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POSTER ABSTRACT

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Threshold for an acute ELF-induced neurophysiological response in human – magnetophosphenes

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In the Extremely Low Frequency (ELF) range (< 300 Hz), the threshold for magnetophosphene perception constitutes the experimental basis of international recommendations regarding exposure to magnetic fields (MF). Both the International Commission for Non-Ionizing Radiation Protection (ICNIRP) and the Institute of Electrical and Electronics Engineers (IEEE) provide international recommendations regarding human exposure to ELF MF based on the threshold for magnetophosphene perception as reported by Lövsund in the early eighties. However, significant uncertainties persist and the aim of this project was to establish thresholds in humans for acute, objective and quantifiable responses to ELF MF up to 50 mT at 20/50/60/100 Hz.

Two experiments were conducted using the exact same protocols and tested a total of 145 volunteers in 4 frequency conditions (20, 50, 60 and 100 Hz), each delivered at flux densities up to 50 mT. Participants were sitting eyes closed in a dark room, and were asked to report magnetophosphene perception by button-press, while occipital EEG activity (O2, O1 and OZ electrodes) was continuously recorded (HSREB #18882).

Results showed a frequency-dependent threshold: 2.51 T/s at 20 Hz, 6.28 T/s at 50 Hz, 7.54 T/s at 60 Hz, and 12.57 T/s at 100 Hz. Choosing dB/dt as the proper metric to analyze the data allowed to properly apprehend the *in-situ* electric field value. Results also showed greater magnetophosphene sensitivity at lower frequencies for a similar *in-situ* induced electric field level.

Results strongly suggest that magnetophosphenes are due to the effect of the induced electric fields interacting with the retinal rod membrane potential, translating in cascade into a visual perception. Rods are graded potential neurones very sensitive to small membrane potential modulations, and this effect cannot be extrapolated to action potential neurones or to the entire central nervous system. This has critical implications from a guideline perspective.

Future protocols will investigate the full ELF spectrum (up to 300 Hz) in order to fully document the frequency response curve, and will study the adaptation to the darkness dynamics in order to improve our understanding of underlying mechanisms.