Technical Program

Davos Congress Centre
Davos, Switzerland
June 14 – 19, 2009
# BioEM2009: Technical Program Committee

<table>
<thead>
<tr>
<th>BEMS</th>
<th>EBEA</th>
</tr>
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<tbody>
<tr>
<td>Dariusz Leszczynski <strong>Co-Chair</strong></td>
<td>Guglielmo d’Inzeo <strong>Co-Chair</strong></td>
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<tr>
<td>Ewa Czerska</td>
<td>Elisabeth Cardis</td>
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<tr>
<td>Niels Kuster</td>
<td>Peter Gajšek</td>
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<tr>
<td>Bruce McLeod</td>
<td>Volker Hansen</td>
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<tr>
<td>James McNamee</td>
<td>Maila Hietanen</td>
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<tr>
<td>Michael Murphy</td>
<td>Jukka Juutilainen</td>
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<td>Gabi Nindl Waite</td>
<td>Isabelle Lagroye</td>
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<tr>
<td>Rich Nuccitelli</td>
<td>Carmela Marino</td>
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<td>Frank Prato</td>
<td>Luis Mir</td>
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<td>Joachim Schütz</td>
<td>Theodoros Samaras</td>
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<tr>
<td>Asher Sheppard</td>
<td>Maria Rosaria Scarfi</td>
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<td>Mays Swicord</td>
<td>Zenon Sienkiewicz</td>
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<tr>
<td>Masao Taki</td>
<td>György Thuróczy</td>
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<td>Shoogo Ueno</td>
<td>Eric Van Rongen</td>
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### THE BIOELECTROMAGNETICS SOCIETY

#### Officers and Board of Directors
- **President:** Niels Kuster (2010)
- **Vice President/President Elect:** Michael Murphy (2011)
- **Past President:** Ewa Czerska (2009)
- **Treasurer:** Vijayalaxmi (2010)
- **Secretary:** Philip Chadwick (2010)
- **Editor-in-Chief:** James Lin (2009)

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- Jeffrey Carson (2009)
- Maren Fedowitz (2010)
- Joachim Schütz (2009)
- David Black (2011)
- Ann Rajnicek (2011)

#### ENGINEERING/PHYSICAL SCIENCES
- Dariusz Leszczynski (2009)
- Indira Chatterjee (2010)
- Art Thansandote (2011)

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- **Vice President:** Ferdinando Bersani
- **Treasurer:** Alejandro Ubeda
- **Secretary:** Isabelle Lagroye

#### BIOLOGICAL/MEDICAL SCIENCES
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- Maria Rosaria Scarfi
- Marion Crasson

#### ENGINEERING/PHYSICAL SCIENCES
- Micaela Liberti
- Kjell Hansson Mild
- György Thuróczy

### AT LARGE
- Nam Kim (2009)
- Chiyuji Ohkubo (2010)
- Andrei Pakhomov (2011)

#### NEWSLETTER
- Janie Page, Newsletter Editor

#### MANAGEMENT
- Gloria L. Parsley, Association Services International, Inc.
FROM THE CO-CHAIRS OF THE TECHNICAL PROGRAM COMMITTEE

Welcome to Davos, Switzerland for the Joint Meeting of the European BioElectromagnetics Association and the Bioelectromagnetics Society - the BioEM2009.

We have prepared a meeting that consists of four Plenary Sessions, three Plenary Topic in Focus Sessions, eighteen Podium Sessions and two Poster Sessions (from submitted abstracts), and six Tutorial Sessions (from submitted proposals).

There are some novelties that we have introduced in order to increase attractiveness of the meeting. Firstly, we have extended the requested abstract length to make them more informative for both, reviewers and meeting participants. For this reason the abstract submission deadline was at date later than usually and that is a reason why the evaluation and final acceptance decisions were send out also later than usually. In addition to the 2-page abstracts we have requested 100-word summaries that will be included in the program book. This should help to guide us through the sessions without need of continuous screening through the “heavy” abstract book.

Plenary sessions topics will cover several timely issues: Session #1 will review effects of RF-EMF on mobile phone users, Session #2 will review the occupational safety of MRI machines, Session #3 will present some new directions in bioelectromagnetics research and, finally, Session #4 will present some “hot topic” presentations. The speakers for this last session and their topics will be selected at the last moment before the meeting in order to present the issues that are the “talk of the town” at that very time, in June 2009.

The new kind of plenary session, presented at this meeting for the first time, are the Topic in Focus sessions. These sessions are designed to present two 30-minute talks on the same issue but by researchers who have the different or opposite points of view. Following the presentations will be 30 minutes moderated discussion time. We hope that these sessions will help to better understand why we have divergent, often contradictory opinions on some bioelectromagnetics issues. As the topics for these novel sessions we have selected this year: mechanisms of EMF biological effects, RF-EMF effect on blood-brain barrier and the use of EM in clinical therapy of cancer.

This year we have received record number (394) of abstract submissions. In order to make presentations more informative we have extended time of oral presentations to total of 20 minutes. As always, only part of the submitted abstracts we were able to select for oral podium presentations and the remaining abstracts will be presented in two large poster sessions.

Members of both societies have submitted proposals for several tutorial sessions. These sessions are aimed at giving brief reviews of the specific topics. The sessions will run in two blocks of three sessions in parallel.

Also, if you only can, it is worth to come to the meeting early and attend the Sunday workshops sponsored by the U.S. Air Force and by the Swiss Non-Ionizing Radiation Research Program.

This meeting would not be possible without the efforts of many individuals. With thanks to all, we would like to mention, in particular, Gloria Parsley (Executive Director), Lynn Plitt and Kelly Husser in the BEMS Office; all the Members of the Technical Program Committee who diligently reviewed and scored all the submitted abstracts, John Harvey at Abstract Central, Carmela Marino, the President of EBEA and the members of EBEA Council and Niels Kuster, the President of BEMS and the Chair of the Local Organizing Committee and the members of the BEMS Board of Directors. Their help and advice was crucial in preparation of the program of this meeting. Finally, the both Societies are most grateful to our sponsors for their generous support.

Welcome! We hope the meeting will be exciting and informative for all.

Guglielmo d’Inzeo (EBEA) and Dariusz Leszczynski (BEMS)
Co-Chairs of the Technical Program Committee
<table>
<thead>
<tr>
<th>TIME</th>
<th>BIOEM2009 SCHEDULE AT A GLANCE</th>
<th>LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>13:00–18:00</td>
<td>The Next Generation of Bioelectromagnetics <em>(by invitation only)</em></td>
<td>Press Centre</td>
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<tr>
<td>8:30–18:00</td>
<td>BEMS Board Meeting</td>
<td>Press Centre</td>
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<tr>
<td>13:30–18:00</td>
<td>EBEA Council Meeting</td>
<td>Office 41</td>
</tr>
<tr>
<td>18:00–20:00</td>
<td>BEMS &amp; EBEA Presidents’ Reception <em>(by invitation only)</em></td>
<td>Kirchner Museum</td>
</tr>
<tr>
<td>8:30–12:00</td>
<td><strong>US AIR FORCE LABORATORY WORKSHOP: SHORT PULSE ELECTROMAGNETIC FIELDS &amp; BIOLOGY</strong></td>
<td>Plenary Hall</td>
</tr>
<tr>
<td>8:30–18:00</td>
<td><strong>SWISS NATIONAL RESEARCH PROGRAMME 57 (NRP 57): “NON-IONISING RADIATION – HEALTH AND ENVIRONMENT</strong></td>
<td>Aspen</td>
</tr>
<tr>
<td>12:00–19:00</td>
<td>Poster Setup</td>
<td>Sanada &amp; Foyer C1</td>
</tr>
<tr>
<td>12:00–19:00</td>
<td>Registration</td>
<td>Foyer A2</td>
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<tr>
<td>12:00–17:00</td>
<td><strong>LOADING TIME FOR MONDAY’S ORAL PRESENTATIONS</strong></td>
<td>Convention Office</td>
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<tr>
<td>13:00–18:00</td>
<td>EFHRAN</td>
<td>Presse</td>
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<tr>
<td>16:30–18:30</td>
<td>NRP STEERING COMMITTEE MEETING</td>
<td>Office 41</td>
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<tr>
<td>TBD</td>
<td>COST MB0704</td>
<td>TBD</td>
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<tr>
<td>16:30–18:00</td>
<td>URSI COMMISSION K</td>
<td>Plenary Hall</td>
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<tr>
<td>17:00–19:00</td>
<td>Welcome Reception</td>
<td>Foyer A2</td>
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<tr>
<td>19:00–21:00</td>
<td>Student Ice Break</td>
<td>Musicbar Rotliechli</td>
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<tr>
<td>7:30–18:00</td>
<td><strong>LOADING TIME FOR TUESDAY’S ORAL PRESENTATIONS</strong></td>
<td>Convention Office</td>
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<tr>
<td>8:00–8:30</td>
<td>Opening &amp; Welcome Remarks</td>
<td>Plenary Hall</td>
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<tr>
<td>8:30–10:00</td>
<td>PLENARY 1: RF-EMF EPI AND HUMAN</td>
<td>Plenary Hall</td>
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<tr>
<td>10:00–10:30</td>
<td>Coffee Break</td>
<td>A &amp; C Foyers</td>
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<tr>
<td>10:30–12:00</td>
<td>Poster Session 1 <em>(odd numbered posters will be presented)</em></td>
<td>Sanada &amp; Foyer C1</td>
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<tr>
<td>12:00–13:00</td>
<td>Lunch</td>
<td><em>On your own</em></td>
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<tr>
<td>13:00–14:30</td>
<td>Topic in Focus 1: EMF Interaction Mechanisms</td>
<td>Plenary Hall</td>
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<tr>
<td>14:30–15:00</td>
<td>Coffee Break</td>
<td>A &amp; C Foyers</td>
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<tr>
<td>15:00–16:40</td>
<td>Session 1: Dosimetry 1</td>
<td>Plenary Hall</td>
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<td>Session 2: Animal Studies</td>
<td>Aspen</td>
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<tr>
<td>TIME</td>
<td>BIOEM2009 SCHEDULE AT A GLANCE</td>
<td>LOCATION</td>
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<tr>
<td>17:00–18:00</td>
<td>Tutorial 1: RF Safety Standards, Tutorial 2: Medical Imaging, Tutorial 3: Biofilms</td>
<td>Plenary Hall</td>
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<td>18:00</td>
<td>Editorial Board Dinner</td>
<td>TBD</td>
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**Tuesday, June 16**

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<thead>
<tr>
<th>TIME</th>
<th>BIOEM2009 SCHEDULE AT A GLANCE</th>
<th>LOCATION</th>
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<tbody>
<tr>
<td>8:00–18:00</td>
<td>Loading Time for Wednesday's Oral Presentations</td>
<td>Convention Office</td>
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<tr>
<td>8:30–10:00</td>
<td>PLENARY II: MRI SAFETY</td>
<td>Plenary Hall</td>
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<tr>
<td>10:00–10:30</td>
<td>Coffee Break</td>
<td>A &amp; C Foyers</td>
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<tr>
<td>10:30–12:00</td>
<td>Poster Session 2 (even numbered posters will be presented)</td>
<td>Sanada &amp; Foyer C1</td>
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<tr>
<td>12:00–13:00</td>
<td>Lunch</td>
<td>On your own</td>
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<tr>
<td>12:00–13:00</td>
<td>BEMS 2010 Technical Program Committee Meeting</td>
<td>Jakobshorn</td>
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<tr>
<td>13:00–14:30</td>
<td>Topic in Focus 2: RF-EMF and BBB</td>
<td>Plenary Hall</td>
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<tr>
<td>14:30–15:00</td>
<td>Coffee Break</td>
<td>A &amp; C Foyers</td>
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<tr>
<td>15:00–16:20</td>
<td>Session 3: Dosimetry II</td>
<td>Plenary Hall</td>
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<td>Session 4: Mechanisms of Interaction I</td>
<td>Aspen</td>
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<tr>
<td>16:20–16:40</td>
<td>Coffee Break</td>
<td>A &amp; C Foyers</td>
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<tr>
<td>16:40–18:00</td>
<td>Session 5: Dosimetry III</td>
<td>Plenary Hall</td>
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<td>Session 6: Epidemiology</td>
<td>Aspen</td>
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<tr>
<td>19:00</td>
<td>Social Event, Sponsor Recognition &amp; EBEA’s 20th Anniversary Celebration</td>
<td>Hotel Schatzalp</td>
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**Wednesday, June 17**

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<thead>
<tr>
<th>TIME</th>
<th>BIOEM2009 SCHEDULE AT A GLANCE</th>
<th>LOCATION</th>
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<tr>
<td>8:00–12:40</td>
<td>Loading Time for Thursday's Oral Presentations</td>
<td>Convention Office</td>
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<tr>
<td>8:30–9:30</td>
<td>PLENARY III: NEW DIRECTIONS</td>
<td>Plenary Hall</td>
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<tr>
<td>9:30–9:45</td>
<td>Coffee Break</td>
<td>A &amp; C Foyers</td>
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<tr>
<td>9:45–11:25</td>
<td>Session 7: In Vitro Studies I</td>
<td>Plenary Hall</td>
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<td>Session 8: Medical Applications</td>
<td>Aspen</td>
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<tr>
<td>11:25–11:40</td>
<td>Coffee Break</td>
<td>A &amp; C Foyers</td>
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<tr>
<td>11:40–12:40</td>
<td>Tutorial 4: Deep Brain Stimulation</td>
<td>Plenary Hall</td>
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<td>Tutorial 5: Medical Applications</td>
<td>Aspen</td>
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<td></td>
<td>Tutorial 6: Preservation of Art</td>
<td>Pischa &amp; Parsenn</td>
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<tr>
<td>13:00</td>
<td>Free afternoon for optional tours</td>
<td>Hotel Schatzalp</td>
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<tr>
<td>13:00–18:00</td>
<td>COST BM5704 MCM (by invitation only)</td>
<td>Strela &amp; Rinerhorn</td>
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**Thursday, June 18**

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<tr>
<th>TIME</th>
<th>BIOEM2009 SCHEDULE AT A GLANCE</th>
<th>LOCATION</th>
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<tr>
<td>8:00–18:00</td>
<td>Loading Time for Friday's Oral Presentations</td>
<td>Convention Office</td>
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<tr>
<td>8:00–9:40</td>
<td>Session 9: Dosimetry IV</td>
<td>Plenary Hall</td>
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<td>Session 10: Mechanisms of Interaction II</td>
<td>Aspen</td>
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<tr>
<td>TIME</td>
<td>EVENTS</td>
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<tr>
<td>9:40–10:10</td>
<td>Coffee Break</td>
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</table>
| 10:10–11:50 | Session 11: In Vitro Studies II  
                      Session 12: Theoretical and Practical Modeling |
| 12:00–13:15 | BEMS Annual Business Meeting  
                      (bag lunches are available for advance purchase) |
| 13:20–14:50 | Topic in Focus 3: EM Cancer Therapy                                  |
| 14:50–15:20 | Coffee Break                                                          |
                      Session 14: Pulsed Fields                                      |
| 16:20–16:30 | Short Break                                                           |
| 16:30–18:10 | Session 15: Human Studies  
                      Session 16: Animal Studies                                       |
| 18:15     | EBEA Assembly                                                          |
| 8:30–10:10 | Session 17: Epidemiology  
                      Session 18: Risk, Safety Standards, and Public Policy        |
| 10:10–10:40 | Coffee Break                                                          |
| 10:40–12:10 | PLENARY 4: HOT TOPIC                                                  |
| 12:10–13:00 | Student Awards and Closing Ceremony                                  |
| 13:00–17:00 | SPEAG SEMCAD X Workshop                                              |
| 13:00–17:00 | EMSS WORKSHOP: RF COMPLIANCE MANAGEMENT FOR MOBILE NETWORKS         |
| 13:00–17:00 | CST WORKSHOP: COMPLETE TECHNOLOGY FOR MEDICAL AND BIO-EM-SIMULATIONS |
| 13:00–17:00 | SWISSCOM Workshop (by invitation only)                                |
| 13:00–18:00 | BEMS Board of Directors Meeting                                      |
| 13:30–18:00 | EBEA Council                                                          |
| 13:00     | IEEE ICES TC34                                                        |
REGISTRATION INFORMATION

THE DEADLINE FOR RECEIPT OF PAYMENT FOR DISCOUNTED EARLY REGISTRATION IS MAY 22, 2009

Payments received after that date will be charged the late registration fee. Paid registration includes the following:

- Entry to all meeting sessions & exhibits
- Roundtrip 2nd class train ticket from anywhere in Switzerland to Davos (>80€ value)
- Welcome Reception
- Official Program booklet & welcome gift
- Online access to meeting abstracts
- Single admission to Social Event
- Coffee and tea daily

BEMS Annual Business Meeting bag lunches are available for advance purchase

Bag lunches may be purchased online with your registration for the BEMS Annual Business Meeting which will be held on Thursday, June 18th.

Participants wishing to include guests at any of the meal functions must purchase additional meals.

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<thead>
<tr>
<th></th>
<th>Early/Discounted On or Before May 22, 2009</th>
<th>Late After May 22, 2009</th>
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<tbody>
<tr>
<td>Member</td>
<td>€450 / CHF675</td>
<td>€550</td>
</tr>
<tr>
<td>Non-Member</td>
<td>€550 / CHF825</td>
<td>€650</td>
</tr>
<tr>
<td>Student/Emeritus Member</td>
<td>€250 / CHF375</td>
<td>€350</td>
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There are no technical sessions scheduled for Wednesday afternoon to allow free time and optional tours. Descriptions of the optional tours and registration are available on the joint meeting web site: BioEM2009

- Stop and Smell the Roses (€80.00)
- Friends of the Devil (€80.00)
- Thus Spoke BEMS/EBEA (€80.00)

GUEST FEE INCLUDES:

- Complimentary roundtrip 2nd class train ticket from anywhere in Switzerland to Davos
- Welcome Reception @ Davos Congress Centre
- Tuesday Social Event and Sponsor Recognition Ceremony @ Hotel Schatzalp

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<tr>
<td>Adult</td>
<td>€100 / CHF150</td>
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<tr>
<td>Child (10-17)</td>
<td>€70 / CHF105</td>
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<tr>
<td>Child (5-10)</td>
<td>€50 / CHF75</td>
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REGISTRATION CANCELLATION POLICY:

Refunds are offered only for medical emergencies. There are no refunds for no shows.
If you have not paid your BioEM2009 registration, you can purchase a train ticket at any SBB Train Station. English is spoken and Euro, CHF and other foreign currencies (i.e. dollars) are accepted, along with credit cards.

Paid BioEM2009 Registrants traveling by train from stations other than Zurich Airport will receive their Train Ticket by mail.

If you have paid your BioEM2009 registration, you can purchase a train ticket at any SBB Train Station. English is spoken and Euro, CHF and other foreign currencies (i.e. dollars) are accepted, along with credit cards.

General Information:

Nestled in a majestic alpine valley in the heart of canton Grubünden, Davos is the highest town in Europe, situated at 1560 m / 5100 ft, and a world-renowned winter-sunmmer resort with sport, spa and congress facilities. You can find all the amenities of a city in the middle of breathtaking mountain scenery, surrounded by the wonders of nature. The famous Promenade, flanked by boutiques, shops, hotels, and cafes, links the town's two sections, Davos-Platz and Davos-Dorf. There are also over 90 restaurants, ranging from cozy, typically Swiss eating establishments to elegant and trendy restaurants, bars, cinema, nightclubs, theater, and specialty shops. Given its alpine location, Davos offers a wide variety of sport and leisure activities, including, swimming, hiking and high alpine golfing. Excursions by train, bus & cable car, and walks into the mountains, uncover a tapestry of traditional Swiss villages, dramatic views and abundant wildlife. Walkers have access to both sides of the valley by cable car and mountain railways and a vast network of paths ranging from half hour strolls to full day hikes. Guests have complimentary use of selected cable cars, mountain railways, etc. Davos also has an interesting cultural life, including five museums, theater performances, exhibitions, local crafts, etc. The technical sessions will be held at the Davos Congress Centre in Davos Platz. The Centre is renowned for its modern facilities and services and it hosts the World Economic Forum (WEF) every year. In addition to meeting facilities, the Congress Centre features a number of bars, shops and cafes. It is conveniently located within 10 minutes walking distance from most hotels in Davos. Please visit www.davos.ch to acquaint yourself further with Davos.

Meeting Location:

Nestled in a majestic alpine valley in the heart of canton Grubünden, Davos is the highest town in Europe, situated at 1560 m / 5100 ft, and a world-renowned winter-sunmmer resort with sport, spa and congress facilities. You can find all the amenities of a city in the middle of breathtaking mountain scenery, surrounded by the wonders of nature. The famous Promenade, flanked by boutiques, shops, hotels, and cafes, links the town's two sections, Davos-Platz and Davos-Dorf. There are also over 90 restaurants, ranging from cozy, typically Swiss eating establishments to elegant and trendy restaurants, bars, cinema, nightclubs, theater, and specialty shops. Given its alpine location, Davos offers a wide variety of sport and leisure activities, including, swimming, hiking and high alpine golfing. Excursions by train, bus & cable car, and walks into the mountains, uncover a tapestry of traditional Swiss villages, dramatic views and abundant wildlife. Walkers have access to both sides of the valley by cable car and mountain railways and a vast network of paths ranging from half hour strolls to full day hikes. Guests have complimentary use of selected cable cars, mountain railways, etc. Davos also has an interesting cultural life, including five museums, theater performances, exhibitions, local crafts, etc. The technical sessions will be held at the Davos Congress Centre in Davos Platz. The Centre is renowned for its modern facilities and services and it hosts the World Economic Forum (WEF) every year. In addition to meeting facilities, the Congress Centre features a number of bars, shops and cafes. It is conveniently located within 10 minutes walking distance from most hotels in Davos. Please visit www.davos.ch to acquaint yourself further with Davos.

Train Information:

The journey from Zurich Airport to Davos Platz takes just under 3 hours, 2 train changes are required, one at Zurich main station and one at Landquart Station. The airport train station is situated under the airport shopping area, a few minutes walk from either of the airport terminals. The local train station nearest to the Congress Centre is called Davos Platz. It takes 10 min from the airport to the main railway station in Zurich and trains from Zurich main station to Davos Platz station depart every hour.

- If you have not paid your BioEM2009 registration, you can purchase a train ticket at any SBB Train Station. English is spoken and Euro, CHF and other foreign currencies (i.e. dollars) are accepted, along with credit cards.
- Paid BioEM2009 Registrants traveling by train from stations other than Zurich Airport will receive their Train Ticket by mail.
- Paid BioEM2009 Registrants’ train ticket pick up instructions at Zurich Airport:
  - BioEM2009 paid registrants are eligible to pick up their complimentary train ticket at the Service Center. After clearing customs, do NOT go directly to the SBB train station or their ticket counter. The Service Center is truly easy to locate, just follow the signs. You will not get lost. Zurich is a small airport and the signage is first rate. The Service Center is located on the upper level of Airport Shopping next to multi-level car park #2, and is open every day from 6 a.m. to 11.30 p.m. After you have passed through customs follow the signs for the Service Center or Park 2 and just ask the attendant for your complimentary second class roundtrip full fare ticket to Davos. Then proceed to the train terminal.

From Zurich Airport train station to Main Station Zurich:

If you do not have to exit the terminal; you can proceed directly to the train station underground departure. Once you have your train ticket, follow the signs down to the train. Take the train 10 minutes to transfer at the Main Station Zurich where you will find the platform for the connecting train to Davos Platz. Your second transfer will be at the Landquart Station.

Landquart to Davos Platz:

Until Landquart you have been travelling on the SBB Train Line - from Landquart on, you will travel with the Rhätische Railway (our little red train). In Landquart, please go to the pedestrian undercrossing and then follow the signs for platform 5 and 6. In general, the train to Davos Platz departs from Platform 5 - however re-check the display panel before boarding, otherwise you will end up in Engadin St. Moritz!

Ticket pick-up instructions for Geneva Airport:

The SBB airport railway station can be accessed directly from the Arrivals level. The Travel Agent "Agence de Voyage CFF" is located on the same level. After you have passed Customs, follow the signs for Railway Station. The Travel Agent is open Monday to Friday from 9am to 7pm, Saturday from 9am to 5:30pm and Sunday from 10am to 5:30pm.

Hotel Information:

Many hotels offering a range of quality, rates, and amenities have been reserved by BioEM2009 for the joint meeting in Davos, Switzerland. The Davos Congress Centre will coordinate all hotel reservations for participants. To reserve a room at the special meeting rate, participants must make their reservations through the official housing company, Davos Congress Centre online at www.bioem2009.org/hotels.

Reserving a room online will only take a few minutes of your time. Please have your credit card ready. A credit card is required as payment of the required deposit. If you need assistance, please contact Michele Lagger of the Davos Congress at +41 (0)81 415 21 63 or Michele.Lagger@davos.ch.

There is no reservation deadline; however, room availability at the special low meeting rates is not guaranteed as rooms will be available on a first come, first served basis. Please book your rooms early to guarantee your preferred room at these special low meeting rates.
Neither BEMS, EBEA, Association Services International, Inc. nor the Davos Congress Centre, is liable for personal injuries, loss or damage to private property for participants, students, accompanying persons either during or indirectly arising from BioEM2009. Participants should make their own arrangements with respect to health, accident and travel insurance.

**MEALS**

Registrants will receive complimentary:
- Welcome Reception on Sunday evening;
- Coffee and tea daily;
- Tuesday evening Social Event

Bag lunches for BEMS Annual Business Meeting on Thursday will be available for advance purchase.

**AWARDS**

A student competition will be held and awards will be given on Friday for best presentations in both the platform and poster sessions.

**POSTER SESSIONS**

Poster Size: 100 cm x 150 cm (landscape format). Double-sided tape will be provided by the Congress Centre for mounting your poster. Poster setup is in the Sanada & Aspen Foyers of the Congress Centre in Davos on Sunday, June 14th from 12:00 to 19:00.

The boards will be numbered to correspond with the numbers assigned in the Program and student posters will be clearly identified. Authors are asked to be present at their poster on the day and time scheduled in the Program.

- **Poster Session 1:** Monday, June 15th: Odd numbered posters will be presented from 10:30 to 12:00, Sanada & Foyer C1
- **Poster Session 2:** Tuesday, June 16th: Even numbered posters will be presented from 10:30 to 12:00, Sanada & Foyer C1

AUTHORS MUST REMOVE THEIR POSTERS THURSDAY, JUNE 18, by 18:10.

**ABSTRACT COLLECTION**

The BioEM2009 Abstract Collection will be available on the BioEM2009 website two weeks prior to the Meeting. Attendees may wish to download the Abstract Book and print out abstracts prior to attending the meeting. Registrants will receive a CD with the Abstract Collection at registration. The BioEM2009 website will offer a link to purchase a print copy of the Abstract Collection online (printing plus shipping & handling).

**PLATFORM (ORAL) SESSIONS**

The entire technical Program, including all the platform and poster sessions, will be held in the Davos Congress Centre. The total presentation time for each platform paper will be 15 minutes with 5 minutes for questions and discussion unless otherwise noted.

An audiovisual technician will be in each meeting room. Speakers who want to use computer projection must load their presentation onto the conference computer the day before their session. The format of the presentations can be PPT, PDF or keynote with Quicktime, Avi and other movie formats. Under no circumstances will presenters be allowed to use their own computers for presentation.
ANCILLARY EVENTS & ACTIVITIES

FRIDAY, JUNE 12

THE NEXT GENERATION OF BIOELECTROMAGNETICS
(Extended Long-Range Planning Committee of BEMS & EBEA) (by invitation only)
13:00-18:00 Press Centre

SATURDAY, JUNE 13

BEMS BOARD OF DIRECTORS MEETING
8:30 – 18:00 Press Centre

EBEA COUNCIL MEETING
13:30-18:00 Office 41

BEMS AND EBEA PRESIDENTS’ RECEPTION
(by invitation only) 18:00 – 20:00 Kirchner Museum

SUNDAY, JUNE 14

US AIR FORCE LABORATORY WORKSHOP: SHORT PULSE ELECTROMAGNETIC FIELDS & BIOLOGY
8:30 – 12:30 Plenary Hall, Organizer: Patrick Roach

The Air Force Research Laboratory is hosting a special session entitled “Short Pulse Electromagnetic Fields and Biology” at BioEM2009. This session will include fundamental short pulse theory, ongoing cellular work, emerging technologies, and current safety standards. The session will be held on Sunday June 14, 2009 in Davos, Switzerland. Confirmed speakers include Dr. Andrei Pakhomov of Old Dominion University, and Dr. W. Patrick Roach, Mrs. Stephanie Miller, and Mr. Noel Montgomery of AFRL. The session will also include an interactive panel discussion. If you are interested in presenting work in this area at this session, please contact Dr. W. Patrick Roach at william.roach@brooks.af.mil or 1-210-536-2770.

SWISS NATIONAL RESEARCH PROGRAMME 57 (NRP 57): NON-IONISING RADIATION – HEALTH AND ENVIRONMENT
8:30-18:00 Aspen, Organizer: Marjory Hunt

The Swiss National Research Programme 57 (NRP 57) “Non-Ionising Radiation – Health and Environment” is organizing a satellite symposium on June 14, 2009 at the Congress Centre in Davos, Switzerland. The NRP 57, a four-year program, was launched in 2007 and contributes to the international efforts to clarify possible health risks of ELF and RF EMF exposure. Altogether eleven research projects address open questions related to dosimetry and exposure assessment, short term, medium and long-term exposure effects of non-ionizing radiation assessed by laboratory and epidemiological studies, effects at the cellular level as well as risk perception and evaluation of the topic in the public.

In the symposium, all project leaders will report on their most recent results. This full-day scientific event will provide an outstanding opportunity to learn about the NRP 57 and to discuss its significance and implications in an international framework.

REGISTRATION & POSTER SETUP
12:00 – 19:00, Poster Setup: Sanada & Foyer C1
Registration: Foyer A2

SPEAKER LOADING TIME FOR MONDAY’S PRESENTATIONS
12:00-17:00 Convention Office

EFHRAN STEERING COMMITTEE MEETING
13:00 – 18:00 Press, Organizer: Paolo Ravazzani

The EFHRAN project was initiated to establish a European health risk assessment network on EMF. The main strategic objectives are 1) to monitor and search for evidence of health risks related to EMF; 2) to characterize and quantify potential health risk posed by EMF exposure; 3) enhance the EC’s ability to rapidly respond to health issues and concerns related to EMF using scientifically sound advice and analyses; and 4) improve the compilation of knowledge and its dissemination on issues related to EMF and health.

URSI COMMISSION K
16:30 – 18:30 Office 41

WELCOME RECEPTION
17:00 – 19:00 Foyer A2

STUDENT ICE BREAKER
19:00 – 21:00 Musicbar Rotlichtli Berglistutz 1 (10 minute walk from the Congress Centre)

MONDAY, JUNE 15

SPEAKER LOADING TIME FOR TUESDAY’S PRESENTATIONS
7:30 – 18:00 Convention Office

EDITORIAL BOARD DINNER
18:00 Location to be announced

TUESDAY, JUNE 16

SPEAKER LOADING TIME FOR WEDNESDAY’S PRESENTATIONS
8:00 – 18:00 Convention Office

BEMS 2010 TECHNICAL PROGRAM COMMITTEE MEETING
12:00 – 13:00 Jakobshorn

SOCIAL EVENT, SPONSOR RECOGNITION & EBEA’s 20th ANNIVERSARY CELEBRATION
19:00 Hotel Schatzalp

WEDNESDAY, JUNE 17

SPEAKER LOADING TIME FOR THURSDAY’S PRESENTATIONS
8:00 – 12:40 Convention Office

COST BM0704 MCM (by invitation only)
13:00 – 18:00 Strela and Rinerhorn
Organizer: Eric van Rojen
The increasing number of RF, SAR as well as temperature related requirements and standards make the certification of today's systems a complex and highly challenging procedure. The standards vary from performance guidelines (CTIA OTA), general categorization (ANSI C63.19 HAC), to mandatory compliance testing (IEEE 1528).

Today's most advanced numerical simulation tools, however, can greatly support any design process to make the systems compliant. Based on the FDTD and FE methods, SEMCAD X offers a GPU-accelerated simulation platform for investigating a full range of typical BioEM applications and device compliance verifications. The semi-interactive workshop will cover typical case studies, outlining SEMCAD's features and highlighting how to use the tool effectively. Applications will address mobile and stationary communication device compliance, medical systems analysis, implant safety, exposure setups, validation and much more - using 3-D full-wave RF, ELF and thermal solvers. A fully posable set of 3-D CAD anatomical human phantoms will also be presented.

Additionally, the workshop will touch on related topics such as:

• SAR extraction according to latest standards
• thermal modeling (living tissue, perfusion, vessels, blood flow, thermo-regulation, tissue damage, etc.)
• special effects (EM-nerve interaction, Magnetoe-Hemodynamics, etc.)
• EM-based cancer treatments
• high-resolution anatomical models (human, animal), posture modeling
• high performance computing
• field optimization

*experimental validation: EM and thermal measurements / uncertainty assessment

The goals of the workshop are to provide a good overview of the current state-of-the-art in numerical bioelectromagnetics on the basis of SEMCAD X, to allow hands-on experience within interactive sessions and to provide the necessary insight into the field's underlying techniques and procedures.

EMSS WORKSHOP: RF COMPLIANCE MANAGEMENT FOR MOBILE NETWORKS
13:00 – 17:00 Plenary Hall, Organizer: Tilmann Wittig
Pre-registration required no fee.

Tools and procedures have been developed for implementing and managing RF compliance and an RF safety program in a mobile network. The procedures developed are based on the WHO proposed EMF legislation, the EU Directive and the IEEE Recommended Practices for RF Safety programs but made applicable to mobile networks. Measurements and computations, used for compliance assessments, are based on CENELEC and IEC standards.

In this workshop the presenters will talk about the practical aspects of how to implement and successfully manage such an RF safety program in a mobile network, without significant disruption to the mobile network operations. An EMF compliance database is at the core of the RF program and tools have been developed to make computations, measurement surveys and reporting as easy and automatic as possible. This makes the RF program of a large, rapidly changing mobile network manageable and auditable.

The presenters will draw from their practical experience in managing RF compliance at more than 7500 sites in a mobile network over the past five years.

CST WORKSHOP: COMPLETE TECHNOLOGY FOR MEDICAL AND BIO-EM SIMULATIONS
13:00 – 17:00 Plenary Hall, Organizer: Peter Futter, Nicolas Chavannes
No registration required, no fee.

The CST CST in the IEEE standardization committees. The presenters will draw from their practical experience in managing RF compliance at more than 7500 sites in a mobile network over the past five years.

The workshop will start with a general overview of CST technology, including live demonstrations and a number of typical bio EM and medical applications, such as: MRI, mobile phone and wireless applications, computational dosimetry (SAR, IEEE 1528, HAC), EM cancer treatment (thermal ablation, hyperthermia), and pace makers. The presentations will be given by experienced application engineers who have worked in the area for several years and who represent CST in the IEEE standardization committees.

SWISSCOM WORKSHOP: RISK TALK – NEW SCIENTIFIC FINDINGS AND PUBLIC PERCEPTION
13:30 – 18:00 Strela & Rinerhorn
(by invitation only)

New scientific findings - as presented at BioEM2009 - are essential for the risk assessment of wireless communication technologies. However, due to the required precision in science, scientific results are presented in a technical terminology extremely challenging to communicate to laypersons.

On the other hand, the media covers the issue in a mostly simplified and entertaining manner. Simplification leads to distortion of the original message and may also lead to misunderstanding. Nevertheless, the public perception relays heavily on these transposed messages. Therefore, the scientific findings and public perception are often miles away.

In this risk talk, we want to discuss best practices for the communication of scientific findings and explore ways to bridge the gap between scientific knowledge and public perception.

EMSS BOARD OF DIRECTORS MEETING
13:00 – 18:00 Jakobshorn

ESEA COUNCIL
13:30 – 18:00 Strela & Rinerhorn
### MONDAY, JUNE 15

**PLENARY I: RF-EMF: EPI AND HUMAN**
8:30 – 10:00 Plenary Hall, Chair: J. Schüz
- A. Auvinen: Mobile Phones and Cancer: Current Epidemiological Evaluation
- M. Röösli: Human Laboratory Studies on Mobile Phone Exposure – A Critical Review

**TOPIC IN FOCUS 1: EMF INTERACTION MECHANISMS**
13:00 – 14:30 Plenary Hall, Moderator: G. d’Inzeo
- C. Timmel: The Role of the Radical Pair Mechanism in the Discussion of Weak magnetic Field Effects on Biological Systems

**TUTORIAL 1: RF SAFETY STANDARDS**
17:00 – 18:00 Plenary Hall, Organizer: M. Murphy
- D. Black: RF Standards in 2009 - A Medical Practitioner’s View

**TUTORIAL 2: MEDICAL IMAGING**
17:00 – 18:00 Aspen, Organizer: F. Prato
- J. Carson: Photoacoustic Imaging for High-Resolution Diagnostic Imaging of Cancer
- S. Ueno: Recent Advances in New MRI Methods for Electrical Impedance and Current Imaging of the Brain

**TUTORIAL 3: BIOFILMS**
17:00-18:00 Pischa & Parsenn, Organizer: B. McLeod
- B. Costerton: Biofilms, prosthetics, and re-occurring infections spell serious trouble for the patient with a prosthetic implant
- B. McLeod: DC current can control laboratory biofilms but can similar control in vivo with a prosthetic knee implant be achieved?

### TUESDAY, JUNE 16

**PLENARY II: MRI SAFETY**
8:30 – 10:00 Plenary Hall, Chair: W. Kainz
- N. Kuster: MR Safety of Implants
- S. Rajan: How Safe is Magnetic resonance Imaging (MRI)?

**TOPIC IN FOCUS 2: RF-EMF AND BBB**
13:00 – 14:30 Plenary Hall, Moderator: D. Leszczynski
- L. Saltord: Non-Thermal Electromagnetic Fields From Mobile Phones and Base Stations Do Have Effects Upon the Mammalian Brain
- J. Finnie: Increased Blood-Brain Barrier Permeability as a Market of Brain Damage After Exposure to Mobile Telephone-Type Radiofrequency Fields

### WEDNESDAY, JUNE 17

**PLENARY III: NEW DIRECTIONS**
8:30 – 9:30 Plenary Hall, Chair: C. Marino
- J. Weaver: In Silico Bioem: Multiscale Modeling for Assessing Effects of Non-Ionizing electromagnetic Fields in Humans
- A. Ito: Hyperthermia Using Functional Magnetite Nanoparticles

**TUTORIAL 4: DEEP BRAIN STIMULATION**
11:40 – 12:40 Plenary Hall, Organizer: S. Ueno
- M. Lu: Non-Invasive Magnetic Deep Brain stimulation: From Coil Design to Realistic head Model calculations
- R. Ilmoniemi: Transcranial Magnetic Stimulation and Neuronal Connectivity in the Brain

**TUTORIAL 5: MEDICAL APPLICATIONS**
11:40 – 12:40 Aspen, Organizer: A. Pilla
- A. Pilla: A Unified Mechanism for Pulsed Electromagnetic Field Bioeffects: Cellular, Animal and Clinical Evidence
- R. Cadossi: Biophysical Protection and Repair of Articular Cartilage

**TUTORIAL 6: PRESERVATION OF ART**
11:40 – 12:40 Pischa & Parsenn, Organizer: B. Bicceglia
- R. De Leo: Innovative system for Cultural Heritage Conservation
- V. Meriake: Millimeter Waves Application for Non-Invasive Monitoring and Treatment of Works of Art

### THURSDAY, JUNE 18

**TOPIC IN FOCUS 3: EM CANCER THERAPY**
13:20 – 14:50 Plenary Hall, Moderator: N. Kuster
- G. van Rhoon: Treatment of cancer with thermal electromagnetic fields: Past, Present and Future
- B. Pasche: Treatment of cancer with non-thermal electromagnetic fields: Past, Present and Future
- TBD: EM Cancer Treatment: A Perspective from the Broader Oncologic Community

### FRIDAY, JUNE 19

**PLENARY IV: HOT TOPIC**
10:40 – 12:10 Plenary Hall, Chair: N. Kuster
Topic and speakers will be selected prior to the meeting to ensure discussion of the most current hot topics.
TECHNICAL PROGRAM

MONDAY, JUNE 15

OPENING CEREMONY
8:00 - 8:30 Plenary Hall

Welcome: Niels Kuster, BEMS President and Carmela Marino, EBEA President
Program Highlights: Guglielmo d’Inzeo and Dariusz Leszczynski, Co-Chairs

PLENARY I: RF-EMF: EPI AND HUMAN
Chair: Joachim Schüz
8:30 - 10:00 Plenary Hall

MOBILE PHONES AND CANCER - CURRENT EPIDEMIOLOGICAL EVALUATION.
A. Auvinen; STUK - Radiation and Nuclear Safety Authority, Tampere, Finland.
The results of more than 20 epidemiological studies on the association between mobile phone use and risk of intracranial tumours have yielded ambiguous results with disparate conclusions. Most studies show no increased risks overall, but commonly suggest slightly elevated risks in some sub-groups including those with long-term or ipsilateral use, or large cumulative hours of use. Yet, the subset with the highest point estimate has not been very consistent across studies. Interpretation of the evidence is challenging, as the findings could reflect either a local effect of heavy long-term exposure or recall bias producing an apparent effect on features whose reporting is affected by the tumour diagnosis.

HUMAN LABORATORY STUDIES ON MOBILE PHONE EXPOSURE – A CRITICAL REVIEW.
M. Röösli; University of Basel, Basel, Switzerland.
The conduct of human laboratory studies is the most preferred method to directly evaluate short-term effects of mobile phone radiation on humans. High quality studies use an exposure setup that results in well-defined and replicable exposure circumstances. The exposure conditions need to be applied in a randomized counter-balanced way including a sham condition. A crossover study design minimizes the impact of confounding because each volunteer is used as his or her own control in the data analysis. So far, human laboratory studies have primarily focussed on cognitive functions, electrical activity of the brain, symptoms of ill health and the auditory system.

