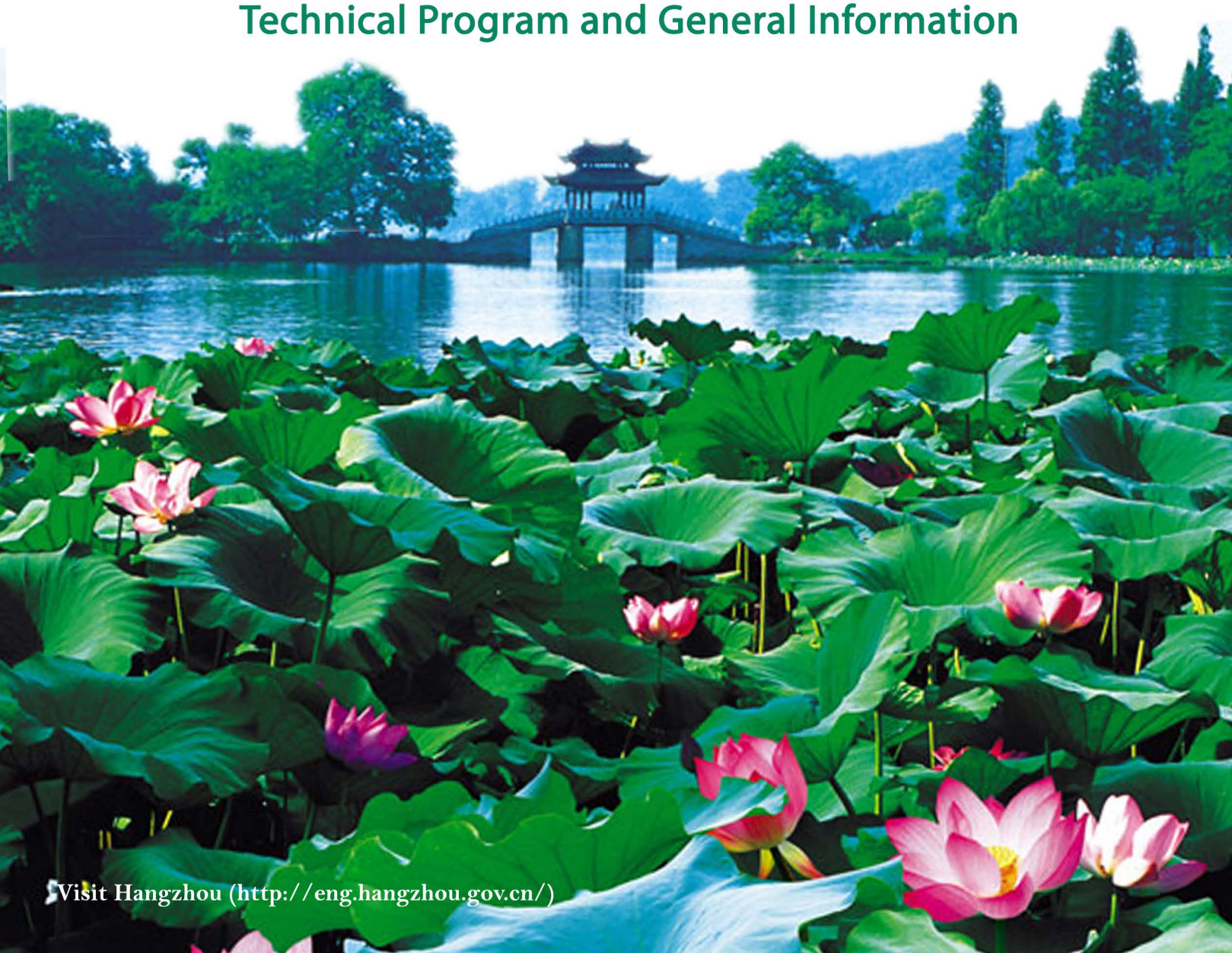
# BioEM 2017

5-9 June West Lake Villa

**Hangzhou, China**

## The Joint Annual Meeting of
## The Bioelectromagnetics Society (BEMS) and
## the European BioElectromagnetics Association (EBEA)

## Technical Program and General Information



Visit Hangzhou (http://eng.hangzhou.gov.cn/)

## The Bioelectromagnetics Society - Officers and Board of Directors

| | | |
|---|---|---|
| President | Nam Kim | Korea |
| President-Elect | Andrew Wood | Australia |
| Treasurer | Myles Capstick | Switzerland |
| Secretary | Sarah Loughran | Australia |
| Board Member | Teruo Onishi | Japan |
| Board Member | Marthinus Van Wyk | South Africa |
| Board Member | Azadeh Peyman | United Kingdom |
| Editor-In-Chief (ex-officio) | James C. Lin | United States |

## European BioElectromagnetics Association Council

| | | |
|---|---|---|
| President | Isabelle Lagroye | France |
| Past President | Eric Van Rongen | Netherlands |
| Executive Secretary | Micaela Liberti | Italy |
| Treasurer | Niels Kuster | Switzerland |
| Biological/Medical Sciences | Heidi Danker-Hopfe | Germany |
| Biological/Medical Sciences | Florence Poulletier De Gannes | France |
| Biological/Medical Sciences | Martin Roosli | Switzerland |
| Engineering/Physical Sciences | Theodoros Samaras | Greece |
| 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 |

# Local Organizing Committee


Zhengping Xu
Co-chairs
China


Zhengping Yu
Co-chairs
China


Guangdi Chen
China


Luc Martens
Belgium


Myles Capstick
Switzerland


Niels Kuster
Switzerland


Andrew Wood
Australia


Peter Gajsek
Slovenia


James C. Lin
USA


Masao Taki
Japan

# From the Co-chairs of the Local Organizing Committee

On behalf of the BioEM2017 Local Organizing Committee, we welcome you to Hangzhou, China, for the Annual Joint Meeting of the Bioelectromagnetics Society (BEMS) and the European BioElectromagnetics Association (EBEA). We thank the two societies for their supports and helps during the organization of this meeting.

BioEM2017 will be held in the West Lake Villa near the West Lake scenic area in Hangzhou, which is located in the southwest of Shanghai and close to the scenic Yellow Mountain. The city of Hangzhou is one of the Seven Ancient Capitals of China, and shares with Suzhou the ultimate fame of "Paradise on Earth". The historic city Hangzhou has won a lot of national and international reputations, such as the "Oriental Capital of Leisure" by the World Leisure Organization, the "Best Tourist City of China" by National Tourism Administration and the "Nations in Bloom" by United Nations. Both the West Lake and the Grand Canal are UNESCO World Heritage Sites.

The West Lake Villa as a provincial ambassador reception center, affiliated to the Provincial authority affairs administration, is a third state guesthouse in the province. It reaches the history street in the south and the Ge Ling mountain ridge in the north, covering an area of hundreds square miles. The Villa is just like a natural oxygen bar in the city center with ancient trees and green lawns around it. The West Lake Villa was a G20 Summit hotel in 2016 and will offer professional services for our delegates in the international BioEM meeting in China.

On Tuesday the banquet will be held in the Hangzhou Cuisine Museum, which is located in the side of Jiang Yang fan original ecological park, next to the Southern Song Dynasty imperial, and on the sunny side of the Fenghuang Hill (Phoenix Hill). The museum consists of four sections – Exhibition Area, Qiantang Kitchen, Taste of Hangzhou, and Dongpo Pavilion. The exhibition area dates back to thousands years history of development of Hangzhou Cuisine, with more than one hundred dietary exhibits and three hundred pieces of food models, while Qiantang kitchen shows folk culture of Hangzhou cuisine. Taste of Hangzhou and Dongpo Pavilion provide many delicious traditional Hangzhou foods, e.g., West Lake Carp in Sweet and Sour Sauce, Sister Song's Fish Broth, Shelled Shrimps with Dragon Well Green Tea (or Long Jing), Honey Lotus Root Stuffed with Glutinous Rice, Stewed Spring Bamboo Shoots.

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

We look forward to seeing you throughout the week. Wish you have an interesting conference with a lot of enlightening and entertaining moments.

Welcome to Hangzhou!

Zhengping Xu and Zhengping Yu
Co-Chairs, Local Organizing Committee

## Technical Program Committee


Joachim Schüz
Co-chair
France


Luc Martens
Co-chair
Belgium


Francesca Apollonio
Italy


Heidi Danker-Hopfe
Germany


Meike Mevissen
Switzerland


Martin Roosli
Switzerland


Zhengping Xu
China


Yun-Sil Lee
South Korea


Jianqing Wang
Japan

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

Dear Colleague,

We warmly welcome you to Hangzhou for the Joint Annual Meeting of the Bioelectromagnetics Society (BEMS) and European Bioelectromagnetics Association (EBEA), BioEM2017. 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 opportunities of the bioelectromagnetics field. This is the first time the Annual Meeting is hosted in China and we thank the local organizers for providing the framework for shaping the meeting – this illustrates that BioEM 2017 is indeed reaching a global audience.

We are happy that many proposals were submitted by our scientific community for the invited speakers program, the workshops and tutorials, showing great vitality providing interesting and new ideas. The Technical Program Committee (TPC) selected 6 plenary talks with distinguished speakers, 4 workshops and 1 tutorial.

The plenary sessions will cover most of the key issues of bioelectromagnetics, with having some of the most distinguished speakers in each area. Several emerging areas are covered, as epigenetic research, use of mobile technology in disease prevention and in research, clinical applications and electroportation, and optogenetics.

The tutorial will give you insights in how different disciplines can be involved and how each other can be informed in an EMF project in order to obtain the best outcome of the project, and thereby aligns with a plenary session on how multi-disciplinary collaboration is used for achieving the scientifically most rigorous results in another research field (nanotechnology).

Three of the four workshops will elaborate on specific EMF dosimetry topics and one on the establishment of thresholds for acute neurophysiological effects of ELF magnetic fields.

223 abstracts from 22 different countries all over the world were submitted. Many scientists from our community have acted as reviewers; each submitted abstract was scored by at least three referees. After selection of the accepted abstracts, the TPC assigned them into 13 oral Platform Sessions and two Poster Sessions, preceded by Flash Student Poster presentations. A strong participation of students (49 submitted abstracts) demonstrates again the ability of our Societies to attract young researchers and it gives hope for a continuous renewal of our community.

BioEM2017 will also give a number of awards and recognitions.

BioEM2017 continues the tradition of the Chiabrera Lecture for Excellence in Bioelectromagnetics, an honor bestowed on an outstanding young researcher by EBEA. On the last day of the conference, the prestigious d'Arsonval Award from BEMS will be presented this year to Prof. Karl Schoenbach, in recognition of his outstanding achievements in various fields of bioelectromagnetics. Finally, we will end with the traditional awards of the students and the last year added 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 the members of the TPC of their dedication to design an interesting program, the referees who diligently reviewed and scored all the submitted abstracts, as well as Astrid Chamson-Reig and Jeff Carson from Lawson Health Research Institute in Canada who have supported us with hard work and constant

contributions on the submission website and the abstract book, which have been essential for the final result.

Furthermore, our personal thanks go to Professor Guangdi Chen and the Local Organizing Committee, to Professor Isabelle Lagroye, EBEA President, and to Professor Nam Kim, BEMS President for all the support.

On behalf of the Technical Program Committee, we conclude thanking you for your participation and support to BioEM2017 conference and we hope that you will enjoy the meeting!

Luc Martens and Joachim Schüz
Co-Chairs, Technical Program Committee, BioEM2017

# Technical Program Review Committee


Francesca Apollonio
Italy


Quirino Balzano
United States


Frank Barnes
United States


Christian Bornkessel
Germany


Myles Capstick
Switzerland


Phil Chadwick
United Kingdom


Astrid Chamson-Reig
Canada


Indira Chatterjee
United States


Chuanfang Chen
China


Guangdi Chen
China


C-K. Chou
United States


Michal Cifra
Czech Republic


Robert Cleveland
United States


Rodney Croft
Australia


Jan Cuppen
Netherlands


Anna Dalecki
Australia


Heidi Danker-Hopfe
Germany


Shirin Davarpanah Jazi
Canada


Gui-Rong Ding
China


Kenneth Foster
United States


Juerg Froehlich
Switzerland


Osamu Fujiwara
Japan


Martin Gledhill
New Zealand


Jose Gomez-Tames
Japan


Ben Greenebaum
USA


Francis Hart
United States


Steve Iskra
Australia


Wout Joseph
Belgium


Efthymios Karabetsos
Greece


Yoon-Won Kim
Korea


Leena Korpinen
Finland


Stavros Koulouridis
Greece


Shin Koyama
Japan


Susanna Lagorio
Italy


Hae-June Lee
Korea


James C. Lin
USA


Sarah Loughran
Australia


Mai Lu
China


Edwin Mantiply
United States


Carmela Marino
Italy


Marko Markov
United States


Luc Martens
Belgium


Mats-Olof Mattsson
Austria


Robert McIntosh
Australia


Caterina Merla
Italy


Meike Mevissen
Switzerland


Hiroaki Miyagi
Japan


Junji Miyakoshi
Japan


Mihaela Morega
Romania


Mirjana Moser
Switzerland


Satoshi Nakasono
Japan


Georg Neubauer
Austria


Richard Nuccitelli
United States

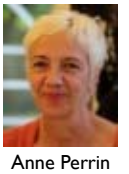

Gunnhild Oftedal
Norway


Hideyuki Okano
Japan


Andrei Pakhomov
United States


Olga Pakhomova
United States


Weidong Pan
China


Anne Perrin
France


Rosanna Pinto
Italy


Blanka Pophof
Germany


Florence Poulletier De Gannes
France


Alan Preece
United Kingdom


Victoria Ramos
Spain


Mary Redmayne
New Zealand


Stefania Romeo
Italy


Martin Roosli
Switzerland


Jack Rowley
Australia


Joachim Schüz
France


Tsukasa Shigemitsu
Japan


Aude Silve
Germany


Tao Song
China


Arno Thielens
Belgium


Gunter Vermeeren
Belgium


Thomas Vernier
United States


Kanako Wake
Japan


Andrew Wood
Australia


Tongning Wu
China


Zhengping Xu
China


Sachiko Yamaguchi-Sekino
Japan


Kenichi Yamazaki
Japan


Shengyong Yin
China


Olga Zeni
Italy


Xin Zhang
China

# Schedule at a Glance

NO PHOTOS ARE ALLOWED DURING THESE PRESENTATIONS

**Sunday, June 4, 2017**

| Time | Session | Name | Location |
|---|---|---|---|
| 09:00 - 12:30 | M1 | BEMS Board Meeting | Jinghua |
| 13:15 - 17:00 | SS | Special Symposium: RF hyperthermia and cancer therapy in China | Fengyu |
| 14:00 - 17:00 | M2 | EBEA Council Meeting | Jinghua |
| 18:30 - 20:30 | | Welcome Reception | Jinhua |
| 20:30 - 23:30 | | Student Ice Breaker | Jinghua Bar |

**Monday, June 5, 2017**

| Time | Session | Name | Location |
|---|---|---|---|
| 09:00 - 09:30 | OC | Welcome | Jinhua |
| 09:30 - 10:30 | P1 | Plenary 1: Epigenetics and EMF – current status of research | Jinhua |
| 10:30 - 11:00 | | Coffee Break | |
| 11:00 - 12:30 | S01 | In vivo | Jinhua |
| 11:00 - 12:30 | S02 | Dosimetry-measurements 1 | Fengyu |
| 12:30 - 13:30 | | Lunch | |
| 13:30 - 14:30 | FA | Student Flash Poster Session A | Jinhua |
| 14:30 - 16:00 | PA | Poster Session A | 2nd floor hallway |
| 16:00 - 16:30 | | Coffee Break | |
| 16:30 - 18:00 | W1 | Workshop 1: Computational models for Non-Invasive Brain Stimulation | Jinhua |
| 16:30 - 18:00 | W2 | Workshop 2: 5G and IoT exposure: RF-EMF Exposure assessment and novel devices | Fengyu |

**Tuesday, June 6, 2017**

| Time | Session | Name | Location |
|---|---|---|---|
| 09:00 - 10:30 | P2 | Plenary 2: mHealth – New horizons for prevention implementation and for research using mobile technology | Jinhua |
| 10:30 - 11:00 | | Coffee Break | |
| 11:00 - 12:30 | S03 | Epidemiology | Jinhua |
| 11:00 - 12:30 | S04 | Dosimetry-computational 1 | Fengyu |
| 12:30 - 13:30 | | Lunch | |
| 12:30 - 13:30 | M3 | EBEA Assembly Lunch | Fengyu |
| 13:30 - 14:00 | FB | Student Flash Poster Session B | Jinhua |
| 14:00 - 15:30 | PB | Poster Session B | 2nd floor hallway |
| 15:30 - 16:00 | | Coffee Break | |
| 16:00 - 17:30 | W3 | Workshop 3: Utilities Threshold Initiative Consortium - Experimental Responses in Humans exposed to High ELFs Fields and Impact on Standards and Guidelines | Jinhua |
| 16:00 - 17:30 | W4 | Workshop 4: Is the Evaluated In Vivo Exposure Level in a Reverberation Chamber Reliable? | Fengyu |
| 18:00 - 23:30 | | Conference Dinner | Hangzhou Cuisine Museum |

**Wednesday, June 7, 2017**

| Time | Session | Name | Location |
|---|---|---|---|
| 08:30 - 10:00 | S05 | Clinical | Jinhua |
| 08:30 - 10:00 | S06 | Behavioural | Fengyu |
| 10:00 - 10:30 | | Coffee Break | |
| 10:30 - 12:00 | P3 | Plenary 3: New challenges in tissue ablation clinical applications based on electroporation | Jinhua |
| 12:00 - 13:00 | CA | Chiabrera Award | Jinhua |

**Thursday, June 8, 2017**

| Time | Session | Name | Location |
|---|---|---|---|
| 08:30 - 10:30 | S07 | In vitro | Jinhua |
| 08:30 - 10:30 | S08 | Dosimetry-computational 2 | Fengyu |
| 10:30 - 11:00 | | Coffee Break | |
| 11:00 - 12:30 | P4 | Plenary 4: Current knowledge of biological effects above 6 GHz | Jinhua |
| 12:30 - 13:30 | | Lunch | |
| 12:30 - 13:30 | M4 | BEMS Business Lunch | Fengyu |
| 13:30 - 14:30 | P5 | Plenary 5: Bridging research disciplines and how EMF research can learn from other disciplines: the example of nanotechnology | Jinhua |
| 14:30 - 16:00 | S09 | Electroporation | Fengyu |
| 14:30 - 16:00 | T1 | Tutorial: Bridging disciplines in an EMF project: ARIMMORA | Jinhua |
| 16:00 - 16:30 | | Coffee Break | |
| 16:30 - 18:00 | S10 | Mechanistic/Theoretical | Jinhua |
| 16:30 - 18:00 | S11 | Standards / Public Health Policy | Fengyu |

**Friday, June 9, 2017**

| Time | Session | Name | Location |
|---|---|---|---|
| 08:30 - 10:00 | S12 | Human | Jinhua |
| 08:30 - 10:00 | S13 | Dosimetry-measurements 2 | Fengyu |
| 10:00 - 11:00 | DA | D'Arsonval Award | Jinhua |
| 11:00 - 11:30 | | Coffee Break | |
| 11:30 - 12:30 | P6 | Plenary 6: Optogenetics: involving light to control cells | Jinhua |
| 12:30 - 13:30 | | Student Awards - BioEM2018 Slovenia Presentation | Jinhua |
| 13:30 - 14:00 | | Closing Ceremony | Jinhua |
| 14:00 - 16:00 | M5 | BEMS Board Meeting | Tiancheng |
| 14:00 - 16:00 | M6 | EBEA Council Meeting | Jinghua |

## THE CONFERENCE VENUE

BioEM2017 will take place at the West Lake Villa, a state guesthouse. It is located at 84, Beishan street, north street around the West Lake. Among the world's top-rated lakes, Hangzhou's wondrous West Lake is one of the best. The real attraction of West Lake, however, lies not on the surface but in its abundant wealth of legend, myth, and enigma accumulated over various dynasties. The historic Hangzhou, renowned as one of China's seven Ancient Capitals, is proudly among the first group of cities that the central government designated as Historic and Cultural City. June is an early summer month with average temperatures between 21°C (69°F) and 29°C (84°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, you will spot the Registration and Information Desk on the right (see Ground Maps). Please follow the directions.

From Sunday, June 4 to Friday, June 9, the Registration Desk will be open from 8: 00 AM to closing of all session each day.

## 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/Chinese foods buffet will be provided on Monday, June 5, on Tuesday, June 6, on Wednesday, June 7, and on Thursday, June 8 in the restaurants. Coffee breaks will take place in the hallway.

## SOCIAL EVENTS

### WELCOME FUNCTION

Sunday, June 4, 6:30 PM at the conference venue. Expected end time: approximately 8:30 PM.

### STUDENT ICE BREAKER

Sunday, June 4, 8:30 PM till 11:00 PM at the Jinghu Bar (Beishan street), a short walk from the conference venue. We will meet at the conference venue Registration Desk at 8:15 PM and then walk in group to the Jinghu Bar.

### CONFERENCE BANQUET

Join us Tuesday, June 6, 8:00 PM for Conference Banquet at the Hangzhou Cuisine Museum. We will gather at the Registration Desk at 5:45 PM and take the shuttle buses to the Hangzhou Cuisine Museum.

The Buses are on a tight schedule, so please make sure to be at the quay no later than 5:45 PM. The buses will take us to the museum, where we will disembark at 6:30 PM for a reception and the conference banquet.

# ORAL AND POSTER PRESENTATION GUIDELINES

Please find below some potentially useful material to assist you in preparing a presentation for BioEM2017.

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@bioem.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 15-minute time slot. These 15-minutes must include the presentation, questions, and transitioning to the next speaker. It is recommended that speakers plan on a 10-12 minute presentation to allow for some 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 audio-visual 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 BioEM2017 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 5 at 2:30 PM, and B on Tuesday, June 6 at 2:00 PM, are planned.
- **All student posters** will also be presented as **poster flash presentation.** The two poster flash sessions will take place on Monday, June 5 in meeting room from 1:30 PM to 2:30 PM (FA), and on Tuesday, June 6 in meeting room from 1:30 PM to 2:00 PM (FB).
- Please ensure that you plan your communication carefully. The language is English. Each presenter will have **3 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 3 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 5 before 12:30 PM for the FA session, and on Tuesday June 6 before 12:30 PM 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 the 2nd floor hallway**.** Poster boards will be available for each author to attach their posters to. Authors are limited to use the **A0 portrait format**. Poster size should be less than 90 cm (length) X 120 cm (height). 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 9, 12:00 PM (noon).

## CONFERENCE ORGANIZERS

**杭州圆正会议展览有限公司**
**Yuanzheng Convention Company**

Conference Organizing and Service, Events Planning, Registration and Accommodation Arrangement, Meeting Website Maintenance.

Jiang Zhiqiu
Dandan Dong

Yuanzheng Convention Company
No.27 Shengfu Road
Hangzhou
China
jiangzhiqiu@zju.edu.cn

杭州圆正会议展览有限公司
Yuanzheng Convention Company

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

Abstract submission, abstract review, program and abstract books, student award judging, and meeting survey

Jeffrey Carson
Astrid Chamson-Reig

Lawson Health Research Institute
268 Grosvenor Street
London, Ontario,
Canada, N6A-4V2
office@bems.org
office@bioem.org

LAWSON
HEALTH RESEARCH INSTITUTE

## Sunday June 4, 2017

**Session: M1**
**BEMS Board Meeting**
**Sunday June 4, 2017 • 09:00 - 12:30**
**Jinghua**

**Session: SS**
**Special Symposium: RF hyperthermia and cancer therapy in China**
**Sunday June 4, 2017 • 13:15 - 17:00**
**Fengyu**

**Session: M2**
**EBEA Council Meeting**
**Sunday June 4, 2017 • 14:00 - 17:00**
**Jinghua**

**Welcome Reception**
**Sunday June 4, 2017 • 18:30 - 20:30**
**Jinhua**

**Student Ice Breaker**
**Sunday June 4, 2017 • 20:30 - 23:30**
**Jinghua Bar**

**Session: OC**
**Welcome**
**Monday June 5, 2017 • 09:00 - 09:30**
**Jinhua**

**Session: P1**
**Plenary 1: Epigenetics and EMF – current status of research**
**Monday June 5, 2017 • 09:30 - 10:30**
**Jinhua**
**Chair: Meike Mevissen**

**P1-1 [09:30]**

## Epigenetic Landscapes and Electromagnetic Fields: Concepts and Observations

Primo Schär[1]
[1]*Department of Biomedicine, University of Basel, Mattenstrasse 28, Basel, Switzerland, CH-4058*

### Biographical sketch

Primo Schär is Professor of Molecular Genetics at the Faculty of Medicine of the University of Basel, where he leads a research group at the Department of Biomedicine. He is a trained biologist with a strong background in genetics, biochemistry and cell biology. The long-standing research interest has been the molecular mechanisms underlying the structural and functional plasticity of genomes, i.e. the (in)stability of the genetic and epigenetic codes of cell identity under the influence of the environment. The objective of his work is to provide a thorough understanding of the origin of genetic and epigenetic change and its relationship to human ageing and age-related disease such as cancer. The Schär laboratory has pioneered research in the DNA repair and DNA methylation fields with seminal discoveries in the areas of DNA double strand-break repair, DNA base excision repair and its role in DNA demethylation control. The lab has also made significant contributions towards understanding the mode of action of DNA-directed cancer therapeutic drugs and towards unravelling the origin and role of DNA methylation instability in carcinogenesis.

Five relevant publications

Focke, F., Schuermann, D., Kuster, N., and Schär P. (2010). DNA Fragmentation in Human Fibroblasts Under Extremely Low Frequency Electromagnetic Field Exposure. Mutat Res 683, 74-83.

Cortazar, D., Kunz, C., Selfridge, J., Lettieri, T., Saito, Y., MacDougall, E., Wirz, A., Schuermann, D., Jacobs, A., Siegrist, F., Steinacher, R., Jiricny, J., Bird, A. & Schär, P. (2011) Embryonic lethal phenotype reveals a function of TDG in maintaining epigenetic stability. Nature 470, 419-423.

Noreen, F., Röösli, M., Gaj, P., Pietrzak, J., Weis, S., Urfer, P., Regula, J., Schär, P.*, and Truninger, K.* (2014). Modulation of age- and cancer-associated DNA methylation change in the healthy colon by aspirin and lifestyle. J Natl Cancer Inst 106 (7): dju161. (*co-corresponding authors)

Weber, A. R., Krawczyk, C., Robertson, A. B., Kuśnierczyk, A., Vågbø, C. B., Schuermann, D., Klungland, A., and Schär, P. (2016). Biochemical reconstitution of TET1-TDG-BER-dependent active DNA demethylation reveals a highly coordinated mechanism. Nat Commun 7, 10806.

Manser, M., Sater, M. R., Schmid, C. D., Noreen, F., Murbach, M., Kuster, N., Schuermann, D., and Schär, P. (2017). ELF-MF exposure affects the robustness of epigenetic programming during granulopoiesis. Sci Rep 7, 43345.

### Abstract

The susceptibility to any human disease is determined variably by genetic predisposition and environmental exposure, whereby exposure can impact on the genome and thereby generate genetic effects. A most extreme case is when environmental mutagens induce changes in the DNA sequence and thereby mutate the genetic code. This, however, requires agents, such as ultraviolet light, with a capacity to chemically damage the DNA molecule. Less severe but more frequent are environment-genome interactions that do not cause

mutations but may perturb patterns of DNA and protein modifications that instruct how the genome is read. Unlike the DNA sequence itself, these chemical flags are dynamic; they are positioned in response to environmental cues, creating a heritable but metastable "epigenetic code" that determines the cell-type-specific gene usage. Research into the effect of electromagnetic fields (EMF) on the stability of DNA, prompted by concerns of a potential carcinogenicity of such exposure, has failed to produce consistent evidence for a mutagenic action. Yet, whether EMFs have the capacity to perturb "epigenetic codes", similar to a range non-mutagenic carcinogens, has not been systematically addressed. We have started to investigate this possibility in leukaemia cells and in stem cells undergoing differentiation to specialized blood cell-types, focusing on the establishment and the maintenance of key epigenetic DNA and histone modifications. I will discuss the general concept of environment-epigenome interactions and present data on the influence of EMF exposure on the epigenetic programming of blood cells.

**Coffee Break**
**Monday June 5, 2017 • 10:30 - 11:00**

**Session: S01**
**In vivo**
**Monday June 5, 2017 • 11:00 - 12:30**
**Jinhua**
**Chairs: James Lin & Xiangjun Hu**

**S01-1 [11:00]**

### Assessment of mice's bone marrow epigenetic modification by low frequency electromagnetic field (50 Hz) exposure. Final results from the CLeMAn project.

Denis Habauzit[1], Catherine Martin[1], Florence Poulletier De Gannes[2], Rémy Le Guével[3], Emmanuelle Poque-Haro[2], Annabelle Hurtier[2], Isabelle Lagroye[2] & Yves Le Dréan[1]

[1]*Institute for research on environmental and occupational health (IRSET), Inserm U1085, University of Rennes 1, Rennes, France, 35000*

[2]*EPHE & IMS laboratory, Bordeaux University, Talence, France, 33405*

[3]*ImPACcell, SFR Biosit, UMS 3480 CNRS, US 018 INSERM, University of Rennes 1, Rennes, France, 35043*

***Keywords: In vivo, ELF/LF, Completed (unpublished)***
***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. The Cleman project have aimed to study epigenetic changes (histone and DNA modifications) in the bone marrow of mice, exposed 8 h/d, 5d/wk at 1000 µT. The use of the high-content microscopy screening was performed for rare epigenetic modification highlight but also for the potential subpopulation characterisation.

**S01-2 [11:15]**

### Examination of apoptosis related protein expression in mouse testis after continuous

**Session: S02**
**Dosimetry-measurements 1**
**Monday June 5, 2017 • 11:00 - 12:30**
**Fengyu**
**Chairs: Wout Joseph & Manuel Murbach**

**S02-1 [11:00]**

### Personal measurements of radiofrequency electromagnetic fields in adolescents in the SCAMP cohort study, London

Martin Roosli[1, 2], Marloes Eeftens[1, 2], Benjamin Struchen[1, 2] & Mireille Toledano[3]

[1]*Swiss TPH, Basel, Switzerland*

[2]*University of Basel, Basel, Switzerland*

[3]*Imperial College London, London, United Kingdom*

***Keywords: Dosimetry (measurements), RF/Microwaves, Work in Progress***
***Presented by: Martin Roosli***

In the framework of the Study of Cognition, Adolescents and mobile phone (SCAMP cohort study) personal exposure data are collected in 200 adolescent aged 12-13 years for 2-3 days and activity is recorded with an electronic diary and the GPS integrated in the measurement device Expom-RF. Currently, preliminary data from 44 participants are available and mean total RF-EMF exposure is 0.21 V/m. Updated exposure data from approx. 100 adolescents will be presented at the meeting.

**S02-2 [11:15]**

### Near-field exposure assessments of power density above 6 GHz

**exposure of 60 Hz Magnetic fields**

Sungman Park[1], Yena Lee[1], Sapaev Mukhtor[2], Young-Nam Lee[1], Min-Sol Kim[1], Young Deuk Kim[1], Suyeon Kim[1], Young Ae Park[1], Eun Young Hwang[1], Min Soo Kim[1], Nam Kim[3], Yoon-Myoung Gimm[4], Sang-Kon Lee[2] & Yoon-Won Kim[1, 5]

[1]*Institute of Medical Science, Hallym University, Chuncheon, Korea, 24232*

[2]*Department of Urology, Sacred Heart Hospital , Hallym University, Chuncheon, Korea*

[3]*Chungbuk National University, Chengju, Korea*

[4]*Department of Electronics and Electrical Engineering, Dankook University, Yong-In, Korea*

[5]*Department of Microbiology, Hallym University, Chuncheon, Korea*

***Keywords: In vivo, ELF/LF, Completed (unpublished)***

***Presented by: Sungman Park***

We investigated the expression of apoptosis related genes following the continuous exposure of 60 Hz magnetic fields (MF) for 8 weeks in mouse testis. We found the upregulation of Endonuclease G, Bax, and downregulated anti-apoptotic bcl-2 family proteins using immunohistochemistry. There was no significantly changed apoptosis related genes expression in RNA levle during the exposure. We found that the expressions of anti-apoptotic protein Bcl-xL and Mcl-1 were decreased after 25 and 100 μT of 60 Hz MF exposure using western blot. These results indicate that the exposure of 60 Hz MF does not regulate de novo gene expression but broke the homeostasis through the anti-apoptotic protein levels and induced cell death.

**S01-3 [11:30]**

**Global analysis of gene expression in mouse brain after exposure to around 85-kHz intermediate-frequency magnetic fields**

Shin Ohtani[1], Akira Ushiyama[2], Kenji Hattori[1], Machiko Maeda[1], Naoki Kunugita[2], Keiji Wada[3], Yukihisa Suzuki[3] & Kazuyuki Ishii[1]

[1]*Department of Hygienic Chemistry, Meiji Pharmaceutical University, Kiyose, Japan, 204-8588*

[2]*Department of Environmental Health, National Institute of Public Health, Wako, Japan, 351-0197*

[3]*Graduate School of Science and Engineering, Tokyo metropolitan University, Hachioji, Japan, 192-0397*

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

***Presented by: Shin Ohtani***

To explore the possible nonthermal biological effects of an intermediate-frequency magnetic field (IF-MF), we performed a comprehensive evaluation of gene expression in the mouse brain after IF-MF exposure. Compared with sham-exposed mice, differentially expressed genes were not identified in exposed mice under a fold change cut-off of ≥2.0,

Teruo Onishi[1], Daisuke Funahashi[2], Iyama Takahiro[1] & Akimasa Hirata[2]

[1]*NTT DOCOMO, INC., Kanagawa, Japan, 239-8536*

[2]*Nagoya Institute of Technology, Nagoya, Japan, 466-8555*

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

***Presented by: Teruo Onishi***

Recently research and development as well as standardization on the 5th mobile communication system (5G) have been actively conducted all over the world. Frequency bands above 6 GHz for 5G are considered in addition to those used for current mobile systems. From exposure assessment point of view, the incident power density should be used above 6 GHz as a measurement index while the Specific Absorption Rate (SAR) has been used for near-field exposure up to 6 GHz. It is shown that evaluation results of power density by a conventional probe such as a waveguide (WG) probe, which is used for near-field to far-field transformation.

**S02-3 [11:30]**
**STUDENT PAPER**

**Investigation of LTE user equipment transmit power control and comparison of uplink exposure between small and macro cell environment**

Thomas Kopacz[1], Christian Bornkessel[2], Matthias Hein[2] & Dirk Heberling[1]

[1]*Institute of High Frequency Technology, RWTH Aachen University, Aachen, Germany, D-52074*

[2]*RF & Microwave Research Laboratory, TU Ilmenau, Ilmenau, Germany, D-98684*

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

***Presented by: Thomas Kopacz***

A low UE transmit power is desired to save battery runtime and to minimize interferences as well as the personal exposure to electromagnetic fields in LTE networks. In this study, we investigated the transmit power control for UE depending on the RSRP in a small cell. RSRP had to exceed a threshold of about -90 dBm in order to reduce the

with the exception of one small nucleolar RNA, Snord13. When the fold level was reduced to a cut-off of ≥1.5, 12 transcripts containing mRNA and noncoding RNA were identified. In summary, IF-MF exposure, which corresponds to the basic restriction level of internal inducted electronic field defied by ICNIRP guidelines, has limited ability to detect small changes in some mRNAs and noncoding RNAs.

**S01-4 [11:45]**
**STUDENT PAPER**

### Pulsed electromagnetic fields (PEMFs) improve deteriorated bone strength induced by ovariectomy via inhibiting inflammatory cytokines (TNF-α and IL-6) responses: newer potential targets for therapeutic PEMFs

Siyi Zhu[1, 2, 3], Hongchen He[1, 2], Chi Zhang[1, 2], Haiming Wang[1, 2], Chengfei Gao[1, 2], Qian Wang[1, 2], Quan Wei[1, 2], Xijie Yu[3] & Chengqi He[1, 2]

[1]*Department of Rehabilitation Medicine, West China Hospital, Chengdu, China, 610041*

[2]*Rehabilitation Key Laboratory of Sichuan Province, West China Hospital, Chengdu, China, 610041*

[3]*Laboratory of Endocrinology and Metabolism, West China Hospital, Chengdu, China, 610041*

***Keywords: In vivo, ELF/LF, Completed (unpublished)***
***Presented by: Siyi Zhu***

Accumulating evidences indicated that estrogen withdrawal is associated with increased production of pro-inflammatory cytokines which can perturb bone metabolism and promote increased bone loss. This study was designed to investigate the effects of PEMFs on bone metabolism using ovariectomy-induced osteoporosis animal models and gene knockout mice to explore whether tumor necrosis factor-α(TNF-α) and interleukin-6 (IL-6) are involved. Our results suggest that TNF-α and IL-6 played an important pathogenic role in bone loss after oestrogen deficiency and the beneficial effect of pulsed electromagnetic field may be associated with regulation of the inflammatory factors including TNF-α and IL-6.

UE transmit power below the maximum output power. The decrease is roughly proportional to the inverse of RSRP. Furthermore, to compare the exposure to mobile terminals in small cells and macro cells, the transmit power was measured in both environments. In small cells, the transmit power was clearly lower in case of LOS. However, for NLOS conditions, the transmit power was lower in the macro cell.

**S02-4 [11:45]**

### Effect of human body morphology on measurement uncertainty of a multi-band body-worn distributed-exposimeter

Reza Aminzadeh[1], Arno Thielens[1], Patrick Van Torre[1], Sam Agneessens[1], Matthias Van Den Bossche[1], Stefan Dongus[2], Marloes Eeftens[2], Anke Huss[3], Roel Vermeulen[3], Rene De Seze[4], Paul Mazet[5], Elisabeth Cardis[6], Hendrik Rogier[1], Martin Roosli[2], Luc Martens[1] & Wout Joseph[1]

[1]*Department of Information Technology (INTEC), Ghent University/imec, Ghent, Belgium, B-9052*

[2]*Department of Epidemiology and Public Health, Swiss Tropical and Public Health Institute, Basel, Switzerland*

[3]*Institute for Risk Assessment Sciences (IRAS), Utrecht University, Utrecht, the Netherlands*

[4]*National Institute for Industrial Environment and Risks (INERIS), Verneuil en Halatte, France*

[5]*Technical Center for Mechanical Industries (CETIM), Paris, France*

[6]*Barcelona Institute for Global Health (ISGlobal), Barcelona, Spain*

***Keywords: Dosimetry (measurements), RF/Microwaves, Completed (unpublished)***
***Presented by: Wout Joseph***

For the first time, a multi-band body-worn distributed exposimeter (BWDM) calibrated for simultaneous measurement of the incident power density $S_{inc}$ in 11 frequency bands, is proposed. The BDWM consists of 22 textile antennas integrated in a garment and is calibrated on five human subjects in an anechoic chamber to assess its measurement uncertainty in terms of 68% confidence interval ($CI_{68}$) of the on-body antenna aperture. The BWDM has a $CI_{68}$ range of 2.7-8.8 dB for the five subjects participating in calibration measurements. The results show that using a combination of two antennas on the body leads to a maximum 0.1-3.2 dB difference in $CI_{68}$ values for different body morphologies.

**S01-5 [12:00]**

### Pulsed electromagnetic wave exposure induces functional alteration in hormone secretion by the adenohypophysis in rats

Kang Cheng[1], XiaoGuang Zhou[2], HuiJuan Sun[3], Ying Li[4], TingTing Suo[4], Tao Zhao[3], DongQing Ren[4] & GuiYing Zeng[4]

[1]*Department of Cardiology, Xi'an Third Hospital, Xi'an, China, 710018*

[2]*Department of Pediatric Urology, Bayi Children's Hospital Affiliated to PLA Army General Hospital , Beijing, China, 100700*

[3]*Department of Radiation Biology, Fourth Military Medical University, Xi'an, China, 710032*

[4]*Department of Radiation Medicine, Fourth Military Medical University, Xi'an, China, 710032*

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

***Presented by: Tao Zhao***

The stability of the endocrine system is critical to maintaining health. The aim of this study was to investigate the effects of pulsed electromagnetic wave (PEMW) exposure on adenohypophysis function. Male Sprague–Dawley rats were sham- or whole-body-exposed to PEMW at different pulses. The concentrations of adrenocorticotropic hormone (ACTH), thyroid stimulating hormone (TSH), prolactin (PRL), growth hormone (GH), and luteinizing hormone (LH) in serum were measured. The hormone secretion of the rats changed with time and number of pulses. These results suggest that exposure to PEMW elicits functional alteration in hormone secretion by the adenohypophysis of the rat.

