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Electron Flow Stability in Magnetically Insulated Vacuum Transmission Lines[1] D.V. ROSE, T.C. GENONI, R.E. CLARK, D.R. WELCH, Voss Scientific, LLC, W.A. STYGAR, Sandia National Laboratories — We evaluate the stability of electron current flow in high power magnetically insulated transmission lines (MITLs). A detailed model of electron flow in cross-field gaps yields a dispersion relation for electromagnetic TM waves [1] which is solved numerically to obtain growth rates for unstable modes in various density profiles. These results are compared with 2D particle-in-cell (PIC) simulations of electron flow in high power MITLs. We find that the macroscopic properties (charge and current density, self-fields) of the equilibrium profiles observed in the simulations are well represented by the laminar flow model of [1]. Idealized simulations of sheared flow in electron sheaths show that unstable, sharp-cutoff radial density profiles rapidly evolve into stable flows with a more gradual density gradient. Growth rates for both long (diocotron) and short (magnetron) wavelength instabilities observed in the simulations agree well with the dispersion analysis. We conclude that electron sheaths in high power 2D MITL flows form stable profiles and that sheath expansion is not caused by flow instability. Subsequently, we investigate the impact of electrode plasma formation and evolution on sheath stability and gap closure using PIC simulations. We compare MITL simulations with experimental measurements. [1] R. C. Davidson, et al., Phys. Fluids 27, 2332 (1984).

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