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Dynamics of Statistical Fluctuations in Low-Current Microdischarges. VLADIMIR KHUDIK, University of Toledo, ALEX SHVYDKY, University of Rochester, CONSTANTINE THEODOSIOU, University of Toledo — According to the Paschen's similarity law, when the product of the gas pressure and the system dimension is kept constant, pd = const, discharges in small and large systems exhibit the similar behavior. However, the influence of fluctuations (as well as nonlinear processes such as, for example, stepwise ionization and radiation trapping) on the discharge dynamics in systems with different dimensions is different: Their level is higher in smaller systems, so that statistical fluctuations change dramatically the discharge behavior in microdischarges operating in Townsend regime. We present a simple model that incorporates all main processes which cause fluctuations and that allows to describe analytically their dynamics. Close analogy to an oscillator driven by a random force is revealed. In this analogy, the voltage across the discharge gap is related to a generalized coordinate, the number of ions in subsequent generations is related to a generalized momentum, and fluctuations in the number of ions (i.e. fluctuations in the generalized momentum) play, in essence, role of the random force. In the same manner as a random force, fluctuations pump "energy" in natural oscillations of the discharge current. Without dissipation they grow in time which eventually leads to disruption of the discharge. Dissipation suppresses fluctuations and limits them at some level.

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