3rd Asia-Pacific Conference on Plasma Physics, 4-8,11.2019, Hefei, China

Excitations of dust density waves with discharge polarity reversal

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Plasmakristall-4 (PK-4) is microgravity complex plasma apparatus on-board the International Space Station which facilitate the study of complex plasma in liquid phase. The setup consists of a glass tube of 3 cm diameter and about 20 cm working area [1]. In the chamber, the plasma is generated by DC glow discharge whose polarity can be switched with a frequency up to 5 kHz. Additionally, the setup is equipped with rf-coils for exciting inductively coupled plasma and for microparticles trapping.

Here, we report the observation of the self- excited dust density waves in dc discharge plasma using the PK-4 facility. In the experiment, the microparticles cloud was first trapped in an inductively coupled plasma, then released to drift in a dc discharge of negative and, after some seconds, positive polarity. DC plasma containing a drifting microparticle cloud was found to be asymmetric with respect to discharge polarity reversal in terms of microparticle drift velocity and plasma emission in accord with [2]. In addition to that, asymmetry in the self-excited wave pattern was observed: In the front edge of the microparticle cloud (defined as head), the waves had larger phase velocity than in the rear edge (defined as tail). Also, after the polarity reversal, the wave pattern exhibited several bifurcations: between each of the two old wave ridges a new wave ridge has formed. These bifurcations, however, occurred only in the head of the microparticle cloud. Observed variation of the phase velocity as well as the growth rate of the new ridges is discussed based on the dispersion relation for dust density waves in electric field.

References

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