10:00 - 10:30 Coffee Break

POSTER SESSION 1
Authors with ODD Numbers Present
10:30 - 12:00 Sanada and Foyer C1
12:00 - 13:00 Lunch on your own

TOPIC IN FOCUS 1: EMF INTERACTION MECHANISMS
Moderator: Guglielmo d’Inzeo
13:00 - 14:30 Plenary Hall

THE ROLE OF THE RADICAL PAIR MECHANISM IN THE DISCUSSION OF WEAK MAGNETIC FIELD EFFECTS ON BIOLOGICAL SYSTEMS. C. Timmel1,2, K. Madea1,2, K. Henbest1,2, C. Rodgers1,2, C. Wedge1, A. Robinson2, P. Hore1; 1Inorganic Chemistry Laboratory, University of Oxford, Oxford, United Kingdom. 2Physical and Theoretical Chemistry Laboratory, University of Oxford, Oxford, United Kingdom: The Interaction Association for Cancer Research (IARC), a specialized cancer research agency of WHO, classifies extremely low frequency (ELF) magnetic fields as ‘possibly carcinogenic to humans (category 2B), . . . a classification used to denote an agent for which there is limited evidence of carcinogenicity in humans and less than sufficient evidence for carcinogenicity in experimental animals’. At the same time, it is an established fact that weak static magnetic fields (for instance, that of the Earth) are affecting many animals (e.g., a wide variety of birds) enabling the creatures to navigate and orient using the strength and orientation of the magnetic field to design compasses and maps. Here we discuss what role the radical pair mechanism (RPM) – the only known mechanism proven to act as a mediator between magnetic fields and chemical reactions - might play in the explanation of these phenomena. [1]C. R. Timmel and K. B. Henbest, Phil. Trans, Roy. Soc., 362 (1825): 2573-2589, 2004.

ESTABLISHING BIOPHYSICAL MECHANISMS OF EM FIELDS: A DIFFICULT TASK. Q. Balzano1, A. R. Sheppard2, M. Swicord3; 1University of Maryland, College Park, MD, USA. 2Asher Sheppard Consulting, Redlands, CA, USA. 3Mays Swicord Consulting, Ft. Lauderdale, FL, USA. Concomitant with numerous experiments on electromagnetic energy-exposed life systems, many hypothetical interaction mechanisms have been formulated to explain experimental outcomes. Close examination over the spectrum shows that the initial physical event requires certain combinations of field strength, frequency, etc. in order to transfer energy to a biomolecule, possibly launching a biochemical/biological cascade [1]. Per the Second Principle of Thermodynamics, any such energy transformation increases system entropy above its background level of molecular disorder. The paper suggests criteria useful in formulating new mechanisms of interaction, not an easy task, because (Nature likes to hide) (Heraclitus, VI century BC, Fragment 123). The hiding place is the background noise. [1]A. Sheppard, M. Swicord, Q. Balzano: “Quantitative Evaluations of the Mechanisms of Radiofrequency Interactions with Biological Molecules and Processes”, Health Physics, October 2008, Volume. 95, No. 4, pp 365-396.
SESSION 1: DOSIMETRY I
Chairs: M. Capstick and J. Wiart
15:00 - 16:40 Plenary Hall

1-1 AN INTERNATIONAL INTER-LABORATORY COMPARISON OF MOBILE PHONE SAR CALCULATION WITH CAD-BASED MODELS. M. Bacher², M. Douglas ³; 1Electrical Engineering, University of South Carolina, Columbia, SC, USA. ²Motorola Inc, Ft. Lauderdale, FL, USA. ³Motorola Inc., Plantation, FL, USA.

An international inter-laboratory comparison for the calculation of head phantom SAR involving three mobile phones with CAD-based models has been conducted in order to evaluate the repeatability of such calculations and for providing input in the development of standardized procedures. SAR in the standardized SAR head phantom was calculated by nine laboratories in a blind study manner. The agreement in calculated SAR between the participating laboratories is very similar to the agreement obtained in inter-laboratory comparisons involving SAR measurements. This clearly shows that standardized procedures can be developed.

1-2 STUDENT HYBRID SAR ANALYSIS OF VARIOUS HUMAN MODELS IN FRONT OF BASE STATION ANTENNAS IN THE FREQUENCY RANGE FROM 300MHZ TO 5000MHZ. M. Ali¹, M. A. Mazady¹, G. Schmid², N. Überacker³; ¹Imaging, Lawson Health Research Institute, London, ON, Canada. ²Physics and Astronomy, University of Waterloo, Waterloo, ON, Canada. ³London Regional Cancer Program, London, ON, Canada.

The aim of this study was to assess the exposure of various human models in front of base station antennas (900 MHz - 6 GHz) were studied at phantom-to-antenna distances 40 - 200 mm. The models were placed at distances of 10mm to 3000mm from the antenna. As before, the smallest model resulted in the highest exposure. From the results of 412 different configuration simulations, a formula has been derived to conservative estimate the whole-body average SAR and the peak spatial average SAR.

1-3 SAR INDUCED BY DIPOLE ANTENNAS TO DETERMINE LOW POWER THRESHOLDS FOR WIRELESS TRANSMITTERS AT DISTANCES OF 25 - 200 MM FROM THE USER. M. Ali¹, M. A. Mazady¹, G. Schmid¹, N. Überacker¹, M. Douglass²; ¹Electrical Engineering, University of South Carolina, Columbia, SC, USA. ²Austrian Research Center, Seibersdorf, Austria. ³Motorola Inc., Plantation, FL, USA.

Peak 1g and 10g averaged SAR induced in an elliptical phantom representing the human body by half wave dipole antennas (900 MHz - 6 GHz) were studied at phantom-to-antenna distances 40 - 200 mm. Different effects of near-field, radiating near-field and radiating far-field were observed. These effects enable the determination of a relationship between SAR and input variables (distance and frequency) that are used to develop a rationale to demonstrate
inherent SAR compliance for devices operating at distances up to 200 mm from the body.

A 7-year-old Korean (KR_7y) and a 6-year-old European (EU_6y) child head models were used to investigate if the SAM phantom offers a conservative SAR result for children's head exposure to a mobile phone operating at 835 and 1900 MHz. As a result, the peak SAR averaged over 10 g in the Korean child head model did not exceed that in the SAM model in any position or frequency. However, the SAR values in the European child head model were very high compared with those in the Korean child. Except the SARs for the normal ear at 835 MHz, every other SAR results in the European child model exceeded that in the SAM phantom.

International exposure assessment standard IEC 62232 is under development. There is need to know how Specific Absorption Rate (SAR) in human body models depends on various parameters in the exposure setup. Parallel-FDTD SAR simulations were performed using free-space plane-wave exposure at 300, 450, 900, 2100, 3500 and 5000 MHz with vertical and horizontal polarizations. Incoming angle was varied and total number of models was 15 (also including other than regular standing postures). Variation data was obtained for WBASAR and peak 10-g-averaged SAR. Simulation data and certain approximations were applied to create frequency distributions of SAR.

Some literature supports the finding that pulsed and static magnetic fields can be used to manipulate microcirculatory parameters. Previously, we reported no meaningful effects of a 225μT specific pulsed electromagnetic field (PEMF) after 30 and 60 min on peak blood flow, heart rate, and myogenic activity, but perhaps an attenuation effect on anesthetic-induced respiratory depression. Here, we investigated effects of the PEMF, 60Hz, and parametric resonance conditions on blood flow, blood pressure, heart rate variability, and other circulatory parameters in healthy and hypertensive rats. The data suggests subtle differences in circulatory/microcirculatory effects due to magnetic field intensity and type. In hypertensive rats these differences may become more evident.

Weak low frequency pulsed magnetic fields (PLFMF) capable of reducing pain perception may have habit forming potential. We compared the rewarding potential of two PLFMF and a sham treatment to a morphine positive control in an animal model of reward called the conditioned place preference test. We found that our positive control morphine was rewarding, however, this was not the case for any other treatment condition. This study does not support the hypothesis that PLFMF capable of reducing pain are rewarding.
RF STANDARDS IN 2009 - A MEDICAL PRACTITIONER’S VIEW, D. Black, E.A.F.O.E.M, Senior Lecturer in Environmental Medicine, University of Auckland, New Zealand. Radio-frequency standards have evolved over six decades to provide protection against all proven adverse effects of exposure. Current RF standards all set thresholds based on established deterministic effects. In recent years, international measures for health protection, including those supported by the WHO, sometimes promote precautionary approaches to deal with uncertainties which can include increasing safety margins. Whether this approach is valid or could produce any conceivable benefit to public health depends on factors which can be determined, even in a situation of uncertainty, and these should be taken into account in formulating both standards thresholds and advice for their application.

ELECTROMAGNETIC FIELDS (EMF) HEALTH AND SAFETY STANDARDS IMPACTS: A TUTORIAL, P. Gajšek1, B. Klauenberg2; 1Institute of Nonionising Radiation (INIS), Ljubljana, Slovenia, 2State University of New York, Buffalo. Fifty years of scientific study has led to EMF safety standards based on sound biophysical research. Binding legislation setting EMF exposure limits for the public and the worker has been passed or proposed. Socio-economic and environmental impacts of standards have not been determined. None of the standards provides a balanced risk characterization including assessment of shifting of risk shifts or re-introduction of presently controlled risks. This tutorial will describe potential impacts of EMF safety standards on different sectors. Examples of potential decreases in overall safety due to operational effectiveness reduction or degradation of EMF based safety systems will be presented.

RECENT ADVANCES IN NEW MRI METHODS FOR ELECTRICAL IMPEDANCE AND CURRENT IMAGING OF THE BRAIN, S. Ueno; Kyushu Univ, Fukuoka, Japan. Magnetic resonance imaging (MRI) is nowadays a powerful tool for medicine, but conventional MRI gives no electrical information such as impedance/conductivity and currents related to the neuronal activities in the brain. We review the recent advances in impedance/conductivity MRI and current MRI based on the achievements obtained mostly in our laboratory in recent years. We have developed three different methods to obtain impedance or conductivity distributions in the human brain using MRI, allowing to visualize in vivo the electrical properties of tissues without the need to attach electrodes to the surface of the body; a large flip angle method, additional AC field method, and a method based on diffusion tensor MRI. We have also studied the sensitivity limit for the detection of neuronal currents by MRI, and obtained that the current MRI method required neuronal currents generating a change of magnetic field of order 1 nT at the imaging slice. We have demonstrated the detection of the signals related to the somatosensory evoked responses in rat brain using a 4.7 T MRI. These measurements are important not only for the diagnosis of brain diseases and cognitive dysfunctions but also for various analyses in biomedical engineering and bioelectromagnetics, such as obtaining current distributions in transcranial electrical stimulation (TES) and transcranial magnetic stimulation (TMS), calculating the specific absorption rate (SAR), and current-source estimations in electroencephalography (EEG) and magnetoencephalography (MEG).

PHOTOACOUSTIC IMAGING FOR HIGH-RESOLUTION DIAGNOSTIC IMAGING OF CANCER, J. J. Carson; Lawson Health Research Institute, London, Ontario, ON, Canada. Optical imaging methods are sensitive indicators of tumour angiogenesis and metabolism and have the capacity to distinguish benign from malignant lesions. However, most optical techniques provide low-resolution images, which degrade diagnostic specificity. To improve diagnostic specificity, several groups are developing photoacoustic imaging for cancer diagnostics. Photoacoustic imaging offers the ability to capture high-resolution optical images and therefore may provide a means to distinguish benign from malignant lesions with improved specificity. This would lead ultimately to a method for positively impacting patient care, especially for women with breast lesions not readily identifiable by mammography, ultrason, or MRI.

DC CURRENT CAN CONTROL LABORATORY BIOFILMS BUT CAN SIMILAR CONTROL IN-VIVO WITH A PROSTHETIC KNEE IMPLANT BE ACHIEVED, B. R. McLeod, Montana State Univ, Bozeman, MT, USA. It has been known for nearly twenty years that small direct electric currents can enhance the efficacy of certain antibiotics, in vitro, against Pseudomonas aeruginosa biofilms and, more recently, against Staphylococcus aureus and Staphylococcus epidermidis. The use of electric and possibly magnetic fields to control bacterial biofilms appears promising. Now the challenge is to move EM fields laboratory research into the clinic. One approach is to prevent a biofilm from forming on a prosthetic surface. A second is to combat a biofilm that forms, post surgery. Several questions concerning device design are presented along with possible developmental approaches.

TUTORIAL 1: RF SAFETY STANDARDS
Organizer: Michael Murphy
17:00 - 18:00 Plenary Hall

TUTORIAL 2: MEDICAL IMAGING
Organizer: Frank Prato
17:00 - 18:00 Aspen

TUTORIAL 3: BIOFILMS
Organizer: Bruce McLeod
17:00 - 18:00 Pischa and Parsenn

18:00 Editorial Board Dinner
PLENARY II: MRI SAFETY
Chair: Wolfgang Kainz
8:30 - 10:00 Plenary Hall

MR SAFETY OF IMPLANTS. N. Kuster; ETH, Zurich, Switzerland.
In the RF fields of magnetic resonance (MR) scanners, implanted medical device (IMD) can receive considerable energy that may be deposited/absorbed very locally (e.g., at the lead tip). Demonstrating that the energy deposition is non-hazardous for the entire patient population is a rather complicated task since the exciting incident electric fields are strongly dependent on anatomy, position, frequency and coil design. Other potential hazards result from the gradient and static magnetic fields. The state of the art in IMD design and test procedures are discussed.

HOW SAFE IS MAGNETIC RESONANCE IMAGING (MRI)? S. Rajan; Center for Devices and Radiological Health, Rockville, MD, USA. MRI has evolved into a premier radiologic modality for imaging. Approximately 30 million MRI procedures are estimated to be performed annually in USA alone. Although MRI utilizes nonionizing radiofrequency waves and is considered safe for repeated procedures there are a number of hazards associated with MRI. This review will review the various safety issues associated with MRI. The most studied are the bio-effects associated with high power radiofrequency pulses, rapidly switched magnetic field gradients and slowly varying high fields on the subjects being scanned. These include risk of tissue heating, burns, peripheral nerve stimulation and temporary sensations. Furthermore, these fields can interact with active and passive devices, such as stents and infusion pumps implanted in the body. In addition, to the direct effects of the MRI device on the patient, a number of indirect hazards have also been reported. These include the risk of injury from ferromagnetic objects that are accidentally brought in the vicinity of the magnet and the potential for infection due to the challenges in cleaning the patient contact areas. Adverse events experienced during MRI scans are voluntarily reported to the FDA as a part of the Medwatch program and logged in the FDA database. All the above safety issues and reported events will be described in the context of the current MRI practice and reports from the FDA database.

10:00 - 10:30 Coffee Break

POSTER SESSION 2
Authors with EVEN Numbers Present
10:30 - 12:00 Sanada and Foyer C1

12:00 - 13:00 Lunch on your own

BEMS 2010 Technical Program Committee Meeting
12:00 - 13:00 Forum Room

TOPIC IN FOCUS 2: RF-EMF AND BBB
Moderator: Dariusz Leszczynski
13:00 - 14:30 Plenary Hall

NON-THERMAL ELECTROMAGNETIC FIELDS FROM MOBILE PHONES AND BASE STATIONS DO HAVE EFFECTS UPON THE MAMMALIAN BRAIN. L. G. Salford; Lund University, Lund, Sweden. Since 1988 we have studied the effects of non-thermal RF-EMF in TEM-cells upon the BBB in >2000 rats. We have shown significantly increased leakage of the rats’ own blood albumin through the BBB at energy levels of 1 W/kg and below, as compared to non-exposed animals. The lowest studied energy levels, (below 10mW/kg), give rise to the most pronounced albumin leakage. SAR 1 mW/kg exists about one meter away from the mobile phone antenna and about 200 meters from base-stations. Further, we have registered neuronal damage in rat brains 28 and 50 days after a 2-hour GSM exposure.

INCREASED BLOOD-BRAIN BARRIER PERMEABILITY AS A MARKER OF BRAIN DAMAGE AFTER EXPOSURE TO MOBILE TELEPHONE-TYPE RADIOFREQUENCY FIELDS. J. Finnie; Veterinary Services Division and Hanson Institute Centre for Neurological Diseases, Adelaide, SA, Australia. Most BBB permeability changes after exposure to RF fields have been small and rapidly reversible, while the few positive results have been attributed to hyperthermia, procedural side-effects such as restraint, or inadequate dosimetry, and have not been successfully replicated. However, comparison between studies is often difficult due to different exposure systems, animal species, and assessment modalities. Any vasogenic oedema produced by BBB breakdown is probably not functionally or pathologically significant as it is generally subtle and transient, after acute or prolonged exposure, with re-establishment of the normal BBB and no significant rise in intracranial pressure or reduction of cerebral perfusion.

14:30 - 15:00 Coffee Break
3-1 A REAL TIME EXPOSURE SYSTEM FOR NEURONAL NETWORKS IN THE MW BAND.
C. Merla1, S. Saïghi 2, D. Turner 2, F. Tambuwala2, S. Turner 2, D. Winship 2; 1ACRBR, Hawthorn, VIC, Australia. 2Swinburne University of Technology, Hawthorn, VIC, Australia.

To study possible alterations in neuronal networks functionality induced by microwave fields, a new real time exposure set-up has been designed and realized. The recording of neurons action potential under exposure is detected by an integrated electrically passive microelectrode array as an alternative technique to the patch clamp approach. Numerical as well as experimental measurements are going on the system. First numerical results have evidenced the importance of an accurate chip modeling to correctly evaluate SAR and E field distributions homogeneity in the recording zone.

3-2 COMPARISON OF RF EXPOSURE AND THERMAL RESPONSE IN A MOUSE DAM AND MOUSE FETUSES USING FINITE-DIFFERENCE MOUSE MODELS.
A. Wood1,2, R. L. McCall1, L. Deppeler1, M. Oliver1, J. Parente1, P. Tamboula1, S. Turner1, D. Winship1, 2/ACRBR, Hawthorn, VIC, Australia. 3University of Technology, Sydney, NSW, Australia.

In-vivo studies involving exposure of rodents to radiofrequency (RF) exposure require precise dosimetric analysis to enable correct interpretation of biological outcomes. Detailed finite-difference models of mice - a female, a pregnant female, a male, and a fetus - have been developed. The mouse models, consisting of up to 50 tissues, are available for use by the Biorelectromagnetics community. Dielectric and thermal tissue properties have been sourced and included, with allowances made for the increased water content of the fetuses. A comparison was made between the RF exposure (at 900 MHz) of the mother and the fetuses as specified by the SAR and the resultant temperature change.

3-3 STUDENT VISUALIZATION OF TEMPERATURE DISTRIBUTION CHANGE DUE TO MILLIMETER-WAVE EXPOSURE WITH MICRO-ENCAPSULATED THERMOCHROMIC LIQUID CRYSTAL.
Y. Kurogi1, Y. Suzuki1, M. Kojima2, T. Sakai3, S. Watanabe3, H. Sasaki2, W. Wood1,2, R. L. McIntosh1, L. Deppeler2, M. Oliva2, J. Parente2; 1ACRBR, Hawthorn, VIC, Australia. 2Swinburne University of Technology, Hawthorn, VIC, Australia. 3National Institute of Information and Communications Technology, Koganei, Tokyo, Japan.

Millimeter-waves (MMWs) exposure causes highly localized energy absorption and generates steep temperature gradient within several millimeter areas. Appropriate temperature measurement methods are required to correctly characterize of MMW exposure. We propose micro-encapsulated thermo-chromic liquid crystal (MTLC) as a micro temperature probe for dosimetry of MMW exposures. The purpose of this study is to investigate feasibility of MTLC method to apply dosimetry of MMW exposures. We show results of visualizations of 2-dimensional temperature distribution changes in both in vitro and in vivo studies. These results indicate that MTLC method is effective in temperature measurement for MMW exposure experiments.
**SESSION 3: DOSIMETRY II (continued)**

**Chairs: N. Kim and P. Vecchia**

**15:00 - 16:20 Plenary Hall**

**3-4**

**PROPAGATION OF UNCERTAINTIES IN SAR EVALUATION USING A STOCHASTIC COLLOCATION TECHNIQUE.** M. Wurbach1,3, S. Kuehn1,3, M. Christopoulou1,2, A. Christ1, P. Achermann4, N. Kuster1; 1IT'IS Foundation, Switzerland. 2University of Bern, Switzerland. 3University of Zurich, Switzerland. 4Institute of Pharmacology and Toxicology, University of Zurich, Switzerland.

Collimation stochastic techniques are applied in dosimetry engineering to determine the uncertainties of absorbed power or SAR due to uncertainties in the input parameters. More efficient than the standard Monte Carlo method, they enhance deterministic electromagnetic modelling like FDTD when the geometries or the dielectric properties are variable or uncontrollable. The statistical moments of the SAR are then accurately calculated. The mean and the standard deviation are useful for sensitivity analysis. The higher order moments can be used to reconstruct the probability density function. The approach is illustrated through examples when the source or the object is subject to variations.

**SESSION 4: MECHANISMS OF INTERACTION I (continued)**

**Chairs: F. Hart and F. Apollonio**

**15:00 - 16:20 Aspen**

**4-4**

**CYTOSKELETAL FORCES PRODUCED BY EXTERNALLY-APPLIED, PULSED ELECTRIC FIELDS OF PHYSIOLOGICAL STRENGTH.** F. X. Hart; Physics, The University of the South, Sewanee, TN, USA.

An externally applied electric field produces a force on charged, transmembrane glycoproteins which is transmitted to the cytoskeleton. This cytoskeletal force is calculated for two pulses, each with an amplitude of 100 V/m, a repetition rate of 1 Hz and a pulse duration of 0.2 s. One pulse is unipolar; the other, bipolar. For a 27-rod unit of the glyocalyx of a hamster cremaster cell the unipolar pulse produces a maximum force of 1.9 pN; the bipolar pulse, 1.6 pN. Such forces in the cytoskeleton are comparable to mechanical forces observed to produce physiological effects.

**SESSION 5: DOSIMETRY III**

**Chairs: M. Taki and T. Samaras**

**16:40 - 18:00 Plenary Hall**

**5-1**


The paper is focused on the relationship between the body surface area illuminated by a plane wave and the whole body absorbed power. The frequency 2100 MHz, the vertical polarization and isolated conditions are considered. Results observed on 8 adult models have led to compare the Body Cross Section defined as the ratio between the sum of the absorbed and the radiated power and the incident power density. First results on boxes filled by different type of media homogenous or not show that this Body Cross Section is quite constant whatever the characteristics of the media filling the box.

**5-2**

**EVALUATION OF ARTIFACTS BY EEG ELECTRODES DURING RF EXPOSURES.** M. Taki1, S. Kuc1, M. Christopoulou1, A. Christ1, P. Achermann4, N. Kuster1, S. Lavorgo1, P. Buffler1; 1School of Public Health Division of Epidemiology, University of California at Berkeley, Berkeley, CA, USA. 2Environnet, Electric Power Research Institute, Palo Alto, CA, USA.

There is evidence that RF EMF can alter brain physiology such as human EEG. Exposure prior to sleep was often performed with attached EEG electrodes to minimize time between exposure and sleep onset. This study aims to quantify possible field enhancements coupled via EEG leads to the tissues around the electrodes, and (2) the shielding of the conducting wires. The SAR assessment matrix comprised measurements with and without EEG electrodes, electrically isolated and non-isolated at two carrier frequencies (900MHz, 2140MHz). Earlier findings of shielding effects could be verified. Electrode artifact analysis showed induced currents remaining within superficial skin tissues.
6-3 MOBILE TELECOMMUNICATION NETWORKS AND ACUTE WELL-BEING IN CHILDREN AND ADOLESCENTS – RESULTS OF THE GERMAN MOBILEE- STUDY, S. Heinrich, A. Kuehnlein, S. Thomas, G. Praml, R. von Kries, K. Radon; 1Inst and Outpatient Clinic for Occupational, Social and Environmental Medicine, Ludwig-Maximilians-University, Munich, Germany. 2Institute for Social Paediatrics and Adolescent Medicine, Ludwig-Maximilians-University, Munich, Germany. In a population-based cross-sectional study, 24-hour exposure profiles of 3022 children (age 8-12 years) and adolescents (age 13-17 years) were recorded using personal dosimeters. Personal interview data on participants' well-being, socio-demographic characteristics and potential confounding variables were collected. The overall exposure to high frequency electromagnetic fields was far below the ICNIRP reference level. No consistent association between exposure to mobile telecommunication networks and acute well-being in children and adolescents was found. The MobilEe-study was the first study to use personal dosimetry to assess the individual exposure to mobile telecommunication networks in children and adolescents. More research is needed to investigate possible long-term effects.

5-3 STUDENT EVALUATION OF THE ACTIVATING FUNCTION IN A 3D DEEP BRAIN STIMULATION MODEL, F. Maggio, A. Poffi, G. Giudici, M. Liberti, F. Apollonio, M. Parazzini, F. d’Inzeo; 1Department of electronic engineering, ‘La Sapienza’ University of Rome, Rome, Italy. ‘Biomedical Engineering Institute, CNR, Milan, Italy. The Deep Brain Stimulation is an effective treatment for advanced Parkinson’s disease. Previous studies on a 2D electromagnetic model of the neuroanatomical nuclei involved in the stimulation showed a significant influence of the analysis domain dimensions and shape and ground positioning on the values of both electric potential and activating function (AF) inside the target nuclei. Recent analysis based on a realistic 3D electromagnetic model confirms the results obtained with the 2D one. In this work, the AF has been evaluated in the 3D model along fibers direction connecting neuroanatomic nuclei to understand the neural response to the applied stimulation.

5-4 MEASUREMENT, SIMULATION AND UNCERTAINTY ASSESSMENT OF IMPLANT HEATING DURING MRI, E. Neufeld, S. Kuehn, N. Kuster; IT’IS, Zurich, Switzerland. The heating of tissues around implants during MRI can pose severe health risks. A recent inter-laboratory comparison study has shown that different groups can produce widely varying results when performing measurements according to current guidelines. To derive optimized procedures, two different generic lead structures (straight and coiled isolated wires with bare tips) have been investigated using simulations and measurements (EM and thermal). A detailed uncertainty budget has been determined. The use of state-of-the-art techniques (thin structure model, unidirectional subgridding, robot based volumetric measurements, accurate probes...) results in excellent agreement between simulations and measurements. An optimized testing procedure is being developed.
NETIC FIELDS IN HUMANS.

J. C. Weaver; Harvard-MIT Division of Health Sciences and Technology, MIT, Cambridge, MA, USA.

Applying an external alternating magnetic field to induce heat generation by the magnetite nanoparticles. Recent years have seen the remarkable advances in magnetite nanoparticles-mediated hyperthermia; both functional magnetite nanoparticles and alternating magnetic field generators have been developed. Currently, some researchers are attempting to begin clinical trials, suggesting that time may have come for clinical application. This review describes recent advances in magnetite nanoparticles-mediated hyperthermia.

...
HSP70/LUC REPORTER SYSTEM. M. Belton, F. S. Prato, J. Univ of Texas, Health Sci Ctr, San Antonio, TX, USA. 3Radiation On-
cology, Univ of Texas, Health Sci Ctr, San Antonio, TX, USA. 2Electromagnetismo y Teoria de Circuito,
ETSIT, Madrid, Madrid, Spain. 2Children’ s Hospital Oak-
land Research Inst, Oakland, CA, USA. 2Dept of Pathology, Albert Einstein
College of Medicine, Bronx, NY, USA. 2Dept of Pathology, Albert Ein-
stein College of Medicine, Bronx, NY, USA. 2Biomedical Engineering,
Columbia Univ, New York, NY, USA.

We undertook real-time measurements of bioluminescence in an HSP70/luciferase reporter system. We examined the effect of treat-
ment with DEM to deplete free radical scavengers (GSH), exposure to a static magnetic field (SMF) and exposure to 42° separately and in 
combination. We found that DEM alone significantly decreased the rate of bioluminescence production. There was a statistically signifi-
cant interaction of DEM with SMF to increase bioluminescence in the absence of heat and a significant interaction of DEM to decrease 
bioluminescence in the presence of heat. The addition of SMF to 
DEM and heat significantly lessened the above mentioned decrease 
in bioluminescence.

7-4  CELL GROWTH RESPONSE TO PULSE-MODULAT-
ED RF SIGNALS. M. A. Trillo1, M. A. Cid 1, M. A. Martinez 1, J.
E. Page1, A. Úbeda 1; 1Investigacion-BEM, Hospital Ramon y Cajal,
Madrid, Madrid, Spain. 2Electromagnetismo y Teoria de Circuito,
ETSIT, Madrid, Madrid, Spain.

A 24-hour exposure to 2.2-GHz, pulse-modulated (5 μs pulse du-
ration, 100 Hz repetition rate) signals at subthermal doses, induces 
significant reduction in the number of cells (-16% with respect to 
controls) in the NB69 human neuroblastoma line. This effect is ac-
companied with modest, though statistically significant increases in 
the percent of cells in the G0/G1 and G2/M phases of the cell cycle.

7-5  INDUCTION OF ADAPTIVE RESPONSE IN HUMAN 
LYMPHOCYTES EXPOSED TO RADIFREQUENCY 
RADIATION. M. B. Scarfe, A. Sanmario, J. Vivas-Salazar, M. Sert, 
S. B. Reddy, J. T. Prihoda1; 1IREA, CNR , Naples, Italy. 2Pathology,
Univ of Texas, Health Sci Ctr, San Antonio, TX, USA. 3Radiation Onc-
ology, Univ of Texas, Health Sci Ctr, San Antonio, TX, USA.

The "adaptive response" (AR) is documented in vitro and in vivo. 
Mammalian cells exposed to a small ‘adaptation’ dose of a genotoxic 
agent are less susceptible to DNA damage when given a higher 'chal-
lenge' dose. In this study micronucleus (MN) frequency was eval-
uated to assess the induction of AR to radiofrequency (RF) radiation in 
peripheral lymphocytes. Following 24 h PHA stimulation, cells were 
exposed to 900 MHz RF radiation (10 W/kg peak value) for 20 hours 
and then challenged with mitomycin C (100 ng/ml) at 48 hours. Cells 
exhibited the induction of AR, suggesting that AR can be induced in 
cells pre-exposed to non-ionizing radiation.
NON-INVASIVE MAGNETIC DEEP BRAIN STIMULATION: FROM COIL DESIGN TO REALISTIC HEAD MODEL CALCULATIONS. M. Lu. Univ of Lisbon, Lisbon, Portugal. Transcranial magnetic stimulation (TMS) has been most frequently used to study brain physiology and is also being developed as a therapeutic tool. This talk will discuss several issues relating to deep transcranial magnetic stimulation. Firstly, we will review the TMS coil design, particularly highlights the double-cone and H-coils for stimulating deeper brain regions. Secondly, we will show how to build 3D patient-specific head model from MRI images. Finally, we will present numerical results by employing 3D impedance model. The induced currents and electric fields in realistic head model by applying sound, figure-of-eight, double-cone and H-coils will be presented.

TRANSCRANIAL MAGNETIC STIMULATION AND NEURONAL CONNECTIVITY IN THE BRAIN. E. Ilmoniemi; Helsinki University of Tech, TKK, Finland. Transcranial magnetic stimulation (TMS) allows one to deliver pulses to selected superficial brain sites noninvasively. A modern TMS navigation system displays in real time the location and orientation of the current that will be induced in the cortex when the pulse is given. This MRI-based targeting enables one to deliver the stimuli with an accuracy of about 3 mm, allowing functional mapping of cortical areas. Furthermore, when the TMS-evoked EEG is measured, one can obtain time-resolved measures of cortico-cortical connectivity. Such measures reflect, in addition to the anatomical connections, also vigilance and the pharmacological state of the subject. For example, functional connectivity is much reduced during deep sleep; alcohol has been found to alter the pharmacological state of the subject. For example, functional connectivity is much reduced during deep sleep; alcohol has been found to alter the pharmacological state of the subject.

A UNIFIED MECHANISM FOR PULSED ELECTROMAGNETIC FIELD BIOEFFECTS: CELLULAR, ANIMAL AND CLINICAL EVIDENCE. A. A. Pilla; Biomedical Engineering, Columbia Univ New York, NY, USA. It has been reported PEMF signals can modulate growth factor release. There is also strong evidence that modulation of Ca2+ binding to calmodulin (CaM), upon increase in intracellular calcium when homeostasis is interrupted, can be a fundamental PEMF transduction pathway. A mechanism is proposed here which suggests PEMF signals, configured to match the dielectric properties of the Ca/CaM binding pathway, causes a rapid rise in anti-inflammatory nitric oxide (NO) followed by increases in cGMP which cascades to growth factors, a ubiquitous pathway for tissue repair. Evidence for this PEMF transduction mechanism is provided at the cellular, animal and clinical levels.

A complete disinfestation of pests.

Evidence for this PEMF transduction mechanism is provided at the cellular, animal and clinical levels.

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A UNIFIED MECHANISM FOR PULSED ELECTROMAGNETIC FIELD BIOEFFECTS: CELLULAR, ANIMAL AND CLINICAL EVIDENCE. A. A. Pilla; Biomedical Engineering, Columbia Univ New York, NY, USA. It has been reported PEMF signals can modulate growth factor release. There is also strong evidence that modulation of Ca2+ binding to calmodulin (CaM), upon increase in intracellular calcium when homeostasis is interrupted, can be a fundamental PEMF transduction pathway. A mechanism is proposed here which suggests PEMF signals, configured to match the dielectric properties of the Ca/CaM binding pathway, causes a rapid rise in anti-inflammatory nitric oxide (NO) followed by increases in cGMP which cascades to growth factors, a ubiquitous pathway for tissue repair. Evidence for this PEMF transduction mechanism is provided at the cellular, animal and clinical levels.

A complete disinfestation of pests.

Evidence for this PEMF transduction mechanism is provided at the cellular, animal and clinical levels.
SESSION 9: DOSIMETRY IV

9.1 MEASUREMENT OF MAXIMUM SAR IN A SPHERICAL PHANTOM WHEN USING AN ACTUAL MOBILE PHONE IN CLOSE PROXIMITY TO A METALLIC WALL. A. T. Simbe1, S. Watanabe1, T. Hikage2, T. Nojima2; 1EMC PHONE IN CLOSE PROXIMITY TO A METALLIC WALL. A. T. Simbe1, S. Watanabe1, T. Hikage2, T. Nojima2; 1EMC Group, National Institute of Information and Communications Technology, Tokyo, Japan. 2Graduate School of Information Science and Technology, Hokkaido University, Sapporo, Japan.

A spherical phantom head irradiated with an actual mobile phone is placed in close proximity to metallic walls and its specific absorption rate (SAR) was investigated experimentally. The main goal of this study was to determine the effect of reflected electromagnetic fields from the walls on the maximum spatial average 10-g SAR.

9.2 EVALUATION OF EXPOSURE OF SCHOOL CHILDREN TO ELECTROMAGNETIC FIELDS FROM WIRELESS COMPUTER NETWORKS (Wi-Fi); PHASE 1 LABORATORY MEASUREMENTS. A. Peyman, C. Caldeira1, M. Azanza1; 1Laboratorio de Magnetobiologia, Dpto. Anatomia e Histologia Humanas, Universidad de Zaragoza, Zaragoza, Spain. 2Dpto. Fisica de Materia Condensada e Inst de Ciencia de Materiales, Univ de Zaragoza y CSIC, Zaragoza, Zaragoza, Spain.

Wireless networking is being increasingly used in schools and it is important to quantify the exposure of children to the radiofrequency fields. This paper presents a series of laboratory measurements with selected items of Wi-Fi equipment known to be popular in UK schools. Unlike most of the previous similar studies, a signal analyzer has been used in this work with a bandwidth of 25 MHz allowing the detection of the whole WLAN signal. The results revealed the effect of having multiple transmitting antennas, as currently used in most of the wireless enabled laptops.

SESSION 10: MECHANISMS OF INTERACTION II

10.1 NON-LINEAR BEHAVIOUR OF BIOLOGICAL CELLS: DETECTION BY INTERMODULATION. H. Lehmann, B. Eicher; Innovation Competence Center, Swisscom (Switzerland) Ltd, Bern, Switzerland.

To test the hypothesis of a possible non linear behaviour of biological cells under exposure to a radiofrequency electromagnetic field, higher intermodulation (IM) products can be measured. Standard microwave test procedures have been adapted for extremely sensitive measurement of 3rd order IM products in biological tissues. The adapted set-up is designed for the DCS frequency range (1.8 GHz) and the sample holder allows the exposure of a sample in a Petri dish with a diameter of 30 mm. First tests with biological samples show no alteration of the IM level as compared to the empty waveguide set-up.

10.2 EXPERIMENTAL OUTCOMES OF A TEST TO DETECT NONLINEAR RESPONSES IN BIOLOGICAL PREPARATIONS EXPOSED TO RF ENERGY. C. Kowalczyk1, G. Yarwood1, R. Blackwell1, S. Braffett1, I. Ahmed2, R. Abd-Alhameed2, P. Excell3, V. Hodic4, C. David1, R. Gammer1, Q. Balzano4; 1Health Protection Agency, Chilton, United Kingdom. 2Univ of Bradford, Bradford, United Kingdom. 3Glyndwr Univ, Wrexham, United Kingdom. 4Univ of Maryland, College Park, MD, USA.

A doubly resonant cavity was used to search for non-linear radiofrequency (RF) energy conversion in a range of biological materials. Over 500 cell and tissue samples were exposed to RF fields at the resonant frequency of the loaded cavity (around 883 MHz), and monitored for generation of the second harmonic. No consistent responses attributable to non-linearities in the exposed biological samples were detected. Therefore, these results do not support the suggestion that living cells can demodulate RF energy. Further analyses of the system sensitivities and dosimetric parameters are underway.

10.3 FREQUENCY-RESONANCE AND DEMODULATION IN NEURONES UNDER LOW FREQUENCY MODULATED MICROWAVES. A. del Moral, R. Pizarro-Bruzó, T. Figóz, M. Azanza; 1Laboratorio de Magnetobiologia, Dpto. Anatomia e Histologia Humanas, Universidad de Zaragoza, Zaragoza, Spain. 2Lab de Magnetismo, Dpto. Física de Materia Condensada e Inst de Ciencia de Materiales, Univ de Zaragoza y CSIC, Zaragoza, Zaragoza, Spain.

Neurons exposure to a microwave E/MF (carrier frequency=13.6 GHz; power P=5 mW; H(0)=10 Am-1; E(0)=50 V/m; ΔF=0.01°C; SAR: 1.25-2.35 W/Kg) amplitude modulated by ELF-AC field (frequency, fm=0-100 Hz) shows no electrophysiological effect under the carrier MF alone, but “resonances” at 2, 4, 8, 12, 16, 50, 100 Hz, demodulation effect. Resonances appear when applied ELF-MF is close to a characteristic frequency of the impulse Fourier spectrum. Interesting result considering that ELF-MF modulating RF or MW in the range of human EEG could induce frequency-resonant effects on exposed human brain.
The present study discussed a scheme to consider core temperature variation in a bioheat equation. First, the limitation in conventional modeling of the bioheat equation was investigated for a problem in which the whole-body phantom should be considered. Then, schemes for varying body-core temperature in the bioheat equation were discussed for radio-frequency exposures. The computational uncertainty in the core temperature elevation is found to be less than 20% for different sets of thermal parameters when a proper scheme for computing the net rate of heat acquisition by blood from body tissue was introduced.

**9.5 COMPARISON OF THE RF-FIELDS ALONG TYPICAL LEAD PATHS FOR VARIOUS MEDICAL IMPLANTED DEVICES IN THE HUMAN BODY AND IN HOMOGENEOUS PHANTOMS.** E. Cabastró, A. Chefitz, S. Kuchel, M. Capstick, N. Kuster.


Neuromodulation has been demonstrated with deep brain stimulation, transcranial magnetic stimulation, and whole-body exposure. However, little is known about the requirements for stimulus amplitude and the size of neuron population receiving that stimulus to elicit an effect. We used our computerized large-scale brain model to explore these requirements for a simple stimulus (60Hz sinusoid) and a complex Pulsed Electromagnetic Field (PEMF). Our findings indicate that the PEMF stimulus is more attenuated than the 60Hz stimulus to being propagated from the stimulated neuron population to the entire neuron population.
SESSION 11: IN VITRO STUDIES II (continued)
Chairs: J.-S Lee and M.R. Scarfi
10:10 - 11:50 Plenary Hall

11-2 INFLUENCE OF A HIGH-FREQUENCY ELECTROMAGNETIC FIELD AT 2.45 GHZ ON NEURITE OUT-GROWTH IN PC12VG CELLS. E. Naito1, T. Saburou1, M. Tak1, J. Miyakoshi1; 1Grad School of Health Sci, Hiroaki Uni, Hiroaki, Aomori, Japan. 2Grad School of Engineering, Tokyo Metropolitan Uni, Hachioji, Tokyo, Japan.

We studied the average length of neurites, the longest neurite lengths and the percentage of neurite-bearing cells in PC12VG cells cultured for 7 days after the exposure to high-frequency electromagnetic field at average specific absorption rates of 1 and 10 W/kg for 4h.

We found that HFEMF exposure slightly inhibited the percentage of neurite-bearing cells. However, the average length of all neurites per neurite-bearing cells. We further observed no evidence of effects of the EDGE signal on oxidative stress in the volume close to the electrode-tissue interface. Results show no harmful effects in the cochlear tissues due to the described interaction in three cell lines used as models of neuronal, astroglial, or microglial cell cultures. For all tested cell lines and exposure conditions, there was no evidence of effects of the EDGE signal on oxidative stress as assayed using the DCFH-DA dye.

11-3 EFFECT OF EXPOSURE TO THE EDGE SIGNAL ON HYDROGEN PEROXIDE PRODUCTION IN BRAIN CELLS. F. Poulietier de Guerm1, E. Han1, A. Haertlet1, M. Tissier1, G. Ruffle1, B. Billaut2, B. Voyer2; 1, 2Institut de Physique de Rennes, Rennes, France. 3EPHE Bioelectromagnetics, Rennes, France.

Only few in vitro experiments have studied the effects of RFR exposure on the product of oxygen species. In this study, we have focused on the effect of the EDGE signal on hydrogen peroxide production in three cell lines used as models of neuronal, astroglial, or microglial cell cultures. For all tested cell lines and exposure conditions, there was no evidence of effects of the EDGE signal on oxidative stress as assayed using the DCFH-DA dye.

11-4 NOVEL 3D CELL CULTURE SYSTEMS FOR ELECTROMAGNETIC EXPOSURE STUDIES. A. Davis, M. Goldhammer, C. Theilemann; BioMEMS & Bioelectronics Lab, Univ of Applied Sci Aschaffenburg, Aschaffenburg, Germany.

In vitro studies of monolayer cell cultures for the investigation of genotoxic and electrophysiological effects due to high-frequency electromagnetic fields are well established and often replace animal experiments. Monolayer cultures are easy to handle, but obviously there is a gap between these two-dimensional in vitro models and live tissues. We have established a scaffold-free three-dimensional cell culture system for the exploration of electrophysiological effects due to electromagnetic fields. Induced by permanent rotation, dissociated neuronal cells and cardiac myocytes aggregated into spheroids. Cell-Cell and Cell-ECM interactions established a 3D cellular network that mimics the properties of living tissue in vivo better than conventional monolayer cultures.
TOPIC IN FOCUS 3: EM CANCER THERAPY
Moderator: Niels Kuster
13:20 - 14:50 Plenary Hall

TREATMENT OF CANCER WITH THERMAL ELECTROMAGNETIC FIELDS: PAST, PRESENT AND FUTURE.
Gerard C. van Rhoon, Erasmus MC, Rotterdam, Netherlands; "Department of Oncology, Erasmus MC, Rotterdam, Netherlands. "Department of Oncology, Erasmus MC, Rotterdam, Netherlands. "Department of Oncology, Erasmus MC, Rotterdam, Netherlands.

