ROTATION OF PLASMA-DUST STRUCTURES IN A MAGNETIC FIELD IN A NARROW CURRENT CHANNEL [[1]](#footnote-1)\*)

DOI: 10.34854/ICPAF.2023.50.2023.1.1.128

Karasev V., Dzlieva E., Pavlov S., Novikov L.

St. Petersburg State University, 7/9 Universitetskaya Emb., St Petersburg 199034, Russia, [v.karasev@spbu.ru](mailto:v.karasev@spbu.ru)

Dusty plasma [1] in the form of three-dimensional structures created under the conditions of a glow discharge in a magnetic field shows a number of effects. When studying the dust structure formed in the region of the current channel waist in a strong magnetic field with an induction of 0.1 T, two phenomena were discovered. The first is an increase in the velocity of rotation of the dust structure to very high values, on the order of 100 rad/s. The second is a change in the compactness and arrangement of particles: compaction in a section perpendicular to the magnetic field and the formation of circular shells around the center of rotation. In this report, the detected effects are presented and the conditions for their appearance are discussed.

Dusty plasma in this trap is formed in a magnetic field from 0 to 150 G [2]. Initially, the trap near the change in the current cross section was associated with the region of the low-voltage arc [3, 4]. According to the observations in neon at 0.4 Torr, in argon at 0.23 Torr, and in helium at 0.1 Torr, a strong dependence of the rotation velocity on the length of the current channel (the length of the dielectric insert narrowing the discharge) was found for the same waist size. So far, there is an interpretation of the appearance of rotation for a short insert (up to 1 cm) in a magnetic field up to 1 T [5].

It has been found that in a magnetic field above 0.1 T in neon (the product of the Hall parameters ωeτe ωiτi = 1), the arrangement of particles is rearranged. The radial interparticle distance is reduced to 0.1 mm (three times), and with a further increase in the magnetic field, the interparticle distance does not change. These changes correlate with the measurement of the structure diameter in a magnetic field; it decreases and then becomes constant. In this case, circles are formed in the cross section perpendicular to the magnetic field instead of the hexagonal arrangement of particles. Their appearance is influenced by two factors: the magnetization of the ions and the high (more than 10 rad/s) rotation velocity. The restructured structure during vertical scanning looks like a system of nested coaxial cylinders.

The work was supported by the Russian Science Foundation, grant № 22-12-00002.

References

1. *Complex and dusty plasmas: from laboratory to space* Fortov V E, Mofill G E (NewYork: Taylor & Francis Group) 2010 p 418
2. Dzlieva E S, Karasev V Y, Pavlov S I 2016 *Plasma Physics Reports* **42** 147.
3. A.M. Lipaev *et al.*, JETP. 1997. **85**, 1110.
4. Nedospasov A. V. *Phys. Rev. E* .2009. **79.** 036401.
5. Dzlieva E.S., Dyachkov L.G., Novikov L.A., Pavlov S.I. and Karasev V. Yu., Plasma Sources Science and Technology, 2019, **28**, 085020.

1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/L/Lt/ru/EK-Karasev.docx) [↑](#footnote-ref-1)