Research Center for Bioelectromagnetic Interaction (femu), RWTH Aachen University, Aachen, Germany, 52074*

**Keywords: Public Health Policy, Static, Completed (unpublished)**

**Presented by: Anne-Kathrin Petri**

Little is known about the effects of static electric fields on human health. Therefore, the aim of this project was to conduct a systematic review according to well-defined scientific criteria. We were looking for experimental and epidemiological studies examining the effect of static electric fields on humans and vertebrates. The literature search was conducted in our highly specialized publication database EMF-Portal ([www.emf-portal.de/?l=e](http://www.emf-portal.de/?l=e)). A total of 44 articles have been identified that deal with the effects of static electric fields on humans or animals.

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## ***Mobile Manufacturers Forum***

The MMF is an international association of telecommunications equipment manufacturers with an interest in mobile or wireless communications. Established in 1998, the association's mission is to facilitate joint funding of key research projects and cooperation on standards, regulatory issues and communications concerning the safety of wireless technology. The MMF's members include Alcatel OneTouch, Apple, Cisco, Ericsson, Huawei, Intel, LG, Microsoft, Motorola Mobility, Motorola Solutions, Samsung and Sony Mobile.



Korean Institute  
of Electromagnetic  
Engineering Society

## Mobile EMF Consortium

The purpose of this Consortium, which is composed of Korean mobile operators and EMF experts, is to share together the human effect and its social responsibility over electromagnetic fields. The MEC's key activities include: the researches on adverse health effect on human body of EMF exposure radiated by radio wave sources, risk communications for conflict resolution among stakeholders, website ([www.emf.or.kr](http://www.emf.or.kr)) operation support, publication of the EMF Weekly Brief Report, preparation for legislation and standards, domestic and international joint researches, etc.. The MEC has begun in 2000 and particularly this year is in the third term (from August of 2014 to July of 2019). Korea's major telecommunication companies, SKT, KT and LGU+, are funding for the MEC. The steering committee consists of KIEES, three major telecommunication companies, ETRI, Chungnam National University, Chungbuk National University, Dankuk University, Korean Center for social conflict resolution, and IFRE (Institute for Future Radio Engineering).

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It is ZonMw's goal to ensure that healthy people stay that way for as long as possible, that ill people recover as quickly and completely as possible and that people who require care and nursing receive the highest standard of services. To achieve this, we need to focus on prevention: on stopping people from becoming ill. And we need good health care for people who nevertheless fall ill. The question ZonMw faces is how to improve disease prevention and health care. One thing is clear: you need a lot of knowledge, and therefore a lot of research. And it is important that people actually use that knowledge. With this in mind, ZonMw funds and promotes research, development and implementation.





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