BOUNDARY CONDITION ON the SURFACE OF PLASMA EMITTER AFFECTED BY A COUNTER flow OF PARTICLES

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The theory of plasma emitters [1–5] generally deals with emission of the plasma electrons or ions from a plasma surface. In real sources, beams of particles are usually transported to a target through a plasma, which is created by ionization of residual or intentionally injected gas into the transport channel (a so-called secondary plasma). The secondary plasma can also propagate along the magnetic field lines from an open magnetic trap being heated by an electron beam injected into the trap [6]. Such a plasma can significantly affect the operation of the beam source, distorting the distribution of electric fields and particle flows, sometimes causing electrical breakdowns.

Accounting for secondary plasma in the numerical modeling of sources with plasma emitters involves a preliminary theoretical study of the laws of the emission from the plasma in the presence of the oncoming stream of particles. In this paper, such an analysis has been conducted in a one-dimensional approach, but the results are suitable for numerical simulation of multi-dimensional systems with multiple plasma regions, which emit counter flows of particles with charges of opposite signs.

For plasma emitters of ions and electrons, we have formulated boundary conditions for the potential and the electric field on the surface of the plasma and the initial conditions for the flow rate and current density of the emitted particles in the presence of a counter flow from the secondary plasma. We used these conditions to upgrade the numerical code POISSON-2 [7] and to simulate a two-dimensional proton beam source [8].

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