



ICNIRP 7th International NIR Workshop

Edinburgh, United Kingdom, 9-11 May 2012



POSTERS

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Overview

- 35 posters
- Electromagnetic fields
 - Biological responses (ELF: 4; RF: 2)
 - Exposure assessment (Static/ELF: 5; RF: 9)
 - Interference (2)
 - Modeling (4)
 - Guidelines (3)
 - Other (2)
- Optical
 - Exposure assessment (3)
 - Guidelines (1)



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EMF - Biological responses



EMF - Biological responses - ELF

Huang, Chuan, Tsu:

Gene expression profiling of human HaCaT keratinocytes exposed to extremely low frequency electromagnetic field revealing inhibition of cell cycle progress

- 60 Hz, 1.5 mT, 4-96 h
- Cell cycle genes at 96 h
 - 1 gene up, 6 genes down
- Inhibition of cell growth at 144 h



EMF - Biological responses - ELF

Kabacik, Kirschenlohr, Badie, Bouffler, Brindle, Sienkiewicz:

Transcriptional responses of mouse bone marrow to power frequency magnetic fields

- 50 Hz, 100 μ T, 2 h, in vivo
- 4 genes downregulated
- No significance
- Problem detecting small changes
 - Technical limitations
 - Biological variation



EMF - Biological responses - ELF

Legros, Modolo, Goulet, Plante, Souques, Deschamps, Prato,
Lambrozo, Thomas:

Magnetophosphenes and associated brain activation: a study
protocol in humans exposed to up to 50 milliTesla 50/60 Hz
magnetic fields

- Need to establish magnetophosphene threshold @ 50/60 Hz
- 0 – 50 mT
- Neurophysiological responses (EEG, fMRI)
- Mathematical modeling
- Results exposure up to 3 mT



EMF - Biological responses - ELF

Maeda, Henbest, Neil, Hogben, Biskup, Ahmad, Schleicher, Weber,
Mackenzie, Timmel, Hore:

Magnetically sensitive light-induced reactions in cryptochrome

- Blue light photo-receptor proteins (cryptochromes):
magnetoreceptors birds, mediators biological effects ELF EMF?
- Spectroscopy: magnetic sensitivity *Arabidopsis* cryptochrome & *E coli* photolyase consistent with radical pair mechanism
- Development powerful methods for measuring MF effects: cavity-enhanced absorption spectroscopy and cavity ring-down spectroscopy (use of very small number molecules)



EMF - Biological responses - RF

Broom, Whitehill, Sienkiewicz:

Subtle alterations in behaviour and hippocampus structure in mice following a short-term exposure to 905 MHz fields

- SAR (head): 0.5, 2, 3.3 W kg⁻¹, 60 min (n=7 / group)
- Behaviour (water maze)
 - No overall effect
 - Subtle changes two parameters, SAR-independent
 - Differences male / female two parameters
- Immunohistochemistry
 - Changes structure hippocampal synapses
 - No changes blood brain barrier permeability
 - No changes reactive astrocytes, microglial activation, c-fos expression
- No dose-response: other factors?



EMF - Biological responses - RF

Partsvania:

Investigation into influence of high SAR on neuron excitability

- GSM signal, SAR > limit on single neurons
- Habituation ~ information storage
- Exposure in TEM cell; modeling: SAR=8.2 W/kg, $\Delta T=1.21$ °C
- 60 min exposure:
 - Threshold action potentials decreased
 - Habituation to stimulation increased
- Acute exposure to high SAR: increases neuron excitability, impairs the ability to store information



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EMF - Exposure assessment



EMF - Exposure assessment - ELF

Ittermann, Zilberti, Seifert, Rabus, de Prez, de Pooter, Nettelbeck, Jokela, Hand, Bottauscio, Borsero:

Metrology for next-generation safety standards and equipment in MRI - a new joint research project within the framework of the European metrology research programme EMRP

