DUSTY PLASMA IN GLOW DISCHARGE IN HELIUM IN MAGNETIC FIELDS UP TO 1.5 T

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A dust structure has been created in a glow discharge in helium in a strong magnetic field of up to 1.5 T. Previously, this could only be done in fields an order of magnitude smaller. Perhaps, such success is due to the fact that the dust structure is formed not in the stratum, but inside a conical insert, narrowing the current channel and serving to stabilize the discharge. The dust structure rotation velocity was measured in the entire range of magnetic field changes from 0 to 1.5 T. As in neon, under similar conditions, rotation occurs counterclockwise, if you look in the direction of the magnetic field, in the entire range of its change. However, in this case, the dependence of the velocity on the magnetic field differs significantly from what was observed in neon. There is a sharp maximum of the rotation velocity (in absolute value) at magnetic field 0.1 T up to 33 rad/s. Then it quickly drops to 11 rad/s at 0.2 T and continues to drop at a slow pace to 3 rad/s at 1 T. After this, the velocity begins to increase and reaches 35 rad/s (in absolute value) at 1.5 T.

We have performed the calculation based on the assumption of two rotation mechanisms: ion drag and neutral gas drag. The second mechanism is associated with the assumption of some expansion of the current channel inside the conical insert below its narrowest point and the appearance of a radial component of the current. As shown by Nedospasov, the radial component of the eddy current in the striation causes the neutral gas to rotate, and along with it, the dust particles. We assume the same mechanism of action of the discharge current radial component inside the insert, with the only difference being that it is directed from the discharge tube axis to the wall, while the eddy current radial component in the striation at the level of the dust structure has the opposite direction. With some reasonable assumptions about the nature of the expansion of the current channel inside the insert, it is possible to explain the observed dependence of the rotation velocity of dust particles on the magnetic field.