Results from a Double Vlasov Model for Negative Ion Extraction from Volume Sources*,
D.K. OLSEN, R.J. RARIDON, J.H. WHEALTON, ORNL - A new, highly nonlinear, self-consistent negative ion source extraction model has been formulated and implemented. The model explicitly considers the motion of positive ions and the volume generation of negative ions. Both a time dependent and steady-state model have been constructed in 2D. The time dependent model explores the domain of ion time scale instabilities, due to violation of the Bohm sheath stability criteria using a simplified model of the negative ion distribution. The steady-state model smoothes over these instabilities and does a full Vlasov treatment of the negative ion distribution. It is found that (1) in the absence of ion acoustic instabilities, there is a saddle point with a potential barrier tending to prevent most volume produced negative ions from being extracted; (2) for high-beam currents, the beam current is limited by a transverse space charge limit, meaning that an increase in negative ion density at the extraction sheath will result in a lower beam; (3) introduction of cesium may cause an increase in the transverse space charge limit; (4) cesium may also result in a reduction of extracted electrons by dint of a less negative bias on the plasma electrode with respect to the adjacent plasma, thus allowing the transverse space charge limit budget to be taken up wholly by the ions. (The combination of 3 - 4 represents the way an actual increase in the beam current can be achieved.) The insights developed using these models are expected to lead to improvements in volume negative ion sources.

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