**S01-6 [12:15]**

### Non-invasive EMP-induced BBB opening facilitated drug delivery in rat glioma model

Gui-Rong Ding[1], Ke-Ying Zhang[1], Kangchu Li[1], Shenglong Xu[1], Xiaowu Wang[1], Peng Gao[2], Yan Zhou[1] & Guozhen Guo[2]

[1]*Department of Radiation Biology, Fourth Military Medical University, Xi'an, China, 710032*

[2]*Department of Radiation Medicine, Fourth Military Medical University, Xi'an, China, 710032*

***Keywords: In vivo, All Frequencies, Completed (unpublished)***

***Presented by: Gui-Rong Ding***

Chemotherapy on gliomas is not effective because of the presence of BBB. In order to facilitate the chemotherapeutics to penetrate BBB and increase the treatment efficacy of gliomas, EMP was applied in this study. The concentration of CCNU in tumor tissue, tumor size, tumor apoptosis and sides effects were measured in glioma-bearing rat model. The results showed that EMP exposure could

**S02-5 [12:00]**
**STUDENT PAPER**

### Emissions of electric and magnetic fields at intermediate frequencies by household appliances

Sam Aerts[1], Carolina Calderon[2], Blaz Valic[3], Matthias Van Den Bossche[1], Leen Verloock[1], Myron Maslanyj[2], Darren Addison[2], Peter Gajsek[3], Luc Martens[1] & Wout Joseph[1]

[1]*Department of Information Technology, Ghent University / imec, Ghent, Belgium, 9000*

[2]*Public Health England, Chilton, Didcot, United Kingdom, OX11 0RQ*

[3]*Institute of Non-Ionizing Radiation, Ljubljana, Slovenia*

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

***Presented by: Sam Aerts***

Despite ample investigation of residential exposure to electric and magnetic fields in the extremely-low-frequency (ELF) and radiofrequency (RF) ranges, research on intermediate frequencies (IF) remains limited. A comprehensive measurement survey on the levels of electric and magnetic IF fields emitted by a wide range of household appliances was performed as part of the GERoNiMO study. It was found that the use of appliances at close distance (20 cm) can result in relatively high IF exposures, though none exceeded the ICNIRP exposure summation rule. The observed spectra were either repeatable, containing harmonic signals with fundamental frequencies between 6 kHz and 293 kHz, or unpredictable, dominated by 50 Hz harmonics in the IF domain.

**S02-6 [12:15]**

### Exposure evaluation due to PLC used by Linky meters

Dominique Picard[1] & Joël Legrand[1]

[1]*Electromagnetisme - GeePs, CentraleSupélec, Gif sur Yvette, France, 91192*

***Keywords: Dosimetry (measurements), Static, Completed (published)***

***Presented by: Dominique Picard***

Linky meters are going to be spread in France. These smart meters use G1 PLC and G3 PLC to communicate. These PLC signals create non-intentional electromagnetic fields in the frequency range 36-91 kHz around the meter. This is a new source of exposure which has to be characterized. This study defines an accurate measurement methodology in laboratory to assess the level of these electromagnetic fields of both the vicinity of the Linky meter and the low-voltage electric cable connected to the meter, and presents the level of these electromagnetic fields.

enhance the delivery of CCNU to tumor tissue, facilitate tumor apoptosis and inhibit tumor growth without obvious side effects. The data indicated that EMP-induced BBB opening could enhance delivery of CCNU to tumor and increase treatment efficacy in glioma-bearing rats.

**Lunch**
**Monday June 5, 2017 • 12:30 - 13:30**

**Session: FA**
**Student Flash Poster Session A**
**Monday June 5, 2017 • 13:30 - 14:30**
**Jinhua**
**Chairs: Niels Kuster & Christopher Portier**

**Session: PA**
**Poster Session A**
**Monday June 5, 2017 • 14:30 - 16:00**
**2nd floor hallway**

**Coffee Break**
**Monday June 5, 2017 • 16:00 - 16:30**

**Session: W1**
**Workshop 1: Computational models for Non-Invasive Brain Stimulation**
**Monday June 5, 2017 • 16:30 - 18:00**
**Jinhua**
**Chair: Mai Lu**

**W1-1 [16:30]**

**Introduction**

Mai Lu[1]
[1]*Key Lab. of Opt-Electronic Technology and Intelligent Control of Ministry of Education, Lanzhou Jiaotong University, Lanzhou, China, 730070*

The workshop aims to provide a forum for researchers working on non-invasive brain stimulation by electromagnetic fields. Talks will focus on computational modelling in transcranial magnetic stimulation and transcranial direct current stimulation (tDCS).

**Session: W2**
**Workshop 2: 5G and IoT exposure: RF-EMF Exposure assessment and novel devices**
**Monday June 5, 2017 • 16:30 - 18:00**
**Fengyu**
**Chair: Wout Joseph**

**W2-1 [16:30]**

**Introduction**

Wout Joseph[1], Niels Kuster[2], Joe Wiart[3] & Azadeh Peyman[4]
[1]*Department of Information Technology, Ghent University / IMEC, Ghent, Belgium, 9000*
[2]*IT'IS Foundation, Zurich, Switzerland*
[3]*ParisTech, Paris, France*
[4]*Public Health England, Harwell, Oxfordshire, United Kingdom*

The aim of this workshop is to provide an introduction into equipment and procedures to perform compliance and exposure assessment of 5G at 60 GHz, and to develop methods to assess exposure of small cells, IoT smart meters, and novel massive MIMO (multiple-input multiple output) technologies.

**W1-2 [16:30]**

### Transcranial direct current stimulation: inter-subject variability in brain electric fields

Ilkka Laakso[1], Marko Mikkonen[1], Soichiro Koyama[2], Akimasa Hirata[3] & Satoshi Tanaka[4]

[1]*Department of Electrical Engineering and Automation, Aalto University, Espoo, Finland, 00076*

[2]*Fujita Health University, Toyoake, Japan*

[3]*Nagoya Institute of Technology, Nagoya, Japan*

[4]*Hamamatsu University School of Medicine, Hamamatsu, Japan*

Every brain is different, and so are the electric fields generated in the brain when it is stimulated using non-invasive electrical or magnetic techniques. Individual variations in the electric fields may be a major factor contributing to the variability in the outcomes of stimulation. The electric fields can be determined using numerical techniques such as the finite-element method and segmentation of MR images. This paper reviews methods we have recently developed for statistical analysis of the electric fields in a group of subjects, as opposed to conventional approach of analysing electric fields of single subjects. The methods are useful for planning, analysing and interpreting tDCS studies.

**W1-3 [17:00]**

### Numerical models for transcranial magnetic stimulation

Masaki Sekino[1] & Shoogo Ueno[1]

[1]*Department of Electrical Engineering and Information Systems, The University of Tokyo, Tokyo, Japan, 113-8656*

We introduce recent applications of human head models to analysis of transcranial magnetic stimulation. Shape and size of the stimulator coil can be optimized using numerical simulations using simplified spherical models. Realistic human models enable us to estimate the electric field intensity for activating neurons in the brain. Constructing numerical models for individual patients is important for evaluating stimulus conditions in therapeutic use of magnetic stimulation. Mapping of electric properties is one of the technical challenges in such modeling.

**W1-4 [17:30]**

### Transcranial magnetic stimulation with improved penetration depth utilizing slinky coils

Mai Lu[1] & Shoogo Ueno[2]

[1]*Key Lab. of Opt-Electronic Technology and Intelligent Control of Ministry of Education, Lanzhou Jiaotong University, Lanzhou, China, 730070*

**W2-2 [16:30]**

### Exposure evaluation of ultra high dense cells (attoconcept) and comparison with exposure due to massive MIMO

Wout Joseph[1]

[1]*Department of Information Technology, Ghent University / IMEC, Ghent, Belgium, 9000*

**W2-3 [16:35]**

### Advanced equipment for evaluating 60 GHz fields

Niels Kuster[1]

[1]*IT'IS Foundation, Zurich, Switzerland*

**W2-4 [16:40]**

### Femtocell exposure assessment in real environments

Joe Wiart[1]

[1]*ParisTech, Paris, France*

[2]*Department of Applied Quantum Physics, Kyushu University, Fukuoka, Japan, 812-8581*

This study presents the numerical study of transcranial magnetic stimulation by considering slinky coils with different number of return current paths. Three-dimensional distribution of the electric field in realistic head model was obtained by impedance method, and the results were compared with the conventional figure-of-eight coil. It was found the slinky-19 and slinky-7 coils can penetrate into gray matter and white matter by 7~8 mm, which is 2.3~2.7 times larger than the conventional figure-of-eight (Fo8) coil with 3mm depth. The slinky coils with multiple return paths potentially provide the possibility for realizing the deep transcranial magnetic stimulation.

**W2-5 [16:45]**

### Exposure of people to IoT Smart Meter devices

Azadeh Peyman[1]

[1]*Public Health England, Harwell, Oxfordshire, United Kingdom*

**W2-6 [16:50]**

### Plenary discussion

Wout Joseph[1], Niels Kuster[2], Joe Wiart[3] & Azadeh Peyman[4]

[1]*Department of Information Technology, Ghent University / IMEC, Ghent, Belgium, 9000*

[2]*IT'IS Foundation, Zurich, Switzerland*

[3]*ParisTech, Paris, France*

[4]*Public Health England, Harwell, Oxfordshire, United Kingdom*

**Session: P2**
**Plenary 2: mHealth – New horizons for prevention implementation and for research using mobile technology**
**Tuesday June 6, 2017 • 09:00 - 10:30**
**Jinhua**
**Chair: Joachim Schüz**

**P2-1 [09:00]**

## The Be He@lthy, Be Mobile initiative of WHO and ITU

Emilie van Deventer[1]

[1]*Team Leader Radiation Programme, Department of Public Health, Environmental and Social Determinants of Health, World Health Organization, Geneva, Switzerland*

### Biographical sketch

Emilie van Deventer is the team leader of the Radiation Programme at the World Health Organization. This programme covers the public health aspects of both ionizing and non-ionizing radiation safety. She is responsible for the WHO EMF Project, the InterSun programme and the Radon programme, providing information on the health impact of radiation exposure and guidance to national authorities on effective awareness programmes. Before joining WHO, she was a professor of Electrical and Computer Engineering at the University of Toronto, Canada where she held the NSERC/Bell Canada/Nortel Junior Industrial Research Chair in Electromagnetics. She was a visiting Professor at the European Organization for Nuclear Research (CERN) in Geneva, Switzerland (1998-99) and joined the World Health Organization in 2000. She holds a PhD from the University of Michigan, USA and received a doctorate Honoris Causa from the University of San Marcos, Lima, Peru in 2014.

### Abstract

The use of mobile phones to deliver health services – mHealth – has generated considerable enthusiasm among governments, donors, and implementers of health programs.. Pilot projects have demonstrated conceptually how mHealth can alleviate specific health system constraints that hinder effective coverage of health interventions. However, challenges remain around its use as a population-level health intervention due to a lack of large-scale examples. This has led to limitations on the global understanding of key technical and policy factors affecting its impact.

In 2013 the World Health Organization (WHO) and the International Telecommunications Union (ITU) joined forces to address this gap. They support countries to build, introduce and monitor mHealth interventions for chronic diseases. They are currently supporting programs in 9 countries for a range of disease areas and target audiences.

Their largest program is a collaboration with the government of India, which has seen the launch of national services for both tobacco cessation and diabetes using two-way SMS. The talk will highlight some of the ways in which these services were designed, the role of different stakeholders, and the model for sustainability in the longer term. It will also look at how this compares with examples from other countries such as Senegal and Zambia.

References

Be he@lthy, be mobile initiative Initiative of WHO/ITU
http://www.itu.int/en/ITU-D/ICT-pplications/eHEALTH/Be_healthy/Pages/Be_Healthy.aspx
http://www.who.int/nmh/publications/be-healthy-be-mobile/en/

Contact

Dr. Emilie van Deventer
Tel: + 41 22 791 3950 | Email: vandeventere@who.int

**P2-2 [09:30]**

## Breast cancer survival in sub-Saharan Africa: the value of mHealth in research in low resource settings

Valerie McCormack[1]

[1]*Environment and Radiation Section, International Agency for Research on Cancer (IARC), Lyon, France*

### Biographical sketch

I have a background in epidemiology and medical statistics and since joining IARC in 2011, I have had a large focus on cancer research relevant to cancer prevention in low and middle income countries, particularly in sub-Saharan Africa. These activities entail fieldwork in 8 African countries, including leading a large pan-African prospective study of barriers to early diagnosis and treatment of breast cancer, as well as East African research on the aetiology of squamous cell oesophageal cancer, including lifestyle, molecular and environmental (geochemical) factors. For all studies, mobile-Health data collection is implemented for improved efficiency and quality. I also lead an International Consortium on Mammographic Density, to study the epidemiology of this strong marker of breast cancer risk in heterogeneous populations.

References

V McCormack, D Menya, MO Munishi, C Dzamalala, N Gasmelseed, M Leon Roux, M Assefa, O Odipo, M Watts, AO Mwasamwaja, BT Mmbaga, G Murphy, C Abnet, S Dawsey, J Schüz. Informing aetiologic research priorities for squamous cell oesophageal cancer in Africa: A review of setting-specific exposures to known and putative risk factors. Int J Cancer 2017.

Dickens C, Duarte R, Zietsman A, Cubasch H, Kellett P, Schuz J, Kielkowski D, McCormack V. Racial comparison of receptor-defined breast cancer in Southern African women: subtype prevalence and age-incidence analysis of nationwide cancer registry data. Cancer Epidemiol Biomarkers Prev. 2014 Nov;23(11):2311-21.

M. Oresto Munishi, R. Hanisch, O. Mapunda, T. Ndyetabura, A. Ndaro, J. Schuz, G. Kibiki, V. McCormack. Africa's oesophageal cancer corridor - do hot beverages contribute? Cancer Causes and Control 2015.

Jedy-Agba E, McCormack V, Adebamowo C, Dos-Santos-Silva I. Stage at diagnosis of breast cancer in sub-Saharan Africa: a systematic review and meta-analysis. Lancet Glob Health. 2016 Dec;4(12):e923-e935.

McKenzie F, Zietsman A, Galukande M, Anele A, Adisa C, Cubasch H, Parham G, Anderson BO, Abedi-Ardekani B, Schuz J, Dos Santos Silva I, McCormack V. African Breast Cancer-Disparities in Outcomes (ABC-DO): protocol of a multicountry mobile health prospective study of breast cancer survival in sub-Saharan Africa. BMJ Open. 2016 Aug 23;6(8):e011390.

### Abstract

MHealth, the use of mobile devices and mobile technology in medicine and public health, has impacted on the possibilities for and conduct of health research, as it has on changes in medical care and health-related behaviours. MHealth has a particular role in the fieldwork phase of data collection, enabling the inclusion on disparate study populations. As an illustration of the application of mHealth technologies in an epidemiological study, the African Breast Cancer – Disparities in Outcomes study (ABC-DO, abc-do.iarc.fr) will be presented. This on-going cohort is a prospective multi-country study of outcomes after breast cancer diagnosis in women in 5 sub-Saharan African countries. In this talk, full integration of mHealth into the fieldwork protocol will be discussed, as well as the specific challenges and benefits it led to.

**Coffee Break**
**Tuesday June 6, 2017 • 10:30 - 11:00**

**Session: S03**
**Epidemiology**
**Tuesday June 6, 2017 • 11:00 - 12:30**
**Jinhua**
**Chairs: Emilie van Deventer & Lei Zhang**

**S03-1 [11:00]**

### Comparative analyses of studies of childhood leukemia and magnetic fields, radon and gamma radiation

Leeka Kheifets[1], John Swanson[2], Yingzhe Yuan[1], Cynthia Kusters[1] & Ximena Vergara[1, 3]

[1]*Department of Epidemiology, UCLA, Los Angeles, California, USA, 90095*

[2]*National Grid, London, United Kingdom,*

[3]*EPRI, Palo Alto, , USA,*

***Keywords: Epidemiology, All Frequencies, Completed (published)***

***Presented by: Ximena Vergara***

Epidemiological studies of childhood cancer and magnetic fields, radon, or gamma radiation all have methodological problems. We expect many of those issues to depend on the study design rather than the specific exposure. So we systematically reviewed studies that have examined more than one of these radiation exposures to see what we could learn about the methodological issues from comparing results for the different exposures. We found some indication of bias but little evidence that confounding, including SES, has had a substantial influence on results. The influence of residential mobility is complex and can manifest itself in several ways.

**S03-2 [11:15]**

### Factors affecting validity of self-reported mobile phone use in the COSMOS study

Mireille Toledano[1], Anssi Auvinen[2, 3], Yang Cao[4, 5], Maria Feychting[4], Anders Ahlbom[4], Karin Fremling[4], Giorgio Tettamanti[4], Sirpa Heinavaara[6], Katja Kojo[3], Gemma Knowles[1, 7], Rachel B. Smith[1], Joachim Schüz[8], Christoffer Johansen[9, 10], Aslak Poulsen[9], Isabelle Deltour[8], Roel Vermeulen[11], Hans Kromhout[11], Paul Elliott[1] & Lena Hillert[4, 12]

[1]*MRC-PHE Centre for Environment and Health, Department of Epidemiology and Biostatistics, Imperial College, London, United Kingdom*

[2]*School of Health Sciences, University of Tampere, Tampere, Finland*

[3]*Radiation and Safety Authority (STUK), Helsinki, Finland*

[4]*Institute of Environmental Medicine, Karolinska Institutet, Stockholm, Sweden*

[5]*Clinical Epidemiology and Biostatistics, Örebro University, Örebro, Sweden*

**Session: S04**
**Dosimetry-computational 1**
**Tuesday June 6, 2017 • 11:00 - 12:30**
**Fengyu**
**Chairs: Myles Capstick & Masao Taki**

**S04-1 [11:00]**

### Numerical characterization of the exposure level in electrical vehicles equipped with a Wireless Power Transfer system

Valerio De Santis[1], Tommaso Campi[1], Silvano Cruciani[1] & Mauro Feliziani[1]

[1]*Department of Industrial and Information Engineering and Economics, University of L'Aquila, Italy, Italy, 67100*

***Keywords: Dosimetry (computational), IF, Work in Progress***

***Presented by: Valerio De Santis***

This study deals with the numerical evaluation of the magnetic (outside) and electric (inside the body) fields produced by a wireless power transfer (WPT) system in an electrical vehicle (EV). First, the COMSOL software is used to predict the magnetic field around the EV assuming the bodycar made by three different materials: steel, aluminum and fiber composite. These fields have been compared with the ICNIRP reference levels demonstrating compliance for an EV with metallic (steel or aluminum) chassis. On the contrary, a fiber composite chassis is much more penetrable and therefore a dosimetric analysis using Sim4Life is needed to compare the induced electric fields with the ICNIRP basic restrictions.

**S04-2 [11:15]**

### Assessment of neuronal Conduction Block (CB) related to medical implants in conjunction with Wireless Power Transfer (WPT) using simplified and electrophysiologically functionalized anatomical models

Antonino Mario Cassara[1], Ilaria Liorni[1], Esra Neufeld[1] & Niels Kuster[1, 2]

[1]*IT'IS Foundation for Research on Information Technology in Society, Zurich, Switzerland, 8004*

[2]*Swiss Federal Institute of Technology, Zurich, Switzerland, 8001*

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

***Presented by: Niels Kuster***

Wireless power transfer (WPT) technologies are expected to being installed pervasively in uncontrolled areas in the very near future, causing concerns about possible health hazards for the

[6]*Finnish Cancer Registry, Mass Screening Registry, Helsinki, Finland*
[7]*Health Service and Population Research, Institute of Psychiatry, King's College, London, United Kingdom*
[8]*International Agency for Research on Cancer (IARC), Section of Environment and Radiation, Lyon, France*
[9]*The Danish Cancer Society Research Center, Copenhagen, Denmark*
[10]*Oncology clinic, Finsen Center, Copenhagen, Denmark*
[11]*Institute for Risk Assessment Sciences, , Utrecht University, Utrecht, the Netherlands*
[12]*Centre for Occupational and Environmental Medicine, Stockholm County Council, Stockholm, Sweden*
***Keywords: Epidemiology, RF/Microwaves, Work in Progress***
***Presented by: Joachim Schüz***

This study investigates the validity of self-reported mobile phone use, by comparing cross-sectional baseline data on self-reported and operator-derived mobile phone use (frequency and duration of calls), in a large sub-population of almost 76,000 adults participating in the international COSMOS cohort study of mobile phone use and health. It also investigates, for the first time, validity among general population subgroups, e.g. those who experience symptoms during mobile phone use or have concerns related to mobile phones. Results from this study differ compared to previous validation studies, with an underestimation of call duration but overall better agreement.

**S03-3 [11:30]**
**STUDENT PAPER**

### Personal exposure to radio frequency electromagnetic fields in children in Europe

Laura Birks[1, 2, 3], Marloes Eeftens[4, 5], Benjamin Struchen[4, 5], Marisa Estarlich[3, 6], Mariana Fernandez[3, 7], Amparo Ferrero[3, 6], Peter Gajsek[8], Mara Gallastegi[9, 10], Llúcia González[6, 11], Anke Huss[12], Ana Jiménez-Zabala[9, 13], Leeka Kheifets[14, 15], Inger Kristine Meder[15], Jørn Olsen[15], Loreto Santa-Maria[3, 9], Maties Torrent[16], Blaz Valic[8], Roel Vermeulen[12, 17, 18], Elisabeth Cardis[1, 2, 3], Martine Vrijheid[1, 2, 3], Martin Roosli[4, 5] & Mònica Guxens[1, 2, 3, 19]
[1]*ISGlobal, Center for Research in Environmental Epidemiology, Barcelona, Spain*
[2]*Pompeu Fabra University, Barcelona, Spain*
[3]*Spanish Consortium for Research on Epidemiology and Public Health (CIBERESP), Instituto de Salud Carlos III, Madrid, Spain*
[4]*Department of Epidemiology and Public Health, Swiss Tropical and Public Health Institute, Basel, Switzerland*
[5]*University of Basel, Basel, Switzerland*
[6]*Epidemiology and Environmental Health Joint Research Unit,*

**S04-3 [11:30]**

### Novel approach for compliance testing with basic restrictions of exposure to gradient magnetic fields generated by Wireless Power Transfer systems

Ilaria Liorni[1], Myles Capstick[1], Sven Kuehn[1] & Niels Kuster[1, 2]
[1]*Foundation for Research on Information Technologies in Society (IT'IS), Zurich, Switzerland, 8004*
[2]*Swiss Federal Institute of Technology (ETHZ), Zurich, Switzerland, 8092*
***Keywords: Dosimetry (computational), IF, Completed (unpublished)***
***Presented by: Ilaria Liorni***

Magnetic fields (MFs) generated by powerful Wireless Power Transfer (WPT) systems generally exceeds the exposure limits in the closest vicinity of the coils and might also violate the basic restrictions (BR). In this study a new method is proposed for demonstration of compliance in the closest vicinity of sources with the BRs from 3 kHz to 10 MHz. This approach mitigates overestimation by incident field assessment in strong field gradients close to WPT systems. The spatial peak MF

*FISABIO-Universitat Jaume I-Universitat de València, Valencia, Spain*
[7]*Instituto de Investigación Biosanitaria ibs.Granada, University of Granada, Granada, Spain*
[8]*Institute of Non-ionizing Radiation, Ljubljana, Slovenia*
[9]*BIODONOSTIA Health Research Institute, San Sebastian, Spain*
[10]*University of the Basque Country (UPV/EHU), Preventative Medicine and Public Health Department, Faculty of Medicine, Leioa, Spain*
[11]*Medicine Department, Universitat Jaume I, Castelló de la Plana, Spain*
[12]*Institute for Risk Assessment Sciences (IRAS), Utrecht University, Utrecht, the Netherlands*
[13]*Public Health Division of Gipuzkoa, Basque Government, San Sebastian, Spain*
[14]*Department of Epidemiology, School of Public Health, University of California, Los Angeles, California, USA*
[15]*Danish Epidemiology Science Centre, Department of Public Health, Aarhus University, Aarhus, Denmark*
[16]*ib-salut, Area de Salut de Menorca, Menorca, Spain*
[17]*Julius Center for health Sciences and Primary Care, University Medical Center, Utrecht, the Netherlands*
[18]*School of Public Health, Imperial College London, London, United Kingdom*
[19]*Department of Child and Adolescent Psychiatry/Psychology, Erasmus University Medical Centre–Sophia Children's Hospital, Rotterdam, the Netherlands*
***Keywords: Epidemiology, RF/Microwaves, Work in Progress***
***Presented by: Laura Birks***

Little is known about the exposure of children to radiofrequency electromagnetic fields (RF-EMF) from mobile communication technologies.This study aims to describe personal RF-EMF exposure levels in European children and adolescents. Using portable RF-EMF measurement devices, measurements were collected over 72 hours for 529 children, ages ranging 8-18 years, in Denmark, the Netherlands, Slovenia, Switzerland, and Spain. Exposure from mobile phone base stations was the largest contributor to total levels of RF-EMF (median 27.20 $\mu W/m^2$) followed by broadcast transmitters (median 9.89 $\mu W/m^2$). Exposure from cell phones accounted for a median of 4.71 $\mu W/m^2$. WiFi and cordless phones contributed very little to the total exposure levels.

**S03-4 [11:45]**
**STUDENT PAPER**

## Decrease in adolescents' figural memory performance associated with cumulative brain dose over one year

Milena Foerster[1, 2], Arno Thielens[3], Wout Joseph[3] &

amplitude and gradient generated by WPT systems are measured by a field gradient probe at the closest location. The induced fields and absorbed power are then calculated by specific transformation matrices considering all international safety guidelines.

**S04-4 [11:45]**
**STUDENT PAPER**

## Estimation of local temperature elevation from local averaged power density from patch antenna arrays

Daisuke Funahashi[1], Akimasa Hirata[1], Iyama Takahiro[2] &

Martin Roosli[1, 2]
[1]*University of Basel, Basel, Switzerland*
[2]*Swiss TPH, Basel, Switzerland*
[3]*Waves research group, Department of Information Technology, Ghent University/imec, Ghent, Belgium*
***Keywords: Epidemiology, RF/Microwaves, Completed (unpublished)***
***Presented by: Milena Foerster***

We investigated the potential impact of RF-EMF dose and media usage on figural and verbal memory functions in adolescents using longitudinal data from the Swiss HERMES cohort as part of the GERoNiMO framework. Applying linear regression models stratified by five media usage type patterns to control for unmeasured confounding, we found significant decreases in figural memory score after one year associated with RF-EMF dose and RF-EMF related media usage but not with RF-EMF unrelated media usage (negative exposure controls). Figural memory involves mainly the right side brain hemisphere and a laterality analysis indicates stronger effects in right side users than left side users.

**S03-5 [12:00]**

### Hints of media: An experimental study of effect of media warnings about health hazards of MP use on self-reported symptoms

Lei Zhang[1, 2], Huifeng Pi[1, 2], Peng Gao[1, 2], Zhou Zhou[1, 2] & Zheng-Ping Yu[1, 2]
[1]*Department of Occupational Health, Third Military Medical University, Chongqing, China, 400038*
[2]*Key Laboratory of Medical Protection for Electromagnetic Radiation, Ministry of Education, 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 anothersetof 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.

Teruo Onishi[2]
[1]*Department of Electrical and Mechanical Engineering, Nagoya Institute of Technology, Nagoya, Japan, 466-8555*
[2]*NTT DOCOMO, INC., Yokosuka, Japan, 239-8536*
***Keywords: Dosimetry (computational), RF/Microwaves, Work in Progress***
***Presented by: Daisuke Funahashi***

Incident power density is used as the dosimetrically quantity to specify the restrictions on human exposure to electromagnetic fields at frequencies above 3 or 10 GHz in order to prevent excessive temperature elevation at the body surface. International standards and guidelines have different definitions for the size of the area over which the power density should be averaged. Our previous study suggested that a good relation can be obtained between power density averaged over 4 $cm^2$ and the temperature elevation for dipole antenna, its antenna array, and ideal beam. In this study, we investigated and confirmed that the relationship is still reasonable for a realistic antenna (a patch antenna array with 25 elements) at 10, 30 and 60 GHz.

**S04-5 [12:00]**

### User exposure in forthcoming 5G phone call and browsing scenarios in the 60-GHz band

Anda Guraliuc[1], Maxim Zhadobov[1], Ronan Sauleau[1], Loic Marnat[2] & Laurent Dussopt[2]
[1]*Institute of Electronics and Telecommunications of Rennes (IETR), CNRS / University of Rennes 1, Rennes, France, 35042*
[2]*French Alternative Energies and Atomic Energy Commission (CEA) - LETI, Grenoble, France, 38054*
***Keywords: Dosimetry (computational), RF/Microwaves, Completed (unpublished)***
***Presented by: Maxim Zhadobov***

The continuous need in high-performance mobile communications leads to a fast development of next generation heterogeneous 5G cellular networks. They will exploit the wide bands available in the millimeter-wave spectrum, including the 60-GHz band. We present a numerical dosimetry study for a terminal with a 60-GHz antenna module for several representative human body exposure scenarios within 5G small cells. The user exposure levels in the near field are analyzed for phone call and browsing scenarios. Results show that the absorption is locally distributed on the ear helix and fingertips. The presence of the hand in a phone call scenario increases the absorption in the head due to the modifications of the antenna radiation patterns.

**S03-6 [12:15]**

**Maternal exposure to high magnetic fields during pregnancy and the risk of abnormal thyroid hormone levels in offspring: A prospective cohort study with up to 20 years of follow-up**

De-Kun Li[1], Hong Chen[1], Roxana Odouli[1] & Jeannette Ferber[1]

[1]*Division of Research, Kaiser Permanente, Oakland, California, USA, 94612*

***Keywords: Epidemiology, ELF/LF, Work in Progress***
***Presented by: De-Kun Li***

In this prospective cohort study, maternal high MF level during pregnancy was found to be associated with increased risk of low thyroid hormone levels in offspring, largely due to low TSH levels. The lower TSH concentration resulting from high in-utero MF exposure indicates an adverse MF impact on the pituitary gland during in-utero fetal brain development. The finding of this important association needs to be further examined in future studies.

**S04-6 [12:15] -**

**WITHDRAWN**

**Lunch**
**Tuesday June 6, 2017 • 12:30 - 13:30**

**Session: M3**
**EBEA Assembly Lunch**
**Tuesday June 6, 2017 • 12:30 - 13:30**
**Fengyu**

**Session: FB**
**Student Flash Poster Session B**
**Tuesday June 6, 2017 • 13:30 - 14:00**
**Jinhua**
**Chairs: Niels Kuster & Christopher Portier**

**Session: PB**
**Poster Session B**
**Tuesday June 6, 2017 • 14:00 - 15:30**
**2nd floor hallway**

**Coffee Break**
**Tuesday June 6, 2017 • 15:30 - 16:00**

**Session: W3**
**Workshop 3: Utilities Threshold Initiative Consortium - Experimental Responses in Humans exposed to High ELFs Fields and Impact on Standards and Guidelines**
**Tuesday June 6, 2017 • 16:00 - 17:30**
**Jinhua**
**Chairs: Alexandre Legros & Michel Plante**

**W3-1 [16:00]**

### Utilities Threshold Initiative Consortium - Experimental Responses in Humans exposed to High ELFs Fields and Impact on Standards and Guidelines

Alexandre Legros[1, 2, 3], Akimasa Hirata[4], Michel Plante[5] & Jacques Lambrozo[6]

[1]*Bioelectromagnetics and Human Threshold Research Group, Imaging Program, Lawson Health Research Institute, London, ON, Canada, N6A 4V2*

[2]*School of Kinesiology, Medical Biophysics & Medical Imaging, Western University, London, ON, Canada*

[3]*EuroMov, University of Montpellier, Montpellier, France*

[4]*Department of Electrical and Mechanical Engineering, Nagoya Institute of Technology, Nagoya, Japan*

[5]*Health and Safety division, Hydro-Québec, Montreal, QC, Canada*

[6]*Service des études médicales, EDF, Paris, France*

The objective this Utilities Threshold Initiative Consortium (UTIC) is to provide the audience with a comprehensive integrated overview of an experimental research program in its whole. This will be achieved by presenting as part of the same "package": 1. The modalities of genesis of a specific industry-sponsored/academic model; 2. The experimental and scientific developments resulting from the research project; 3. The impact of outcomes in terms of contribution to basic science, guidelines and standards.

**Session: W4**
**Workshop 4: Is the Evaluated In Vivo Exposure Level in a Reverberation Chamber Reliable?**
**Tuesday June 6, 2017 • 16:00 - 17:30**
**Fengyu**
**Chairs: Jianqing Wang & Niels Kuster**

**W4-1 [16:00]**

### Is the evaluated in vivo exposure level in a reverberation chamber reliable?

Jianqing Wang[1], Niels Kuster[2], Jerdvisanop Chakarothai[3], Joe Wiart[4], Jingjing Shi[1], Jong Hwa Kwon[5], Jeong-Ki Pack[6] & Tongning Wu[7]

[1]*Nagoya Institute of Technology, Nagoya, Japan*

[2]*IT'IS Foundation, Zurich, Switzerland*

[3]*National Institute of Information and Communication Technology, Tokyo, Japan*

[4]*Telecom ParisTech , Paris, France*

[5]*Electronics and Telecommunications Research Institute, Daejeon, Korea*

[6]*Chungnam National University, Daejeon, Korea*

[7]*China Academy of Telecommunication Research, Beijing, China*

This workshop aims to discuss the validity, limitation and potential problems on current dosimetry methods used for exposure level evaluation in reverberation chamber.

A considerable number of studies investigating possible adverse health effect of whole-body electromagnetic field (EMF) exposure, frequently use reverberation chambers (RCs) for standardized animal exposure. Recent examples include e.g. the large study of the National Toxicology Program of the National Institute of Environmental Health Sciences (NTP Study), several whole-body exposure projects supported by the Ministry of International Affairs and Communications of Japan, and several projects conducted in Korea. Accurate dosimetry, i.e. the reliable quantification of EM energy absorbed by the animals placed in RCs in such studies, is of particular importance in order to draw the right conclusions from the results. The assessment of the correct radiation dose received is, however, challenging due to the multi-mode and statistical nature of the EMF distribution in RC. One example of reported contradicting findings from dosimetric reports is whether a whole-body average SAR of 4 W/kg will cause a significant temperature rise in an exposed animal in RC.

This workshop specifically focuses on the dosimetric aspect of RCs as a widely used whole-body exposure setup. We will discuss the advantages, validity, limitations and potential problems of current dosimetry methods used for evaluating the exposures in RC systems. By the end of the workshop, participants should have a common view on how to reliably assess whole-body EMF exposure levels in animals exposed in RCs.

***Workshop Speakers***

1. Jianqing Wang, Nagoya Institute of Technology, Japan
2. Niels Kuster, IT'IS Foundation, Switzerland
3. Jerdvisanop Chakarothai, National Institute of Information and Communications Technology, Japan
4. Joe Wiart, Université Paris Saclay, France

**W3-2 [16:20]**

**The UTIC: What, why, whom and how?**

Michel Plante[1]

[1]*Medical advisor, Health and safety division, Hydro-Quebec, Montreal, Quebec, Canada*

The presentation will explain the rationale for utilities to support human experimental research looking for particular neurophysiological effects under high power-frequency magnetic fields and create the Utilities Threshold Initiative Consortium (UTIC). The objectives, values, operating rules and the current members list will be presented. An invitation to join UTIC will be made as well.

**W3-3 [16:40]**

**Sixteen years of UTIC supported science: Overview of human physiological, neurophysiological and behavioural responses to ELF MF exposures up to 100,000 µT**

Alexandre Legros[1, 2]

[1]*Lawson Health Research Institute, London, Ontario, Canada*

[2]*Scientist and Associate Professor, Western University, London, Ontario, Canada*

This presentation will give an overview of the research projects enabled by the UTIC since 2001 until now. Results from human studies testing for the impact of ELF exposures ranging from 1,000 µT to 100,000 µT will be covered. Studied outcomes include human physiological tremor, posture and vestibular performance, cognitive performance, EEG, fMRI, cardiovascular biomarkers, blood stress parameters, magnetophosphene perception. Future directions will be discussed.

**W3-4 [17:00]**

**Interest and impact of human experimental research on exposure guidelines and current gaps to address**

Akimasa Hirata[1]

[1]*Department of Electrical and Mechanical Engineering, Nagoya Institute of Technology, Nagoya, Japan*

This presentation reviews the research need, particularly related to the limit prescribed in the international guidelines/standard for low-frequency exposure. The role of human experimental study as well as related topics, such as dosimetry, biophysics, etc. will be summarized.

**Conference Dinner**
**Tuesday June 6, 2017 • 18:00 - 23:30**
**Hangzhou Cuisine Museum**

**Session: S05**
**Clinical**
**Wednesday June 7, 2017 • 08:30 - 10:00**
**Jinhua**
**Chairs: Richard Nuccitelli & Alexandre Legros**

**S05-1 [08:30]**

### Potential of millimeter waves for selective heating of skin layers: airflow effect

Maxim Zhadobov[1], Stanislav Alekseev[2] & Yves Le Dréan[3]

[1]*Institute of Electronics and Telecommunications of Rennes (IETR), CNRS / University of Rennes 1, Rennes, France, 35042*

[2]*Institute of Cell Biophysics, Russian Academy of Sciences, Pushchino, Russian Federation, 142290*

[3]*Institute for Research on Environmental and Occupational Health (IRSET), University of Rennes 1, Rennes, France, 35042*

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

***Presented by: Maxim Zhadobov***

This study demonstrates that 20 - 100 GHz range can be used for spatially-accurate focusing of heating inside the skin by varying the frequency, exposure beam size, and by enforcing the air convection. The latter is also used to reduce the overheating of the skin surface. Heating at different skin depths depending on these parameters is investigated using the hybrid bio-heat equation. Dependence on the exposure intensity, impact of the blood flow rate, skin water content, as well as duration of the hyperthermia treatment is also investigated. The results suggest that the lower part of the millimeter-wave range is an attractive solution for non-invasive thermal treatment of skin cancer.

**S05-2 [08:45]**

### Nanosecond electric pulses as a potent immunogenic cell death inducer for the treatment of advanced breast cancer

Siqi Guo[1], Yu Jing[1], Niculina Burcus[1], Brittany Lassiter[1], Royena Tanaz[1], Richard Heller[1] & Stephen J. Beebe[1]

[1]*Frank Reidy Research Center for Bioelectrics, Old Dominion University, Norfolk, Virginia, USA, 23508*

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

***Presented by: Siqi Guo***

We have discovered that breast cancer cells treated with nsEPs released high level of damage-associated molecular patterns (DAMPs) and stimulated the

**Session: S06**
**Behavioural**
**Wednesday June 7, 2017 • 08:30 - 10:00**
**Fengyu**
**Chairs: Xiaomei Wang & Shoogo Ueno**

**S06-1 [08:30]**

### Light dependent magnetic field effects in *Drosophila melanogaster*

Giorgio Fedele[1], Celia Hansen[1], Ezio Rosato[1] & Charalambos Kyriacou[1]

[1]*Department of Genetics, University of Leicester, Leicester, United Kingdom, LE1 7RH*

***Keywords: Behavioural, Static, Work in Progress***

***Presented by: Giorgio Fedele***

Previously, we have confirmed that exposure to electromagnetic fields (EMF) affects the circadian behaviour of the fruit fly in a light dependent manner, supporting, at least to some extents, the Radical Pair mechanism (RPM) for magnetoreception. Here we have attempted a preliminary genetic dissection aiming to identify responsible neuronal clusters and we have found that in addition to some CRY positive canonical clock neurons,the eyes seem to be necessary for mediating the EMF-mediated response, thus providing a putative input pathway.

