



“Electromagnetic Fields and the Brain”

3rd international workshop in the framework of

NRP 57 “Non-Ionising Radiation – Health and Environment”

A research programme of the Swiss National Science Foundation

- Organizer:** Swiss National Science Foundation, National Research Programmes
- Date:** October 6 and 7, 2008
- Venue:** Zurich, Hotel Zürichberg (www.zuerichberg.ch)
- Chairs:** Peter Achermann, Alexander Borbély, Elisabeth Cardis, Yngve Hamnerius, Dariusz Leszczynski, Martin Röösli
- Invited Speakers:** Peter Achermann, Jürg Baumann, Elisabeth Cardis, Lawrie Challis, Jim Horne, Niels Kuster, Sarah Loughran, Arne Lowden, Frank S. Prato, Riccardo Russo, Martin Wolf, Louis Slesin

For the agenda with further information on the affiliations of the speakers and the titles of their respective talks, see www.nfp57.ch.

General Conclusions

The third scientific workshop “Electromagnetic Fields and the Brain” focused on a critical discussion regarding non-thermal biological effects of ELF and RF EMF exposure in human provocation studies. To date, several and in part independently replicated short or medium-term EMF effects have been reported on brain activity with emphasis on EEG, cerebral blood flow, brain excitability and cognitive function. Yet, despite an increasing number of “positive” studies an interpretation of these effects remains difficult, especially in view of a potential health risk. Moreover, as the use of mobile phones in adolescence is increasing and commencing at an ever younger age, a whole session was dedicated to common practices of mobile phone usage in children, differences in RF energy absorption and corresponding methodological considerations for future research relevant to this age-group.

The significance of the data and their potential effects on human health were presented and discussed in depth across the disciplines which led to a fruitful exchange of views during the one and a half day workshop. The following reflects these views and perspectives as expressed by the invited speakers and chairs in both day’s final panel discussions.

Similar to the two previous workshops, special emphasis was given to the fact that it is still a matter of debate whether non-thermal biological effects of EMF exposure exist or not. A refreshing discussion was initiated on the question of whether a paradigm shift towards the acceptance of the effects reported to date is called for, rather than for the field to continue to desperately try and prove the existence of an effect. In general the research community is very cautious in interpreting positive results, which in the end may even lead to an underestimation of potential risks. Similar to other fields of research, the question of whether there is an effect or not remains controversial and is unlikely to be resolved in the near future. Therefore a change in attitude was considered necessary in order to accept consistently obtained outcomes and follow them up rather than continually talking the results down, questioning them or simply



classifying them as false positives.

A large proportion of the first day's panel discussion was spent on the evaluation of the reported effects on sleep and the sleep EEG. When considering all studies published so far, about half of them have reported an effect. However, when studies suffering from important methodological limitations are not considered, results yield a surprising degree of consistency between different laboratories with respect to the effects reported on the spindle/ alpha frequency range during non-REM sleep. The discussion mainly focused on the robustness and the validity of these results. It was mentioned that a high variation between outcomes might be due to general differences in the exposure parameters (length or source of exposure, SAR of exposure), the study design or the statistics. An interesting point of view was that it might be worthwhile thinking beyond these typical study limitations. Individual differences in sensitivity may exist in a way that some participants may show a response to EMF exposure, while others may not be affected at all. Some workshop participants were sceptical but agreed that a future task will be to accumulate more evidence on possible responders and non-responders to RF EMF exposure as current scientific evidence is scarce.