Electromagnetic heating of cancer involves complex technology, physiology and biology, and concentrates on two methods: - Thermal ablation, i.e. direct cell destruction through coagulation of malignant tissue, is mostly performed using radiofrequency and microwave technology using thin needle-shaped applicators. The rapid decay of energy with distance to the source restricts thermal ablation treatments to small tumor volumes. - Hyperthermia, i.e. raising the temperature of tumor tissue to 40 - 44°C, is the most potent modifier of radiation known today and is evidence-based by multiple randomized trials. The majority of hyperthermia treatments are applied using external devices, employing RF or MW technology.

TREATMENT OF CANCER WITH NON- THERMAL ELECTROMAGNETIC FIELDS: PAST, PRESENT AND FUTURE.
Boris Pasche, Albert Mudry, Division of Hematology/Oncology, Department of Medicine, The University of Alabama at Birmingham and UAB Comprehensive Cancer Center, Birmingham, AL, USA; 2 Cabinet Médical, Avenue de la Gare 6, Lausanne, Switzerland. Cancer arises through a multistep, mutagenic process whereby tumor cells acquire common features such as unlimited proliferation potential and resistance to antiproliferative and apoptotic signals. There is growing evidence that tumor cell growth may be modulated by athermal electromagnetic fields. Various approaches have been used to attempt treatment of cancer with electromagnetic fields. Different devices were proposed such as the Radioinert, and the Multiple Wave Oscillator. Past, present and future strategies to control tumor growth with non-thermal electromagnetic fields such as electroporation and Low Energy Emission Therapy will be discussed.

EM CANCER TREATMENT: A PERSPECTIVE FROM THE BROADER ONCOLOGIC COMMUNITY. TBD
With other devices. In the environment, these radiated emissions may cause interference increase efficiency can originate significant radiated noise, since the operating at high frequencies. However, the currents generated to provide public information on exposure to EMFs from mobile commu-
nication systems. During measurement campaigns near base station antennas, it was found that compact fluorescent lamps are important sources of radiation to take into consideration in indoor environments. With the purpose of saving energy, these lamps use electronic ballasts operating at high frequencies. However, the currents generated to increase efficiency can originate significant radiated noise, since the whole lamp acts like an antenna. More than increasing EMF levels in the environment, these radiated emissions may cause interference with other devices.

13-2

Electric utility workers are exposed to a combination of ELF magnetic fields, electric fields, nuisance shocks, imperceptible contact current, and electrical injuries. Previous occupational exposure assessments have emphasized magnetic fields with less attention to electric fields. Nuisance shocks and electrical injuries, though palpable, have received little to no attention. This paper presents a prototype job-exposure-matrix that addresses all these agents. Exposures for all factors were essentially limited to four job categories that work near electrical equipment: cable splicers, electricians, line workers, and substation operators.

13-3
MICROCHAMBER SET-UP FOR REAL TIME STUDIES OF BIOLOGICAL STRUCTURES IN PRESENCE OF ELECTROMAGNETIC FIELDS. M. Liberti1, P. Marra,1, P. Carrascia,1, F. Colarutti2, A. Massarotti1, F. Caroli2, M. Beccari1, R. Crescenz2, A. Ramundo Orlando2, G. d'Inzeo1; 1Department of Electronic Engineering, “La Sapienza” University of Rome, Rome, Italy. 2Neurobiology and Molecular Medicine Institute, National Research Council (CNR), Rome, Italy.

To enable real-time investigation of microscopic biological structures in presence of external electromagnetic field, an appropriate design of an exposure microchamber with integral electrodes and optical path to observe target samples seems to be greatly advantageous. In this work we give the technical specs and a complete description of the production processes necessary to obtain conductive, nonreactive electrodes whose plates are uniformly outdistanced to avoid unecessary complexity in the electric field, and the current distribution that can result in a undesired variability in the delivered dose.

14-4
FLUORESCENT IMAGING ANALYSIS OF PLASMA MEMBRANE NANOPORES FORMED BY ULTRA-SHORT ELECTRIC PULSES. A. G. Pakhomov1, B. L. Ibe2, M. Liberti1, A. M. Rosenman3, P. M. Stabile2, G. N. Pakhomova1, M. R. Murphy1; 1Frank Reidy Res Ctr for Bioelectrics, Old Dominion Univ, Norfolk, VA, USA. 2Radio Frequency Rad Branch, Human Effectiveness Directorate, Air Force Res Lab, Brooks City Base, San Antonio, TX. 3Dept of Biochem, Univ of Texas Hlth Sci Ctr, San Antonio, TX, USA.

We found that treatment of mammalian cells with nanosecond-range electric pulses (nEP) increases membrane permeability selectively to ions smaller that about 1 nm. This phenomenon was demonstrated by selective uptake of Ti+, but not of larger propidium+ cation by nEP-exposed cells. Furthermore, we employed detection of phosphoryl dile-serine (PS) externalization to differentiate between the formation of lipidic nanopores and opening of some endogenous, protein-made ion channels. These experiments confirmed that nEP treatment results in opening of anomalously long-lived, nanometer-diameter lipidic pores in cell plasma membrane.
Extremely low frequency magnetic fields (ELF-MF; from DC to 300 Hz) have been shown to affect pain sensitivity in snails, rodents, and humans. Here, a functional magnetic resonance imaging (fMRI) study demonstrates how the neurormodulation effect of these magnetic fields influences the processing of acute thermal pain in normal volunteers. Significant activations were found between pre- and post-exposure activation between the sham and exposed groups for the ipsilateral (right) insula, anterior cingulate, and bilateral hippocampus/auditory areas. These results show, for the first time, that the neuromodulation induced by exposure to low intensity low frequency magnetic fields can be observed in humans using functional brain imaging.

The aim of this study is to investigate if selective attention, mental imagery, and sensory motor processing can be modulated by 1 hour of 60 Hz, 300 μT magnetic field (MF) exposure. Participant performances on the Stroop task, mental rotation task, and Fitts’ motor task are studied using a balanced, double-blind protocol. Based on the literature, we expect exposure will result in poorer accuracy in test performances on the Stroop task, mental rotation test, and Fitts’ motor task. Since the suppressed baseline of the Sham condition seemed homogeneous, extremely large data sets were monitored. We attempted to address limitations of previous studies including small samples, non-GSM-specific exposures and short in-trial monitoring. Results show that pulsed radiofrequency radiation used to date in published human neurocognitive studies.

Seventy-two volunteers were exposed to GSM-like RF and ELF radiation in a single-day experiment while resting EEG activity was monitored. The study used a balanced, double-blind protocol. Based on the literature, we expect exposure will result in poorer accuracy in test performances on the Stroop task, mental rotation test, and Fitts’ motor task. Seventy-two volunteers were exposed to GSM-like RF and ELF radiation in a single-day experiment while resting EEG activity was monitored. The study used a balanced, double-blind protocol. Based on the literature, we expect exposure will result in poorer accuracy in test performances on the Stroop task, mental rotation test, and Fitts’ motor task.
Various provocation studies have been conducted on electromagnetic hypersensitivity (EHS) caused by Global System for Mobile Communications (GSM) phones in which sensibility was investigated. However, there have been few sham-controlled provocation studies on EHS with Code Division Multiple Access (CDMA) phones where perception of RF radiation for EHS and non-EHS groups was investigated. In this study, two volunteer groups of 18 self-reported EHS and 15-5 non-EHS people were tested for both sham and real RF exposure from CDMA cellular phones with a 300 mW maximum exposure that lasted half an hour. In conclusion, there was no evidence that the EHS group better perceived EMF than the non-EHS group.

16-5 STUDENT

EXPOSURE TO A 900 MHZ MOBILE PHONE-LIKE SIGNAL AND SERUM LEVELS OF S100B AND TRANSTHYRETIN IN HUMAN VOLUNTEERS. F. Sladek,$^{1,2}$ M. Carlgren,$^{3}$ K. Hansen$^{4,5}$, L. Hasse,$^{6}$ 'School of Health and Medical Sciences, University of Örebro, Örebro, Sweden. 'Department of Oncology, University Hospital, Örebro, Sweden. 'Department of Radiation Physics, University of Umeå, Umeå, Sweden.

The aim of this study was to test whether exposure to a mobile phone-like signal alters the integrity of the human blood-brain and blood-cerebrospinal fluid barriers. A provocation study that exposed 41 volunteers to a 30 minute GSM 900 MHz signal at SAR$_{10G} = 1.0$ W/kg was carried out. The outcome was assessed by changes in serum concentrations of two putative markers of brain barrier integrity, namely S100b and transthyretin. Repeated blood sampling before and after the provocation gave no statistically significant changes in CDMA cellular phone levels with a 300 mW maximum exposure that lasted half an hour. In conclusion, there was no evidence that the EHS group better perceived EMF than the non-EHS group.

16-6 STUDENT

MICRONUCLEI IN MICE EXPOSED TO PULSED MAGNETIC FIELDS. S. B. Reddy$^1$, J. Weller$^1$, D. Dejardin-Holmes$^1$, T. Winters$^2$, L. D. Keelindsay$^2$, F. S. Prato$^1$, Vijayakann$^1$, A. W. Thomas$^1$, 'Imaging, Lawson Health Research Institute, London, ON, Canada. 'Radiation Oncology, University of Texas Health Science Centre, San Antonio, TX, USA.

Adult CD-1 male mice were exposed to pulsed magnetic fields (CNPs) at a peak flux density of 1 mT for 8 weeks. From each mouse, peripheral blood was collected initially and at 2, 4 and 6 weeks. At the end of 8 weeks, all mice were sacrificed. Peripheral blood and bone marrow smears were prepared. In each mouse, 2000 immature red cells were examined to record the incidence of micronuclei. The results indicated that the frequency of micronuclei, in both tissues, were similar in CNPs- and sham-exposed mice.

Nanosecond, versus millisecond, pulsed electric fields (nsPEFs) change plasma membranes and intracellular structures in unique morphological/physiological ways. We used high-intensity nsPEFs in vertebrate immobilization trials to assess physiological effects on myocardium and diaphragm. After low-voltage electrode stimulation of hind-limb motor cortex to elicit leg movement, a nanosecond high-voltage pulse was administered across the spinal column. Physiological parameters of heart rate, blood pressure, respiratory rate and ECG were recorded pre- and post-nsPEF. No significant change was recorded in any parameter in response to the HV pulse demonstrating that skeletal muscle contraction can be disrupted by nsPEFs without short-term muscle morbidity.

17-1

EXPOSURE MEASUREMENTS FOR AN EPIDEMIOLOGICAL FIELD STUDY EVALUATING SLEEP QUALITY AROUND A BASE STATION. M. Schubert$^1$, M. Wusche$^1$, P. Schmidt$^1$, H. Dunker-Hoppe$^2$, H. Dorm$^2$, C. Bornkessel$^2$; 'IMST GmbH, Kamp-Lintfort, Germany. 'Deggendorf Univ of Applied Sciences, Deggendorf, Germany. 'EM-Institut GmbH, Regensburg, Germany. 'Charité-Univ Medicine Berlin, Berlin, Germany.

Exposure assessment for an epidemiological investigation of a possible influence of mobile phone base transceiver station exposure on sleep quality under residential conditions with frequency selective measurements had the advantage of getting the most precise exposure values in contrast to other commonly used methods. It was shown...
that a desired dominance of GSM signals from a transportable BTS, which was built up in ten residential areas in Germany, to ambient RF signals of more than 13 dB is not realistic. Furthermore it was shown again that the lateral distance is not a well quantity for exposure assessment.

17.2
A MODEL FOR THE PREDICTION OF RADIOFREQUENCY ELECTROMAGNETIC FIELDS AT OUTDOOR AND INDOOR LOCATIONS FOR USE IN AN EPIDEMIOLOGICAL STUDY. A. Bürgi1, P. Frei1, G. Theis1, K. Mohler2, G. Neubauer3, C. Braun-Fahrländer1, J. Fröhlich1, M. Egger1, M. Röösli1,2; 1Inst of Social and Preventive Medicine, Univ of Bern, Bern, Switzerland. 2Univ of Bern, Bern, Switzerland. 3Austrian Research Centers GmbH, Seibersdorf, Austria.

We present a model to predict the electromagnetic field from fixed site transmitters of mobile communication, radio broadcast and television for application in an epidemiological study. The predictions are compared to measurements made at street level and in the homes of study participants. We find that the model is robust and well suited to classify exposure levels in an epidemiological study.

17.3
STUDENT
EFFECTS OF RADIO FREQUENCY ELECTROMAGNETIC FIELDS ON SLEEP QUALITY: A CROSS-SECTIONAL STUDY. E. Mohler1,2, P. Frei1, A. Bürgi1, G. Neubauer1, A. Hetlich1, G. Theis1, J. Fröhlich1, C. Braun-Fahrländer1, M. Egger1, M. Röösli1,2; 1Inst of Social and Preventive Medicine, Univ of Bern, Bern, Switzerland. 2Univ of Bern, Bern, Switzerland. 3Austrian Research Centers GmbH, Seibersdorf, Austria. 4Austrian Research Centers GmbH, Seibersdorf, Austria.

The aim of this cross-sectional study was to investigate the association between levels of exposure to RF-EMF and sleep quality. We sent questionnaires to 4000 individuals who were randomly selected from the inhabitants of the city of Basel and surroundings in Switzerland. Questions about sleep quality and exposure relevant factors were asked. Preliminary analyses suggest that exposure to RF-EMF was not associated with day-time sleepiness or subjective sleep quality.

17.4
STUDENT
DEVELOPMENT OF A PREDICTIVE MODEL FOR PERSONAL RF-EMF EXPOSURE. P. Frei1, K. Mohler1,2, A. Bürgi1, G. Neubauer1, A. Hetlich1, G. Theis1, J. Fröhlich1, C. Braun-Fahrländer1, M. Egger1, M. Röösli1,2; 1Inst of Social and Preventive Medicine, Univ of Bern, Bern, Switzerland. 2Univ of Basel, Basel, Switzerland. 3Austria Research Centers GmbH, Seibersdorf, Austria.

We developed a multivariable regression model to predict personal exposure to RF-EMF. Data on RF-EMF exposure of 166 volunteers were collected by means of personal exposure meters. As predictors we included the output of a geospatial propagation model and exposure-related factors from the inhabitants of the city of Basel and surroundings in Switzerland.

18.1
PUBLIC POLICY (continued)
8:30 - 10:10 Plenary Hall
Chairs: G. Berg-Beckhoff and M. Röösli

18.2
OCCUPATIONAL EXPOSURE TO RF AND GRADIENT FIELDS IN OPEN MRI. M. Capstick1, S. Kaeh1, M. Oberle1, A. Papadaki1, R. A. Quest2, M. Rea2, M. McBribe2, N. Kuster3; 1Foundation for Research on Information Technologies in Society, Zurich, Switzerland. 2Radiological Sciences Dept, Clinical Sciences Ctr, Hammersmith Hospital, Imperial College Healthcare Trust, Zurich, Switzerland.

EU Directives 2004/40/EC and 2008/46/EC require risk assessment of occupational exposure to electromagnetic fields. MRI is one application where the reference levels and interventional medical procedures (IP) lead to occupational exposure to electric field, magnetic field, or magnetic flux density values that exceed action values (AVs) defined in the Directives. Movements of radiologists during an interventional procedure carried out in an open MR scanner were systematically measured and analyzed. The measured gradient fields and RF fields exceed AVs as laid out in 2004/40/EC during these interventional procedures, hence further investigation is required to determine if they exceed the basic restrictions.

18.3
MODELING OCCUPATIONAL EXPOSURE DURING INTERVENTIONAL OPEN MRI. A. Christ1, Y. Li2, A. Combe2, J. Hand3, D. McBribe2, M. Capstick1, M. Oberle1, N. Kuster3; 1Foundation for Research on Information Technologies in Society, Zurich, Switzerland. 2Imaging Sciences Dept, Clinical Sciences Ctr, Hammersmith Hospital, Imperial College Healthcare Trust, London, UK.

Interventional MR procedures may involve exposure of staff to electric or magnetic fields that exceed action values (AVs) as defined in European Union Directives 2004/40/EC and 2008/46/EC. Numerical calculations of specific absorption rate (SAR) and current density (J) were used to investigate compliance with defined exposure limit values (ELVs). Whole body SAR and SAR10g were compliant with relevant ELVs. The current density ELVs relevant to frequencies in switched gradient fields were exceeded by more than an order of magnitude. The maximum E-field induced in the body was compliant with safety guidelines recommended by IEEE.

18.4

The rationale for deriving basic restrictions to EM field exposure is not fully standardized and diverse values are employed depending upon the thermal effect being considered. A matching effect and the skull being a protection for thermal stress due to EMF exposure have been confirmed after exposing a human head to 125 mW at 1800 MHz, suggesting that it is possible to reduce uncertainties for deriving the reference levels and the human-EMF exposure scenario with the adoption of a basic restriction directly involving the temperature increase in combination to already existing SAR-based limits.
## SESSION 17: EPIDEMIOLOGY (continued)

**Chairs:** G. Berg-Beckhoff and M. Röösli  
**8:30 - 10:10 Plenary Hall**

We performed a validation study by repeating RF-EMF exposure measurements for 30 study participants. We could demonstrate that it is feasible to model personal RF-EMF exposure and the validation study yielded satisfactory results.


Y. Han1,2, M. L. Bondy2, R. B. Herberman2, D. L. Davis2; 1Center for Environmental Oncology, Univ of Pittsburgh Cancer Inst, Pittsburgh, PA, USA. 2Epidemiology, Graduate School of Public Health, Univ of Pittsburgh, Pittsburgh, PA, USA. 3Epidemiology, The Univ of Texas MD Anderson Cancer Center, Houston, TX, USA. 4Medicine and Pathology, School of Medicine, Univ of Pittsburgh, Pittsburgh, PA, USA.

We examined age-specific incidence of all malignant brain tumors and glioma in younger persons in the USA. US SEER Program and Joinpoint regression were used to determine age and year-specific incidence for persons less than 40 years of old, 1975-2005. Incidence for all malignant brain tumors has increased over time in all age groups, except for the 0-9 age group. Trends for glioma incidence consistently increased in all age groups between 1975 and 2005. The reasons for these increased rates in young persons should be investigated, including increased use of diagnostic radiation and the growing use of cell phones.

### 18-5 A SCIENTIFIC APPROACH TO RF SAFETY HARMONIZATION.

S. Perov1, Q. Balzano2, N. Kuster3; 1RAMS Inst of occupational health, Moscow, Russia. 2Department of electrical and computer engineering, Univ of Maryland, Maryland, MD, USA. 3Foundation for Research on Information Technologies in Society, Zurich, Switzerland.

The safety (hygienic) standard harmonization is one of the main problems of the international trade and of the rapid diffusion of wireless products. The first step towards the solution of the harmonization problem is the definition of a common science-based dosimetric approach of exposure to RF. It will consist in finding a homogeneous base for the two current science-based dosimetric approaches. Definition of unequivocal interrelations between SAR and PE will allow the development of more suitable approaches to safety regulation and harmonization of standards.

## SESSION 18: RISK, SAFETY STANDARDS AND PUBLIC POLICY (continued)

**Chairs:** V. Anderson and E. Van Rongen  
**8:30 - 10:10 Aspen**

### 10:10 - 10:40 Coffee Break

**PLENARY IV: HOT TOPIC**  
**Chair:** Niels Kuster  
**10:40 - 12:10, Plenary Hall**

Topic and speakers will be selected prior to the meeting to ensure discussion of the most current hot topic.

### 12:10 - 13:00

**Student Awards and Closing Ceremony, Plenary Hall**

### 13:00 - 18:00

**BEMS Board Meeting, Jakobshorn**  
**EBEA Council Meeting, Strela & Rinerhorn**
The sensitivity of children to radiofrequency fields has raised concerns. Investigations on the effects of in utero WiFi exposure of rats (0.08, 0.4, and 4 W/kg SAR) were performed, using a reverberation chamber, on the immune and central nervous systems. Rats were tested at 5 weeks of age. There was no effect of in utero exposure on the immune system (assay of circulating antibodies directed against specific antigens) and central nervous systems (apoptosis). Complementary results at the brain level (HSP70/25, GFAP, and 3-nitrotyrosine) will be presented at the meeting.

P-2 RESEARCH ON PREVENTIVE AND THERAPEUTIC EFFECT AND MECHANISM OF ADILOU FUZHENG LI IN ON BRAIN OF RATS AFTER MICROWAVE EXPOSURE.

P. Ruiyun; Beijing Inst of Radiation Medicine, Beijing, China.

30mW/cm² microwave exposure might damage the abilities of learning and memory and brain structure of rats, and induce the turbulence of amino acid, abnormal expressions of NR2B, PSD-95 and p-CaMK2. 12g/kg/d ADL might prevent the neuron damages induced by microwave and the effect of remedial administration was better than prophylactic administration. Alas2 and NMDA receptor signal passageway might participate the molecular mechanism of ADL on prevention of the brain injury exposure to microwave.

P-3 EFFECTS OF PULSED-MODULATED MICROWAVES ON BEHAVIOR AND BLOOD-BRAIN BARRIER IN ADULT RAT: PRELIMINARY RESULTS.

C. Amoore1, I. Lamprong1, M. Ouse1, C. Chyladice2, W. Faquique2, P. Levaque3, A. Joffre-Georges1, S. Pla1, A. Perrin1; 1Centre de Recherches Emile Eleyar, 2C. Amoore; Instituto Nazionale Tumori, Milan, Italy. 3Pathology Department, Catholic Univ, Rome, Italy. 4Bioelectromagnetic laboratory, EPHE, Pessac, France. 5Orange Labs, R&D, Ilay les Moulins, France.

Recent French Navy platforms are equipped with high peak power microwave radars. They are characterized by pulsed-modulated microwaves in particular in the S-band (3GHz) or the X-band (10GHz). To confirm the reproducibility of the results. Several endpoints, including organ weights, clinical chemistry variables except for clinical sign, body weight and hematology variables, were statistically significant differences between groups. However, since these differences were not reproducible in duplicated experiments, these were not considered to be an effect of MF exposures.

P-4 EFFECT OF ELECTROMAGNETIC FIELDS EXPOSURE ON THYROID GLAND HISTOLOGY AND FUNCTION IN RATS.

P. Galloni1, M. Boscherini2, M. Bossola3, A. R. Lanzoni3, I. Ocal1, M. Pischellli, E. Paquaoldi, C. Maruo1; 1BAS Dept Section of toxicology and Biomedical Sciences, ENEA, Rome, Italy. 2Institut de Pathophysiology and Cytodiagnosis, Catholic Univ, Rome, Italy. 3Pathology Dept, GlionSmithKline, Verona, Italy. 4Medical Faculty, Dept. of Bio-physics, Cukurova Univ, Adana, Turkey. 5Dept. of Experimental Oncology, Istituto Nazionale Tumori, Milan, Italy.

P-5 ACUTE TOXICITY OF 20 KHZ SINUSOIDAL MAGNETIC FIELDS IN RATS.


Male and female Crl(CDSD) rats, 7 weeks old, were randomly assigned to magnetic field (MF)-exposed or sham-exposed group, 12 rats of each sex in each group. They were exposed to a 20 kHz, 0.20 mT(rms) MFs or sham-exposed for 14 days. The experiment was conducted twice to confirm the reproducibility of the results. Several endpoints, including organ weights, clinical chemistry variables except for clinical sign, body weight and hematologic variables, were statistically significant differences between groups. However, since these differences were not reproducible in duplicated experiments, these were not considered to be an effect of MF exposures.

P-6 EFFECT OF ELF MAGNETIC FIELD ON OXIDATIVE STRESS IN LUNG AND KIDNEY TISSUES.

A. G. Canseren1, S. Cokcan Cevher1, B. Balamud1, N. Seyhart2; 1Biphysics, Gazi Univ Medical Faculty, Ankara, Turkey. 2Biology, Gazi Univ Science and Art Faculty, Ankara, Turkey. 3Biphysics, Gazi Univ Medical Faculty, Ankara, Turkey. 4Pathology Department, Catholic Univ, Rome, Italy. 5Bioelectromagnetic laboratory, EPHE, Pessac, France. 6Orange Labs, R&D, Ilay les Moulins, France.

ELF EMF has been thought to prolong the life of free radicals and can act as a promoter or co-promoter of cancer. It has been known that free radicals are very reactive and unstable molecular species, which may initiate chain reactions to form new free radicals. Free radical formation induces changes in enzymes activity, gene expression, alteration of membrane structure and DNA damage. ELF magnetic fields (MFs) penetrate the cells and can alter cell membrane potential and the concentration of ions. These modifications may cause an increase in free radical activity within the cell. Lipid peroxidation is a normal phenomenon which occurs continuously at low levels in every individual. NOS has a prognostic value, which may show the degree of EMF induced tissue damage. Myeloperoxidase (MPO) is a bactericidal enzyme secreted by activated phagocytes. It has been known that magnetic fields increase the respiratory bursts response of neutrophils. In the present study, the aim was to investigate that ELF magnetic field’s exposure effects the oxidative stress and respiratory burst system activities. The levels of TBARS, NOx, and MPO-activities were determined in lung and kidney tissues of guinea pigs.
P-7
LACK OF TERATOGENICITY IN COMBINED EXPOSURE OF CDMA AND WCDMA RADIO-FREQUENCY ELECTROMAGNETIC FIELDS IN PREGNANT MICE. H. Lee1, J. Lee2, J. Park1, H. Choi2, N. Kim2, S. Kim2, Y. Lee1. 1Division of Radiation Research, Korea Inst of Biological and Medical Sciences, Seoul, Korea, South; 2Korea Inst of Biological and Medical Sciences, Seoul, Korea, South; 3ETRI, Seoul, Korea, South. The mortality patterns in male and female group exposed to IF-EMF were compared to those found in sex-matched sham control. Significant alteration of additional population in Korea using Sprague-Dawley rats. The mortality of offspring and placentas, the lengths of offspring bodies and tails, also increase the incidence of mouse embryo limb bud development malformation in vivo and increase the polyembryonic rate in male and female group exposed to IF-EMF were compared to those found in sex-matched sham control. Significant alteration of additional population in Korea using Sprague-Dawley rats. The mortality of offspring and placentas, the lengths of offspring bodies and tails, also increase the incidence of mouse embryo limb bud development malformation in vivo and increase the polyembryonic rate in mice exposed to IF-EMF.

P-8
CHRONIC EXPOSURE TO 20 KHZ TRIANGULAR MAGNETIC FIELDS ON SPRAGUE-DAWLEY RATS. Y. Lee1, H. Lee2, Y. Gim2, H. Choi2, N. Kim2, S. Kim2; 1Korea Inst of Biological and Medical Sciences, Seoul, Korea, South; 2ETRI, Daegu, Korea, South. We investigated chronic toxicity and possible health effects of 20 kHz EMF as the peak intensity 30 μT which is limit standard for occupational population in Korea using Sprague-Dawley rats. The mortality patterns in male or female group exposed to IF-EMF were compared to those found in sex-matched sham control. Significant alteration of body weights were not observed by EMF exposure. No significant differences were shown between the groups in urology, hematology, blood biochemistry, and tumor incidences. These data suggested that chronic exposure to 20 kHz EMF with 30 μT peak intensity did not support evidence of toxicity or oncogenicity.

P-9 STUDENT
STUDY OF THE EFFECTS OF REDUCTION OF THE EARTH’S NATURAL MAGNETIC FIELD ON DROSOPHILA MELANOGASTER AND ON ITS ABILITY TO SURVIVE TO LATER EXPOSURE TO IONIZING RADIATION. I. Portelli1, T. Su2, F. Barnes1; 1Electrical and Computer Engineering, Univ of Colorado at Boulder, Boulder, CO, USA; 2Mo- lecular, Cellular and Developmental Biology, University of Colorado at Boulder, Boulder, CO, USA. Drosophila melanogaster (DM) was cultured for its entire life cycle in a reduced Geomagnetic Field (GMF) of about >1μT by using a Mu- metal shield. Then, the effect on resistance to Ionizing Radiation (IR) was tested. The effect of GMF was differentiated from the effect of diminished EMF fields by shielding with stainless steel. Preliminary data suggests that the reduction of the GMF may affect the ability of DM to survive further insult in the form of IR in the order of 40 to 60 Gy and that this effect may differ from being a consequence of the background EMF reduction.

P-10 EFFECTS OF EMP ON MOUSE EMBRYO LIMB BUD. Z. Limba, Z. Yongchina, M. Xia2, G. Guochu3, Radiation Medicine, Fourth Military Medical University, Xi’an, Shaanxi, China. Morphological analysis indicated that EMP exposure can decrease the weights of offspring and placenta, the lengths of offspring bodies and tails, also increase the incidence of mouse embryo limb bud development malformation in vivo and increase the polyembryonic rate in mice exposed to EMP exposure in vivo and in vitro. EMP exposure may play important role in the limb bud development.

P-11 STUDENT
THE 60 Hz MAGNETIC FIELD AFFECTS SPERM IN MOUSE EXPOSED CONTINUOUSLY FOR 20 WEEKS. Y. Kim1, J. Lee2, S. Lee2, K. Jung2, S. Myung2, N. Kim2, Y. Gim2; 1Dept of Microbiology, School of Medicine, Hallym Univ, Chuncheon, Gangwon-do, Korea, South; 2Dept of Medical Science, School of Pharmacy, Hallym Univ, Chuncheon, Gangwon-do, Korea, South. We recently reported that continuous exposure to ELF MF of 0.1 or 0.5 mT for 8 weeks might induce testicular germ cell apoptosis in mice. Furthermore, we found that apoptosis of testicular germ cells increased after continuous exposure to 14 μT for 16 weeks. In the present study, we aimed to characterize the effect of 60 Hz MF on the motility, morphology and number of sperm as well as the apoptosis rate of germ cell in mice after continuous exposure for 20 weeks. Our experimental results suggest that continuous exposure to 60 Hz MF of 20 microT may affect testicular functions including the motility of sperm as well as the apoptosis of testicular germ cell in mice.
study at 914 MHz RFID and its validity has been verified under supervision of Korea Electromagnetic Engineering Society (KEES). Our preliminary results demonstrate significant increase of serum T3, T4 and TSH significantly (p<0.05) in extremely high energy long-duration RFID exposed group.

P-14 ABNORMALITY OF SYNAPTIC VESICULAR ASSOCIATED PROTEINS IN CEREBRAL CORTEX AND HIPPOCAMPUS AFTER MICROWAVE RADIATION. L. Wang; Inst of Beijing Radiation Medicine, Beijing, China.

Little is known about the mechanisms which underlie the cognitive perturbation of microwave exposure. During exocytosis, the synaptic vesicles accumulate neurotransmitters and several synaptic vesicular proteins alter their activities for neurotransmitter release. But it is unclear if these synaptic vesicular associated proteins are altered under microwave exposure and the potential mechanisms which show the relation between the change and the injury of learning and memory is still unknown. In this paper, we report the change of several exocytotic synaptic vesicular proteins such as synapsin, syntaxin, VAMP-2 and synaptophysin, in cerebral cortex and hippocampus after microwave radiation, which might be relative to the dysfunction of the synaptic transmission, even the cognition deficit. Thus, this study has revealed, for the first time, the abnormality of synaptic vesicular associated proteins after microwave radiation and its relation with the cognitive perturbation of microwave exposure.

P-15 LONG TERM EFFECT OF 900 MHZ CELL PHONE IRRADIATION ON THE MOLLUSK SINGLE NEURON. B. Partsvania, L. S. Shviolashvili, T. G. Sulaberidze, Z. Modebadze; Inst of Cybernetics, Tbilisi, Georgia.

Possible effect of long term exposure of mollusk neurons to cell phone irradiation was studied. Mollusks’ Helix Pomatia were exposed to radiation of GSM-900 MHz cell phone for two hours everyday for 2 months. The experiments revealed that the dynamics of habituation to intracellular stimulation of sham and irradiated neurons are similar. The average numbers of AP triggered as a result of stimulation, the time necessary for the onset of habituation and average value of the AP threshold for sham and actually exposed identified neurons are approximately equal. AP peak parameters are similar also.

P-16 STUDENT CHANGES IN RAT’S DUODENUM UNDER THE HIGH POWER PULSE MAGNETIC FIELD EXPOSURE. R. V. Dray; Medical Biology, Saint-Petersburg State Medical Academy, Saint-Petersburg, Russia.

The aim of our research is to study reaction of rat’s duodenal mucosa including its endocrine cells on the magnetic stimulation (pulse magnetic field 1.5 T, 2.5 Hz) of abdominal cavity organs. Procedure lasted for 10 min per day for 2 weeks except weekends with a total of 10 procedures. Material was collected on the 1st, 7th and 14th day after the last exposure and examined by light microscopy. We observed clear pathological changes in the duodenum epithelia which are thought to be secondary changes as a result of longtime circulatory insufficiency and tissue hypoxia after magnetic field exposure.

P-17 ALTERATIONS IN TISSUE’S COPPER AND ZINC CONCENTRATIONS BY INTERMITTENTLY OR CONTINUOUSLY EXPOSED ELF MAGNETIC FIELD. A. G. Covscev; C. Akay1; O. Ender1; A. Saya1; N. Seyhan1; Biophysics, Gazi Univ Medical Faculty, Ankara, Turkey. Toxicology, Gazi University, Ankara, Turkey.

Physiological processes in organisms can be influenced by nonionizing electromagnetic energy. From the point of view of public health, there is now a growing demand for the studies on possible adverse health effects from the interactions between the human body and electromagnetic fields (EMFs). Epidemiological studies and many laboratory investigations have suggested a link between ELF magnetic fields and cancers specially childhood leukemia. ELF magnetic fields have been classified as a “possible human carcinogen” by The International Agency for Research on Cancer-IARC. Modifications of ion concentration could contribute to explaining the biological effects of EMF. Copper could have an important role in the development and maintenance of immune system function. Zinc may affect the immune status of animals and human. The aim of this study was to investigate whether ELF magnetic field’s exposure effects the Cu and Zn concentrations in serum and renal tissues of guinea pigs.

P-18 WITHDRAWN

P-19 IMMUNOMODULATORY EFFECTS OF CHARGED ETS IN ASTHMATIC MICE. Y. Kim1, D. Kong1, S. Lee1, Y. Roh1, S. Hong1; ‘Hanyang Univ, Seoul, Korea, South. ‘Occupational Health & Environmental Inje Univ, Kimhae, Korea, South.

There is growing epidemiological evidence between the electric and magnetic fields (EMFs) and an increased risk of ill health. Corona ions emitted from high voltage power lines can attach at a given rate to atmospheric aerosols, enters the body by inhalation and may then be deposited in the respiratory system and thus may alter the inflammatory responses of the immune system. This study aims to investigate experimentally the effect of charged ETS on the immune system of the asthmatic mice. In our study, the levels of cytokines in charged ETS group and ETS alone exposed group showed no significant difference. There was no significant change in the lung weight and bodyweight in the experimental groups compared to that of control.

CLINICAL DEVICES


The relationship of RF induced heating is a multi-parameter dependent issue and basically related to parameters like the dimension of a conductive structure, the electromagnetic properties of the surrounding medium/tissue as well as the electromagnetic environment of the MR system including the MR transmit coil. The numerical investigation is very helpful in depicting the local SAR distribution at implants before performing experiments.

P-21 REDUCTION OF OCCUPATIONAL EXPOSURE FROM THE SWITCHED GRADIENT MAGNETIC FIELD FROM AN MRI SCANNER BY USE OF MODIFIED PULSE SEQUENCES. J. Willen1, J. Hauksson1, K. Hamson Mild1; Dept of radiation sciences, Umeå Univ, Umeå, Sweden. ‘Radiation physics laboratory, Umeå Hospital of Northern Sweden, Umeå, Sweden.

The switched gradient fields used in Magnetic Resonance Imaging (MRI) have been measured in line with ICNIRP guidelines for different pulse sequences near a 1.5 T scanner. We have also assessed how a modification of the gradient current will affect the exposure. The results showed that the exposure differs between different pulse sequences and that a slight modification of the gradient current will reduce the exposure by a factor of 1.5. By optimizing the gradient current and the image quality, this could in the long run be a method to reduce the exposure, especially for interventional MRI.
In recent times, there has been an increasing concern regarding the safety of pregnant women and fetuses following exposure to radio-frequency electromagnetic fields. In this study, we estimated the specific absorption rates (SARs) of pregnant-woman models at 5 different gestational stages (10, 13, 18, 26, and 28 weeks) exposed to vertically and horizontally polarized electromagnetic wave from 30 MHz to 2 GHz. We found that the stage of pregnancy affected the fetus-averaged SAR although it hardly affected the whole-body-averaged SAR and that the fetus-averaged SAR did not greatly exceed the whole-body averaged SAR.

P-26
EVALUATION OF HUMAN EXPOSURE TO ELECTROMAGNETIC FIELDS FROM RFID DEVICE AT 910 MHZ.
S. Kong, D. Choi, J. Park, H. Oh; Radio Research Agency of Korea

This paper presents the analyzed results for the evaluation of the human exposure from the RFID device operated at 910 MHz. According to the IEC 62369-1, we evaluated the SAR, and the electric field strengths for the direct and spatially averaged measurement. And also, we suggested the improved measurement method to reduce the evaluation time for the spatially averaged measurement of the IEC 62369-1. From the evaluated results, we found that the exposure levels exceeded for the RFID device used close by human body. But if the RFID device was a little way off above 10 cm, it did not exceed the reference level of the ICNIRP guideline.

P-27
STUDENT SPECIFIC ABSORPTION EVALUATION WITHIN THE TISSUE SLICES EXPOSED TO PULSED WAVES. Z. Wang, Y. Alfadhli, X. Chen, J. E. Tattersall; 1Electronic Engineering, Queen Mary, Univ of London, London, United Kingdom. 2Biomedical Science, Doll, Salisbury, United Kingdom.

The concept of SAR (Specific Absorption Rate) has been broadly used in the evaluation of energy absorption in dosimetry studies. It represents the rate of energy absorption, rather than the total quantity of the absorbed energy, which is also important in evaluation of EM wave exposures. Therefore, another concept, SA (Specific Absorption), was defined in order to express the total energy absorption in a certain time. In this paper, we present the analyzed results for the evaluation of the human exposure from the RFID device operated at 910 MHz. According to the IEC 62369-1, we evaluated the SAR, and the electric field strengths for the direct and spatially averaged measurement. And also, we suggested the improved measurement method to reduce the evaluation time for the spatially averaged measurement of the IEC 62369-1. From the evaluated results, we found that the exposure levels exceeded for the RFID device used close by human body. But if the RFID device was a little way off above 10 cm, it did not exceed the reference level of the ICNIRP guideline.

P-28

Sound and robust exposure metrics are required for use in epidemiological studies on the possible health effects of human exposure to RF fields. In the past, the applied exposure metrics were based on incident field estimates, ranging from simple distance metrics over wireless propagation modeling to recent in-situ incident exposure assessments, e.g., from personal dosimeters. However, biological effects that are not related to the thermal load of the whole-body exposure correspond only to the locally induced fields. The aim of this study was to provide detailed information about the induced fields of specific organs and functional subregions for plane-wave incident ranging from 50MHz to 6GHz.
P-29

WHOLE BODY AVERAGE SAR IN ANATOMICAL CHILD MODELS AT PLANE WAVE EXPOSURE IN THE 2GHz-5.8GHz RANGE. G. Schmidt1*, A. Christ1, R. Djafarzadeh2, R. Uberbacher1, S. Ceci1, M. Zefferer3, M. Kuster1,2; 1Austrian Research Centers, Seefeldorf, Austria. 2IT’IS Foundation, Zurich, Switzerland. 3Swiss Federal Inst of Tech (ETH), Zurich, Switzerland.

In order to investigate the conservatism of the ICNIRP reference levels, 6 MRI-based whole body child models, aged between 5 and 14 years were used for FDTD computations under plane wave exposure, considering the 6 orthogonal main directions of propagation at vertical and horizontal polarization each. The computations confirm that the ICNIRP reference levels are not conservative for younger children in the frequency range around whole body resonance and between approximately 1.5 and 5 GHz. Additional models and further investigations are necessary to find an envelope for the reference levels that is conservative for any person, including even young children.

P-30

A DETERMINATION OF THE ELECTROMAGNETIC FIELD INTENSITIES RESULTING FROM VARIOUS WIRELESS DEVICES AS A FUNCTION OF TIME AND LOCATION IN THE CITY OF BOULDER. F. Barnes, A. Hegde; M. Joshi, S. Pillai, S. Shah; ITP, Univ of Colorado at Boulder, Boulder, CO, USA.

This paper determines electromagnetic field intensity measurements resulting from various wireless devices as a function of time and location in the city of Boulder, Colorado. The resulting measurements would provide new baseline data for researchers carrying out epidemiological studies in the field of effects of RF radiation on humans. This study will also be able to determine the RF levels to which the general population of Boulder is exposed and compare these levels to surrounding areas like Lookout Mountain, Colorado where the RF levels are supposedly much higher than the rest of the state.

P-31

INFLUENCE OF A REFLECTIVE ENVIRONMENT ON THE ABSORPTION OF A HUMAN MALE EXPOSED TO REPRESENTATIVE BASE STATION ANTENNAS FROM 300 MHZ TO 5 GHz. G. Vermeeren, M. Gosselin1, S. Kuehn2, W. Repp3; 1IT’IS Foundation, Zurich, Switzerland. 2IfN Bretagny, Plouzane, Finistere, France. 3Child Models at Plane Wave Exposure in the 2GHz-5.8GHz Range.

The influence of a reflective ground and/or wall on the whole-body and local absorption in the human body has been numerically investigated in the proximity of representative base station antennas. The research has been carried out within the framework of the MMF-GSMA Dosimetry Program Phase 2. It has been observed that the absorption in a reflective environment can be up to 7.77 dB higher than in free space. In general, the environments which include a vertical wall can be reflective environments can be up to 7.77 dB higher than in free space.

P-32

DESIGN AND CHARACTERIZE ONE REVERBERATION CHAMBER FOR RATS IN VIVO WI-FI EXPOSURE BY SIMULATION-MEASUREMENT HYBRID METHOD. T. Wu1*, A. Hadjiev2, T. Touratin2, A. Gáti1, Y. Toutain2, A. Worton2; 1’IT’IS NMR BD, RUES WSAU, WAVE, France telecom Orange lab, laxy les moulineaux, hauts-de-seine, France. 2Satimo Bretagne, Satimo Bretagne, Plouzane, Finistere, France. 3ISYCOM, universite Paris-est, Marne la vallee, seine et marne, France.

