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Limits of Particle-beam Extraction from Single-Component Plasmas[1] T.R. WEBER, J.R. DANIELSON, C.M. SURKO, University of California, San Diego — Recently, a non-destructive technique was developed to create finely focused beams of electrons (or positrons) from single-component plasmas confined in a Penning-Malmberg trap[2]. This technique exploits the fact that the plasma potential is largest near the plasma center; thus, when the confining potential at one end is carefully lowered, a beam is formed that is composed only of particles escaping from the region near r = 0. Here, we investigate the limits of this technique. A simple model for beam extraction is described that predicts a Gaussian beam profile when the number of extracted particles is small. This expression gives a minimum beam diameter of four Debye lengths (full width to 1/e) and is verified using electron plasmas over a broad range of plasma temperatures ($0.05 < T < 2$ eV) and densities ($0.06 < n < 2{\times}10^{10}$). Numerical calculations are used to predict the profiles of beams with large numbers of extracted particles, and they are in fair agreement with the measurements. The extraction of over 50% of a trapped plasma in a train of nearly identical beams is demonstrated. Applications to create state-of-the-art positron beams, including the possibility of extracting the beam from the magnetic field to form an electrostatic beam, are also discussed.

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[2]J. R. Danielson et al., Appl. Phys. Lett. **90**, 081503 (2007).

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