- Measurements RF EMF from MRI scanners (64 - 300 MHz)
- Model RF EMF, thermal effects in human body
- Assess risk of moving through stray fields of up to 7 T MRI
- Measurements SAR hazards parallel transmission, up to 7 T MRI
- Dosimetry MRI guided radiotherapy
- Assess risks metallic implants during MRI scan



EMF - Exposure assessment - ELF

Zilberti, Chiampi:

A numerical survey of the electric fields experienced by humans moving within MRI static fields MRI

- Tubular, open MRI
- Translations, rotations, revolutions, knee-bending, bowing simulated
- Rotation: higher E fields than translations
- Motion near open MRI: E fields comparable to tubular MRI



EMF - Exposure assessment - ELF

Yamaguchi-Sekino, Nakai, Izawa, Okuno:

Occupational exposure to static magnetic fields during a routine MR examination using a 3.0 T MR system

- Magnetometer to chest (n=4)
- Max field 0.63–1250.00 mT
- Max (ΔB) 1249.97 mT
- High: patient monitoring (e.g., for contrast agent injection)



EMF - Exposure assessment - ELF

Magne:

Cartography of 50 Hz electric and magnetic fields in a utility

- Exposure assessment:
 - electric power plants
 - electricity distribution: representative work situations
- Comparison with Directive 2004/40/EC



EMF - Exposure assessment - ELF

Karpowicz, Zradziński, Gryz:

The measures applicable in assessing electrodynamic exposure effects of exposure to time-varying low frequency magnetic fields of non-uniform spatial distribution

- Assessment: non-uniform exposure workers
- Various distances to sources
- Induced electric field
- Averaged MF less correlated with exposure effects than parameters of exposure at body surface



EMF - Exposure assessment - RF

Aerts, Deschrijver, Joseph, Verloock, Goeminne, Martens, Dhaene:

A new methodology for RF-EMF exposure assessment based on sequential surrogate modeling

- In situ measurements
- Iteratively: learning algorithm uses knowledge from previous measurements to propose optimal locations for the following measurements



EMF - Exposure assessment - RF

Pinto, Lopresto, Mariotti, Marino:

Procedures for the exposure assessment of electromagnetic fields emitted by WiFi devices

- Wideband: wideband isotropic E-field probes; narrowband: spectrum analyzer (SA) and dedicated antenna
- Output access point 2.45 GHz: comparison SA & power meter
- SA underestimates (up to -3 dB)



EMF - Exposure assessment - RF

Koutsojannis:

Measurement and simulation of electromagnetic radiation distribution in physiotherapy units

- Diathermy unit (2.45 GHz)
- Various distances, heights, blocking objects
- Good comparison measurements / simulations
- Regular control of output needed
- Measurement values > limits
- Guidelines for physiotherapy units useful



EMF - Exposure assessment - RF

Shrivastava, Vaughan:

Radio-frequency heating due to head coils in ultra-high field magnetic resonance imaging scanners

- Need for data for healthy, thermoregulatorily challenged / compromised, pregnant subjects
- Development Generic Bioheat Transfer Model (GBHTM)
- Measure with fluoroptic temperature probes in healthy swine (n=24), 3 T & 9.4T MRI head coil
- GBHTM better predictor than Pennes Bioheat Transfer Model (underestimates heating in brain and rectum)
- Validation underway for thermoregulatorily challenged / compromised, pregnant subjects (head & body coils)



EMF - Exposure assessment - RF

Thuróczy, Bakos, Kubinyi, Gajsek, Samaras, Wiart, Ravazzani:

EFHRAN project: exposure assessment to radiofrequency EMF in Europe

- EFHRAN: European Health Risk Assessment Network
- Information for risk identification, analysis, dose response evaluation human EMF exposure; create exposure categories / classification
- Various RF exposure surveys, modeling EU member states
- Measurements: >60% <1 V/m, <1% >6 V/m, <0.1% >20 V/m
- Possible classifications / clusters: indoor vs. outdoor, long term vs. acute, far-field vs. near-field
- No noticeable differences between EU countries
- Differences rural / urban



EMF - Exposure assessment - RF

Urbinello, Röösl:

