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NASA TECH BRIEF

Computer Programs Calculate Potential and Charge Distributions in a Plasma

The problem:

To devise a set of computer programs for determining the potential and charge distributions between two electrodes in a plasma in a variety of geometries.

The solution:

Computer programs are written to determine solutions of the Vlasov equations for plane, cylindrical, and spherical geometries. Potential and charge density distributions are found for each of these configurations over a range of conditions. Values of the independent parameters of bias potential, electrode spacing (in Debye lengths), and charge density ratio are chosen so as to provide a variety of solutions.

How it's done:

The report, entitled "Computer Solutions of the Vlasov Equations," studies solutions of the collisionless Boltzmann or Vlasov equations for two related physical problems.

In one problem, designated the diode problem, the objective is to predict current-voltage characteristics between two electrodes, an emitter and a collector, in the presence of a plasma. Primary attention is given to an emitter on which charged particles are formed. In principle, the electron current of positively and negatively charged particles leaving the emitter may be varied quite independently, and the motion of the charged particles after leaving the emitter is determined by the electrostatic field distribution. The diode configurations in this problem either have an electrode spacing which is small compared to the radius of curvature, or are concentric cylindrical or spherical situations with the collector external to the emitter.

In a second problem designated the probe problem the intent is to predict the disturbance caused by a small object at some enforced bias potential relative to a much larger (or nearly infinite) container. The disturbance involves, in general, both a local departure from an essentially neutral plasma and a charged particle current of one sign or the other from the plasma to the probe. Cylindrical or spherical symmetry is implied by the definition of the problem. The distinguishing feature of the probe problem compared with the diode problem is that most of the particles of either sign leave the emitter with a velocity component perpendicular to the radius, which prevents them from negotiating the bias potential barrier to the collector or probe. Instead, these particles follow trajectories that become entirely tangential at some radius, and finally return to the emitter.

Note:

Inquiries concerning this innovation may be directed to:

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Patent status:

No patent action is contemplated by NASA.

Source: David C. Prince and N. P. Jefferies
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