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Nonequilibrium statistical mechanics of electrons in a diode, SAMUEL MARINI, FELIPE B. RIZZATO, YAN LEVIN, RENATO PAKTER, *Instituto de Física - UFRGS* ■Fully kinetic descriptions of long-range self-interacting systems are generally very difficult to obtain because these systems do not relax to the Maxwell-Boltzmann distribution and the tools of equilibrium statistical mechanics cannot be employed. This is the case of electron flows in diodes and in crossed-field devices which are fundamental for the development of several advanced applications in areas ranging from microwave sources to space propulsion, as well as in the semiconductor industry. Here, a statistical theory is presented that allows the calculation of the stationary state achieved by the electron in such systems after a process of collisionless relaxation. The stationary collisionless Boltzmann (Vlasov) equation with appropriate boundary conditions is reduced to an ordinary differential equation, which is then solved numerically. Special attention is given to the space-charge limited transition when the electron density becomes high enough to screen the accelerating electric field at the cathode. It is found that while for unmagnetized diodes this transition is always continuous [1], in the case of crossed-field diodes it becomes discontinuous below a critical temperature [2]. We also investigate how intrinsic space-charge oscillations may drive stationary states unstable in certain parameter regimes [2]. The results are verified with molecular-dynamics simulations.

[1] F. B. Rizzato, R. Pakter, and Y. Levin, Phys. Rev. E, **80**, 021109 (2009).

[2] S. Marini, F. B. Rizzato, and R. Pakter, Phys. Plasmas, **21** 083111 (2014).