Long-term monitoring of temporal and spatial variability of radiofrequency electromagnetic fields (RF-EMF) in Basel and surroundings

- Data collected 2 d / mo, 2 y, standardized measurement protocol (May 2010 - March 2012)
 - Central / peripheral residential areas, downtown, train station, airport, shopping centres, train, tram, bus rides
- Highest in trains (mean: 0.62 V/m); lowest in central / suburban residential areas (mean: 0.15 V/m)
 - Mobile phone highest, except shopping centres (cordless phone)
 - Base stations: lowest trains, highest downtown; phones: highest trains, lower residential; WLAN: low (max 5.3% shopping centres)



EMF - Exposure assessment - RF

Vulević, Belić, Stalevski:

In-situ measurements of electric, magnetic and electromagnetic fields in the environment

- Objective: describe basis of in-situ measurements; contribute to development of non-ionizing radiation protection in Serbia



EMF - Exposure assessment - RF

Litchfield, Sorahan:

The national register of RF workers (UK): a long-term follow-up study

- National Register of RF Workers
 - 1961-2011
 - Job title
- Mortality compared to general population England, Wales



EMF - Exposure assessment - RF

Sasaki, Mizuno, Wake, Fukunaga, Watanabe:

An assessment of measurement uncertainty for dielectric property measurement system in the millimeter wave band

- Measurement system dielectric properties of biological samples:
- Evaluated measurement uncertainty
- Complex permittivity: 15% real, 10% imaginary



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EMF - Interference



EMF - Interference

Driessen, Dechent, Joosten, Stunder, Wienert:

Electromagnetic interference of electronic implants: internet information system EMF-portal and research at *femu*

- EMF-Portal: information system biological, health effects EMF
- EMI: >200 studies cardiac pacemakers, cardioverter defibrillators; ~70 studies other electronic implants
- Unipolar systems can be disturbed by environmental EMF, bipolar systems not
- Both systems can be disturbed under specific occupational exposures (e.g., power plant, welding)
 - Individual risk assessment necessary



EMF - Interference

Souques, Magne, Perrino, Lambrozo:

Implanted cardiac defibrillator (ICD) and professional exposure to electromagnetic fields

- In situ measurement + control ICD function
- 50 Hz MF electrical distribution company worker
 - Max 200 μ T, no dysfunction
- RF exposure fireman
 - 280-400 MHz communication system: max 24 V/m, no dysfunction



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Modeling - EMF



EMF - Modeling

Thielens, Vermeeren, Joseph, Martens:

Organ specific averaged SAR for the central nervous system

- E fields in phantom determined from plane wave exposure
- Recalculated for realistic exposure scenarios
- Determine organ / tissue SAR
 - Up to 10 dB difference between brain regions
 - Differences between environments less (<30%)
 - SAR lower for higher frequencies



EMF - Modeling

Vermeeren, Joseph, Martens:

Whole-body absorption in heterogeneous adult and child human body model in realistic environments

- Statistical exposure tool to assess whole-body SAR in adult and child model
- GSM 950 MHz; rural, urban-macrocell, urban-microcell, indoor-outdoor, indoor-picocell
- Incident fields, whole-body SAR for 4000 samples
- Worst-case single plane wave exposure exceeded ~4% of samples in multipath exposure environment
- ICNIRP basic restrictions unlikely exceeded at 950 MHz in a realistic exposure environment for child



EMF - Modeling

Lee, Choi:

Korean male models and the ICNIRP reference level in the frequency range of 10 MHz - 3 GHz

- Models 1, 3, 5, 7, 20 yrs, whole body SAR with exposure at ref level
- Normal, thin models; standing with arms up / down
- Safety factor ~30 for 20 – 200 MHz arms-up, for 40 - 200 MHz arms-down, and >1 GHz for both
- Basic restrictions exceeded with exposure at ref level (for infant / child models, arms up)



EMF - Modeling

Nagaoka, Watanabe:

Enrichments of central nerve system in Japanese computational models for numerical dosimetry in intermediate frequency range

