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Particle-In-Cell Simulations of a Current-Free Double Layer[1] S.D. BAALRUD, T. LAFLEUR, C. CHARLES, R.W. BOSWELL, SP3 group, The Australian National University — A current-free double layer that forms between a magnetized source plasma (upstream) and an unmagnetized plasma in a larger volume expansion chamber (downstream) is studied using a particle-in-cell code. The code is 1D in space and 3D in velocity phase-space. Plasma expansion is modeled by invoking a loss profile in the downstream region. This profile is obtained from the plasma volume expansion that results from the diverging magnetic field of the source chamber. Emphasis is placed on the electron velocity distribution functions (EVDFs). We find that the EVDFs perpendicular to the simulation axis are nearly Maxwellian. Upstream, the EVDF in the parallel direction is significantly depleted in the downstream facing ($+\hat{x}$) direction for energies greater than that required to escape the sheath at the upstream chamber wall. The EVDF is not significantly depleted in the ($-\hat{x}$) direction. Downstream, the EVDF has a two-temperature Maxwellian distribution with an additional depletion in the upstream facing ($-\hat{x}$) direction, corresponding to electrons escaping to the downstream wall. These findings are compared with the EVDFs assumed in previous analytic models and a modified model is developed based on the EVDFs from the simulations.

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