Human exposure to power-line frequency magnetic fields of up to 50 milliTesla: where is the threshold for an acute neurophysiological effect?

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Magnetophosphenes are often defined as a 'flickering-lights' sensation perceived with the eyes closed in a dark environment as a consequence of a time-varying magnetic field (MF) exposure. The threshold for Magnetophosphene perception is currently considered the 'best estimate' of an acute biological effect in humans of low frequency (LF) electric and magnetic fields [1]. The estimated threshold for magnetophosphene perception in humans is reported to be above 5 mT at 20 Hz [1-3], but no consensus exists yet [4]. Indeed, magnetophosphene perception threshold is only extrapolated to 50 and 60 Hz [5], and there is a need for experimental results from human studies conducted at those frequencies.

Since 2005, our group from has studied the effects of 60 Hz MFs in humans at levels reaching 1.8 mT (2005-2007), and then 3 mT (2008-2010) [6-8]. We are currently initiating a research project aiming to establish a MF threshold at 50 and 60 Hz for systematic magnetophosphene perception in humans exposed to MF levels between 0 and 50 mT.

This project also aims to objectively characterize the neurophysiological responses associated with magnetophosphene perception: we are analyzing brain electrical (using electroencephalography – EEG) and metabolic (using hybrid functional Magnetic Resonance Imaging and EEG – simultaneous fMRI-EEG) activity in two distinct experiments. Experimental results will be complimented with mathematical modeling: computational neuroscience uses mathematical equations to predict neuronal electrical and metabolic activity, both from single neurons and neuronal networks, when exposed to a magnetic or electric stimuli [9]. This approach offers a complementary perspective on the potential involved mechanisms.

At the conference, we will be summarizing our results at 1.8 and 3 mT and reporting on current projects aiming to support, with experimental data collected in humans, the current reference values.

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