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Low frequency turbulence in space plasmas with dust impurities

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In order to enhance our understanding of the rich plasma physical processes that drive the solar-terrestrial space environment and to create the adequate and rich services for Space Weather Program, we need to increase our ability to perform multi-point measurements by means of different sensors. Moon as the natural spacecraft can be a target for localisation the radio receiver dedicated to monitoring Earth's space environment and obtain a much more complete picture of electromagnetic plasma turbulence in different space regions than those available hitherto. Moreover this diagnostic can give the information about the localisation and property of the plasmopause, magnetosheet, magnetopause, bow shock, solar wind and radio burst and CME.

It is well known that even systems with a finite number of interacting waves can be realized in the turbulent state of the active media. At the same time the essential role of dissipation of the waves suggests that, at low threshold of instability, a typical perturbed state of the plasma can be described as a finite set of interacting waves, some of which are unstable and others are strongly damped. In such cases, the number of waves remains finite, but because of competition between the instability and damping of the waves when they interact, the dynamics of the amplitudes of the waves becomes stochastic in nature and the so-called few-mode turbulence. In analyzing the conditions of the various modes of instability of nonlinear low-frequency waves and discussed the transition from quasi-periodic regime to a few-mode turbulence, and then to the fully developed turbulence, depending on the density and composition of the dust component of the plasma.

An important topic for lunar missions is understanding how the charged dust behaves, roles of dust transport, levitated dust and electrodynamics around the lunar surface . It could be essential for ensuring the continued safe operation of equipment and long-term exploration. Lunar dust is charged by its interaction with the surrounding plasma. The moon's orbit carries it through the solar wind and the Earth's own magnetotail (particularly the charging of Lunar surface in plasmasheet region is a crucial effect) . The crucial point is to study the influence of the dust particles on various plasma instabilities and fluctuations and then apply the theoretical results to the dusty plasma environment of the lunar surface. The natural plasma emission detected in the dusty environment can be modified. On other hand effect this can be used for determined the dust property.

In our presentation, we base on a linear analysis of the effect of dust particles on the properties of low-frequency waves and the conditions of instability, we consider stabilization of nonlinear instabilities via three-wave interaction. Emphasis is placed on a resistive instability of drift waves, but also the results of studies in other cases, including the instability of current carrying and Farley-Buneman instability.

This problem requires essentially three-dimensional consideration due to the specifics of the nonlinear interaction of waves in a magnetized plasma, it is very difficult for fully 3D numerical simulations. Considering the conditions under which the linear growth rates are lower than the frequency drift waves, we can assume that nonlinear interaction also remains weak. Then, despite the important role of dissipative processes of the original system can reduce the nonlinear equations to a system of ordinary differential equations describing the dynamics of the wave amplitudes in the active medium taking into account the three-wave interaction and use it to explore different regimes of turbulence.

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