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Equilibrium plasma formation in coaxial plasma accelerators

VIVEK SUBRAMANIAM, LAXMINARAYAN RAJA, The University of Texas at Austin — Coaxial plasma accelerators are electromagnetic acceleration devices that utilize the Lorentz force generated by self-induced magnetic fields to accelerate high density thermal plasmas to large velocities (10Km/s). The deflagration mode of accelerator operation is achieved by introducing a neutral gas puff into an evacuated coaxial inter-electrode volume that is stood off to a high potential (5 kV). The neutral gas breaks down to form a two-temperature non-equilibrium plasma that rapidly thermalizes to produce an arc. In this work, a computational model based on the self-consistent, multi-species continuum description of the plasma is used to study the neutral gas breakdown and the incipient stages of the thermalization process. The non-equilibrium plasma model is used to obtain a timescale associated with the temperature equilibration process. The plasma model is subsequently coupled with a Navier-Stokes based flow model to yield an effective length over which the plasma equilibrates as it expands into the initially evacuated inter-electrode volume. The objective of this study is to self-consistently obtain an inlet temperature boundary condition and an effective accelerator length for a MHD model that is used to describe the equilibrium plasma as it accelerates under the effect of the Lorentz force.

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