EFFECT OF ION DRAG ON THE DUST PARTICLE ROTATION IN A GLOW DISCHARGE IN STRONG MAGNETIC FIELDS

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It is known that dust structures in a stratified DC discharge under the influence of an axial magnetic field B come into rotational motion. At low fields ($B \sim 0.01$ T), the rotation occurs counterclockwise if viewed in the direction of the magnetic field (in this case, we set the rotation angular velocity to be negative, $\Omega < 0$). The rotation in this case is associated with the azimuthal ion drag as a result of the ion drift in crossed axial magnetic and radial ambipolar electric fields, as well as with the radial ion pressure gradient. With an increase in magnetic induction, rotation inversion occurs, which is associated with the predominance of another rotation mechanism. In a stratified DC discharge under the action of eddy currents in a magnetic field, the neutral gas rotates. Along the striation length, this rotation changes direction, but in the striation head (its lower luminous part), in the region of stable dust particles equilibrium, it occurs clockwise, $\Omega > 0$. In fields $B \gtrsim 0.1$ T, rotation of dust particles entrained by gas is observed in the same direction. In [1] we measured the rotation velocity in fields of 1.1−2.2 T and proposed an analytical model to describe such rotation. Satisfactory agreement between the calculation by this model and the experimental data was obtained. In this case, the effect of ion drag was not taken into account, since under these conditions it is of secondary importance and it was assumed that its contribution is small. Nevertheless, the influence of this mechanism on the dust structure rotation velocity is of some interest. In this report, we present the results of the corresponding calculation and show that it is not negligible and amounts to about 20% of the main mechanism contribution. However, it should be noted that the uncertainty in the value of the neutral gas drag contribution, calculated in [1] using the analytical model, is apparently close to this value, since some parameters required for calculation by the model are known approximately.

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1. Dzlieva E. S., D′yachkov L. G., Novikov L. A., Pavlov S. I., Karasev V. Yu. // Plasma Sources Sci. Technol. 2020. V. 28. 085020