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Fast pulsed electrical breakdown of water: electron multiplication in liquid ruptures[1] ZDENEK BONAVENTURA, PETR BILEK, JAN TUNGLI , Masaryk University, Department of Physical Electronics, Kotlarska 2, 6110 37 Brno, Czech Republic, MILAN SIMEK, Institute of Plasma Physics of the CAS, Department of Pulse Plasma Systems, Za Slovankou 3, 18200 Prague 8, Czech Republic — Liquid water under the action of sharp pulse of the electric field may be disrupted so that cavities of nanometer scale would eventually appear and expand. Electric field forces these cavities to rapidly elongate to the form of long needle-like ruptures. We propose a scenario for electron multiplication inside of these ruptures: Electrons are accelerated by the electric field inside the ruptures and can create a multitude of secondary electrons by sequence of bounce-like collision events with the surface of water. This results in electron avalanche that is confined inside of the cavity. For electron transport and electron water-interactions we use Monte Carlo model based on Geant4-DNA simulation toolkit. We show that there exists a minimum value of the product of electric field strength and the cavity radius, when this electron multiplication scenario can be put in action. We will also discuss the avalanche dynamics and present its characteristic time and spatial scales. Conclusions of our work shed light on one of the crucial steps behind the nanosecond electrical breakdown of liquid water.

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