Animal EMF exposure studies have been conducted with restrained animals by various systems. To better evaluate exposure results, non-restrained in vivo animal exposure experiments are always recommended by World Health Organization (WHO). This paper includes the works to design one non-restrained Wi-Fi exposure system by means of Reverberation Chamber (RC) and to characterize the power absorption by the rats with simulation-measurement hybrid method. The system should be able to provide as much as 4 W/kg whole body averaged SAR (WBSAR) to four identical rats who weight 1.5 Kg in total. The rats have the ability to move in one volume of about 400 mm x 400 mm x 400 mm. Uniform exposure needs to be maintained for the rats wherever they move in this volume.

P-33

STUDENT CORRELATION OF THE EXPOSURE OF MOBILE PHONES ASSESSED IN SAM BY APPLYING STANDARD PROCEDURES WITH THE SAR IN ANATOMICAL HUMAN HEADS. M. Gosselin1, M. Zefferer2, P. Crespo Valero2, A. Christ1, S. Kuehn2; 1BioEM Group, Integrated Systems Laboratory, ETH Zurich, Zurich, Switzerland. 2IT’IS Foundation, Zurich, Switzerland. 3SPEAG, Zurich, Switzerland.

The aim of this study was to correlate the region specific absorption in the homogeneous SAM head to the one in the anatomical heads of the Virtual Family. Virtual tissues, such as cheek, inner-ear, eye, and brain, were created in the SAM head, based on an anatomical head. The region specific absorption has been assessed using an FDTD method. The correlation in the region specific absorption is shown, as well as the uncertainties and limitations of this approach.

P-34

DOISMETRY OF AN IN VITRO EXPOSURE SYSTEM FOR FLUORESCENCE MEASUREMENTS AT 2.45 GHz. D. Arnaud-Cormot1, T. Saragol1, M. G. Moazezal2, M. Kember1, P. Lesueur1; 1Dept. OSA, XLIM, CNRS-Univ de Limoges, Limoges, France. 2Dept. of Biophysics and Cell Biotechnologies, Carol Davila Medical Univ, Bucharest, Romania.

The dosimetry of an in vitro system for microwave exposure of a biological medium is presented. The dosimetry is based on electromagnetic simulations which permit to estimate SAR levels in well-controlled numerical models. In the conducted experiments, a suspension of giant unilaminar vesicles used as model of living cells is exposed to 2.45 GHz MW in a spectrofluorimetric cuvette. During the MW application, fluorescence measurements of the generalized membrane polarization are made. The aim of this work is to provide the distribution of the electromagnetic fields inside the exposure applicator in order to support the interpretation of experimental results.

P-35


The reference level of basic guideline is established based on the whole-body averaged specific absorption rate (SAR). Whole-body averaged SAR estimations for high accuracy human models using numerical calculations have been reported. In order to confirm the validity of computer results for the whole-body averaged SAR, it is important to develop an experimental estimation system. We refer to a numerical estimation method using external cylindrical electromagnetic field scanning applied to an experimental measurement. In this paper, the validity of the experimental setup for whole-body averaged SAR of European child and adult phantom models is investigated using some numerical analyses.

P-36

MODIFIED BIO-HEAT EQUATION ACCORDING TO NEW VASCULAR SYSTEM MODEL. G. Bit-Babik2, M. Prishvin1, D. Kakulish1, R. Zaridze1, A. Faremee1; 1Laboratory of Applied Electrodynamics, Tbilisi State Univ, Tbilisi, Georgia. 2Motorola Inc., Fort Lauderdale, FL, USA.
The purpose of this work is to study the thermal response of human tissues and organs due to RF exposure with detailed consideration and modeling of blood flow. A new algorithm capable of generating realistic 3D models of blood vessels and a new method to consider capillary blood flow effect on heat distribution during exposure are presented. The proposed methodology may provide more accurate results compared to widely used Penne’s Bio-Heat equation model with constant blood perfusion term in it.

P-37
MAGNETIC FIELDS REDUCTION CHARACTERISTICS OF SHIELDING WEAR FOR A WORKER USING AC ARC WELDER, S. W. Min, J. H. Park; Electrical communication Engineering, Sunchunhyang Univ, Changwon, Korea. South.

Power cable of an AC arc welder can surround a body of worker at the moment of welding. Applying the boundary element method, we calculated the current distribution inside a worker in case he was located at 1(cm), 3(cm), 5(cm), 10(cm), 15(cm) and 20(cm) far from power cable flowing 1000(A). We found a maximum current density induces at a heart surface and might be higher than 10(mA/m²) of IC-NIRP guideline if he works within 15(cm) from power cable. To solve this problem, three kinds of materials of copper, silicon, and permalloy were studied. We know shielding wear with high permeability materials lowers current density more than high conductivity materials.

P-38
EXPOSURE TO WIFI SIGNAL OF PREGNANT AND NEWBORNS MICE: DOSIMETRY AND SETUP, R. Pinto, R. Lodato, S. Mancini, P. Galliani, M. Piccilli, C. Pioili, C. Marino, G. A. Lertora; Section of Toxicology and Biomedical Science, ENEA, Rome, Italy.

The aim is the dosimetric evaluation of the WiFi exposure in immature animals. An actual WiFi signal obtained by a commercial Access Point feed two TEM cells chosen as radiating system. The dosimetric studies from both numerical and experimental determined the variation of dose due to the increase of weight and size of the biological target during the exposure period. A SAR vs weight curve was evaluated, to assure a constant chosen dose during the whole exposure period. A pilot test was performed to check the system on maintenance of power input and of a suitable temperature inside the system.

P-39
EFFECTS OF SKELETAL MUSCLE ANISOTROPY ON INDUCED CURRENTS FROM LOW FREQUENCY MAGNETIC FIELDS, T. Samaras, N. J. Tachas, K. Baskourelos, J. N. Sahalos; Dept of Physics, Aristotle Univ of Thessaloniki, Thessaloniki, Greece.

The studies which take into account the anisotropy of tissue dielectric properties for the numerical assessment of induced currents from low frequency magnetic fields are scarce. In the present study we compare the induced currents in two anatomical models, using the impedance method. In the first model we assume that all tissues have isotropic conductivity, whereas in the second one we assume anisotropic conductivity for the skeletal muscle. Results show that tissue anisotropy should be taken into account, when investigating the exposure to low frequency magnetic fields, because it leads to higher induced current values.

P-40
STUDENT DOSIMETRIC ASSESSMENT OF C. ELEGANS EXPOSURE IN VIVO TO 900MHZ ELECTROMAGNETIC FIELDS, M. Marbach1, M. Mevissen2, N. Kuster3; 'ITIS Foundation, Zurich, Switzerland. 2Dept Clinical Research and Veterinary Public Health, Bern, Switzerland. 3Swiss Federal Inst of Tech (ETH), Zurich, Switzerland.

There is evidence that RF EMF elicit biological effects in a variety of organisms. The nematode C. elegans is a well known model organism and qualified for research on EMF effects. This study aims to provide detailed dosimetric data on C. elegans at 900MHz. Numerical FDTD analysis was conducted and temperature measurements performed. The size of the nematodes (<1mm) won’t allow for any significant temperature differences to the AGAR. By placing nourishment in the center area only, C. elegans receive a quite uniform exposure. Results show a 6-15 fold higher exposure level in C. elegans than within the underlying AGAR.

P-41
STUDENT SYSTEM TO STUDY CNS RESPONSES OF ELF MODULATION AND CORTEX VERSUS SUBCORTICAL RF EXPOSURES, M. Murbeck1, M. Christopoulos1, A. Christ2, P. Crespo Valero2, M. Zefferer1, S. Kucher3, A. Pachernegg1, N. Kuster2; 'ITIS Foundation, Zurich, Switzerland. 2Biomedical Simulations and Imaging Laboratory, National Technical Univ, Athens, Greece. 3Swiss Federal Inst of Tech (ETH), Zurich, Switzerland. 'Schmid & Partner Engineering AG, Zurich, Switzerland. 'Inst of Pharmacology and Toxicology, Univ of Zurich, Zurich, Switzerland.

There is evidence that RF EMF can alter brain physiology such as human EEG. Subsequent studies must be designed to obtain information about the site of interaction and mechanism. Novel tools and setups were developed and validated to test the following hypotheses: 1) modulation is a key parameter. 2) thalamus is the main site of interaction, and 3) adolescents are particularly sensitive to RF EMF exposure. Functional subregions of the Talairach-Space were implemented in numerical simulations. At 2.14GHz, the exposure of the thalamus can be substantially reduced, while keeping a similar exposure of the cortex as at 900MHz.

P-42
STUDENT IDENTIFICATION OF FACTORS INFLUENCING THE WHOLE BODY ABSORPTION RATE USING STATISTICAL ANALYSIS, A. Elshabaky1, Y. Wuttke, E. Conti2, G. Fiarito3, A. Haddad1, R. Vazquez2; 1FT/ NSM/ RD/ RESA/ WASA/ WAVE, Orange Labs, Issy les Moulineaux, hauts-de-seine, France. 2SSE, SUPELEC, Gif Sur Yvette, Essonne, France.

To protect people from Electromagnetic Fields (EMF), ICNIRP has defined limits. The fundamental ones are the Basic Restrictions (BRs) [1]. The BRs determine the maximum values (averaged over the whole body and averaged over 10 grams of tissues) of Specific Absorption Rate (SAR). Since BRs can be complex to assess ICNIRP has also defined derived value: the reference levels (RLs). These RLs were established to guaranty the compliance to the BRs. Several studies with human model voxels (a.k.a. phantoms) show that even below the RLs, the WBSAR (Whole Body average SAR) may exceed the BRs due to the variability of human morphology [2]. In this paper we will identify the morphological factors influencing the WBSAR in the case of a frontal plane wave exposure at the frequency of 2100MHz in isolated conditions and vertical polar. The method is based on the construction of a model that makes it possible to estimate the statistical distribution of the WBSAR for a given human population.

P-43
STUDENT A STUDY ON EXPOSURE SYSTEM WITH DOUBLE NEGATIVE MATERIAL LENS AT 3.4 GHZ BAND, D. Usui1, T. Arima2, S. Watanabe3, T. Uno4; 'NICT, Koganei, Japan. 2'TUAT, Koganei, Japan.

In order to investigate the biological effects of exposure to microwaves from mobile phones, several localized exposure systems have been developed. In this study, we investigate an exposure system by using a double negative (DNG) material lens. It is possible to realize perfect focusing using the DNG material lens. Electric-field and SAR distributions were calculated. The results indicated that the locality of exposure almost quadruples when using the DNG material lens.
The objective of this project was to estimate terminal output power for both voice and data traffic using network-based measurements in the TeliaSonera 3G WCDMA network in Sweden. Different types of environments such as urban, rural and indoor areas were included and measurements were performed separately for voice, video and data connections. The average output power for 3G voice calls was below 1 mW for both rural and urban environments based on measurements during at least a week. For data applications and video calls the average terminal output power was up to 6-8 dB higher than for voice calls.

For data applications and video calls the average terminal output power was up to 6-8 dB higher than for voice calls.

In this paper, we describe the development of a measurement system comprising an array of sensors. The measurement system enables the high-spatial-resolution and short-time measurement of the intermediate-frequency (IM) magnetic field. We also perform numerical simulation of the induced current density by considering a human voxel model exposed to an IM magnetic field and by using preliminary measurements. In the preliminary measurement, the magnetic field around the IFF coil is measured and the magnetic dipole moment of the coil is determined from the measured magnetic field distribution.

In the preliminary measurement, the magnetic field around the IFF coil is measured and the magnetic dipole moment of the coil is determined from the measured magnetic field distribution.
P-52
THE DEPENDENCE OF AVERAGE SAR IN CHILD HEAD ON ANTENNA POSITIONS OF MOBILE PHONES. T. Arimura1, Y. Miyoshi2, K. Sato2, S. Watanabe2, K. Wake2; 1National Inst of Info and Comm Tech(NICT), Tokyo, Japan. 2NTT Advanced Technology, Tokyo, Japan. *Tokyo Univ of Agriculture and Tech, Tokyo, Japan.

In this paper, we calculate the average SAR in a child head for various antenna positions of mobile phones. The antennas of mobile phones are modeled three type, i.e., the case that antennas are located upper, middle or lower position of the mobile phones, respectively.

P-53
SAR VARIATIONS BY THE EMI PAINT CONDITION OF THE BAR AND SLIDE TYPE MOBILE PHONE. D. Choi1, S. Kong1, J. Park1, H. Oh1, D. Kwam1; 1Radio Research Agency of Korea Communications Commission, Seoul, Korea, South. *EPiK, Seoul, Korea, South.

In this study, the simulated and measured SAR value variations on the Bar and Slide type mobile phone with and without the EMI paint inside the phone were analyzed and discussed. As a result, the SAR values of the Bar type mobile phone with EMI paint was higher than without it. And the SAR value of the Slide type mobile phone in the down condition was bigger than it of the SAR value. Also contrary to the Bar type result, the SAR values of down and up condition of the Slide type mobile phone without the EMI paint was higher than with it. Consequently, the SAR values vary with the condition of the EMI paint distribution, because the SAR is proportional in the induced current value at the surface of a phantom. Therefore we suggest that we have to consider the SAR and EMI problem simultaneously when we develop a new mobile phone.

P-54
REAL EXPOSURE TO BLUETOOTH EARPIECES. D. Picard; EMG, Supelec, Gif sur Yvette, France.

The use of the Bluetooth earpiece as an accessory of mobile phones, is increasing. It must allow a significant reduction of the exposure of the head to the electromagnetic field compared to the mobile phone. The Electromagnetism Dept of Supelec conceived and carried out a dosimetric assessment system with high performances which makes possible to carry out measurements of so low SAR values. For the SAR measurement, the mobile phone and the earpiece are controlled by a BTS emulator and the earpiece radiates a given power. The real exposure evaluation of Bluetooth earpieces requires the measurement of the emitted power in real use these accessories.

P-55
COMPARISON OF THE RESULTS OF TWO HANDS FREE KIT DOSIMETRY PROTOCOLS. D. Picard; EMG, Supelec, Gif sur Yvette, France.

Since a few years the use of hands free kits (HFK) with mobile phones is increasing. The distance between the phone antenna and the user head is larger with the use of HFK and one can think that the RF deposited power in the user head is significantly reduced. However the wire of HFK is metallic and the RF currents induced on this wire can be the sources of power deposition in the user head. Two different HFK dosimetry measurement protocols are compared. Their results are different but show similar statistical characteristics. They highlight an important SAR reduction compared to the direct exposure of the mobile phone.

P-56
A CORNER-ROUNDED FLAT PHANTOM FOR THE COMPLIANCE TEST FOR MOBILE PHONES. L. Ham mood1, T. Iyama2, T. Ohishi2, S. Watanabe2; 1EMC Group, NICT, Tokyo, Japan. 2NTT DoCoMo Inc., Yokosuka, Japan.

We have investigated a simplification procedure of the Specific Absorption Rate (SAR) compliance test for mobile phones. We have fabricated a new flat phantom whose corner is rounded to be similar to the curvature of the SAM. Then the maximum 10g-average SAR of an actual Clamshell-phone at 835 MHz is measured and compared with the SAR values by the SAM. The result shows that this round-cornered flat phantom may be utilised to test Clamshell shape phones.

P-57
TEMPERATURE SENSITIVITY OF TISSUE EQUIVALENT LIQUIDS USED FOR SAR TESTING. M. Douglas, M. Ballon, C. Chou; Corporate EME Research Laboratory, Motorola, Inc., Ft. Lauderdale, FL, USA.

Specific absorption rate testing of wireless devices is performed by measuring the electric field in a tissue equivalent liquid, in accordance with existing and future international standards. The laboratory conditions must remain stable during testing. The liquid temperature should be kept within a tolerance of ±2 °C, as the liquid dielectric parameters are sensitive to temperature. It was previously assumed that the temperature sensitivity was small enough to be ignored. However, the temperature sensitivities of a large number of commonly-used tissue equivalent liquids have not been published to date. The temperature sensitivities of fourteen tissue-equivalent liquids are presented here.

P-58
VARIABILITY OF WHOLE-BODY AVERAGED SAR IN MODELS OF ADULTS AND CHILDREN FOR PLANE-WAVE EXPOSURE. A. Hirata1,2, O. Fujii1, T. Nagata1, S. Watanabe1; 1Nagoya Inst of Tech, Nagoya, Japan. 2Natl Inst of Infor- mation and Communications Tech, Tokyo, Japan.

This study proposed an estimation scheme for estimating whole-body average specific absorption rate (WBA-SAR) in the human body models for plane-wave exposure at whole-body resonance frequency and around 2 GHz. The necessity of this study is that the WBA-SAR takes maximal at these frequencies and approaches to the basic restriction in international guidelines/standards for human protection. From the schemes proposed in this scheme, the variability of the WBSAR due to body shape was clarified.

P-59
RELIABILITY OF RF EXPOSIMETERS USING REAL LIFE SIGNALS FOR CALIBRATION. G. Neubauer1, J. K. Agbudan Prince2, J. Fröhlich2, P. Peer1, E. Mohler1, A. Bürgi1, G. Theis1, C. Brandl-Fahlbrand1, M. Egger1, M. Röösli1; 1EMC & Optics, Austrain Research Centers GmbH - ARC, Seelershof, Lower Austria, Austria. 2Swiss Fedral Inst of Tech, ETH Zentrum, ETZ, Zurich, Swit- zerland. 3Inst of Social of Preventive Medicine, Basel, Switzerland. 4ARIAS, Bern, Switzerland. 5Air Quality Management Agency of Basel, Basel, Switzerland.

When using RF exposimeters it is crucial to use realistic calibration factors representing signals the population is exposed to. CW signals are usually not representative for real life exposure, e.g. GSM networks are using TDMA signals leading to variations between peak and average field levels. Therefore calibrations of EMF SPY 120 exposimeters using realistic signals were performed. It was shown that there is a general variation of the calibration factor within a specific band, for instance GSM 900 downlink, depending on the specific calibration frequency. Linearity was usual within +/-1.5 dB, in some cases considerable out of band response occurred.
P-60
A COMPREHENSIVE TISSUE PROPERTIES DATABASE PROVIDED FOR THE THERMAL ASSESSMENT OF A HUMAN AT REST. V. Anderson1,2, R. L. McIntosh1; 1Australian Centre for Radiofrequency Bioeffects Research (ACRBR), Hawthorn, VIC, Australia. 2Brain Sciences Inst, Hawthorn, VIC, Australia.

The calculation of temperature rise in humans exposed to RF requires reliable estimates of the following tissue properties: specific heat capacity (c), thermal conductivity (k), blood perfusion, metabolic heat production, and density. A sixth property, water content, can also be used to derive c and k. In an effort to standardize these parameters we have documented 140 key references and developed a database of the properties for around 50 tissues. For each tissue and each property the following were obtained: the average value, the number of values, the minimum and maximum, and the reference. Only values from original measurements were accepted. The database will be made available to the Bioelectromagnetics community.

P-61
SAR DISTRIBUTION AND TEMPERATURE RISE IN CULTURE FLUID IN LARGE-SCALE IN VITRO EXPERIMENT SYSTEM AT 1.95 GHZ. T. Iyama, T. Nishimi. Graduate School of Infsci & Tech, Hokkaido Univ, Sapporo, Hokkaido, Japan.

A large-scale in vitro experiment system was used to investigate whether exposure to 1.95 GHz Wideband Code Division Multiple Access (W-CDMA) radiofrequency (RF) fields induces activation of microglial cells. Since this system was originally designed for use at 2.1425 GHz, the SAR distribution and temperature rise in the culture fluid are newly evaluated. When the mean SAR for the four groups (each group comprises three dishes) is 2.0 W/kg, the standard deviation of the SAR distribution is 1.1 W/kg (57%). The mean temperature and the standard deviation of the temperature distribution in the steady state are 37.7°C and 0.1°C, respectively.

P-62
NUMERICAL ANALYSIS OF HEART CURRENTS IN AN ANATOMICAL HUMAN MODEL DUE TO THE CONTACT WITH 60HZ ENERGIZED CONDUCTOR. H. Tanou1, N. Hayashi1, K. Isaka1, T. Matsumoto1; Takamatsu National College of Tech, Takamatsu-shi, Japan. 2Kyushu Univ, Kasuga-shi, Japan. 3The Univ of Tokushima, Tokushima, Japan. 4Anan National College of Tech, Anan-shi, Japan.

The contact currents have received wide attention from the point of view of electric shocks and stimuli for long time. Till recently, most data associated with the contact current were collected from experimental works using the body of researchers themselves, animals, or corpses. However, several numerical human models have been developed and opened recently, and hence analyses of the contact current characteristics by using such human models become available. In this paper, numerical results of current densities in the Japanese adult model[4] under four scenarios of current paths are demonstrated. Especially, currents passing through the heart are investigated.

P-63
THE USE OF FLUORESCENT DYES AND OTHER MARKERS TO MEASURE ELEVATED TEMPERATURE IN CELLS DURING RF EXPOSURE. A. W. Wood1,2, Y. Chen1; 1Brain Sciences Inst, Shieuburne Univ of Tech, Hawthorn, VIC, Australia. 2Australin Centre for Radiofrequency Bioeffects Research, Melbourne, VIC, Australia.

A method of measuring internal changes in temperature in tissue exposed to RF radiation has been developed using a temperature-sensitive dye, Rhodamine B. The method has been applied to samples of tissue of dimensions approximately 1 x 1 x 0.3 mm. Confocal microscopy, which provides optical slicing within such samples has been used to map the 3D changes in temperature due to RF exposure. Spatial resolution is a few microns, and temporal resolution is determined by image acquisition time, of the order of seconds. Temperature changes of less than 1 degree C have been detected by this method.

P-64
STUDENT
FRENCH POPULATION EXPOSURE TO 50 HZ MAGNETIC FIELDS: INTERMEDIATE RESULTS. M. Bedjai1, L. Magnet2, M. Souquet3, J. L. Priaux4, G. Fleury5, A. Azoulay6, S. Rauzychny7; 1Lab des Matériaux Électriques, EDF R&D, Moez sur Loing, France. 2Service des Etudes Medicales, EDF, Paris, France. 3Dept Signaux et Systemes Electroniques, Supélec, Gif sur Yvette, France. 4Dept Electromagnetisme, Supélec, Gif sur Yvette, France. 5M2V Conseil, Montrouge, France.

The French Ministry of Health initiated in 2006 a large study of the individual exposure to 50 Hz magnetic field (MF) of a randomly selected sample of the French population. The total exposure database will contain 1000 data for children (0-14 years) and 1000 data for adults. Each data is composed of a 24h EMDEX II measurement and a questionnaire with a timetable. This paper presents intermediate results on 437 children and 553 adult, based on the data already analysed. The analysis of results is still ongoing, and should be published in 2010.

P-65

In this paper, temporal measurements during a week of the exposure to GSM and UMTS base stations and FM transmitters at different sites are presented. The purpose of this paper is to investigate how short-period measurements can be related to the actual maximal and average exposure following from measurement runs made over longer time e.g., a week. The proposed procedure and methodologies can be used by authorities and in epidemiological studies to estimate the maximal and median exposures for longer periods from short-period measurements.

P-66
METHODOLOGY FOR THE RELIABLE ASSESSMENT OF THE EXPOSURE OF SPECIFIC GROUPS OF THE POPULATION WITH KNOWN UNCERTAINTY. A. Christ1, W. Kaintz2, E. Neufeld3, D. Siczserba4, N. Kuster5; 1IT’S Foundation, Zurich, Switzerland. 2Ctr for Devices and Radiological Health, FDA, Silver Spring, MD, USA. 3Swiss Fed Inst of Tech, Zurich, Switzerland.

There are currently about 20 human anatomical whole body models available for dosimetric simulations to the scientific community. A majority of the models represent average weight, height and only available in upright posture. However, the induced fields of a given EM exposure strongly depend on the weight, height and posture of the subjects. The objective of this study was to develop the methodology to obtain exposure values representing a certain subgroup of the population. The novel methodology based on variation analysis has been applied to a specific subpopulation.

P-67
STUDENT
EVOLUTION OF WHOLE BODY AVERAGED SAR FOR SMALL RATS IN LONG TERM IN VIVO WI-FI EMF EXPOSURE. T. War1, A. Hadjadj2, O. Picot2, J. Wiert1; 1FT, NSM RD/ RSEA/ WSA/ RAVE, FRANCE TELECOM ORANGE LABS, ISSY LES MOULINEAUX, hauts-de-seine, France. 2ESTCOM, universite paris-est, marne la vallee, seine et marne, France.

Study has demonstrated that different human models would have different whole body averaged SAR (WBSAR) if they are exposed by the same plane wave. It means that children and adult would experience different WBSAR even in face of the same field level. Some researches have been carried with the small rats for the long term non-restrained exposure experiments. This paper introduces the works on the evolution
of the WBSAR in the young rats for in vivo non-restrained Wi-Fi exposure experiment from the embryo period to 30 days after birth. Several parameters as well as physical, physiological properties and habits of rat change with ages. They influence WBSAR greatly. The result of WBSAR for small rats vs. age has been presented in this paper.

**P-72**

**DOSIMETRIC ANALYSIS OF AN IN VITRO EXPOSURE SETUP AT 3 GHz.**

A. Collin¹,², A. Perrin¹,³, P. Louqueur¹,², SLIMM, Lille, France. CRSSA, LA TRONCHIE, France.

Since detailed dosimetry of exposure setup is essential for adequate interpretation of experimental results, a dosimetric analysis of an in vitro set-up at 3 GHz has been realized. The exposure system was previously characterized at different frequencies (1.8, 2.45 GHz) within its wide working frequency range (from 0.8 up to 10 GHz). The characterization has been performed for a plane wave exposure as well as considering an horn antenna circularly polarized. This paper, starting from an accurate numerical modeling methodology used for previous analysis, aims to calculate SAR and related standard deviation values in the Petri dishes at 3 GHz.

**P-73**

**SAR AND TEMPERATURE RISE IN DIFFERENT HEAD MODELS DUE TO THE ELECTROMAGNETIC RADIATION FROM CANONICAL ANTENNAS.** M. Ali, M. R. Islam; Electrical Engineering, Univ of South Carolina, Columbia, SC, USA.

The temperature rise due to the radiation from a dipole and a PIFA were studied in two head models. The temperature rise is dependent on the head model under consideration. For the same antenna a higher 10g SAR corresponded to a higher temperature rise.

**P-74**

**FORMULATIONS FOR NUMERICAL DOSIMETRY OF CURRENTS INDUCED IN THE HUMAN BODY BY ELF MAGNETIC FIELDS.** R. Scorretti¹,², R. Perrussel¹,², D. Heyer³, N. Berati³, L. Nicolò³,², Lab. Ampere, Université de Lyon, Villeurbanne, France. 

The classical \( \partial \)-a formulation for numerical dosimetry of currents induced by ELF magnetic fields requires that the source field is provided through a vector potential. We present here a new formulation which accepts directly the flux density as source term. This formulation is implemented through the Finite Element method and validated by comparison with analytical solutions. An example of computation with an anatomical phantom is also presented.

**P-75**

**EVALUATION OF ELECTROMAGNETIC FIELDS FROM WIFI DEVICES: SPECIFIC ABSORPTION RATE MEASUREMENTS.** Y. Monchkarout¹, T. Leterrie²; Dept of Electromagnetics, SUPELEC, Gif-sur-Yvette Cedex, France. Dept of Telecommunications, SUPELEC, Gif-sur-Yvette Cedex, France.

The signal transmitted by WiFi devices during data exchange is complex and difficult to predict during time. The current recommendations for the SAR (Specific Absorption Rate) measurement of WiFi devices are based on the manufacturer’s test mode. An alternative procedure for the SAR measurement of laptops with WiFi functionality is herein proposed. A commercially available software is adopted to generate specific WiFi waveforms compatible with the probe’s response. A peak detection approach provides the SAR corresponding to a 100% duty cycle. On the basis of the data rate observed during the measurement, the actual SAR value can be derived.

**P-76**

**ON THE RELATIONSHIP BETWEEN HANDSET EMITTED AND RECEIVED POWERS IN 2G AND 3G OPERATING NETWORKS.** A. Gati, E. Conil, M. Wong, J. Wiart; Orange Labs, Issy les moulineaux, France.

The proposed paper deals with the assessment of emitted and received power during real use. The purpose of this study is to analyse the re-
lution between power emitted by the mobile phones and the signal strength received from operating fixed base stations. The goal is to build a first approach for assessing instantaneous local and whole body exposures and to underline the reciprocity of the uplink and the downlink channels. Such an analysis allows precise understanding of exposure to handssets depending on the receiving conditions and the power management mechanisms.

P-77 STUDENT
CHARACTERIZATION OF MAGNETIC FIELD EXPOSURE ON BRITISH ELECTRIFIED AND NON-ELECTRIFIED TRAINS. A. Lacambry, D. L. Henshaw; Physics, Univ of Bristol, Bristol, United Kingdom.

In recent years investigations into residential and occupational exposure to magnetic fields have been carried out, however there is potential for relatively high exposure from other sources such as public transport. This study highlights the complex exposure patterns encountered on British electrified and non-electrified trains. Results show that the position within the carriage and height above floor level are significant factors. Increased field variability was shown to be dependent on the type of train and the route travelled. Diesel trains travelling along an electrified route are subject to more variable fields due to overhead power cables.

P-78 STUDENT
ASSESSMENT OF THE SAR FROM HANDS-FREE KITS FOR MOBILE PHONES. S. Kuchto, E. Cabot, A. Christ, M. Capstick, N. Kuster; IT’IS Foundation / ETH Zurich, Zurich, Zurich, Switzerland.

We investigated the specific absorption rate (SAR) of mobile phones used with hands-free kits (HFK). The SAR from wired and wireless HFK was determined experimentally. Wired HFK were evaluated dosimetrically whilst connected to mobile phones (GSM900/1800, UMTS1950) under maximized current coupling to the HFK cable and various routing configurations. Simulations were performed for HFK and a mobile phone in operation on anatomical whole-body models. Wired HFK reduce head region exposure considerably compared to the mobile phone at the head. Wired HFK may cause a localized increase in the exposure in the upper chest. Wireless HFK show a lower SAR.

P-79 ACCELERATION OF THE DOSIMETRIC MEASUREMENTS OF GSM MOBILE PHONES. D. Picard; EMG, Supélec, Gif-sur-Yvette, France.

Classical dosimetric assessment systems are very slow, which leads to important measurement durations, typically 15 minutes per mobile phone configuration. This duration comprises two parts: the movement of the probe and the time of measurement on each space point. Supélec has conceived and implemented a new dosimetric assessment system with high performances. Fast mechanical movements reduce strongly the probe displacement duration. High sensitivity and low time response of the probe and its electronic allow low measurement time. A duration of 4s per mobile phone configuration was obtained.

P-80 COMPUTED SAR AND TEMPERATURE RISE IN AN ANATOMICAL HEAD MODEL EXPOSED TO A 900 MHZ DIPOLE ANTENNA. M. Ali; M. R. Islam; A. Raza.<sup>1</sup> E. Bahill<sup>1</sup>; Electrical Engineering, Univ of South Carolina, Columbia, SC, USA. <sup>1</sup>Dept of Applied Electrodynamics, Tele University, Tele University, Georgia. <sup>1</sup>Motorola Inc., Plantation, FL, USA.

The SAR and temperature rise in the anatomically correct human head model exposed to EM radiation from dipole antennas were computed using two different simulation tools. The obtained results will contribute to the development of a new threshold power rationale for low power wireless devices compliance test exemption based on the temperature response of human tissue exposed to RF energy.

P-81 ANALYSIS OF RAY-TRACING TECHNIQUES IN RF EXPOSURE ASSESSMENT. B. Rodríguez<sup>1</sup>; J. Bla; R. Lorenzo<sup>1</sup>; A. Bahill<sup>1</sup>; S. Matuza<sup>1</sup>; P. Fernández<sup>1</sup>; E. Abri<sup>1</sup>; Research & Development Dept, CEDETEL, Valladolid, Spain. <sup>1</sup>Dept of Signal Theory and Communications and Telematic Engineering, Univ of Valladolid, Valladolid, Spain.

Personal exposure meters (PEM) are usually used to assess individual RF exposure. In this work, ray-tracing techniques are employed to reproduce and analyze PEM results in a dynamic outdoor environment. The model is calibrated by a set of PEM measurements in GSM band. Moreover, a method for comparing “body shadowing” effect is presented. This technique has been proved as a simple and useful tool to identify affected readings and to provide estimation of the E-field level in the absence of the body. As this method depends mainly on directional angles, it could be further extended to compute axial isotropy effect.

P-82 SAR AND TEMPERATURE ELEVATION EVALUATION USING JAPANESE ANATOMICAL HUMAN MODELS FOR BODY-WORN USAGE. Y. Onishi<sup>1</sup>, T. Iyama<sup>1</sup>, L. Hamada<sup>1</sup>, S. Watanabe<sup>2</sup>; <sup>1</sup>NTT DOCOMO Inc., Yokosuka, Kanagawa, Japan. <sup>2</sup>National Inst of Information and Communications Tech (NICT), Tokyo, Japan.

We previously presented Specific Absorption Rate (SAR) calculation results for Japanese adult male and female models at 900 MHz using the Finite-Difference Time-Domain (FDTD) method when an antenna is located in close proximity to the trunk of the body. It was shown that the 10g average SAR of the model was approximately two times higher than that for the female model. The next step is to investigate the relationship between the SAR and the temperature elevation including other higher frequencies.

P-83 PARAMETERS AFFECTING NUMERICAL ESTIMATION OF INTERNAL BODY RESISTANCE OF HUMAN MODEL AT POWER FREQUENCY. N. Hayashi<sup>1</sup>, H. Tanou<sup>1</sup>, K. Isaka<sup>1</sup>; <sup>1</sup>Fac of Eng Sci, Kyushu Univ, Fukuoka, Japan. <sup>1</sup>Elec & Comp Eng, Takamatsu Nat’l Coll of Tech, Takamatsu, Japan. <sup>1</sup>Tokushima Univ, Tokushima, Japan.

Characteristics of power-frequency touch current inside an anatomically realistic human model of Japanese adult were numerically analyzed under various scenarios of current paths by using a modified spld method. Then, complex distributions of the electric fields and current densities in the model were visually illustrated, and effects of current scenarios on the internal body impedance are discussed. The internal body resistances Ri obtained are larger than the measured values reported to date. It is demonstrated that Ri measured by the four-terminal method may be underestimated when the large potential detection electrodes are used. It is also indicated that the conductivity of muscle significantly affects the estimated value of Ri.

P-84 EXPOSURE OF THE DRIVER AND THE PASSENGER OF A CAR TO THE RADIATION OF A GPS EQUIPMENT. D. Picard<sup>1</sup>; S. Chaurvet<sup>1</sup>; <sup>1</sup>EMG, Supélec, Gif-sur-Yvette, France. <sup>1</sup>Frequences et Protection, Bouygues Telecom, Boulogne, France.

Certain vehicles are equipped with a GPS making it possible to locate it remotely. This GPS equipment sends its data by the GSM network. During the exchange of the data the driver of the vehicle and the possible passenger are exposed to a radiofrequency electromagnetic field. The evaluation of this exposure requires the measurement of the average power radiated by the antenna and the electric field at the location of the front seats for a given emitted power.

Overhead transmission lines are considered one of the major sources of extremely low frequency (ELF) Magnetic Fields. Great public concerns have arisen near the transmission lines. Magnetic field measurements of sensitive areas near transmission lines were collected in residential areas in 2006 and 2008. Areas in which tests were conducted focused on apartments, schools, kindergartens, etc. The average magnetic field level in these areas was less than 0.3 μT. The maximum value of 8.54μT was measured at the top of the building at a distance of 5 meters from 154kV transmission line. We have to predict the maximum/average magnetic field value of the year to assess the exposure to maximum/average magnetic fields for new overhead transmission line construction. In this study, the analysis result is summarized as follows: - The predicted value of average MF strength of that year (New T/L) = 25% of magnetic field value based on transmission thermal capacity. - The predicted value of average MF strength of that year (New T/L) = 45% of magnetic field value based on transmission thermal capacity.

P-86 STUDENT ABSORPTION IN AN ADULT AND CHILD BODY AT 900 MHz FOR OBLIQUE INCIDENCE OF A PLANE WAVE. S. Iskar, R. J. McKenzie, J. Cost ; Electrical and Computer Engineering, RMIT Univ, Melbourne, VIC, Australia.

The FDTD method has been used to examine the variation in whole body average specific absorption rate (SARW) in an adult and child sized body for oblique incidence of a 900 MHz plane wave. For a constant amplitude plane wave, the SARW remains relatively constant over a range of incident angles and polarisations of the field.

P-87 EVALUATION OF ELECTROMAGNETIC FIELDS FROM WIFI DEVICES: IN-SITU MEASUREMENTS. V. Munteanu1, T. Leterme2; Dept of Electromagnetics, SUPELEC, Gif-sur-Yvette Cedex, France. 1Dept of Telecommunications, SUPELEC, Gif-sur-Yvette Cedex, France.

The in-situ measurement of the electric fields produced by WiFi access points is considered. Signals transmitted by WiFi devices during data exchange are complex and difficult to predict during time. For access points, the measurements can be based on the beacon mode. The parameters of the spectrum analyzer are set to record the maximum electric field. The actual electric field level can be deduced from the correspondence between observed data rate and temporal occupation of the WiFi signal. Measurements performed at several sites show that the maximum electric field is about 1 V/m at 1 m from the access point.

P-88 STUDENT A NUMERICAL STUDY ON MILLI-METER BAND ELECTROMAGNETIC DOSIMETRY WITH COMPLEX ENVELOPE FDTD METHOD. K. Sawaki1, Y. Suzuki2, S. Watanabe2, M. Takii3; 1Tokyo Metropolitan Univ., Hachioji, Tokyo, Japan. 2National Inst of Info and Comm Tech, Koganei, Tokyo, Japan.

An effective numerical method is required for the dosimetry of millimeter wave (MMW) band exposure. The complex envelope FDTD (CE-FDTD) method was proposed as electromagnetic solver for the MMW dosimetry. This method is numerical method on the envelope components of bandwidth-limited electromagnetic wave. In this study, we investigated the scattering analysis for MMW with the CE-FDTD method. The homogeneous dielectric sphere was employed for scattering model as a case study. It was showed that the CE-FDTD method had advantage in computational costs by comparing with the FDTD method. The CE-FDTD method was expected as the effective numerical scheme for the MMW dosimetry.

P-89 MEASUREMENT OF SAR OF THIN LIQUID LAYERS USING A RESONANT CAVITY AT MICROWAVE FREQUENCIES. Q. Balazs1, R. W. Gammon1, V. Hadzi1, C. Davis1, C. Kowalczyk1; 1Inst for Physical Science and Tech, Univ of Maryland, College Park, MD, USA. 2Electrical and Computer Engineering, Univ of Maryland, College Park, MD, USA. 3Health Protection Agency, Chilton, United Kingdom.

This paper describes an experimental methodology to evaluate the average SAR of cell preparations exposed to RF energy in a resonant high quality factor (Q) cavity. The method requires minimal computations and uses exclusively the experience of the reflection coefficients of the cavity over its operational frequency band. We show that the SAR in thin, small volume samples placed in a large cylindrical cavity can be evaluated conveniently from the measurements of frequency shift and Q degradation before and after the insertion of the sample in the cavity.

P-90 CONSERVATIVE EVALUATION OF COMBINED EXPOSURE FROM MULTIPLE RF SOURCES (100 KHZ - 300 GHZ). A. Faraone1, G. Bis-Bahid1, J. Keshvari2, T. Onishi3, J. Pack4, J. Pledl5, J. Prats6, M. Wood7, P. Zollman8; 1Motorola Inc., Fort Lauderdale, FL, USA. 2National Inst of Info and Comm Tech, Koganei, Tokyo, Japan. 3NTT DOCOMO Inc., Kanagawa, Japan. 4Chungnam National Univ, Chungnam, Korea, South. 5Federal Network Agency, Rosenheim, Germany. 6Sony Deutschland GmBH, Stuttgart, Germany. 7Telstra Corp, Melbourne, VIC, Australia. 8Vodafone Group, Newbury, United Kingdom.

A number of approaches to evaluate the combined exposure from multiple RF sources are presented. Depending on the signal characteristics, they may involve the scalar or vector superposition of field quantities, potentially requiring vector sensors if measurements are performed. Alternative approaches, shown to be conservative, are described to enable the use of scalar probes in all cases, thus simplifying the evaluation process. The contents of this paper constitute a Technical Report developed by the IEC TC 106 to guide the various Project Teams establishing standards for the evaluation of the exposure from RF emitting devices and antennas.

P-91 COMBINING RAY-TRACING AND FULL-WAVE NUMERICAL METHODS FOR THE ASSESSMENT OF HUMAN EXPOSURE AT RF TRANSMITTER SITES. P. J. Meyer, F. De Plessis; EMSS Consulting, Stellenbosch, WC, South Africa.

The assessment of radiation intensity around cellular base station antennas is necessary for the prevention of overexposure to the general public and RF-trained personnel. To perform the assessment a computational tool has been developed for calculating 3-D regions where the power density exceeds specified reference levels. Panel and omnidirectional antennas are modeled using a ray-tracing technique for a linear array of point sources. The E-field at an observation point is calculated for each of these antennas considering the path length, radiation pattern and phase of each point source. For other kinds of antennas such as Yagi-Uda arrays, simulations are performed using full-wave computation. Models for these antennas are created by calculating and storing the E-fields on a 3-D uniform grid. Our computational tool then uses fast trilinear interpolation to calculate the E-field at any observation point within the boundaries of the 3-D uniform grid. The individual power density for each antenna is determined using the calculated E-field in a free-space medium. The total power density at an observation point is calculated by summing the individual power density of all transmitting antennas.
P-92

SPECIFICATION AND EVALUATION OF SAR VALUES OF DIFFERENT MOBILE PHONES. A. Bahr, IMST GmbH, Kamp-Lintfort, Germany.

In this paper the exposure from relevant mobile phones in different frequency and operating mode configurations is investigated. Technical reasons for the assessed SAR values are discussed.

ELECTROPORATION

P-93

COMPARISON OF ELECTROPORATION THRESHOLD OF DIFFERENT CELL LINES. G. Saulis, R. Saulis; Dept of Biology, Vytautas Magnus Univ, Kaunas, Lithuania.

The electroporation threshold was compared at various durations of electric pulse for human erythrocytes, Chinese hamster ovary, mouse hepatoma MH-22A, and rat glioma C6 cells. The dependences of the fraction of electroporated cells on the pulse intensity were obtained for the cells exposed to square-wave electric pulses with the durations of 0.02-2 ms. The transmembrane potential required to electroporate 50% of cells was in the range of 480-930 mV and decreased with increasing pulse duration. The dependences of the transmembrane potential on the pulse duration were close to each other for all cell lines studied.

