# Simulation of electron interactions with liquid water and processes related to sub-nanosecond electrical breakdown

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Initiation of electric discharge in dielectric liquids such as water can be caused either by formation of gaseous bubbles (when the system is driven by high-voltage waveforms of microsecond duration) or due to creation of cavitation voids in case of very-steep high-voltage pulses with sub-nanosecond rise times. Presence of these deformations prolong mean-free path of electrons, which can then gain enough energy for excitation/ionization/dissociation of water molecules. We propose to use Geant4-DNA [1, 2] toolkit for studies of elementary processes related to interaction of accelerated electrons with liquid water. The Geant4-DNA provides a complete set of models describing the step-by-step physical electromagnetic interactions of electrons with liquid water. These models describe both the cross sections and the final states of the physical interactions, with a full description of the interaction products, taking into account the molecular structure of liquid water. Geant4-DNA electron models for the calculation of ionization and excitation cross sections are based on the Emfietzoglou model [3] of the dielectric function of liquid water. The dielectric function approach is currently the state-of-the-art technique for modeling the energy-loss of low-energy electrons in the condensed phase [4]. The aim of our work will be to study elementary processes related to interaction of electrons with liquid water. Basic parameters such as stopping distance and electron bremsstrahlung spectra will be determined for given voltage pulse conditions and confronted with experimental data aquired in point-plane electrode geometry [5, 6].

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