Geophysical Research Abstracts
Vol. 18, EGU2016-2088, 2016
EGU General Assembly 2016

Wave turbulence in a complex (dusty) plasma

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Complex or dusty plasmas consist of micrometer-sized particles embedded in a low-temperature plasma and are ideal model systems for nanofluids, phase transitions, transport processes. As an example of complex system dynamics, these solid particles immersed into a weakly ionized plasma are the subject of many detailed studies. The microparticles can be visualized individually in real time, thus providing a kinetic level of observations. We report on a complex plasma under microgravity conditions that is auto-oscillating due to a heartbeat instability. The instability triggers the low-R turbulent flow in a complex plasma cloud. The flow reveals a complicated and neatly structured multi-cascade turbulent process. A direct and an inverse energy cascade influenced by friction, modulational and short-wavelength instabilities resulting in a quasi-stationary turbulent state seems to be a promising model able to adequately address all the fine features of the observed particle and energy transport. We numerically studied two-dimensional vortices in a complex plasma. In particular, we showed that turbulence is present in the flow induced by the vortices and demonstrated that the velocity structure functions scale very close to the predictions by Kolmogorov theory. The results obtained show that complex plasmas are a promising tool to study turbulence on the level of individual particles.