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Two-Dimensional Axisymmetric Child-Langmuir Scaling Law[1]
BENJAMIN RAGAN-KELLEY, JOHN VERBONCOEUR, University of California Berkeley — The classical one-dimensional Child-Langmuir law has been extended to two dimensions by numerical simulation in planar geometries [1]. By considering an axisymmetric cylindrical system with emission radius r, outer radius $R > r$, and gap length L, we further examine the space charge limit in two dimensions. The ratio of the observed current density limit J_{CL2} to the theoretical one-dimensional value J_{CL1} is found to be a monotonically decreasing function of the ratio of emission area (r^2) to gap separation (L). This result is in agreement with the planar results, where the emission area is proportional to the cathode width (r) [1]. The simulations were run in the particle in cell code, OOPIC [2]. [1] J. W. Luginsland, Y. Y. Lau, and R. M. Gilgenbach, Phys. Rev. Lett. 77, 4668 (1996). [2] J. P. Verboncoeur, A. B. Langdon, and N. T. Gladd, Comp. Phys. Comm. 87, 199 (1995).

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