

§16. Two Dimensional Particle Simulation on Negative Ion Extraction from a Volume Source

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Two dimensional electrostatic particle simulation was done to study the extraction of negative ions from a volume plasma source. Simulation model is shown in Fig.1. There is a magnetic filter (MF), an extractor grid (EG), and a plasma grid (PG) in the system. Periodic end condition is used in the y -direction. Particles reaching PG, EG, or the right wall are absorbed there. Electrons and (positive and negative) ions are injected constantly into the source region (SR) to equal the particle loss. To attain the stationary state, the velocity distribution of electrons in the source region is reset to form a new Maxwell distribution in every several tens of time steps.

Simulation results agree with the Child-Langmuir law for the lower value of ϕ_{EG} . While for the higher value of ϕ_{EG} , simulation results do not coincide with the law. The phase space (x, v_x) plot of negative ions are presented in Fig.2. It is clear for the higher value of ϕ_{EG} , two types of negative ions enter into the acceleration region. One is from the bottom of the concavity of the beam extraction surface. The other is from the top of the beam extraction surface. The space charge effect of the second type negative ions reduces the beam current density of the first type negative ions. It is hence expected that if we can suppress second type negative ions from the system, the negative ion current density will increase for the higher value of the extraction grid potential.

References

- 1) Naitou, H., Fukumasa, O., Sakachou, K. and Mutou, K., Rev. Sci. Instrum. **65** (1994) 1438.
- 2) Naitou, H., Fukumasa, O., Sakachou, K. and Mutou, K., accepted for publication in Fusion Eng. Design.

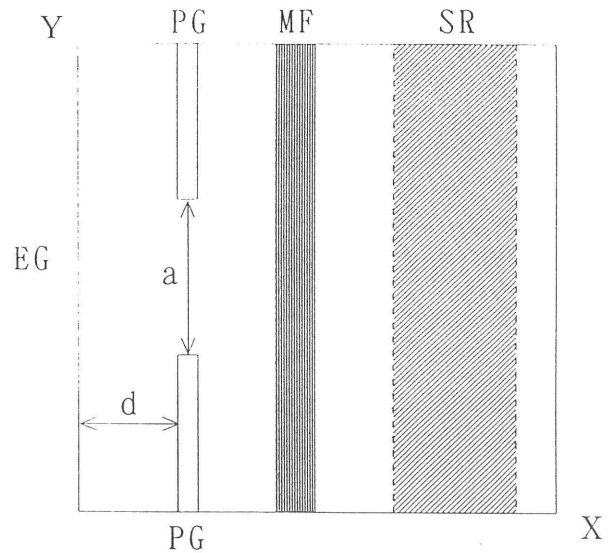


FIG. 1. Schematic diagram of the simulation model.

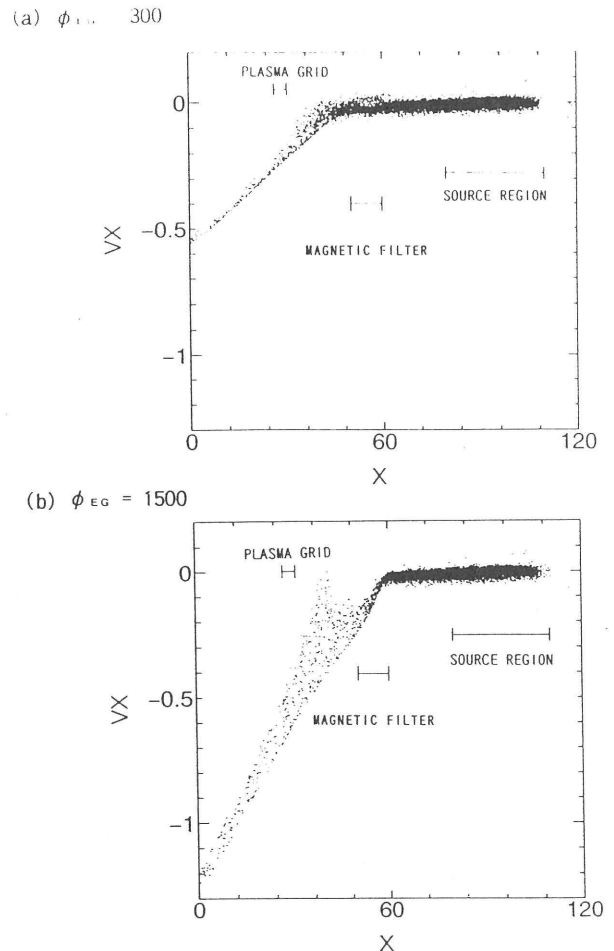


FIG. 2. Phase space (x, v_x) plots of negative ions which are located in the region, $40 < y < 80$, for (a) $\phi_{EG} = 300$ and $\phi_{EG} = 1500$ at $t = 2000$.