**Space-charge limited current calculation using the minimum energy principle**[1] ADAM DARR, ALLEN GARNER, Purdue University West Lafayette — Classical space-charge limited emission (SCLE) theory for cylindrical and spherical diodes were first formulated by Langmuir and Blodgett (LB) [1]. Recent studies improved LB results using analytical techniques [2]; however, they assume zero space-charge. This presentation applies variational calculus (VC) and the minimum energy principle to derive analytic solutions for the current-voltage behavior of these diodes. This yielded exact, closed-form solutions for SCLE from first principles and a second order differential equation valid for any geometry. VC agreed better with simulations than LB, particularly at extreme ratios of anode to cathode radius. We further report extensions of these calculations to include a crossed magnetic field to assess cycloidal flow stability [3]. The application of this approach for other electron emission mechanisms and conditions will be discussed. [1] I. Langmuir and K. Blodgett, Phys. Rev. 24, 49-59 (1924). [2] Y. B. Zhu, P. Zhang, A. Valfells, L. K. Ang, and Y. Y. Lau, Phys. Rev. Lett. 110, 265007 (2013). [3] P. J. Christenson and Y. Y. Lau, Phys. Plasmas 1, 3725-3727 (1994).

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