**S06-2 [08:45]**
**STUDENT PAPER**

### Optimization of targeted neurostimulation based on activating functions and validation by coupled electromagnetic-neuronal dynamics modeling

Hazael Montanaro[1, 3], Esra Neufeld[1], Antonino Mario Cassara[1], Manuel Guidon[2] & Niels Kuster[1, 3]

[1]*ITIS Foundation for Research on Information Technologies in Society, Zurich, Switzerland*

[2]*Zurich MedTech, Zurich, Switzerland*

[3]*Swiss Federal Institute of Technology (ETHZ), Zurich, Switzerland*

***Keywords: Mechanistic/Theoretical, ELF/LF,***

maturation of dendritic cells. Local tumor ablation with nsEPs can induce antitumor immune responses and generate long-term immune memory to reject secondary tumor challenge and substantially reduce spontaneous distant metastases in a poor immunogenic and highly metastatic breast cancer model.

***Completed (published)***
***Presented by: Hazael Montanaro***

A novel approach to automatically tune the stimulation parameters of multi-contact stimulation electrodes in order to achieve targeted and steerable stimulation has been developed. The approach, which is based on precomputed activating function contributions determined along individual neuron fiber trajectories, has been successfully compared and validated against fully coupled electromagnetic-neurophysiological modeling in neuro-functionalized anatomical models. The applications investigated include deep brain and spinal cord stimulation. Proper consideration of tissue anisotropy has been found to be crucial.

**S05-3 [09:00]**

### Evaluating the effect of transcranial magnetic stimulation in patients with disorder of consciousness with functional near-infrared spectroscopy

Mengsha Lv[1], Bin Lv[1], Jianghong He[2] & Tongning Wu[1]
[1]*China Academy of Information and Communication Technology, Beijing, China, 100191*
[2]*PLA Army General Hospital, Beijing, China, 100000*
***Keywords: Clinical (therapy), ELF/LF, Work in Progress***
***Presented by: Bin Lv***

Our ultimate objective is to apply fNIRS to explore the modulation effect of TMS on patients with disorder of consciousness(DOC). In this abstract, we presented the experimental design and preliminary results in healthy people. First, we designed passive and active movement task. Second, we performed single-pulse TMS stimulation and TMS-like sound stimulation. We collected and compared the fNIRS data. Our current results indicated that passive movement task can modulate the brain activation as well as active movement task. Therefore we could apply passive movement task for DOC patients in subsequent experiment. Meanwhile, the significant activation was detected during the real TMS stimulation, while not in the TMS-like sound stimulation.

**S06-3 [09:00]**

### Acute effect of low frequency magnetic fields on the vestibular system: perception of verticality

Sebastien Villard[1, 2], Nicolas Bouisset[1, 3], Michael Corbacio[1, 2], Daniel Goulet[4], Michel Plante[4], Martine Souques[5], François Deschamps[6], Genevieve Ostiguy[4], Jacques Lambrozo[5], Michel Guerraz[7] & Alexandre Legros[1, 2, 3, 8, 9]
[1]*Human Threshold Research Group, Lawson Health Research Institute, London, Ontario, Canada*
[2]*Medical Biophysics, University of Western Ontario, London, Ontario, Canada*
[3]*School of Kinesiology, University of Western Ontario, London, Ontario, Canada*
[4]*Hydro-Québec, Montréal, Québec, Canada*
[5]*Service des Études Médicales, EDF, Paris, France*
[6]*Service Environnement Réseaux, RTE, Paris, France*
[7]*Laboratoire de Psychologie et Neurocognition, Université de Chambéry, Chambéry, France*
[8]*Medical Imaging, University of Western Ontario, London, Ontario, Canada*
[9]*EuroMov, Université de Montpellier, Montpellier, France*
***Keywords: Behavioural, ELF/LF, Work in Progress***
***Presented by: Sebastien Villard***

The study of magnetophenes suggests that sensory systems interact with induced electric fields generated by time-varying magnetic stimulation. Postural control literature, also suggests that the vestibular system is sensitive to induced electric fields. Yet, postural control is an indirect indicator of the vestibular performance. We are proposing to probe the vestibular function through the measurement of the Subjective Visual Vertical (SVV). Participants will be exposed to 4 frequencies of stimulation (20, 60, 120 and 160 Hz) at 100 mT in the Magnetic Field condition and 2 mA in the electric condition. Pilot participants showed encouraging results but are too precarious to

discuss to date. More results will be presented at the conference.

**S05-4 [09:15]**

### Multi-objective optimization of TMS coil position and orientation according to clinical needs

Congsheng Li[1] & Tongning Wu[1]

[1]*China Academy of Information and Communication Technology, Beijing, China, 100191*

***Keywords: Clinical (therapy), ELF/LF, Completed (unpublished)***

***Presented by: Congsheng Li***

The effectiveness of Transcranial Magnetic Stimulation (TMS) experiments critically depends on precise TMS coil position and orientation. In this work, an effective methodology for a global optimization of the TMS position and orientation is developed based on the multi-objective optimization method. This study benefits not only to the clinics but also to the research on brain modulation.

**S05-5 [09:30] -**

**WITHDRAWN**

**S06-4 [09:15]**
**STUDENT PAPER**

### Behavioural effects of prenatal to postnatal exposure to intermediate frequency magnetic fields in mice

Kajal Kumari[1], Henna Koivisto[2], Myles Capstick[3], Matti Viluksela[1], Jonne Naarala[1], Heikki Tanila[2] & Jukka Juutilainen[1]

[1]*Department of Environmental and Biological Science, University of Eastern Finland, Kuopio, Finland, 70150*

[2]*A. I. Virtanen Institute, University of Eastern Finland, Kuopio, Finland, 70150*

[3]*IT'IS Foundation, ETH, Zurich, Switzerland*

***Keywords: Behavioural, IF, Work in Progress***

***Presented by: Kajal Kumari***

Human exposure to Intermediate frequency (IF) fields is increasing due to applications like electronic article surveillance systems, wireless power transfer and induction heating cooking hobs. However, little data is available on possible health effects of exposure to IF magnetic fields (MF). The present study set out to assess cognitive and behavioural effects of prenatal to early postnatal exposure to IF MF. Pregnant female mice were exposed continuously to 7.5 kHz MFs at 12 and 120 μT from mating until weaning of pups. A behavioural teratology study was conducted as a sensitive test to detect possible effects on the developing nervous system. Results will be presented during the BioEM meeting-2017.

**S06-5 [09:30]**

### Affecting mechanisms of long-term microwave exposure on learning and memory of mice at different power densities

Zhenzhong Yang[1], Jinxue Fei[1] & Yali Zhao[1]

[1]*China Astronaut Research and Training Center, Beijing, China, 100094*

***Keywords: In vivo, RF/Microwaves, Concept***

***Presented by: Yali Zhao***

As one of the most sensitive parts to microwave radiation, the damage to central nervous system is best shown in learning and memory. The purpose of this article is to explore the effect of long-term microwave exposure on learning and memory at different power densities and the mechanism through animal experiment. The paper shows long-term microwave exposure (2100 MHz, 3.6W/kg) could induce downregulation of Sbdn and Cryab expression, increase of oxidative stress and hippocampus injury, which may be the way to inhibit

the learning and memory of the animal.

**S05-6 [09:45] -**

**WITHDRAWN**

**S06-6 [09:45]**

### Effects of chronic radiofrequency electromagnetic field exposure on behavior and memory in aged mice

Hae-June Lee[1], Jonghwa Kwon[2], Jeong-Ki Pack[3], Nam Kim[4] & Yun-Sil Lee[5]

[1]*Division of Basic Radiation Bioscience, Korea Institute of Radiological & Medical Sciences, Seoul, Korea, 01812*

[2]*Department of EMF Research Team, ETRI, Daejon, Korea, 34129*

[3]*Department of Radio Sciences and Engineering, Chungnam National University, Daejon, Korea, 34134*

[4]*School of Electrical and Computer Engineering, Chungbuk National University, Cheongju, Korea, 28644*

[5]*Graduate School of Pharmaceutical Sciences, Ewha Womans University, Seoul, Korea, 03760*

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

***Presented by: Hae-June Lee***

Female C57BL/6 mice, from an age of 12 months to 20 months, were exposed in whole body for 2 h per day, 5 days per week, to a 1,950 MHz radiofrequency electromagnetic field (SAR 5W/kg). To investigate the effects of chronic exposure to 1,950 MHz RF-EMF on memory and behaviors in the aging mice, five behavioral tests were conducted. The result of this study indicates that long-term exposure to RF-EMF did not induce memory and behavioral alteration in aged C57BL/6 mice.

**Coffee Break**
**Wednesday June 7, 2017 • 10:00 - 10:30**

**Session: P3**
**Plenary 3: New challenges in tissue ablation clinical applications based on electroporation**
**Wednesday June 7, 2017 • 10:30 - 12:00**
**Jinhua**
**Chair: Lluis M. Mir**

**P3-1 [10:30]**

## Implications and considerations to improve therapies based on nanoelectroablation

Richard Nuccitelli[1]
[1]*Pulse Biosciences, Inc., 849 Mitten Rd., Ste 104, Burlingame, CA, USA, 94010*

### Biographical sketch

Rich Nuccitelli received his B.S. degree in Physics from the University of Santa Clara in 1970 and an M.S. degree in Physics from Purdue University in 1972. He received his Ph.D. in Biological Sciences from Purdue University in 1975. He was a Professor in Molecular and Cellular Biology at the University of California, Davis for 23 years where he studied the role of endogenous ionic currents in cell and tissue physiology, such as the ionic regulation of egg activation and the use of endogenous electric fields to guide cell migration and wound healing. He was Professor of Electrical and Computer Engineering at the Center for Bioelectrics at Old Dominion University for 3 years where he began studying the use of nanosecond pulsed electric fields for cancer therapy. He is now Chief Science Officer at Pulse Biosciences, Inc. directing Research and Development. This company recently developed the PulseTx System for ablating tumors and skin cancer with nanosecond pulses. He has published four books and over 137 papers in peer-reviewed journals. He has organized several International conferences including the Gordon Research Conferences on Fertilization and the Activation of Development in 1997, the Bioelectrochemistry in 2004 and was Technical Program Chair for the BEMS meeting in Japan in 2007. He served as Chair of the Local Organizing Committee for BioEM2015 in Asilomar, California. He was elected Fellow in the American Association for the Advancement of Science in 1995 for his contribution to cell physiology and was elected Fellow in the American Institute of Medical and Biological Engineering in 2015. He is an Associate Editor of Bioelectromagnetics Journal, Bioelectrochemistry, and Cell Biochemistry and Biophysics. He served as President of BEMS from 2013-2014.

Five relevant publications

Nuccitelli, R., McDaniel, A., Anand, S., Cha, J., Mallon, Z., Berridge, J.C. and Uecker, D. (2017) Nano-Pulse Stimulation is a physical modality that can trigger immunogenic tumor cell death. J. Immunotherapy Cancer 5:32 DOI 10.1 186/s40425-017-0234-5

Nuccitelli, R., Berridge, J.C., Mallon, Z., Kreis, M., Athos, B. and Nuccitelli, P. (2015) Nanoelectroablation of Murine Tumors Triggers a CD8-Dependent Inhibition of Secondary Tumor Growth. PLos One 10(7):e0134364

Pliquett, U. and Nuccitelli, R. (2014) Measurement and simulation of Joule heating during treatment of B-16 melanoma tumors in mice with nanosecond pulsed electric fields. Bioelectrochemistry doi:10.1016/j.bioelecchem.2014.03.001

Nuccitelli, R., Wood, R., Kreis, M., Athos, B., Huynh, J., Lui, K., Nuccitelli, P. and Epstein, E.H. Jr. (2014) First-in-human trial of nanoelectroablation therapy for basal cell carcinoma: proof of method. Exp. Dermatol., 23:135-7.

Nuccitelli, R.; Lui, K.; Kreis, M.; Athos, B., and Nuccitelli, P. (2013) Nanosecond Pulsed Electric Field Stimulation of Reactive Oxygen Species in Human Pancreatic Cancer Cells is $Ca^{2+}$-Dependent. Biochem. Biophys. Res. Comm., 435(4):580-5.

### Abstract

We have been developing a non-thermal Nano-Pulse Stimulation (NPS) therapy for ablating tumors and unwanted skin lesions using ultrashort (200 ns long) electric pulses 20-30 kV/cm in amplitude delivered to the tissue with contact electrodes. Our PulseTx system is a completely adjustable solid state pulse generator

with variable pulse width (160-1000ns), amplitude (1-15 kV) and pulse frequency (1-10 pps) controlled by a touch-screen interface. We have used this system to treat hundreds of tumors in mice and rats and have found that NPS stimulates immunogenic apoptosis which leads to a CD8-dependent adaptive immune response directed against neo-antigens in the tumor. We have recently shown that NPS is a physical modality that triggers immunogenic cell death in three cancer cell lines. We have also been using NanoString technology to probe NPS-treated tumors with 760 different mRNA transcripts related to the immune response. We find that primary tumors are invaded by the innate immune system players such as mast cells and neutrophils shortly after NPS treatment, while the secondary challenge tumors exhibit mainly adaptive immune response cells.

We have begun clinical trials to characterize human skin's dose-response to NPS. We find that the treated epidermis peels off above a regenerated epidermal layer and there is no effect on collagen fibers within the dermis. We have also initiated a clinical trial to treat canine oral melanoma.

**P3-2 [11:15]**

### Recent advances in irreversible electroporationfor treating deep-seated tumors

Paulo Garcia[1, 2]

[1]*Mechanical Engineering Department, Massachusetts Institute of Technology, Cambridge, MA, USA*

[2]*School of Biomedical Engineering and Sciences, Virginia Tech – Wake Forest University, Blacksburg, VA, USA*

**Biographical Sketch**

Dr. Paulo A. Garcia is a Research Scientist in the laboratory for energy and microsystems innovation (LEMI) at MIT. Dr. Garcia leads the experimental and computational investigations to develop and optimize microfluidic platforms for high throughput cell engineering using pulsed electric fields (PEF). His research interests are in pulsed electric fields for therapeutic and biotechnology applications such as tumor ablation, genetic engineering, and synthetic biology. Dr. Garcia completed his Ph.D. at the Virginia Tech – Wake Forest University (VT-WFU) School of Biomedical Engineering and Sciences. During his time at VT-WFU he pioneered the use of irreversible electroporation (IRE) for the treatment of spontaneous malignant glioma in canine patients. Specifically, he developed imaging-based computational models for the planning and implementation of IRE treatments in vivo. Dr. Garcia is committed to advancing the development and application of irreversible electroporation (IRE) and high frequency irreversible electroporation (H-FIRE), two PEF technologies with great promise for the treatment of solid tumors in the prostate, pancreas, liver, and brain in humans.

**Abstract**

Irreversible Electroporation (IRE) is a minimally invasive non-thermal ablation technique that uses a series of pulsed electric fields (PEFs) to kill undesirable tissue. These intense (~1000 V) but short (~100 μs) electric pulses disrupt the cell membranes of the targeted tissue, resulting in spontaneous cell death. The non-thermal mode of cell death preserves critical tissue components such as extracellular matrix, major blood vessels, and myelin sheaths. The IRE zone can be accurately predicted to optimize treatment outcome with therapeutic planning algorithms. The treatment planning takes into account the electric field distribution based on the electrode geometry, pulse parameters, and physical properties of the tissue. Recently, we developed High-Frequency IRE (H-FIRE) for the treatment of malignant glioma (MG), the most common yet malignant type of brain cancer in humans. The median survival of patients suffering from MG is 15 months with the standard care. A reason for poor survival in this patient population is that malignant glioma cells typically infiltrate up to 2 cm beyond the visible tumor margin. We have demonstrated that malignant cells are more susceptible to H-FIRE than healthy cells, providing treatment selectivity. Our work has focused on helping canine patients with spontaneous malignant glioma (MG), which are excellent translational models of human MG. We have shown that H-FIRE can be planned and monitored with surgical techniques used routinely in the operating room and administered in a minimally invasive fashion. Results of our ongoing trials have been encouraging, further supporting that H-FIRE is effective for the treatment of MG, including tumors refractory to surgery, radiation, and chemotherapy.

**Session: CA**
**Chiabrera Award**
**Wednesday June 7, 2017 • 12:00 - 13:00**
**Jinhua**
**Chairs: Isabelle Lagroye & Zhengping Yu**

**CA-1 [12:00]**

**Effect of pulsed electric fields on biological cells: adding some pieces to the large puzzle**

Aude Silve[1]

[1]*Institute for Pulsed Power and Microwave Technology, Karlsruhe Institute of Technology, Eggenstein-Leopoldshafen, Germany, 76344*

**Session: S07**
**In vitro**
**Thursday June 8, 2017 • 08:30 - 10:30**
**Jinhua**
**Chairs: Azadeh Peyman & Gui-Rong Ding**

**S07-1 [08:30]**

### Effects of constant magnetic field on oocytes maturation

Yingying Zhao[1] & Xiaomei Wang[1]
[1]*Physiology Department, Shenzhen University, Shenzhen, China, 518060*
***Keywords: In vitro, Static, Completed (unpublished)***
***Presented by: Yingying Zhao***

The results showed that the growth rates and the survival percentages of follicles in 200 mT and 300 mT treated groups are significant decreased ($p<0.05$), but that of 5mT treated group is obviously increased comparing with those of control group ($p<0.05$). However, No significant abnormalities were observed in the chromosome numbers or structure prepared from matured oocytes of 200 mT treated group. Thus, Slow-growing of preantral follicles cultured in vitro is due to 6Hz (200mT and 300 mT) rotating constant magnetic fields exposure. However, the follicles growth was stimulated by 5mT constant magnetic fields exposure.

**S07-2 [08:45]**
**STUDENT PAPER**

### An alternative explanation of the irreproducible experiments results in the vitro studies of EMF enhanced magnetic isotope effect and radical pair mechanism in Magnesium-dependent enzymes catalytic ATP synthesis

Yanyu Xiong[1]
[1]*Department of Electrical, Computer & Energy Engineering, University of Colorado Boulder, Boulder, Colorado, USA, 80309*
***Keywords: In vitro, ELF/LF, Review, Commentary, Recommendation, Evaluation***
***Presented by: Yanyu Xiong***

**Summary:** a new method that using mechanisms of nature adaptation and different bio-sensitivity of magnetic isotope have been used to explain the irreproducible experiments results in the study field of EMF enhanced magnetic isotope effect in ATP synthesis. The paper will show that experimental conditions widely used in recent studies in the area of magnetic isotope bio-effects do not match

**Session: S08**
**Dosimetry-computational 2**
**Thursday June 8, 2017 • 08:30 - 10:30**
**Fengyu**
**Chairs: Marthinus Van Wyk & Gunter Vermeeren**

**S08-1 [08:30]**

### Experimental and simulation study of welder's electromagnetic exposure

BOULDI Mélina[1]
[1]*Electromagnetism, Vibration and Optics Laboratory, French National Institute for Occupational Health and Safety, Vandoeuvre lès Nancy, France, 54519*
***Keywords: Occupational, ELF/LF, Work in Progress***
***Presented by: BOULDI Mélina***

Spot welding is an industrial process commonly used in metallurgical industries. Regarding the European Directive 2013/35/UE, evaluating the electromagnetic safety of workers requires a detailed study of the workplace and exposure values. Experiments and simulations were combined to determine the interaction between a 50 Hz welding gun, the working environment, and a human body model. An experimental map of the radiated magnetic field was obtained. 2D numerical simulations were carried out to determine the electric field in a complex body model, and compared to the Directive limits. Locations at risks were finally determined.

**S08-2 [08:45]**

### Numerical MRI radiofrequency exposure estimation in morphed patient anatomies

Manuel Murbach[1], Bryn Lloyd[1], Esra Neufeld[1] & Niels Kuster[1, 2]
[1]*ITIS Foundation, Zurich, Switzerland*
[2]*Swiss Federal Institute of Technology (ETH), Zurich, Switzerland*
***Keywords: Dosimetry (computational), RF/Microwaves, Work in Progress***
***Presented by: Manuel Murbach***

Radiofrequency absorption in magnetic resonance imaging is heavily dependent on the patient's anatomy. In this study, we investigate the effect of varying muscle and fat content in two anatomical human models by employing novel morphing techniques for regional shrinkage and expansion of tissues. Larger muscle cross-sections unexpectedly lead to higher local exposure in the arms in our initial investigation. This behavior will therefore be investigated systematically with more models, morphing variants, and imaging positions.

realistic biological conditions. An experimental design for error correction will also be proposed. A new thought will also be described to show that how EMF enhanced magnetic isotope effect can be used as a protection mechanism to solve the cell functionality loss issue which widely exists in banked blood storage process.

**S07-3 [09:00]**

### Uncertainty associated with replication of experimental conditions on cell cultures exposed to low frequency electric and magnetic fields is a potential confounder for experimental inconsistency, variability and irreproducibility.

Lucas Portelli[1, 2]
[1]*Departament of Electrical, Computer and Energy Engineering, University of Colorado, Boulder, Colorado, USA, 80302*
[2]*IT'IS foundation, Zürich, Switzerland, 8004*
***Keywords: In vitro, ELF/LF, Completed (published)***
***Presented by: Lucas Portelli***

This presentation will show a quantitative analysis on the replicability of exposure conditions for experiments on cell cultures exposed to electric and magnetic fields. The data is clear: such uncertainty may be enough magnitude to potentially hinder reasonable reproduction of such exposure conditions on future experimental replication attempts. These findings, coupled to the potential exquisite sensitivity of biological systems to environmental parameters, add to a reasonable explanation for the variability and irreproducibility associated with in vitroexperimental reports. This report add to a fundamental piece of the foundation for the modern Bioelectromagnetics researcher on future experimental design, development and reporting.

**S07-4 [09:15]**
**STUDENT PAPER**

### Studies on immediate and delayed genotoxicity of intermediate frequency magnetic fields in rat primary astrocytes

Mikko Herrala[1], Jonne Naarala[1] & Jukka Juutilainen[1]
[1]*Department of Environmental and Biological Sciences, University of Eastern Finland, Kuopio, Finland*
***Keywords: In vitro, IF, Completed (unpublished)***
***Presented by: Mikko Herrala***

In this study, genotoxic effects of 7.5 kHz magnetic fields were studied in rat primary astrocytes exposed for 24 h at 30 or 300 μT. DNA damage was measured by the single cell gel electrophoresis (Comet) assay, and a flow cytometric assay was used for micronuclei. Measurements performed

**S08-3 [09:00]**
**STUDENT PAPER**

### Test Medium derivation for the safety assessment of RF-induced heating of leaded cardio implants during 1.5-T MRI

Aiping Yao[1, 2], Earl Zastrow[1] & Niels Kuster[1, 2]
[1]*IT'IS Foundation, Zurich, Switzerland, CH-8004*
[2]*Department of Information Technology and Electrical Engineering, ETH Zurich, Zurich, Switzerland, CH-8092*
***Keywords: Dosimetry (computational), RF/Microwaves, Work in Progress***
***Presented by: Aiping Yao***

It is a common practice that an equivalent mathematical model of an implant is used to estimate in vivo power deposition caused by RF-implant interactions. The model is often derived under in vitro conditions. We assess the suitability of test media for RF-induced heating model derivation at 64 MHz. Based on simple generic leaded-implants, our preliminary analysis shows that the test medium recommended in ISO/TS 10974 ($\varepsilon_r$ = 78, $\sigma$= 1.2 S/m) may be appropriate for the safety assessment of leaded cardio implants with respect to RF-induced heating. Future analysis shall include implants with diverse topology and increased realism.

**S08-4 [09:15]**

### Organ-specific electrothermal dosimetry in various numerical mouse-models exposed to 1.97 GHz radiofrequency electromagnetic fields

Manuel Murbach[1], Bryn Lloyd[1], Silvia Farcito[1], Aileen Schroeter[2], Theodoros Samaras[3] & Niels Kuster[1, 4]
[1]*ITIS Foundation, Zurich, Switzerland*
[2]*Institute for Biomedical Engineering, University and ETH Zurich, Zurich, Switzerland*
[3]*Department of Physics, Aristotle University of Thessaloniki, Thessaloniki, Greece*
[4]*Swiss Federal Institute of Technology (ETH), Zurich, Switzerland*
***Keywords: Dosimetry (computational), RF/Microwaves, Completed (unpublished)***

immediately after exposure showed improved survival in the magnetic field exposed cells. Possible effects on DNA damage and repair were also observed, but the responses were either inconsistent or complex (depending on both time and magnetic field strength) and difficult to interpret. No statistically significant induction of genomic instability (delayed genotoxicity) was observed in measurements performed 36 days after exposure.

***Presented by: Manuel Murbach***

In recent animal provocation studies, tumor-promoting effects of radiofrequency electromagnetic fields (RF-EMF) have been found in mice. That basically the same effects have been found in two different studies at exposure levels below the accepted limits for humans is cause for concern. In this study, we aim to clarify electrothermal absorption of mice in unprecedented detail, including organ-specific evaluations of the RF-induced temperature increase. For this purpose, new anatomical mouse models have been developed. The dosimetric results extracted allow previous animal studies, for example, regarding a possible correlation to histopathological examinations, to be interpreted more precisely.

**S07-5 [09:30]**

### Investigation of membrane lipids oxidation possibly induced by UltraWide Band and Narrow Band signals

Florian Gailliegue[1], Alexandre Catrain[2], Rene Vezinet[2], Lluis M. Mir[1] & Marie Breton[1]

[1]*Laboratory of Vectorology and Anticancer Therapies UMR 8203, Gustave Roussy, Villejuif, France, 94805*

[2]*CEA, DAM, Gramat, France, 46500*

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

***Presented by: Lluis M, Mir***

The aim of this study was 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 and cells. 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, UWB pulses induced an oxidation of the GUVs lipids with a threshold in voltage.UWB pulses were then applied to cells. Membrane modifications were detected but they did not entail any membrane permeabilization. This result is important since an accumulation of oxidized lipids in membranes can impact the cell physiology and play a key role in many diseases.

**S08-5 [09:30]**

### High accuracy estimation of brain temperature elevation in rats for localized microwave exposure

Sachiko Kodera[1], Jose Gomez-Tames[1], Akimasa Hirata[1], Hiroshi Masuda[2], Takuji Arima[3] & Soichi Watanabe[4]

[1]*Department of Electrical and Mechanical Engineering, Nagoya Institute of Technology, Nagoya, Japan, 466-8555*

[2]*Dpartment of Environmental Medicine, Kurume University, Fukuoka, Japan, 830-0011*

[3]*Department of Electrical and Electronic Engineering, Tokyo University of Agriculture and Technology, Tokyo, Japan, 830-0011*

[4]*EMC Group, National Institute of Information and Communications Technology, Tokyo, Japan, 184-8795*

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

***Presented by: Akimasa Hirata***

The aim of this study is to develop and improve multiphysics code to simulate temperature elevation in rat brains under localized exposure with high-intensity microwave. Different exposure systems at 1.5 GHz and 6 GHz are considered. Comparison between measurement and computation is presented.

**S07-6 [09:45]**
**STUDENT PAPER**

### Exposure to 1950MHz radio-frequency field promoted X-ray-induced apoptosis in GC-1 cells

Ke-Ying Zhang[1], Hui Xu[2], Jun-Ping Zhang[1], Ling Guo[1], Yan Zhou[1], Jun-Ling Xing[1], Guang-Zhou An[1], Jia-Jin Lin[1],

**S08-6 [09:45]**

### Increased risk of acute effects in implant wearers in coexistence with Wireless Power Transfer systems below 10MHz

Ilaria Liorni[1], Sven Kuehn[1], Esra Neufeld[1] & Niels Kuster[1, 2]

Guozhen Guo[3] & Gui-Rong Ding[1]
[1]*Department of Radiation Biology, Fourth Military Medical University, Xi'an, China, 710032*
[2]*Radiological College, Taishan Medical University, Taian , China, 271000*
[3]*Department of Radiation Medicine, Fourth Military Medical University, Xi'an, China, 710032*
***Keywords: In vitro, RF/Microwaves, Completed (unpublished)***
***Presented by: Ke-Ying Zhang***

In this study, we first investigated the effect of mobile phone-based 1950 MHz radio-frequency (RF) field combined with X-ray on cell proliferation and apoptosis in mouse spermatocyte-derived (GC-1) cells. Our data indicate that although exposure to RF field at SAR of 3.0 W/kg for 24h alone cannot affect cell proliferation and apoptosis in GC-1 cells, it could aggravate cell proliferation inhibition and apoptosis induced by X-ray at 6.0 Gy, in which apoptosis related genes such as Bcl-2 and Bax might be involved.

**S07-7 [10:00]**

## High static magnetic field: Its translational implication to bone research

Peng Shang[1], Jian Zhang[1], Jiancheng Yang[1], Bin Jia[1], Pengfei Yang[1], Zhe Wang[1], Li Ren[1], Yanting Hu[1] & Zhouqi Yang[1]
[1]*Key Laboratory for Space Bioscience & Biotechnology, Institute of Special Environmental Biophysics, School of Life Sciences, Northwestern Polytechnical University, Xi'an, China, 710072*
***Keywords: In vitro, Static, Completed (published)***
***Presented by: Peng Shang***

High static magnetic field (HiMF) is defined as be with a intensity more than 1 T. Many reports have indicated that SMFs have positive effects on bone tissue. Certain static magnetic fields (SMFs) can contribute to bone formation and bone healing process in clinical invasion, ovariectomized rats, osteotomy animals and bone fracture. However, almost all the researches focus on moderate SMF generated by permanent magnets. There are limited studies concerning HiMF effects with tesla order.

[1]*Foundation for Research on Information Technologies in Society (IT'IS), Zurich, Switzerland, 8004*
[2]*Swiss Federal Institute of Technology (ETHZ), Zurich, Switzerland, 8092*
***Keywords: Dosimetry (computational), IF, Work in Progress***
***Presented by: Ilaria Liorni***

The derived exposure limits defined in current safety guidelines for human exposure to electromagnetic fields (EMF) exclude persons with medical implants, i.e., that excludes a significant portion of the population for which safety limits are not defined. In this study, we demonstrate that it cannot be excluded if persons with medical implants are exposed at the level of the exposure limits in the frequency range of wireless power transfer (WPT) systems that the basic restrictions are strongly violated for persons with medical implants, by larger than 40dB. In this paper, we propose a safety concept with which the safety of persons with medical implants can be reliably demonstrated without penalizing technological advances.

**S08-7 [10:00]**

## Accurate modeling of vagus nerve stimulation for selective A-, B- and C- fibers recruitment in functionalized generic and anatomical head models

Antonino Mario Cassara[1], Esra Neufeld[1] & Niels Kuster[1, 2]
[1]*IT'IS Foundation for Research on Information Technologies in Society, Zurich, Switzerland, 8004*
[2]*Swiss Federal Institute of Technology, ETHZ, Zurich, Switzerland, 8004*
***Keywords: Dosimetry (computational), ELF/LF, Completed (unpublished)***
***Presented by: Niels Kuster***

We created a detailed, realistic model of a vagus verve (VN) for advanced neurostimulation investigations including stimulator device design and waveform optimization for selective fiber recruitment within an anatomical head model. The model features stimulation electrodes as well as different electrophysiological axon models of myelinated sensory A and B fibers and unmyelinated C-fibers statistically distributed across the nerve fascicles. Conduction velocity (CV) and fiber recruitment curves for different electrode setups (cuff electrodes, catheter- and stent-based electrodes in vessels, external electrodes) are compared with measurements showing good agreement and providing mechanistic insight.

**S07-8 [10:15]**

### Effects of 0.3 THz exposure on cytokine production in human keratinocyte cells

Shin Koyama[1], Eijiro Narita[1], Yoko Shimizu[1], Kensuke Sasaki[2], Maya Mizuno[2], Soichi Watanabe[2], Masao Taki[3], Naoki Shinohara[1] & Junji Miyakoshi[1]

[1]*Laboratory of Applied Radio Engineering for Humanosphere, Research Institute for Sustainable Humanosphere, Kyoto University, Uji, Japan, 611-0011*

[2]*Electromagnetic Compatibility Laboratory, National Institute of Information and Communications Technology, Koganei, Japan, 184-8795*

[3]*Department of Electrical & Electronic Engineering, Tokyo Metropolitan University, Hachioji, Japan, 192-0397*

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

***Presented by: Shin Koyama***

The cellular effects of 24-hour exposure to 0.3 terahertz (THz) in human keratinocyte (HaCaT) cells were investigated. There was no significant increase on the IL-1α production in the cells exposed to 0.3 THz compared with the sham-exposed control and the incubator control. This result indicates that the exposure to 0.3 THz would be considered to have no or very little effect on the IL-1α production in HaCaT cells.

**S08-8 [10:15]**

### Mapping computational phantoms to subject specific body shapes

Alessandro Alaia[1], Bryn Lloyd[1] & Niels Kuster[1, 2]

[1]*IT'IS Foundation, Zurich, Switzerland, CH-8004*

[2]*Department of Information Technology and Electrical Engineering, ETH-Zurich, Zurich, Switzerland, CH-8092*

***Keywords: Mechanistic/Theoretical, All Frequencies, Completed (unpublished)***

***Presented by: Niels Kuster***

Safety assessments require the use of different computational phantoms to analyze the variability among a target population. In order to obtain accurate results, computational phantoms must incorporate a description of internal anatomical structures, which are difficult and time-consuming to generate. Here we present a novel registration algorithm capable of morphing a high-resolution anatomical model into arbitrary body shapes, thereby significantly reducing the time effort required to generate computational human models. Internal anatomical structures are morphed using only the outer skin of the target model, so that the registration is possible even in case of target models with partial or missing information about internal tissues.

**Coffee Break**
**Thursday June 8, 2017 • 10:30 - 11:00**

**Session: P4**
**Plenary 4: Current knowledge of biological effects above 6 GHz**
**Thursday June 8, 2017 • 11:00 - 12:30**
**Jinhua**
**Chair: Teruo Onishi**

**P4-1 [11:00]**

### Acute ocular injuries caused by 40, 75, 95 GHz millimeter wave exposure

Masami Kojima[1, 2, 3]

[1]*Division of Vision Research for Environmental Health, Medical Research Institute, Kanazawa Medical University, Kahoku, Japan*

[2]*Department of Ophthalmology, Kanazawa Medical University, Kahoku, Japan*

[3]*School of Nursing, Kanazawa Medical University, Kahoku, Japan*

**Biographical sketch**

Masami Kojima received his Ph. D. in Medicine from Kanazawa Medical University in 1991. He is a professor of Kanazawa Medical University belonging to three departments, Medical Research Institute, Department of Ophthalmology, and the Nursing School. He was an Alexander von Humboldt Research Fellow in the Department of Experimental Ophthalmology, University of Bonn, Germany, from 1988 to 1990. His research is focused on the mechanisms of cataract development in the crystalline lens. Currently, he works in the field of ocular damage from exposure to non-ionizing radiation including ultraviolet, infra-red, micro- and millimeter- waves. He has been awarded many academic honors, such as International Society of Ocular Toxicology (1990), The Japanese Society for Cataract Research Award (1992), International Scheimpflug Club Meeting Award (1993), US-Japan Cooperative Cataract Research Group Meeting Award (1997), Kanazawa Medical University Article Award (1997), and US-Japan CCRG the Alvira Reddy Award (2007). He is/was a member of the International Commission on Non-Ionizing Radiation Protection (Scientific Expert Group, 2001-2004, 2015-), Association for Research in Vision and Ophthalmology (International Members Committee 2001- 2004).

**Abstract**

Millimeter wave (MMW) technologies are used in the fields of high-speed wireless communications, sensing, imaging, spectroscopy, and automobile collision prevention systems in our daily life. Nowadays, WiGig (Wireless Gigabit) products operate in the 60 GHz frequency band. As daily exposure to MMWs is increasing, evaluation of the possible related health effects has become important.

In this presentation, use of our in vivo rabbit thermal ocular damage model induced by 40, 75, 95 GHz MMW exposure will be described.

In addition, details of ocular damage, clinical course, and ocular temperature distributions (in the anterior chamber) during MMW exposure will be elucidated.

In our results, difference in ocular damage according to exposed frequency was observed.

Although ocular damage induced by 40 and 75 GHz did not differ greatly, ocular damage induced by 95 GHz was more localized and milder. Ocular damage thresholds among 40, 75 and 95 GHz in rabbit eye depend on the following factors; MMW penetration depth, and heat transport in the eye including heat dissipation from the cornea.

**P4-2 [11:45]**

### Human Skin as Arrays of Helical Antennas in the Millimeter and Submillimeter Wave Range

Yuri Feldman[1]

[1]*Applied Physics Department, the Hebrew University, Jerusalem, Israel*

**Biographical sketch**

Yuri Feldman received the M.S. degree in radio physics and Ph.D. degree in molecular physics from the Kazan State University, Kazan, USSR, in 1973 and 1981, respectively. From 1973 to 1991, he was with the

Laboratory of Molecular Biophysics, Kazan Institute of Biology, Academy of Science of the USSR. In 1991, he moved to The Hebrew University of Jerusalem, Israel, where he is currently a Full Professor and the Head of the Soft Condensed Matter Physics Laboratory. He has spent over 40 years in the field and has more than 400 scientific publications related to dielectric spectroscopy and its applications. He holds 12 patents in the areas of electromagnetic properties of the matter. In 1992 and 2010 the Israel Government acknowledged his work with an award for the outstanding contribution to the development of Israel Science, in 1998 he received the Kaye Award for the best innovation and invention. Feldman is a Director of the Centre for Electromagnetic Research and Characterization (CERC); he is a Secretary and Member of the International Dielectric Society Board. His current interests include broadband dielectric spectroscopy in frequency and time domain; theory of dielectric polarization and relaxation; relaxation phenomena and strange kinetics in disordered materials; electromagnetic properties of biological systems in vitro and in vivo.

Five relevant publications:


1. Y. Feldman, A. Puzenko, P. Ben Ishai, A. Caduff, and A. J. Agranat, "Human skin as arrays of helical antennas in the millimeter and submillimeter wave range," Physical Review Letters, vol. 100, p. 128102, 2008.
2. Y. Feldman, A. Puzenko, P. Ben Ishai, A. Caduff, I. Davidovich, F. Sakran, et al., "The electromagnetic response of human skin in the millimetre and submillimetre wave range," Physics in Medicine and Biology, vol. 54, pp. 3341-3363, 2009.
3. I. Hayut, P. Ben Ishai, A. J. Agranat, and Y. Feldman, "Circular polarization induced by the three-dimensional chiral structure of human sweat ducts," Physical Review E, vol. 89, p. 042715, 2014.
4. I. Hayut, A. Puzenko, P. Ben Ishai, A. Polsman, A. J. Agranat, and Y. Feldman, "The Helical Structure of Sweat Ducts: Their Influence on the Electromagnetic Reflection Spectrum of the Skin," IEEE Transactions on Terahertz Science and Technology, vol. 3, pp. 207-215, 2013.
5. E. Safrai, P. Ben Ishai, A. Polsman, S. Einav, and Y. Feldman, "The Correlation of ECG Parameters to the Sub-THz Reflection Coefficient of Human Skin," IEEE Transactions on Terahertz Science and Technology, vol. 4, pp. 624-630, 2014.



**Abstract**

In the interaction of microwave radiation and human beings, the skin is traditionally considered as just an absorbing sponge stratum filled with water. This approach is justified when the impinging wavelength is greater than the dimensions of the skin layer. However, in the sub-THz band this condition is violated. In the end of last decade, we demonstrated that the coiled portion of the sweat duct in upper skin layer could be regarded as a helical antenna in the sub-THz band [1,2]. The full ramifications of what these findings represent in the human condition are still very unclear, but it is obvious that the absorption of electromagnetic energy is governed by the topology for the skin and its organelles, especially the sweat duct.

An additional factor comes in to play when it is realized that the Sympathetic Nerve Response controls sweat gland activity and this activity affects the reflectance, R. Our findings suggest the possibility of a direct reading of the human mental state with all that this implies [3-6]. These considerations, coupled with the view that the interaction of the sweat duct with an EM wave is based on their helical morphology, lead one to question the health implications of sub-THz communications and their possible consequent side effects on the public.


