



## Final Report

Project reference: A2011-05  
Applicant's name: Reto Huber and Peter Achermann  
Project title: Investigating the origin of individual differences in the response to electromagnetic field exposure

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### 1. State of Research.

#### 1.1 Research activities performed, milestones and deliverables accomplished

After the ethical approval of the study and testing of the exposure setup (by IT IS) subjects were recruited.

In this study 20 young, male adults had four experimental sessions (one week apart), two of them with 30-minutes 2-Hz pulse-modulated RF EMF exposure before sleep (same field as used in Schmid et al., 2012). All-night high-density EEG recordings were obtained from all subjects. An anatomical MR scan was obtained after the end of the sleep sessions.

The data was processed and a detailed analysis was performed.

Finally, the data was recently published. See below.

#### 1.2 Findings

Our main study aim was to investigate inter-individual variation and intra-individual stability of the field effects on the sleep EEG. The topographical analysis of EEG power revealed, 1) exposure related increases in the delta-theta frequency range in several fronto-central electrodes (as found previously, e.g. Schmid et al., 2012) and 2) but no differences in the spindle frequency range. Moreover, our data revealed that subjects do not respond with a similar power change after the first and second exposure in both frequency ranges. Thus, our results imply that no biological trait exists of how subjects react to RF EMF exposure. These results were recently published in a peer-reviewed journal: Lustenberger et al., Bioelectromagnetics 2015. The publication is attached to this report (see also summaries for the annual report).

#### 1.3 Problems

We have no problems to report.

### 2. Annex

#### 2.1 Publications

Inter-individual and intra-individual variation of the effects of pulsed RF EMF exposure on the human sleep EEG. Caroline Lustenberger, Manuel Murbach, Laura Tüshaus, Flavia Wehrle, Peter Achermann, Reto Huber. Bioelectromagnetics, 2015, in press.



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Additional publications based on the sham data of this study (with own funding):

1) Sleep spindles are related to schizotypal personality traits and thalamic glutamine/glutamate in healthy subjects. Caroline Lustenberger, Ruth O'Gorman, Fiona Pugin, Laura Tüshaus, Flavia Wehrle, Peter Achermann, Reto Huber. *Schizophrenia Bulletin*, 2015, 41, 522-531.

2) The multidimensional aspects of sleep spindles and their relationship to word-pair memory consolidation. Caroline Lustenberger, Flavia Wehrle, Laura Tüshaus, Peter Achermann, Reto Huber. *Sleep*, in press.

## 2.2 Documents

All listed publications are attached.

## Date and Signature

Zurich, 7.4.2015