Investigating of ignition of positive corona discharge in air using a time dependent fluid model

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Sharp point electrodes generate significant electric field enhancements where electron impact ionization leads to formation of electron avalanches that are seeded by photoionization. Photoionization of molecular oxygen due to extreme ultraviolet emissions from molecular nitrogen is a fundamental process in the inception of positive corona in air [1]. In a positive corona system, the avalanche of electrons in bulk of discharge volume is initiated by specific distribution of photoionization far away from region of maximum electron density near the electrode where those photons are emitted [2,3,4]. Here we present an approach using a time dependent fluid model in one dimensional spherical geometry to obtain electric field threshold for postive corona inception. The results are compared to Pasko et al., 2023 [5], where a novel approach to finding inception conditions of positive corona was introduced. The results agree well with steady state solutions. The time dependent model additionally shows that the steady state solutions are reached on timescale of electron drift. The time dependent model demonstrates the time dynamics of the space charge regime due to the increase of particle densities when the applied field is above threshold. The results emphasize significance of correct photoionization boundary conditions for accurate modeling of corona.

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