In the same context, a considerable amount of time was spent on the general question whether the use of a very homogeneous study sample in sleep studies ("good sleepers") complicates the interpretation of existing results or may even lead to an underestimation of the effect. The main criticism referred to the fact that effects on sleep and the sleep EEG may not be easily visible in very healthy volunteers and instead, a broader range of subject groups should be targeted. That is, "poor sleepers" like elderly people or insomniacs may increase the possibility to a) find an effect and b) be able to ultimately generalize the results to the wider population. This argument was challenged by practical considerations regarding less consolidated sleep in aged people and patient groups, and an associated higher variability within the dataset. Some participants argued that the problem could be circumvented if indeed responders/non-responders could be identified. In the end no clear consensus was reached on the topic. Nevertheless, general agreement existed with respect to the need of sufficiently large study samples to increase the validity of future research with respect to the interpretation of study outcomes. This may for instance be achieved by collaborations between labs using a common protocol.

Consensus was reached that a strong methodology is most important to prevent a potential bias in the experiments and to ensure comparability between outcomes of different laboratories. In this respect it was emphasized that under standardized conditions, the EEG is an excellent tool to investigate small effects, as are expected in bioelectromagnetic research. Besides such robust and well-established methods, new methods like near infrared spectroscopy hold exciting possibilities of real-time measurements that must be pursued to further elucidate specific effects of RF EMF exposure on the brain.

In the course of the discussion some participants argued that EMF research is still at an exploratory stage, whereas most agreed and repeatedly stressed that by now there are consistent findings such as the reported effects on the sleep EEG that are worthy of further exploration. In this context it was proposed that future experiments should move forward by focusing on the possible mechanism behind the observed effects rather than continuing with the usual "fishing experiments". It may not be sufficient just to look at the EEG because the identification of a mechanism in the brain is extremely difficult based on a huge amount of possible causes. All participants agreed that the identification of the fundamental mechanism(s) mediating EMF effects remains an important issue that needs to be addressed. Only then conclusions may be drawn on possible long-term effects, particularly health-related effects, of EMF exposure. Indications exist that the modulation of the signal might be an important factor and research performed in the framework of the NRP 57 is currently addressing this issue. However, it was also generally acknowledged that the lack of a mechanistic framework should not hamper the acceptance of the positive results obtained so far but that they should form the basis for further research.

With respect to the actual exposure, it was speculated that the timing of exposure and laboratory testing may be an important factor as an effect may need time to evolve. Perhaps not only one but repeated doses of EMF exposure are necessary to induce an observable effect. In line with this, it may well be possible



that short or medium-term EMF exposure leads to subtle changes in some physiological measures like the EEG, while revealing no immediate behavioural effect or only effects after long-term exposure. Potential long-term effects were considered as important to address in the future as effects may not be stable but increase with exposure time.

A recurrent theme of the workshop was the question whether future efforts should focus on empirical scientific research or rather on health aspects connected to EMF exposure. A much cited example with respect to this dilemma was the contrasting use of generic phones (“real life”) in provocation studies to identify negative health outcomes in the general population vs. the use of sophisticated, controlled exposure setups (empiric approach) in studies aimed at identifying the precise nature of any response independent of its relevance for health. Criticism was raised regarding the fact that science at present does not provide a satisfactory answer about the risk of low-dose exposure. While numerous studies show interesting findings, effects on health cannot yet be determined. Accordingly, there is a strong need to replace the many unknowns and its proxy - the precautionary principle -, by science and solid data to base guidelines on meaningful protection limits.

Overall, there was general agreement that a lot has been achieved in the past by the various completed or ongoing European national programmes on NIR. In this respect it was highlighted that the NRP 57 programme differs considerably to other European programmes as the focus of research varies in many respects. During the discussion on research needs of current and future programmes on NIR, two opposing opinions emerged. Whereas some participants supported the notion that despite performing good science with good techniques, research should also be driven by addressing the health issue and underlying public concern, others argued that the question of possible adverse health effects will only be solved by identifying the underlying mechanism. For the latter a purely scientific approach is necessary, including going beyond everyday-like exposures by using higher exposures or more exposure levels within experiments. Moreover, the need to widen the interest when looking at effects and to consider other areas of brain functions and behaviour was emphasized. In particular the lively discussions between participants made this workshop a great success and generated valuable suggestions for future research.