**Lunch**
**Thursday June 8, 2017 • 12:30 - 13:30**

**Session: M4**
**BEMS Business Lunch**
**Thursday June 8, 2017 • 12:30 - 13:30**
**Fengyu**

**Session: P5**
**Plenary 5: Bridging research disciplines and how EMF research can learn from other disciplines: the example of nanotechnology**
**Thursday June 8, 2017 • 13:30 - 14:30**
**Jinhua**
**Chair: Luc Martens**

**P5-1 [13:30]**

## An interdisciplinary and intelligent approach to assessing the safety of nanotechnology

Vicki Stone[1]
[1]*Heriot-Watt University, Edinburgh, UK*

### Biographical sketch

Vicki Stone (BSc PhD FRSB FRSE FRSC) is Director of the Nano Safety Research Group at Heriot-Watt University, Edinburgh, and an Honorary Principal Scientist at the Institute of Occupational Medicine. She was the holder of the Royal Society of Chemistries Toxicology Award (2015-16) andthe Editor-in-chief of the journal Nanotoxicology (http://informahealthcare.com/nan) for 6 years (2006-2011). Vicki has also published over 165 publications pertaining to particle toxicology over the last 20 years and is recently recognised by Clarivate Analytics (formerly Thomson Reuters) as one of the top 1% of all researchers in the world for the most cited publications in the field of Pharmacology and Toxicology.

Vicki has provided evidence for the government commissioned reports published by the Royal Society (2003) and the on Environmental Pollution (2008) and she has previously worked as a member of the UK Government Committee on the Medical Effects of Air Pollution (COMEAP) and an advisory board member for Center for the Environmental Implications of NanoTechnology (CEINT; funded by the US Environmental Protection Agency).

The nanotoxicology work at Heriot-Watt University involves funding from Research Councils (NERC, BBSRC and EPSRC), the European Commission (ITS-NANO, ENRHES, ENPRA, InLiveTox, NanoImpactNet, Marina, SUN and Qnano), charities (The Colt Foundation and The Cunningham Trust), the UK Government (http://www.iom-world.org/research/nanoparticles.php) and industry (Unilever and GlaxoSmithKline). Vicki recently coordinated a European project to identify the work needed to develop an intelligent testing strategy for nanomaterials (http://nano.hw.ac.uk/research-projects/itsnano.html).

References

1. Poland, C.A., et al., Carbon nanotubes introduced into the abdominal cavity of mice show asbestos-like pathogenicity in a pilot study. Nat.Nanotechnol., 2008. 3(7): p. 423-428.
2. Maynard, A.D., et al., Safe handling of nanotechnology. Nature, 2006. 444(7117): p. 267-269.
3. Brown, D.M., et al., Size-dependent proinflammatory effects of ultrafine polystyrene particles: a role for surface area and oxidative stress in the enhanced activity of ultrafines. Toxicol.Appl.Pharmacol., 2001. 175(3): p. 191-199.
4. Stone, V., et al., ITS-NANO--prioritising nanosafety research to develop a stakeholder driven intelligent testing strategy. Part Fibre Toxicol, 2014. 11: p. 9.
5. Kermanizadeh, A., et al., A Multilaboratory Toxicological Assessment of a Panel of 10 Engineered Nanomaterials to Human Health-ENPRA Project-The Highlights, Limitations, and Current and Future Challenges. Journal of Toxicology and Environmental Health-Part B-Critical Reviews, 2016. 19(1): p. 1-28.

### Abstract

Nanomaterials are highly diverse. Exploitation of their highly interesting physicochemical characteristics has allowed the development of a wide range of new and exciting commercial products. When designing a new nanomaterial or nanostructured material scientists have a wide range of substances to choose from and so what strategy should be employed to allow effective and efficient development. Obviously assessing the effectiveness of the material relative to the application being developed is key, but once a short list has been identified, how do you prioritise further? In addition, how do regulators consider the risks of such a diverse array of nanomaterials used in so many different applications.

The physicochemical characteristics that influence how nanomaterials behave also influence how they enter the human body, interact with cells and molecules, ultimately influencing their potential safety or toxicity. Toxicology studies have revealed that a range of properties such as composition, size, shape and charge can

all influence toxicity. This toxicity includes local effects at the point entry into the body (e.g. lungs following inhalation) as well as at distal sites (e.g. the liver and immune system).

To address the needs of industry and regulators Intelligent Testing Strategies for nanomaterial risk are required, coupled with the use of advanced alternative methods to reduce testing, especially those using animals, are needed. This presentation will discuss how this information can be used by industry, chemists and material scientists to inform the design choices for nanomaterials and nanostructured materials as well as the safe handling of nanomaterials.

**Session: S09**
**Electroporation**
**Thursday June 8, 2017 • 14:30 - 16:00**
**Fengyu**
**Chairs: Andrei Pakhomov & Shengyong Yin**

**S09-1 [14:30]**

### Stimulation of nerves by 10 nanosecond pulsed electric fields

Maura Casciola[1], Vincenzo Anania[2], Shu Xiao[1], Agnese Denzi[2], Micaela Liberti[2], Francesca Apollonio[2] & Andrei Pakhomov[1]

[1]*Frank Reidy Research Center for Bioelectrics , Old Dominion University, Norfolk, VA, USA, 23510*

[2]*Department of Information Engineering, Electronics and Telecommunications , Sapienza University, Rome, Italy, 00184*

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

***Presented by: Maura Casciola***

In this work, we demonstrated for the first time that 10-ns pulsed electric fields (PEFs) can elicit action potentials (AP) in isolated frog sciatic nerve preparations. Compound APs (CAPs) evoked by 10-ns, 0.48-0.60 kV/cm PEF in nerves did not differ from CAPs evoked by conventional stimuli (100-250 µs, 1-5 V). Nerves sustained repeated tetanic stimulations (50 Hz for 1 min), alternately 10-nsPEF and conventional pulses, fired tens of thousands of CAPs with no signs of damage. Then, we investigated the effect of emitted 10-ns, 5.5 kV/cm PEF, showing that under these conditions the nerve was neither excited nor its conduction properties affected by 5 min of exposure at 1 kHz repletion rate.

**S09-2 [14:45]**

### Glioma specific cell death model for planning of irreversible electroporation treatments

Bor Kos[1], Paulo Garcia[2, 3], John H. Rossmeisl, Jr.[3, 4, 5], Damijan Miklavcic[1] & Rafael Davalos[3]

[1]*Faculty of Electrical Engineering, University of Ljubljana, Ljubljana, Slovenia, 1000*

[2]*Laboratory for Energy and Microsystems Innovation, Massachusetts Institute of Technology, Cambridge, MA, USA,*

**Session: T1**
**Tutorial: Bridging disciplines in an EMF project: ARIMMORA**
**Thursday June 8, 2017 • 14:30 - 16:00**
**Jinhua**
**Chairs: Meike Mevissen & Luc Martens**

**T1-1 [14:30]**

### Introduction

Meike Mevissen[1]

[1]*Berne, Switzerland*

This tutorial gives a summary of a multi-disciplinary consortium project involving dosimetry, in vitro and in vivo experiments, epidemiology, and risk assessment to address the open question of a relationship between extremely low-frequency magnetic field exposure and the risk of childhood leukaemia. Opportunities and challenges of the multi-disciplinary work are discussed also in the context of what can be learnt from other fields (plenary 5).

Speakers in the tutorial are:

1. Dr Myles Capstick - Dosimetry; IT'IS Foundation, Zürich (Switzerland)

2. Dr Primo Schär - Epigenetics;University of Basel, Basel (Switzerland)

3. Dr Joachim Schüz - Epidemiology; International Agency for Research on Cancer (IARC), Lyon (France)

**T1-2 [14:35]**

### Bridging disciplines in an EMF project: ARIMMORA

Myles Capstick[1], Primo Schär[2] & Joachim Schüz[3]

[1]*IT'IS Foundation, ETH, Zurich, Switzerland*

[2]*University of Basel, Basel, Switzerland*

[3]*International Agency for Research on Cancer (IARC), Lyon, France*

Exposure to extremely low-frequency magnetic

*02142*
[3]*School of Biomedical Engineering and Sciences, Virginia Tech – Wake Forest University, Blacksburg, VA, USA, 24060*
[4]*Department of Small Animal Clinical Sciences, Virginia-Maryland Regional College of Veterinary Medicine, Blacksburg, VA, USA, 24060*
[5]*Veterinary and Comparative Neuro-oncology Laboratory, Virginia-Maryland Regional College of Veterinary Medicine, Blacksburg, VA, USA, 24060*
***Keywords: Electroporation, Pulsed, Completed (unpublished)***
***Presented by: Bor Kos***

We developed a glioma specific model for predicting cell death due to irreversible electroporation in vivo. The model is amendable for implementation into a general-purpose treatment planning platform for planning electroporation-based treatments.

fields (ELF-MF) was judged in 2001 by the International Agency for Research on Cancer (IARC) Monograph program on the evaluation of carcinogenic risks to humans as possibly carcinogenic to humans (Group 2 B), based on limited scientific evidence for childhood leukaemia (IARC, 2002). For other cancers in children or cancers in adults (including leukaemia), the evidence was judged inadequate. No re-evaluation has been performed by the IARC since then, but other assessments came to similar conclusions notably those by the World Health Organization (WHO) in their Environmental Health Criteria series in 2007 (WHO, 2007) and the European Commission's (EC) Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR) in 2007, 2009, and 2015 (SCENIHR 2015). In particular, all of those assessments commonly pointed to the lack of convincing mechanistic data and the lack of appropriate animal models when addressing childhood leukaemia. To overcome these limitations, the European Commission-funded project "Advanced Research on Interaction Mechanisms of electroMagnetic exposures with Organisms for Risk Assessment" (ARIMMORA), led by the IT'IS foundation and conducted between October 2011 and May 2015, embarked on a series of experiments targeted to find possible pathways to explain the association between ELF-MF and childhood leukaemia and concluded with a risk assessment of the new evidence (Schüz et al., 2016).

ARIMMORA has been designed as a multi-disciplinary project to target a very specific question on ELF-MF and childhood leukaemia. To explain how the disciplines worked together and informed each other – i.e. the bridging of disciplines – is the aim of this tutorial, with the perspectives from three different disciplines, namely dosimetry, experimental research and epidemiology. The aim is to discuss with the audience on how these experiences in ARIMMORA together with those from other research fields (i.e. nanotechnology as in the previous plenary session) can be utilised for other large-scale projects.

References:

IARC Monographs on the Evaluation of carcinogenic Risks to Humans. Volume 80. Non-Ionizing Radiation, Part 1: Static and extremely low-frequency (ELF) electric and magnetic fields. IARC Press, Lyon, 2002.

Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR). 2015. Potential health effects of exposure to electromagnetic fields (EMF). European Commission, Luxembourg.

World Health Organization (WHO). 2007. Environmental Health Criteria 238. Extremely low frequency (ELF) Fields. WHO, Geneva, Switzerland.

Schüz J, Dasenbrock C, Ravazzani P, Röösli M, Schär

P, Bounds PL, Erdmann F, Borkhardt A, Cobaleda C, Fedrowitz M, Hamnerius Y, Sanchez-Garcia I, Seger R, Schmiegelow K, Ziegelberger G, Capstick M, Manser M, Müller M, Schmid CD, Schürmann D, Struchen B, Kuster N. Extremely low-frequency magnetic fields and risk of childhood leukemia: A risk assessment by the ARIMMORA consortium. Bioelectromagnetics 2016; epub ahead of print 15 March.

**S09-3 [15:00]**

### Extraction of lipids from wet microalgae using pulsed electric field treatment and green solvents

Aude Silve[1], Ioannis Papachristou[1], Rüdiger Wüstner[1], Ralf Straessner[1] & Wolfgang Frey[1]

[1]*Institute for Pulsed Power and Microwave Technology, Karlsruhe Institute of Technology, Eggenstein-Leopoldshafen, Germany, 76344*

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

***Presented by: Aude Silve***

Pulsed electric field (PEF) treatment is an efficient technique to permeabilise external membranes of biological cells. This work reports howit can be used in combination with solvent extraction to recover intracellular lipids produced by microalage. The results indicate that up to 84% of oil can be recovered in only two hours and the total yield can reach 97% after 20 hours of extraction. The overall process can easily be run in continuous mode, and only 1.5MJ of energy is required for the treatment of 1 kg of dry microalage i.e. approximatly 5% of the energy content of the processed microalgae. These results open new perspectives regarding exploitation of microalage for biofuel production.

**S09-4 [15:15]**

### Excitation and permeabilization of neurons by 200-ns pulsed electric field

Andrei Pakhomov[1], Iurii Semenov[1], Maura Casciola[1] & Shu Xiao[1, 2]

[1]*Frank Reidy Research Center for Bioelectrics, Old Dominion University, Norfolk, VA, USA, 23508*

[2]*Department of Electrical and Computer Engineering, Old Dominion University, Norfolk, VA, USA, 23508*

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

***Presented by: Andrei Pakhomov***

We utilized fast imaging of the optical membrane potential (OMP) to reveal how nanosecond pulsed electric field (nsPEF) activates voltage-gated sodium channels (VGSC). Electroporation depolarized OMP within <1 ms, with recovery taking > 20-30 s. VGSC activation resulted in an OMP peak in 4-5 ms

after nsPEF. In 40% of cells, nsPEF triggered action potential (AP) with the median threshold of 3 kV/cm; no APs could be evoked by stimuli below the electroporation threshold (1.5-1.9 kV/cm). However, VGSC opening could already be seen 0.5 ms after nsPEF, which is too fast to be mediated by electroporation. The overlap of electroporation and AP thresholds does not prove the causal relation, but suggests a low potency of nsPEF for AP induction.

**S09-5 [15:30]**

### Investigation of the chemical mechanisms involved in the electropulsation of membranes at the molecular level

Marie Breton[1] & Lluis M. Mir[1]
[1]*UMR 8203, CNRS, Villejuif, France, 94805*
***Keywords: Electroporation, Pulsed, Completed (unpublished)***
***Presented by: Lluis M. Mir***

The description of membrane electropulsation at the molecular level as a purely physical phenomenon is not satisfactory yet since it only considers nanoseconds kinetics whereas electric pulses display long-term effects. The chemical consequences of electropulsation on giant unilamellar vesicles have been investigated by mass spectrometry, flow cytometry and absorbance methods. UV-light and $O_2$ increased the level of pulse-induced lipid peroxidation whereas the presence of antioxidants completely suppressed peroxidation. Importantly, lipid peroxidation seems to result from a facilitation of the lipid peroxidation by the ROS already present in the solution before pulsing, not from a direct pulse-induced peroxidation.

**S09-6 [15:45]**

### The supra-additive effect of split-dose electroporation treatments

Olga Pakhomova[1], Sarah Jensen[1], Vera Khorokhorina[2], Claudia Muratori[1] & Andrei Pakhomov[1]
[1]*Research Center for Bioelectrics, Old Dominion University, Norfolk, Virginia, USA, 23508*
[2]*A. Tsyb Medical Radiological Research Center, Obninsk, Russian Federation, 249036*
***Keywords: Electroporation, Pulsed, Completed (unpublished)***
***Presented by: Olga Pakhomova***

We explored how one electroporation treatment alters the efficiency of a second similar treatment. Each treatment was a burst of 300-ns, 9 kV/cm pulses (50 Hz, n=10-100), and the membrane permeabilization was measured by propidium dye

uptake at 15 min after the exposure. The efficiency of the 2nd treatment could be reduced due to desensitization or increased due to the delayed sensitization (DES). Under the conditions optimal for DES, the 2nd treatment became 2.5 times (23 °C) or even 6 times (37 °C) more effective. DES was not blocked by antioxidants or the inhibition of cell swelling.

**Coffee Break**
**Thursday June 8, 2017 • 16:00 - 16:30**

**Session: S10**
**Mechanistic/Theoretical**
**Thursday June 8, 2017 • 16:30 - 18:00**
**Jinhua**
**Chairs: P. Thomas Vernier & Junji Miyakoshi**

**S10-1 [16:30]**

### Molecular simulations of calcium transport through lipid electropores - the model matters!

Federica Castellani[1, 2] & P. Thomas Vernier[2]
[1]*Biomedical Engineering Institute, Frank Batten College of Engineering and Technology, Norfolk, Virginia, USA, 23529*
[2]*Frank Reidy Research Center for Bioelectrics, Norfolk, Virginia, USA, 23508*
***Keywords: Mechanistic/Theoretical, All Frequencies, Work in Progress***
***Presented by: Thomas Vernier***

The reliability of molecular simulations of ion transport through lipid electropores rests heavily on the validity of the force fields that govern interactions among the atomic and molecular species in the system. During our comparisons of the GROMOS-OPLS and CHARMM36 force fields that we are using for simulations of pore formation and ion conductance, we noticed significant deficiencies of the CHARMM36 calcium ion model. Here we describe the unacceptable behavior of the standard calcium ion model in phospholipid bilayer systems, and we propose modifications to the model that result in more realistic interactions between the calcium ion, water, and phospholipids.

**S10-2 [16:45]**

### Effects of time delays on biological feedback systems and electromagnetic field exposures

Frank Barnes[1]
[1]*Department of Electrical, Computer & Energy Engineering, Boulder, Colorado, USA, 80309*

**Session: S11**
**Standards / Public Health Policy**
**Thursday June 8, 2017 • 16:30 - 18:00**
**Fengyu**
**Chairs: Andrew Wood & Martin Roosli**

**S11-1 [16:30]**

### Facts and opinions in studying electromagnetic fields bioeffects

C. K. Chou[1] & Ron Petersen[2]
[1]*C-K. Chou Consulting, Dublin, CA, USA, 94568*
[2]*R. C. Petersen Associates LLC, Bedminster, NJ, USA, 07921*
***Keywords: Standards, All Frequencies, Completed (unpublished)***
***Presented by: C-K. Chou***

Research on the bioeffects of electromagnetic fields has been ongoing for 70 years, but the controversy continues regarding safety. Two international groups, ICNIRP and IEEE ICES, have been addressing this issue for decades. While the goal of both groups is to provide limits that protect against established or known adverse health effects, there are groups that advocate more stringent exposure limits based on possible biological effects, at limits that are impossible to implement without serious consequence. The two different approaches, i.e., protection against established adverse effects versus protection against possible effects, polarize the debate. This presentation focuses on facts and opinions when dealing with EMF bioeffect studies.

**S11-2 [16:45]**

### Magnetophosphene perception threshold increases as a function of time spent in the dark in humans exposed to extremely low frequency magnetic fields

Shirin Davarpanah Jazi[1, 2], Cadence Baker[1, 3], Michael

***Keywords: Mechanistic/Theoretical, All Frequencies, Concept***
***Presented by: Frank Barnes***

**Summary:** A simple model for an operational amplifier with a time delay in the feedback loop is used to show that a time delay τ will lead to a change in the sign of the feedback as a function of frequency for periodic input signals. Thus shifting the frequency or phase of the electric or magnetic exposure with respect to a naturally oscillating biological system can lead to either the amplification or attenuation of the biological response. Many biological systems are stabilized by negative feedback signals. However, time delays in the feedback can lead positive feedback for externally applied signals at some frequencies and negative feedback at others.

**S10-3 [17:00]**

## Computational method for characterizing dispersive tissue layers from surface reflection data

Will Haines[1], Esra Neufeld[2], Myles Capstick[2], Niels Kuster[2] & Zoya Popovic[1]
[1]*Electrical, Computer, and Energy Engineering, University of Colorado, Boulder, Colorado, USA, 80309*
[2]*IT'IS Foundation for Research on Information Technologies in Society, Zurich, Switzerland, 8004*
***Keywords: Mechanistic/Theoretical, RF/Microwaves, Completed (unpublished)***
***Presented by: Myles Capstick***

Knowledge about the thicknesses and dielectric properties of layered tissues is important for a wide range of applications such as high frequency (>10GHz) dosimetry, where the layered structure of the skin can result in increased energy deposition not captured in homogeneous models. A method developed to determine tissue thicknesses and dispersive dielectric properties from wideband reflection coefficient measurements/simulations is

Corbacio[1], Daniel Goulet[4], Michel Plante[4], Martine Souques[5], François Deschamps[6], Genevieve Ostiguy[4], Jacques Lambrozo[5] & Alexandre Legros[1, 2, 3, 7]
[1]*Bioelectromagnetics and Human Threshold Research Group, Imaging Program, Lawson Health Research Institute, London, ON, Canada*
[2]*Department of Medical Biophysics, Western University, London, ON, Canada*
[3]*Departmentt of Medical Imaging and School of Kinesiology, Western University, London, ON, Canada*
[4]*Hydro-Québec, Montréal, QC, Canada*
[5]*Service des études médicales, EDF, Paris, France*
[6]*Service Environnement Réseaux, RTE, Paris, France*
[7]*EuroMov, Université de Montpellier, Montpellier, France*
***Keywords: Standards, ELF/LF, Work in Progress***
***Presented by: Shirin Davarpanah Jazi***

Magnetophosphene (MP) perception at the level of the retina has been used as model of how extremely low frequency magnetic fields (MF) effect the brain. However, a detailed understanding of the neurophysiological basis of MPs is unavailable. We have used adaptation to darkness as a tool to uncover the underlying mechanism of MP perception. Healthy subjects are exposed to MF of different frequency with flux density up to 80mT. MP threshold is measured by averaging four button presses at different times of remaining in the dark. Data from one participant have been collected. Examining the change in MP detection threshold after different durations of adaptation, we are able to better understand the retinal elements involved in MP production.

**S11-3 [17:00]**
**STUDENT PAPER**

## A study of risk perception on EMF from mobile phone and base stations in India

Rojalin Pradhan[1, 2], Mahim Sagar[2] & Jack Rowley[2, 3]
[1]*Bharti School of Telecommunication Technology and Management, Indian Institute of Technology Delhi, New Delhi, India, 110016*
[2]*Department of Management Studies, Indian Institute of Technology Delhi, New Delhi, India, 110016*
[3]*Global Service Mobile Association, London, United Kingdom*
***Keywords: Public Health Policy, RF/Microwaves, Work in Progress***
***Presented by: Rojalin Pradhan***

Due to the ever increasing use of the mobile phones in India, EMF radiation emitted from mobile phone and base stations has become a largely researched topic. There is a major apprehension among a certain division of people that radiations from mobile phone and base station are affecting the human health. Many studies on risk perception by EMF radiation have been done in many countries

presented. An optimization approach with a computationally efficient, transmission-line theory based forward model is developed. Using computational modeling for validation, the method can be demonstrated to successfully recover the quantities of interest, given sufficiently constrained search space.

**S10-4 [17:15]**

### The absorption of Terahertz radiation by bacterial spores - a modelling study

Alireza Lajevardipour[1] & Andrew Wood[1]

[1]*Bioelectromagnetic Research Group, Swinburne University of Technology, Melbourne, Australia, VIC 3122*

***Keywords: Dosimetry (computational), THz, Work in Progress***

***Presented by: Alireza Lajevardipour***

The induced fields inside bacterial spores exposed to THz radiation have been computed for a 5-layer spore model, using dielectric values for each layer extrapolated from literature values. The FDTD simulations indicate strong fields induced in lipid membranes, with most of the energy absorbed in the coat.

**S10-5 [17:30]**

### The effects of magnetic fields on the circadian rhythms of *cryptochrome* in mouse embryonic fibroblast cell

Chuanfang Chen[1], Zhaoyu Sun[2], Duyan Geng[2] & Tao Song[1]

[1]*Beijing Key Laboratory of Bioelectromagnetism, Institute of Electrical Engineering, Chinese Academy of Sciences, Beijing, China, 100190*

[2]*Hebei University of Technology, Tianjin, China, 300130*

***Keywords: Mechanistic/Theoretical, ELF/LF, Completed (published)***

***Presented by: Chuanfang Chen***

To investigate the effects of extremely low frequency magnetic fields (ELF-MF) on circadian

but hardly any research has been done in India. So we present a study conducted on Indian citizens where we have not only tried to identify their perception towards risks associated with EMF radiation emitted from mobile phones and base stations but have also tried to address the reasons for their concerns.

**S11-4 [17:15]**

### The importance of evaluating 'endurance of RF EMF risk perception'

Frederik Freudenstein[1, 2, 3, 4], Christoph Boehmert[5], Rodney Croft[1, 2, 3, 4] & Peter Wiedemann[1, 3, 4]

[1]*University of Wollongong, Wollongong, Australia, 2522*

[2]*Illawarra Health and Medical Research Institute, Wollongong, Australia, 2522*

[3]*Australian Centre for Electromagnetic Bioeffects Research, Wollongong, Australia, 2522*

[4]*Centre for Population Health Research on Electromagnetic Energy, Melbourne , Australia, 3800*

[5]*Karlsruhe Institute of Technology, Karlsruhe, Germany, 76131*

***Keywords: Public Health Policy, RF/Microwaves, Work in Progress***

***Presented by: Frederik Freudenstein***

Whether lay people's risk perception regarding the potential health effects of electromagnetic fields exists only during a survey situation or extends beyond that into everyday life was the primary question of the present research. The results of an online survey indicated that people who just claim that they are concerned based on a single closed question differ from 'enduringly concerned' respondents regarding exposure perception, their moral and affective evaluation of particular exposure situations, and their acceptance of base station deployment in fictional exposure reduction scenarios.

**S11-5 [17:30]**

### Electric and magnetic field related precautionary requirements on electricity grid facilities in Germany

Dirk Geschwentner[1]

[1]*Department Radiation Protection and Health, Federal Office for Radiation Protection, Oberschleissheim, Germany, 85764*

***Keywords: Public Health Policy, ELF/LF, Completed (published)***

***Presented by: Dirk Geschwentner***

Magnetic fields from stationary AC and DC installations with rated voltages of 1000 V or 2000 V respectively as well as low frequency electric fields from corresponding AC installations are subject to legally binding limits in Germany. The

rhythms of cryptochrome in mouse embryonic fibroblast cell (NIH3T3). The NIH3T3 cells stimulated with 50% horse serum for 2 hours, were exposed to 50Hz, 0.3 mT magnetic field. The results shown that the circadian rhythm of cryptochrome decreased to 23.87±1.69 hours after the cells were exposed to magnetic fields and the circadian rhythm of period wasn't affected by the magnetic fields.

restrictions correspond to guidelines developed by the International Commission on Non-Ionizing Radiation Protection. When the relevant ordinance was reviewed in 2013, additional precautionary requirements were imposed. They apply to new and substantially altered installations and aim at keeping exposure increases low. In 2016, an administrative regulation came into force concretising the requirements. This contribution details the requirements as specified in the administrative regulation.

**S10-6 [17:45]**

### Biological effects of geomagnetic activity and its possible mechanisms

Viacheslav Krylov[1]

[1]*Papanin Institute for Biology of Inland Waters Russian Academy of Sciences, Borok, Russian Federation, 152742*

***Keywords: Mechanistic/Theoretical, ELF/LF, Review, Commentary, Recommendation, Evaluation***

***Presented by: Viacheslav Krylov***

Possible mechanisms by which geomagnetic activity influences organisms are considered. Special attention is paid to the idea that geomagnetic activity is perceived by organisms as a disruption of diurnal geomagnetic variation. This variation, in turn, is viewed by way of a secondary zeitgeber for biological circadian rhythms.The utility of the cryptochrome-magnetoreceptor protein complex as a biological detector of geomagnetic activity is discussed. Perspectives for the studying of mechanisms by which geomagnetic storms affect organisms are suggested.

**Session: S12**
**Human**
**Friday June 9, 2017 • 08:30 - 10:00**
**Jinhua**
**Chairs: Sarah Loughran & Guangdi Chen**

**S12-1 [08:30]**
**STUDENT PAPER**

### Magnetophosphene frequency-response in humans exposed to extremely low frequency magnetic fields

Cadence Baker[1, 2], Shirin Davarpanah Jazi[1, 3], Michael Corbacio[1], Daniel Goulet[5], Michel Plante[5], Martine Souques[6], François Deschamps[7], Genevieve Ostiguy[5], Jacques Lambrozo[6] & Alexandre Legros[1, 2, 3, 4, 8]

[1]*Bioelectromagnetics and Human Threshold Research Group, Lawson Health Research Institute, London, ON, Canada*

[2]*School of Kinesiology, Western University, London, ON, Canada*

[3]*Department of Medical Biophysics, Western University, London, ON, Canada*

[4]*Department of Medical Imaging, Western University, London, ON, Canada*

[5]*Hydro-Québec, Montréal , QC, Canada*

[6]*Service des études médicales, EDF, Paris , France*

[7]*Service Environnement Réseaux, RTE, Paris , France*

[8]*EuroMov, University of Montpellier, Montpellier, France*

***Keywords: Human, ELF/LF, Work in Progress***
***Presented by: Cadence Baker***

Although magnetophosphene perception is the most reliably reported effect of exposure to extremely low frequency (ELF) magnetic fields (MF), its frequency dependence needs to be further documented. Healthy volunteers will be exposed to MFs from 0-300 Hz, with a flux density up to 80 mT. Phosphene perception will be reported with a button-press and EEG will be recorded. To date, two volunteers have been tested. The perception threshold is calculated as the average flux density in each of the 4 button-presses per frequency. Establishing reliable thresholds for magnetophosphene perception as a function of MF frequency, and providing an associated experimental frequency-response curve, will allow insights on the underlying mechanisms of action.

**S12-2 [08:45]**
**STUDENT PAPER**

### Human vestibular system exposed to extremely low frequency magnetic fields up to 100 mT: a body sway investigation

Nicolas Bouisset[1, 2], Sebastien Villard[1, 3], Michael Corbacio[1, 3], Daniel Goulet[8], Michel Plante[8], Martine

**Session: S13**
**Dosimetry-measurements 2**
**Friday June 9, 2017 • 08:30 - 10:00**
**Fengyu**
**Chairs: Peter Gajsek & Mark Douglas**

**S13-1 [08:30]**

### Radiofrequency electromagnetic field and its exposure situation in everyday microenvironments in Europe: a systematic literature review

Sanjay Sagar[1, 2], Stefan Dongus[1, 2], Marloes Eeftens[1, 2], Benjamin Struchen[1, 2], Milena Foerster[1, 2] & Martin Roosli[1, 2]

[1]*Swiss TPH, Basel, Switzerland*

[2]*University of Basel, Basel, Switzerland*

***Keywords: Dosimetry (measurements), RF/Microwaves, Completed (unpublished)***
***Presented by: Martin Roosli***

The aim of this study was to systematically review literature on the distribution of RF-EMF exposure in the everyday environment in Europe. In total, 21 published studies met our eligibility criteria. We observed substantial differences between different study types. On average, spot measurement studies and personal measurements with trained researchers yielded higher total RF-EMF exposure than personal measurement studies with volunteers. These differences can be explained by the methods but are a challenge for comparisons between areas and studies.

**S13-2 [08:45]**

### A Study on back-propagation technique for compliance assessment of power density in millimeter-wave frequency

Kensuke Sasaki[1], Jerdvisanop Chakarothai[1], Iyama Takahiro[2], Teruo Onishi[2] & Soichi Watanabe[1]

[1]*National Institute of Information and Communications*

Souques[7], François Deschamps[5], Genevieve Ostiguy[8], Jacques Lambrozo[7], Michel Guerraz[6] & Alexandre Legros[1, 2, 3, 4, 9]
[1]*Human Threshold Research Group , Lawson Health Research Institute, London, ON , Canada*
[2]*Department of Kinesiology, Western University, London, ON , Canada*
[3]*Department of Medical Biophysics, Western University, London, ON, Canada*
[4]*Department of Medical Imaging, Western University, London, ON, Canada*
[5]*RTE, Département Concertation et Environnement, Cœur Défense , Paris-La Défense, France*
[6]*Départment de Psychologie, , Université Savoie Mont Blanc, Chambéry, Savoie, France*
[7]*Service des Études médicales, EDF, Levallois-Perret Cedex, France*
[8]*Hydro-Québec, , Montréal, Québec, Canada*
[9]*EuroMov, Université de Montpellier, Montpellier, France*
***Keywords: Human, ELF/LF, Work in Progress***
***Presented by: Nicolas Bouisset***

Exposure to extremely low frequency magnetic fields (ELF-MF) modulates nervous system function. Indeed, induced electric fields and currents produced by time-varying magnetic fields (TVMF) can impact the peripheral and central nervous system functions. Today the most reliable experimental outcome relates to magnetophosphene perception, which is linked to retinal electric activation. Given the close neurophysiological characteristics existing between the retina and the vestibular system, we chose to investigate the vestibular response to ELF-MF and electrical currents, and to analyze their impact on body sway.

**S12-3 [09:00]**
**STUDENT PAPER**

### IEI-EMF provocation case studies: Does RF exposure influence self-reported symptoms?

Adam Verrender[1, 2], Sarah Loughran[1, 2], Vitas Anderson[1, 3], Lena Hillert[1, 4, 5], G. James Rubin[1, 6], Gunnhild Oftedal[1, 7] & Rodney Croft[1, 2]
[1]*Australian Centre for Electromagnetic Bioeffects Research, Wollongong, Australia*
[2]*School of Psychology, Illawarra Health and Medical Research Institute, University of Wollongong, Wollongong, Australia*
[3]*Two Fields Consulting, St Kilda, Australia*
[4]*Institute of Environmental Medicine, Karolinska Institutet, Stockholm, Sweden*
[5]*Centre for Occupational and Environmental Medicine, Stockholm County Council, Stockholm, Sweden*
[6]*King's College London, Department of Psychological Technology, Koganei, Japan, 184-8795*
[2]*Research Laboratories, NTT DOCOMO, INC, Yokosuka, Japan, 239-8536*
***Keywords: Dosimetry (measurements), RF/Microwaves, Work in Progress***
***Presented by: Kensuke Sasaki***

The use of frequencies over 6 GHz is expected in 5$^{th}$-generation (5G) mobile and wireless communications technologies. An effectinve system measures the power density from wireless communication devices is required for compliance assessment. We are currently developing a system using a waveguide probe. Our approach is to reconstruct electromagnetic fields from those measured at some wavelengths away from that of an antenna. The validity of the reconstruction technique was assessed by comparing the obtained power density with that obtained by computational analysis using two simple antennas at 60 GHz. The results indicated good agreement for the maximum spatially averaged power density.

**S13-3 [09:00]**

### Novel electromagnetic safety test system for 5G millimeter wave near-field sources

Sven Kuehn[1], Serge Pfeifer[1], Pedro Crespo-Valero[2] & Niels Kuster[1, 3]
[1]*IT'IS Foundation, Zurich, Switzerland, 8004*
[2]*Schmid&Partner Engineering AG, Zurich, Switzerland, 8004*
[3]*Swiss Federal Institute of Technology, Zurich, Switzerland, 8092*
***Keywords: Dosimetry (measurements), RF/Microwaves, Completed (unpublished)***
***Presented by: Sven Kuehn***

Fifth generation (5G) technologies will bring millimeter-wave communication into mobile devices, which becomes a near-field problem and will lead to new requirements on test systems for assessment of compliance with electromagnetic safety guidelines. In this paper, we present the first validated 5G millimeter near-field electromagnetic

*Medicine, London, United Kingdom*
[7]*Department of Electronic Systems, Faculty of Information Technology and Electrical Engineering, Norwegian University of Science and Technology, Trondheim, Norway*
***Keywords: Human, RF/Microwaves, Completed (unpublished)***
***Presented by: Adam Verrender***

While many studies have shown that there is no relationship between RF exposure and self-reported IEI-EMF symptoms, a number of methodological concerns have been raised. Addressing these concerns in its methodology, the present experiment was designed as a series of individual case-studies to determine whether there is a relationship between RF exposure and an IEI-EMF individual's self reported symptoms. Despite accounting for several potential limitations, the present study was unable to find a difference in symptom severity or exposure detection for any of the participants between the active and sham conditions. A strong relationship between symptoms and the belief of being exposed was revealed for all participants.

**S12-4 [09:15]**

## Brain functional connectivity modulated by the acute long-term evolution electromagnetic fields exposure

Bin Lv[1], Congsheng Li[1], Donghui Li[2] & Tongning Wu[1]
[1]*China Academy of Information and Communication Technology, Beijing, China, 100191*
[2]*Department of Bio-Pharmaceutical, Mudanjiang University, Mudanjiang, China, 157021*
***Keywords: Human, RF/Microwaves, Completed (unpublished)***
***Presented by: Bin Lv***

We aimed to investigate whether acute LTE related EMF exposure could modulate brain functional connectivity by using Regional homogeneity (ReHo) and seed based analysis on resting state fMRI data. ReHo method reflects the local consistency of spontaneous fluctuations in the brain, while seed-based method reflects the functional connectivity between the selected regions and all other voxels over the whole brain. Our results provided the new evidences about the acute effect of LTE related EMF exposure.

**S13-4 [09:15]**

## Methods and instrumentation for reliable experimental SAR assessment at 6 – 10 GHz

Katja Pokovic[2], Andreas Christ[1], Theodoros Samaras[3], Mark Douglas[1] & Niels Kuster[1, 4]
[1]*IT'IS Foundation, Zurich, Switzerland, 8802*
[2]*Schmid & Partner Engineering AG, Zurich, Switzerland, 8802*
[3]*Aristotle University of Thessaloniki, Thessaloniki, Greece, 54124*
[4]*Swiss Federal Institute of Technology, Zurich, Switzerland, 8092*
***Keywords: Dosimetry (measurements), RF/Microwaves, Completed (unpublished)***
***Presented by: Mark Douglas***

In this paper, we present the scientific foundation underlying the 6 – 10 GHz frequency extension of specific absorption rate (SAR) measurements. This work fills the gap between published measurement standards that specify parameters for measurements made at up to 6 GHz and the SAR limits proposed by ICNIRP for frequencies up to 10 GHz, which have been adopted in several countries. Homogeneous dielectric parameters of phantoms that result in a conservative exposure assessment have been derived. Measurement equipment and scanning resolutions for accurate measurement have also been determined. This work is proposed for inclusion in the next revision of IEC 62209-1.

**S12-5 [09:30]**

### Does acute RF-EMF exposure affect early sensory or later cognitive ERPs in healthy adults?

Anna Dalecki[1, 2], Sarah Loughran[1, 2, 3], Adam Verrender[2, 3], Catriona Burdon[4] & Rodney Croft[1, 2, 3]

[1]*Population Health Research on Electromagnetic Energy, Monash University, Melbourne, Australia*

[2]*Illawarra Health & Medical Research Institute, University of Wollongong, Wollongong, Australia*

[3]*Australian Centre for Electromagnetic Bioeffects Research, Wollongong, Australia*

[4]*School of Medicine, University of Wollongong, Wollongong, Australia*

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

***Presented by: Anna Dalecki***

We tested whether acute exposure to RF-EMF affects sensory and cognitive event-related potentials (ERPs). Thirty-six healthy subjects completed a visual discrimination task during exposure to a GSM-like, 920 MHz signal (peak-spatial $SAR_{10g}$ of 0, 1 and 2 W/kg) under double-blind conditions. P1 amplitude was reduced ($p = .02$) and anterior N1 latency increased during Exposure compared to Sham ($p = .04$). If RF exposure affects early perceptual (P1) and preparatory/motor (N1) processes these effects appear to be small, and may be compensated for (as no effects were observed on later cognitive ERPs). However these results were not entirely internally consistent and require replication before conclusions can be drawn.

**S12-6 [09:45]**

**WITHDRAWN**

**S13-5 [09:30]**

### Radiofrequency exposure induced by an attocell of an ultra-high density access network

Gunter Vermeeren[1], Arno Thielens[2], Olivier Caytan[3], Guy Torfs[3], Piet Demeester[3], Johan Bauwelinck[3], Hendrik Rogier[3], Luc Martens[1] & Wout Joseph[2]

[1]*WAVES, imec / Ghent University, Ghent, Belgium, 9052*

[2]*WAVES, Ghent University, Ghent, Belgium, 9052*

[3]*IBCN, Ghent University, Ghent, Belgium, 9052*

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

***Presented by: Gunter Vermeeren***

We evaluated the exposure induced by an attocell of an ultra-high density access network radiating at 3.5GHz with an antenna input power of 1mW. We simulated and measured incident field exposure and absorption induced by the antenna of a single cell in a flat phantom and assessed the absorption in a realistic human body model. All measured and simulated $E_{RMS}$ values above the attocell were below 5.9 V/m. The $SAR_{10g}$ values were measured in a homogeneous phantom, which resulted in a $SAR_{10g}$ of 9.7 mW/kg, and using FDTD simulations, which resulted in a SAR10g of 7.2 mW/kg. Simulations of realistic exposure of a heterogeneous phantom yielded $SAR_{10g}$ values below 2.8 mW/kg. The studied dosimetric quantities are compliant with ICNIRP guidelines.

