Minimal Model of a Positive Glow Corona and Its Transition to Streamers

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***Abstract*—We propose a minimal model of the positive glow corona that exploits the pulsating nature of the discharge to eliminate the detailed kinetic computations and replace them with simple assumptions about the onset and quenching of ionization near the anode surface. The onset is determined through the integral electron multiplication condition, using the self-consistent existing field; the quenching is assumed to occur at an empirically determined lower field. The results are shown to be consistent with previous work and with experimental data, and shed light on the mechanisms present. The role of the ionic space charge is shown to be dominant, with kinetics being secondary, except in determining the onset and quenching fields; in particular, the anode surface field is seen to drop below the classical Peek level when the potential is rising rapidly. In addition, we have identified some issues with the calculation of the current in the literature and propose an alternative evaluation. We apply the model to cylindrical coaxial electrode geometry and map the region of existence of the Glow Corona as a function of potential and potential rate of rise. This simple model paves the way towards developing predictive simulations of glow corona and transition into streamers for realistic configurations relevant to technological applications and lightning research.**