- Improved, more detailed definition of nerve tissues in models
- Optimization of calculations



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EMF - Guidelines



EMF - Guidelines

Heinrich, Hilpert, Neuschulz, Börner, Brüggemeier, Eggert, Fischer, Hentschel, Udovicic:

Occupational exposure to static and low frequency electric and magnetic fields - a new health and safety concept

- European Directive 2004/40/EC on occupational EMF exposure
- Implementation postponed
- New health and safety concept up to 100 kHz
- 2 sets of ELVs & action levels
- EMI implanted medical devices, projectile risk adressed
- High level of health and safety protection of workers, no need for unnecessary and costly measures or restricting use of MRI, other technologies



EMF - Guidelines

Karpowicz, Rossi:

The model of application of ICNIRP's principles into the work place legislation on electromagnetic hazards - lessons learned from drafting European directive

- Proposals for amendment of European Directive 2004/40/EC on occupational EMF exposure during Polish presidency
- Insufficient support
- Revision ongoing



EMF - Guidelines

Lambrozo, Souques, Magne:

Medical survey after 50 Hz electric or magnetic field exposure

- EU Directive: health surveillance
- Under limits: only for workers with medical devices
- Accidental exposure: careful interrogation for first signs, such as perception of magnetophophenes; physical examination, no biological or radiological examination
- Registration of overexposure, health data, to allow retrospective analysis



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EMF - Other



EMF - Other

Sebastião, Branco, Oliveira, Correia:

Usage of mobile phones and concern on electromagnetic radiation of Portuguese youngsters

- 2471 interviews, 40 secondary schools, 10-12th (+7-9th) grade
 - Knowledge health aspects, precaution
 - Usage
- <0.5% no phone
- On average: 6 calls, >30 min / d, >100 SMS / d
- >50% concerned, but <20% searched info, even lower % took precautions
- Girls: >20% longer call duration, # SMS equal



EMF - Other

Šira, Malarić:

Design of a 50 ohm open TEM-cell

- Lightweight TEM cell, low production costs
- Septum and outer plates made of cardboard wrapped into multiple levels of glued household aluminum foil



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Optical – exposure assessment



Optical – Exposure assessment

Necz, Bakos:

Photobiological safety of newly introduced energy efficient lamps

- UV and blue light emission of halogen lamps (n=11), compact fluorescence lamps (n=19), LED lamps (n=4)
- According to IEC 62471:2006 standard
- All measurements below ICNIRP public exposure limits



Optical – Exposure assessment

Udovicic, Janßen, Ott, Mainusch, Romanus:

Photobiological safety of light emitting diodes (LED)

- Single LEDs, LED torches, LED lamps emitting visible spectrum
- Following Lamp Safety Standard EN 62471
- All below levels retinal thermal injury
- Photochemical retinal hazard: at most moderate risk
 - Worst-case: viewing distance 20 cm, ELVs exceeded after 20 s
 - Risk assessment: summing of all exposures during working day
 - LED manufacturing employees: may exceed 20 sec rapidly



Optical – Exposure assessment

Wittlich:

Emission of optical radiation by gas burners: a project with surprises

- Comprehensive analysis of the radiation emission of gas flames
- Non-negligible hazard for workers
 - Prominent UV-B emission
 - Radiation emissions time-independent
 - No correlation gas burner power, radiation emission
 - Spectral irradiance distribution depends on burnable gas
 - Glass workpiece has substantial influence on radiation emission
- Skin, eye limit values often exceeded only after a few minutes



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Optical - guidelines



Optical – Guidelines

Wittlich:

Problems and open questions with limit values in directive 2006/25/EC in daily use

- Irradiance, radiance, radiant exposure: to be measured in different wavelength regimes with different action spectra
 - Inadequate optical filters for measurement equipment
- Some wavelengths: no limit values exist
- What if infrared skin exposure exceeds ten seconds?
- Pulsed sources
- German trade and industry accident insurance institutions: regulations
- Technical rules in preparation