P-94

PULSED LASER FLUORESCENCE MICROSCOPY AS A TOOL FOR TRANSMEMBRANE-POTENTIAL RECORDINGS OF MAMMALIAN CELLS. T. Berghofer1, C. King1, B. Flickinger1, S. Schneider1, W. Frey1; 1Inst for Pulsed Power and Microwave Tech, Forschungszentrum Karlsruhe GmbH, Eggenstein-Leopoldshafen, Germany. 2Inst of Toxicology and Genetics, Forschungszentrum Karlsruhe GmbH, Eggenstein-Leopoldshafen, Germany.

Several effects of pulsed electric fields on the transmembrane potential of mammalian cells (HEK293, HeLa, 22R1v1) have been investigated. Electric field-strengths up to 30 kV/cm have been applied to biological cells using a Blumline line pulse generator triggered by an ultra-fast MOSFET-switch. Field-strength dependencies of the transmembrane potential indicate an enhanced formation of micropores in the plasma membrane of the cells at membrane potential values exceeding 200 mV. Furthermore, time-courses of the transmembrane potential of HEK293 cells measured with a high temporal resolution of 5 ns have been compared with predictions of a theoretical network model.

P-95

STUDENT SIZE OF THE PORES CREATED BY AN ELECTRIC PULSE: MICROSECOND VS MILLISECOND PULSES. R. Saulis, G. Saulis; Dept of Biology, Vytautas Magnus Univ, Kaunas, Lithuania.

Modeling studies have revealed that the pulse of nanosecond-duration should create smaller pores than the pulse of micro-millisecond duration. It can be expected, that similar differences should also exist between the pore populations created by the pulses of micro- and millisecond-durations. Here, we compared the size of the pores created by a square-wave electric pulse with the duration of 100 μs and 2 ms. For all cells studied (mouse hepatoma MH-22A, Chinese hamster ovary, and rat glioma C6 cells) short 100 μs-duration pulse created smaller pores than longer 2 ms-duration pulse.

P-96

INVESTIGATION OF THE EFFECTS OF NON THERMAL MICROWAVE RADIATION ON PROKARYOTIC CELLS. Y. Shamis1,2, A. Tanh1, R. Croft1, R. J. Crawford1, E. P. Ivanov1; 1Life and Social Sciences, Swinburne Univ, Melbourne, VIC, Australia. 2Australian Centre for Radiofrequency Bioeffects Research, Swinburne Univ Melbourne, VIC, Australia. 3Brain Science Inst, Swinburne Univ Melbourne, VIC, Australia.

The present study aimed to observe the morphology and recovery of Escherichia coli and Staphylococcus aureus, detect and identify leakage through the bacterial membrane, and theoretically evaluate the effect of MW radiation on cells. SEM analysis revealed morphological differences for E. coli following treatment, but no visible changes were observed for S. aureus. Also, analysis of leakage revealed cytosol and membrane based proteins from both bacteria. Results inferred that the interaction of radiation with bacteria is electrokinetic in nature and that leakage of cellular proteins may be caused by electroporation within the cell membrane.

EPIGENOMICS

P-97

MOBILE PHONE USE AND SYMPTOMS OF ATTENTION DEFICIT HYPERACTIVITY IN THIRD GRADE ELEMENTARY SCHOOL CHILDREN. M. Ha1, E. Burn1, E. Kim2, H. Kwon3, Y. Hong4, J. Lee5, J. Sakong5, S. Kim6, D. Kang7, C. Lee7, N. Kim8; 1Preventive Medicine, Dankook Univ Coll of Medicine, Cheonan, Chungnam, Korea, South. 2Preventive Medicine, Seoul Nat’l Univ College of Medicine, Seoul, Korea, South. 3Occupational and Environmental Medicine, Inha Univ College of Medicine, Incheon, Korea, South. 4Preventive Medicine, Yeungnam Univ College of Medicine, Daegu, Korea, South. 5Preventive Medicine, Cheju Nat’l Univ Coll of Medicine, Jeju, Korea, South. 6Occupational Medicine, Chungbuk Nat’l Univ School of Medicine, Cheonju, Korea, South. 7Information and Communication Eng, Chungbuk Nat’l Univ School of Electrical and Computer Engineering, Cheonju, Korea, South.

To examine a possible association between mobile phone use and symptoms of ADHD in children, 2,337 3rd grade students participated in this study at 22 elementary schools in 10 Korean cities. Parents and guardians administered a questionnaire including DuPaul’s ADHD scale and about ownership and use of mobile phone. The children having ADHD symptoms was 10.6% and 22% had their own mobile phone. The symptoms of ADHD associated with the frequency of use of other’s mobile phone, spending time for a call and game or internet. Because of the limitation of cross-sectional design of this study, further study is warranted.

P-98


The study aims to build an Activity Exposure Matrix (AEM), describing for 30 common, everyday activities in 1 extremely low and 12 radio frequency bands the estimate of the exposure level. In this way the exposure to EMF in future epidemiological studies can be estimated based on the AEM and a questionnaire on activity patterns without the need to actually measure. By plotting combined data from personal exposure measurements and GPS-receivers in a geographical information system we performed a temporal-spatial analysis. The contrast ratio between everyday activities is clear enough to distinguish between high and low exposure activities.

Reports of electromagnetic hypersensitivity have appeared, especially from European countries and North America, since the 1980s. Electromagnetic hypersensitivity is characterized by non-specific symptoms that the afflicted individuals attribute to exposure to electromagnetic fields but scientific studies have failed to confirm a causal relationship between electromagnetic fields and non-specific symptoms. Little is known about the changes over time in prevalence of self-reported electromagnetic hypersensitivity. The results in two Swedish population-based surveys show little change between 1999 and 2007, the percentage of responders who reported electromagnetic hypersensitivity was 3.1% and 3.2% respectively. Additional characterization of this group of responders will be presented.

P.100 Exposure to Magnetic Fields and Survival After Childhood Leukaemia - Study Design of an International Meta-Analysis. K. Grell, K. Frederiksen, J. Schüz; Inst of Cancer Epidemiology, Danish Cancer Society, Copenhagen, Denmark.

The objective of our project is to pool international studies to investigate whether exposure to extremely low-frequency magnetic fields (ELF-MF) is associated with a poorer prognosis of childhood acute lymphoblastic leukaemia (ALL). There has been published two studies observing a somewhat poorer survival among ALL patients exposed to ELF-MF but due to small numbers the studies is only hypothesis generating. We have estimated that the number of eligible cases is large enough to achieve an appropriate statistical power and the data analysis will consist of testing both a primary and a secondary hypothesis.

P.101 Dosimeter Quality Control for Quebec Epidemiological Study. C. Bornkessel, M. Blättner, J. Breckenkamp; G. Berg-Beckhoff; 1IMST GmbH, Kamp-Lintfort, Germany. 2Inst of Medical Biostatistics, Epidemiology and Informatics, Johannes-Gutenberg-Univ of Mainz, Mainz, Germany. 3Dept of Epidemiology and International Public Health, Bielefeld Univ, Bielefeld, Germany.

A methodology for quality control of dosimeters in epidemiological studies is described, which bases on defined field strength generation in a GTEM cell. The method is able to detect damages by overload, mechanical stress and hardware/software errors. In the application to the German QUEBE study one of 20 dosimeters was identified to be faulty; the other devices were stable with deviations of ±1 dB to their initial state. By the quality control the confidence in the measurements obtained in the field work was strengthened significantly. It is recommended to apply similar checks in other studies with exposure assessment by dosimeters.

P.102 WITHDRAWN

P.103 Cohort Study on Mobile Phone Use and Brain Tumor Among Children in Japan. S. Sato; Dept of Public Health, Tokyo Women's Medical Univ, Shinjuku, Tokyo, Japan.

Subjects are fourth to sixth graders in elementary schools, and guardians reply the survey. We carry out this study on the Internet. The survey consists of a base line survey and follow-up surveys. We send e-mail requests to participants asking to answer surveys every four months. Additionally, to conduct a nested case-control study, we are going to carry out interview surveys to some of the participants. The numbers of participants were 1433 guardians and 1605 children as of January 14, 2009. A current challenge of this study is to increase the number of the participants.

P.104 Electromagnetic Hypersensitivity (EHS) of Brain Tumor Patients and Use of Mobile Phone in Case-Control Study. J. Choi, N. Kim, H. Choi; Korea Univ, Korea, Korea. 2Chungbuk National Univ, Chungju, Korea, South. 3Electronics and Telecommunications Research Inst, Daejeon, Korea, South.

Among the studies in Korea on the correlation between brain tumor and electromagnetic waves produced by mobile phones, this paper aims to find out whether the subjective symptoms (Electromagnetic Hypersensitivity, EHS) of brain tumor patients are caused by the brain tumor or by the effects of their cell phone usages by means of comparing them with non-patients and analyzing the results.

P.105 Estimation of the ELF-MF Exposure Level of the Korean Population Through 24-Hour Personal Exposure. S. Hong, M. Hae; 1J. Kim, K. Kim; 1Occupational Health & Safety Engineering, INJE Univ, Gimhae, Korea, South. 2Dept. of Medical Engineering, Univ of Yonsei, Seoul, Korea, South. 3Inst of Environmental and Industrial Medicine, Hanyang Univ, Seoul, Korea, South.

The main purpose of this research is to identify the MF exposure level of the Korean population and then to estimate the size of the MF exposure population using the results of the personal-exposure measurement. Another aim of the research is to compare its results with those of the EMF RAPID program carried out by U.S. EPA to find the characteristics of ELF-MF exposure in Korea. The estimated percentage of people with a 24h average magnetic field exceeding 2 mT was 11.34% (95% CI: 10.74-11.92%), and that exceeding 4 mT was 6.07% (95% CI: 5.34-6.85%). Based on the complete data from KOSIS, it was found that the people in Korea with a 24h average magnetic field larger than 2 mT number between 505.2 and 569.7 million.

P.106 Dosimetric Measured Radiofrequency Electromagnetic Field Exposure in Sleeping Rooms and Health Disturbances of Adults. G. Berg-Beckhoff, M. Blättner, B. Kowall, J. Breckenkamp; B. Schlehuber; 1JKW, 2S. Schneidt, C. Bornkessel, U. Reiß, P. Pothoff, J. Schüz; 1Epidemiology and International Public Health, Univ of Bielefeld - School of Public Health, Bielefeld, Germany. 2Inst of Medical Biostatistics, Epidemiology, and Informatics, Johannes Gutenberg Univ, Mainz, Germany. 3Unit of Environmental Epidemiology, German Cancer Research Center, Heidelberg, Germany. 4Danish Cancer Society, Copenhagen, Denmark. 5IMST GmbH, Kamp-Lintfort, Germany. 6TIS-Health Care Gmbh, Munich, Germany.

The objective was to investigate whether radiofrequency electromagnetic fields (RF-EMF) and risk perception of participants were associated with their health disturbances. In 2006, a cross-sectional study was conducted in German urban regions including a questionnaire on health disturbances and RF-EMF measurements in the sleeping room of 1,500 participants. Overall, RF-EMF exposures were far below the protection guidelines for the general public. The measured exposure in sleeping rooms was not associated with any health disturbances. However, sleep disturbances and health complaints were related to participants’ attribution of adverse health effects to mobile phone base stations.

We evaluated 50 Hz magnetic field exposure in 31 multi-level apartment buildings with built-in step-down transformer stations. In each building, three apartments were selected; one apartment located immediately above the transformer room (index apartment), one located on the same floor, and one on a higher floor. The mean value of measured magnetic fields was 0.98 uT in apartments above transformers, 0.13 uT on the same floor, and 0.1 uT in on higher floors. We conclude that apartments in building with built-in transformers can be reliably classified into high and low exposure categories based on their location in relation to transformers.

IF CELLPHONE USE IS A RISK FOR BRAIN TUMORS WHEN AND HOW MANY CELLPHONE-INDUCED BRAIN TUMORS MAY OCCUR, L. Morgan; Central Brain Tumor Registry of the US [For identification purposes only. All statements are mine and mine alone and do not represent positions or opinions of the Central Brain Tumor Registry US]. Hinsdale, IL, USA.

If cellphones are a risk for brain tumors then, with the enormous prevalence of cellphone use, the public health consequences will be large. Given this assumption, estimates are made for cellphone-induced brain tumors by year based on US cellphone subscription data, a 30-year latency time, and the percentage of people who are eventually diagnosed with brain tumors by year based of US cellphone subscription data, a 30-year latency time, and the percentage of people who are eventually diagnosed with brain tumors from exposure to known carcinogens. The results vary substantially as to the number of cellphone-induced brain tumors in a given year, but the impact is similar-a long time delay without a noticeable tendency time, and the percentage of people who are eventually diagnosed with cancer from exposure to known carcinogenic agents. The results vary substantially as to the number of cellphone-induced brain tumors in a given year, but the impact is similar-a long time delay without a noticeable tendency time, and the percentage of people who are eventually diagnosed with cancer from exposure to known carcinogenic agents.

CHARACTERISTICS OF CHARGED AEROSOL VALUE AROUND HIGH VOLTAGE AC POWER LINE, S. Hong, M. Han, K. Kim, J. Jeon; Occupational Health & Safety Engineering, INJE Univ, Gimhae, Korea, South. ’Air Pollution & Indoor Quality, Green Jeonnam Environmental Complex Center, Suncheon first College, Suncheon, Korea, South.

The aim of this study is to identify the mechanism of aerosol discharging around high voltage (154, 345 and 765kV) AC power line and to compare the level of charged aerosol current and calculated concentration (the number of charged aerosol per cm3) with directly under and away off the power line. And also, to confirm the seasonal variation of charged aerosol value at each sites simultaneously.

RELATION TO CHARGED AEROSOL WITH AIR POLLUTANTS AROUND HIGH VOLTAGE AC POWER LINE, S. Hong, K. Kim, M. Han, J. Jeon; ’Occupational Health & Safety Engineering, INJE Univ, Gimhae, Korea, South. ’Green Jeonnam Environmental Complex Center, Suncheon first College, Suncheon, Korea, South.

To identify the interrelation factors to charged aerosol currents and calculated concentration with various air pollutants including EMF, relative humidity and temperature. The aerosol current were measured by magnetic field (r=0.972, p<0.05) and electric field (r=0.992, p<0.01) statistically significant. This means high level of electromagnetic field induced increasing of aerosol current. On the other hand, the electric and magnetic field level were not well correlated with the calculated concentration. In case of positive charged aerosol and relative humidity shows well correlated.

AMPLITUDE-MODULATED ELECTROMAGNETIC FIELDS FOR THE TREATMENT OF CANCER: DISCOVERY OF TUMOR-SPECIFIC FREQUENCIES AND ASSESSMENT OF A NOVEL THERAPEUTIC APPROACH, B. Pachoud1, A. Barbanerd2, F. Costal, B. Bottger, R. Munden, F. Bomhof, N. Kuster; ’Univ of Alabama at Birmingham, Birmingham, AL, USA. ’Cabinet Medical, Lausanne, Switzerland. ’Columbia, France. ’Sírio-Libanés Hospital, Oncology Center, Sao Paulo, Brazil. ’Radiology Associates, Danbury Hospital, Danbury, CT, USA. ’SPEAG AG, Zurich, Switzerland. ’ITIS, Swiss Federal Institute of Technology, Zurich, Switzerland.

We examined patients with cancer using a noninvasive biofeedback method to identify tumor-specific frequencies. We identified a total of 1524 frequencies ranging from 0.1 Hz to 114 kHz. Compassionate treatment with tumor-specific frequencies was offered to 28 patients. One patient with hormone-refractory breast cancer metastatic to the adrenal gland and bones had a complete response lasting 11 months. One patient with hormone-refractory breast cancer metastatic to liver and bones had a partial response lasting 13.5 months. Four patients had stable disease lasting +31.5 months (thyroid cancer), 5.1 months (non-small cell lung cancer), 4.1 months (pancreatic cancer) and 4.0 months (leiomyosarcoma).


Even in 397 residents living in German sites without any mobile telephone supply and without emotional EMF discussions in those villages, possible EMF-related health effects are a reason of concern in a substantial part of the population. The number of inhabitants, who claim...
to suffer from EMF exposure related adverse health effects (13%) is similar to the percentage reported from annually telephone surveys in a representative German population (8–10% of 2500 subjects; infas 2003–2006). Furthermore, our results correspond to a population-based cross-sectional German study, in which 10.3% of 50,047 participants stated to suffer from RF-EMF related health effects.

P-115

SWISS NATIONAL RESEARCH PROGRAMME NPR 57: NON-IONISING RADIATION - HEALTH AND ENVIRONMENT, S. J. Regel, S. Negovetic, A. A. Borbely; Univ of Zurich, Zurich, Switzerland.

National Research Programme 57, "Non-Ionising Radiation - Health and Environment" comprises key research projects concerning potential health related consequences of low-level radio frequency and extremely low frequency electromagnetic fields. The programme addresses open questions related to dosimetry and exposure assessment, short term, medium and long-term exposure effects assessed by laboratory and epidemiological studies, processes at the cellular level as well as risk perception and communication. A final synthesis of the results in the context of the international research effort will be published in the course of 2010 and is expected to enhance the knowledge in the areas of risk assessment and communication.

P-116

DO 2ND AND 3RD GENERATION MOBILE PHONE EXPOSURES AFFECT SENSORY AND COGNITIVE FUNCTION IN ADOLESCENTS, ADULTS AND ELDERLY? R. J. Croft1, S. Leung1, R. J. McKenzie2, R. Ikezi2, S. Loughean1,1

1Psychology, Univ of Wollongong, Wollongong, NSW, Australia. 2Brain Sciences Inst, Swinburne Univ, Melbourne, VIC, Australia. 

Australian Centre for RF Bioeffects Research, Melbourne, VIC, Australia.

In order to determine whether adolescents, adults and elderly are differently affected by mobile phone exposures, a repeated measures, double blind crossover design was employed where each participant was tested on a cognitive task (auditory oddball) while exposed to each of Sham, 2G and 3G. 42 adolescents, 41 young adults and 19 elderly participants completed the experiment. Behavioural and event related EEG parameters were assessed. No effect of either 2G or 3G exposure was found, and these results were not affected by the age of the participant.

P-117

THE EFFECT OF 2G GSM MOBILE PHONE ELECTROMAGNETIC FIELDS ON THE ALPHA RHYTHM OF HUMAN RESTING EEG: RETESTING THE SAME INDIVIDUALS, A. Diaz-Trujillo1, V. Crepey1, S. Leung1, V. Anderson1, R. J. Croft1,2, Brain Sciences Inst, Swinburne Univ of Tech, Melbourne, VIC, Australia. 2Australian Centre for Radiofrequency Bioeffects Research, Melbourne, VIC, Australia.

The effect of exposure to a mobile phone with a handset wave is known to alter the human resting electroencephalogram (EEG). Moreover, there are differences in the amplitude of the alpha wave between young and elderly people. In this study, we restested 10 individuals (8 young adults and 2 elderly) with respect to their EEG in the absence and in the presence of a mobile phone emitting 2G GSM (1.95 GHz, 850MHz) electromagnetic radiation. For the present study, we used the same procedures as the first. The data is being analysed and will be presented.

P-118

EFFECTS OF THIRTY-MINUTE MOBILE PHONE EXPOSURE ON THE VOLUNTARY INITIATION AND INHIBITION OF SACCADES, T. Okano1, Y. Terao2, T. Furuyashita3, A. Yuge4, Y. Uga4.2, Laboratory Medicine, The Univ of Tokyo, Tokyo, Japan. 2Dept of Neurology, Fukushima Medical Univ, Fukushima, Japan. 3Dept of Radiology, The Univ of Tokyo, Tokyo, Japan. 4Dept of Neurology, Fukushima Medical Univ, Fukushima, Japan.

We investigated whether mobile phone use for thirty minutes has any short-term adverse effects on cortical regions responsible for initiating or inhibiting voluntary oculomotor responses according to the behavioral context. Using double blind, counterbalanced crossover design, exposure was either real mimicking that to the Japanese mobile phone (1.95 GHz EMF, W-CDMA) at its maximal output or sham. We used the antisaccade, cue-saccade, and overlap saccade tasks. We found no significant changes in the parameters of the tasks differently after real and sham exposure. Thus, mobile phone use for thirty minutes has no adverse effects on the responsible cortical regions.

P-119


In this paper, we studied the relationship between the subjective symptoms and EMF from the mobile phone handset. Prior to the provocation study, we did the cross-sectional and population-based questionnaire survey of Japanese to find subjects for the provocation study. In the experiment, we aim to investigate whether subjects with MPS is more susceptible to EMF than controls in several aspects, i.e. have more symptoms or show more changes in psychological, neurophysiological or physiological measures when exposed to EMF simulating that emitted by a handset.

P-120

IS HUMAN BRAIN FUNCTIONAL ACTIVATION MODULATED BY A 60 HZ, 1800 MICROTESLA MAGNETIC FIELD EXPOSURE? A. G. Legros1,2, J. Weller1, J. Robertson1,2, M. Corbacho1,2, S. Dubois, A. Reuter, R. Stadnik1,2, D. Goullet, J. Lamber, M. Plante1, M. Souquet1, F. S. Prato1, A. W. Thomas1,2, Bioelectromagnetics Group, Imaging Program, Lawson Health Research Inst, London, ON, Canada. 2Dept of Medical Biophysics, Univ of Western Ontario, London, ON, Canada. 3Bio-electromagnetics, IM 5, CNRS, Bordeaux, France. 4Hôpitaux Universitaires de Bordeaux, Aquitaine region, France. 5Univ Paris Descartes, Biomecaniques et Electricité de France, Paris, France.

Finger tapping is known to activate the contralateral Supplementary Motor Area and Primary Motor Area of human brain. Interestingly, exposure to Extremely Low Frequency Magnetic Fields (ELF MF, below 300Hz) tends to reduce spontaneous motor activity and seems to decrease brain electrical activity in healthy volunteers. We thus hypothesise that for a rhythmic index finger vs. thumb opposition task realized at natural frequency, thirty minutes of ELF MF exposure will decrease functional activation in the involved brain structures. Functional Magnetic Resonance Imaging results of nine subjects will be presented.
# Program June 14 - 19, 2009

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<th>Sunday</th>
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| 08:30 - 12:00 | U.S. Air Force Laboratory Workshop  
Short Pulse Electromagnetic Fields & Biology | Swiss National Research Programme 52 (NRP 52) 
Non-Ionising Radiation - Health and Environment | 12:00 - 12:00  
Sweda & Foyer C1  
Poster Setup | 12:00 - 12:00  
Sweda & Foyer C1  
Poster Setup |
| 12:00 | Registration | | | 13:00 - 18:00  
Pavion EPFLAN |
| 16:30 | URSI Commission K | | | 16:30 - 18:30  
Office 41  
NRP Steering Committee Meeting |
| 17:00 - 19:00 | Welcome Reception | | | Office 31  
COST MB6704  
Student Ice Breaker |
| 19:00 - a.e. | | | | |

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| 08:30 - 10:00 | Plenary 1  
RF EMF EPI & Human | | | 10:00 - 10:30  
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Poster Session 1 |
| 10:00 - 10:30 | Coffee Break (A & C Foyers) | | | |
| 10:30 - 12:00 | | | | |
| 12:00 - 13:00 | Lunch (on your own) | | | |
| 13:00 - 14:30 | Topic in Focus 1  
EMF Interaction Mechanisms | | | |
| 14:30 - 15:00 | Coffee Break (A & C Foyers) | | | |
| 15:00 - 16:40 | Session 1  
Dosimetry I  
Session 2  
Animal Studies | | | |
| 16:40 - 17:00 | Short Break | | | |
| 17:00 - 18:00 | Tutorial 1  
RF Safety Standards  
Tutorial 2  
Medical Imaging  
Tutorial 3  
Biofilms | | | 19:30 a.e.  
Editorial Board Dinner |
| 19:00 a.e. | | | | |

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| 08:30 - 10:00 | Plenary II  
MR1 Safety | | | 10:00 - 10:30  
Sweda & Foyer C1  
Poster Session 2 |
| 10:00 - 10:30 | Coffee Break (A & C Foyers) | | | |
| 10:30 - 12:00 | | | | |
| 12:00 - 13:00 | Lunch (on your own) | | | |
| 13:00 - 14:30 | Topic in Focus 2  
RF-EMF & BBB | | | 14:30 - 15:00  
Sweda & Foyer C1  
Poster Session 3 |
| 14:30 - 15:00 | Coffee Break (A & C Foyers) | | | |
| 15:00 - 16:20 | Session 3  
Dosimetry II  
Session 4  
Mechanisms of Interaction I | | | 16:20 - 16:40  
Sweda & Foyer C1  
Poster Session 4 |
| 16:40 - 18:00 | Session 5  
Dosimetry III  
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Epidemiology | | | |
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<th>Time</th>
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<tr>
<td>08:00 - 09:30</td>
<td>Plenary Hall: New Directions</td>
<td>Plenary Hall: Dosimetry IV</td>
<td>Plenary Hall: Epidemiology</td>
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<td>09:30 - 10:00</td>
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<td>Coffee Break (A &amp; C Foyers)</td>
<td>Coffee Break (A &amp; C Foyers)</td>
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<tr>
<td>10:00 - 10:30</td>
<td>In Vitro Studies I</td>
<td>In Vitro Studies II</td>
<td>Plenary IV: Hot Topic</td>
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<td>10:30 - 11:00</td>
<td>Tutorial 6: Deep Brain Stimulation</td>
<td>Session 11: Devices, Instrumentation Modeling</td>
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<td>11:00 - 11:30</td>
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<td>11:30 - 12:00</td>
<td>Tutorial 6: Preservation of Art</td>
<td>Lunch &amp; BEMS Annual Business Meeting (Plenary Hall)</td>
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<td>12:00 - 12:45</td>
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<td>12:45 - 13:00</td>
<td>13:00 - 14:15</td>
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<td>13:00 - 14:00</td>
<td>Tutorial 6: Preservation of Art</td>
<td>Tutorial 1: Friends of the Devil Tour 1</td>
<td>Tutorial 2: Friends of the Devil Tour 2</td>
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<td>14:00 - 15:00</td>
<td>Tutorial 5: Medical Applications</td>
<td>Tutorial 3: Step and Small the Roses</td>
<td>Tutorial 3: Step and Small the Roses</td>
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<tr>
<td>15:00 - 16:00</td>
<td>Tutorial 6: Preservation of Art</td>
<td>Tutorial 4: EM Cancer Therapy</td>
<td>Tutorial 5: EM Cancer Therapy</td>
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<td>16:00 - 17:00</td>
<td>Tutorial 5: Medical Applications</td>
<td>Tutorial 1: Friends of the Devil Tour 1</td>
<td>Tutorial 2: Friends of the Devil Tour 2</td>
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Loading time for oral presentations at Convention Office:
- Sunday: 12:00 - 17:00 (for Monday's oral presentations)
- Monday: 07:30 - 18:00 (for Tuesday's oral presentations)
- Tuesday: 08:00 - 18:00 (for Wednesday's oral presentations)
- Wednesday: 08:00 - 18:00 (for Thursday's oral presentations)
- Thursday: 08:00 - 18:00 (for Friday's oral presentations)
- Friday: 08:00 - 18:00 (for Saturday's oral presentations)
Maps of Davos

1. Best Western Bahnhof Terminus
2. Hotel Davoserhof
3. Hotel Esplanade
4. Hotel Sirela
5. Hotel Pension Alpina
6. Arabella Sheraton Seehof
7. Arabella Sheraton Waldhaus
8. Hotel Cresta Sun
9. Steigenberger Hotel Belvédère
10. Kongress Hotel
11. Hotel Maienfeld
12. Waldhotel Davos
13. Hotel Bünda
14. Hotel Casanne
15. Hotel Cresta
16. Hotel Dischma
17. Hotel Sennenberg
18. Hotel Zum alten Räsitli
19. Hotel Alte Post
20. Hotel Edelweiss
21. Hotel Elli
22. Hotel Joseph's House
23. Congress Center Davos
24. Kirchner Museum Davos
25. Music Bar Reisilechli
26. Hotel Schatzalp
27. Railway Station Davos Dorf
28. Railway Station Davos Platz
29. Hotel Europe
30. Morossani Posthotel
31. Morossani Schweizerhof
32. Hotel National
33. Hotel Sunstar and Sunstar Parkhotel

In this paper, an electromagnetic model is designed to study the effects of realistic exposure of human body to RF signals from communication systems. The human is modelled with a homogeneous body and a multi-layered inhomogeneous head and exposed to a Continuous Wave (CW) oscillating at 48MHz and 1.206GHz. The SAR within the head (especially the brain) and the body has been evaluated and hotspots are identified for the designed model at the two frequencies. Difference of SAR distribution due to varying body postures is also analysed for straight arms and turning positions.

P-122 STUDENT MEASUREMENT OF THERMAL SENSATION THRESHOLD FOR CONVERGING MILLIMETER-WAVE BEAM EXPOSURE BY CONSTANT METHOD. M. Konzai, A. Nishikawa, Y. Takeuchi, Y. Takenaka, Y. Uguwal, Y. Urayama; Tokyo Inst of Tech, Tokyo, Japan. 2National Inst of Information and Communications Tech, Tokyo, Japan. 3Fukushin Medical Univ, Fuku-shinh, Japan.

The millimeter-waves will be more widely used for communication, sensing, or industrial purposes in near future. Any adverse effects of millimeter-waves on humans and animals should be avoided. The thermal effect is only well known biological effect of the millimeter-waves. The current guidelines for human protection against millimeter-waves is based on the insufficient experimental knowledge. We measured the thermal sensation threshold for millimeter-wave beam given to several exposure areas of the palm. The thermal sensation threshold expressed by the maximum power density on the palm negatively correlated with the exposure area.

P-123 MAGNETIC FIELD SHIELDING FACILITY TO STUDY THE EFFECTS OF A HYPOGEOMAGNETIC ENVIRONMENT ON HUMANS. L. D. Keenliside, P. S. Prato, J. Robertson; 1Imaging, Lawson Health Research Inst, London, ON, Canada. 2Dept of Medical Biophysics, Schlich School of Medicine, Univ of Western Ontario, London, ON, Canada.

A unique facility for research in magnetic shielding effects on humans includes two rooms, one active with mu-metal lining and one sham with aluminum lining. Both rooms appear to be identical and include LED lighting and 64 channel EEG. An adjacent control room provides monitoring, lighting control and future ability to introduce specific magnetic fields. This research may answer questions relating to EEG, behavioral changes and pain reduction in humans due to magnetic shielding.

P-124 IDIOPATHIC ENVIRONMENTAL INTOLERANCE ATTRIBUTED TO ELECTROMAGNETIC FIELDS - DO SUBGROUPS 1 NS? M. Sandstrom, A. Johansson; Public Health & Clinical Medicine, Occupational and Environmental Medicine, Umea Univ, Umea, Sweden.

Idiopathic Environmental Intolerance (IEI) with attribution to EM fields has been suggested as a label for symptoms related to being near equipment emitting EM fields. In this presentation three possible sub-types that have been in focus for research are described; people with visual display terminal (VDT)-related symptoms, general electrical sensitivity or mobile phone(MP)-related symptoms. The subgroups display differences in basic physiological characteristics, but also in their reaction to work related factors. It is likely that the differences between these subgroups as well as the IEI phenomenon within them are of consequence for the prognosis of individuals, and they should be considered in the choice of remedial activities and medical treatment.

P-125 EVENT-RELATED POTENTIALS AND WELL-BEING IN PEOPLE COMPLAINING ABOUT IDIOPATHIC ENVIRONMENTAL INTOLERANCE (IEI) ATTRIBUTED TO ELECTROMAGNETIC FIELDS. M. Creason, P. Papare, J. Legros, A. Anneck; Psychoneuroendocrinology Unit, Medical Psychology and Psychiatry Dept, Univ of Liège, Liège, Belgium.

A growing number of people report a variety of health problems, claiming that the reason for their adverse health symptoms is exposure to electric, magnetic or electromagnetic fields (EMF) from nearby electric installations or appliances. The term hypersensitivity to electricity or electrohypersensitivity (EHS) is often used to describe this phenomenon. The goal of this study is to assess well-being, cognitive performance and information processing through cognitive event-related potentials (i.e. CNV and P300) in comparison with a control group.

P-126 THE THRESHOLD CURRENTS FOR PERCEPTION DETERMINED BY TWO DIFFERENT THRESHOLD TRACKING METHODS. T. Kaminoura, Y. Furuyahashi, Y. Terao, Y. Mitani, K. Hanagami, T. Sakai; 1Dept of Biomedical Engineering, 2Grad School of Materials Science, 3Grad School of Medicine, Univ of Tsukuba, Ibaraki, Japan.

Our studies of perception threshold for 10 and 20 kHz sinusoidal currents in 6 normal subjects showed that the method of constant stimuli was better than the method of limits for threshold tracking (BEMS meeting last year). In this investigation, we compared those threshold tracking methods for 50 and 100 Hz sinusoidal currents in addition to 10 and 20 kHz sinusoidal currents in 15 normal volunteers. In conclusion, we recommend that we should use the method of constant stimuli in the threshold tracking.

P-127 CARPAL TUNNEL SYNDROME AND STATIC MAGNETIC FIELD THERAPY. A. P. Colbert, M. S. Markov, W. L. Gregory, H. Carluo, N. Carluo, J. S. Souda, P. Elmo; 1Helfgott Research Inst, National College of Natural Medicine, Portland, OR, USA. 2Orthopaedics and Rehabilitation, Oregon Health and Science Univ, Portland, OR, USA. 3Research International, Williamsville, NY, USA.

This feasibility study compared the effects of two neodymium magnets delivering 45mT or 15mT to the median nerve in the carpal canal, to an aluminum disk (0mT). Devices were applied nightly to the wrist for 6 weeks. Change in symptoms and median nerve electrophysiology was assessed in 60 participants. Fifty-eight individuals completed the study. Significant change in symptoms from baseline to 6 weeks was observed in all three groups, with no between-group differences. Except for the combined sensory index which improved by a mean of 0.55msec at 6 weeks in the control group, median nerve conduction studies showed no significant change.

P-128 PHASE II STUDY OF INTRABUCCELLAR-ADMINIS- TERED AMPLITUDE-MODULATED ELECTROMAGNETIC FIELDS IN PATIENTS WITH ADVANCED HEPA- TOCELLULAR CARCINOMA. B. Pasche, F. Costa, A. Coome de Oliveira, R. Mecilla, M. M. Machado, T. Zaneco, R. Sarjat, M. Chamauf, M. Souza Rocha, B. Battaja, D. Morgan, P. Bomhhor, N. Kuster, A. Barbaull; 1Univ of Alabama at Birmingham, Birmingham, AL, USA. 2Dept of Transplantation and Liver Surgery, Hospital das Clinicas, Sao Paulo, Brazil. 3Radiology Associates, Danbury Hospi- tal, Danbury, CT, USA. 4Schmid & Partner Engineering AG, Zurich, Switzerland. 5ITC Foundation, Swiss Federal Inst of Tech, Zurich, Switzerland. 6Rue de Verdun 20, Colmar, Colmar, France.
We assessed the effects of amplitude-modulated electromagnetic fields administered by means of an intrabucal spoon-shaped probe in patients with advanced hepatocellular carcinoma. Three daily 60 min outpatient treatments were administered until disease progression or death. Imaging studies were performed every eight weeks. A total of 41 patients were enrolled. Seventeen patients (41.5%) were progression-free for more than 6 months. Median progression-free and overall survivals were 4.8 months (95% CI 2.3-6.0) and 6.9 months (95 CI 4.8-11.1). As of January 2009, four patients are alive and two patients, who are still undergoing therapy, remain progression-free for 32.8 and 32.5 months, respectively.

P.129 STUDENT EFFECTS OF DROWSINESS ON HEART RATE VARIABILITY IN EHS AND NON-EHS PERSONS EXPOSED TO RF RADIATION FROM MOBILE PHONES. Y. Shin', J. Lee', K. Nam', D. Kim'; 1Brain Korea 21 Project for Medical Science, Seoul National Univ, Seoul, Korea, South. 'Dept of Medical Engineering, Yonsei Univ College of Medicine, Seoul, Korea, South. 'Korea ElectroTech Research Inst, Ansan, Korea, South.

The power spectrum of HRV has been known as an effective quantitave method to evaluate the action of sympathetic and parasympathetic nerves of the autonomic nervous system. LFP (low frequency power)/HFP (high frequency power) was used as an index for the balance of autonomic nerve activity in this study. Eighteen self-reported electromagnetic hypersensitivity (EHS) persons and 19 non-EHSs were tested for both sham and real RF exposures from CDMA cellular phones with 300 mW lasted half an hour. Drowsiness occurred during our experiment approximately in half of the subjects, and we investigated how this drowsiness influenced on LFP/HFP.

P.130 SUBTYPES OF IDIOPATHIC ENVIRONMENTAL INTOLERANCE WITH ATTRIBUTION TO ELECTROMAGNETIC FIELDS - DIFFERENCES IN SYMPTOM PICTURE AND PSYCHOLOGICAL ASPECTS. A. Johans- son', S. Nordli', M. Sandgren', 'Public Health and Clinical Medicine, Occupational and Environmental Medicine, Umeå Univ, Umeå, Sweden. 'Dept of Psychology, Umeå Univ, Umeå, Sweden.

This descriptive questionnaire study assessed symptom prevalence and anxiety, depression, somatization, exhaustion, and stress in people with symptoms attributed to mobile phones (MP) and people with symptoms attributed to electrical equipment in general (EHS). The EHS group reported more symptoms than the MP group. Concerning personality traits and stress, the MP group reported increased levels of exhaustion and depression when compared with a reference group. The EHS group showed increased levels for all of these conditions except for stress. The findings support the idea of distinguishing people with symptoms related to mobile phones from and with people with EHS.

P.131 HEALTH RISK ASSESSMENT IN OCCUPATIONAL EMF EXPOSURE, D. Dubala; Occupational Medicine, Agency of Public Health-Ministry of Transport, Cluj Napoca, Romania.

In our study we tried to evaluate the health estate of physiotherapists in relationship with occupational exposure. EMF measurement were made in workplaces, we applied special questionnaires, performed micronuclear test from lymphocytes, and urinary thiocysteins assay. The results were compared to those of a control group by statistical analytical methods. We found an overexposure of this profession to diathermy procedures and magnetsidial. Significant relationships were found for presented syndromes (astheno-vegetative, neurological, cardiovascular), biological parameters (micronucleus, urinary thiocysteins) and values of exposure to RF EMF, respectively ELF EMF, and RF+ELF. We conclude that physiotherapists are exposed to electromagnetic risk, that imposing adequate health monitoring and limiting exposure.

IN VITRO STUDIES

P.132 EFFECT OF RADIO FREQUENCY RADIATION ON PROTEIN EXPRESSION PROFILES. J. Lee, K. Kim, Y. Ko', H. Byun', N. Han', H. Cho', N. Kim', J. Park'; 'Division of Radiation Cancer Research, Korea Institute of Radiological and Medical Sciences, Seoul, Korea, South. 'School of Life Sciences and Biotechnology, Korea Univ, Seoul, Korea, South. 'EM Environment Research Team, Electronics and Telecommunications Research Institute, Seoul, Korea, South. 'School of Electrical and Computer Engineering, Chungnam National University, Seoul, Korea, South. 'Dept of Radio Sciences and Engineering, Chungnam National Univ, Seoul, South.

In this study, we have monitored protein expression profiles in RF-exposed MCF7 human breast cancer cells, using two-dimensional gel electrophoresis (2-DE). MCF7 cells were exposed to either 2 W/kg or 10 W/kg SAR of 849 MHz RF radiation for 1 h per day for three consecutive days. Twenty-four hours after the final RF exposure, two-dimensional electrophoretic analyses were conducted. None of the protein spots on 2-DE showed reproducible changes in three independent experiments. To determine effect of RF radiation more clearly, three spots showing altered expression without reproducibility were identified using mass spectrometry, and then their expression changes were examined by western blot and Western blot analysis. There was no alteration in their mRnas and protein levels. Therefore, we conclude that it seems unlikely that RF exposure modulates the protein expression profile.

P.133 STUDENT CHARACTERIZATION OF BIOLOGICAL EFFECT OF 1763 MHZ RADIOFREQUENCY EXPOSURE ON AUDITORY HAIR CELLS. E. Kim', T. Hwang', M. S. Lee', E. Oh', P. Kalinec'; B. Zhang', J. Seo', W. Park'. 'Dept of Biochemistry and Molecular Biology, College of Medicine, Seoul, Korea; 'ILCHUN Genomic Medicine Inst, RBC and Dept of Biochemistry and Molecular Biology, College of Medicine, Seoul, Korea; 'Biointelligence Laboratory, School of Computer Science and Engineering, Center for Bioinformation Tech, Seoul National Univ, Seoul, Korea; 'Dept of Industrial Health & Env Industrial Safety and Health Bureau, Ministry of Labor, Seoul, Korea, and 'Dept of Cell and Molecular Biology, Hoseo Univ, Los Angeles, CA, USA.

Radiofrequency (RF) is a non-ionizing radiation that does not have sufficient energy to destabilize electrons or break chemical bonds in DNA. Non-ionizing radiation is electromagnetic radiation that consists of waves of electric and magnetic energy. Electromagnetic waves have frequencies in the range of about 3 KHz to 300 GHz. Recently widespread concerns have been raised about the biological effects of RF radiation [1]. Radiofrequency (RF) exposure at the frequency of mobile phones has been reported not to induce cellular damage in in vitro and in vivo models. We chose HEI-OCl immortalized mouse auditory hair cells to characterize the cellular response to 1763 MHz RF exposure, because auditory cells could be exposed to mobile phone frequencies.

P.134 RESPONDING AND NON-RESPONDING HUMAN MONO MAC 6 CELLS TO ELF MAGNETIC FIELD EXPOSURE. M. Lustov', M. Sinko', M. Mattsson', 'Univ of Rostock, Inst of Cell Biology and Biosystems Tech, Division of Environmental Physiology, Rostock, Germany; 'Örebro Univ, Dept of Natural Science, Cell Biology Laboratory, Örebro, Sweden. 'Inst of Tech Assessment, the Austrian Academy of Sciences, Strudengasse 45, Vienna, Austria.

In earlier studies we showed a significant increase of free radical production after exposure to 50 Hz magnetic fields at a flux density of 1 mT in primary human umbilical cord blood derived monocytes, mouse bone marrow-derived macrophages and in the Mono Mac 6 cell line.
indicating a cell-activating capacity of extremely low frequency magnetic fields (ELF-MF) [1,2]. The aim of this study is to investigate if 50 Hz MF can induce reactive oxygen species (ROS) release and influence antioxidant levels in human Mono Mac 6 cells, at lower flux densities (10-200 µT) and during co-exposure conditions (FMA, LPS).