**S13-6 [09:45]**

### Robust and comprehensive validation of SAR array systems: antennas, procedures, and acceptance criteria

Mark Douglas[1], Lucas Portelli[1], Eduardo Carrasco[1], Andreas Christ[1], Nitin Jain[2], Benjamin Loader[3] & Niels Kuster[1, 4]

[1]*IT'IS Foundation, Zurich, Switzerland, 8802*

[2]*BNN Communication Engineers, Ghaziabad, India, 201005*

[3]*National Physical Laboratory, Teddington, United Kingdom, TW11 0LW*

[4]*Swiss Federal Institute of Technology, Zurich, Switzerland, 8092*

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

***Presented by: Mark Douglas***

A rigorous validation method for specific absorption rate (SAR) array systems has been developed, implemented, and successfully tested for inclusion in IEC draft 62209-3. Validation is the core

section of this standard, as it has been defined as a performance standard compared to IEC 62209-1 and IEC 62209-2 that describe the instrumentation details. In this paper, we present the antennas, procedures, and pass/fail validation criteria we developed for IEC draft 62209-3. We present the results of the experimental verification of the numerical target values. We also discuss the application of the validation protocol to three SAR measurement systems, and we present the results of a large interlaboratory study of commercial devices.

**Session: DA**
**D'Arsonval Award**
**Friday June 9, 2017 • 10:00 - 11:00**
**Jinhua**
**Chairs: Nam Kim & Zhengping Xu**

**DA-1 [10:00]**

**The Joy of Exploring the Healing Power of Ultrashort Electrical Pulses**

Karl Schoenbach[1]

[1]*Frank Reidy Research Center for Bioelectrics, Old Dominion University, Norfolk, Virginia, USA*

**Coffee Break**
**Friday June 9, 2017 • 11:00 - 11:30**

**Session: P6**
**Plenary 6: Optogenetics: involving light to control cells**
**Friday June 9, 2017 • 11:30 - 12:30**
**Jinhua**
**Chair: Guangdi Chen**

**P6-1 [11:30]**

## Application of optogenetic techniques in neuroscience

Hailan Hu[1]
[1]*Hangzhou, China*

### Biographical sketch

Dr. Hailan Hu is the Professor and Senior Principal Investigator at the ZIINT and School of Medicine at Zhejiang University. Dr. Hu graduated from Beijing University with a B.S. degree in Biochemistry (1996). She pursued her Ph.D. degree in neuroscience at University of California at Berkeley with Prof. Corey Goodman. After completing PhD (2002), she conducted postdoctoral research with Dr. Julius Zhu at University of Virginia (2003-2004), and Dr. Roberto Malinow at Cold Spring Harbor Laboratory (2004-2008). Before joining Zhejiang University, Dr. Hu was a principal investigator at the Institute of Neuroscience, Chinese Academy of Sciences (2008-2015). Her laboratory seeks to understand how emotional and social behaviors are encoded and regulated in the brain. Dr. Hu is a recipient of the Howard Hughes Predoctoral Fellowship, the Damon Runyon Postdoctoral Fellowship, the CAS Excellent Mentorship (2012, 2014), the National Distinguished Young Scholar, the Meiji Life Science Award, L'Oreal Women Scientist Award and Changjiang Scholar Award.

Selected Publications

1. Hu H. (2016) Reward and aversion. Annual Review in Neuroscience (invited review)
2. Lv Q, Yang L, Li G, Wang Z, Shen Z, Yu W, Jiang Q, Hou B, Pu J, Hu H, Wang Z. (2015) Large-scale persistent network reconfiguration induced by ketamine in anesthetized monkeys: relevance to mood disorders. Biological Psychiatry, in print.
3. Xiu JB, Zhang Q, Zhou T, Zhou TT, Hu H. (2014) Visualizing an emotional valence map in the limbic forebrain by TAI-FISH. Nature Neuroscience,17:1552-1559
4. Li K, Zhou T, Liao L, Yang Z, Wong C, Henn F, Malinow R, Yates J, Hu H. (2013) βCaMKII in lateral habenula mediates core symptoms of depression. Science, 341:1016-1020.
5. Wang F, Zhu J, Zhu H, Zhang Q, Lin Z,Hu H (2011) Bidirectional control of social hierarchy by synaptic efficacy in medial prefrontal cortex. Science, 334: 693-697.

### Abstract

Optogenetics has become one of the most popular neuromodulation tools in neuroscience research in the last decade. With genetically engineered light-sensitive ions channels, it allows precise and instant light control of neural activity and animal behavior. In this talk, I will take our own reserach on social hiearchy behavior as an example to showcase the application of optogenetics. My lab is investigating the neural circuit mechanism of social hierarchy, a most robust form of social behavior. We established that dominance ranking in group-housed mice is transitive, relatively stable, and highly correlated among multiple dominance measures. Using electrophysiology recording and viral-based gene manipulation, we found that social rank of mice correlates with the synaptic strength (how strong neurons connect with each other ) in the medial prefrontal cortex (mPFC), and can be tweaked by molecular manipulations that alter the synaptic efficacy in mPFC (Wang et al., Science, 2011). Recently, we have started applying optogenetical tools to study the social dominance behavior. We have expressed light-sensitive channels in specific cell types within mPFC to dissect their function in social hiearchy regulation. We are also optogenetically stimulate specific input pathways to mPFC to delineate the neural circuit involved in the control of social dominance behavior.

**Student Awards - BioEM2018 Slovenia Presentation**
**Friday June 9, 2017 • 12:30 - 13:30**
**Jinhua**

**Closing Ceremony**
**Friday June 9, 2017 • 13:30 - 14:00**
**Jinhua**

**Session: M5**
**BEMS Board Meeting**
**Friday June 9, 2017 • 14:00 - 16:00**
**Tiancheng**

**Session: M6**
**EBEA Council Meeting**
**Friday June 9, 2017 • 14:00 - 16:00**
**Jinghua**

**Session: FA**
**Student Flash Poster Session A**
**Monday June 5, 2017 • 13:30 - 14:30**
**Jinhua**
**Chairs: Niels Kuster & Christopher Portier**

**FA-1 [13:30]**
**STUDENT PAPER**

### Engineering the cell group migration with patterned electrical field

Yan Zhang[1, 2, 3], Zijie Zhu[1], Guangdi Chen[2], Zhengping Xu[2], Min Zhao[3] & Tingrui Pan[1]

[1]*Micro-Nano Innovations (MiNI) Laboratory, Department of Biomedical Engineering, University of California, Davis, CA, USA, 95616*

[2]*Institute of Environmental Medicine, Zhejiang University School of Medicine , Hangzhou, China, 310058*

[3]*Department of Dermatology, University of California, Davis, CA, USA, 95616*

***Keywords: In vitro, Static, Work in Progress***
***Presented by: Yan Zhang***

In this study, using a novel vacuum channel assisted multi-electrode microfluid chip and a quantitative visualization technique — Particle Image Velocity (PIV) — we demonstrated for the first time that human keratinocyte cells in sheet can sense and follow the local electrical field lines: in a three-electrode system, Line Intergral Convolutions (LIC) assay of cell collective migration vividly displayed as a striking blooming four-petal flower as we tuned up the magnitude of electrical field, which matched the pattern of electrical field lines. Our work paves the way for using programmed electrical signals to engineer cell group migration and tissue regeneration with extreme spatial and temporal resolution.

**FA-2 [13:33]**

**WITHDRAWN**

**FA-3 [13:36]**
**STUDENT PAPER**

### Experimental study of nanosecond pulsed electric field ablation of lilver echinococcus granulosus in mice - The dose effects were validated on animal models to explore the suitable electrode layout for the treatment of echinococcus granulosus

Ruiqing Zhang[1, 2], Tuerganaili Aji[1, 2], Yingmei Shao[1, 2], Bo Ran[1, 2], Tiemin Jiang[1, 2], Xinhua Chen[3] & Hao Wen[1, 2]

[1]*Xinjiang Key Laboratory of Echinococcosis, First Affiliated Hospital of Xinjiang Medical University, Urumqi, China, 830011*

[2]*Hepatobiliary & Hydatid Department, First Affiliated Hospital of Xinjiang Medical University, Urumqi, China, 830011*

[3]*Key Laboratory of Combined Multi-organ Transplantation, Ministry of Public Health, The First Affiliated Hospital, School of Medicine, Zhejiang University, Hangzhou, China, 310003*

***Keywords: Clinical (therapy), Pulsed, Completed (unpublished)***
***Presented by: Ruiqing Zhang***

Echinococcosis is a human parasitic disease that has beenreported worldwide, and Cystic echinococcosis (CE) and alveolar echinococcosis(AE) have beenmajorreported in the epidemic regions, among which CE is the most common type inhumans, and the liver the major affected organ. Radical surgery isthe main strategy for the treatment of hepatic cystic echinococcosis(HCE). In this study, HCE model mice were treated in nanosecond pulsed electric fields (nsPEFs)to investigate the dose-effect for ablation treatment of HCE.

**FA-4 [13:39]**
**STUDENT PAPER**

### Modeled electric fields can explain the interindividual variability of tDCS

Marko Mikkonen[1], Ilkka Laakso[1], Soichiro Koyama[2], Akimasa Hirata[3] & Satoshi Tanaka[4]

[1]*Aalto University, Espoo, Finland*

[2]*Fujita Health University, Toyoake, Japan*

[3]*Nagoya Institute of Technology, Nagoya, Japan*

[4]*Hamamatsu University School of Medicine, Hamamatsu, Japan*
***Keywords: Dosimetry (computational), Static, Completed (unpublished)***
***Presented by: Marko Mikkonen***

Transcranial direct current stimulation (tDCS) is a noninvasive method for modulating cortical activity. A major problem with the method is that its efficacy varies between individuals. Computational studies suggest that this variation could arise from differences in electric fields between each individual brain. In the present study we addressed this issue by combining data from experimental tDCS with individualized computer simulations and showed that the electric fields have a statistically significant effect on interindividual variation.

**FA-5 [13:42]**

**WITHDRAWN**

**FA-6 [13:45]**

**WITHDRAWN**

**FA-7 [13:48]**
**STUDENT PAPER**

### Effects of electromagnetic fields on blood lipids and sex hormones in workers of a power plant

Zhaopin Wang[1], Lijuan Wang[1], Shuangshuang Zheng[1], Zheyuan Ding[1], Hui Liu[1], Wen Jin[1], Yifeng Pan[1], Zexin Chen[1], Ying Fei[1], Guangdi Chen[2], Zhengping Xu[2] & Yunxian Yu[1]

[1]*Department of Epidemiology & Health Statistics, Zhejiang University, Hangzhou, China, 310058*

[2]*Bioelectromagnetics Laboratory, Zhejiang University, Hangzhou, China, 310058*
***Keywords: Epidemiology, All Frequencies, Completed (published)***
***Presented by: Zhaopin Wang***

In present cross-sectional study, we found that chronic exposure to electromagnetic fields (EMF) exposure was associated with an increased level of low density lipoprotein cholesterol and male plasma testosterone and testosterone/estradiol ratio in workers of an electric power plant. Furthermore, we also demonstrated joint effects on serum lipids and plasma sex hormones between occupational EMF exposure and various other occupational or non-occupational EMF exposures, including employment duration, daily EMF exposure duration, mobile phone or electric fee per month. Therefore, EMF exposure might modulate the process of lipid metabolism and affect reproductive functions.

**FA-8 [13:51]**
**STUDENT PAPER**

### A diagnosis platform for breast cancer using radar-based microwave imaging with ultra-wideband antenna array

Fengzhou Wang[1] & Guohua Wang[2]

[1]*School of Engineering, University of Edinburgh, Edingburgh, United Kingdom, EH9 3FF*

[2]*School of Instrumentation Science and Opto-electronics Engineering, Beihang University, Beijing, China, 100191*
***Keywords: Human, RF/Microwaves, Work in Progress***
***Presented by: Fengzhou Wang***

This study aims at building a portable diagnose platform for breast cancer using ultra-wideband radar-based method to allows home-based healthcare. First, a body-coupled UWB antenna which operates from 2GHz to 10GHz is designed and fabricated. Then, one system consists of a wirelessly controlled automated data acquisition part is developed using NI MyRIO board for the proposed platform. At last, the delay-and-sum algorithm is implemented for image reconstruction. An experiment using a 3D printed breast phantom is conducted to demonstrate the feasibility of tumour detection. Results show that tumours of radius more than 5mm can be detected in 2D imaging with the designed UWB antenna array mounting on the portable control system.

**FA-9 [13:54]**
**STUDENT PAPER**

### The effects of a 50-Hz magnetic field exposure on phosphorylation of PKCζ and related signaling pathways in FL cells

Liangjing Chen[1], Liwen Zhu[1], Xiaobo Yang[1] & Wenjun Sun[1]
[1]*Bioelectromagnetics Lab, Hangzhou, China, 310031*
***Keywords: In vitro, ELF/LF, Work in Progress***
***Presented by: Liangjing Chen***

Nowadays, there has been substantial concern about the possible adverse effects of ELF-EMFs on public health. But the biological mechanism underlying the effects of ELF-EMFs is poorly understood. Some related studies have showed that the PKC family might participate in the biological effects of ELF-EMFs. PKCζ as a member of the atypical PKC family is involved in many intracellular signaling pathways. In the present study, we found that exposure to a 50-Hz MF for short duration could induce PKCζ dephosphorylation and enhanced JNK phosphorylation in FL cells. The results indicate that PKCζ may play a key role in biological mechanisms of a 50-Hz MF.

**FA-10 [13:57]**
**STUDENT PAPER**

### Effect of exposure to 1950 MHz radiofrequency field on cultured sertoli cells

Ling Guo[1], Tao Zhao[1], Le Du[2], Jun-Ping Zhang[1], Ke-Ying Zhang[1], Yan Zhou[1], Huan Wang[1], Hui-Juan Sun[1], Guozhen Guo[2] & Gui-Rong Ding[1]
[1]*Department of Radiation Biology, Fourth Military Medical University, Xi'an, China, 710032*
[2]*Department of Radiation Medicine, Fourth Military Medical University, Xi'an, China, 710032*
***Keywords: In vitro, RF/Microwaves, Completed (unpublished)***
***Presented by: Ling Guo***

In this paper, we first investigated the effects of exposure to 1950-MHz radiofrequency (RF) radiation for 24 h at SAR of 3 W/kg on proliferation and secretory function in cultured mouse testis Sertoli (TM4) cells. It was found that compared with sham group, the cell proliferation increased and the stem cell factor (SCF) level transiently decreased after RF exposure. These results suggested that exposure to 1950-MHz RF could promote cell proliferation and affect secretory function in cultured Sertoli cells.

**FA-11 [14:00]**
**STUDENT PAPER**

### The effects of 50 Hz magnetic fields exposure on SPR signals of cell culture medium

Aziguli Yimaer[1], Yue Fei[1], Xinyuan Zhao[1], Zhengping Xu[1] & Guangdi Chen[1]
[1]*Department of Public Health, Zhejiang University, HANGZHOU, China, 310058*
***Keywords: In vitro, ELF/LF, Work in Progress***
***Presented by: Aziguli Yimaer***

It has been reported that static MF or pulse electric fields exposure can influence physical properties of water, and solution of sodium or biological molecules, suggesting that static MF or pulse electric fields induced biological effects in organisms may be through its acting on the their medium. This study evaluated surface plasmon resonance (SPR) sensing signals of cell culture medium under magnetic fields exposure, and demonstrated that 50 Hz MF exposure can affect SPR signals of cell culture medium, while the exposed medium did not elicit significant changes of cell viability, ROS level and the DNA damage in FL cells, suggesting 50 Hz MF exposure influences the physical properties of cell culture medium but not incellular response.

**FA-12 [14:03]**
**STUDENT PAPER**

### *In vivo* detection the electrical impedance variation in rabbit abdominal cavity using magnetic induction tomography

Qihui Chen[1] & RuiGang Liu[1]

[1]*Medical Electronic Engineering, Fourth Military Medical University, Xi'an, China, 710032*
***Keywords: In vivo, All Frequencies, Work in Progress***
***Presented by: Qihui Chen***

Our study aimed to investigate the feasibility of magnetic induction tomography (MIT) detecting the conductivity distribution in vivo. In present study, we tested the conductivity distribution variation with MIT data acquisition system during injecting normal saline into rabbit's abdominal cavity. The reconstructed difference images showed conductivity variation at injected position. Moreover, the conductivity value of target indicated a linear relation that the conductivity increased with the increase of saline injection volume, which proved the potent availability of our MIT system.

**FA-13 [14:06]**
**STUDENT PAPER**

### The effects of microwave radiation on the ovarian follicles and corpora lutea in female rats of different estrous stages

Yifan Xie[1], Hongyan Zuo[1], Xiao Liu[1], Shuiming Wang[1], Hongmei Zhou[2], Cuifang Zhang[1], Shaoxia Wang[1], Liang Cui[1], Hongxing Han[1], Yuan Zhang[3], Qiong Wu[4] & Dewen Wang[1]

[1]*Department of Experimental pathology, Beijing, China, 100850*

[2]*Department of Radiation Protection and Health Physics, Beijing, China, 100850*

[3]*Department of Medical oncology, Beijing, China, 100032*

[4]*Department of Gynaecology, Beijing, China, 100700*
***Keywords: In vivo, RF/Microwaves, Work in Progress***
***Presented by: Yifan Xie***

In recent years the wide use of microwave (MW) was accompanied by tremendous expansion of communication networks. MW exposure was reported to influence embryo implantation and pregnancy, but the effects of MW radiation on ovaries in mammals remain unknown. Therefore, the purpose of this study was to investigate the effects of MW radiation on ovaries. Adult female rats on different stages of estrous cycle were exposed to MW. Rat ovaries of different estrous phases all suffered injuries, and proestrus ovaries were most seriously damaged. Our findings firstly revealed that MW caused various adverse effects on ovaries at different estrous phases.

**FA-14 [14:09]**
**STUDENT PAPER**

### Impacts of environmental static electric field induced by high voltage direct current transmission lines on cognition of mice in relation to ultrastructure alteration in the hippocampus

Yaqian Xu[1], Sixia Wu[1] & Guoqing Di[1]

[1]*Institute of Environmental Pollution & Control Technology, Zhejiang University, Hangzhou, China, 310058*
***Keywords: In vivo, Static, Completed (published)***
***Presented by: Yaqian Xu***

The presented study investigated the impacts of exposure to environmental static electric field with intensities of 2.3~15.4 kV/m and 9.2~21.85 kV/m for 35 d on the cognition of mice. It was found that long-lasting, full-body exposure to static electric field with certain intensity did not induce significant influences on learning ability, but might impair memory ability. In addition, this effect of memory impairment was dose-dependent and was not causally linked to the glutamate and gamma-aminobutyric acid levels in the hippocampus, but it might be caused by the damage of hippocampal neurons ultrastructure.

**FA-15 [14:12]**
**STUDENT PAPER**

### Research on the neurobehavioral abnormality induced by Short Wave Radiation

Chao Yu[1], Yanxin Bai[1], Li Zhao[1], Yabin Gao[1], Xinping Xu[1], Yanhui Hao[1], Hui Wang[1], Shengzhi Tan[1], Wenchao Li[1], Tongning Wu[2] & Ruiyun Peng[1]

[1]*Department of Experimental Pathology, Beijing Institute of Radiation Medicine, Beijing, China, 100850*

[2]*China academy of information communication, Beijing, China, 100083*
***Keywords: In vivo, RF/Microwaves, Work in Progress***
***Presented by: Chao Yu***

Currently most of the researches on the biological effects of electromagnetic radiation were focused on microwave band, and what would happen in central nervous system after shortwave (SW) radiation was seldom reported. In this study, we evaluated the alteration of cognitive competence and hippocampal formation in rats after SW radiation, and representative indicators of oxidant stress were detected also. We found that SW radiation could do damage to the function and structure of rat brain, and induce an abnormal oxidative stress reaction. We concluded that the pathophysiological process of oxidative stress should partly result in the neurobehavioral abnormality of rats, which was to be proven by further study.

## FA-16 [14:15]
## STUDENT PAPER

### Effect of 1840MHz radiofrequency field exposure on behaviors in mice

Jun-Ping Zhang[1], Ke-Ying Zhang[1], Ling Guo[1], Tian Wang[1], Peng Gao[2], Wen-Yao Zhang[3], Huan-Bo Wang[3], Jing Li[1], Guozhen Guo[2] & Gui-Rong Ding[1]

[1]*Department of Radiation Biology, Fourth Military Medical University, Xi'an, China, 710032*

[2]*Department of Radiation Medicine, Fourth Military Medical University, Xi'an, China, 710032*

[3]*Brigade of cadets, Fourth Military Medical University, Xi'an, China, 710032*
***Keywords: In vivo, RF/Microwaves, Completed (unpublished)***
***Presented by: Jun-Ping Zhang***

In this study, we investigated the effects of 4-weeks exposure to 1840MHz radiofrequency (RF) field at the power density of 400μW/cm$^2$ on behaviors in adult male mice by using open field test and Morris water maze. It was found that exposure to RF field did not affect the spatial learning and memory ability. Moreover, the morphology and histology of the brain did not change. However, 4-weeks exposure to RF filed induced anxiety-like behavior and altered the level of some amino acid neurotransmitters in brain.

## FA-17 [14:18]
## STUDENT PAPER

### Microwave radiation leading to shrinkage of dendritic spines in hippocampal neurons mediated by SNK-SPAR pathway

Weijia Zhi[1], Haijuan Li[1], Xiangjun Hu[1] & Lifeng Wang[1]

[1]*Laboratory of Experimental Pathology, Beijing Institute of Radiation Medicine, Beijing, China, 100850*
***Keywords: In vivo, RF/Microwaves, Work in Progress***
***Presented by: Weijia Zhi***

The popularization of microwave raised concerns about its influence on cognitive function which is associated greatly with dendritic spines plasticity. The results of Morris Water Maze test indicated microwave radiation caused dysfunction of spatial learning and memory in exposed rats. Spines in granule cells showed density decrease and spines in pyramidal cells appeared as shrinkage of heads. The ultrastructure of hippocampus neurons such as length and thickness of post synaptic density showed a decrease as well. The up-regulated SNK induced decrease of SPAR and PSD-95. In summary, the microwave radiation led to shrinkage and even loss of dendritic spines in hippocampus by SNK-SPAR pathway, resulting in the cognitive impairments of rats.

## FA-18 [14:21]
## STUDENT PAPER

### Effect of transcranial ultrasonic-magnetic stimulation on neural spiking behaviours and stability in the FitzHugh-Nagumo model

Cui Kun[1], Zhang Shuai[1], Shi Xun[1] & Guizhi Xu[1]

[1]*Province-Ministry Joint Key Laboratory of Electromagnetic Field and Electrical Apparatus Reliability, Hebei University of Technology, Tianjin, China, 300000*
***Keywords: Mechanistic/Theoretical, Ultrasound, Other***
***Presented by: Cui Kun***

Transcranial ultrasonic-magnetic stimulation (TUMS), a novel method to non-invasive brain neuromodulation, does not necessitate surgery or genetic alteration, but it confers spatial resolutions and depth of penetration superior to other noninvasive methods such as transcranial direct current stimulation(tDSC) and transcranial magnetic stimulation(TMS). Simulation analysis of current based on FitzHugh-Nagumo neuron model is considered. It describes how to use transcranial TUMS to modulate neural activity. The results confirm that different spiking behaviours and stabilityare associated with parameter values of TUMS. Parameter values of TUMS are crucial factors that effect spiking behaviours and stability of neuron.

**FA-19 [14:24]**

**WITHDRAWN**

**FA-20 [14:27]**
**STUDENT PAPER**

### The decreased permittivity of zebrafish embryos medium by magnetic fields dose not affect early development of zebrafish embryos

Chuning Zhao[1], Li Jiang[2], Jianyao Lou[1], Bing Han[1], Guangdi Chen[1] & Xinyuan Zhao[1, 3]

[1]*Bioelectromagnetics Laboratory, School of Medicine, Hangzhou, China, 310058*

[2]*State Key Laboratory of Modern Optical Instrumentation, Hangzhou, China, 310058*

[3]*Department of occupational Medicine and Environmental Toxicology, School of Public Health, Nantong, China, 226001*

***Keywords: Mechanistic/Theoretical, ELF/LF, Completed (unpublished)***

***Presented by: Chuning Zhao***

We hypothesized that MF acts on tissues or cells via affecting relative permittivity of surrounding solutions. Thus, we exposed zebrafish embryos medium to 50 Hz MF with various parameters, and detected its relative permittivity based on the phase-sensitive SPR sensing system. Then, we incubated zebrafish embryos with medium pretreated or untreated with 50 Hz MF followed with toxicity assessment.The results demonstrated that 50 Hz MF could decrease the permittivity of zebrafish embryos medium in a dose and time dependent way, although this effect failed to cause significant adverse outcomes under current conditions. The physiological consequences of medium exposed to MF are still unclear and require future examination.

**Session: PA**
**Poster Session A**
**Monday June 5, 2017 • 14:30 - 16:00**
**2nd floor hallway**

**PA-1 [14:30]**

**WITHDRAWN**

**PA-3 [14:30]**

### The effects of pulsed electromagnetic fields on learning and memory abilities in STZ-induced dementia in Rat.

Yue Li[1], Lulu Li[1] & Weidong Pan[1]

[1]*Beijing Key Laboratory of Bioelectromagnetism, Institute of Electrical Engineering, Chinese Academy of Sciences., Beijing, China, 100190*

***Keywords: Behavioural, Static, Work in Progress***
***Presented by: Yue Li***

Recent studies have shown that pulsed magnetic stimulation has therapeutic potential for some disorders such as dementia. However, the neurobiological effects of this tool are not sufficiently explained so far. This study aimed to determine the effects of pulsed magnetic field on STZ-induced dementia rat. MWM is used to assess the learning and memory abilities. Results showed that the mean escape latency of the STZ+MF group significantly decreased compared with that of the model group. These results indicate that pulsed magnetic field can improve cognitive function inSTZ-induced dementia in Rat. Themechanismneedsfurtherinvestigation.

**PA-5 [14:30]**

### New clues to near-zero magnetic field effects in the rice planthoppers

Weidong Pan[1], Jingjing Xu[1], Guijun Wan[2] & Fajun Chen[2]

[1]*Beijing Key Laboratory of Bioelectromagnetics, Institute of Electrical Engineering, CAS, Beijing, China, 100190*

[2]*Department of Entomology, Nanjing Agricultural University, Nanjing, China, 210095*

***Keywords: Behavioural, ELF/LF, Completed (published)***
***Presented by: Weidong Pan***

Magnetic fields markedly affect the growth and development of many species of organisms potentially due to cryptochrome and endogenous presence of magnetic materials. Sensitivity to magnetic fields can also be involved in geomagnetic orientation by some long-distance migratory insects. In this study, near-zero magnetic fields (NZMF) in relation to normal geomagnetic fields (GMF) were setup using the Hypomagnetic Field Space System (HMFs) to investigate the effects of magnetic fields on the growth, development and reproduction with characterized behavior and gene expression in the migratory rice planthoppers.

**PA-7 [14:30]**

### The impact of nanosecond pulse ablation on the sheep liver which is naturally infected with echinococcus granulosus

Hui Wang[1], Ruiqing Zhang[2], Jian Dong[3], Xinhua Chen[4], Yuqing Ma[1] & Hao Wen[2]

[1]*The Department of Pathology, First Affiliated Hospital of Xinjiang Medical University, Urumqi, China, 830011*

[2]*Xinjiang Key Laboratory of Echinococcosis, First Affiliated Hospital of Xinjiang Medical University, Urumqi, China, 830011*

[3]*Ultrasound Diagnosis Department, First Affiliated Hospital of Xinjiang Medical University, Urumqi, China, 830011*

[4]*Key Laboratory of Combined Multi-organ Transplantation, Ministry of Public Health, The First Affiliated Hospital, School of Medicine, Zhejiang University, Hangzhou, China, 310003*

***Keywords: Clinical (diagnostics), Static, Completed (unpublished)***
***Presented by: Hui Wang-2***

Echinococcosis is a human parasitic disease that has been reported worldwide, and Cystic echinococcosis (CE) and alveolar echinococcosis (AE) have been major reported in the epidemic regions, among which CE is the most common type in humans, and the liver the major affected organ. In this study, CE model sheep

were treated in microsecond pulsed electric fields (nsPEFs) to investigate the effect for ablation treatment of CE.

**PA-9 [14:30]**
**STUDENT PAPER**

### Experimental study of nanosecond pulsed electric field ablation of lilver echinococcus granulosus in mice - The dose effects were validated on animal models to explore the suitable electrode layout for the treatment of echinococcus granulosus

Ruiqing Zhang[1, 2], Tuerganaili Aji[1, 2], Yingmei Shao[1, 2], Bo Ran[1, 2], Tiemin Jiang[1, 2], Xinhua Chen[3] & Hao Wen[1, 2]
[1]*Xinjiang Key Laboratory of Echinococcosis, First Affiliated Hospital of Xinjiang Medical University, Urumqi, China, 830011*
[2]*Hepatobiliary & Hydatid Department, First Affiliated Hospital of Xinjiang Medical University, Urumqi, China, 830011*
[3]*Key Laboratory of Combined Multi-organ Transplantation, Ministry of Public Health, The First Affiliated Hospital, School of Medicine, Zhejiang University, Hangzhou, China, 310003*
***Keywords: Clinical (therapy), Pulsed, Completed (unpublished)***
***Presented by: Ruiqing Zhang***

Echinococcosis is a human parasitic disease that has beenreported worldwide, and Cystic echinococcosis (CE) and alveolar echinococcosis(AE) have beenmajorreported in the epidemic regions, among which CE is the most common type inhumans, and the liver the major affected organ. Radical surgery isthe main strategy for the treatment of hepatic cystic echinococcosis(HCE). In this study, HCE model mice were treated in nanosecond pulsed electric fields (nsPEFs)to investigate the dose-effect for ablation treatment of HCE.

**PA-11 [14:30]**

### Electric field stimulation attenuates secondary apoptotic responses in acute spinal cord injury of rats

Cheng Zhang[1], Guanghao Zhang[1], Changzhe Wu[1] & Xiaolin Huo[1]
[1]*Beijing Key Laboratory of Bioelectromagnetism, Institute of Electrical Engineering, Beijing, China, 100190*
***Keywords: Clinical (therapy), All Frequencies, Completed (published)***
***Presented by: Cheng Zhang***

Injury potential, a direct current voltage between intact and injured nerve ends, is caused mainly by the injury-induced $Ca^{2+}$ influx. Our previous papers reported that an application of applied electrical field stimulation (EFS) of the opposite polarity to $Ca^{2+}$ influx could attenuates the injury potential formation. The aim of this study is to determine the effects of (EFS on protecting spinal cord from secondary injury. The results, in this present study, demonstrates that early EFS can significantly inhibit secondary apoptotic responses.

**PA-13 [14:30]**

### Numerical estimation of frequency characteristics of interference voltage in cellular band for active implantable medical device EMI assessment

Takashi Hikage[1], Toshio Nojima[1], Iyama Takahiro[2] & Teruo Onishi[2]
[1]*Graduate School of Information Science and Technology, Hokkaido University, Sapporo, Japan, 0600814*
[2]*Research Laboratories, NTT DOCOMO, INC, Yokosuka, Japan*
***Keywords: Dosimetry (computational), RF/Microwaves, Work in Progress***
***Presented by: Takashi Hikage***

We developed a numerical model of single chamber implantable-cardiac pacemaker connected with monopole lead placed in a torso phantom for active implantable medical devices EMI assessment. The developed model can be used to estimate induced RF interference voltage due to electromagnetic fields emitted from various types of RF device in FEM/FDTD simulation. In this paper, frequency characteristics of induced interference voltage in cellular band is discussed.

**PA-15 [14:30]**
**STUDENT PAPER**

### Modeled electric fields can explain the interindividual variability of tDCS

Marko Mikkonen[1], Ilkka Laakso[1], Soichiro Koyama[2], Akimasa Hirata[3] & Satoshi Tanaka[4]
[1]*Aalto University, Espoo, Finland*
[2]*Fujita Health University, Toyoake, Japan*
[3]*Nagoya Institute of Technology, Nagoya, Japan*
[4]*Hamamatsu University School of Medicine, Hamamatsu, Japan*
***Keywords: Dosimetry (computational), Static, Completed (unpublished)***
***Presented by: Marko Mikkonen***

Transcranial direct current stimulation (tDCS) is a noninvasive method for modulating cortical activity. A major problem with the method is that its efficacy varies between individuals. Computational studies suggest that this variation could arise from differences in electric fields between each individual brain. In the present study we addressed this issue by combining data from experimental tDCS with individualized computer simulations and showed that the electric fields have a statistically significant effect on interindividual variation.

**PA-17 [14:30]**

### The gap design on the EM protective clothes affects the shield effectiveness: A numerical investigation

Hongxin Qi[1], Lifang Sun[1], Jie Zhang[1] & Xianghui Wang[1]
[1]*Biophysics Lab, East China Normal University, Shanghai, China, 200241*
***Keywords: Dosimetry (computational), Pulsed, Completed (published)***
***Presented by: Xianghui Wang***

Present work is focused on how the gap width affects the shield effectiveness (SE) of the protective clothes wearing on a Chinese male that exposed to 300 MHz-3 GHz EMF via computer simulation. Here, 3 different gap width and gap position, 10 different incidence direction, and 11 different site of the clothes were considered, and the whole body average specific absorption rate (WBASAR) were calculated by means of Finite-difference time-domain method to obtain the SE of the clothes. The calculation results show that the actual SE of the protective clothes depends not only on the position and the width of the gap, but also on the incidence, E-polarization and the frequency of the EMF.

**PA-19 [14:30]**

### Assessment of the Induced SAR within human head due to exposure from LTE MIMO Mobile Handset

Muhammad Qureshi[1], Yasir Alfadhl[1] & Xiaodong Chen[1]
[1]*School of Electronic Engineering and Computer Science, Queen Mary University, London, United Kingdom, E14NS*
***Keywords: Dosimetry (computational), RF/Microwaves, Completed (published)***
***Presented by: Yasir Alfadhl***

SAR performance of LTE MIMO mobile handset antenna evaluated in standalone or SISO mode configurations. A numerical model representing an MIMO mobile handset antenna designed with a multi-band antenna covering all of the GSM/UMTS, WLAN and LTE bands. The model used to investigate the two different exposure scenarios namely, calling mode and body-worn case. Numerical simulations carried out on an adult human head model represented. Both ICNIRP and FCC standards considered in order to compare the resultant peak/maximum SAR values due to the exposure from MIMO mobile handset antenna. It found that maximum SAR values are above the basic restriction levels in most assessment configurations when MIMO mobile handset antenna operates in SISO mode.

**PA-21 [14:30]**

### Time averaged electric field strength around Massive MIMO transmitter antenna

Iyama Takahiro[1] & Teruo Onishi[1]
[1]*Research Laboratories, NTT DOCOMO, INC., Yokosuka, Kanagawa, Japan, 239-8536*

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

In calculations for obtaining a separation distance for human protection from EMF for massive MIMO transmitter antenna, it might be required that the maximum gain is applied to all directions. Then, this study investigates the effect of time of beam switching on such separation distance. Our simulations indicate that beam switching in massive MIMO provides the variation in separation distance for human protection from EMF even if directions formed by whole antenna systems stay unchanged. Electric field distribution around antenna system and separation distance will be significantly varied when the antenna elements are placed in two-dimensions and the size of antenna system is considerably larger than wavelength.

## PA-23 [14:30]

### Calculation of current densities inside dentin by applying 500-kHz current

Hiroo Tarao[1], Masatake Akutagawa[2], Takahiro Emoto[2], Hiromichi Yumoto[3], Toshihiko Tominaga[3, 4], Takashi Matsumoto[5], Toshitaka Ikehara[6] & Yohsuke Kinouchi[2]

[1]*Dept. of Electrical & Computer Eng, National Institute of Technology, Kagawa College, Takamatsu, Japan, 761-8058*

[2]*Tokushima University, Tokushima, Japan*

[3]*Tokushima University, Tokushima, Japan*

[4] *Tominaga Dental Clinic, Naruto, Japan*

[5]*National Institute of Technology, Anan College, Anan, Japan*

[6]*Tokushima Bunri University, Tokushima, Japan*

***Keywords: Dosimetry (computational), IF, Work in Progress***
***Presented by: Hiroo Tarao***

Apical periodontitis with bone resorption is caused by an inflammatory reaction to bacterial infection. Conventionally, such bacteria inside a human dentin have been removed manually by an endodontic file which is a kind of surgical instrument used by dentists when performing root canal treatment. To develop new control techniques against bacterial infection, it has been reported that applying a current at 500 kHz – 1 MHz to a root canal of a tooth has bactericidal effects. In the present paper, we demonstrated the calculation of current distribution in a simple tooth model to which two electrodes are attached.

## PA-25 [14:30]

### Evaluation of workers' radiofrequency exposure on low power FM radio transmitters

Blaz Valic[1], Bor Kos[2] & Peter Gajsek[1]

[1]*Institute of Non-ionizing radiation, Ljubljana, Slovenia, 1000*

[2]*Faculty of Electrical Engineering, University of Ljubljana, Ljubljana, Slovenia, 1000*

***Keywords: Dosimetry (computational), RF/Microwaves, Completed (unpublished)***
***Presented by: Peter Gajsek***

We investigated workers' exposure to 500 W FM transmitters with four different antenna array configurations according to action levels and exposure limit values of the EU directive 2013/25/EU. Results show that action levels are very conservative for such exposure situations.

## PA-27 [14:30]

### Calibration of a reverberation chamber for mice exposure experiments in the 60-GHz band

Abdou Khadir Fall[1], Maxim Zhadobov[1], Philippe Besnier[1], Christophe Lemoine[1], Ronan Sauleau[1], Frederic Percevault[2], François Ferrière[2] & Yves Le Dréan[2]

[1]*Institut d'Electronique et de Télécommunications de Rennes (IETR), UMR CNRS 6164, INSA de Rennes, Université de Rennes I, Rennes, France, 35708.*

[2]*Transcription, Environment and Cancer Group, Institute of Research in Environmental and Occupational Health (IRSET), INSERM U1085, Université de Rennes 1, Rennes, France, 35042.*

***Keywords: Dosimetry (measurements), RF/Microwaves, Work in Progress***
***Presented by: Maxim Zhadobov***

The aim of this work is to calibrate the average power density in a mode-stirred reverberation chamber (RC)

designed for in vivo experiments on mice in the 60-GHz band. Mouse skin-equivalent phantoms of realistic shape and dimensions were fabricated for this purpose. The scattering parameters measured between two antennas placed in the RC loaded with the mouse phantoms were used to assess the input power. Statistical uncertainties and variability of the average power density for different scenarios according to the positions of the phantoms were estimated to ±2.8% and ±5%, respectively. The thermal imaging of the temperature distribution on the mouse phantoms was measured by an infrared camera and compared to simulation.

**PA-29 [14:30]**

### An improved way to estimate the specific absorption rate of biological tissue samples

Lars-Ole Fichte[1], Sebastien Lallechere[2], Andreas Lankowski[3], Matthias Kreitlow[4] & Marcus Stiemer[1]

[1]*Helmut Schmidt University, Hamburg, Germany, 22885*

[2]*Universite Clermont Auvergne, UBP, Aubiere, France, 63178*

[3]*Bundeswehr Institute of Radiobiology affiliated to the University of Ulm, München, Germany, 80937*

[4]*Bundeswehr Institute of Protective Technology - NBC Protection, Munster, Germany, 29633*

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

***Presented by: Lars-Ole Fichte***

The specific absorption rate of tissue samples in during in vitro or ex vivo exposure test is one of the key parameters if one investigates possible damages to cells or their components by electromagnetic waves. While many other interactions were investigated, no non-thermal damage was ever verified by reproducible and scientifically valid experiments. Among the many ways for SAR value estimation, one more sophisticated method is to use the temperature change at the start of the heating and to employ a fitting algorithm. Here, fitting all measured data to a model based on physical parameters, we are able to increase the accuracy of SAR value dosimetry and to avoid the assessment of some difficult to achieve material parameters.

