

INTERPRETATION OF PROBE MEASUREMENTS IN A COLLISIONLESS PLASMA FLOW

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The aim of this work is to develop and substantiate a procedure for the characterization of an unperturbed collisionless plasma on the basis of a parametric description of the current-voltage characteristic of a thin cylindrical probe positioned perpendicular to the plasma flow with the use of a priori information on the plasma properties and the experimental conditions. Based on the Vlasov–Poisson kinetic model, the two-dimensional direct problem of probe measurements was studied numerically. The ion and electron currents to a cylinder positioned perpendicular to the plasma flow were calculated as a function of the ion velocity ratio, the degree of plasma nonisothermality, and the ratio of the probe radius to the Debye length. Based on the results of the calculations, the classical approximations of the probe currents were corrected, and the applicability ranges of the approximation of the total current–voltage characteristic of a thin cylindrical probe in a collisionless plasma flow were determined. A procedure was developed for identifying the parameters of an unperturbed plasma based on a comparison of the theoretical approximation of the current–voltage characteristic with the measured data. A priori information on the plasma properties and the experimental conditions is given as limitations to the approximation parameters of the current–voltage characteristic. The effect of probe measurement errors on the identification of the plasma parameters was studied. The results obtained may be used in the diagnostics of a collisionless plasma.

Keywords: *weakly ionized collisionless plasma flow, cylindrical Langmuir probe, numerical simulation, parametric identification, a priori information.*

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