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A relativistic self-consistent model for studying enhancement of space charge limited emission due to counter-streaming ions M. C. LIN, Hanyang University, J. VERBONCOEUR, Michigan State University — A maximum electron current transmitted through a planar diode gap is limited by space charge of electrons dwelling across the gap region, the so called space charge limited (SCL) emission. By introducing a counter-streaming ion flow to neutralize the electron charge density, the SCL emission can be dramatically raised, so electron current transmission gets enhanced. In this work, we have developed a relativistic self-consistent model for studying the enhancement of maximum transmission by a counter-streaming ion current. The maximum enhancement is found when the ion effect is saturated, as shown analytically. The solutions in non-relativistic, intermediate, and ultra-relativistic regimes are obtained and verified with 1-D particle-in-cell simulations. This self-consistent model is general and can also serve as a comparison for verification of simulation codes, as well as extension to higher dimensions.

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