**PA-31 [14:30]**

**WITHDRAWN**

**PA-33 [14:30]**

### Measurement campaign for RF exposure in typical everyday scenarios

Thomas Kopacz[1], Christian Bornkessel[2], Matthias Hein[2] & Dirk Heberling[1]

[1]*Institute of High Frequency Technology, RWTH Aachen University, Aachen, Germany, D-52074*

[2]*RF & Microwave Research Laboratory, TU Ilmenau, Ilmenau, Germany, D-98684*

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

***Presented by: Thomas Kopacz***

A measurement campaign on the 6-min time averaged RF radiation exposure in typical everyday scenarios was performed for 20 different measurement points in three everyday scenarios (home, traffic and work). The highest measured exposure has been determined to 0.13 % of ICNIRP's power density reference level. It occurred inside a vehicle in a tunnel scenario with GSM coverage and was dominated by terminal devices. The results show that exposure is mostly dominated by own or other terminal devices when being actively used in close proximity. However, in case of excellent radio coverage (indoor network), exposure is dominated by base stations regardless of active mobile phones due to their transmission power control.

**PA-35 [14:30]**

### Transmitted power of WCDMA mobile phones in urban and rural areas of Korea

Ae-kyoung Lee[1], Jonghwa Kwon[1] & Hyung-Do Choi[1]

[1]*ETRI, Daejeon, Korea, 34129*

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

***Presented by: Ae-kyoung Lee***

Data of power transmitted (Tx) from mobile phones operating in Wideband Code Division Multiple Access (WCDMA) networks were collected in rural areas of Korea. The measured areas are three sparsely populated counties in Gyeonggi province. The measurements for two operators providing WCDMA service

were performed in voice call mode and the results are compared with those in Seoul. From the results, on average, 2-3 dB higher Tx power in the rural areas was observed than in Seoul and a marked difference in power level was shown for the different two operators.

**PA-37 [14:30]**

### Near-field measurement of wireless power transfer system for electric vehicles

SangWook Park[1], SeaWon Lee[1], BeomJin Choi[1] & JongWoo Kim[2]
[1]*EMI/EMC R&D Center, Korea Automotive Technology Institute, Cheonan, Korea*
[2]*R&D Center, Green Power Co. Ltd., Hwaseong, Korea*
***Keywords: Dosimetry (measurements), Static, Work in Progress***
***Presented by: SangWook Park***

In the case of a wireless charging system for an electric vehicle, a large output power is required, so that interest in human safety for electromagnetic field exposure is increasing. An evaluation method is needed to make it safe for consumers to use. In this paper, we developed a wireless charging system for electric vehicles and measured the electromagnetic field by describing the situation during charging.

**PA-39 [14:30]**

### A analysis of the RF-EMF measurement results within the child care facilities

Hyelyun Seo[1], Taewook Hwang[1], Geojung Kim[1] & Kyuhyeon Kim[1]
[1]*Radio Wave Environment Dept., Korea Communications Agency, Naju, Korea*
***Keywords: Dosimetry (measurements), RF/Microwaves, Work in Progress***
***Presented by: Hyelyun Seo***

In this research, the exposure of human body to EMF through the frequency bands in indoor and outdoor environment has been measured. 120 child care facilities where the children are mainly active were visited for the research. The result is less than 1% of the reference level for human body protection and it was concluded that it is appropriate to protect the children from RF-EMF in the current reference level for human body protection in Korea.

**PA-41 [14:30]**

### Measurement of electromagnetic field and contact current in the vicinity of AM broadcasting antenna in Japan

Kanako Wake[1], Jerdvisanop Chakarothai[1] & Soichi Watanabe[1]
[1]*Electromagnetic Compatibility Laboratory, National Institute of Information and Communications Technology, Tokyo, Japan, 184-8795*
***Keywords: Dosimetry (measurements), IF, Work in Progress***
***Presented by: Kanako Wake***

In response to the revision of the ICNIRP guideline in 2010, we have measured the electromagnetic field strengths in the vicinity of eight AM broadcasting antennas, which are operating in the frequency range between 526.5 and 1606.5 kHz in Japan. Contact currents were also measured with metal board of 2 m height. We distinguished two contact currents with ungrounded and grounded metals. It was indicated that the contact current with ungrounded metal object is dominant and correlates well with electric fields.

**PA-43 [14:30]**

### The survey and analysis of electromagnetic environment in Xiamen

Chuanjun Yang[1], Linlin Duan[1], Lu Zhang[1], Chao Tang[1], Ziyan Zhang[1], Hongyin Zhang[1] & Peng Cai[1]
[1]*Urban Ecological Health and Environmental Safety Research Center, Institute of Urban Environment, Chinese Academy of Sciences, Xiamen, China, 361021*
***Keywords: Dosimetry (measurements), All Frequencies, Completed (published)***
***Presented by: Chuanjun Yang***

Through the results obtained from the electromagnetic environment monitoring in Xiamen, it can be found

that the intensity of the electric and magnetic fields in the city is closely related to the city's functional areas. Electromagnetism mainly came from urban railway system, power transmission system and wireless communication system.

**PA-45 [14:30]**

### The study of association between sleeping disorders, headache, and eye irritation and the use of cordless phones

Ali Zeinali[1]

[1]*Sina Health Development High Tech Co, Tehran, Iran*

***Keywords: Dosimetry (measurements), RF/Microwaves, Completed (unpublished)***
***Presented by: Ali Zeinali***

Exposure to electromagnetic fields may cause different biological effects which can lead to some kinds of diseases. Despite many studies over last years, it still remain ambiguous the real biological effects of radiofrequency electromagnetic fields (RF EMF). However, there is many reports of common kinds of symptoms from the people who exposed to RF EMFs. The symptoms such as headache and sleeping disorders are very common among the people under RF exposure. Here, we studied the relation between using cordless phones and Existence of these symptoms. Also, we studied the effect of removing of these phones on disappearance of the symptoms.

**PA-47 [14:30]**

**WITHDRAWN**

**PA-49 [14:30]**

**WITHDRAWN**

**PA-51 [14:30]**

### Transport of electropore dye indicators through stable lipid defects, a molecular dynamics study

Maura Casciola[1], Zachary A. Levine[2], Pablo Campomanes[3], Federica Castellani[1], Esin B Sözer[1], Mounir Tarek[3, 4] & P. Thomas Vernier[1]

[1]*Frank Reidy Research Center for Bioelectrics, Old Dominion University, Norfolk, VA, USA, 23508*

[2]*Department of Physics, Department of Chemistry and Biochemistry, University of California Santa Barbara, Santa Barbara, CA, USA, 93106*

[3]*UMR 7565, Université de Lorraine, Vandoeuvre les Nancy, France, F-54506*

[4]*UMR 7565, CNRS, Vandoeuvre les Nancy, France, F-54506*

***Keywords: Electroporation, Pulsed, Work in Progress***
***Presented by: Maura Casciola***

In this work, we present for the first time results from molecular dynamics simulations on the transport of the electroporation indicators propidium and YO-PRO-1 through stable lipid electropores.

**PA-53 [14:30]**

### Use of mobile and cordless phones and change in cognitive function: a prospective cohort analysis of Australian primary school children

Chhavi Bhatt[1], Geza Benke[1], Catherine Smith[1], Mary Redmayne[1], Christina Dimitriadis[1], Anna Dalecki[2], Skye Macleod[2], Malcolm Sim[1], Rodney Croft[1, 2], Rory Wolfe[1], Jordy Kaufman[3] & Michael Abramson[1]

[1]*Centre for Population Health Research on Electromagnetic Energy (PRESEE), School of Public Health and Preventive Medicine, , Monash University, Melbourne, Australia*

[2]*Australian Centre for Electromagnetic Bioeffects Research, University of Wollongong, Wollongong, Australia*

[3]*School of Health Sciences, Swinburne University of Technology , Melbourne, Australia*

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

***Presented by: Geza Benke***

This research summarises the findings of possible longitudinal associations between the use of mobile and cordless phones in a cohort of primary school children and effects on their cognitive function over a one year period.

**PA-55 [14:30]**
**STUDENT PAPER**

### Effects of electromagnetic fields on blood lipids and sex hormones in workers of a power plant

Zhaopin Wang[1], Lijuan Wang[1], Shuangshuang Zheng[1], Zheyuan Ding[1], Hui Liu[1], Wen Jin[1], Yifeng Pan[1], Zexin Chen[1], Ying Fei[1], Guangdi Chen[2], Zhengping Xu[2] & Yunxian Yu[1]

[1]*Department of Epidemiology & Health Statistics, Zhejiang University, Hangzhou, China, 310058*

[2]*Bioelectromagnetics Laboratory, Zhejiang University, Hangzhou, China, 310058*

***Keywords: Epidemiology, All Frequencies, Completed (published)***
***Presented by: Zhaopin Wang***

In present cross-sectional study, we found that chronic exposure to electromagnetic fields (EMF) exposure was associated with an increased level of low density lipoprotein cholesterol and male plasma testosterone and testosterone/estradiol ratio in workers of an electric power plant. Furthermore, we also demonstrated joint effects on serum lipids and plasma sex hormones between occupational EMF exposure and various other occupational or non-occupational EMF exposures, including employment duration, daily EMF exposure duration, mobile phone or electric fee per month. Therefore, EMF exposure might modulate the process of lipid metabolism and affect reproductive functions.

**PA-57 [14:30]**

### The relationship between amplitude of motor evoked potentials and the stimulation intensity of transcranial magnetic stimulation

Yangyang Kang[1], Bin Lv[1], Congsheng Li[1] & Tongning Wu[1]

[1]*China Academy of Information and Communications Technology, Beijing, China*

***Keywords: Human, ELF/LF, Completed (unpublished)***
***Presented by: Congsheng Li***

The motor evoked potentials (MEP) from Electromyography (EMG) signal can be recorded to characterize the induced neurophysiological effect while the motor cortex is stimulated by TMS.Previous studies have investigated the relationship between MEP amplitude and the coil orientation. Till now, there is no study about the relationship between MEP amplitude and the stimulation strength of TMS. In this study, our aim is to investigate the relationship between MEP amplitude and the stimulation intensity of TMS, and also its variability among different people.

**PA-59 [14:30]**

### Can messages about the harmfulness of EMF exposure trigger a nocebo response in the general population?

Adam Verrender[1, 2], Sarah Loughran[1, 2], Frederik Freudenstein[1, 2], Peter Wiedemann[1, 2] & Rodney Croft[1, 2]

[1]*Australian Centre for Electromagnetic Bioeffects Research, Wollongong, Australia*

[2]*School of Psychology, Illawarra Health and Medical Research Institute, University of Wollongong, Wollongong, Australia*

***Keywords: Human, RF/Microwaves, Work in Progress***
***Presented by: Adam Verrender***

A number of studies have shown that sham exposures are sufficient to trigger symptoms in IEI-EMF participants, leading many to suggest that IEI-EMF may be the result of a nocebo response. Given the increasing prevalence of the condition, there is a great need to better understand the triggers for eliciting such a response. The present study has been designed to determine whether public messaging about adverse health effects of EMF exposure can act as a potential trigger for a nocebo response. The study aims to test whether watching a short video which claims that EMF is harmful can influence symptom detection, risk perception and physiological response in a general population sample.

**PA-61 [14:30]**
**STUDENT PAPER**

### A diagnosis platform for breast cancer using radar-based microwave imaging with ultra-wideband antenna array

Fengzhou Wang[1] & Guohua Wang[2]
[1]*School of Engineering, University of Edinburgh, Edingburgh, United Kingdom, EH9 3FF*
[2]*School of Instrumentation Science and Opto-electronics Engineering, Beihang University, Beijing, China, 100191*
***Keywords: Human, RF/Microwaves, Work in Progress***
***Presented by: Fengzhou Wang***

This study aims at building a portable diagnose platform for breast cancer using ultra-wideband radar-based method to allows home-based healthcare. First, a body-coupled UWB antenna which operates from 2GHz to 10GHz is designed and fabricated. Then, one system consists of a wirelessly controlled automated data acquisition part is developed using NI MyRIO board for the proposed platform. At last, the delay-and-sum algorithm is implemented for image reconstruction. An experiment using a 3D printed breast phantom is conducted to demonstrate the feasibility of tumour detection. Results show that tumours of radius more than 5mm can be detected in 2D imaging with the designed UWB antenna array mounting on the portable control system.

**PA-63 [14:30]**

### A potential mechanism for RF-induced adaptive response

Yi Cao[1], Lin Zong[1], Vijayalaxmi[2], Yulong Sun[1] & Zhen Gao[1]
[1]*Department of Toxicology, Soochow University, Suzhou, China, 215123*
[2]*Department of Radiology, University of Texas, San Antonio, Texas, USA, 78229*
***Keywords: In vitro, RF/Microwaves, Completed (published)***
***Presented by: Yi Cao***

Increased expression of poly ADP-ribose polymerase (PARP) mRNA and protein were observed in mouse bone marrow stromal cells exposed to 900 MHz radiofrequency fields (RF). Such an increase was negated when the cells were treated with 3-aminobenzamide, a potent inhibitor of PARP. Exposure of the cells to gamma radiation (GR) alone increased strand breaks in the DNA while the cells which were pre-exposed to RF and subsequently subjected to GR showed decreased DNA strand breaks as well as faster kinetics of their repair. These observations indicated pre-exposure of the cells to RF is capable of inducing AR in BMSC. Exposure of BMSC to RF+GR+3-AB negated such AR suggesting that PARP plays an important role in RF-induced AR.

**PA-65 [14:30]**
**STUDENT PAPER**

### The effects of a 50-Hz magnetic field exposure on phosphorylation of PKCζ and related signaling pathways in FL cells

Liangjing Chen[1], Liwen Zhu[1], Xiaobo Yang[1] & Wenjun Sun[1]
[1]*Bioelectromagnetics Lab, Hangzhou, China, 310031*
***Keywords: In vitro, ELF/LF, Work in Progress***
***Presented by: Liangjing Chen***

Nowadays, there has been substantial concern about the possible adverse effects of ELF-EMFs on public health. But the biological mechanism underlying the effects of ELF-EMFs is poorly understood. Some related studies have showed that the PKC family might participate in the biological effects of ELF-EMFs. PKCζ as a member of the atypical PKC family is involved in many intracellular signaling pathways. In the present study, we found that exposure to a 50-Hz MF for short duration could induce PKCζ dephosphorylation and enhanced JNK phosphorylation in FL cells. The results indicate that PKCζ may play a key role in biological mechanisms of a 50-Hz MF.

**PA-67 [14:30]**

**WITHDRAWN**

**PA-69 [14:30]**
**STUDENT PAPER**

### Effect of exposure to 1950 MHz radiofrequency field on cultured sertoli cells

Ling Guo[1], Tao Zhao[1], Le Du[2], Jun-Ping Zhang[1], Ke-Ying Zhang[1], Yan Zhou[1], Huan Wang[1], Hui-Juan Sun[1], Guozhen Guo[2] & Gui-Rong Ding[1]

[1]*Department of Radiation Biology, Fourth Military Medical University, Xi'an, China, 710032*

[2]*Department of Radiation Medicine, Fourth Military Medical University, Xi'an, China, 710032*

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

***Presented by: Ling Guo***

In this paper, we first investigated the effects of exposure to 1950-MHz radiofrequency (RF) radiation for 24 h at SAR of 3 W/kg on proliferation and secretory function in cultured mouse testis Sertoli (TM4) cells. It was found that compared with sham group, the cell proliferation increased and the stem cell factor (SCF) level transiently decreased after RF exposure. These results suggested that exposure to 1950-MHz RF could promote cell proliferation and affect secretory function in cultured Sertoli cells.

**PA-71 [14:30]**

### Effects of reactive oxygen species induced by 405 nm light irradiation on cultured HeLa S3 cells

Toshitaka Ikehara[1, 2], Mutsumi Nakahashi[3], Takahiro Emoto[4], Masatake Akutagawa[4], Koichiro Tsuchiya[5], Akira Takahashi[5] & Yohsuke Kinouchi[4]

[1]*Department of Human Welfare, Tokushima bunri University, Tokushima, Japan, 770-8514*

[2]*Institute for Health Sciences, Tokushima Bunri University, Tokushima, Japan, 770-8514*

[3]*Graduate School of Bioscience and Bioindustry, Tokushima University , Tokushima, Japan, 770-8506*

[4]*Institute of Science and Technology, Tokushima university, Tokushima, Japan, 770-8506*

[5]*Institute of Biomedical Sciences, Tokushima University , Tokushima, Japan, 770-8504*

***Keywords: In vitro, All Frequencies, Work in Progress***

***Presented by: Toshitaka Ikehara***

We tested effects of 405 nm light irradiation on HeLa cells. The irradiation for 3 hr did not affect the cell viability, but ROS (reactive oxygen species) induced in cells and medium were increased rapidly by the irradiation. This ROS measured by a fluorescent probe, 2',7'–dichloro dihydrofluorescein diacetate was mainly singlet oxygen. The intracellular ROS was more rapidly increased in the cells decreased intracellular glutathione (GSH) by 1-chloro-2,4-dinitrobenzen. Also, the irradiation for more than 2 hr increased lactate dehydrogenase released into medium in the cells preloaded buthionine sulfoximine. These results suggest that the intracellular GSH plays as a scavenger of intracellular ROS induced by the irradiation.

**PA-73 [14:30]**

### Differential pro-inflammatory responses of astrocytes and microglia involve STAT3 activation in response to 1800 MHz radiofrequency fields

Yong-Hui Lu[1, 2], Huifeng Pi[1, 2], Lei Zhang[1, 2], Zheng-Ping Yu[1, 2] & Zhou Zhou[1, 2]

[1]*Department of Occupational Health, Third Military Medical University, Chongqing, China, 400038*

[2]*Key Laboratory of Medical Protection for Electromagnetic Radiation, Ministry of Education, Chongqing, China, 400038*

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

***Presented by: Yong-Hui Lu***

We investigated the pro-inflammatory responses of microglia and astrocytes and the involved mechanism in response to RF fields. RF exposure induced differential pro-inflammatory responses in astrocytes and microglia, characterized by different expression and release profiles of IL-1β, TNF-α, IL-6, PGE2, nitric oxide (NO), inducible nitric oxide synthase (iNOS) and cyclooxygenase 2 (COX2). Moreover, the RF exposure activated STAT3 in microglia but not in astrocytes. This data provide novel insights into the potential mechanisms of the reported CNS impacts associated with mobile phone use and present STAT3 as a promising target to protect humans against increasing RF exposure.

**PA-75 [14:30]**

### Quantum biology of low frequency magnetic fields: cryptochrome, radicals and genomic instability (MACRI)

Jukka Luukkonen[1], Jukka Juutilainen[1] & Jonne Naarala[1]

[1]*Department of Environmental and Biological Sciences, University of Eastern Finland, Kuopio, Finland*

***Keywords: In vitro, ELF/LF, Work in Progress***

***Presented by: Jukka Luukkonen***

This is a description of the MACRI project, which aims at a breakthrough in understanding mechanisms for the suggested carcinogenic effects of weak extremely low frequency (ELF) magnetic fields (MFs). The hypothesis of this project is that MF effects on radical pairs, rather than affecting overall cellular oxidative processes, might more likely lead to marked effects when they occur in molecules (cryptochromes) that are key components in biological regulatory networks. Novel experiments will be performed to reveal causal relationships, by studying temporal order of the biological changes using fluorescent live cell imaging system equipped with an advanced MF exposure system.

**PA-77 [14:30]**

### Study on the Effects of 1950 MHz Radiofrequency Electromagnetic Fields on Aβ Processing in Human Neuroblastoma and Mouse Hippocampal Neuronal Cells

Jeongyeon Park[1], Jong Hwa Kwon[2], Nam Kim[3] & Kiwon Song[1]

[1]*Department of Biochemistry, College of Life Science & Biotechnology, Yonsei University, Seoul, Korea, 03722*

[2]*Department of EMF Research Team, Radio and Broadcasting Technology Laboratory, Electronics and Telecommunications Research Institute (ETRI), Daejon, Korea, 305-307*

[3]*School of Electrical and Computer Engineering, Chungbuk National University, Cheongju, Korea, 362-763*

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

***Presented by: Kiwon Song***

We exposed HT22 mouse hippocampal neuronal cells and SH-SY5Y human neuroblastoma cells to 1950 MHz radiofrequency electromagnetic fields (RF-EMF) (SAR 6 W/kg) for 2 hours per day for 3 days, and analyzed the mRNA level and protein expression of the key genes related to Aβ processing and secretion. Expressed mRNA levels of APP, BACE1, ADAM10, and PSEN1 did not change after HT22 and SH-SY5Y cells were exposed to RF-EMF. The processing and secretion of Aβ peptide was not significantly different between RF-EMF exposed cells and the unexposed controls. These observations suggest that RF-EMF exposure may not have a significant physiological effect on Aβ processing of neural cells in the short term exposure.

**PA-79 [14:30]**

### Investigation of DNA damage in rat primary neurons and SH-SY5Y human neuroblastoma cells exposed to the GSM-1800 signal

Rémy Renom[1], Florence Poulletier De Gannes[1], Corinne El Khoueiry[1], Emmanuelle Poque-Haro[1], Annabelle Hurtier[1], Bernard Veyret[1, 2] & Isabelle Lagroye[1, 2]
[1]*Bordeaux University, Talence, France, 33405*
[2]*Paris Sciences et Lettres Research University, Paris, France, 75005*
***Keywords: In vitro, RF/Microwaves, Work in Progress***
***Presented by: Isabelle Lagroye***

The potential role of RF in cancer, behavioural effects, and neurodegenerative diseases is addressed through in vitro experiments and the assessment of DNA damage in rat primary neurons and human neuroblastoma cells exposed to a GSM-1800 signal.

**PA-81 [14:30]**

### Using real-time impedance-based assays to monitor the effects of environmental radiofrequency signals on breast cancer and neuroblastoma cell lines

Hermanus Ruigrok[1], Delia Arnaud-Cormos[2], Annabelle Hurtier[1], Emmanuelle Poque-Haro[1], Florence Poulletier De Gannes[1], Isabelle Lagroye[1], Bernard Veyret[1], Philippe Leveque[2] & Yann Percherancier[1]
[1]*IMS Laboratory (CNRS UMR 5218), Bordeaux University, Talence, France, 33400*
[2]*XLIM Laboratory (CNRS UMR 7252), Limoges University, Limoges, France, 87060*
***Keywords: In vitro, RF/Microwaves, Completed (unpublished)***
***Presented by: Yann Percherancier***

**Summary** We have recently described the characterization of an EMF exposure setup compatible with real-time impedance measurements of adherent biological cells (Garcia-Fernandez et al., 2016). We used this innovative system to assess the potential effect of RF electrical fields emitted at 1800 MHz at four different levels of specific absorption rate (SAR). We exposed two different cell lines, both in the presence or the absence of a chemical activation, using CW, GSM, UMTS, LTE or Wi-Fi modulation. Our results suggest that the RF electric fields tested are not able to modify significantly the behavior of either SH-SY5Y neuroblastoma cells or MCF-7 breast cancer cell line, even when co-exposed with a chemical activator.

**PA-83 [14:30]**

### Research on roles of NMDAR in synaptic plasticity injuries induced by microwave radiation and its relationship to neuronal calcium

Hui Wang[1], Shengzhi Tan[1], Li Zhao[1], Jing Zhang[1], Hongmei Zhou[2] & Ruiyun Peng[1]
[1]*Department of Experimental Pathology, Beijing Institute of Radiation Medicine, Beijing, China, 100850*
[2]*Division of Radiation Protection and Health Physics, Beijing Institute of Radiation Medicine, Beijing, China, 100850*
***Keywords: In vitro, RF/Microwaves, Completed (unpublished)***
***Presented by: Hui Wang***

The study intended to build microwave radiation induced synaptic plasticity damage model in vitro and to explore the roles of NMDAR and its relationship with the neuronal calcium. Results found the 50 mW/cm$^2$ microwave exposure could induce the synaptic plasticity injuries, the decrease of NMDAR's current densities and the protein and mRNA expression of key NMDAR's subunits in vitro. Moreover, the NMDAR played specially important roles on the microwave induced injuries of synaptic plasticity after adding the NMDAR's agonist and detecting changes of synaptic plasticity. The decreased cytoplasmic, mitochondrial, and endoplasmic reticulum calcium may result from the inactivation of NMDAR.

**PA-85 [14:30]**
**STUDENT PAPER**

### The effects of 50 Hz magnetic fields exposure on SPR signals of cell culture medium

Aziguli Yimaer[1], Yue Fei[1], Xinyuan Zhao[1], Zhengping Xu[1] & Guangdi Chen[1]
[1]*Department of Public Health, Zhejiang University, HANGZHOU, China, 310058*
***Keywords: In vitro, ELF/LF, Work in Progress***
***Presented by: Aziguli Yimaer***

It has been reported that static MF or pulse electric fields exposure can influence physical properties of

water, and solution of sodium or biological molecules, suggesting that static MF or pulse electric fields induced biological effects in organisms may be through its acting on the their medium. This study evaluated surface plasmon resonance (SPR) sensing signals of cell culture medium under magnetic fields exposure, and demonstrated that 50 Hz MF exposure can affect SPR signals of cell culture medium, while the exposed medium did not elicit significant changes of cell viability, ROS level and the DNA damage in FL cells, suggesting 50 Hz MF exposure influences the physical properties of cell culture medium but not incellular response.

**PA-87 [14:30]**

### Study on bioeffects of electromagnetic field exposure in China

Zheng-Ping Yu[1, 2]

[1]*Department of Occupational Health, Third Military Medical University, Chongqing, China, 400038*

[2]*Key Laboratory of Medical Protection for Electromagnetic Radiation, Ministry of Education, Chongqing, China, 400038*

***Keywords: In vitro, All Frequencies, Completed (unpublished)***

***Presented by: Zheng-Ping Yu***

The EMF exposure of the general public is growing sharply in China due to the social and economical development. This presentation introduces the EMF project in China supported by National Basic Research Projects (973) and highlights some important results in bioelectromagnetics in China these years.

**PA-89 [14:30]**
**STUDENT PAPER**

### Engineering the cell group migration with patterned electrical field

Yan Zhang[1, 2, 3], Zijie Zhu[1], Guangdi Chen[2], Zhengping Xu[2], Min Zhao[3] & Tingrui Pan[1]

[1]*Micro-Nano Innovations (MiNI) Laboratory, Department of Biomedical Engineering, University of California, Davis, CA, USA, 95616*

[2]*Institute of Environmental Medicine, Zhejiang University School of Medicine , Hangzhou, China, 310058*

[3]*Department of Dermatology, University of California, Davis, CA, USA, 95616*

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

***Presented by: Yan Zhang***

In this study, using a novel vacuum channel assisted multi-electrode microfluid chip and a quantitative visualization technique — Particle Image Velocity (PIV) — we demonstrated for the first time that human keratinocyte cells in sheet can sense and follow the local electrical field lines: in a three-electrode system, Line Intergral Convolutions (LIC) assay of cell collective migration vividly displayed as a striking blooming four-petal flower as we tuned up the magnitude of electrical field, which matched the pattern of electrical field lines. Our work paves the way for using programmed electrical signals to engineer cell group migration and tissue regeneration with extreme spatial and temporal resolution.

**PA-91 [14:30]**
**STUDENT PAPER**

### *In vivo* detection the electrical impedance variation in rabbit abdominal cavity using magnetic induction tomography

Qihui Chen[1] & RuiGang Liu[1]

[1]*Medical Electronic Engineering, Fourth Military Medical University, Xi'an, China, 710032*

***Keywords: In vivo, All Frequencies, Work in Progress***

***Presented by: Qihui Chen***

Our study aimed to investigate the feasibility of magnetic induction tomography (MIT) detecting the conductivity distribution in vivo. In present study, we tested the conductivity distribution variation with MIT data acquisition system during injecting normal saline into rabbit's abdominal cavity. The reconstructed difference images showed conductivity variation at injected position. Moreover, the conductivity value of target indicated a linear relation that the conductivity increased with the increase of saline injection volume, which proved the potent availability of our MIT system.

**PA-93 [14:30]**

### Anti-stress effects of exposure to a 50-Hz electric field in immobilized mice

Takuya Hori[1, 2], Takaki Nedachi[2], Hiroshi Suzuki[1] & Shinji Harakawa[1, 2]

[1]*Bio-Self-Regulating Science Laboratory, Obihiro University of Agriculture and Veterinary Medicine, Obihiro, Japan, 0808555*

[2]*Research and Development, Hakuju Institute for Health Science, Tokyo, Japan, 1510063*

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

***Presented by: Takuya Hori***

We previously reported that increased plasma adrenocorticotropic hormone (ACTH) levels in immobilized rat were suppressed by exposure to a 50-Hz electric field (EF). Herein, we investigated the dose-response effect of exposure to an EF, time-dependent changes in plasma glucocorticoid (GC) levels as an indicator of stress, and different configurations of an EF exposure system in mice. Plasma GC levels and blood parameters were compared between mice assigned to control, EF-only, immobilization (IM)-only, and co-treated groups. Exposure to a 50-Hz EF suppressed the stress response in mice in a kV/m- and duration-dependent manner.

**PA-95 [14:30]**

### Assessment of genotoxicity in mice exposed to IF magnetic fields

Kajal Kumari[1], Myles Capstick[2], Jonne Naarala[1], Heikki Tanila[3] & Jukka Juutilainen[1]

[1]*Department of Environmental and Biological Science, University of Eastern Finland, Zurich, Switzerland, Finland*

[2]*IT'IS Foundation, ETH, Zurich, Switzerland, Finland*

[3]*A. I. Virtanen Institute, University of Eastern Finland, Kuopio, Finland, 70150*

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

***Presented by: Kajal Kumari***

Human exposure to intermediate frequency (IF) magnetic fields (MF) is increasing due to new applications such as electronic article surveillance systems and induction heating cookers. However, few data are available on possible health effects of IF MFs. This study was conducted to assess possible genotoxic effects from exposure to IF MFs. Male C57BL/6J mice were exposed continuously for 5 weeks to 7.5 kHz MFs at 12 or 120 μT. Whole blood cells were analysed for DNA damage by the Comet assay. No exposure-related differences in DNA damage level were observed ($p = 0.537$). The results of possible effects of IF MF on micronuclei formation in blood cells will be presented during the BioEM-2017 meeting.

**PA-97 [14:30]**

### Comparison of RNA expression in Testis between Mouse and Rat after continuous long-term exposure of 60 Hz Magnetic fields

Young-Nam Lee[1], Min-Sol Kim[1], Young Deuk Kim[1], Suyeon Kim[1], Yena Lee[1], Young Ae Park[1], Eun Young Hwang[1], Sungman Park[1], Min Soo Kim[1], Sapaev Mukhtor[2], Sang-Kon Lee[2], Nam Kim[3], Yoon-Myoung Gimm[4] & Yoon-Won Kim[1, 5]

[1]*Institute of Medical Science, Hallym University, Chuncheon, Korea, 24252*

[2]*Department of Urology, Sacred Heart Hospital, , Hallym University, Chuncheon, Korea, 24252*

[3]*School of Electrical and Computer Engineering, Chungbuk National University, Chengju, Korea*

[4]*Department of Electronics and Electrical Engineering, , Dankook University, Yong-In, Korea*

[5]*Department of Microbiology, Hallym University, Chuncheon, Korea, 24232*

***Keywords: In vivo, ELF/LF, Completed (unpublished)***

***Presented by: Young-Nam Lee***

In this study, we investigated the differentially expressed genes following the continuous exposure of 60 Hz magnetic fields (MF) in mouse and rat. We found several genes which were differentially expressed in these animals. However, commonly regulated genes both mouse and rat were not existed. When the genes were classified with it`s functions, expression of several genes were changed in both mice and rats including cytochrome P450, olfactory receptors, G-protein coupled receptors (GPCR), and vomeronasal receptor. We need further to define the roles of the gene in testis after the exposure of 60 Hz MF.

**PA-99 [14:30]**

### Autophagy in spermatogonial stem cells of mice exposed to extremely low frequency magnetic fields (ELF-MF)

Gloria Lévano[1], Victor Cruz[2] & Martha Valdivia[1]

[1]*Laboratory of physiology and animal reproduction, San Marcos University, Lima, Peru, Lima01*

[2]*Electronic electrical Engineering, San Marcos University, Lima, Peru, Lima01*

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

***Presented by: Victor Cruz***

The aim of this study was to evaluate endogenous recovery capacity in testis from 4-day postpartum (dpp) mice exposed in vivo for 10 days to 715 μT and 60 Hz magnetic fields. One group of them was sacrificed to analyze the viability, concentration and amount of DBA-positive cells from testes (Group I), another group of mice exposed in vivo under the same conditions of exposition to ELF-MF, were allowed to develop until 70 dpp without magnetic fields (Group III), were sacrificed and were evaluated the spermatogonial stem cells and also the epidydimal spermatozoa parameters. Controls without exposition were sacrificed on day 14 and 70 dpp (Group II and Group IV respectively).

**PA-101 [14:30]**

### Weak magnetic field manipulation disrupts planarian regeneration by blocking accumulation of reactive oxygen species

Jacob Morton[1], Luke Kinsey[1], Julian Cyrus[2], Frank Barnes[2] & Wendy Beane[1]

[1]*Department of Biological Sciences, Kalamazoo, MI, USA, 49008-5410*

[2]*Department of Electrical, Computer, and Energy Engineering, Boulder, CO, USA, 80309-0425*

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

***Presented by: Frank Barnes***

Weak magnetic fields (WMF) can affect the rate of cellular proliferation. Our data shows that exposing planarian regenerates to 200μT WMF inhibits new tissue (blastema) growth, as compared to controls exposed to 45μT (earth-normal). Increased reactive oxygen species (ROS) at the wound site occurs after injury and is required for blastema growth. 200μT exposure prevents ROS accumulation, phenocopying direct pharmacological ROS inhibition. Inhibition of superoxide dismutase (SOD) increases ROS and rescues 200μT exposure. Since WMF variations can change the combined nuclear and electron spin states in radical molecules and radical pair recombination rates, these data suggest WMF affects regeneration in vivo via changes in ROS production.

**PA-103 [14:30]**

### Exposure of Rotating Magnetic Fields Promotes Central Nervous Regeneration in Planarian

Xiaomei Wang[1] & Xiaoyun Zhang[1]

[1]*Physiology Department, Shenzhen University, Shenzhen, China, 518060*

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

***Presented by: Xiaomei Wang***

we used a planarian decapitated model to investigate beneficial effects of early rotary non-uniform magnetic fields (RMFs) exposure on central nervous regeneration. Our results clearly indicated that magnetic stimulation induced from early RMFs exposure significantly promoted neural regeneration of planarians. This stimulating effect is frequency and intensity dependent. Optimum effects were obtained when decapitated planarians were cultured at 20C, starved for 3 days before head-cutting, and treated with 6 Hz 0.02 T RMFs.RMFs exposure up-regulated expression of EGR4 and Netrin 2, and mature nerve cell marker proteins, NSE and NPY. These results suggest that RMFs therapy produced significant benefit in central nervous regeneration.

**PA-105 [14:30]**
**STUDENT PAPER**

### The effects of microwave radiation on the ovarian follicles and corpora lutea in female rats of different estrous stages

Yifan Xie[1], Hongyan Zuo[1], Xiao Liu[1], Shuiming Wang[1], Hongmei Zhou[2], Cuifang Zhang[1], Shaoxia Wang[1], Liang Cui[1], Hongxing Han[1], Yuan Zhang[3], Qiong Wu[4] & Dewen Wang[1]

[1]*Department of Experimental pathology, Beijing, China, 100850*

[2]*Department of Radiation Protection and Health Physics, Beijing, China, 100850*

[3]*Department of Medical oncology, Beijing, China, 100032*

[4]*Department of Gynaecology, Beijing, China, 100700*

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

***Presented by: Yifan Xie***

In recent years the wide use of microwave (MW) was accompanied by tremendous expansion of communication networks. MW exposure was reported to influence embryo implantation and pregnancy, but the effects of MW radiation on ovaries in mammals remain unknown. Therefore, the purpose of this study was to investigate the effects of MW radiation on ovaries. Adult female rats on different stages of estrous cycle were exposed to MW. Rat ovaries of different estrous phases all suffered injuries, and proestrus ovaries were most seriously damaged. Our findings firstly revealed that MW caused various adverse effects on ovaries at different estrous phases.

**PA-107 [14:30]**
**STUDENT PAPER**

### Impacts of environmental static electric field induced by high voltage direct current transmission lines on cognition of mice in relation to ultrastructure alteration in the hippocampus

Yaqian Xu[1], Sixia Wu[1] & Guoqing Di[1]

[1]*Institute of Environmental Pollution & Control Technology, Zhejiang University, Hangzhou, China, 310058*

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

***Presented by: Yaqian Xu***

The presented study investigated the impacts of exposure to environmental static electric field with intensities of 2.3~15.4 kV/m and 9.2~21.85 kV/m for 35 d on the cognition of mice. It was found that long-lasting, full-body exposure to static electric field with certain intensity did not induce significant influences on learning ability, but might impair memory ability. In addition, this effect of memory impairment was dose-dependent and was not causally linked to the glutamate and gamma-aminobutyric acid levels in the hippocampus, but it might be caused by the damage of hippocampal neurons ultrastructure.

**PA-109 [14:30]**
**STUDENT PAPER**

### Research on the neurobehavioral abnormality induced by Short Wave Radiation

Chao Yu[1], Yanxin Bai[1], Li Zhao[1], Yabin Gao[1], Xinping Xu[1], Yanhui Hao[1], Hui Wang[1], Shengzhi Tan[1], Wenchao Li[1], Tongning Wu[2] & Ruiyun Peng[1]

[1]*Department of Experimental Pathology, Beijing Institute of Radiation Medicine, Beijing, China, 100850*

[2]*China academy of information communication, Beijing, China, 100083*

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

***Presented by: Chao Yu***

Currently most of the researches on the biological effects of electromagnetic radiation were focused on microwave band, and what would happen in central nervous system after shortwave (SW) radiation was seldom reported. In this study, we evaluated the alteration of cognitive competence and hippocampal formation in rats after SW radiation, and representative indicators of oxidant stress were detected also. We found that SW radiation could do damage to the function and structure of rat brain, and induce an abnormal oxidative stress reaction. We concluded that the pathophysiological process of oxidative stress should partly result in the neurobehavioral abnormality of rats, which was to be proven by further study.

**PA-111 [14:30]**
**STUDENT PAPER**

### Effect of 1840MHz radiofrequency field exposure on behaviors in mice

Jun-Ping Zhang[1], Ke-Ying Zhang[1], Ling Guo[1], Tian Wang[1], Peng Gao[2], Wen-Yao Zhang[3], Huan-Bo Wang[3], Jing Li[1], Guozhen Guo[2] & Gui-Rong Ding[1]

[1]*Department of Radiation Biology, Fourth Military Medical University, Xi'an, China, 710032*

[2]*Department of Radiation Medicine, Fourth Military Medical University, Xi'an, China, 710032*

[3]*Brigade of cadets, Fourth Military Medical University, Xi'an, China, 710032*

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

***Presented by: Jun-Ping Zhang***

In this study, we investigated the effects of 4-weeks exposure to 1840MHz radiofrequency (RF) field at the power density of 400μW/cm$^2$ on behaviors in adult male mice by using open field test and Morris water maze. It was found that exposure to RF field did not affect the spatial learning and memory ability. Moreover, the morphology and histology of the brain did not change. However, 4-weeks exposure to RF filed induced anxiety-like behavior and altered the level of some amino acid neurotransmitters in brain.

**PA-113 [14:30]**

**WITHDRAWN**

**PA-115 [14:30]**
**STUDENT PAPER**

## Microwave radiation leading to shrinkage of dendritic spines in hippocampal neurons mediated by SNK-SPAR pathway

Weijia Zhi[1], Haijuan Li[1], Xiangjun Hu[1] & Lifeng Wang[1]

[1]*Laboratory of Experimental Pathology, Beijing Institute of Radiation Medicine, Beijing, China, 100850*

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

***Presented by: Weijia Zhi***

The popularization of microwave raised concerns about its influence on cognitive function which is associated greatly with dendritic spines plasticity. The results of Morris Water Maze test indicated microwave radiation caused dysfunction of spatial learning and memory in exposed rats. Spines in granule cells showed density decrease and spines in pyramidal cells appeared as shrinkage of heads. The ultrastructure of hippocampus neurons such as length and thickness of post synaptic density showed a decrease as well. The up-regulated SNK induced decrease of SPAR and PSD-95. In summary, the microwave radiation led to shrinkage and even loss of dendritic spines in hippocampus by SNK-SPAR pathway, resulting in the cognitive impairments of rats.

