Biological effects of electromagnetic waves: stimulation of cell proliferation and differentiation during regeneration as a unique property of THz impulses

László Molnár[1,2], Edit Pollák[2], Anita Erdélyi[2], Gyula Polónyi[3], János Hebling[3], and József A. Fülöp[3,4]

[1]EETRG, Balaton Limnological Research Institute Tihany, ELKH, Hungary
[2]Institute of Biology. University of Pécs, Hungary
[3]Institute of Physics, University of Pécs, Hungary
[4]ELI-ALPS, ELI-HU Nonprofit Ltd., Szeged, Hungary

There is a growing experimental evidence that all living things respond to electromagnetic waves. However, the published results, applying various experimental protocols and model animals, are controversial (both beneficial and disadvantageous effects of distinct electromagnetic irradiations have been reported).
The exploration of the biological effects of any electromagnetic irradiation needs both an exact, reproducible optical background and a standardisable biological model. One of them (posterior segments regeneration of earthworms) has been developed in our laboratory. The kinetic of the segment renewing (with its biochemical, cytological and histological backgrounds) has been elucidated under various physiological parameters. Therefore, its application in exact photobiological experiments can contribute to the recognition of the effects of defined electromagnetic irradiation on living things and supports the selection of relevant parameters for medical sciences.
Earlier we have shown that single-cycle THz pulses of 5 μJ energy, 0.30 THz mean frequency, 293 kV/cm peak electric field, and 1 kHz repetition rate has been overridden of the genetically determined, endogenously mediated segment renewing capacity of our model animal (*Eisenia andrei*, Annelida, Oligochaeta, Lumbricidae). In contrast to control specimens, a significantly higher number of renewing segments have been found in THz pulses exposed worms. The regenerated segments have had regular histological organization, no malformation has been seen in their tissues. In contrast, advanced tissue development has been recognized e.g. in body wall epithelium and muscles, circulatory system and immune cells and especially in the renewing ventral nerve cord ganglia. No similar effects have been seen in green, or red light exposed experimental animals, and the possible heating effect of THz pulses has also been experimentally excluded. In this presentation we show the ultrastructural and some histochemical characteristics (collagen deposition in cicatrix, dedifferentiation and redifferentiation of muscle cells, development of neurotransmitter specific cells, and iron distribution in old and new tissues) of distinct animal tissues exposed to defined THz pulses, suggesting their possible medical application.

Biography:

Dr. Molnár is a senior research fellow at Ecophysiological and Environmental Toxicological Research Group, Balaton Limnological Research Institute of Eötvös Loránd Research Network, Tihany, Hungary and an associate professor at the Department of Comparative Anatomy and Developmental Biology, Institute of Biology Faculty of Natural Sciences, University of Pécs, Hungary.

He is interested in the reparative regeneration of earthworms and its regulation with definite chemical and physical factors. He investigates the interaction of the immune and neural systems during regeneration and the effect of electromagnetic waves on tissue dedifferentiation and redifferentiation. He has been a PhD supervisor of the Doctoral School of Biology and Sportbiology and the Doctoral School of Physics (University of Pécs). In the London Interdisciplinary Doctoral Programme (King's College, London, UK) he was a co-supervisor of a specific regeneration topic of a PhD dissertation (Brain regeneration, an earthworm phenomenon: from molecular characterization to bioengineering a functional "brain in a dish").