P-135 REACTIVE OXYGEN SPECIES FORMATION IS NOT ENHANCED BY EXPOSURE TO UMTS 1950 MHz RADIATION AND CO-EXPOSURE TO FERROUS IONS IN JURKAT CELLS. M. R. Scarfi1, F. Brescia1, M. Sarti1, R. Massa1, M. L. Catelani2, A. Santini2 (IEA CNR, Naples, Italy; “Electronic Engineering and Telecommunications, Unit Federico II, Naples, Italy.

This study was designed to assess if 1950 MHz radiofrequency (RF) radiation, UMTS signal modulation, induces ROS in Jurkat cells exposed or co-exposed to FeSO4. Cell viability was also measured. The results obtained indicate that non thermal RF exposures for all the experimental conditions investigated are able to alter neither ROS formation nor cell viability Jurkat cells. Moreover, such electromagnetic fields are not able to modulate FeSO4 induced ROS production. At variance, in cultures treated with FeSO4 as positive control, a dose-dependent increase in ROS formation was recorded, validating the sensitivity of the method employed.

P-136 OXIDATIVE STRESS OF 50 Hz ELECTROMAGNETIC FIELDS IN COMBINATION WITH CHEMICAL EXPOSURE ON A HUMAN MONOCYTIC CELL LINE, P. De Rover, R. Vanschot, G. Kuppen, R. Van Don Heuvel, G. Schoeters; Toxicology, VITO, Geel, Belgium.

The in vitro results using a human monocytic cell line suggest an interplay between chemical exposure and 50 Hz electromagnetic radiation ranging from 0.01 to 1.0 mT. Evidence was collected under non-cytotoxic exposure conditions (0.156 mM paraquat and/or 0.5 mT 50 Hz magnetic field) that 50 Hz-fields induced additional oxidative stress. This was reflected in an increase of oxidative DNA-damage as measured with the Comet assay. Parallel to an increase of ROS, a subset of genes was differentially regulated. The results warrant further investigation into mechanisms that may cause this additional oxidative stress. Furthermore, the results should be related to the possible biological effects that are linked to 50 Hz-magnetic fields.

P-137 STUDENT COMBINATION OF EXTREMELY LOW FREQUENCY LOW ENERGY ELECTROMAGNETIC FIELDS AND DYNAMIC COMPRESSION AND SHEAR ON 3D CONSTRUCTS FOR CARTILAGE TISSUE ENGINEERING, F. M. Hilz1,2, S. Grab, M. J. Stoddart1, P. Amores1, C. Dahmani3, T. Weyh3, M. Crochetet1, F. Terro1,3, P. Leveque2; 1Dept Cell Biol and Biotechnology, Faculty of Medicine, Limoges, France; 2XLIM CNRS-Univ de Limoges, Limoges, Université de Limoges, LIMOGES, France; Service d’Histologie et Cytogenétique Hôpital de la Mere et de l’Enfant, CHU de Limoges, LIMOGES, France.

Chaperone-mediated autophagy (CMA) is a process of protein degradation in the lysosome: the constitutive heat-shock protein Hsc70 and the lysosome-associated membrane receptor (LAMP-2A) are the most known molecular components of CMA. We show that exposure of primary cultured neurons and astrocytes to GSM 900MHz, at a non-thermal level (SAR 0.25 W.Kg-1, 24h), slightly increased Hsc70 whereas LAMP-2A had a tendency to decrease. These preliminary data should be confirmed and statistically analyzed for significance. It also will be necessary to determine whether eventual changes in the protein expression of Hsc70 and LAMP-2A are linked to alterations in the CMA process.


The aim of this study was to investigate whether skin cells respond to low-power millimeter-waves (MMW) exposure. Human skin cell lines were exposed to 60-4 GHz with an incident power density (IPD) between 1 and 5 mW/cm2. To determine whether MMW could affect cell growth and viability, MIT test was performed. Then, by RT-PCR, we monitored expression levels of stress-induced survival factors and inflammatory genes. Our experimental results demonstrate that for an IPD below 2 mW/cm2, MMW radiations do not impact cells. Effect of higher power density is currently under process and the data will be available at the meeting.

P-139 STUDENT EFFECTS OF GSM-900 MHZ ON THE PROTEIN EXPRESSION OF CHAPERONE-MEDIATED AUTOPHAGY COMPONENTS IN CULTURED NEURONS AND ASTROCYTES. M. Crochetet1, F. Terro1, P. Leveque2; 1Dept Cell Biol and Histology, Faculty of Medicine, Limoges, France; 2XLIM CNRS-Univ de Limoges, Limoges, Université de Limoges, LIMOGES, France; Service d’Histologie et Cytogenétique Hôpital de la Mere et de l’Enfant, CHU de Limoges, LIMOGES, France.

1950 MHz radiofrequency (RF) radiation, UMTS signal modulation, induces ROS in Jurkat cells exposed or co-exposed to FeSO4. Cell viability was also measured. The results obtained indicate that non thermal RF exposures for all the experimental conditions investigated are able to alter neither ROS formation nor cell viability Jurkat cells. Moreover, such electromagnetic fields are not able to modulate FeSO4 induced ROS production. At variance, in cultures treated with FeSO4 as positive control, a dose-dependent increase in ROS formation was recorded, validating the sensitivity of the method employed.
Alternative splicing of the acetylcholinesterase (AChE) leading to an overexpression of the non-synaptic R-form is a hallmark of various cellular stresses. The effects of GSM basic RF-EMF on the expression of the AChE-R isoform were studied by western blot and immunofluorescence. We did not observe any change in the expression of the AChE-R isoform upon exposure to RF-EMF (expected average SAR of 4 W/kg for up to 16h) in rat neuroblastoma PC12 undifferentiated or differentiated cells when compared to sham-exposed cells.

P-142
IN VITRO CYTOSTATIC RESPONSE TO 0.57-MHZ ELECTRIC CURRENTS. M. Hernández-Balle, A. Uend, Bioelectromagnetismo-Investigacion, Hospital Ramon y Cajal, Madrid, Spain.

The capacitive-resistive electric transfer (CRET) in a non-invasive electro-thermal therapy that applies 0.57-MHz currents to the treatment of osteoarticular injuries. Preliminary clinical results are indicative that electro-thermal therapy that applies 0.57-MHz currents induce a cytostatic response in the human hepatocarcinoma cell line HepG2 that could be mediated by changes in the expression of cyclins A and D1, and p27Kip1, proteins intervening in the regulation of the cell cycle.

P-143
EFFECT OF STATIC AND GRADIENT MAGNETIC FIELDS ON DNA REPAIR. G. Kuhn1, Y. Zeilitz1, P. Jižlás1, J. Bakor1, G. Thüröczy1, J. László2; 1Department of Non-Ionising Radiation, National Frederic-Joliot-Curie Research Inst for Radiobiology and Radiogyne, Budapest, Hungary. 2Section for Mathematics, Hungarian Academy of Sciences, Budapest, Hungary.

We studied the DNA damage in human lymphocytes that was induced by 60Co x 4 Gy irradiation, but the samples were let repair in homogenous static magnetic field (145.8 mT) or in inhomogeneous gradient static magnetic field (47.7 T/m, or 1.2 T/m, or 0.3 T/m respectively) for 30 min, 1, 2, 4, 6, 18, 20 or 24 hours. Another set of samples was exposed to magnetic fields for 24 h, before irradiation. DNA repair analysis was made by single cell gel electrophoresis (Comet assay). We found no effect on DNA repair for either homogenous or gradient static magnetic field on human lymphocytes.

P-144
STUDIES ON POSSIBLE EFFECTS ON TUBULIN PULSED HIGH POWER MICROWAVES IN CELL CULTURES. M. G. Reiling1, E. Malin1, M. Angerlä1, M. Malmeberg1; Neurosciences, Karolinska Instt, Stockholm, Sweden.

We have reported a decrease in the content of the cytoskeletal protein tubulin in endothelial cells exposed to multiple pulses (duration 0.55 microsecond) of 1.6 GHz powerful microwaves (HPM). In this study we examined if the possible effect of 9.1 GHz pulsed HPM fields. In other experiments, cell cultures were exposed to heating to 39°C. The results showed that pulsed HPM fields at both 1.6 and 9.1 did cause a decrease of tubulin, whereas heating seem to increase the content of tubulin.

P-145
EVALUATION OF THE EFFECT OF 2.45 GHZ RADIOFREQUENCY ELECTROMAGNETIC FIELD ON THE THERMAL TOLERANCE OF SACCHAROMYCES CEREVISIAE. S. Tsuchi1, M. Behra2, A. Saito3, S. Hirotsune4, Y. Suzuki5, T. Hayakawa1, M. Taki6; 1Environmental Engineering Division; BioTech Laboratories, Tokyo University of Science, Tokyo, Japan. 2Faculty of Electrical & Electronic Engineering, Tokyo Metropolitan University, Tokyo, Japan.

The major biological effects of radiofrequency electromagnetic fields (RFs) exposure is thermal one, but several reports claim possible eter- nal effects recently. In previous study, we revealed that survival rate of RF-exposed budding yeast cells was higher than that of unexposed cells. In this study, expression of mRNA relating to stress response in yeast cells was investigated. The effect on expression of HSF (heat shock factor) in Saccharomyces cerevisiae in following RF exposure (2.45 GHz, 50 W/kg) did not observed in this study. This suggests that stress response pathway regulated by HSF might little respond to RF exposure under the condition in this study.

P-146
EFFECTS OF 900 MHZ GSM IN VITRO EXPOSURE ON GENE EXPRESSION IN HUMAN FIBROBLASTS. P. Gallo1, L. Bocchio Chiarele2, A. Cattaneo3, M. Gemaroli3, R. Pirotta3, A. Sesta3,4, C. Martino1; 1BAS Dept, section of toxicology and biomedical sciences, ENEA, Rome, Italy. 2Neuropysicopharmacology Unit, IRCCS, Centre S. Giovanni di Dio, FBF, Brescia, Italy. 3Genetic Unit, IRCCS, Centre S. Giovanni di Dio, FBF, Brescia, Italy. 4Division of Biology and Genetics, Dept of Biomedical Science and Biotechnologies, Univ of Brescia, Brescia, Italy.

The aim of this study was the evaluation of possible effects of exposure to 900 MHz GSM RF fields on gene expression in human fibroblasts. Six cell lines were exposed to a SAR of 0.4 W/kg, 1 W/kg or sham exposed for 24 or 72 hours. The expression levels of the target genes, involved in cell stress response, neuronal differentiation and apoptosis processes were analyzed by Real Time PCR. A reduction in the expression levels of some genes (BCl2; MAPK-P38; IBDN) was evidenced, at different SAR levels and exposure times, failing to put in evidence a dose-response trend.

P-147
THE EFFECTS OF STRONG STATIC MAGNETIC FIELDS ON ASTROCYTE DIFFERENTIATION. T. Sakurai1,2, T. Kiyokawa3, J. Miyakoshi1, Hirotsuki Univ, Hirotsuki, Japan.

MRI has been introduced to many hospitals and MRI systems with a much higher magnetic flux density have been under development. In this study, we evaluated the effects of exposure to strong static magnetic fields (SMFs) on astrocyte differentiation using an astrocyte progenitor cell line, AP-16. Cells were exposed to SMF at 0, 4, 8, or 12 T for 30 min, and then introduced to astrocyte differentiation. The effects of strong SMFs were quantified by the expression of GFAP and cystatin C mRNA. Exposure to SMF at 10 T increased GFAP mRNA expression.

P-148
THE EFFECTS OF EXTREMELY LOW FREQUENCY MAGNETIC FIELDS ON ADIPOGENESIS. T. Sakurai, T. Kiyokawa, J. Miyakoshi, Hirotsuki Univ, Hirotsuki, Japan.

MRI has been introduced to many hospitals and MRI systems with a much higher magnetic flux density have been under development. In this study, we evaluated the effects of exposure to strong static magnetic fields (SMFs) on astrocyte differentiation using an astrocyte progenitor cell line, AP-16. Cells were exposed to SMF at 0, 4, 8, or 12 T for 30 min, and then introduced to astrocyte differentiation. The effects of strong SMFs were quantified by the expression of GFAP and cystatin C mRNA. Exposure to SMF at 10 T increased GFAP mRNA expression.

P-149
REAL-TIME MEASUREMENT OF HSP70/LUC REPORTER SYSTEM IN RESPONSE TO A 100 MT STATIC MAGNETIC FIELD. M. Belton1, P. S. Prati2, J. J. Carson3; 1Imaging, Lawson Health Research Inst, London, ON, Canada.
We undertook real-time measurements of bioluminescence in an HSP70/luciferase reporter system. We examined the effect of exposure to a 100 mT static magnetic field (SMF) alone and after exposure to 42°C. We found that heat alone significantly increased bioluminescence with and without SMF exposure. There was a significant effect of time of measurement (i.e. during field exposure vs. post field) on the rate of bioluminescence production. There was no significant effect of SMF on the level of bioluminescence; however, a trend towards increased levels could be observed in the post-field exposure time points for both hyperthermic and non-hyperthermic conditions.

P-150  STUDY OF THE EFFECT OF PULSED RF EXPOSURE ON GENE TRANSCRIPT CHANGES USING A HUMAN T-LYMPHOCYTE MODEL. S. Macildowie, C. D. Lindsay, R. Inns, A. D. Wright, J. E. Tattersall; Biomedical Sci. dott. Salisbury, UK.

Whilst effects due to radio-frequency (RF) heating are not in dispute, there is continued interest as to whether other, more subtle effects exist which may be hazardous to health in the long term. In particular, there is a lack of data upon the effects of pulsed RF exposure to underpin safety guidelines: such exposures are characteristic of many military RF sources. This study used a purified human white blood cell preparation to examine alterations in a gene expression cell system following exposure to pulsed RF sources.

P-151  NAK ATPASE UPREGULATION AND MEMBRANE HYPERPOLARIZATION INVOLVE IN ELECTRICALLY GUIDED CELL MIGRATION. N. Özkucur, S. Perikse, S. Wetzal, R. H. Funk; Anatomy, Carl Gustav Carus School of Medicine, TU Dresden, Dresden, Germany.

Besides involving in membrane physiology, Na/K ATPase is studied for its interactions with intracellular proteins. Marine osteoblasts, stimulated by 5V/cm-5h, were analysed using immunocytochemistry, vital microscopy or flow cytometry. Na/K ATPase accumulations occurred at the leading-edge of migrating cells as its expression was upregulated, too. Na/K ATPase-vinculin labelling revealed that Na/K ATPase might interact with focal adhesion proteins. Membrane was hyperpolarized then recovered upon first minutes of stimulation while it later hyperpolarized again. As conclusion, electrically induced membrane hyperpolarization may upregulate Na/K ATPase which might affect adhesion turnover in filopodia. Our data can contribute to the mechanism of electrical stimulation on cell membrane biology.

P-152  INTERMEDIATE FREQUENCY MAGNETIC FIELDS DID NOT HAVE GENOTOCIC POTENTIALS IN MOUSE LYMPHOMA ASSAY (MLA). S. Nakasone1, M. Sekhani2, M. Dateki1, S. Yaksh1, T. Nagoshi1; EMF Environment Sector, Central Research Inst of Elec Power Industry, Abiko, Chiba, Japan. 2EMF Environment Sector, Railway Technical Research Inst, Kokubunji, Tokyo, Japan.

In contrast to extremely low frequency and radio frequency electromagnetic fields (EMF), the biological effects of intermediate frequency (IF; 300Hz to 10MHz) EMF have not been studied very well. In this study, we have investigated the effects of the IF MFs (0.91mT at 2kHz, 1.1mT at 20kHz, 0.11mT at 60Hz) on genotoxicity in mammalian cells by mouse lymphoma assay. The results indicated that the strong IF MFs used in this study did not induce point mutation and chromosomal aberration, and did not affect DNA damage by MMS or DNA damage repair system in mammalian cells.

P-153  STUDENT EFFECTS OF MAGNETIC FIELDS GENERATED BY INDUCTION HEATING (IH) COOKTOPS ON MUTAGENICITY AND HSP EXPRESSION IN CULTURED CELLS. T. Kiyokawa, T. Sakurai, J. Miyakoshi; Hiraoaki Univ, Hiraoka, Aomori, Japan.

The purpose of this study was to evaluate the effects of intermediate frequency (IF) fields generated by induction heating (IH) cooktops on mutagenicity and stress responses. We evaluated the effect of an IF magnetic field at 6 mT for 2 hours on cell growth, mutagenicity, and the expression of heat shock proteins. There were no significant differences between the exposure and sham-exposure groups for each cellular criterion, suggesting that exposure to an IF magnetic field at 6 mT for 2 hours did not induce mutagenicity and expression of heat shock proteins (HSPs) in this study.

P-154  INHIBITORY EFFECTS OF CLINICAL USED LOW-FREQUENCY ELECTROMAGNETIC FIELDS ON DIFFERENT BACTERIA STRAINS WITHOUT ANTIBIOTICS. A. Obermeier1, A. Zlotnik1, A. Stemberger1; 1Institute for Experimental Onkologie und Therapieforschung, Im Münchner, Germany. 2Technische Univ München, München, Germany.

Magnetic-field therapy is an established treatment of non-unions today. In case of bone infections this technique is clinically applied in combination with antibiotics. This work focuses in vitro on the impact of different electric and electromagnetic fields on growth of bacterial pathogens, especially Staphylococcus aureus. Moreover, we investigate the antibiotic efficacy under the influence of the used low-frequency electromagnetic fields. Under the influence of electromagnetic fields both the bacterial growth was inhibited significantly and in combination with antibiotics the antibiotic efficacy was increased.

P-155  STUDENT  STUDENT STUDY OF THE EFFECT OF PULSED RF EXPOSURE STUDENT STUDENT STUDENT

MURINE MECENCHYMAL STEM CELLS MAINTAIN THE MULTIPOTENT DIFFERENTIATION CAPABILITY DURING THE SINGLE PULSED ELECTROMAGNETIC FIELDS STIMULATION. M. Tsai1, R. Hou1, W. Li1, W. H. Chang2, T. Y. Chao3; 1Biomedical Engineering, Chung Yuuan Christian Univ, Chung-Li, Taiwan. 2Center for Nano Biotechnology (CNB), Chung Yuuan Christian Univ, Chung-Li, Taiwan.

Mesenchymal stem cells (MSCs) have been regarded as a promising cell type for regenerative medicine, by virtue of their great capacity for self-renewal and potential for differentiation into cells of various types of tissues. Due to the pulsed electromagnetic fields (PEMFs) have been widely used as an effective treatment for orthopedic disorders, PEMF with three magnetic field intensities was applied to murine MSCs for modulating their proliferation and multipotent differentiation capability. The results showed that the proliferation of murine MSCs was enhanced by PEMF exposure, and MSCs still possessed the capability of multipotential differentiation after PEMF stimulation in vitro.

P-156  STUDENT EFFECTS OF EXPOSURE TO 1.8 GHZ RADIOFREQUENCY FIELD ON THE EXPRESSION OF HSPS AND PHOSPHORYLATION OF MAPKS IN HUMAN LENS EPITHELIAL CELLS. Y. Yu1, K. Yao2, W. Wu1, K. Wang1, G. Chen1, D. Lu1; 1Eye Center, Affiliated Second Hospital, College of Medicine, Zhejiang Univ, Hangzhou, China. 2Bioelectromagnetic Laboratory, College of Med, Zhejiang Univ, Hangzhou, China.

To investigate the expression of heat shock protein (HSP) and the activation of mitogen-activated protein kinases (MAPKs) of human lens epithelial cells (LECs) after exposure to the 1.8GHz radiofrequency field (RF) of a global system for mobile communications (GSM), immediately after 2 hour exposure to RF at a specific absorption rate

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(SAR) 1, 2, 3, 4 W/kg, the expression of HSP27, HSP70 and HSP90 was evaluated by Western Blot. The results showed that HSP27 and HSP70 protein expression but not HSP90 increased significantly after exposure at a SAR of 2, 3, 4 W/kg for 2 hours (P<0.05), and there were no significant differences in HSP27 and HSP70 expression among cells exposed at SAR 2, 3, 4 W/kg (P>0.05). Based on the results of HSP expression, the activation of MAPKs was detected after exposure to RF at SAR 2, 3, 4 W/kg for 0, 5, 15, 30, 60, 120 minutes by Western Blot. The results show that phosphorylation of ERK1/2 started at 5 minutes, peaked at 30 min and lasted up to 2 h after exposure at SAR 2, 3, 4 W/kg. Phosphorylation of JNK1/2 was detected at 2 hours after exposure at SAR 2, 3, 4 W/kg. P38 MAPK was not activated. The results indicate that non-thermal exposure of RF for wireless communications can induce increased HSP27 and HSP70 protein expression, and the activation of ERK1/2 and JNK1/2 in human LECs.

P-157 MAPHYS PROGRAM: CHARACTERIZATION OF HUMAN KERATINOYCES RESPONSES TO A HIGH FREQUENCY ELECTROMAGNETIC FIELD BY MICRO-ARRAY ANALYSIS, D. Roux1, S. Girard2, S. Latichchariy1, P. Bonnet3, E. Dureau4, P. Palabran5, A. Voua6, Physique, Université Blaise Pascal, Aubière, France. Plant Biology, North Carolina State Univ, Raleigh, NC, USA.

The MAPHYS program aims to determine the biological effects of High Frequency Electromagnetic Field (HF EMF) on cultured Normal Human Epidermal Keratinocyte (NHEK). Cells were exposed 10 minutes to a low amplitude EMF (900 MHz, 8 V/m, SAR: 0.03 W/kg) generated in a Mode Stirred Reverberation Chamber (MSRC). Using a gene-candidate approach, we demonstrated that this treatment evoked calmodulin mRNA accumulation (2.6-fold) after 120 min. We then analysed the diversity of this response by studying the transcriptome through micro-arrays (47,000 transcripts). Preliminary data indicate only limited changes in the gene pattern expression after cell exposure to HF EMF.

P-158 STUDENT VIABILITY OF MAMMALIAN NEURAL PROGENITOR CELLS IN ELECTRIC FIELDS, C. A. Arizt1, S. K. Mallapragada2, D. S. Salkier1. Chemical and Biological Engineering, Iowa State Univ, Ames, IA, USA. Genetics, Development, and Cell Biology and the Neuroscience Program, Iowa State Univ, Ames, IA, USA.

The effect of electric fields (EF) on mammalian neural progenitor cells (NPCs) has not been demonstrated. Potentially encouraging results were achieved that indicate the differentiation profile of NPCs changes due to EF. To determine if changes in the differentiation profiles of EF-treated NPCs compared to non-treated NPCs, can be attributed to EF treatment or to differences in cell population, we are testing the viability of NPCs grown in an EF. Our preliminary results indicate that EF-treated NPCs do not align with the EF and that differentiation may involve. Accurate dosimetry therefore requires field strength measurement is inaccurate, due to the very small temperature changes and that a pulsed frequency sweep with a 100 ms pulse width in the frequency range 5-6 GHz elicited this effect most often.

P-161 EPIDEMIC CHANGES ARE INDUCED FOLLOWING EXPOSURE OF PERIPHERAL BLOOD CELLS TO CW 800MHz RADIATION, A. Korenstein-Ilan, R. Mazor, A. Barbul, R. Korenstein, Physiology and Pharmacology, Tel-Aviv Univ, Tel-Aviv, Israel.

Genetic and epigenetic changes are involved in initiation and progression of cancer. We exposed peripheral blood cells from young male volunteers to CW 800 MHz radiation at SAR values of 2.9 and 4.1 W/kg for 24 h. The average specific absorption rate (SAR) was 0.25 W/kg. We analyzed the effect on the level of asynchronous replication in both chromosomes and synchrony. Our results demonstrate radiation induced non-thermal effect on the level of asynchronous replication in both chromosomes following exposure to the higher SAR level.

P-162 DOSIMETRY OF CELL CULTURES EXPOSED TO PULSED RADIOFREQUENCY FIELDS, A. D. Wright, S. D. MacKillop, R. Ines, J. E. Tattersall; Biomedical Sciences, Dstl, Salisbury, Wiltshire, United Kingdom.

This abstract describes an exposure system used in studies on human T lymphocytes with pulsed RF and the methods used for dosimetry. Determination of the specific absorption rate (SAR) by temperature measurement is accurate, due to the very small temperature changes involved. Accurate dosimetry therefore requires field strength measurements and numerical modelling.

P-163 STUDENT RELATIONSHIP BETWEEN DURATION OF HEATING AND TEMPERATURE THRESHOLD IN RAT HIPPOCAMPAL SLICES, S. J. Armstrong, A. Green, J. E. Tattersall; Biomedical Sciences, Dstl, Salisbury, Wiltshire, United Kingdom.

Electrode-mediated RF heating artifacts were used to characterise the effects of short pulses of heating on electrophysiological responses in brain tissue slices. Localised tissue heating around the tip of a steel stimulating electrode produced reversible or persistent decreases in the amplitude of the evoked field potential response, depending on the duration and intensity of heating. Characterisation of this relationship will help to provide a scientific evidence base for exposure standards for RF pulses. Microthermocouples can be used to induce the heating artifact and measure temperature rises in tissues, at faster time resolution and lower cost than infrared cameras.
Cardiac implants are the most common medical devices. They are subject to specific international product standards. However, since the European directive 2004/40/EC on exposure of workers to electromagnetic (EM) fields, supplementing the EC recommendation-99, many questions remain still open. To establish a risk assessment procedure for workers bearing medical implant is very complex goal due to the diversity of the potential situations involving EM fields interactions in professional environment. Assessment of human exposure at the workplace for persons bearing active implantable medical devices (AIMD) in electromagnetic fields is thus a current challenge for all the concerned electrical industries. In this paper we describe a method [1] P. Schmitt, L. Joly, P. Roth, I. Magne, M. Nadi. /Implantable defibrillators immunity to low frequency electromagnetic disturbances./ Bioelectromagnetics 2005, Dublin, Ireland - June 19-24 2005.

A 0.2 MT, 50HZ MAGNETIC FIELD EVOKED REORGANIZATIONS IN ANIMAL Models FROM IN VITRO STUDIES. A. Fujita1, Y. Kawahara2, S. Inoue 3,
C. Buckner1, A. Buckner2, L. St-Pierre3, S. Koiro1, M. Persinger1, B. Lafrenie2, I.E.T.R., Univ of Rennes I, Rennes, France.

Authors systematically investigate differences among three kind of typical electromagnetic radiation with different frequency (EMP, S-HPM and X-HPM) in damaging effect on testis, and the roles of related genes in spermatogenesis includes c-fos, Cyclin A, Pp2A and the sex-determining region Sry gene of Y chromosome. The results shown that damaging effects of tests structure, function and the failure in spermatogenesis, spermatoloesis and spermiotelyosis induced by three kind of electromagnetic radiation possess general similarity. Main difference lies in injury degree, which shows direct correlation with radiation frequency. All above mentioned changes showed an attenuating trend in radiation groups as EMP, X-HPM, S-HPM.

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HALF-WAVE RESONANCE OF BACTERIA DNA IR-RADIATED FROM 4 TO 8 GHZ. G. Dubost, J.E.T.R., Univ of Rennes I, Rennes, France.

DNA conductivity is attributed to the water molecules in compact surrounding hydration layers. Knowing the base-pairs number of nucleotides of a bacterium DNA, we deduced its resonance frequency. In the millimeter range the wave absorption into the water along the DNA is weak. Plasma oscillations near the ionic plasma frequencies have been obtained upon two enclosed gas plasma device antennas lighted with a modulated R.F electronic discharge. The modulation frequencies are low (< 500 to 1000 Hz).One antenna used an helium gas, the other an argon gas. Due to non linear effects, the ion density depends on the modulation frequency. Plasma oscillations explain the bacteria destruc-
P-171 STUDENT IN VITRO STUDIES OF LOW FREQUENCY ELECTROMAGNETIC FIELD EFFECTS ON THE IMMUNE SYSTEM USING A SOLENOID COIL EXPOSURE SYSTEM. S. de Kleijn1, M. Bouwens2, J. Arte1, L. Verburg-van Kemenade1, J. Cuppen1, A. van Dijen1, P. Hermans1, Laboratory of Pediatric Infectious Diseases, Radboud Uiv Nijmegen Medical Centre, Nijmegen, Netherlands. 1Cell Biology & Immunology Group, Wageningen Univ, Wageningen, Netherlands. 2Innmet BT, Veldhoven, Netherlands.

Low frequency electromagnetic fields (LF-EMF) are potential activators of the immune system. To study these effects on immune cells in vitro, we designed a solenoid coil exposure system, for use inside a standard incubator, and with minimal interference of LF-EMF in the surroundings. Using transcriptome analysis and immune-activation assays, we plan to elucidate the underlying mechanisms of the potential immune activating effects of LF-EMF in a multi-disciplinary, multi-center study.

P-172 PROOF OF PRINCIPLE TESTS CONFIRM GENOTOXIC POTENTIAL OF RF-EMF. F. Adler1, E. Kratochvil2, H. W. Rüdiger1, VERUM Foundation, München, Germany. 1Medical Univ of Vienna, Vienna, Austria.

Human fibroblasts were exposed to 1800 MHz RF-EMF without and with different system modulations and to 1950 MHz UMTS at a SAR of 2 W/kg and below using different exposure times and patterns. The samples were analysed with the alkaline comet assay by calculating the comet tail factor and with the micronucleus test by counting the micronuclei after blocking the cytokinesis with cytochalasin B. The experiments clearly demonstrate a significant increase in DNA strand breaks and in micronuclei thus confirming the genotoxic potential of RF-EMF and its various modulations, but do not provide any insight into the mechanism of their genesis.

P-173 MILLIMETER-WAVE EXPOSURE SETUP AND DOSIMETRY FOR IN VITRO STUDIES. M. Zadahori1, R. Soual2, C. Nicolai Nicolaz1,2, D. Thourous1, D. Miché1, C. Le Quement1, Y. Le Drianc1, Inst of Electronics and Telecommunications of Rennes (IETR), Univ of Rennes 1, Rennes, France. 2Cellular and Molecular Interactions Group, Univ of Rennes 1, Rennes, France.

In this paper, we consider a specific millimeter-wave exposure setup developed to perform far-field or near-field exposures of cell cultures with power densities close to those expected from the near-future wireless communications in the 60-GHz band. System sub-units and exposure characteristics are described. Numerical dosimetry results are provided for the typical biological samples used in in vitro experiments. The exposure setup has been validated in a series of biolocmagnetic experiments at cellular and sub-cellular levels and complete results will be presented during the meeting.

P-174 OCCUPATIONAL EXPOSURE MEASUREMENTS IN THE VICINITY OF MRI SCANNERS. S. Känsälä1, T. Tenh1, T. Aalton1, K. Jokela1, Non-Ionizing Radiation Laboratory, STUK - Radiation and Nuclear Safety Authority, Helsinki, Finland. 1New Technologies and Risks, Finnish Inst of Occupational Health, Helsinki, Finland.

A measurement setup that detects time rate of change of magnetic flux density (dB/dt) was developed for simultaneous measurements of gradient magnetic fields and magnetic fields generated by motion in static fields of MRI scanners. The magnetic field components were measured for an open 1 T scanner and a cylindrical 3 T scanner. The values were compared to dB/dt reference levels derived from magnetic flux density reference levels given by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). The exposure significantly exceeded the derived ICNIRP reference levels in positions where the medical staff can have access during interventional procedures.

P-175 AN IMPROVED [0.08-6GHZ] PORTABLE DOSIMETER FOR EPIDEMIOLOGIST STUDIES. C. Persi1, Y. Toutain2, M. Le Henaff1, G. Toutain2, LabSTICC, Institut Télécom/telecom Bretagne, Brest, France. 1SATTMO Bretagne, Brest, France.

In order to answer the combined requests of the WHO and epidemiologists, selective epidemiologic dosimeters have been designed for evaluating the electromagnetic field of the general population, as well as occupation peoples. In this paper, we propose to carry on the results of a study aiming at improving these dosimeters, for reducing their dimensions, and improving their performances (sensitivity,...) in an extended frequency range.

P-176 DEVELOPMENT OF MULTIPLE-FREQUENCY EXPOSURE UNIT FOR IN VITRO EXPERIMENTS. T. Kim, W. Jeong, J. Pack, Radio science and engineering, Chungnam national Univ, Daejeon, Korea, South.

Most of the studies were focused on the single frequency EMF exposure. People in real environment, however, are exposed by EMFs from various electromagnetic sources simultaneously. For multiple-frequency exposure unit, we adopted a RTL structure terminated with an absorber at the outer edge of the RTL, which has been used widely for broadband EMF exposure system for in vitro experiment.

P-177 MEASUREMENT UNCERTAINTIES FOR IN-SITU RF MEASUREMENTS. J. Estenberg; Swedish Radiation Safety Authority, Stockholm, Sweden.

In this study, the variation of measured field strength in a controlled environment was compared with the variation for in-situ measurements. The purpose was to estimate how uncertainty factors can affect results of real life measurement. The measurements were performed by twelve teams, using totally 20 different measuring equipments. The deviation of the measured levels was found to be only +/-7 dB for the real life measurements even though there were many sources of error. This deviation is surprisingly small in relation to the +/-3 dB and +/-6 dB for the measured CW signals in the controlled environment.

P-178 LABORATORY PERFORMANCE TESTING OF PERSONAL RF EXPOSIMETRY DEVICES. P. Juhász1, P. Gál2, G. Thuróczy1, 1Dept. of Non-Ionizing Radiation, NRIRR, Budapest, Pest, Hungary. 2Faculty of Electrical Eng. and Informatics, Budapest Univ of Tech and Economics, Budapest, Pest, Hungary.

Three PEMs were tested in an anechoic chamber in a controlled laboratory environment to characterize their usability in future real-life observation campaigns. Several hardware-related issues were identified during the laboratory test: the ESP 090 and EMG-Spy 121 are limited by narrow measurement range, while the ESM-140 has poor band filtering which causes adjacent-channel interference. Furthermore, the importance of the PEMs’ position relative to the subject’s body was revealed. Also a test mobile phone was placed at various positions around the subject. Results at the same phone position may differ by a factor of 3 when the PEM position changes.
NEW METHODOLOGY FOR THE ESTABLISHMENT OF INTENSITY LEVEL MAPS OF ELECTROMAGNETIC FIELDS IN HOSPITALS. N. Carranza1, J. Hervías1, C. S. Luñá1, J. García1, J. F. Aldecoa1, V. Ramos1, Telemedicine Unit, Hospital Carlos III, Madrid, Spain. Subdirección de Ingeniería, Hospital Universitario de Canarias, Tenerife, Spain.

An important issue to consider when planning building a hospital is the electromagnetic fields which will be present. High signal peaks could generate unwanted electromagnetic interferences in electro-medical equipment, which may result in a wrong diagnosis or treatment for the patient. In this work, a new methodology for the generation of intensity level maps of electromagnetic fields taken in each unit of a hospital is proposed. A set of samples situated on a grid of a certain dimension is collected, and processed subsequently. Several level curves have been obtained, showing that this methodology could help in the design of new health centres.

STUDENT THERMOSENSOR PROTEIN GrpE OF THE HEAT SHOCK PROTEIN HSP70 SYSTEM AS TARGET FOR ELECTROMAGNETIC FIELDS. C. Beyer1, J. Jelesarov1, P. Christen1, J. Fröhlich1, Information Tech and Electrical Engineering, ETH Zurich, Zurich, Switzerland. Biochemistry, Univ of Zurich, Zurich, Switzerland.

A mechanism-oriented approach to analyse the influence of uniform electromagnetic fields in the frequency range from 50 MHz up to 2 GHz on the conformational equilibrium of exposed proteins using a novel experimental setup is presented. The exposure chamber is placed in the measurement compartment of a spectropolarimeter recording the circular dichroism signal. Thus, potential conformational changes induced by electromagnetic fields can be observed. Since the point of observation becomes identical with the potential electromagnetic field interaction site in space and time, the detection of even small effects becomes possible. By examining proteins like GrpE, that undergo completely reversible thermal transitions, thermal and non-thermal effects of electromagnetic fields should be distinguishable due to the different time scale of immediate EMF effects and delayed thermal effects.


Magnetic resonance imaging (MRI) is one of the noninvasive imaging techniques inside human body. The radio frequency (RF) coil is one of the important parts in the MRI system. During imaging, the RF coil radiates electromagnetic (EM) pulse to the human body and receives the NMR signals emitted from the body. Therefore, it is necessary to estimate the specific absorption rate (SAR) in the human body due to the radiated EM energy from the RF coils. In this study, by use of thermographic method, SAR distribution inside head model was intended to measure employing birdcage coil for MRI system.

RF FIELD STRENGTH MEASUREMENT METHOD FOR EVALUATION OF HUMAN EXPOSURE IN MODERN RADIO FREQUENCY SPECTRUM USE. J. Higashiyama, T. Oshita, Y. Tanezawa; Research Laboratories, NTT DOCOMO, INC., Yokosuka-shi, Kanagawa, Japan.

This paper proposes a method for measuring the field strength for human exposure evaluation. The field strength represents the combined field strength from many radio sources which are generated by a variety of modern radio communication systems and have different occupied bandwidths. In the first step of the method, the occupied bandwidth of a target signal is detected from the received frequency spectrum. The power density of the target signal is calculated by taking the integral of the received levels to cover the occupied bandwidth. The experimental results are shown, to confirm the validity of the proposed method.

RECONSTRUCTION BY EXTRAPOLATION OF ELECTRIC FIELD DISTRIBUTION IN PHANTOM WITH GAUSSIAN FUNCTIONS FOR SAR PREDICTION. F. Gallo1,2, J. Wiart3. 1 Micro-ondes, Institut telecom - telecom Bretagne, Brest, France. 2Safe/ waive, Orange labs, lisy les Moulinaux, France.

In literature, relations describe the variation of the electric field peak intensity in the phantom. However, to assess the 1g SAR and 10g SAR values, the electric field distribution is necessary. From a measurement plane, we propose to extrapolate the distribution with a Gaussian function. The variance in other plane can be predicted with simple relation based on linear or polynomial interpolation. This approach could be used for the prediction of peak, 1g and 10g SAR with neural network.
sioning system has been developed in TELECOM ITALIA LAB (TI-Lab). The new system actuates an optical alignment of the terminal by using shadow maps projected to intercept the reference lines represented on the cellular phone.

P-187 CALIBRATION SYSTEM FOR SAR PROBES AT FREQUENCIES FROM 20 TO 450 MHZ. T. Törö, T. Mattonen, T. Tuovinen, L. Paturanen, K. Jokela, STUK - Radiation and Nuclear Safety Authority, Helsinki, Finland.

To enable accurate SAR measurements at frequencies from 20 to 450 MHz a Transverse Electromagnetic (TEM) cell system has been developed for calibration of SAR-probes in tissue equivalent liquids. The system can be used around 400 MHz (TETRA and PMR devices) and with some modifications at other lower frequencies. The TEM cell consists of tapered air-filled lower section, matching section and liquid-filled upper section. The SAR-probe is calibrated against temperature rise measurement with an efficiency of 0.24 W/kg/W, which coincides well with FDTD simulations and analytical calculations. The estimated expanded uncertainty of the calibration at 380 MHz is ±13.5%.

P-188 STUDENT FLEXIBLE MEASUREMENT SETUP FOR ELECTROMAGNETIC EXPOSITION OF BIOLOGICAL SAMPLES. M. Goldhammer, A. Doss, C. Thielemann, U. Bochler; Faculty of Engineering Sciences, University of Applied Sciences Aschaffenburg, Aschaffenburg, Germany.

In this work we describe a stripline as alternative to current exposition setups, especially to often used standing-wave based systems. Our approach features a larger available homogeneous field volume, making the setup more flexible in use and allowing different kinds of samples. Other advantages are the wide frequency range, reaching from 0 Hz up to mobile phone and wireless LAN bands, as well as the possibility of using local heating elements to improve the stability of the sample temperature during exposition time.

P-189 STUDENT ELECTROMAGNETIC RADIATION MONITORING TIME SERIES ANALYSIS BASED ON EMPIRICAL MODE DECOMPOSITION. A. Karagiannis1,2, P. Constantinou2,1; 1National Technical Univ of Athens, Athens, Greece. 2Electrical and Computer Eng, Nat’l Technical Univ of Athens/ICCS, Athens, Greece.

A wide network of electromagnetic radiation monitoring is deployed in Greek territory measuring the effective value from the frequency band 100 KHz to 300 GHz on 24 hours basis. Time series concerning effective value at the aforementioned band as well as time series at sub bands along with environmental data are extracted for specific time intervals and processed using a new method for processing, the Empirical Mode Decomposition.

P-190 SELECTION OF MEASUREMENT TECH FOR FIELD STRENGTH MEASUREMENT AND DOSIMETRY OF PULSED HIGH ELECTRIC FIELD STRENGTH MICRO-WAVE FIELDS, N. D. Montgomery1, R. L. Scarmari2; 1RHDR, AFRL, Brooks City Base, TX, USA. 2General Dynamics Advanced Information Systems, Brooks City-Base, TX, USA.

The availability of devices producing very high peak electric field strengths creates challenges for the bioeffects community because of the difficulty characterizing the field strengths for safety and dosimetry purposes. Bioeffects field strength measurement challenges include the need to characterize very high field strengths accurately, with high resolution, and in less than ideal environments. Air Force Research Laboratory, 711th HPW/RHDR has selected an electro-optical measurement technique due to its linear response over a wide range of field strengths using nonperturbing sensors and transmission lines, and its availability in a small package for transportation.

P-191 ON MICROWAVE IMAGING OF FEMALE BREAST. T. Cotnapur, O. M. Bucci2, L. Crocccor, L. D. Dinato; 1Institute for Electromagnetic Sensing of the Environment - National Research Council, Napoli, Italy. 2Dept of Electronic and Telecommunication Engineering, Federico II Univ of Naples, Napoli, Italy. 3Dept of Informatics, Mathematics, Electronic and Transportation, Mediterranean Univ of Reggio Calabria, Reggio Calabria, Italy.

As far as breast cancer imaging is concerned, microwave tomography is worth to be considered since it is in principle capable of providing a morphological and a functional screening. However, since a nonlinear and ill-posed inverse scattering problem has to be addressed, its effectiveness is still an open issue. In this communication, we will point out how the features of the measurement environment can contribute in reducing/increasing the complexity of the problem at hand. Hence, provided a proper design of the measurement setup is carried out, microwave screening is expected to be able of achieving functional images of the female breast.

P-192 DEVELOPMENT OF MEASUREMENT SYSTEM FOR MMW EXPOSURE TO AN EYE OF A RABBIT. T. Sakai1, M. Kojima2, Y. Miyata3, Y. Yamashiro1, K. Sasaki2, H. Sasaki3, S. Watanabe4,5, K. Sato; 1National Inst of Information and Communications Technologies, Tokyo, Japan. 2Kanazawa Medical Univ, Kakeso, Japan. 3NTT Advanced Tech, Tokyo, Japan. 4Tohoku Banka Gakuen Univ, Sendai, Japan.