**PA-117 [14:30]**

## Investigating the molecular composition of live cells exposed to pulsed electric fields based on label-free optical methods

Antoine Azan[1], Marianne Grognot[2], Lucie Descamps[1], Valérie Untereiner[3, 4], Olivier Piot[3, 4], Guilhem Gallot[2] & Lluis M. Mir[1]

[1]*UMR8203, CNRS/Gustave Roussy/Univ. Paris-Sud/Université Paris-Saclay, Villejuif, France, 94805*

[2]*UMR7645, CNRS/Ecole Polytechnique, Palaiseau, France, 91228*

[3]*Cellular and Tissular Imaging Platform PICT, Universy of Reims Champagne-Ardenne, Reims, France, 51096*

[4]*UMR7369, CNRS/University of Reims Champagne-Ardenne, Reims, France, 51096*

***Keywords: Mechanistic/Theoretical, Pulsed, Completed (published)***

***Presented by: Lluis M. Mir***

This study report the first quantitative and qualitative comparison between label-free optical methods (Raman and Terahertz microscopies) and fluorescence microsocopy to investigate the interaction between pulsed electric fields and biological cells.

**PA-119 [14:30]**

## Regulation of Akt/mTOR on HIF-1α after microwave radiation and its role in neuronal mitochondrial damage

Yanhui Hao[1], Wenchao Li[1], Chao Yu[1], Xinping Xu[1], Ji Dong[1], Binwei Yao[1], Jing Zhang[1], Hongmei Zhou[1], Li Zhao[1] & Ruiyun Peng[1]

[1]*Department of Experimental Pathology, Beijing Institute of Radiation Medicine, Beijing 100850, China*

***Keywords: Mechanistic/Theoretical, RF/Microwaves, Completed (unpublished)***

***Presented by: Yanhui Hao***

Neurons are extremely sensitive to energy metabolism disorders due to their specificity. In our previous study, the up-regulation of HIF-1α improved the mitochondrial dysfunction induced by microwave radiation and activated Akt increased the expression of HIF-1α. However, the way how Akt regulates HIF-1α is still unclear. In this study, we found that both Akt and mTOR of PC12 cells had a positive regulation on HIF-1α after microwave radiation; the effect of Akt pathway on the regulation of HIF-1α after microwave radiation was achieved by mTOR, at least partially; Akt intervention aggravated mitochondrial injury of PC12 cells after microwave radiation, which was possibly achieved through the inhibition of mTOR and HIF-1α activity.

**PA-121 [14:30]**
**STUDENT PAPER**

### Effect of transcranial ultrasonic-magnetic stimulation on neural spiking behaviours and stability in the FitzHugh-Nagumo model

Cui Kun[1], Zhang Shuai[1], Shi Xun[1] & Guizhi Xu[1]

[1]*Province-Ministry Joint Key Laboratory of Electromagnetic Field and Electrical Apparatus Reliability, Hebei University of Technology, Tianjin, China, 300000*

***Keywords: Mechanistic/Theoretical, Ultrasound, Other***

***Presented by: Cui Kun***

Transcranial ultrasonic-magnetic stimulation (TUMS), a novel method to non-invasive brain neuromodulation, does not necessitate surgery or genetic alteration, but it confers spatial resolutions and depth of penetration superior to other noninvasive methods such as transcranial direct current stimulation(tDSC) and transcranial magnetic stimulation(TMS). Simulation analysis of current based on FitzHugh-Nagumo neuron model is considered. It describes how to use transcranial TUMS to modulate neural activity. The results confirm that different spiking behaviours and stabilityare associated with parameter values of TUMS. Parameter values of TUMS are crucial factors that effect spiking behaviours and stability of neuron.

**PA-123 [14:30]**

### Application of omics techniques on Biological Effects Study of Magnetic Field Exposure

Yongyan Sun[1, 2], Ziyan Zhang[1], Chao Tang[1], Xiaomei Huang[1, 2] & Peng Cai[1]

[1]*Physical Environment Group, Institute of Urban Environment, Chinese Academy of Sciences, Xiamen, China, 361021*

[2]*University of Chinese Academy of Sciences, Beijing, China, 100049*

***Keywords: Mechanistic/Theoretical, ELF/LF, Work in Progress***

***Presented by: Ziyan Zhang***

In our study, we mainly applied omics analysis to explore the biological effects on electromagnetic exposure. Three kinds of model organisms (Saccharomyces cerevisiae, Drosophila melanogaster and Caenorhabditis elegans) were used in our investigations. Our results demonstrated EMF exposure may affect energy metabolic activities (TCA cycle and glycolysis), aging, immunological stress and reproduction progress and it may throw light on exploring responses to EMF exposure in humans.

**PA-125 [14:30]**

**WITHDRAWN**

**PA-127 [14:30]**
**STUDENT PAPER**

### The decreased permittivity of zebrafish embryos medium by magnetic fields dose not affect early development of zebrafish embryos

Chuning Zhao[1], Li Jiang[2], Jianyao Lou[1], Bing Han[1], Guangdi Chen[1] & Xinyuan Zhao[1, 3]

[1]*Bioelectromagnetics Laboratory, School of Medicine, Hangzhou, China, 310058*
[2]*State Key Laboratory of Modern Optical Instrumentation, Hangzhou, China, 310058*
[3]*Department of occupational Medicine and Environmental Toxicology, School of Public Health, Nantong, China, 226001*
***Keywords: Mechanistic/Theoretical, ELF/LF, Completed (unpublished)***
***Presented by: Chuning Zhao***

We hypothesized that MF acts on tissues or cells via affecting relative permittivity of surrounding solutions. Thus, we exposed zebrafish embryos medium to 50 Hz MF with various parameters, and detected its relative permittivity based on the phase-sensitive SPR sensing system. Then, we incubated zebrafish embryos with medium pretreated or untreated with 50 Hz MF followed with toxicity assessment.The results demonstrated that 50 Hz MF could decrease the permittivity of zebrafish embryos medium in a dose and time dependent way, although this effect failed to cause significant adverse outcomes under current conditions. The physiological consequences of medium exposed to MF are still unclear and require future examination.

## PA-129 [14:30]

## WITHDRAWN

## PA-131 [14:30]

### A questionnaire survey of safety awareness among MRI technologists

Sachiko Yamaguchi-Sekino[1], Shuhei Izawa[1] & Shinya Imai[2]
[1]*National Institute of Occupational Safety and Health, Japan, Kawasaki, Japan, 2148585*
[2]*Osaka Butsuryo University, Osaka, Japan, 5938328*
***Keywords: Occupational, Static, Work in Progress***
***Presented by: Sachiko Yamaguchi-Sekino***

The present study investigated safety awareness of the pregnancy, stray field, and safety standards among MRI technologists as a pilot study for a further large-scale survey. Forty-seven % of respondents selected not to enter (or ask a pregnant worker not to enter) scan room at any stage of pregnancy. Stronger attention to stray field levels was observed in the most frequently MRI operation group (more than 100 scans/month). Use of safety standards was not active: in most cases MRI technologists selected "occasionally" or "rarely". These results would be helpful for designing the questionnaire to assess safety awareness in MRI use.

## PA-133 [14:30]

### The study in bio-effects of pulsed microwave with different pulse widths and peak densities on Neuro-immunity

Yali Zhao[1], Zhenzhong Yang[1], Jinxue Fei[1] & Hongbo Ma[1]
[1]*China Astronaut Research and Training Center, Beijing, China, 100094*
***Keywords: Standards, RF/Microwaves, Completed (unpublished)***
***Presented by: Yali Zhao***

In order to protect people from pulsed microwave inducing neuroimmunity effects such as auditory effects and abnormal behavior, etc, bio-effects of Peak density and pulse width need further research. The research confirmed that pulsed microwave at peak density of 1000 times or more of average limits did not result in abnormalities in neuro-immunity and behavior although it may produce auditory effect. Therefore it's reasonable to set 1000 times of average density limits as peak power density limits.

**Session: FB**
**Student Flash Poster Session B**
**Tuesday June 6, 2017 • 13:30 - 14:00**
**Jinhua**
**Chairs: Niels Kuster & Christopher Portier**

**FB-1 [13:30]**

**WITHDRAWN**

**FB-2 [13:33]**
**STUDENT PAPER**

### Impact of each current applied to surface electrodes on EIT images based realistic head model

Rongqing Chen[1], Haoting Li[1], Xuechao Liu[1], Ge Zhang[1], Canhua Xu[1], Xiuzhen Dong[1] & Feng Fu[1]

[1]*Department of Biomedical Engineering, Xi'an, China, 710032*

***Keywords: Mechanistic/Theoretical, ELF/LF, Completed (unpublished)***
***Presented by: Rongqing Chen***

In EIT reconstruction problems, we assume that weight of every current injection applied to a surface electrode is the same and the current injected directly through the target impacts the quality most. We conducted a simulated experiment on a realistic human head model segmented from the cranial CT. Through detailed analysis of every current stimulation, we concluded that weight which every injection has during reconstruction is actually different. Furthermore, currents injected directly through the object has slighter whereas the currents ejected alongside the target have the more serious impact on the image quality.This will contribute to the following research of cranial EIT algorithm and the improvement of the quality of EIT image.

**FB-3 [13:36]**
**STUDENT PAPER**

### Behavioral evidence for the brown planthopper, *Nilparvata lungens* orient using a magnetic compass

Yingchao Zhang[1, 2] & Weidong Pan[1]

[1]*Beijing Key Laboratory of Bioelectromagnetics, Institute of Electrical Engineering, Chinese Academy of Sciences, Beijing, China, 100190*

[2]*Unversity of Chinese Academy of Sciences, Beijing, China, 100190*

***Keywords: Behavioural, Static, Work in Progress***
***Presented by: Yingchao Zhang***

This experiment indicates that the route orientation of the brown planthopper, Nilaparvata lugens is affected by the inclination of the magnetic fields, suggesting an inclination magnetic compass. These findings support the hypothesis of a magnetic sense used for route orientation in the brown planthopper, Nilaparvata lugens.

**FB-4 [13:39]**
**STUDENT PAPER**

### Study on dose-dependent, frequency-dependent, and cumulative effects of S and L band microwave on cognitive functions in Wistar rats

Shengzhi Tan[1], Hui Wang[1], Li Zhao[1], Jing Zhang[1], Binwei Yao[1], Hongmei Zhou[2] & Ruiyun Peng[1]

[1]*Department of Experimental Pathology, Beijing Institute of Radiation Medicine, Beijing, China, 100089*

[2]*Division of Radiation Protection and Health Physics, Beijing Institute of Radiation Medicine, Beijing, China, 100089*

***Keywords: In vivo, RF/Microwaves, Completed (unpublished)***
***Presented by: Shengzhi Tan***

Brain was considered as one of the most sensitive organ to microwave radiation. In this study, we evaluated the dose-dependent, frequency-dependent, and cumulative effects of S and L band microwave through the creative experimental design (figure 1). We found that the microwave radiation could lead to the decline of cognitive functions, abnormal brain electric activities, hippocampal structural injuries, decreased content of

Nissl substance and multiple metabolic disorders. The Results showed that the injury effects were mainly determined by power, but not frequency. And cumulative exposure could lead to more severe damage. This was a systematic study of microwave induced cognitive injuries.

**FB-5 [13:42]**
**STUDENT PAPER**

### Bio-effects of microwave radiation on autophagy and its markers in hippocampal neurons of rats

Yanhui Hao[1], Li Zhao[1], Wenchao Li[1], Jing Zhang[1], Hui Wang[1], Yabing Gao[1], Ji Dong[1] & Ruiyun Peng[1]
[1]*Department of Experimental Pathology, Beijing Institute of Radiation Medicine, Beijing 100850, China*
***Keywords: Mechanistic/Theoretical, RF/Microwaves, Work in Progress***
***Presented by: Yanhui Hao***

Microwave radiation can cause neuronal synaptic plasticity damage, but related mechanisms are unknown. As a lysosomal-dependent degradation pathway, the role of autophagy in synaptic plasticity is gradually taken seriously. However, the study of neuronal autophagy changes after microwave radiation is still blank, and the expression of its markers has yet to be revealed. This study was to observe the dynamic changes of autophagy and the expression of autophagy markers in hippocampal neurons of rats after microwave radiation. We found that 30mW/cm$^2$ microwave radiation caused synaptic plasticity injury in rats, and autophagy in hippocampal neurons was activated after 30mW/cm$^2$ microwave radiation.

**FB-6 [13:45]**
**STUDENT PAPER**

### Comparison of human EM-exposure in fifth generation wireless technologies: ATTO vs. massive MIMO

Sergei Shikhantsov[1], Arno Thielens[1], Gunter Vermeeren[1], Piet Demeester[1], Luc Martens[1] & Wout Joseph[1]
[1]*Department of Information Technology, Ghent University/IMEC, Ghent, Belgium, 9000*
***Keywords: Dosimetry (computational), RF/Microwaves, Work in Progress***
***Presented by: Sergei Shikhantsov***

In this paper, we compare two potential 5G wireless technologies, ATTO-cell and massive MIMO, from a human EM-exposure point of view. A scenario, which allows one to make such comparison, was proposed. A set of finite-difference time-domain simulations was performed in order to estimate an average worst-case specific absorption rate in both cases. It was shown that starting at a certain distance from a massive MIMO base station, its exposure becomes lower than exposure by ATTO-cells.

**FB-7 [13:48]**
**STUDENT PAPER**

### Fundamental study on the mechanism of electromagnetic wave therapy of periapical periodontitis

Hiroaki Shuu[1], Masatake Akutagawa[2], Hiromichi Yumoto[3], Takahiro Emoto[2], Toshihiko Tominaga[4], Kouji Hirao[3], Hiroo Tarao[5], Toshitaka Ikehara[6] & Yohsuke Kinouchi[2]
[1]*College of Systems Innovation Engineering, Tokushima University, Tokushima, Japan, 770-8506*
[2]*Division of Science and Technology, Tokushima University, Tokushima, Japan, 770-8506*
[3]*Course in Dentistry, Tokushima University, Tokushima, Japan, 770-8504*
[4]*Tominaga Dental Clinic, Naruto, Japan, 771-0360*
[5]*Department of Electrical and Computer Engineering, Kagawa National College of Technology, Takamatsu, Japan, 761-8058*
[6]*Department of Human Welfare, Tokushima Bunri University, Tokushima, Japan, 770-8514*
***Keywords: In vitro, IF, Work in Progress***
***Presented by: Hiroaki Shuu***

The major current treatment of the apical periodontitis is to clean of the root canal with chemicals and treatment instruments. Recently electro-magnetic apical treatment called EMAT have been proposed. However, optimum conditions of the EMAT, such voltage frequency and applied time, have not been clarified.

We examine the relationship between electric energy and a sterilization effect by use of bursted sinusoidal wave. As results of them, the sterilization effect was increased for the higher energy.

**FB-8 [13:51]**
**STUDENT PAPER**

### Leakage magnetic fields from wireless power transfer systems for EVs and human exposure assessment

Naoki Itoh[1], Tomoaki Mori[1], Yukihisa Suzuki[1] & Masao Taki[1]

[1]*Department of Electrical and Electronic Engineering, Graduate School of Science and Engineering, 1-1 Minami-osawa, Hachioji-shi, Japan, Japan, 192-0397*

***Keywords: Dosimetry (computational), IF, Work in Progress***
***Presented by: Naoki Itoh***

We evaluate human exposures to magnetic fields from coils for electric vehicles (EVs) charging Wireless power transfer (WPT) systems. Two types of coils, spiral and DD coils, are assumed. The characteristics of leakage magnetic fields and induced electric fields in the body is evaluated by numerical analyses. The magnetic field strengths for transmission power of 7.7 kW did not exceed the reference levels of ICNIRP guidelines at 85 kHz for the structures of coils examined on the condition assumed.

**FB-9 [13:54]**
**STUDENT PAPER**

### A consideration on the SPFD numerical method for dosimetry of human exposure to quasi-static electric fields

Tatsuya Yamamoto[1], Yukihisa Suzuki[1] & Masao Taki[1]

[1]*Department of Electrical and Engineering , Graduate School of Science and Engineering, 1 - 1 Minami-osawa, Hachioji-shi, Japan, 192-0397*

***Keywords: Dosimetry (computational), IF, Work in Progress***
***Presented by: Tatsuya Yamamoto***

SPFD method is commonly used for dosimetry for electric field exposures. The boundary condition is given by the current flowing into the body from the surface. The total current must be zero based on the physical requirement but this condition is not always satisfied in the numerical calculations. The offset current deteriorates numerical methods to solve simultaneous equations. We propose two methods to overcome this problem. One is a method to take reference point in the human model. The other is a method to compensate offset current. Both approaches are found effective for SPFD calculations.

**FB-10 [13:57]**
**STUDENT PAPER**

### The physiological effects of AC electromagnetic field exposure on human subjects

Akikatsu Fujimura[1], Hideyuki Okano[2] & Keiichi Watanuki[1, 3]

[1]*Graduate School of Science and Engineering, Saitama University, Saitama, Japan, 338-8570*

[2]*Advanced Institute of Innovative Technology, Saitama University, Saitama, Japan, 338-8570*

[3]*Brain and Body System Science Institute, Saitama University, Saitama, Japan, 338-8570*

***Keywords: Human, ELF/LF, Work in Progress***
***Presented by: Akikatsu Fujimura***

This study focuses on the acute effects of AC electromagnetic field (EMF) exposure (50 Hz, peak magnetic flux density $B_{max}$180 mT, 15-min duration of exposure) on blood flow velocity and electromyography (EMG) in healthy human subjects. The values of the blood flow velocity were significantly increased by the EMF exposure during and after exposure periods compared with the CTL exposure. In contrast, the mean power frequency value in EMG were not significantly changed from the baseline value in the presence of EMF exposure. These results imply that the physiological role of an EMF-enhanced blood circulation might help eliminate the metabolic waste products and endogenous pain producing substances inducing muscle stiffness and pain.

**Session: PB**
**Poster Session B**
**Tuesday June 6, 2017 • 14:00 - 15:30**
**2nd floor hallway**

**PB-2 [14:00]**

### Effects on rat learning ability of long-term exposure to a 2mT 50Hz sinusoida magnetic field

Shuangyan Li[1], Longlong Wang[1], Xuehan Wen[1] & Guizhi Xu[1]

[1]*Department of Biomedical Engineering, Hebei University of Technology, Tianjin, China, 30070*

***Keywords: Behavioural, ELF/LF, Work in Progress***
***Presented by: Shuangyan Li***

The present work investigated the behavioral effect of a long-term exposure (8h per day for 53 consecutive days) to a 50 Hz electromagnetic field (50 Hz EMF, 2 mT) in male rats. 50 Hz EMF effects were evaluated by comparing the behavioral difference between the control and the 50 Hz EMF-exposed rats during a delayed-alternation T maze task. The results showed an enhancement of learning abilities of the 50 Hz EMF exposed rat. It may indicate that long -term exposure to a 2 mT 50 Hz EMF lead cognitive enhancement. Besides, the improvement of learning ability may last long. However, it still needs to be further investigated.

**PB-4 [14:00]**

**WITHDRAWN**

**PB-6 [14:00]**
**STUDENT PAPER**

### Behavioral evidence for the brown planthopper, *Nilparvata lungens* orient using a magnetic compass

Yingchao Zhang[1, 2] & Weidong Pan[1]

[1]*Beijing Key Laboratory of Bioelectromagnetics, Institute of Electrical Engineering, Chinese Academy of Sciences, Beijing, China, 100190*

[2]*Unversity of Chinese Academy of Sciences, Beijing, China, 100190*

***Keywords: Behavioural, Static, Work in Progress***
***Presented by: Yingchao Zhang***

This experiment indicates that the route orientation of the brown planthopper, Nilaparvata lugens is affected by the inclination of the magnetic fields, suggesting an inclination magnetic compass. These findings support the hypothesis of a magnetic sense used for route orientation in the brown planthopper, Nilaparvata lugens.

**PB-8 [14:00]**

### The application of ultrasound in the efficacy evaluation of the nanosecond pulse curing the sheep which are naturally infected with hepatic cystic echinococcosis

Jian Dong[1], Ruiqing Zhang[2], Tao Song[1], Xinhua Chen[3] & Hao Wen[2]

[1]*Ultrasound Diagnosis Department, First Affiliated Hospital of Xinjiang Medical University, Urumqi, China, 830011*

[2]*Xinjiang Key Laboratory of Echinococcosis, First Affiliated Hospital of Xinjiang Medical University, Urumqi, China, 830011*

[3]*Key Laboratory of Combined Multi-organ Transplantation, Ministry of Public Health, The First Affiliated Hospital, School of Medicine, Zhejiang University, Hangzhou, China, 310003*

***Keywords: Clinical (therapy), Ultrasound, Completed (unpublished)***
***Presented by: Jian Dong***

Echinococcosis is a human parasitic disease that has been reported worldwide, and cystic echinococcosis (CE) and alveolar echinococcosis (AE) have been major reported in the epidemic regions, among which CE is the most common type in humans, and the liver the major affectedorgan. Radical surgery is the main strategy for the treatment of hepatic cystic echinococcosis (HCE). In this study, using ultrasound to evaluate the nanosecond pulsed electric fields(nsPEFs) curing the sheep which are naturally infected with HCE.

**PB-10 [14:00]**

### Optimal magnetic coil exposure for minimum stimulation threshold of brain cortex

Jose Gomez-Tames[1], Atsushi Hamasaka[1], Shinta Aonuma[1], Ilkka Laakso[2] & Akimasa Hirata[1]

[1] *Department of Electrical and Mechanical Engineering, Nagoya Institute of Technology, Nagoya, Japan, 466-8555*

[2]*Department of Electrical Engineering and Automation, Aalto University, Espoo, Finland*

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

***Presented by: Jose Gomez-Tames***

Transcranial magnetic stimulation simulates a target area of the brain in a non-invasive manner for diagnosis and monitoring of brain functions. One of the dominant factors affecting the induced electric field is the angle of the coil relative to the head. Recent studies have determined that a posterior-anterior coil orientation is optimal for stimulating the motor hand. The aim of this study is to determine the optimal coil orientation to stimulate all cortical regions of the brain. A total of 10,000 exposures were considered in one realistic head model. As a result, the optimal angle of stimulation corresponded for a coil handle perpendicular to the gyrus.

**PB-12 [14:00]**
**STUDENT PAPER**

### Leakage magnetic fields from wireless power transfer systems for EVs and human exposure assessment

Naoki Itoh[1], Tomoaki Mori[1], Yukihisa Suzuki[1] & Masao Taki[1]

[1]*Department of Electrical and Electronic Engineering, Graduate School of Science and Engineering, 1-1 Minami-osawa, Hachioji-shi, Japan, Japan, 192-0397*

***Keywords: Dosimetry (computational), IF, Work in Progress***

***Presented by: Naoki Itoh***

We evaluate human exposures to magnetic fields from coils for electric vehicles (EVs) charging Wireless power transfer (WPT) systems. Two types of coils, spiral and DD coils, are assumed. The characteristics of leakage magnetic fields and induced electric fields in the body is evaluated by numerical analyses. The magnetic field strengths for transmission power of 7.7 kW did not exceed the reference levels of ICNIRP guidelines at 85 kHz for the structures of coils examined on the condition assumed.

**PB-14 [14:00]**

### Analysis on human effect for commercial wireless charging device in actual usage environment

Jun-Seok Kang[1], Kang Hui Jeon[1], Min-Joo Jeong[1], Ic-Pyo Hong[2] & Nam Kim[1]

[1]*College of Electrical and Computer Engineering, Cheongju-si, Korea, 28644*

[2]*College of Information and Communication Engineering, Cheonan-si, Korea, 31080*

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

***Presented by: Jun-Seok Kang***

We consider partucular exposure scenarios to evaluate human effects for commercial wireless power charging device. The coil used in this study is the A10 model in Qi standard proposed by WPC, and input power is 5 W in the operating frequency of 155 kHz. In perfectly alinged condition, the max leakage magnetic field is 257.58 uT which is obtained at the side of the device, and it is exceeded the infernational guidelines. The SAR is evaluated with homogeneous phantom which has electric constants of wet skin. The max value of the SAR is 134 uW/kg, and it is much lower than the infernational guidelines. Especially, in misalignment condition,it showed 48%~54% higher SAR values than theresult of perfectly aligned condition.

**PB-16 [14:00]**

### Magnetic Field shielding structure for EMF human protection in WPT system.

Jong-Chan Kim[1], Byeong-Nam Kang[1], Domin Choi[1], Nam Kim[1] & In-Kui Cho[2]

[1]*College of Electrical Computer Engineering, Chungbuk National University, Cheongju-si, Chungbuk, Korea, 28644*

[2]*Radio Technology Research Department, Electronics and Telecommunications Research Institute, Daejeon, Korea, 34129*

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

***Presented by: Jong-Chan Kim***

In this paper, we proposed the magnetic field shielding structure by using the magnetic material and the conductive material in order to overcome the leakage magnetic field problem that occurred by the wireless power transfer(WPT) system. The leakage magnetic field strength and the SAR value of various magnetic field reduction structures were analyzed through the computer simulation. We implement a small output WPT coil, which is based on the Qi standard A10 coil of the WPC. According to computer simulation results by using each proposed shielding structure, we can reduce the leakage magnetic field and SAR value maintaining WPT efficiency.

**PB-18 [14:00]**

### Exposure to a resonant wireless power transfer system around 10 MHz

Mohsen Koohestani[1], Mauro Ettorre[1], Yves Le Dréan[2] & Maxim Zhadobov[1]

[1]*Institut d'Électronique et de Télécommunications de Rennes (IETR), Rennes, France, 35042*

[2]*Institute for Research on Environmental and Occupational Health (IRSET), Rennes, France, 35042*

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

***Presented by: Maxim Zhadobov***

We analyzed exposure of the human body to a representative resonant wireless power transfer (WPT) system operating around 10 MHz. Exposure levels and maximum allowable input power (MAIP) with respect to the ICNIRP basic restrictions have been evaluated (in terms of $E_{99}$, $J_{1cm^2}$, and local and whole body SAR) for different locations of the body model between the Tx and Rx coils. It has been found that, for the body located one meter from the transmitting coil, the MAIP satisfying $E_{99}$ is in the order of MW, whereas it reduces to tens of kW when considering SAR and $J_{1cm^2}$. The latter has been found to be the most restrictive dosimetric quantity in the considered exposure scenario.

**PB-20 [14:00]**

### Comparative dosimetry for child and adult exposed to ultra-high voltage transmission power lines with AC-750 kV

Mai Lu[1] & Shoogo Ueno[2]

[1]*Key Lab. of Opt-Electronic Technology and Intelligent Control of Ministry of Education, Lanzhou Jiaotong University, Lanzhou, China, 730070*

[2]*Department of Applied Quantum Physics, Kyushu University, Fukuoka, Japan, 812-8581*

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

***Presented by: Mai Lu***

Dosimetry of the three-wire, three-phase ultra-high-voltage (UHV) power lines with AC-750 kV were presented in this work. The induced magnetic flux density and electric fields in both realistic child and adult body models were obtained by impedance method and the results were compared with the ICNIRP guidelines. Results show that higher induced electric fields were somewhat uniformaly presented on the surface of both human bodies. For adult, the obtained values of magnetic field were well below the ICNIRP Reference Level. While the induced electric field in central nervous system (CNS) exceeds the ICNIRP Basic Restriction. For child, both the magnetic and electric fields in tissues were well below the ICNIRP guidelines.

**PB-22 [14:00]**

### Magnetic field distribution under EHV and HV double-circuit catenary power lines which cross paths

Takashi Matsumoto[1], Hitoshi Hirata[1], Hiroo Tarao[2], Noriyuki Hayashi[3] & Katsuo Isaka[4]

[1]*Course of Electrical Engineering, National Institute of Technology, Anan College, Anan, Japan, 774-0017*

[2]*National Institute of Technology, Kagawa College, Takamatsu-shi, Japan*

[3]*University of Miyazaki, Miyazaki-shi, Japan*

[4]*The University of Tokushima, Tokushima-shi, Japan*

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

***Presented by: Takashi Matsumoto***

Transmission power lines are the typical structures which generate ELF magnetic fields. There are few analyses which considered the phase order configuration of EHV and HV double-circuit line conductors to decrease magnetic fields in the vicinity of the ground beneath the lines. In this paper, a special emphasis is placed on EHV and HV double-circuit crossing paths considering the degree of sag in the catenary, and the effect on the total magnetic field distribution.

**PB-24 [14:00]**

### Numerical assessment of the heterogeneous tissues mass density values in liquid phantoms

Muhammad Qureshi[1], Yasir Alfadhl[1] & Xiaodong Chen[1]
[1]*School of Electronic Engineering and Computer Science, Queen Mary University, London, United Kingdom, E14NS*
***Keywords: Dosimetry (computational), All Frequencies, Concept***
***Presented by: Yasir Alfadhl***

Mass densities have been evaluated using the total weight and volume of the human body. Liquid phantoms representing the human body contain averaged dielectric values to represent the overall body. In this paper, full-wave simulations have been applied to assess the impact of using various averaged mass density values when compared with the original heterogeneous model configurations. It was found that muscle equivalent homogenous model mass density can be used to accurately simplify the SAR assessment in heterogeneous models.

**PB-26 [14:00]**
**STUDENT PAPER**

### Comparison of human EM-exposure in fifth generation wireless technologies: ATTO vs. massive MIMO

Sergei Shikhantsov[1], Arno Thielens[1], Gunter Vermeeren[1], Piet Demeester[1], Luc Martens[1] & Wout Joseph[1]
[1]*Department of Information Technology, Ghent University/IMEC, Ghent, Belgium, 9000*
***Keywords: Dosimetry (computational), RF/Microwaves, Work in Progress***
***Presented by: Sergei Shikhantsov***

In this paper, we compare two potential 5G wireless technologies, ATTO-cell and massive MIMO, from a human EM-exposure point of view. A scenario, which allows one to make such comparison, was proposed. A set of finite-difference time-domain simulations was performed in order to estimate an average worst-case specific absorption rate in both cases. It was shown that starting at a certain distance from a massive MIMO base station, its exposure becomes lower than exposure by ATTO-cells.

**PB-28 [14:00]**

### Numerical estimation of SAR enhancement due to implantable vision prosthesis featuring wireless power transfer coil in human head under near- and far-fields exposure conditions

Kazuki Shindo[1], Takashi Hikage[1] & Toshio Nojima[1]
[1]*Hokkaido University, Sapporo, Japan, 0600814*
***Keywords: Dosimetry (computational), RF/Microwaves, Work in Progress***
***Presented by: Takashi Hikage***

This paper introduces numerical evaluations for SAR enhancement for a human head implanted with newly developed vision prosthesis. To investigate the impact of the implantable vision prosthesis featuring wireless power transfer system, SAR distribution estimations using precise numerical phantom model were conducted. From the simulation results, a large enhancement of SAR due to the vision prosthesis implant was not observed under tested exposure conditions.

**PB-30 [14:00]**
**STUDENT PAPER**

### A consideration on the SPFD numerical method for dosimetry of human exposure to quasi-static electric fields

Tatsuya Yamamoto[1], Yukihisa Suzuki[1] & Masao Taki[1]

[1]*Department of Electrical and Engineering , Graduate School of Science and Engineering, 1 - 1 Minami-osawa, Hachioji-shi, Japan, 192-0397*
***Keywords: Dosimetry (computational), IF, Work in Progress***
***Presented by: Tatsuya Yamamoto***

SPFD method is commonly used for dosimetry for electric field exposures. The boundary condition is given by the current flowing into the body from the surface. The total current must be zero based on the physical requirement but this condition is not always satisfied in the numerical calculations. The offset current deteriorates numerical methods to solve simultaneous equations. We propose two methods to overcome this problem. One is a method to take reference point in the human model. The other is a method to compensate offset current. Both approaches are found effective for SPFD calculations.

**PB-32 [14:00]**

### Comparison of ELF-MF exposure before and after construction of transmission lines and its analysis in S. Korea

Seungwoo Lee[1], Geun Teak Yeo[1], Younseog Lim[2] & Hong Lae Kim[1]

[1]*Transmission & Substation Construction Dept., Korea Electric Power Corporation, 55, Jeollyeok-ro, Naju-si, Korea, 58217*

[2]*Transmission & Substation Dept., Korea Electric Power Corporation Research Institute, 105, Munji-ro, Yuseong-gu, Korea, 34056*
***Keywords: Dosimetry (measurements), ELF/LF, Work in Progress***
***Presented by: Seungwoo Lee***

In this study, we measured and analyzed the ELF-MF exposure before and after transmission line construction. The target transmission lines for measurement are newly constructed overhead and underground lines. Total number of the measured transmission lines are 20 overhead lines and 1 underground lines in 2016. By the results, the ELF-MF exposure levels are maximum 0.22 μT before construction. After construction, the maximum exposure level is 0.95 μT because these spots are directly under the lines and near the express train lines. The ELF-MF exposure levels in most residential areas showed similar values compared with before construction.

**PB-34 [14:00]**

### Investigation of occupational exposure to magnetic fields in 765kV Singapyeong substation in Korea

Byeongyoon Lee[1], Yeungyu Cho[1], Sung Ho Myung[1], Younseog Lim[2], Seungwoo Lee[3] & Geun Teak Yeo[3]

[1]*Advanced Power Grid Research Division, Korea Electrotechnology Research Institute, Changwon, Korea, 51543*

[2]*Transmission & Substation Lab, Korea Electric Power Research Institute, Daejeon, Korea, 34056*

[3]*Construction Planning Team, Korea Electric Power Corporation, Naju, Korea, 58217*
***Keywords: Dosimetry (measurements), ELF/LF, Work in Progress***
***Presented by: Byeongyoon Lee***

In this paper, a measurement method and measurement results are presented to investigate occupational exposure to magnetic fields generated by various power equipments in 765kV Singapyeong substation in Korea. Magnetic flux density was measured at three point(50, 100, 150 cm) above the ground with EMDEX II and measured results were compared with ICNIRP guidelines issued both in 1998 and in 2010. Measured magnetic field distribution around 765kV transformer was presented and maximum magnetic flux density was 237.6 [uT] and occurred at 50 cm above the ground around 765kV transformer. According to the measurement results, there is no point where the magnitude of magnetic field is higher than ICNIPR guidelines issued both in 1998 and in 2010.

**PB-36 [14:00]**

### The prevent and resist research of HGS001 material for Active Denial System of millimeter wave

Zhihui Li[1], Yan Gao[1], Miao Zhang[1] & Chenggang Zhang[1]

[1]*Beijing Institue of Radiation Medicine, Academy of Military Medical Sciences, Bejing, China, 100850*
***Keywords: Dosimetry (measurements), RF/Microwaves, Work in Progress***
***Presented by: Zhihui Li***

Zhihui Li: Master Degree Candidate, Biochemistry and molecular Biology, graduating from Northwest A&F University, Working at Academy of Military Medical Sciences

**PB-38 [14:00]**

### Schottky diode based near-field dosimetry probe at millimeter wave frequencies

Hairui Liu[1], Dianyuan Qi[1], Zongying Yu[1], Jun Lin[1] & Jing Zhao[1]

[1]*China Academy of Information and Communications Technology (CAICT), Beijing, China, 100191*

***Keywords: Dosimetry (measurements), THz, Work in Progress***

***Presented by: Hairui Liu***

Schottky diodes are widely used nonlinear components for millimeter and terahertz wave applications. They offer low parasitic capacitance and series resistance when used as mixers, multipliers and detectors. This paper presents an isotropic free space probe using Schottky diode for millimeter wave use. It utilizes 2 dipoles on both sides of a thin quartz substrate, by rotating twice, the probe behaves an isotropic performance. GaAs based planar Schottky diode is used for square law detection, it provides high sensitivity and fast response for room temperature use. Free space calibration employs a quasi-optical system, which gives high dynamic range test by beam focusing.

**PB-40 [14:00]**

### A wide band setup for real-time optical detection of bioelectromagnetic interactions *in vitro*

Caterina Merla[1], Micaela Liberti[2], Paolo Marracino[2], Adeline Muscat[1], Antoine Azan[1], Francesca Apollonio[2] & Lluis M. Mir[1]

[1]*CNRS UMR 8203 Vectorology Anticancer Therapy Lab., Villejuif, France, 94805*

[2]*Department of Information Engineering, Electronic and Telecommunications, Rome, Italy, 00184*

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

***Presented by: Lluis M. Mir***

In this paper, the experimental characterization of an optimal electromagnetic structure based a coplanar wave guide is presented. This biochip was fabricated and measured in frequency and time domains to verify the fulfillment of the bandwidth adaptation, the electric field levels reached within the biological solution (efficacy), and its homogeneity.

**PB-42 [14:00]**

### Exposure to radio-frequency electromagnetic fields emitted by a mobile phone in three exposure conditions

Arno Thielens[1], Sofie Declerck[1], Annelies Bockstael[1, 2], Sam Aerts[1], Dick Botteldooren[1], Luc Martens[1] & Wout Joseph[1]

[1]*Department of Information Technology, Ghent University - imec, Ghent, Belgium, 9052*

[2]*Université de Montréal, Montréal, Canada, H3N 1X7*

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

***Presented by: Wout Joseph***

Mobile Phones emit radio-frequency (RF) electromagnetic fields (EMFs), which might be absorbed in the human body. This exposure to RF EMFs could be reduced by using a phone in speaker mode or by using a headset while calling. In order to investigate whether these measures actually reduce exposure, we studied the emitted RF power by a mobile phone as a proxy for the exposure. This emitted RF power was recorded for 53 subjects who carried out phone calls in three controlled exposure scenarios: calling with the phone at the ear, in speaker-mode, and with a headset. Phone calls were carried out using both WCDMA and GSM. The emitted power at the ear is higher than in the other exposure conditions for both communication technologies.

**PB-44 [14:00]**

### Electrostimulation by picosecond pulses and delivery antennas

Shu Xiao[1, 2], Ross Petrella[2], Khiem Huynh[1], Iurii Semenov[2] & Andrei Pakhomov[2]
[1]*Department of Electrical and Computer Engineering, Old Dominion University, Norfolk, Virginia, USA, 23508*
[2]*Frank Reidy Research Center for Bioelectrics, Old Dominion University, Norfolk, Virginia, USA, 23508*
***Keywords: Dosimetry (measurements), Pulsed, Work in Progress***
***Presented by: Shu Xiao***

Picosecond pulses is a promising stimulus for high-precision targeting (1 $cm^2$) and new biophysics can be involved in such short pulse range. Single picosecond electric pulse (500 ps, 190 kV/cm) has been shown to cause long lasting membrane depolarization in NG108 cells, as measured by both patch clamp and voltage sensitive dye . The mechanism of depolarization by such short pulses was speculated as that the conductance of voltage gated channels is increased by electric fields, rather than that the cell membrane is porated.

**PB-46 [14:00]**

## Narrow band electroporation with sine signals for an accurate control of cell permeabilization

Tomás García-Sánchez[1], Jessica Fontaine[1], Adeline Muscat[1] & Lluis M. Mir[1]
[1]*Vectorology and Anticancer Therapies, UMR 8203, CNRS, Univ. Paris-Sud, Gustave Roussy, Université Paris-Saclay, 94805 Villejuif, France*
***Keywords: Electroporation, RF/Microwaves, Work in Progress***
***Presented by: Lluis M. Mir***

In this study cell electroporation using AC sine waves in the frequency band from 8 - 130 kHz was studied. Single bursts of 5 ms and Epeak of 600 V/cm were used. Also square wave pulses with the same characteristics were applied for comparison. The efficacy of electropermeabilization of cell membrane was studied using $Ca^{2+}$ as indicator. In agreement with theory, results show a clear frequency dependence in the extent of permeabilization of cell membrane. The results obtained show the ability of sine signals to perform electroporation and how by modifying the frequency of the oscillating electric field applied it is possible to accurately modulate the extent of permeabilization performed to the cell membrane.

