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PIC-Simulations of an Intense Electron Beam Plasma using EMPIRE

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PIC simulations are performed to model NRL's Febetron experiment, a small pulsed power device that injects an intense electron beam into a gas cell. The parameters of the pulsed power device are a 100 kV, 4.5 kA, and 100 ns pulse. Three-dimensional models of the vacuum diode and the gas cell are used in EMPIRE simulations. The kinetic model depends on the magnitude of the electron-beam current and energy, and the gas pressure. Within EMPIRE we utilize and compare different emission models for the diode and the gas cell and included a weakly-ionized chemistry set for molecular nitrogen. Simulations assess a range of pressures between 100 mTorr and 10 Torr. The results analyze the electric field, the current enclosed contours ($2\pi r B_{\theta}/\mu_0$), the electron density and the plasma density of various state populations such as electronic, vibrational and rotational states. Additionally, we evaluate different numerical methods in EMPIRE and compare to experimental data.

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