It is expected that quasi-millimeter waves or millimeter waves (MMW) Tech will rise due to the growth and need for high-resolution sensing and high-data transmission. Therefore there are concerns about effects caused by an exposure to millimeter waves. The eye is particularly vulnerable to micro wave (MW)-induced injuries. International protection guidelines limit local MW exposure to certain incident power densities (for example, Japan 3-300 GHz, 10 mW/cm² in public, United states of America, 15-500 GHz, and EU nations, 10-300 GHz). One of the rationale of the safety limits is based on reports of ocular thermal effects, e.g., cataract. To verify these guidelines, we developed a measurement system for MMW exposure to an eye of a rabbit.

P-193 BIOSTIMULATION OF MICROORGANISMS EXPOSED TO MULTIPOLAR EMF SYSTEMS. A. Zavalin1, V. Lensky4, P. McCarrol1, R. Westbrook5, E. Collins3; 1Physics, Fisk Univ, Nashville, TN, USA. 2Biology, Fisk Univ, Nashville, TN, USA. 3NA&MDivision, Fish Univ, Nashville, TN, USA. 4Multipolarity LLC, Nashville, TN, USA. 5Internal Medicine, Southern Illinois Univ, Springfield, IL, USA.

A biostimulation effect of EMFs generated via systems of interdependent emitters in a near-field regime significantly accelerates bacterial growth. Although in industrial environments ecological monitoring of the net EMF in the compensation zone inside of such a system may show near-zero values, the biological effects have to be specifically tested. The biostimulation is especially strong under exposure to symmetric multipolar systems of EMFs. Experimental data based on growth curves for standard E.coli cultures demonstrates a 2-fold biostimulation effect, observed during the lag and log phases. The obtained results, possible mechanisms, and applications to ecology, bioTech, and biofuels production are discussed.

P-194 INTER-LABORATORY 50 HZ EMF MEASUREMENTS. J. Magne, D. Clement, M. Burcau, P. Deschamps; 1 ’EDF R&D, Meurt sur Loing, France. 2’ETE, Paris la Defense, France. 3’LABOR ELEC, Linkebeek, Belgium.

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The accredited laboratory for 50 Hz EMF measurements of RTE-organised in 2008 for the first time in France an inter-laboratory for electric and magnetic field measurements. Two other laboratories participated: EDF R&D and LABORELEC. The measurements were performed under power lines located in the HV substation of Domloup (France). Each laboratory used its own measurement procedures. The synthesis report was done by RTE, following the relevant metrological standards. The inter-comparison has also allowed to give some general advices to improve measurement practices. Other laboratories interested in this topic are invited to participate to another experiment to be organised in 2009.

P-195
NON-STATIONARY EMF SURVEYING. H. Treska, P. Bienkowski, Inst of Telecommunication, Teleinformatics and Acoustics, Wroclaw Univ of Tech, Wroclaw, Poland.

The work presents two new solutions of non-stationary EMF meters calibration methods. The most accurate one requires an additional modulation of a pulse modulated source of an EMF standard, the shape of the modulation effects radiation pattern of a source that then will be investigated. Simplified approach permits a replace of the modulator by a switch and keying the train of pulses such a way that its RMS or mean value is equivalent to then measured one. The procedure must be repeated separately for any radiation source that assures a possibility of measurement uncertainty estimation that was impossible till now.

MECHANISMS OF INTERACTION

P-196
INFLUENCE OF COMBINED AC-DC ELECTROMAGNETIC FIELDS ON CELL PLASMA MEMBRANE. M. N. Hulgamgome, C. Abeyratne, P. Mendis, Civil & Environmental Engineering, University of Melbourne, Melbourne, VIC, Australia; 2Civil & Environmental Engineering, University of Leicester, Leicester, UK.

Exposure to electromagnetic fields is a research area that has generated conflicting results and thus uncertainty regarding possible adverse health effects. Accurate modeling and experimentation increases our understanding of the process. This study has investigated the problem of effect of charged particles according to three possibilities of electromagnetic fields: (i) Oscillating electric field and DC magnetic field. (ii) Oscillating electric field and oscillating magnetic field. (iii) Oscillating electric field and oscillating DC magnetic field by considering AC and DC fields. We show numerical results and then discuss the behavior of the particle with different initial positions and velocities.

P-197
THE ROLE OF HEMICHANNELS IN KERATINOCYTE GALVANOTAXIS. C. E. Pullar, A. Riding, R. J. Evans, Cell Physiology and Pharmacology, Univ of Leicester, Leicester, UK.

Upon wounding, the first guidance signal that cells receive is electrical. A lateral electric field (EF) is generated, immediately, with the cathode at the center of the wound. Keratinocytes and endothelial cells (DECs) migrate directionally towards the cathode of an applied physiological EF in vitro. Here we reveal the novel finding that while the mechanism for keratinocyte galvanotaxis is cAMP-dependent, endothelial cells sense an applied EF completely independently of intracellular CAMP.

This research reveals that wound cells have unique mechanisms for sensing EFs. Future research will delineate the mechanisms and reveal the EF sensor for each wound cell type.

P-198
BACTERIAL GROWTH AND SURVIVAL AND CHANGED PROTRANSPORT AND ATPASE ACTIVITY UNDER MILLIMETER WAVES RADIATION. A. Trchounian, Dept. of Biophysics, Yerevan State University, Yerevan, Armenia.

Low intensity coherent electromagnetic radiation of millimeter range (the frequency of 51.8 and 53 GHz) markedly affected Escherichia coli and Enterococcus hirae growth and survival as well as proton transport across membrane and membrane ATPase activity. Moreover, the increased effects of sodium azide and N,N'-dicyclohexylcarbodiimide, inhibiting H+ transporting F0F1-ATPase, on proton fluxes and ATPase activity were obtained suggesting a role of F0F1 in radiation effects. The frequency of 51.8 GHz was stronger in these effects. The membrane aspects of action mechanisms are discussed among different pathways and effects.

P-199

Upon wounding, the first guidance signal that cells receive is electrical. A lateral electric field (EF) is generated, immediately, with the cathode at the center of the wound. Keratinocytes and endothelial cells (DECS) migrate directionally towards the cathode of an applied physiological EF in vitro. Here we reveal the novel finding that while the mechanism for keratinocyte galvanotaxis is cAMP-dependent, endothelial cells sense an applied EF completely independently of intracellular CAMP. This research reveals that wound cells have unique mechanisms for sensing EFs. Future research will delineate the mechanisms and reveal the EF sensor for each wound cell type.

P-200
MICROWAVE IRRADIATION EFFECT ON PEROXIDASE ACTIVITY OF CYTOCHROME C. G. G. Borisenko, D. Kazarinov; 1Research Inst of Physical-Chemical Medicine, Moscow, Russia. 2Kotel’nikov Inst of Radioengineering and Electronics of the Russian Academy of Sciences, Frunzeev, Moscow region, Russia.

Aptosis, a programmed cell death, plays an essential role in embryonic development, tissue homeostasis and various pathological conditions including inflammation and ischemia. Cytochrome c-driven cardiolipin (CL) oxidation in mitochondria membrane appears to be one of the key events at the initial stage of mitochondria-dependent apoptosis. Here, by using model system of cytochrome c (cyt c) and phospholipid membranes we demonstrated that microwave irradiation can stimulate cyt c-dependent oxidation of substrates in the water and membranes. Our results suggest that microwave irradiation may elevate sensitivity of cells to apoptotic stimuli.

P-201
STUDENT EFFECTS OF 53.37 GHz RADIATION ON CATIONIC LIPOSOMES. M. Cataldo, L. Di Donato, R. Muscat, A. Romando-Orlando, 1Inst of Neurobiology and Molecular Medicine, National Research Council, Rome, Italy. 2Inst for Electromagnetic Sealing of the Environment, National Research Council, Naples, Italy. 3Physics Science, Univ Federico II, Naples, Italy.

The interaction between MW and biological systems could involve resonant/non-thermal mechanisms at very low powers. Recently we observed that low-intensity 53.37 GHz radiation of giant vesicles results in physical changes, induced diffusion of fluorescent dye, and increased attraction between vesicles. Here we used liposomes loading an enzyme to reveal real-time changes on bileyar permeability induced by irradiation. Simulation data indicated power densities of 3.3 mW/cm2 and SAR of 0.005 W/Kg (whole sample) and 0.53 W/Kg (upper layer). When liposomes were subjected to intermittent irradiation (MMW-on 1.5 min-off 1.5 min) during kinetic measurements no significant change on the enzymatic rate resulted.
P-202
EXPOSURE TO 60HZ ELF IN APARTMENT BUILDING WITH BUILT-IN TRANSFORMER STATIONS IN KOREA. Y. Kim1, C. Lee2, K. Kin1, S. Hong3, J. Jeon4; 1Hanyang Univ, Seoul, Korea, South. 2Occupational Health and Safety Engineering, Inje Univ, Kimcheo, Korea, South. 3Korea Ministry of Environment, Gwacheon, Korea, South.

Apartments in multi-level residential buildings located above transformer stations (TRS) might offer the possibility of conducting epidemiological studies of residential MF exposure that include higher exposure levels than previous studies, avoid selection bias and minimise confounding factors. Thus, an epidemiological study focusing on populations living in apartment buildings with transformer stations is likely to reduce the uncertainty surrounding the association between ELF MF and childhood leukemia. Measurements are being in 30 apartment buildings, 20 multi complex building. To get amore representative sample, measurements were taken in Seoul, Korea. In each building, one apartment directly above the transformer station was included in the study. The transformers were selected as a random sample, but technical details of the transformer stations were obtained from the utilities to be able to study the relationship between structural characteristics and MF exposure level. The results of spot measurements of values in apartments on the same floor as the index apartments, but not immediately above transformer rooms, tended to be similar to those in apartments on higher floors. In the apartments above the transformers, the highest values were observed in the living rooms and the bedrooms and lower values were observed in the kitchens and second bedrooms, probably reflecting the relative location of these rooms to the bus-bars or low-voltage cables.

P-203
PHYSIOLOGICAL RESPONSES TO ELF ELECTRIC FIELD EXPOSURE DURING THE MENTAL WORK LOAD TASK - STUDY ON THE MECHANISM OF THE FIELD EFFECTS. 1M. Yamashita, K. Shimizu; 2Hokkaido Inst of Tech, Sapporo, Japan. 3Hokkaido Univ, Sapporo, Japan.

The local exposure of ELF electric field affecte skin temperature and some analysis suggested the effect on autonomic nerve response in the manner of suppression of sympathetic nerve activity. To confirm the mechanism of the field effect, the Kapelken test was introduced to raise the sympathetic nerve activity. Using this test, the Skin Conductance Change due to the mental perspiration and the heart rate were analyzed. Consequently, the increase of the SCC supposed to be suppressed by the field exposure under the mental work load condition. This suggested that the ELF electric field suppressed the skin sympathetic nerve activity.

P-204
GENETIC THERMOMETRY DEMONSTRATES INTRACELLULAR HEATING IS NOT RESPONSIBLE FOR BACTERIAL INACTIVATION IN LOW POWER ELECTROMAGNETIC FIELDS. K. M. McCabe1, L. Portelli2, E. Shee- hant, F. Barnes3, M. Hernandez2; 1Dept of Electronic Engineering, Univ of Rome “La Sapienza, Rome, Italy. 2Electrical Engineering, University of Colorado at Boulder, Boulder, CO, USA. 3Electrical Engineering, Univ of Colorado at Boulder, Boulder, CO, USA.

Intracellular heating has been implicated as a primary mechanism for the inactivation of bacteria and eukaryotic cells exposed to low power EMF (<1 mW/g). We present genetics based intracellular thermometry, which colormetrically reports cytoplasm temperatures near real time. We demonstrate that promoter-mediated thermometry is linear through a 20°C range circumventing the optimal growth of E. coli (37°C) – with accuracy between 1-2°C. We report here, no intracellular heating occurred during lethal EMF exposures (3hr), which resulted in 2 log inactivation. These results confirm that temperature increase is not likely to be responsible for inactivation associated with exposures to weak EMFs.

P-205
STUDENT
ANOMALOUS HEATING IN A LIVING CELL WITH DISPERSIVE MEMBRANE CAPACITANCE UNDER PULSED ELECTROMAGNETIC FIELDS. A. De Vita, R. Croce, V. Piero, I. Pinto; Engineering, Univ of Salento, Benevento, Italy.

The specific capacitance of living cell membranes may be frequency-dependent. In the spectral bands where the membrane specific capacitance drops significantly, most of the absorbed power can be dissipated in the membrane. For pulsed fields acting on timescales shorter than those of thermal diffusion across the cell, this may result in rapid increase of the local membrane temperature up to possible biological damage, even at low, perhaps non-thermal field levels. To this end, an analytic solution of the full heat diffusion problem for a homogeneous spherical cell with dispersive membrane admittance exposed to a pulsed electromagnetic field is derived.

P-206
PEMF POTE NTIATES THE INDUCTION OF NITRIC OXIDE BY GLUTAMATE AND 6-HYDROXYDOPAMINE IN A NEURONAL CELL LINE. D. Casper1, R. Lekhraj1, M. Yeung2, A. A. Pillai3; 1Neurosurgery, Montefiore Medical Center, The Bronx, NY, USA. 2Biomedical Engineering, Columbia Univ, New York, NY, USA. 3Barnard College, New York, NY, USA.

The effects of pulse modulated radio frequency PEMF signals on nitric oxide (NO) production were investigated in real time using two in vitro models of dopaminergic neurodegeneration by an electrophysiological detection system. PEMF signals potentiated NO synthesis in response to 6-OHDA, a selective dopaminergic neurotoxin that induces oxidative stress and inflammation, and glutamate, an excitatory amino acid neurotransmitter that can be toxic under certain conditions. Increases were in the nanomolar range, consistent with a role for NO in neuroprotective signaling.

P-207
STUDENT
CHARACTERIZATION OF MICELLE SYSTEM IN PRESENCE OF AN EXTERNAL ELECTRIC FIELD: A MOLECULAR DYNAMIC STUDY. P. Marrucino1, A. Tarquini1, F. Apolloni2, M. Libert2, A. Amadei1, A. Ramundo Orlando1, G. d’Inzeo3; 1Dept of Electronic Engineering, University of Rome “La Sapienza, Rome, Italy. 2Dept of Chem, Univ of Rome “La Sapienza, Rome, Italy. 3Dept d'Inf Physics of Rome “Tor Vergata, Rome, Italy. 4Neurobiology and Molecular Medicine Inst, Nat Res Council (CNR), Rome, Italy.

Thermodynamic properties of a direct micelle (TDDNO) in water are discussed. The unique behavior of water is largely due to dynamic hydrogen bonded networks that exist when water is in its liquid form. Hydrogen bonds are weak at room temperature, so the clusters modify the dielectric constant and the electric potential gradient across the micelle membrane. For pulsed fields acting on timescales shorter than those of thermal diffusion across the cell, this may result in rapid increase of the local membrane temperature up to possible biological damage, even at low, perhaps non-thermal field levels. To this end, an analytic solution of the full heat diffusion problem for a homogeneous spherical cell with dispersive membrane admittance exposed to a pulsed electromagnetic field is derived.

P-208
THE EFFECTS OF WATER STRUCTURES, ON ITS ELECTRICAL PROPERTIES AND BIOLOGICAL SYSTEMS. F. Barnes, S. Tigges; EECE, Univ of Colorado at Boulder, Boulder, CO, USA.

The structures that water molecules form and their effects on the electrical properties of water and the shielding of ions that bind to biological molecules are discussed. The unique behavior of water is largely due to dynamic hydrogen bonded networks that exist when water is in its liquid form. Hydrogen bonds are weak at room temperature, so the clusters due to these bonds are constantly forming and breaking up. Water molecules form many different structures with lifetimes on the order of 10-7 seconds. These structures modify the dielectric constant and conductivity of water and the mobility of ions in solution.
P-209
DIRECT INTERACTION OF ELECTROMAGNETIC FIELD WITH LONG RANGE ELECTRON TRANSFER. A KEY TO BIOLOGICAL EFFECTS? Z. Kirov, Research Laboratory of Water Quality, Ministry of Health, Tel Aviv, Israel.

It is suggested that harmful biological effects may be related to non ionizing radiation through enhancing a damage already done by ionizing radiation, when the range of charge migration in protein is increased under the influence of time dependent electric field. Calculations of time dependent electronic wave function at donor-bridge-acceptor system in presence of static and oscillatory electric field, oversimplified by ignoring all effects of intervening medium, support that assumption. Main result is that the strength of field counts at the location of interaction with the biological material and not the energy absorbed. Non thermal biological effects are rendered possible.

P-210

We investigated effects of 10-day-long influence of low-intensity extremely-high frequency electromagnetic radiation (EHF EMR) on the spike activity of the rat’s supraoptic neurons. Rats were exposed to EHF EMR at a frequency of 42.2 GHz (power intensity 0.19 mW/cm2, SAR - 1.5 W/kg, daily for an hour). The distributions of neurons by the degree of regularity, dynamics of neuronal current flows, discrete frequency ranges, the mean spike frequency and the interpulse intervals’ coefficient of variation were investigated. The observed changes in internal structure and statistic parameters of impulse streams testify to the modulation of neurons excitability by electromagnetic factor.

P-211 STUDENT A PRELIMINARY STUDY ON THE ROLE OF LIPID RAFTS AND ACID SPHINGOMYELINASE IN RECEPTOR CLUSTERING INDUCED BY 50-HZ MAGNETIC FIELDS. W. Sun; Zhejiang Univ School of Medicine, Hangzhou, China.

To investigate the relationship among a 50-Hz MF-induced EGF receptor (EGFR) clustering, lipid rafts and acid sphingomyelinase (ASM). FL cells were exposed to MF EGF for 15 min. Nystatin served as pre-treatment. EGF receptors, ASM and lipid rafts were labeled with anti-EGFR antibody, anti-ASM antibody and FITC-Cholera toxin subunit B respectively then analyzed by confocal microscopy.

P-212 STUDENT COMPARING EFFECTS OF ELECTROMAGNETIC FIELDS ON SEED GERMINATION AND DEVELOPMENTAL GROWTH IN HIGHER PLANTS. A. Shabrangi1, A. Majd 1, M. Sheidai 2; 1Tehran Tarbiat Moallem Univ, Tehran, Iran. 2Biological Faculty of Shahid Beheshti Univ, Tehran, Iran.

To investigate the relationship between MF and phytochemical characteristics of plants. C3 plants (Brassica napusL.) and C4 plants (Zea maysL.) were exposed to pulsed EMF of strength from 0 to 10mT for 1 to 4 hours in steps of 1 h for all fields. Seed germination rate, developmental growth including: root and shoot length, fresh and dried biomass weight and leaf surface of 7 days seedlings were measured. All experimental data suggested that C4 plants function more precisely and are more resistant than C3 plants against EMFs.

P-213 ASSIMILATORY PIGMENTS AND NUCLEIC ACID CONCENTRATIONS OF VEGETAL TISSUE EXPOSED TO LOW LEVEL 900MHZ CONTROLLED FIELD. S. Mi- claus1, M. Racuciu2, M. Morgen2; 1Land Forces Academy, Sibiu, Romania. 2Politehnica Univ, Bucharest, Romania.

Present work aimed at tracing variations of some common biochemical parameters of vegetal tissue, in controlled exposure conditions (TEM cell). Chlorophylls and carotenoids content together with nucleic acids concentration due to exposure to low-intensity electromagnetic field in the 900MHz band (both continuous wave - CW and modulated wave) were traced in case of Zea mays. Both experimental and computational expo-dosimetry was applied. Exposures of plant seeds for duration in the order of hours...tens of hours, for a SAR<12mW/kg, induced traceable changes in the assimilatory pigments concentration and nucleic acid content. Plantlets developed from exposed seeds grow faster than the not-exposed ones.


Computer-controlled Helmholz coil systems were used to expose cardiac pacemakers and implantable cardiac defibrillators (ICD) to low frequency magnetic field using sine, pulse, ramp and square waveforms with frequencies 2 Hz - 1 kHz. The aim was to find the magnetic field threshold intensities where the pacemakers/ICD’s start to experience electromagnetic interference. Magnetic field intensities used varied from less than the ICNIRP reference levels for occupational exposure to ca. 4 mT. Pacemaker/ICD malfunctions occurred almost immediately after high intensity magnetic field exposure started. Malfunctions were recorded below the occupational reference levels but well above the corresponding limits for public exposure.

P-215 MAGNETO-HYDRODYNAMIC SIMULATIONS FOR NON-INVASIVE CARDIAC BLOOD FLOW MEASUREMENT. W. Kozic1, S. Roehrle2, A. Goua3, V. Krauthamer4, J. Myklebust1, I. Chang1, N. Chavannes2, J. Hwan Kim3, M. Sarntinoranont4, N. Kuster5; 1FDA/CDRH, Silver Spring, MD, USA. 2Schmid & Partner Engineering AG, Zurich, Switzerland. 3Foundation for Research on Information Tech in Society (IT’IS), Zurich, Switzerland. 4Univ. Florida, Gainesville, FL, USA.

The overall goal was to develop a method to non-invasively characterize cardiac blood-flow dynamics based on the magneto-hydrodynamic (MHD) effect. We hypothesize that the MHD signal is capable of rapid and non-invasive measurement of blood flow characteristics that are necessary for evaluating heart failure. We developed a MHD solver which is able to calculate the induced current distribution and the equivalent potentials in simple geometries. Preliminary validation of the MHD solver shows good agreement with values found in the literature. Future simulations will include the calculation of the MHD signals for all four models of the Virtual Family.

P-216 STUDY OF DIELECTRIC PROPERTIES OF HUMAN SKIN IN MILLIMETER WAVE RANGE AND ITS CORRELATION WITH PHYSIOLOGICAL CONDITION. S. F. von Gratowski1, V. F. Meriakri1, C. Alabaster2; 1Laboratory of Spectroscopy and Millimeter Wave Measurements, Inst of Radio Engineering and Electronics, Fryazino Branch, Russian Academy of Sciences, Fryazino, Russia.
those obtained with the CAD and the TDR technique. To the target reflection have been evaluated with the circuital model, behaviours of the electric field in free space and the received voltage due an indirect time domain reflectometry (TDR) technique. The time be-
both with a commercial CAD and with an experimental set-up based on the authors, has been validated by means of comparisons with results obtained both with a commercial CAD and with an experimental set-up based on an indirect time domain reflectometry (TDR) technique: The time be-
aviours of the electric field in free space and the received voltage due to the target reflection have been evaluated with the circuital model, finding a very good agreement between the proposed model results and those obtained with the CAD and the TDR technique.

P-217 STUDENT
NUMERICAL AND EXPERIMENTAL VALIDATION OF A CIRCUITAL MODEL OF A UWB RADAR FOR BREATH ACTIVITY MONITORING. E. Fittella, P. Bernardi, M. Caragno,
o, S. Piso, E. Pinuzzi, Elec Eng, Sapienza Univ of Rome, Rome, Italy.

In this work a circuital model of a UWB radar for a non-invasive and continuous monitoring of breath activity, recently proposed by the authors, has been validated by means of comparisons with results obtained both with a commercial CAD and with an experimental set-up based on an indirect time domain reflectometry (TDR) technique: The time be-
aviours of the electric field in free space and the received voltage due to the target reflection have been evaluated with the circuital model, finding a very good agreement between the proposed model results and those obtained with the CAD and the TDR technique.

P-218 STUDENT
BODY-CENTRIC ANTENNAS FOR BODY AREA NET-
WORKS. T. Yilmaz, T. Karacolak, E. Topsakal; Electrical and Com-
puter Engineering, Mississippi State Univ, Starkville, MS, USA.

In this study, mutual coupling between body-centric antennas for wireless cardiac monitoring is investigated by mounting the antennas on a human torso covered with three layered tissue (skin-fat-muscle) mimicking gel. Particle Swarm Optimization (PSO) algorithm is used to optimize the dimensions of body-centric antennas operating at Industrial, Scientific, and Medical (ISM) (2.40 GHz - 2.48 GHz) band. The antennas are first mounted on a plane covered with three layered tissue mimicking gel, and mutual coupling measurements are performed by varying the position of the antennas. In order to test the performance of the antennas, a female mannequin torso is used. Results regarding the measurements will be presented.

P-219 ELECTROMAGNETIC COMPATIBILITY ISSUES BETWEEN VEHICULAR MOUNTED ANTENNA AND IMPLANTABLE MEDICAL DEVICES. J. Chen1, M. Wang1, J. Short1. G. Bit-Rubin1, W. Kacza2, G. Mendola1, "University of Houston, Houston, TX, USA. "Motorola, Plantation, FL, USA. "FDA, Silver Spring, MD, USA.

In this work, we investigate the electromagnetic compatibility/interference issues related to the human subject with medical implantable de-
ives in the vicinity of vehicle mount antennas. Full-wave electromagnetic analysis was applied to analyze the effects of implantable devices inside anatomically correct human models. Numerical investigation shows that the implantable device can lead to increased SAR in the vicinity of the implant. The wireless receivers on these devices tend to be more susceptible to electromagnetic interference at higher operating frequency.

P-220 ON THE OPTIMAL CHOICE OF THE MAGNETIC FIELD AND NANOPARTICLE PARAMETERS FOR THE SELECTIVE HEATING OF CANCEROUS TISSUES BY MEANS OF HYPERTHERMIA. G. Bellizzi1, O. M. Bucc1; Biomedical, Electronic and Telecommunication Engineering, Univ of Naples "Federico II", Naples, Italy. 1IREA-CNR, Naples, Italy.

The paper presents a criterion to identify the nanoparticle-size and magnetic field parameters to be exploited in Magnetic Particle Hyperthermia to minimize the therapeutic dose of magnetite nanoparticles. The basic idea of the proposed approach consists in estimating the mean values, over the irradiated tissues, of the magnetic and electric power densities to be supplied to the cancerous and surrounding healthy tissues to achieve the heating of the tumour with a desired degree of hyperthermia and selectivity. These quantities are of concern since they allow the estimation of the actual values of the magnetic field parameters exploitable in the treatment.

P-221 EMP EXPOSURE ENHANCED CHEMOTHERAPY AGENT (LOMUSTINE) DELIVERY TO RAT BRAIN TUMOR. G. Dong, S. Xu, X. Wang, K. Li, Y. Zhou, L. Qu, J. Zhou, Z. Zhang, J. Tan, J. Su, G. Guo; Radiation Medicine, Fourth Military Medical Univ, Xi’an, China. "Northwest Inst of Nuclear Tech, Xi’an, China.

To study the effect of EMP exposure on the delivery of chemotherapy agent lomustine (CCNU) into brain tumors, a rat glioma model was used. The animals were sham or whole-body exposed to EMP at 200 kHz for 400 pulses. At 1h after sham or EMP exposure, CCNU (50 mg/kg) was administered i.p. to animals. The content of CCNU in blood and tissues was determined by high-performance liquid chroma-
tography. It was found that EMP exposure significantly increased the CCNU concentration in tumor tissues. The results suggested that EMP exposure (200kHz/m, 400pulses) could enhance CCNU delivery to rat brain tumor.

P-222 LOW INTENSITY MILLIMETER-WAVE ELECTRO-
MAGNETIC RADIATION (EMR) EFFECT ON ERYTH-
ROGENESIS. Y. Kadantsevan1, T. Adamyan1, E. Gevorkyan1, S. Minasyan1, A. Hackhoonian1; "Microwave Radiophysics, Yerevan State Univ, Yerevan, Armenia. "Human and Animal Physiology, Yerevan State Univ, Yerevan, Armenia.

The aim of study was to investigate regeneration processes in the circulatory system of rabbits under conditions of bone-marrow deficiency and long-term exposure to low-power extremely high frequency electromagnetic radiation. Measured incident power density was 0.05 mW/cm2 and calculated specific absorption rate was 2 W/kg. The results of experiments show that repeated exposures can cause erythrogenetic activity, prolonged reticulocyte crisis, hemoglobin and erythrocyte content growth, as well as faster reticulocyte maturation. The data obtained demonstrate that living organisms react to a radiation mobilizing their internal resources. Namely, regenerative processes are intensified, while compensation mechanisms gain broader capacities.

P-223 SIGNIFICANT IMPROVEMENT FOLLOWING A THREE-
MONTH PEMF TREATMENT IN A CLINICALLY DEFI-
NITE PERMANENT HEMIPLEGIC SUBJECT AFTER A ROAD ACCIDENT. J. Charlebois1, A. G. Roberge2; Medical Fam-
ily Doctor, Quebec, QC, Canada. "NeurosAXES Canada International Inc., Montreal, QC, Canada.

A treatment using Pulsed Electromagnetic Fields (PEMF) stimulation was recommended in a hemiplegic woman of 50 years of age in relation with permanent disability involving the pyramidal motor system and...
cognitive disturbances three years after an accident. She treats herself
week days at home, with whole body PEMF stimulation. Three months
later, significant improvements were observed on motor motility as well
as cognitive and sensorial performances such as vision, language, atten-
tion and vigilance. Such a successful response is important enough to
be reported to go further in using PEMF therapy in clinical studies for
neurodegenerative diseases to stimulate cellular regeneration.

P-224 WITHDRAWN

P-225 STUDENT

RADIOFREQUENCY ABLATION IN BREAST CANCER: A CRITICAL REVIEW OF CLINICAL STUDIES. M. F. Cepeda, A. Vera, L. Leija; Bioelectronica, Centro de Investigacion y de
Estudios Avanzados del IPN (CINVESTAV-IPN), Mexico DF, Mexico

The aim of this review is compared the currently used RFA in breast
cancer. Here summarized and compared nine clinical studies of RFA in
the treatment of breast cancer published since 1999. The results include
success, failures and complications of 169 tumors in 167 patients aged
37-89 years, using different RFA devices and protocols. RFA seems
to be a promising tool for minimally invasive ablation of breast car-
cinoma. Additionally, it was difficult to analyze these studies because
several different devices were used in different ways. Nevertheless suc-
cessful cases were obtained for smaller tumors with a low failures and
complication rate.

PULSED ELECTRIC FIELDS

P-226 ENHANCEMENT OF THE EXPRESSION OF GENES ELECTROTRANSFERRED IN CELLS IN CULTURE AND IN SKELETAL MUSCLE BY NANOSECOND ELECTRIC PULSES. V. Jedlert1, L. Villemejane1, L. M. Moret1; 1UMR 8121, CNRS, Villejuif, France. 2UMR 8121, Univ Paris-Sud, Villejuif, France.

Cell electro-manipulation by means of nsPEF delivery may increase
the efficiency of gene electrotransfer, 3-fold in vitro in cells in culture
and of 7- to 8-fold in vivo in the tibialis cranialis muscle. This technol-
ogy can be thus favourably used to increase the efficiency of non viral,
electrically mediated, gene transfer.

P-227 TRANSMEMBRANE POTENTIAL MEASUREMENTS ON PLANT CELLS USING THE VOLTAGE-SENSITIVE FLUORESCENCE DYE ANNINE-6. B. Flickinger, T. Berghöfer, C. Eing, W. Frey; Inst for Pulsed Power and Microwave Tech, Eindhoven, Netherlands. 2Center for Nano Biotechnology Research, Chung Yuan Christian Univ, Chung-Li, Taiwan. 3Center for Nano Bioengineering (CNCB), Chung Yuan Christian Univ, Chung-Li, Taiwan.

Mesenchymal stem cells (MSCs) have been considered to be a prom-
ising cell type for regenerative medicine and tissue engineering ap-
plications. The intent of this study was to characterize and compare
the synergistic effect of pulsed electromagnetic fields (PEMFs) on the
ostegenic differentiation of murine MSCs with/without osteogenic
supplements in vitro. The results indicated that PEMF has the poten-
tial on stimulating the MSC proliferation in vitro. Moreover, the higher
magnetic flux density showed greater proliferation. Also, the osteogenic
differentiation was greatly enhanced. It concluded that the PEMF may
play a synergistic role on modulating the proliferation and osteogenic
differentiation in MSCs.

P-228 ELUCIDATION OF MEMBRANE TRANSPORT PROCESSES IN THE GIANT MARINE ALGA VALONIA UTRICULARIS BY EMPLOYING THE CHARGE PULSE RELAXATION TECHNIQUE. L. H. Wegner, Karlsruhe Inst of
Tech. Egggenstein-Leopoldshafen, Germany.

An overview is given on effects of osmotic stress on membrane transport
processes in Valonia utricularis. Electrical properties of cells were stud-
ied by injecting a current pulse (duration: 1 μs; amplitude ~20 mA) and
recording the subsequent voltage relaxation that is mediated by charge
movement across two membrane systems in series, tonoplast and plasma-
lemma. Information on the cellular organisation, on the perception of os-
monic stress, and on transport processes involved in turgor re-adjustment
was obtained. Hyperosmotic turgor regulation is mediated by electricogenic
K+ and Cl- uptake, whereas KCl efflux during hypo-osmotic regulation
apparently occurs partly via electrically silent transport processes.

P-229 TMS APPARATUS FOR TREATING MIGRAINE WITH AURA: MAPPING OF THE CURRENT INDUCED IN A HUMAN HEAD. R. Charlet de Sauvage, I. Lagroye, B. Veyret; IMS, Bioelectronics group, Univ of Bordeaux, Pessac, France.

Limb responses to voltage pulses applied to the ventral surface of anes-
ethetized swine were studied. Amplitudes of four pulse waveforms elic-
ting the same force response were determined. Square and Gaussian
pulses with durations of 20, 50, 100, and 250 μs and increasing expo-
nential and decreasing exponential pulses with durations of 50, 100,
and 250 μs were tested. The least energy was generally required for the
square pulse; the least charge, for either the square or Gaussian pulse.
Required energy decreased while required charge increased with longer
durations of each waveform.

P-230 TESTS OF FOUR PULSE WAVEFORMS TO ELICIT LIMB RESPONSES IN A SWINE MODEL OF ELECTROMUS-
CULAR INCAPACITATION. R. L. Seaman, J. A. Coman, D. D. Col; 1General Dynamics-ADIS, San Antonio, TX, USA. 2Naval Health Research Center Detachment, Brooks City-Base, TX, USA.

A small-size TMS apparatus was built to treat migraine with aura. A
segmented IRM scan of a human head provided by the National Library
of Medicine with 11 tissues was used to compute the current induced by
the coil of the TMS apparatus. The location of the primary motor cortex
of the right thumb was determined on the head model and the induced
current density was calculated at this point. The optimum location and
the magnetic pulse intensity at motor threshold were determined in a
group of volunteers, allowing the computation of the current density at
the motor cortex.

P-231 STUDENT

SYNERGISTIC EFFECT OF THE SPECIFIC PULSED ELECTROMAGNETIC FIELDS STIMULATION ON THE
OSTEOGENESIS IN MURINE MESENCHYAL STEM
CELLS. M. Tsai, R. Hou, W. Li, W. H. Chung; 1Biomedical En-
gineering, Chung Yuan Christian Univ, Chung-Li, Taiwan. 2Center forNano Biotechnology Research Center Detachment, Brooks City-Base, TX, USA.

Mesenchymal stem cells (MSCs) have been considered to be a prom-
ising cell type for regenerative medicine and tissue engineering ap-
plications. The intent of this study was to characterize and compare
the synergistic effect of pulsed electromagnetic fields (PEMFs) on the
ostegenic differentiation of murine MSCs with/without osteogenic
cell type for regenerative medicine and tissue engineering ap-
plications. The intent of this study was to characterize and compare
the synergistic effect of pulsed electromagnetic fields (PEMFs) on the
ostegenic differentiation of murine MSCs with/without osteogenic
supplements in vitro. The results indicated that PEMF has the poten-
tial on stimulating the MSC proliferation in vitro. Moreover, the higher
magnetic flux density showed greater proliferation. Also, the osteogenic
differentiation was greatly enhanced. It concluded that the PEMF may
play a synergistic role on modulating the proliferation and osteogenic
differentiation in MSCs.

P-232 STUDENT

MANIPULATION OF 3T3-CELLS BY NANOSECOND
PULSED ELECTRIC FIELDS. G. Pemen; Eindhoven Univ of
Tech, Eindhoven, Netherlands.
Pulsed electric field Tech is a way of affecting cells with an externally applied pulsed electric field. This externally applied electric field can affect the cell membrane but also the intracellular structures, depending on the field strength, pulse shape and pulse duration. This Tech is under investigation for biomedical purposes [1]. With short duration pulsed electric fields it is possible to make the cell membrane temporarily permeable so that drugs can be locally delivered. Ultra short duration pulsed electric fields can induce apoptosis, which is interesting for the treatment of cancer [2]. This paper will discuss a novel method to generate intense pulsed electric fields to affect biological cells (patent is applied for, so no details of this method can be given now). It will also be shown that the method can be used to enhance the growth of 3T3 cells.

P-233 STUDENT DESIGN AND FABRICATION OF A PERFUSION MICROELECTRODE CHAMBER FOR HIGH INTENSITY ELECTRIC FIELD STIMULATION USING RAPID PROTOTYPING TECHNIQUES. A. Cerjanic, J. Chatterjee, D. McPherson, G. L. Crismon, Electrical and Biomedical Engineering, Univ of Nevada, Reno, Reno, NV, USA. 1Pharmacology, Univ of Nevada, Reno, Reno, NV, USA.

A microelectrode chamber for performing experiments using ultra short (< 1 ns), high intensity (> 1 MV/m) electric fields is fabricated using a process called Xurography. The chamber incorporates perfusion of the biological medium (balanced salt solution in our experiments) via a microfluidic channel. Finite element and Finite-Difference Time-Domain numerical techniques are used to model the geometry of the microelectrode chamber before prototyping. Electric field magnitude and homogeneity are quantified by modeling and the computed return loss for the chamber is verified by network analyzer measurements.

P-234 PLASMA MEMBRANE PERMEABILIZATION BY MULTIPLE NANosecond ELECTRIC PULSES. B. L. Ibey, A. M. Bowman, J. A. Payne, K. A. Sickendick, W. P. Roach, A. G. Pukkamon, 1Radio Frequency Radiation Branch, Air Force Research Laboratory, Brooks City-Base, TX, USA. 2Frank Reidy Research Center for Bioelectronics, Old Dominion Univ, Norfolk, VA, USA.

Previously, absorbed dose was introduced as the metric that determined the decrease in plasma membrane resistance in cells exposed to a single nanosecond electric pulse (nsPF). This work aims to extend previous findings and quantify the effects of multiple nsPF. We found that increasing the number of pulses or the pulse amplitude facilitates the permeabilization effect. However, the absorbed dose was no longer the reference level.

RISK, SAFETY STANDARDS AND PUBLIC POLICY


The EMF-Portal internet platform provides at www.emf-portal.org/overview.php free summaries of published scientific studies on the potential effects of cellular phones. Studies are displayed in interactive diagrams, which can be sorted according to specific endpoints, and contents of particular experimental studies are provided. Additional tables present the most important parameters of individual studies and enable quick comparisons. New studies are continuously researched and integrated. For a deeper understanding of specific topics (e.g. cancer, genotoxicity) further information on relevance and evaluation is available. The user-friendly structure allows access to both broad overviews of specific topics and detailed information of individual experimental studies.

P-236 STUDENT ELF MAGNETIC FIELD EXPOSURE DURING AN INNER-CITY HYBRIDBUS RIDE. B. L. Ibey, T. Laurila, L. Österholm, L. Korpinen, Tampere Univ of Tech, Tampere, Finland.

On the recommendation (1999/519/EC) of the Council of the European Union the reference level of public exposure to magnetic field is 100 μT (50 Hz). The aim of our project was to investigate public exposure to magnetic fields of 110 kV underground power cables. Measurement places were chosen by calling different electric utilities and asking how high currents were in their cables. Six cables from service areas of two utilities were measured. Maximum value at the height of 1 m from the ground was 1.7 μT and on ground surface 5.9 μT. All results are below the reference level.

P-237 STUDENT MEASURING EXPOSURE TO ELECTRIC AND MAGNETIC FIELDS AT 110 KV SUBSTATIONS IN TAMPERE REGION. T. Laurila, L. Österholm, L. Korpinen, Tampere Univ of Tech, Tampere, Finland.

The aim of our project was to investigate EMF exposure at 110 kV substations. The measurements were designed from the perspective of a person walking on the ground of a substation. Fields were measured at five 110 kV outdoor substations in Tampere region. The highest electric field strength value was 4.5 kV/m and the highest magnetic flux density value was 23.4 μT (at the height of 1 m). The measured values are lower than the directive (2004/40/EC) action values 10 kV/m and 500 μT. However, these measurement results can only be applied to tasks done on the ground level.

P-239 STUDENT NUMERICAL ESTIMATIONS ON IMPLANTABLE CARDIAC PACEMAKER EMI DUE TO MOBILE-RADIO IN ELEVATOR USING INHOMOGENEOUS HUMAN PHANTOM MODELS. A. Cerjanic, T. Hikage, T. Nojima, A. Y. Simba, S. Watanabe, Helsinki Univ of Technology, Helsinki, Finland.

The purpose of this study is to investigate the possible effect of cellular phones’ signals on implantable cardiac pacemakers in elevators. Previously, we investigated it through the examination of the electromagnetic field (EMF) distribution inside elevators. In this paper, in order to implement more detailed estimation, we carried out precise numerical simulations using inhomogeneous numerical human phantom models and examined the electric field strength inside the area of the human phantom.
body in which pacemakers are implanted. The computed results of field strengths were compared with a reference level determined from the experimentally obtained maximum interference distance of implantable cardiac pacemakers.

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**ELECTROMAGNETIC FIELD MEASUREMENT CAMPAIGN IN URBAN ENVIRONMENT FOR RISK ASSESSMENT OF ELF AND RF EXPOSURE OF CHILDREN AND TEENAGERS.**

R. Massé, S. Romeo1, L. Di Donato1, M. Calabrese2, R. Ceccone3, C. Di Giovanni4; "Physical Sciences, Un Naples Federico II, Naples, Italy. 2Information Engineering, Second Un of Naples, Aversa, Italy. 3IREA, CNR, Naples, Italy. 4ULTRAN, Italy, Naples, Italy.

In this work we show the results of ELF and RF field levels monitoring carried out in some towns near Naples (Italy) with high density of both population and electromagnetic sources. A particular attention has been paid to schools: the aim is to evaluate the extended (~4h) exposure of children and teenagers that have a longer exposure lifetime than adults and whose developing nervous system could be more vulnerable to unhealth effects of non ionizing radiation. Results indicate that background electromagnetic levels are below Italian limits and in good agreement with results found in other European countries.

