

Abstract for general public

Electroporation is a commonly applied technique in medicine, biology, and food processing. Applied nanosecond pulsed electric field (nsPEF) is still a developing bioelectrical technology that proved its potential in anticancer therapy. Depending on the pulse shape (form, duration, amplitude) a variety of bioelectrical phenomena can be triggered inside the biological cell providing a flexible tool for treatment of cancer on many levels. This project will involve the development of a new ultra-short (nanosecond) pulse generator with controllable pulse waveform (incl. asymmetric pulses), which will be adapted for biological experiments for manipulation of various cell processes and cell permeability to drugs or other molecules. The supported multi-parametric flexibility of the generator will enable the investigation of new phenomena in the field of electroporation highlighting the importance of transdisciplinary research. Although the electroporation with longer unipolar pulses, used in standard protocols, was well described, the mechanisms of asymmetric nsPEF were not investigated yet and require thorough evaluation. Therefore, the purpose of the project is to understand the mechanisms of action of new type of electric field pulses on the cancer cell model by introducing additional parametric degree of freedom in pulse control. So, can asymmetric pulses be better than the other ones? What happens in nanosecond range? Since there is no comprehensive knowledge in this field, we will answer these questions in this proposal.

We expect that this Project will deliver the following outcomes:

- Novel electroporation platform for asymmetrical nanosecond pulse generation
- Systemic data on the new electroporation protocols including comparison with conventional unipolar nanosecond pulses and ESOPPE procedures
- Recommendations for future research based on the results and phenomena detected in the new parametric electroporation range.