

Comparison between experiment and two simulation strategies for the extraction of focused ion beams

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Computer simulation codes for the extraction of ion beams have been used for over three decades.

Here we describe medium current extraction (~1 mA) from a high density plasma source (10^{12} cm^{-3}) with a three electrode extraction system and compare the extracted current and the angular divergence with the results of two computer simulation programs. The first is called PBgun and is a commercially available ray tracing code; the second, called simulation d'extraction de faisceaux d'ions ~SEFI! uses a particle-in-cell code to simulate the plasma and ion beam. It is the purpose of this article to ascertain whether these codes can adequately model the plasma/beam interface and hence successfully predict the extracted current and beam form across a broad range of extraction parameters. We found that SEFI could accurately predict the function of extracted current versus extraction voltage and that PBgun gave accurate simulations when the current or current density could be specified near the meniscus. Also for a thin plasma aperture and a fixed current at the meniscus, PBgun gave roughly 60% of the functional dependence of the extracted current on the extraction voltage and the other 40% on variations in the plasma pre-sheath. Both codes had some error from beam crossing near the axis which changed the amount of meniscus curvature predicted. © 2004 American Institute of Physics. @DOI: 10.1063/1.1753669#