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Interaction of Linear and Nonlinear Ion-Sound Waves with inclusions of Dusty Plasma

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Last time, a lot of investigations have been devoted to the oscillations and waves in dusty plasmas. The property of the dusty plasma to support a large variety of both linear and nonlinear waves is very attractive. As usually, the charge-to-mass ratio is smaller for dusty particles than for the ions. In this case, the inclusions of the dusty plasma possess smaller velocities of ion-sound waves (ISW) than those velocities in a pure electron-ion plasma. Therefore, the inclusions of the dusty plasma behave like resonators for ISW and can storage the energy of ion-sound oscillations. There exists a problem of an excitation of such a resonator by incident linear and nonlinear ISW pulses.

It is known that the moderately nonlinear ISW in plasma are described by the Kadomtsev – Petviashvili (KP) equation, which reduces in the one dimensional case to the Korteveg – de Vries (KdV) equation. Stable two dimensional solutions (so-called lumps) are absent in the case of ion-electron plasma, due to the signs of dispersion and nonlinear terms.

The report is devoted to numerical simulations of an interaction of linear and nonlinear ISW with inclusions of dusty plasma in electron-ion plasma. The charged dusty particles are assumed as heavy and immobile. The basic equations are the equations of motion for positive ions and dusty particles jointly with the Poisson equation. The excitation of linear ISW has been realized by external curvilinear antenna with an additional possibility of focusing the ISW. The nonlinear ISW have been given as an

initial condition of the KdV soliton with a slight transverse profile. The absorbing boundary conditions have been used at the periphery. The simulations of interaction of non-soliton and soliton ISW pulses with the inclusions of dusty plasma in electron-ion one have demonstrated that such inclusions behave as resonators for ISW. These resonators can be excited effectively by non-solitonic ISW pulses. The KdV solitons do not give an essential portion of their energy to the resonator. But the interaction of solitons with the regions of dusty plasma can lead to destruction of solitons, due to transverse effects.