

Abstract Submitted
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Coordinate System Invariant Space Charge Limited Current for General Initial Velocity¹ JACOB HALPERN, ADAM DARR, ALLEN GARNER, Purdue University — Originally derived exactly for planar diodes [1], more recent analysis of space-charge-limited current (SCLC) has applied variational calculus (VC) to derive a coordinate system invariant solution for any general rectilinear geometry and obtain exact, closed form solutions for planar, spherical, and cylindrical geometries [2]. We extend this VC approach to first derive a coordinate system invariant solution for any generalized emission velocity and then derive closed form solutions for planar, cylindrical, and spherical diodes. The resulting functions show that the position of the virtual cathode approaches the anode with cylindrical and spherical geometries doing so more slowly than planar. Extensions of this VC approach to incorporate relativistic behavior and, ultimately, both relativistic behavior and initial electron velocity will be discussed. [1] P. Zhang, A. Valfells, L. K. Ang, J. W. Luginsland, and Y. Y. Lau, *Appl. Phys. Rev.* 4, 011304 (2017). [2] A. M. Darr, A. M. Loveless, and A. L. Garner, *Appl. Phys. Lett.* 114, 014103 (2019). [3] A. D. Greenwood, J. F. Hammond, P. Zhang, and Y. Y. Lau, *Phys. Plasmas* 23, 072101 (2016).

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