Abstract Submitted
for the GEC17 Meeting of
The American Physical Society

Analytical model of cold-cathode breakdown in helium at extremely high electric field and low pressure[1] LIANG XU, ALEXANDER KHRABROV, IGOR KAGANOVICH, Princeton Plasma Physics Lab, TIMOTHY SOMMERER, General Electric Global Research, PRINCETON PLASMA PHYSICS LAB COLLABORATION, GENERAL ELECTRIC GLOBAL RESEARCH COLLABORATION — An analytical model is developed for gas ionization breakdown at extremely high values of reduced electric field (the ratio E/n of electric field to gas density) between parallel-plate electrodes in helium. The value of E/n under investigation varies in the range of 70–6600 kTd (1 kTd = 10^{-18} Vm^{-2}) for $pd \sim$ 0.5 Torr-cm, where p is the gas pressure and d is the electrode separation. The model includes anisotropic scattering for all species and fast neutral atom backscattering at electrodes, as well as fast-neutral impact ionization. The results are compared to those from a detailed Particle-In-Cell/Monte Carlo (PIC/MCC) simulation (Liang Xu et. al., Investigation of the Paschen Curve for Helium in 100-1000 kV Range), and to experimental measurements. Analytical model results are sufficiently accurate for $E/n \sim$1000 kTd if the model treats the electrons as a single beam and assumes that charge exchange is the dominant collision process which determines the local distributions of ions and fast neutral atoms.

[1]This work was supported by the Advanced Research Projects Agency-Energy (ARPA-E), U.S. Department of Energy, under Award Number DE-AR0000298.

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Date submitted: 29 May 2017 Electronic form version 1.4