P.241

**OCCUPATIONAL HEALTH AND SAFETY ASPECTS OF EXPOSURE TO STATIC MAGNETIC FIELDS OF MRI SCANNERS - STUDY AMONG WORKERS' POPULATION IN POLAND.**

J. Karpowicz, K. Gryz; Laboratory of Electromagnetic Hazards, Central Inst for Labour Protection - National Research Inst, Warszawa, Poland.

Presented study is focused on identification and characterisation of MRI scanners in Poland and workers' activities pattern, as well as investigation of personal exposure level selected of workers. The goal of the study is to cover over 50% of medical MRI centres by investigation of personal exposure of selected workers. Over 100 of medical centres study is to cover over 50% of medical MRI centres by investigation of personal exposure level of selected workers. The aim of the campaign will be presented. The level of SMF exposure of workers is registering by 3-axis Hall probe connected to pocket monitor.

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**STUDENT MEASURING EXPOSURE TO ELECTRIC FIELDS NEAR 110 KV TRANSMISSION LINES IN TAMPERE REGION.**

L. Österholm, T. Laurila, R. Lehtelä, L. Koopinen; Tampere Univ of Tech, Tampere, Finland.

The aim of our project was to investigate exposure to electric and magnetic fields near 110 kV transmission lines in Tampere region. The measurements were made from 7 portal and 3 triangular tower spans at the height of 1 m above the ground. The highest electric field values were between 0.5 - 2.3 kV/m and highest magnetic field values were between 0.6 - 60 µT. All measurement results are clearly below the recommendation (1999/519/EC) reference level 5 kV/m and 100 µT. However, the results are not comprehensive as the measurements were not made in entire Finland.

P.243

**RESULTS OF THE "INTERNATIONAL STUDY OF THE EFFECTS OF INFORMATION ABOUT PRECAUTIONARY MEASURES ON RISK PERCEPTIONS OF MOBILE TELEPHONY (ISEP)".**

P. M. Wicdeman1, R. Shukla1, H. Schuetz1, T. Küpper1, R. Kemp2, J. M. Gatteling2, A. Diaz2, R. de Villiers1, F. N. da Silva Medeiros1, R. Crock3, M. Clauserp1, P. Boerme1, J. Barnert1, J. Alvarez1; 1Inst of Neurosciences and Med (INM-8), Res Centre Juelich, Juelich, Germany. 2Nat Council of Applied Economic Research, New Delhi, India. 3Fax of Business and Commerce, Keio Univ, Tokyo, Japan. 4Fax of Behavioural Sciences, Univ of Twente, Enschede, Netherlands. 5Ray Kemp Consulting, Herts, United Kingdom. 6Brain Sciences Inst, Swinburne Univ of Tech, Hawthorn, VIC, Australia. 7Fax of Health Sci, Stellenbosch Univ, Stellenbosch, South Africa. 8Lab of Estudios Avanzados en Jornalismo, Univ Edo de Campusinos, Sao Paulo, Brazil. 9Australian Centre for RF Bioeffects Research, Hawthorn, VIC, Australia. 10The Inst for Env Modeling, Univ of Tennessee, Knoxville, TN, USA. 11Dept of Psychology, Univ of Surrey, Guildford, UK.

Improvements in risk communication strategies for radiation-emitting technologies require an understanding of risk perceptions, especially when risks are unclear or highly controversial. Precautionary measures are one option to affect risk perceptions. The prevailing assumption to date has been that implementation of precautionary measures, or more precisely communicating or informing about such precautionary measures, will increase trust, alleviate fears, and reduce risk perceptions. In a multi-national, cross-cultural experimental survey research project, we show that a differentiated understanding and approach is needed in regards to risk perceptions related to precautionary measures for mobile phones and base stations.

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**DEEPER RF ENERGY PENETRATION IN HEADS OF CHILDREN THAN ADULTS USING MOBILE PHONES.**

C. Chou; Motorola, Plantation, FL, USA.

In 1996, a study showed different SAR patterns in scaled-head models (simulating heads of an adult and 10 and 5-year old children) exposed to mobile phone frequency fields, i.e., the smallest head had the deepest penetration depth. A figure from this paper has often been shown to support the position that children should not use their mobile phone. This presentation is to compare that result with later studies, which all found that penetration depths in heads of children and adults are about the same, including the results of the more recent paper by the lab that published the 1996 paper.

P.245

**AN AUSTRALIAN EXPOSURE STANDARD FOR ELF ELECTRIC AND MAGNETIC FIELDS.**

L. J. Martin1, A. W. Wood2; 1Non-ionising Radiation Branch, ARPANSA. Yallambie, VIC, Australia. 2Brain Sciences Inst, Swinburne Univ of Tec, Hawthorn, VIC, Australia.

ARPANSA, the national radiation protection agency in Australia, has prepared an exposure standard for ELF electric and magnetic fields, 0 - 3 kHz, including guidelines for static fields. The standard includes basic restrictions on in-tissue electric field preventing the lowest threshold adverse effects and reference levels for electric and magnetic field exposures to ensure basic restrictions are met. Meeting public expectations about proven health effects of ELF fields, while maintaining a science-based approach to setting limits, has needed strong precautionary aspects including assessment of exposure minimisation strategies. The standard recognises the need for some incursion into conservative safety margins during life-saving procedures.
P-246 CONTINUOUS ELECTROMAGNETIC RADIATION MONITORING IN THE ENVIRONMENT: ANALYSIS OF RESULTS IN GREECE. T. Samaras, A. Manassas, J. N. Sahulou; Dept of Physics, Aristotle Univ of Thessaloniki, Thessaloniki, Greece.

In Greece a significant number of monitoring stations, which register electric field values on a 24-hour basis are installed. Although initially these monitors were deployed as a response to public concerns about exposure to electromagnetic radiation, especially from base station antennas, they can now provide useful information about short- and long-term variations of the electromagnetic environment.


Many nations of the world have adopted EMF standards governing non-ionizing radiation that are thermally based, protecting against heating of tissue or burn. In contrast, some national governments have adopted EMF standards that offer greater health and safety protection to human health and the environment, according to the Precautionary Principle, including Italy, Switzerland, Russia, China and Belgium, that are compared to the thermal based EMF standards recommended by some international standard setting bodies. This review will discuss the scientific and policy implications involved in EMF standard setting and, how lowered standards are viewed more positively by the citizens.


EFHRAN (European Health Risk Assessment Network on Electromagnetic Fields Exposure) is a three-year project (2009-2012) of the European Commission in the framework of the Programme of Community Action in The Field of Health (2009-2013). Health 2008. EFHRAN is coordinated by Paolo Ravazzani and involves 7 additional partners (see the author list) from different European countries. More than 15 European research centers, universities and other stakeholders have already expressed their preliminary interest in the activities of this project.


The German Mobile Telecommunication Research Programme was carried out between 2002 and 2008 under the leadership of the Federal Office for Radiation Protection. A financial volume of 17 million Euro was available to fund 54 projects in the fields of biology, dosimetry, epidemiology and risk communication. The findings gave no reason to question the protective effect of current limit values. However, the possibility that children could be more exposed than adults, along with the constantly open question on health risks from long-term exposure, make it necessary to perform further research on the still opened endpoints.

P-250 APPLICATION OF THE 60% AND 70% REDUCTION FACTORS ON EMF EXPOSURE LIMITS PROVISIONED IN GREEK LEGISLATION. G. Filipopoulos, E. Karabottos; Non-Ionizing Radiation Office, Greek Atomic Energy Commission, Ag. Paraskevi, Athens, Greece.

A new Greek Legislation about general public’s exposure to electromagnetic fields in the vicinity of antenna stations provisioned 60% and 70% reduction factors on ICNIRP’s / EU recommendation limits. These factors are applied on basic restrictions contrary to the 80% reduction factor that existed in older legislation and was applied (scientifically inconsistently) on reference levels. In this way, the new Greek reference levels for electric and magnetic field strength occur after the application of the reduction factors directly on ICNIRP’s reference levels when electro-stimulation effects are considered and on their square values when thermal effects are considered.

P-251 EMF MEASUREMENT AND COMMUNICATION ACTIVITY: THE BLUESHUTTLE PROJECT. B. Buecillet, S. Valbonesi; Dept of Information and Electrical Engineering, University of Salerno, Fisciano (SA), Italy; "Comsor FiNet 2009, Bologna, Italy.

Italy has always been characterized by an high risk perception on the effects of electromagnetic fields on human health, this perception has been growing as the operators begun to install antennas and radiobase stations in the territory. During year 2002 the Italian Ministry of Communications established the Italian National Electromagnetic Field (EMF) monitoring network with the technical support of Fondazione Ugo Bordoni (FUB) and in collaboration with the local Environmental Protection Agencies of all Italian regions. The related communication activities still go on, the measurement campaigns performed using the BluShuttle vehicle which are still appreciated by Municipalities and citizens.


The permissible level of occupational exposure to electromagnetic fields (EMF) is in force in Poland since 1972. As it is necessary to transpose the requirements of the European Directive 2004/40/EC into occupational health and safety law, the series of field investigations on pattern of realistic EMF workers exposure and series of computer modeling on assessment of EMF exposure represented by numerical models of EMF sources and human body have been performed. The review of research on the effects of EMF on humans justifying that occupational safety and health regulations should continue to consider worker protection against the effects of chronic exposure to EMF although the minimum requirements of the Directive 2004/40/EC are less strict and refer only to the effects present in exposed body during the continuance of exposure.

P-253 EMF EXPOSURE RISKS FROM FUNCTIONAL MAGNETIC BRAIN IMAGING MAY OUTWEIGH ITS BENEFITS. H. Wachtel; ECEE and Neuroscience, Unit of Colorado, Boulder, CO, USA.

The FMRI method has yielded some valuable information regarding the neuro-geography of human brain function but that knowledge has come at the cost of exposing hundreds of ‘volunteer’ subjects to substantial EMF. This exposure includes large static magnetic fields superimposed with dynamic gradient fields -- as well as RF fields used
to excite nuclear resonances. Each of these field components would be expected to have biophysical interactions with brain (and other) tissue that for repeated exposures could have detrimental effects. Since the temporal and spatial resolution of the FMRI is more limited than generally acknowledged, and other methods can often be used to acquire equivalent information, it may turn out that the downside risk of using the FMRI method on unsuspecting volunteers may outweigh its benefits.

P-254

Exposure of workers and the general public to electromagnetic fields (EMFs) was investigated at railway network surroundings. The buses for the study were the international restrictions for EMF exposure, as well as the increased discussion and concern about potential health effects of EMFs. The project was carried out at various work tasks and situations representing either typical work conditions or normal situations for the general public, such as waiting for the arriving train on the platform. The measured field strengths were compared with the occupational and general public guidelines. The results indicated that EMFs do not exceed recommended exposure values.

P-255
WITHDRAWN

P-256
50 HZ ELECTRIC AND MAGNETIC FIELD MEASUREMENTS IN HIGH VOLTAGE SUBSTATIONS. I. Magne1, P. Audran1, D. Clement1, F. Deschamps1, E. Mayaudon1; 1EDF R&D, Moret sur Loing, France; 2RTE, Paris la Défense, France.

This paper presents results of field measurement done in French transmission substations, in the scope of European Directive 2004/40/EC. These measurement were done by several teams, with the same protocol, which will be described. Results of measurements in 63 kV, 90 kV, 150 kV, 225 kV, and 400 kV substations will be presented. Measurement results will be discussed with regard to the action values and exposure limits set up by the European Directive 2004/40/EC, and also with regards to the relevant standards.

P-257
CARDIAC IMPLANTS AND OCCUPATIONAL EXPOSURE TO 50 HZ MAGNETIC FIELDS. M. Souques1, I. Magne1, J. Lumbrozo1; 1Laboratoire des Matériaux Electriques, KDF R&D, Moret sur Loing, France; 2Service des Études Médicales, EDF, Paris, France

When a worker is implanted with an active cardiac implant, occupational physician has to define his work aptitude. The implant may be perturbed by magnetic field, and the risk has to be evaluated. We have developed a risk assessment methodology, and we present in this paper application to 3 real cases, corresponding to all workers in such a situation in EDF since 2005. We show here the interest of measuring magnetic field and questioning the implant in the same time at the workplace, in order to help the occupational physician to define the work aptitude. The decision of the method to adopt comes under the occupational physician.

P-258
MOBILE COMMUNICATION AND CONDITIONS OF EMF RF EXPOSURE FOR POPULATIONS: NON-AD-EQUACY OF CURRENT EMF SAFETY STANDARDS. Y. Grigoriev, O. A. Grigoriev; Federal Medical Biophysical Centre, Moscow, Russia.

All international EMF RF safety standards continue to be based on THERMAL, ACUTE and PATHOLOGICAL biological effects. However, people usually contact low levels of electromagnetic fields and chronic irradiation not short exposures of thermal intensity. No scientific bases exist to extrapolate international standards to real conditions. The EMF safety standards of RUSSIA/USSR assume non-thermal levels, chronic EMF exposure of all population, and no threshold level for pathological effects, but also do not take into account current daily EMF exposures. Therefore, neither foreign nor Russian EMF standards correspond to the facts of population EMF exposure.
THEORETICAL AND PRACTICAL MODELING

P-262
NEW POWERFUL FDTD SOURCE BASED ON HUYGENS SURFACE: HIGHLY COMPLEX EM SIMULATIONS PERFORMED ON AN ORDINARY PC.
M. Knight; AFRL/RHDR, Brooks City-Base, TX, USA.
A wide range of powerful electromagnetic simulation tools are available today that are based on different methods of computational electromagnetics developed over the past four decades. Each of these software packages can simulate real world problems of large complexity but is limited to a certain problem category. Examples are wave propagation in cities (Ray-Tracing), electrically large antennas and scatterers (MoM=Method of Moments), mobile phone mounted on the body (FDTD=Finite-Difference Time-Domain), micro-devices implanted inside the body or structures on semi-conductors (FEM=Finite Element Method). This study combines a detailed FDTD simulation with a different numerical method and/or another FDTD simulation (sub-gridding). Furthermore, the immediate benefit in memory resources and simulation time is demonstrated.

P-263
DESIGN AND SAR ANALYSIS OF BROADBAND MONOPOLE ANTENNA.
S. Lee, N. Kim, S. Jeon; Chungbuk National Univ, Cheongju-si, Chungbuk, Korea, South.
This paper proposed a novel broadband printed monopole antenna by widening current flow. The bandwidth of dual band antenna is 1.60 - 2.32 GHz and 2.73 - 3.03 GHz. In order to get the broadband characteristics, we insert the patch of diamond shape on the dual band patch antenna. As a result, the bandwidth of new printed monopole antenna is 2.32 GHz and 3.02 GHz below the return loss of -10dB which contain the required bandwidth of PCS/IMT-2000/WLAN band. For the human effects, the analysis of SAR values is important factor. The SAR values are simulated and analyzed.

P-264
SOFTWARE TOOLS FOR EDITING ANATOMICAL MODELS.
M. Knight; AFRL/RHDR, Brooks City-Base, TX, USA.
The Finite Difference Time Domain (FDTD) method is one of the commonly used techniques to assess the interaction of electromagnetic energy with biological media for Modeling and Simulation (M&S). In the past, anatomical models for FDTD were often created by a manual tissue identification and coding process. Inconsistencies in this coding process often led to discontinuous tissue interfaces and other biologically incorrect features in the model. The algorithms developed here will improve this by: optimizing tissue boundaries in current models, performing editing operations on models, and making a more automated process for creating accurate biological models.

P-265
ELECTROMAGNETIC/ THERMAL CO-SIMULATION OF RF THERMAL ABLATION.
T. Wittig1, M. Strydom1, E. Della Loggia2, A. Orlandi2, B. Zobel3; 1CST AG, Darmstadt, Germany, 2UAq Loggia2, A. Orlandi2, B. Zobel3; 1CST AG, Darmstadt, Germany, 1Schmid & Partner Engineering AG (SPEAG), Zurich, Switzerland.
Minimal invasive invasive methods such as Radio Frequency Thermal Ablation are used in cancer treatments with great success. However, testing and development of RFTA devices are limited by the fact that all measurements need to be performed on living tissue, since both current distribution and resulting temperatures depend heavily on blood flow inside the body. As an alternative electromagnetic/thermal co-simulation is shown to be a very helpful tool for designing RFTA devices and for understanding effects during the operation. The results were studied both in a steady state and in transient conditions and show very good agreement to already published references.

P-266
ESTIMATING GENERAL PUBLIC EXPOSURE TO ELECTROMAGNETIC FIELDS GENERATED BY CELLULAR PHONE BASE STATIONS.
P. Fahrni1, U. Knafl2; 1EMC/NIR, OFCOM, Biel-Bienne, Switzerland. 2Foundation for Research on Information Tech in Society (IT’IS), Zurich, Switzerland.
The distribution of the exposed population in function of the field strength of telecommunication base stations is calculated within a typical geographical region. It is shown that standardized data bases for frequency coordination, general population census data, and simple calculation methods result in sufficiently accurate distributions compared to calculations with detailed base station data and more sophisticated propagation tools. Furthermore, drive test measurements were conducted to validate the results. This simple model allows to estimate changes of general exposure over time, to compare them between different countries, and to forecast exposure development due to new technologies.

P-267
EFFICIENT LOW FREQUENCY EM HUMAN BODY SIMULATIONS.
S. Benkler1, X. Chen1, N. Chavannes1, N. Kuster1; 1Schmid & Partner Engineering AG (SPEAG), Zurich, Switzerland.
Because the FDTD method becomes inefficient at low frequencies, other numerical schemes have to be considered. This study investigates the electro and magneto quasi-static approximation in connection with the very detailed human body models. The numerical approach of this study has proven to be very effective in assessing interactions between detailed human body models and electromagnetic fields at low frequencies. Real-world simulation results are presented.

P-268
ANATOMICAL-BASED DEFORMATION OF 3-D CAD HIGH-RESOLUTION HUMAN MODELS FOR COMPLETE ELECTROMAGNETIC SIMULATIONS.
E. Chaves-biol1, N. Chavannes1, N. Kuster1,2,3; 1Schmid & Partner Engineering AG, Zurich, Switzerland. 2Foundation for Research on Information Technologies in Society (IT’IS), Zurich, Switzerland. 3Swiss Federal Inst of Tech (ETHZ), Zurich, Switzerland.
Several techniques have been presented to deal with skeleton driven deformation of 3-D skin models for visual purposes only. The work presented here extends and combines these techniques to deal with high-resolution anatomical full-body models, including deformation of all tissues and organs surrounding the rigid bones in an efficient way. This work also focused on a visual system to set up the hierarchical system of bones that drive the anatomical deformation in an easy way.

P-269
DESIGN AND SAR ANALYSIS OF SPIRAL SLOT ANTENNA FED BY COPLANAR WAVEGUIDE USING THE MAGNETIC PHASE DIFFERENCE.
S. Park2,1, N. Kim1, S. Lee1, S. Park2; 1School of Electrical and computer Engineering, Chungbuk National Univ, Cheongju-si, Chungbuk, Korea, South. 2Chonnam National Univ, Yeosu-si, Chonnam, Korea, South.
A new type of spiral slot antennas, using the magnetic flow in the slots for ultra wide band and circular polarizations fed by a coplanar waveguide, is presented in this paper. As a result of measurement, the bandwidth of the antenna is 2.7-12GHz, and the 3dB bandwidth of the axial ratio is in the ranges 4.2-7.4GHz and 5.9-6.8GHz. The simulated 1g peak SAR value is 1.119W/kg and 10g peak SAR value is 0.562W/kg at 3.5GHz. The results are smaller than the reference SAR limit values that are respectively
For many dosimetric applications, the FDTD method is used to quantify the absorption in the exposed subject. However, the accuracy of numerical results is not evaluated routinely. The objective of this study is to present numerous specialties of the non-equilibrium heating compared to the equilibrium one. Principal differences could be observed in the targeting-selection, and in the membrane reactions of the treated cells, and apoptotic mechanisms could be supported instead of the necrotic heat actions. The effects are temperature induced, but do not depend on the temperature values.

The wavelet transform-based correlation analysis has been used to study microvascular alterations after ELF EMF action. Microcirculatory changes in arterioles were examined in mice exposed to low frequency-electromagnetic fields (EMF), by direct, continuous intravital microscopy. Spectral analysis of the variations in mice skin vascular tone provides useful information about regulatory mechanisms. Arterioles between 45 and 80 mm in diameter were measured. Spectral range of oscillations from 0.0095 to 1 Hz, and four subintervals are revealed, (0.0095-0.02 Hz), (0.02-0.05 Hz), (0.05-0.14 Hz) and (0.14-1.2 Hz), by FFT analysis. In this work our group applied wavelet Daubechies analysis. Daubechies wavelets are a family of orthogonal wavelets defining a discrete wavelet transform.

On the basis of a previously devised subgridding algorithm, we enhance the computing performance further by decomposing the FDTD domain into slices each running as a distinct MPI process. The subgridding algorithm allows the embedding of refined FDTD meshes into coarser ones. High refinement factors can thus directly be used in subregions where an increased resolution is really needed, thus preventing computer resource wasting. With an ad-hoc c.m. field data formatting at the interfaces, an efficient scheme of domain decomposition is then built-in. The techniques will become part of a series of IEEE/ICES-standards for the numerical evaluation of the compliance with RF safety limits.

Finite element meshes with sub-millimetre resolution cannot be generated directly from voxel datasets. However, such datasets provide a convenient starting point for the construction of smooth surface CAD models which be used as input to a mesh generator. We show how various open-source and low-cost commercial software tools can be integrated to facilitate the conversion of existing voxel models to CAD formats. Contouring, smoothing, mesh decimation, and constructive solid geometry modules are described. These are applied to the HPA voxel phantom NORMAN in the construction of a high-resolution model of the eye.

Exposures of magnetic fields with various frequency and intensity can change the antioxidant activity of human and animal bodies. In vivo exposure effects of Extremely Low Frequency (ELF) Electromagnetic Fields (EMFs) on Gliathione (GSH) levels of brain, and heath tissue of experiment animals have been investigated. In this sense, this study focuses on the modeling and formulation of these biological effects for brain and heath using Genetic Programming (GP) based on experimental values. The performances of prediction of the proposed GP formulation versus actual experimental values are found to be quite satisfactory in terms of standard deviation and correlation coefficient. It is concluded that the GP application serves to form a data base for the researchers in this field, without using too many guinea pigs and exposing tissues to EMF.
The impact of source location and human occupancy configurations on in-vehicle SAR levels due to on-board 900 MHz transmitters has been investigated using 3D numerical models. The results suggest that the ICNIRP whole-body average SAR limits for general public exposure would be reached at lower power levels than the localized SAR limits, and that the average field levels over the empty vehicle interior are around twice the field reference levels at the power associated with the average SAR limit in the worst case. Thus, the average empty vehicle field may be a useful measure for in-vehicle human exposure risk assessments.

P-277 INVESTIGATION OF THE FEASIBILITY OF MAGNETIC FIELD VARIATIONS AS A MEDICAL EFFECT WITH HUMAN IN VIVO MEASUREMENTS.

The aim of the research is the investigation of the cardiac stimulation with a magnetic pulse. Starting from the experience of the magnetic brain stimulation, we explored the capability of the magnetic pulse to stimulate the cardiac region. An accurate numerical model has been developed to evaluate the current density flowing into the heart that represents the design constraint of the whole system and will be a compromise between the strength of the induction magnetic field and the pulse rise time. Many technical and technological problems have to be solved. Some preliminary results obtained for a virtual human body are presented.

P-278 STUDENT DOSE ASSESSMENT OF RADIOFREQUENCY EXPOSURE ON FAST PATROL BOATS IN THE ROYAL NORWEGIAN NAVY.

The Royal Norwegian Navy has measured E-fields from communication equipments and radars emitting radiofrequency electromagnetic fields. The measurements, transmitting pattern and sailing time for fast patrol boats (FPB) formed the basis for the approach to a dose assessment. The FPB was equipped with two HF and a Link 11 whip antennas, and two radars. Estimated linear and square E-field dose for both HF and radars were calculated. Difficulties and uncertainty for the different dose assessment will be discussed. The dose approach will be presented.

P-280 NONLINEAR TEMPERATURE BASED OPTIMIZATION FOR HYPERTHERMIA TREATMENT PLANNING USING PDE CONSTRAINED INTERIOR POINT OPTIMIZATION.

We report results obtained from 3-D EM transient thermal co-simulation, performed with the aid of Ansoft HFSS and ePhysics, for a phantom placed within a commercially available 7 T multi-channel coil. The results show that during a heating time shorter than the time constant of the tissue, the heat loss at RF power density hot spots due to thermal conduction and thermal radiation has little effect on SAR estimation obtained from thermal mapping data. Thermal mapping may become an important tool for validation of SAR and power loss profiles obtained from 3-D EM simulations for complex RF coils.

Hyperthermia is a promising treatment modality for cancer. It aims at heating the tumor using EM fields. Antenna arrays are usually used to focus the energy. However, the difficulty of controlling the deposition has so far hindered the acceptance of hyperthermia. A hyperthermia treatment planning tool is required. A nonlinear, temperature based optimization approach has been developed. PDE constrained interior point optimization is used. This method gives flexibility in the underlying thermal model (thermoregulation) and optimization functional (hot-spot reduction, tissue damage based target...). It provides a simple way of performing time-modulated optimization and of specifying temperature constraints in healthy tissue.

P-281 COMPUTATIONAL DOSIMETRY MODELS TO ASSESS EXPOSURE TO LOW FREQUENCY ELECTROMAGNETIC FIELDS.

The paper discusses the application of computational dosimetry techniques to evaluate exposure to ELF EM fields. The available models for human body simulation (FEM, FDM) are quite accurate, however the determination of tissues characteristics (permittivity and conductivity) to calculate internally induced current densities, require some further developments. In current studies the electrical characteristics (permittivity and conductivity) of tissues are based on values which were obtained from measurements done on dead bodies, which may not represent adequately the behaviour of living tissues. In this paper a research designed to characterize the permittivity of human body tissues is presented, consisting on measurements and simulations designed to determine, using indirect methods, the electrical behaviour of living tissues.

P-282 HAND POSITION EFFECT ON SAR AND ANTENNA PATTERN IN RF EXPOSURE STUDY OF A HUMAN HEAD MODEL.

While studying the exposure of the human head to electromagnetic field one the most important quantity to evaluate is SAR inside the head and its distribution. Consideration of only head model interacting with antenna is not enough because other nearby objects such as hand holding the transmitter changes the distribution of the EM field and SAR as well as affects the radiation pattern. These effects are investigated through numerical simulations in this work.

P-283 TRANSIENT THERMAL SIMULATION BASED ON 3-D EM FREQUENCY DOMAIN DATA FOR A 7 T MULTI-CHANNEL COIL.

We focus the energy. However, the difficulty of controlling the deposition has so far hindered the acceptance of hyperthermia. A hyperthermia treatment planning tool is required. A nonlinear, temperature based optimization approach has been developed. PDE constrained interior point optimization is used. This method gives flexibility in the underlying thermal model (thermoregulation) and optimization functional (hot-spot reduction, tissue damage based target...). It provides a simple way of performing time-modulated optimization and of specifying temperature constraints in healthy tissue.
ACKNOWLEDGMENTS

BioEM2009 gratefully acknowledges the following confirmed organizations for their generous financial support for the 2009 Joint Meeting (as of May, 2009). Any additional support received will be acknowledged at the meeting.

Gold Sponsors

Federal Office of Public Health (FOPH)

The overriding aim of the FOPH is to promote and maintain the good health of all people living in Switzerland. On the one hand, it seeks to promote people’s awareness and thereby enable them to take responsibility for their own health. On the other, it wants a general and consistent improvement of everyone’s health through health promotion, disease prevention and health protection campaigns and the curing of illnesses and alleviation of suffering caused by disease and accidents.

In order to achieve these aims, the FOPH deals with issues such as

- epidemiology and infectious diseases,
- substance abuse and drug prevention,
- food safety,
- noise and radiation protection,
- assessment and checks on chemicals and toxic products,
- stem cell research and bioterrorism, and health and accident insurance.

Federal Office for the Environment (FOEN)

The FOEN is the federal government's centre of competence for environmental matters. It contributes to the long term preservation and use of natural resources (air, water, soil, forests, landscape, biodiversity) for society and the economy. Environmental policy is therefore a resource policy and is thus closely linked with the economic and social policies. So the FOEN must seek to implement solutions which also take into account social considerations and the needs of the economy. As far as possible, environmental protection should be achieved by means of voluntary measures and incentives. Just like economic policy, environmental policy is also an innovation policy and creates jobs. Environmental policy also overlaps and influences other policy areas, such as transport, energy, agriculture or financial and fiscal policies.

Federal Office of Communications (OFCOM)

The Federal Office of Communication (OFCOM) handles questions related to telecommunications and broadcasting (radio and television). In this sphere, OFCOM fulfils all sovereign and regulatory tasks. The Office prepares the decisions of the Swiss government (the Federal Council), the Swiss Federal Department for the Environment, Transport, Energy and Communications (DETEC) and the Swiss Federal Communications Commission (ComCom). OFCOM is also developing important international activities.
Acknowledgments

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MMF

The MMF is an international association of telecommunications equipment manufacturers with an interest in mobile or wireless communications. Established in 1998, the association mission is to facilitate joint funding of key research projects and cooperation on standards, regulatory issues and communications concerning the safety of wireless technology, accessibility and environmental issues. The MMF has offices in Belgium, Brazil and Hong Kong and is currently active in more than 30 countries, as well as supporting an extensive international research program.

Our key areas of interest and activity include:

Research in the field of health and safety of mobile communications equipment

- The MMF’s goal in research is to promote the highest quality independent research that provides relevant data to develop sound public policy. MMF funds research to answer important scientific questions. To achieve this, the MMF has responded to the research recommendations of the World Health Organization’s Electromagnetic Fields Project and has coordinated its global activities to correspond with these recommendations.
- Only by enhancing the existing scientific database relating to radio frequency EMF will it be possible to perform an independent health risk assessment recognized by the scientific community as well as by Government and Statutory bodies.

National and international consensus standards

- The MMF’s goal in standards is to have a globally harmonized and consistent approach to conformance and compliance tests and that all safety standards be based on the best available scientific data.
- The MMF coordinates its inputs and contributes relevant expertise within standards-setting processes.
- The MMF commissions quality research in support of standards.

Regulatory policy

- The MMF’s regulatory activities are focused on developing and presenting the views of the mobile industry to regulatory agencies and authorities in a globally coordinated manner.
- The MMF also responds to requests for information, or assistance, by national and international bodies in relation to the safety of wireless technology, accessibility and environmental issues.

Public communications

- The MMF’s communications activity is designed to provide high quality public information and analysis on the safety of wireless technology, accessibility and environmental issues.
- The MMF supports national trade associations by providing a source of information that is based on the pooled resources and networks of our member companies.

SPEAG

Schmid & Partner Engineering AG (SPEAG) is the leading developer and manufacturer of the most reliable, efficient, user-friendly and advanced experimental and numerical tools for the electromagnetic near- and far-fields from DC to light. Our proven technology, application expertise, and worldwide support serve a wide array of markets around the world that use our products to solve applications from the simplest to the most complex and to improve EMI/EMC safety in many industries, including, telecommunications, medical implant, healthcare and automotive. SPEAG invests greatly in research and development to ensure that our customers always benefit from the latest advances in EM technology. Our strategic research alliance with two leading research institutions, the ITIS Foundation and the Swiss Federal Institute of Technology, further ensures that we will always provide the most advanced products/technology with an unmatched level of reliability and efficiency. SPEAG continuously strives to meet the ever-increasing design, R&D and production challenges of complex emerging devices. Our customers can depend on us to optimize radiation efficiency and to solve any EMI/EMC challenges with our broad range of cutting-edge products and solutions without compromising accuracy and efficiency.
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Silver Sponsors

**EPRI**

The Electric Power Research Institute (EPRI), with major locations in Palo Alto, California; Charlotte, North Carolina; and Knoxville, Tennessee, was established in 1973 as an independent, nonprofit center for public interest energy and environmental research. EPRI brings together members, participants, the Institute's scientists and engineers, and other leading experts to work collaboratively on solutions to the challenges of electric power. These solutions span nearly every area of electricity generation, delivery, and use, including health, safety, and environment. EPRI's members represent over 90% of the electricity generated in the United States. International participation represents nearly 15% of EPRI's total research, development, and demonstration program. Robert Kavet, ScD, MEE is the Senior Program Manager responsible for programs in EMF Health Assessment and Radiofrequency Safety.

**NIKKEN**

Nikken is a company with operations in more than 30 countries, recognized as the world leader in wellness technology ever since it pioneered the concept in 1975. Nikken introduced its first product, a magnetic insole, in Japan, and the company launched its North American operations in 1989. With its world headquarters located in Irvine, California, today Nikken offers wellness products in nutrition, skin care, fitness, rest and relaxation, and home environmental control. The company specializes in innovative technologies and Nikken products include unique, patented features, such as EQL Magnetic Technology, a design that provides consistent magnetic coverage; Magnetic Biaxial Rotation, which produces a dynamic magnetic field with constantly changing polarity; Far-Infrared Technology, using specially made ceramic-reflective fibers that absorb energy and reflect it as far-infrared to produce warmth; Kenzen Wellness Technology, whole-foods nutrition; PiMag Water Technology, which recreates the environmental conditions that produce natural pi water; and Air Wellness Technology, an air system that features multistage, advanced filtration and negative-ion generation without the production of ozone.

**SWISSCOM**

Swisscom is Switzerland's leading telecoms provider, with 5.4 million mobile customers and around 1.8 million broadband connections. In 2008, the company's 19,943 employees (full time equivalents) generated revenues of CHF 12.2 billion. Almost 830 young people complete an apprenticeship at Swisscom in the fields of IT, telematics, mediamatics, retailing and commerce.

Swisscom has a presence throughout Switzerland and offers a full range of products and services for mobile, landline and IP-based voice and data communication. Massive investments in network infrastructure ensure that this will remain the case in the future. Since the launch of Bluewin TV, customers too have become increasingly aware of the trend towards multimedia. Swisscom is active in one of the most attractive broadband markets in Europe via the Italian provider Fastweb. Swisscom also offers services for IT infrastructure outsourcing as well as the management of communications infrastructures.

Swisscom fosters close ties with its target groups - shareholders, employees, suppliers, the public and, above all, its customers. Swisscom offers them:

- Everything they need
- Simple, one-stop solutions
- Unbeatable quality and service

With initiatives such as Swisscom Help Point and Internet for Schools, Swisscom is helping to shape the information society in Switzerland.
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U.S. Air Force Research Laboratory

U.S. Air Force Research Laboratory, 711th Human Performance Wing, Radio Frequency Radiation Branch in Brooks Air Force Base began in 1968 under the leadership of John C. Mitchell. Today it is one of the largest centers for the study of the effects of RFR on humans and their environment. Original research is conducted in the science of RFR dosimetry and RFR bioeffects. Quality research is promoted through the publication of the USAF RFR Dosimetry Handbook and support of the International EMF Dosimetry Project. International RFR standards development and harmonization are promoted by working with the IEEE and the World Health Organization. Lt. Col. Scott Nichelson is the Chief of the Radio Frequency Radiation Branch.

Bronze Sponsors

Asian Office of Aerospace Research and Development (AOARD)

The Asian Office of Aerospace Research and Development (AOARD) is a detachment of the Air Force Office of Scientific Research (AFOSR), and is based in Tokyo, Japan. The mission of the AOARD is to support the Air Force S&T community by identifying foreign technological capabilities and accomplishments which can be applied to Air Force needs; by providing liaison with members of the scientific and engineering community in Asia and Pacific Rim Region Countries; and by encouraging open communication between Air Force scientists and engineers and their counterparts within the AOARD area of responsibility, and by supporting Asian research projects of interest to the Air Force. AOARD's primary focus is on basic research with a secondary interest in applied research.

Disclaimer: AFOSR/AOARD support is not intended to express or imply endorsement by the U.S. Federal Government.

ARIB

The Association of Radio Industries and Businesses (ARIB) was chartered by the Minister of Posts and Telecommunications, Japan as a public service corporation on May 15, 1995. Its activities include those previously performed by the Research and Development Center for Radio Systems (RCR) and Broadcasting Technology Association (BTA).

ARIB was established in response to several trends such as the growing internationalization of telecommunications, the convergence of telecommunications and broadcasting, and the need for promotion of radio-related industries. ARIB's goal is to advance rapidly the use of radio technology for the benefit of society. This is done by integrating knowledge and experience in various fields of radio use such as broadcasting and telecommunications, research and development in radio technology, and serving as a standards development organization for radio technology.

Deutsche Telekom

As one of the world's leading telecommunications and information technology service providers, Deutsche Telekom AG is setting international standards.

Deutsche Telekom offers millions of private and corporate customers all over the world the entire spectrum of modern information technology and telecommunications services – whether fixed-network, wireless and broadband or complex IT and telecommunications (ICT) solutions for business customers.
ACKNOWLEDGMENTS

BioEM2009 gratefully acknowledges the following confirmed organizations for their generous financial support for the 2009 Joint Meeting (as of May, 2009). Any additional support received will be acknowledged at the meeting.

EOARD

The European Office of Aerospace Research & Development (EOARD) is a detachment of the Air Force Office of Scientific Research (AFOSR), one of ten directorates of the Air Force Research Laboratory (AFRL). EOARD is based at Blenheim Crescent, Ruislip, UK. The primary focus of EOARD is on basic scientific research. EOARD’s mission is to directly support AFRL research goals by:

- Providing liaison with members of the European scientific community.
- Facilitating contact between AF scientists and their European counterparts.
- Contracting with European scientists to conduct research or support conferences and workshops.

It accomplishes this through three main programs: Window on Science (WOS), Conference Support (CSP) and Research Contracts. Its geographical areas of responsibility include: Europe, Africa, Middle-East and all countries of the former Soviet Union (including Russian and Ukraine).

Fondation Santé et Radiofréquences

The Health and Radiofrequencies Foundation was created to encourage research efforts to study the effects of RF electromagnetic waves on humans, as well as provide information on this subject to the public, governments, doctors, professionals, among others. The Foundation pools available funding needed to finance these actions and to implement an independent assessment system for projects submitted to it. Launched by the Minister for Research and the initial founders, the Health and Radiofrequencies Foundation obtained public interest status by decree dated January 10, 2005.

GSMA

The GSMA represents the interests of the worldwide mobile communications industry. Spanning 219 countries, the GSMA unites more than 750 of the world’s mobile operators, as well as 200 companies in the broader mobile ecosystem, including handset makers, software companies, equipment providers, Internet companies, and media and entertainment organizations. The GSMA is focused on innovating, incubating and creating new opportunities for its membership, all with the end goal of driving the growth of the mobile communications industry.

Mission Statement:
The GSMA’s mission is to create value for operators and the mobile industry in the provision of services for the benefit of end users, so that those users can readily and affordably connect to and use the services they desire, anywhere, anytime.

Strategic Objectives

- To support the evolution and broadest deployment of the GSM family of technologies thereby enabling economies of scale and global interoperability.
- To stimulate and support the development, launch and promotion of new services and products.
- To ensure that mobile services are made interoperable on both a national and international basis as rapidly as possible.
- To provide services to operators and the mobile industry, such as conferencing, that promote and serve the goals of GSMA.
- To support initiatives which stimulate social and economic development and help bridge the digital divide.
- To develop environmentally sound and socially responsible policies for the mobile industry, its products and services.
- To advocate appropriate government policies and regulations on a local, regional and global basis in order to ensure the continued development of the mobile industry to the benefit of everyone.
- To communicate on behalf of the GSM operator community and ensure that its views are clearly communicated and understood.
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**IVIVI Technologies, Inc.**

Ivivi Technologies, Inc leads innovation in the adjunctive, palliative treatment of post-operative pain and swelling in superficial soft tissue with non-invasive electrotherapies. What this means is safe, effective treatment without side effects, overdoses or other dangers. We call it the technology of life.

**Lawson Health Research Institute**

The Lawson Health Research Institute (Lawson) in London, Ontario, Canada is the research institute of London Health Sciences Centre and St. Joseph's Health Care, London. Lawson is one of the largest hospital-based research institutes in Canada attracting over $55 million each year in research funding. More than 500 investigators throughout London investigate disease and ways to detect, prevent and treat illness. Dr. David Hill is Scientific Director of the Institute. For more information on Lawson, visit www.lawsonimaging.ca.

The vision of the Imaging program is to be recognized as one of the top 5 in the world; to support teaching and service in research; and to maintain a strong research program in both support and driver roles, across all hospital sites. Our imaging program is disease/theme based (eg. neuroscience, cardiovascular, musculoskeletal), platform based (eg. X-ray CT, SPECT, MRI, MRS, US, NIR) and integrated (eg. image guided surgery, cancer, neonatology, aging).

We provide theme leadership (eg. Brian Rutt in vascular imaging), platform leadership (eg. Dick Drost in MRI/MRS for Schizophrenia and integrated leadership (eg. Ting-Yim Lee in Stroke). We also provide essential support for many clinical investigators needing state-of-the art imaging such as bone-mineral density imaging for osteoporosis.

The goal of the program is to forge a united imaging program in London under the Lawson umbrella by encouraging all members of the Imaging Sciences Division of the Department of Diagnostic Radiation and Nuclear Medicine, and imaging scientists at both The John P. Robarts Research Institute and The University of Western Ontario to join the Lawson team.

**Municipality of Davos**

Davos is a municipality in the district of Prättigau/Davos in the canton of Graubünden, Switzerland. With the highest elevation of any city in Europe at 1,560 m, Davos’ incorporated area encompasses the largest area in Switzerland at roughly 283.99 km², (45% grassland, 16% woods, 29% rocks and ice). The magnificent, unscathed mountainside is still cared for by 98 farmers. Of the 13,000 inhabitants, 25% are non-Swiss of various nationalities. The Executive Branch consists of a Mayor, currently Peter Michel who will offer a word of welcome at the BioEM2009 Welcome Reception, and five other members, elected at large for four-year terms. The Legislative Body consists of seventeen elected members.

**NFP57**

The NRP 57, a four-year program, was launched in 2007 and contributes to the international efforts to clarify possible health risks of ELF and RF EMF exposure. Altogether eleven research projects address open questions related to dosimetry and exposure assessment, short term, medium and long-term exposure effects of non-ionizing radiation assessed by laboratory and epidemiological studies, effects at the cellular level as well as risk perception and evaluation of the topic in the public.

**USAITC-A**

The U.S. Army International Technology Center – Atlantic reaches out to the scientific community by facilitating the exchange of dialog between European Scientists and technical experts with their counterparts in the laboratories and R&D centers of the U.S. Army. The USAITC-A promotes fundamental research by partnering with European scientists and R&D organizations via grants and sponsorships for qualifying research projects and workshops.
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Title page: Emil Ludwig Kirchner (1880–1938), View of Davos with Church (Davos in Summer), Kirchner Museum Davos