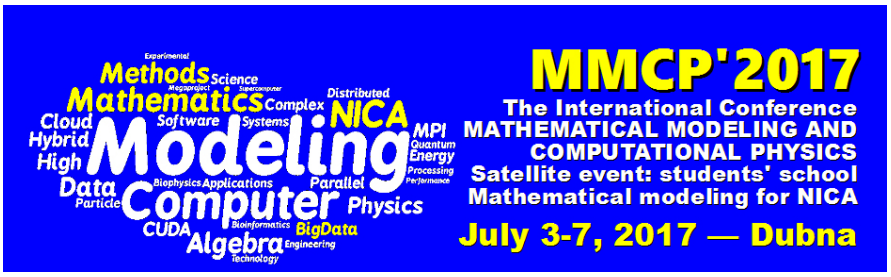

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Radiation damage to nervous system: designing of optimal models for realistic neuron morphology

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A quantitative study of early mechanisms of the central nervous system (CNS) disorders induced by high-energy heavy ions at the molecular and cellular levels is one of urgent problem of modern radiobiology. The present study is focused on the development of optimal models of neuronal morphology for Monte Carlo microdosimetry simulation of initial radiation-induced events of heavy charged particles in the specific types of cells of hippocampus, which is most radiation-sensitive CNS structure. The applied simulation technique is based on the Geant4-DNA toolkit. The calculations were made for beams of heavy ions with doses corresponding to real fluxes of galactic cosmic rays. Simple compartmental model and complex model with realistic morphology extracted from experimental data were constructed and compared. We estimated distribution of energy deposition events and production of reactive chemical species within developed models of CA3, CA1 pyramidal neurons, DG granule cells and interneurons of hippocampus. Similar distributions of energy deposition events were obtained in both simplified and realistic neuron models. The results demonstrate that neuron morphology is an important factor determining the accumulation of microscopic radiation dose and water radiolysis products in neurons.

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