NUMERICAL AND EXPERIMENTAL INVESTIGATIONS ON COLLISIONFREE COMPRESSION OF A PLASMA WITH ANOMALOUS FRICTION

by

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Abstract

Friction of electrons moving under the action of an induced electric field in a dilute collisionless plasma was investigated by comparison of numerical calculations with experimental results. Calculations were made for a cylindrical plasma in an axial time-varying magnetic field. The behaviour of the plasma was treated by two-fluid equations including a friction term for the electron component as was used by Adlam, Holmes and Bardotti, Cavaliere, Engelmann to describe in a phenomenological way the action of a two-stream instability on electron motion. This term forces the electron velocity to stay under a critical value and simultaneously describe the conversion of energy of directed motion in energy of unordered motion. Free parameters in this friction term were to be determined by experiment.

The investigations were made in a density regime ($2 \cdot 10^{11}$ - $5 \cdot 10^{12}$ cm^{-3}) where the characteristic length c/ω_{pe} for the structure of magnetic field, density etc. is comparable to or larger than the radius of the plasma. In this case there are no limitations on the strength of the induced field, which are imposed in the other case by an unadmissible steepening of the front of the compression wave.

Calculated current distributions are compared with probe measurements of magnetic fields.