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Space-charge Limited Emission in Crossed Field Diodes using Variational Calculus[1] ADAM DARR, SREE HARSHA NAROPANTH RAMAMURTHY, ALLEN GARNER, Purdue University — Micro- and nanoscale electronic device design is often driven by space charge, both positively and negatively. A higher space-charge limit allows more current to flow through a vacuum diode, while lower limits may be sought to avoid significant current flow. While space-charge limited emission (SCLE) is well understood for a one-dimensional planar diode, a general solution independent of geometry has only recently been derived using variational calculus [1]. One may also vary SCLE by introducing an external magnetic field perpendicular to the electric field. The emitted electrons travel in curved paths, spending longer in the gap, contributing to increased space-charge; for magnetic fields above the Hull cutoff, electrons no longer reach the anode, but travel in cycloidal orbits back to the cathode [2]. This paper extends our previous work with SCLE for general geometry to the crossed-field case, looking specifically at planar and cylindrical geometries. [1] A. M. Darr and A. L. Garner, Appl. Phys. Lett. 115, 054101 (2019). [2] P. J. Christenson and Y. Y. Lau, Phys. Plasmas 1, 3725-3727 (1994). This material is based upon work supported by the Air Force Office of Scientific Research under award number FA9550-19-1-010.

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Adam Darr
Purdue University

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