

Abstract Submitted
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Theoretical analysis of the transition from field emission to space-charge limited emission in liquids¹ SARAH LANG, ADAM DARR, ALLEN GARNER, Purdue University — Discharge formation and breakdown in water have critical implications for water sterilization and biomedical applications [1]. Several studies in liquids have demonstrated that current transitions from Fowler-Nordheim (FN) for field emission to Mott-Gurney (MG) for space charge limited emission (SCLE) with increasing voltage [2]. A recent theory unified FN, MG, and Child-Langmuir law (CL) for vacuum SCLE in gases as a function of mobility, pressure, and gap distance [3], yielding a third order nexus when the asymptotic solutions for FN, CL, and MG match. Since the relevant physics is independent of the phase of matter, this study assesses the feasibility of applying this theory to liquids. By treating the emission area and Fowler-Nordheim constants as fitting parameters, we fit the theory to liquid data and observe the transition from FN toward MG. The implications of these results on electron emission in liquids and as the phase transitions to vapors and gases will be discussed. [1] J.E. Foster, *Phys. Plasmas* **24**, 055501 (2017). [2] K. Dotoku, H. Yamada, S. Sakamoto, S. Noda, and H. Yoshida, *J. Chem. Phys.* **69**, 1121 (1978). [3] A.M. Darr, A.M. Loveless, and A.L. Garner, *Appl. Phys. Lett.* **114**, 014103 (2019).

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