**PB-48 [14:00]**

## Experimental study *in vitro* and *in vivo* of ablating *echinococcosis granulosis* by nanosecond pulsed electric field and the dose effect investigation

Hao Wen[1], Ruiqing Zhang[1], Jian Dong[1], Hui Wang[2], Yingmei Shao[1], Tuerganaili Aji[1] & Xinhua Chen[3]
[1]*Xinjiang Key Laboratory of Echinococcosis, First Affiliated Hospital of Xinjiang Medical University, Urumqi, China, 830011*
[2]*The Department of Pathology, First Affiliated Hospital of Xinjiang Medical University, Urumqi, China, 830011*
[3]*Key Laboratory of Combined Multi-organ Transplantation, Ministry of Public Health, The First Affiliated Hospital, School of Medicine, Zhejiang University, Hangzhou, China, 310003*
***Keywords: Electroporation, Pulsed, Completed (unpublished)***
***Presented by: Hao Wen***

Human cystic echinococcosis (CE) has beenreported worldwide, and the most frequent site for the cystic lesions observed in the cystic echinococcosis is liver, followed by lung, brain and other organs. Radical surgery isthe main strategy for the treatment of hepatic cystic echinococcosis (HCE). Benzimidazoles are used as chemotherapeutic agents. In this study, in vitro and in vivo of ablating echinococcosis granulosis by nanosecond pulsed electric field was investigated.

**PB-50 [14:00]**

## In utero magnetic field exposure and birth weight: a prospective cohort study

Jianping Chen[1], Maohua Miao[1], De-Kun Li[2], Hong Liang[1], Ziliang Wang[1], Fen Yang[1], Xiaowei Sun[1] & Wei Yuan[1]
[1]*Reproductive Epidemiology and Social Medicine, Shanghai Institute of Planned Parenthood Research, Shanghai, China, 200237*
[2]*Division of Research, Kaiser Foundation Research Institute, Kaiser Permanente, Oakland, California, USA*
***Keywords: Epidemiology, ELF/LF, Completed (unpublished)***
***Presented by: Maohua Miao***

We examined the association between maternal magnetic fields (MF) exposure and birth weight in offspring. Data on time-weighted average (TWA) and five percentiles (P50, P75, P90, P95 and max) of MF

measurements for each woman was extracted. Comparing to girls with maternal MF level of $<50^{th}$, girls with maternal MF level of $\geq 50^{th}$ had a reduction in birth weight, with average reduction of about 350 g for TWA, P50, P75, and P90, and about 250 g for P95. The adjusted IRRs of lower birth weight (<3160 g) were 3.08, 3.73, 3.12, and 2.71 for MF level of $\geq 50^{th}$ in TWA, P50, P75, and P90, respectively. However, we did not find any association between maternal MF exposure and birth weight in boys.

**PB-52 [14:00]**

### Validity of questionnaire information of mobile phone use among elderly in Korea

Kyung-Hwa Choi[1], Mina Ha[1], Ae-kyoung Lee[2] & Hyung-Do Choi[2]

[1]*Department of Preventive Medicine, Dankook University College of Medicine, Cheonan, Korea, 31116*

[2]*Radio Technology Research Department, Electronics and Telecommunications Research Institute, Daejeon, Korea, 34129*

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

***Presented by: Kyung-Hwa Choi***

This study was aimed to assess validity of questionnaire information of mobile phone use by comparison with information of operator's log data and direct measurement data using a personal exposure meter (PEM) among elderly. The study subjects were 396 elderly people aged more than 60 years in Seoul, Korea. PEM and operator's log data might be better than questionnaire to assess radio frequency radiation exposure of mobile phone use among elderly, which might be due to their limited recall capability.

**PB-54 [14:00]**
**STUDENT PAPER**

### The physiological effects of AC electromagnetic field exposure on human subjects

Akikatsu Fujimura[1], Hideyuki Okano[2] & Keiichi Watanuki[1, 3]

[1]*Graduate School of Science and Engineering, Saitama University, Saitama, Japan, 338-8570*

[2]*Advanced Institute of Innovative Technology, Saitama University, Saitama, Japan, 338-8570*

[3]*Brain and Body System Science Institute, Saitama University, Saitama, Japan, 338-8570*

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

***Presented by: Akikatsu Fujimura***

This study focuses on the acute effects of AC electromagnetic field (EMF) exposure (50 Hz, peak magnetic flux density $B_{max}$180 mT, 15-min duration of exposure) on blood flow velocity and electromyography (EMG) in healthy human subjects. The values of the blood flow velocity were significantly increased by the EMF exposure during and after exposure periods compared with the CTL exposure. In contrast, the mean power frequency value in EMG were not significantly changed from the baseline value in the presence of EMF exposure. These results imply that the physiological role of an EMF-enhanced blood circulation might help eliminate the metabolic waste products and endogenous pain producing substances inducing muscle stiffness and pain.

**PB-56 [14:00]**

### Lyme and associated tick-borne diseases: photonic markers, a new detection approach & therapeutic evaluation of a non invasive micro-current device

Georges Vieilledent[1], Christian Perronne[2], Raouf Ghozzi[3] & Raymond Herren[4]

[1]*Electrophotonique Ingénierie, Brens, France, 81600*

[2]*Department Infectiology - University Hospital, Garches, France, 92380*

[3]*Department Infectiology - Hospital, Lannemezan, France, 65300*

[4]*CNRS, Paris, France, 75000*

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

***Presented by: Georges Vieilledent***

Lyme disease is a bacterial infectious disease transmitted mainly by hard tick bite, Ixodes type. It is usually described by an evolution in three stages. The latter, known as the tertiary phase, can lead to severe complications. This is called "post-Lyme syndrome" or chronic Lyme. We launched an observational biomedical study with 400 infected patients or strongly suspected of chronic borreliosis and / or other tick

borne diseases. This study uses an innovative macroscopic imaging device by corona effect in the UV spectrum [3] to identify photonic markers able to characterize pathogens. We also evaluated the use of a micro-current device to assess its therapeutic interest

**PB-58 [14:00]**

### Analysis of neuronal action potential of a single Hodgkin-Huxley model based on Transcranial Magnetic Stimulation

Huilan Yang[1], Guizhi Xu[1] & Hongbin Wang[1]

[1]*Hebei University of Technology, Province-Ministry Joint Key Laboratory of Electromagnetic Field and Electri, Tianjin, China, 300130*

***Keywords: Human, All Frequencies, Other***

***Presented by: Huilan Yang***

To study the mechanism of TMS we constructed the model of transcranial magnetic stimulation (TMS) and the Hodgkin-Huxley model. To establish a more accurate simulation of transcranial magnetic stimulation, the realistic human head model was used to build the simulation model and the transient simulation was executed. The realistic human head model was generated by the data of the medical images, which include the scalp, skull and brain. Based on the equation of the Hodgkin-Huxley model, this paper analyzed the response of a neuron to the time varying current density magnitude induced by the figure-of-8 coil of TMS.

**PB-60 [14:00]**

### An experimental study on the ablation of echinococcus granulosus cyst by nanosecond pulsed electric field in vitro

Tuerganaili Aji[1, 2], Yingmei Shao[1, 2], Ruiqing Zhang[1, 2], Xinhua Chen[3] & Hao Wen[1, 2]

[1]*Xinjiang Key Laboratory of Echinococcosis, First Affiliated Hospital of Xinjiang Medical University, Urumqi, China, 830011*

[2]*Hepatobiliary & Hydatid Department, First Affiliated Hospital of Xinjiang Medical University, Urumqi, China, 830011*

[3]*Key Laboratory of Combined Multi-organ Transplantation, Ministry of Public Health, The First Affiliated Hospital, School of Medicine, Zhejiang University, Hangzhou, China, 310003*

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

***Presented by: Tuerganaili Aji***

Human cystic echinococcosis (CE) refers to a zoonosis caused by the larval cestode Echinococcus granulosus. Residents of the sheep-raising area can be infected incidentally. The most frequent site for the cystic lesions observed in the cystic echinococcosis is liver, followed by lung, brain and other organs. Radical surgery isthe main strategy for the treatment of hepatic cystic echinococcosis(HCE) . benzimidazoles are used as chemotherapeutic agents. In this study, the effective treatment electric field strength on cystic echinococcus of nanosecond pulsed electric fields (nsPEFs) were screened with fixed pulse duration and frequency. The design and placement of electrode was also investigated.

**PB-62 [14:00]**

### Effects of long-term 50Hz power-line frequency electromagnetic field on cell behavior in Balb/c 3T3 cells

Guang-Zhou An[1], Yan Zhou[1], Guo-Zhen Guo[2], Chen Zhang[3] & Gui-Rong Ding[1]

[1]*Department of Radiation Biology, The Fourth Military Medical University, Xi'an, China, 710032*

[2]*Department of Radiation Medicine, The Fourth Military Medical University, Xi'an, China, 710032*

[3]*Ministry of Industry and Information Technology, Beijing, China, 100000*

***Keywords: In vitro, ELF/LF, Completed (published)***

***Presented by: Guang-Zhou An***

This study is to identify the effects of long-term Power-line frequency electromagnetic field (PF-EMF ) exposure on cell behavior, Balb/c 3T3 cells were used to exposed or sham-exposed to 50 Hz PF-EMF at 2.3 mT for 2 hours one day, 5 days (from Monday to Friday) every week. After 11 weeks PF-EMF exposure, it was found that the cell morphology, apoptosis, cell migration ability and cell transformation didn't change. However, compared with sham group, cell viability obviously decreased and cell cycle distribution also changed after 11 weeks PF-EMF exposure. Meanwhile, the protein level of PCNA and CyclinD1 significantly

decreased after PF-EMF exposure.

**PB-64 [14:00]**

### Oxidative stress as an initial step in the biological effects induced by magnetic fields

Rodolfo Bruzon[1], Hakki Gurhan[1], Yanyu Xiong[1] & Frank Barnes[1]

[1]*Electrical, Computer and Energy Engineering, University of Colorado at Boulder, Boulder, Colorado, USA, 80309*

***Keywords: In vitro, ELF/LF, Work in Progress***

***Presented by: Rodolfo Bruzon***

Many studies show that the imbalance between the production of ROS and the antioxidant defense mechanisms in the tissues can be linked to exposure to ELF-MFs. For many years attention has focused on the role of $Ca^{2+}$ as an initiator of the biological effect induced by MFs and now we know that enhanced $Ca^{2+}$ transport through $Ca^{2+}$ channels occurs in presence of oxidants. In this work we try to relate relevant biological parameters that show changes under the action of the MFs. We think that the effect of MFs could begin with the modulation of REDOX reactions and the consequent change in the concentration of the free radicals and that the radical pair mechanism is a suitable theoretical approximation to explain many of the observed effects.

**PB-66 [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[1, 2], Lei Zhang[1, 2], Chun-Hai Chen[1, 2] & Zhou Zhou[1, 2]

[1]*Department of Occupational Health, Third Military Medical University, Chongqing, China, 400038*

[2]*Key Laboratory of Medical Protection for Electromagnetic Radiation, Ministry of Education, Chongqing, China, 400038*

***Keywords: In vitro, ELF/LF, Completed (published)***

***Presented by: Zhou Zhou***

The potential effects of ELF-EMF on eNSCs was studies. We found that eNSC proliferation and eNSC 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. The expression of the proneural genes, NeuroD and Ngn1, was increased. Moreover, the expression of transient receptor potential canonical 1 (TRPC1) was significantly up-regulated accompanied by increased the peak amplitude of intracellular calcium level induced by ELF-EMF. These results suggest that ELF-EMF exposure promotes the neuronal differentiation and neurite outgrowth of eNSCs via up-regulation the expression of TRPC1 and proneural genes NeuroD and Ngn1.

**PB-68 [14:00]**

### The impact of a temporal shifting of diurnal geomagnetic variation on roach *Rutilus rutilus* L. embryos and its comparison with the effects of simulated geomagnetic storms

Elena Osipova[1], Melania Talikina[1], Yulia Chebotareva[1], Yuri Izyumov[1] & Viacheslav Krylov[1]

[1]*Papanin Institute for Biology of Inland Waters Russian Academy of Sciences, Borok, Russian Federation, 152742*

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

***Presented by: Viacheslav Krylov***

Effects of the 6-hours and 12-hours shifting of diurnal geomagnetic variation relative to the night-day light cycle on roach embryos were studied. Obtained results are closely similar to the effects of simulated geomagnetic storm on roach embryos described earlier.

**PB-70 [14:00]**
**STUDENT PAPER**

### Fundamental study on the mechanism of electromagnetic wave therapy of periapical periodontitis

Hiroaki Shuu[1], Masatake Akutagawa[2], Hiromichi Yumoto[3], Takahiro Emoto[2], Toshihiko Tominaga[4], Kouji Hirao[3], Hiroo

Tarao[5], Toshitaka Ikehara[6] & Yohsuke Kinouchi[2]
[1]*College of Systems Innovation Engineering, Tokushima University, Tokushima, Japan, 770-8506*
[2]*Division of Science and Technology, Tokushima University, Tokushima, Japan, 770-8506*
[3]*Course in Dentistry, Tokushima University, Tokushima, Japan, 770-8504*
[4]*Tominaga Dental Clinic, Naruto, Japan, 771-0360*
[5]*Department of Electrical and Computer Engineering, Kagawa National College of Technology, Takamatsu, Japan, 761-8058*
[6]*Department of Human Welfare, Tokushima Bunri University, Tokushima, Japan, 770-8514*
***Keywords: In vitro, IF, Work in Progress***
***Presented by: Hiroaki Shuu***

The major current treatment of the apical periodontitis is to clean of the root canal with chemicals and treatment instruments. Recently electro-magnetic apical treatment called EMAT have been proposed. However, optimum conditions of the EMAT, such voltage frequency and applied time, have not been clarified. We examine the relationship between electric energy and a sterilization effect by use of bursted sinusoidal wave. As results of them, the sterilization effect was increased for the higher energy.

**PB-72 [14:00]**

### The effects of 50 Hz magnetic fields exposure on DNA damage and cellular functions in different neurogenic cells

Liling Su[1], Aziguli Yimaer[1], Xiaoxia Wei[1], Zhengping Xu[1] & Guangdi Chen[1]
[1]*Bioelectromagnetics Laboratory , Hangzhou, China*
***Keywords: In vitro, ELF/LF, Completed (unpublished)***
***Presented by: Liling Su***

Epidemiological studies have indicated possible association between extremely low-frequency magnetic fields (ELF-MF) exposure and the risk of nervous system diseases. However, the laboratory studies have not provided consistent results to clarify this association despite many years of studies. In this study, we proposed a systematic research to investigate the effects of 50 Hz MF exposure on DNA damage and cellular functions in primary cultured neurogenic cells from rats (astrocytes, microglia, cortical neurons). The results showed that exposure to 50 Hz MF at 2.0 mT did not elicit DNA damage effects or abnormal cellular functions in the neurogenic cells.

**PB-74 [14:00]**

### Ultrastructural changes of amniotic epithelial cells induced by pulsed electromagnetic fields to osteoblast differentiation

Qian Wang[1], Wenchao Wu[2], Ai Zheng[3], Jiang Wu[4], Huaiqing Chen[2, 4], Song Lei[5], Chengqi He[1] & Xianjing Liu[2]
[1]*Department of Rehabilitation Medicine, Key Laboratory of Rehabilitation Medicine of Sichuan Province, West China Hospital, Sichuan University, Chengdu, China, 610041*
[2]*Laboratory of Cardiovascular Diseases, Regenerative Medicine Research Center, West China Hospital, Sichuan University, Chengdu, China, 610041*
[3]*Department of Obstetrics and Gynecology, West China Second Hospital, Sichuan University, Chengdu, China, 610041*
[4]*Laboratory of Biomedical Engineering, West China Center of Medical Sciences, Sichuan University, Chengdu, China, 610041*
[5] *Department of Pathology, West China Hospital, Sichuan University, Chengdu, China, 610041*
***Keywords: In vitro, Pulsed, Completed (published)***
***Presented by: Qian Wang***

A combination of PEMFs and osteogenic-inducing medium had synergistic effects on osteogenic differentiation of amniotic epithelial cells. The changes of organelle structure shed insight into the mechanisms of PEMFs-induced osteoblast differentiation of stem cells.

**PB-76 [14:00]**

### The effects of magnetic fields exposure on DNA damage in Wild type and *Dhfr* deficient CHO cells

Aziguli Yimaer[1], Xiaoxia Wei[1], Chuan Sun[1], Guangdi Chen[1] & Zhengping Xu[1]

[1]*Department of Public Health, Zhejiang University, HANGZHOU, China, 310058*
***Keywords: In vitro, ELF/LF, Work in Progress***
***Presented by: Aziguli Yimaer***

The current available laboratory data did not clarify or support the carcinogenic and genotoxic effects of ELF-MF. Our in vitro study about genotoxic effects of ELF-MF exposure on DNA damage in female reproductive system cells revealed that exposure to 50 Hz MF significantly decreased the DNA fragmentation in CHO-K1 cells, while 50 Hz MF exposure slightly but significantly enhanced the cell viability and proliferation in CHO/dhfr$^-$ cells. Our data suggest that the cells derived from reproductive system differentially respond to 50 Hz MF exposure, and its underlying mechanisms and significance await further investigation.

**PB-78 [14:00]**

### Effects of electromagnetic pulse exposure on gelatinase of blood–brain barrier in vitro

Yan Zhou[1], Lian-Bo Qiu[2], Guang-Zhou An[1], Le Du[1], Ya-Hong Ma[1], Guo-Zhen Guo[3] & Gui-Rong Ding[1]
[1]*Department of Radiation Biology, Fourth Military Medical University, xi'an, China, 710032*
[2]*Department of Nutrition, Aviation Medical Evaluation and Training Center of Airforce, Dalian, China, 116000*
[3]*Department of Radiation Medicine, Fourth Military Medical University, xi'an, China, 710032*
***Keywords: In vitro, ELF/LF, Completed (published)***
***Presented by: Yan Zhou***

The biological effects of electromagnetic pulse (EMP) on the brain have been focused on for years. It was reported that gelatinase played an important role in maintaining brain function through regulating permeability in the blood–brain barrier (BBB). To investigate the effects of EMP on gelatinase of BBB, Western blot and gelatin zymography were used to BBB model in vitro. The result showed that EMP exposure could affect the expression and activity of MMP-2 in the BBB model.

**PB-80 [14:00]**

### A novel coplanar-waveguide-based device for cells exposure during electrophysiological recordings

Yong Zou[1], Lifeng Wang[1] & Xiangjun Hu[2]
[1]*Beijing Institute of Radiation Medcine, Beijing, China, 100850*
[2]*Tianjin Institute of Health and Environmental Medcine, Tianjin, China, 300050*
***Keywords: In vitro, RF/Microwaves, Work in Progress***
***Presented by: Yong Zou***

In order to investigate biological effects during the electromagnetic exposure, it is necessary to design a suitable exposure system which meets the requirements of the biological experiments. After discussing the shortcomings of current exposure system with similar structure, a rectangular-shaped microshield coplanar waveguide (CPW) of EM structure for cells exposure during electrophysiological recordings is proposed. Numerical results show that the novel device not only overcomes the drawbacks of similar structure but also have more advantages such as more compact structure, more tunable parameters to enable impendance matching, large range of single-mode operating frequency and lower reflection coefficient.

**PB-82 [14:00]**

### Effects of cronical exposure to magnetic fields on reproductive health of male mice

Victor Cruz[1], Martha Valdivia[2], Bladimir Guevara Minaya[3] & Gloria Lévano[4]
[1]*Universidad Nacional Mayor de San Marcos, Lima, Peru, Lima 01*
[2]*Animal Reproductive Physiology, Universidad Nacional Mayor de San Marcos, Lima, Peru, Lima 01*
[3]*Universidad Nacional Mayor de San Marcos, Lima, Peru, Lima 01*
[4]*Animal Reproductive Physiology, Universidad Nacional Mayor de San Marcos, Lima, Peru, Lima 01*
***Keywords: In vivo, ELF/LF, Completed (unpublished)***
***Presented by: Victor Cruz***

The objective of this study was to investigate the reproductive health effects on male mice from magnetic

fields whose levels were the same as environmental levels in Lima city. The biological sample were 64 male Balb C mice ten weeks old (Mus musculus) including 2 control, 2 sham , 2 exposed to 50 μT and 2 exposed to 550 μT, one group of each type were sacrificed after 35 days and other were sacrificed after 70 days. The results showed that chronic exposure to MF didn´t affect reproductive organ weights and sperm DNA but affected the sperm count, sperm motility and embryo quality.

**PB-84 [14:00]**

### Expression of neurotrophic factors and their receptors in mouse brain following fetal exposure to 1950 MHz electromagnetic field

Na-Kyung Han[1], Ye Ji Jeong[1], Jonghwa Kwon[2], Jeong-Ki Pack[3], Nam Kim[4], Yun-Sil Lee[5] & Hae-June Lee[1]

[1]*Division of Basic Radiation Bioscience, Korea Institute of Radiological & Medical Sciences, Seoul, Korea, 01812*

[2]*Department of EMF Research Team, ETRI, Daejon, Korea, 34129*

[3]*Department of Radio Sciences and Engineering, Chungnam National University, Daejon, Korea, 34134*

[4]*School of Electrical and Computer Engineering, Chungbuk National University, Cheongju, Korea, 28644*

[5]*Graduate School of Pharmaceutical Sciences, Ewha Womans University, Seoul, Korea, 03760*

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

***Presented by: Na-Kyung Han***

In this study, we determine whether in utero exposure to RF-EMF affect the brain in mice. Pregnant mice were exposed to 1950 MHz RF-EMF throughout gestation (days 1-18) for 2 h per day with SAR 4W/kg. Neurotrophic factors and neurotrophic factor receptors were analyzed by quantitative real-time PCR and Western blotting. In the hippocampus, RF-EMF exposure significantly decreased in the expression of TrkB.

**PB-86 [14:00]**

### In vivo evaluation of brain glucose metabolism of RF-EMF exposed 5xFAD mice using positron emission tomography

Ye Ji Jeong[1], Jin Su Kim[2], Ji-Ae Park[2], Jonghwa Kwon[3], Jeong-Ki Pack[4], Nam Kim[5], Yun-Sil Lee[6] & Hae-June Lee[1]

[1]*Division of Basic Radiation Bioscience, Korea Institute of Radiological & Medical Sciences, Seoul, Korea, 01812*

[2]*RI Applied Research Team, Korea Institute of Radiological & Medical Sciences, Seoul, Korea, 01812*

[3]*Department of EMF Research Team, ETRI, Daejon, Korea, 34129*

[4]*Department of Radio Sciences and Engineering, Chungnam National University, Daejon, Korea, 34134*

[5]*School of Electrical and Computer Engineering, Chungbuk National University, Cheongju, Korea, 28644*

[6]*Graduate School of Pharmaceutical Sciences, Ewha Womans University, Seoul, Korea, 03760*

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

***Presented by: Ye Ji Jeong***

Despite increasing public health concerns, the impact on the brain of radiofrequency electromagnetic field remains unclear. In this study, we investigated that RF-EMF on brain glucose metabolism using positron emission tomography (PET) images and their voxel-wise comparison. We found that RF-EMF exposure to 5XFAD animals presented higher cerebral binding of [18F]-FDG than that of sham-exposed controls

**PB-88 [14:00]**

### Power-frequency magnetic fields at 50-Hz do not affect fertility and development in rats and mice

Lai jinsheng[1], Chen Chen[1] & Wang Dao Wen[1]

[1]*Division of Cardiology, Department of Internal Medicine and Gene Therapy Center, Tongji Hospital,, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, China, 430030*

***Keywords: In vivo, ELF/LF, Completed (unpublished)***

***Presented by: Lai jinsheng***

The aim of the current study was to evaluate the potential effects of 50 Hz PF-MF on reproductive system in rats and mice. Results showed that exposure to30 μT, 100 μT, and 500 μTPF-MF may not affect the fertility of the Sprague-Dawley rats and C57BL/6J mice, as well as the development of the neonatal mice.

**PB-90 [14:00]**

### Influence of exposure to radiofrequency identification-electromagnetic fields on white blood cells: in vivo study

Hye Sun Kim[1, 5], Jong Hwa Kwon[2], Hyung Do Choi[2], Jeong-Ki Pack[3], Nam Kim[4] & Young Hwan Ahn[1, 5]

[1]*Department of Neurosurgery, Ajou University School of Medicine, Suwon, Korea, 16499*

[2]*Radio Technology Research Department, Electronics and Telecommunications Research Institute, Suwon, Korea, 34129*

[3]*Department of Radio Sciences and Engineering, Chungnam National University, Daejeon, Korea, 34134*

[4]*Department of of Electrical and Computer Engineering, Chungbuk National University, Cheongju, Korea, 28356*

[5]*Neuroscience Graduate Program, Department of Biomedical Sciences, Graduate School of Ajou University, Suwon, Korea, 16499*

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

***Presented by: Young Hwan Ahn***

As a part of investigation of the potential risks of RFID to human health, we investigated whether exposure to the 915 MHz radiofrequency identification (RFID) signal affected white blood cells (WBCs) in rats.

**PB-92 [14:00]**
**STUDENT PAPER**

### Study on dose-dependent, frequency-dependent, and cumulative effects of S and L band microwave on cognitive functions in Wistar rats

Shengzhi Tan[1], Hui Wang[1], Li Zhao[1], Jing Zhang[1], Binwei Yao[1], Hongmei Zhou[2] & Ruiyun Peng[1]

[1]*Department of Experimental Pathology, Beijing Institute of Radiation Medicine, Beijing, China, 100089*

[2]*Division of Radiation Protection and Health Physics, Beijing Institute of Radiation Medicine, Beijing, China, 100089*

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

***Presented by: Shengzhi Tan***

Brain was considered as one of the most sensitive organ to microwave radiation. In this study, we evaluated the dose-dependent, frequency-dependent, and cumulative effects of S and L band microwave through the creative experimental design (figure 1). We found that the microwave radiation could lead to the decline of cognitive functions, abnormal brain electric activities, hippocampal structural injuries, decreased content of Nissl substance and multiple metabolic disorders. The Results showed that the injury effects were mainly determined by power, but not frequency. And cumulative exposure could lead to more severe damage. This was a systematic study of microwave induced cognitive injuries.

**PB-94 [14:00]**

**WITHDRAWN**

**PB-96 [14:00]**

### nsPEF increase the immunogenicity of CT-26 cells and facilitate immune cell infiltrate in parenchymal tumor after treatment

Shengyong Yin[1], Liming Wu[1], Yuning Xu[1], Danjing Guo[1], Lin Zhou[1] & Shusen Zheng[1]

[1]*1st Affiliated Hospital , Zhejiang University, Hangzhou, China, 310003*

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

***Presented by: Liming Wu***

nsPEF induces the increasing of tumor cells' immunogenicity.In addition to ablate tumor tissue directly, nsPEF ablation facilitate immune cells infiltrating into tumor, which is a prerequisite to patient response to immune checkpoint blockade in clinical.

**PB-98 [14:00]**

### The correlation between magnetic resonance imaging and biological effects in rat hippocampus after microwave exposure

Hongyan Zuo[1], Liang Cui[1], Xiao Liu[1], Yifan Xie[1], Hongmei Zhou[2], Xinping Xu[1], Ruiyun Peng[1] & Dewen Wang[1]

[1]*Department of Experimental Pathology, Beijing Institute of Radiation Medicine, Beijing, China, 100850*
[2]*Department of Radiation Protection and Health Physics, Beijing Institute of Radiation Medicine, Beijing, China, 100850*
***Keywords: In vivo, RF/Microwaves, Work in Progress***
***Presented by: Hongyan Zuo***

With the development of magnetic resonance imaging (MRI) technology, MRI may provide important imageologic evidence for the biological effects of microwave (MW) radiation. However, there was few study about this. This study investigated the spatial memory ability, MRI characteristics and pathological changes in rat hippocampus after MW exposure, and explored the correlations between these changes.

**PB-100 [14:00]**
**STUDENT PAPER**

### Impact of each current applied to surface electrodes on EIT images based realistic head model

Rongqing Chen[1], Haoting Li[1], Xuechao Liu[1], Ge Zhang[1], Canhua Xu[1], Xiuzhen Dong[1] & Feng Fu[1]
[1]*Department of Biomedical Engineering, Xi'an, China, 710032*
***Keywords: Mechanistic/Theoretical, ELF/LF, Completed (unpublished)***
***Presented by: Rongqing Chen***

In EIT reconstruction problems, we assume that weight of every current injection applied to a surface electrode is the same and the current injected directly through the target impacts the quality most. We conducted a simulated experiment on a realistic human head model segmented from the cranial CT. Through detailed analysis of every current stimulation, we concluded that weight which every injection has during reconstruction is actually different. Furthermore, currents injected directly through the object has slighter whereas the currents ejected alongside the target have the more serious impact on the image quality.This will contribute to the following research of cranial EIT algorithm and the improvement of the quality of EIT image.

**PB-102 [14:00]**
**STUDENT PAPER**

### Bio-effects of microwave radiation on autophagy and its markers in hippocampal neurons of rats

Yanhui Hao[1], Li Zhao[1], Wenchao Li[1], Jing Zhang[1], Hui Wang[1], Yabing Gao[1], Ji Dong[1] & Ruiyun Peng[1]
[1]*Department of Experimental Pathology, Beijing Institute of Radiation Medicine, Beijing 100850, China*
***Keywords: Mechanistic/Theoretical, RF/Microwaves, Work in Progress***
***Presented by: Yanhui Hao***

Microwave radiation can cause neuronal synaptic plasticity damage, but related mechanisms are unknown. As a lysosomal-dependent degradation pathway, the role of autophagy in synaptic plasticity is gradually taken seriously. However, the study of neuronal autophagy changes after microwave radiation is still blank, and the expression of its markers has yet to be revealed. This study was to observe the dynamic changes of autophagy and the expression of autophagy markers in hippocampal neurons of rats after microwave radiation. We found that 30mW/cm$^2$ microwave radiation caused synaptic plasticity injury in rats, and autophagy in hippocampal neurons was activated after 30mW/cm$^2$ microwave radiation.

**PB-104 [14:00]**

### A study on the occupational exposure to EMF caused by the resistance welding machine

Junoh An[1], Ilyeob Lee[1], Sangbong Jeon[2] & Jonghwa Kwon[2]
[1]*Institute for Future Radio Engineering, Seoul, Korea, 03175*
[2]*Electronics and Telecommunications Research Institute, Daejeon, Korea, 34129*
***Keywords: Occupational, ELF/LF, Work in Progress***
***Presented by: Junoh An***

In this study, we measured and assessed the electromagnetic fields exposure in resistance welding work environment based on standards. The measured magnetic flux density showed a maximum value of 156.49 μT at the operating frequency of 60 Hz at a distance of 400 mm from the front of the resistance welder. And

the measured magnetic flux density showed a maximum value of 285.37 μT at the operating frequency of 60 Hz at a distance of 300 mm from the side of the resistance welder.

**PB-106 [14:00]**

**WITHDRAWN**

**PB-108 [14:00]**

### Analysis of occupational exposure based on measuring protocol in working environment

Sangbong Jeon[1], Ilyeob Lee[2], Jonghwa Kwon[1] & Hyung-Do Choi[1]

[1]*Radio & Satellite Research Division, ETRI, Daejeon, Korea, 34129*

[2]*Institute for Future Radio Engineering, Seoul, Korea, 03175*

***Keywords: Occupational, ELF/LF, Work in Progress***

***Presented by: Sangbong Jeon***

In this paper, we have established a measurement protocol for occupational exposures in the working environment, such as the electrical welding environment. According to the measurement protocol, the spot welder was evaluated for the electromagnetic fields exposure from the points of investigation as well as the electromagnetic fields exposure from welding cables.

**PB-110 [14:00]**

### Assessment of electromagnetic field from underground transmission line in city area of Korea

Seung-Cheol Hong[1], M.D Rajitha Kawshalya[1], Acharya Shiva Raj[1], Yun Jin Lee[1] & Jung Joon-Sig[1]

[1]*Construction Planning Team, Transmission & Substation Construction, Korea Electric Power Corporation, 55, Jeollyok-ro, Naju-si, Korea, 58217*

***Keywords: Public Health Policy, ELF/LF, Work in Progress***

***Presented by: Seung-Cheol Hong***

Electromagnetic field exposure canleads and environmental impacts. In city areas transmission lines are distributed underground still, can poses negative consequences to the general public. Kindergartens, schools, hospitals are more sensitive in case of EMF exposure. The main objective of this study is to assess and compare the EMF emission level from underground transmission line around the environmentally sensitive area.

**PB-112 [14:00]**

### A study on the depth of tissue-equivalent liquid for SAR measurement of human exposure to EMF from wireless communication devices by numerical simulations

Tomoaki Nagaoka[1], Lira Hamada[1], Nozomu Ishii[2] & Soichi Watanabe[1]

[1]*National Institute of Information and Communications Technology, koganei, Japan, 184-8795*

[2]*Niigata University, Niigata, Japan, 950-2181*

***Keywords: Standards, Static, Work in Progress***

***Presented by: Tomoaki Nagaoka***

We calculated the peak 10g-averaged SARs in the flat and SAM head phantom models exposed to EMF from the mobile phone model and we also discussed the SAR dependence on the liquid depth. We found that the effect of reflection from the upper surface of the tissue-equivalent liquid for the SAM head phantom model is larger than that for the flat phantom model. In contrast, the results suggested that liquid depth can be substantially shallower than the required condition of the existing standard for SAR measuring, i.e., 15 cm. In the future work, we will verify the validity of the calculated results by SAR measurement, as well as the evaluation of the uncertainty of the calculations.

# Gold Sponsors

Since 1981, Auden Techno Corp. actively engaged in cooperation with world-class technology companies, SPEAG, Zurich Med Tech and IT IS foundation, and serve as the agency for RF measurement instruments, equipment of world standard class, active implant safety test system, cell/animal RF exposure system and biomedical electromagnetic simulation software. In terms of new measurement equipment and relevant laws and regulations, we always strive to obtain first-hand information to help create added value for clients, and to meet their productivity and delivery demands. By actively prompting industrial integration, we provide the best one-stop service in technical support and integration solutions for our clients. With a professional management team, strong research and development strength, and solid RF core ability, we have been carrying out various wireless application developments in the market for years. For more information on Auden please visit http://www.auden.com.tw/

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) 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).


Located in the historical and picturesque city of Hangzhou, Zhejiang University is a prestigious institution of higher education with a long history. Qiushi Academy, the predecessor of Zhejiang University, was founded in 1897 and was one of the earliest modern academies of higher learning established in China. In 1928, the academy was named National Zhejiang University. In its 120-year history, Zhejiang University has always been committed to cultivating talent with excellence, advancing science and technology, serving for social development, and promoting culture, with the spirit best manifested in the university motto "Seeking the Truth and Pioneering New Trails". Zhejiang University is a comprehensive research university with distinctive features and a national as well as international impact. Research at Zhejiang University spans 12 academic disciplines, covering philosophy, economics, law, education, literature, history, art, science, engineering, agriculture, medicine, management and etc. With seven campuses, namely Zijingang, Yuquan, Xixi, Huajiachi, Zhijiang, Zhoushan and Haining campus, Zhejiang University encompasses an area of 4,265,678 square meters with school buildings covering 2,575,983 square meters of floor space. Zhejiang University has 7 high-level affiliated hospitals. The university library holds a collection of more than 6.935 million volumes. As of Dec. 2016, there are a total of 48,762 full-time students enrolled at Zhejiang University, including approximately 15,092 graduate students, 9,537 Ph.D candidates, and 24,133 undergraduates. In addition, there are about 6,237 international students currently attending Zhejiang University. For more information on Zhejiang University please visit http://www.zju.edu.cn/english/

# Silver Sponsors


The Electric Power Research Institute, Inc. (EPRI, www.epri.com) conducts research and development relating to the generation, delivery and use of electricity for the benefit of the public. An independent, nonprofit organization, EPRI brings together its scientists and engineers as well as experts from academia and industry to help address challenges in electricity, including reliability, efficiency, affordability, health, safety and the environment. EPRI also provides technology, policy and economic analyses to drive long-range research and development planning, and supports research in emerging technologies. EPRI members represent 90% of the electric utility revenue in the United States with international participation in 35 countries. EPRI's principal offices and laboratories are located in Palo Alto, Calif.; Charlotte, N.C.; Knoxville, Tenn.; and Lenox, Mass. Ximena Vergara, PhD, MPH, a Senior Technical Leader at EPRI, is responsible for managing the research in the Electric and Magnetic Fields and Radio-Frequency Health Assessment and Safety program.

# Bronze Sponsors

About the GSMA The GSMA represents the interests of mobile operators worldwide, uniting nearly 800 operators with almost 300 companies in the broader mobile ecosystem, including handset and device makers, software companies, equipment providers and internet companies, as well as organisations in adjacent industry sectors. The GSMA also produces industry-leading events such as Mobile World Congress, Mobile World Congress Shanghai, Mobile World Congress Americas and the Mobile 360 Series of conferences. For more information on GSMA activities related to electromagnetic fields please visit http://www.gsma.com /publicpolicy/consumer-affairs/emf-and-health

喜尔康

Ningbo Xi Er Kang Health Care Technology Co., Ltd is a high tech health care company founded on May 2010 by Mr. ZHANG Zhiwei. The company is located in Ningbo high-tech business incubator. As a pioneer in the field of magnetic health business, the company integrates benefits of physics, life science, magnetic medicine and traditional Chinese medicine, and holds the key technologies of static magnetic fields and health care, authorized patents and SGS certifications. For more information, please visit http://www.nbxek.com/cn/index.php

Shenzhen Heng An Hong Yuan Mag-Tech Co., Ltd. is a high tech company focused on developing new solutions for variable health problems with advanced magnetic material and technics. We have rich experiences on designing, researching, developing, manufacturing and selling Magnets and Magnetic Assemblies. We have established a good and diligent team with majority of employees and stuffs coming from domestic famous research institutions and universities. Our team featured by two distinguish experts with special allowance of the State Council of China. Our long-term target is to build up an export company of good reputation and develop into a global, creative and bright company. We sincerely expect friends all over the world to form long-term relations with us for the benefit of both sides. For more information, please visit http://www.cishenghuo.com /Default.aspx.

Beijing Safety Test Technology Co., Ltd. (STT) is the first one and only one Listed company in the field of electromagnetic field (EMF) security field. The National Equities Exchange and Quotations Stock code is 832447. STT is the leader in providing EMF test equipment and test technology, and has worked for many years to promote the EMF test technology in China with great effort. STT is the National High-Tech Enterprise. Zhukun, the STT's General Manager, is awarded with the Capital Advance Individual of Environmental Protection, for his great effort in spreading popularization of scientific knowledge in the field of EMF. STT's business domain includes providing EMF test equipment, EMF test, Environmental electromagnetic big data platform. STT's EMF test equipment with proprietary intellectual property rights, is widely used and approved by national and regional customers. Now, STT is a famous brand identity in the field of environmental protection. For more information on STT please visit http://www.safetytech.cn.

The Mobile & Wireless Forum (MWF) is an international association of companies with an interest in mobile and wireless communications including the evolution to 5G and the Internet of Things. The association was established in 1998 with a mission to facilitate joint funding of key research projects and cooperation on standards, regulatory issues and communications concerning the safety of wireless technology. For more information on the MWF please visit www.mwfai.org

Pulse Biosciences, Inc. is a medical technologies company developing commercial clinical applications for its proprietary Nano-Pulse Stimulation ("NPS") technology. NPS is a novel patented technology leveraging non-thermal electric pulses in the nanosecond range that have demonstrated effective local tumor control and the initiation of an adaptive immune response in pre-clinical studies. Pulse Biosciences is pursuing a number of clinical applications for NPS, including human oncology, dermatology, aesthetics and other minimally invasive applications where NPS is believed to provide greater benefits compared to current therapies and treatments.

Since founded in 1993, Shanghai Kaichun Clean-room technology Co., Ltd has played an impotent role in the modern society progress, based on this understanding. Kaichun is dedicated to the clean-room technology and other application field during the 20 years' development. We maintain good cooperation with domestic well-known colleges and universities, international famous enterprises in developed industrialized countries, such as USA, Germany and Japan. With closely following and application of the latest international technologies in clean-room field, Kaichun maintains abundant technic vitality, and serves the clients with distinctive technical character. Nowadays, Kaichun has grown into a modern enterprise with both historical precipitation and innovation vigor. The introduction of ISO international quality certification has made Kaichun's business administration more normative and mature, and the enterprise integrity and team construction gives Kaichun the necessary character, power and passion. For more information, please visit http://www.shkaichun.com/index.php/English/index

# Conference Supporters


# Author Index