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Collapse of nonlinear surface dust sound waves in the system dusty plasma-dielectric

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Dusty plasmas in space, the Earth's ionosphere, in volcano fumaroles, and under laboratory conditions now are under investigations. An important property of dusty plasmas is the support of various waves and oscillations, both linear and nonlinear ones. The dusty plasmas can be bounded, for instance, in the volcano fumaroles, in laboratories, or near spacecrafts, and are the waveguides for surface plasma waves. Note that in the surface plasma waves the oscillations of the surface charge take place. Even in the case when the volume nonlinearity is small, the variations of the dust concentration near the interface can reach essential values. Moreover, because the dust concentration is principally nonnegative, the surface nonlinearity cannot be considered as moderate.

In the report, the nonlinear monopulses of surface dust sound waves in the system dusty plasma – dielectric are investigated. The waves propagate along z-axis whereas they are localized in x-direction near the interface. The dusty plasma includes the positive ions (light component) and the negative dust (heavy component). The set of hydrodynamic equations for the dust, namely, the continuity equation and the equation for the momentum, jointly with the Poisson one are used. The Boltzmann distribution is used for the ions. The electric and hydrodynamic boundary conditions are applied at the interface. The initial condition for the electric potential is monopulse-like, both along z and x axes. The simulations demonstrate that the monopulses of small amplitudes are subject to dispersion and diffraction. But when the moderate nonlinearity manifests, the pulse dynamics change drastically. Namely, near the interface the variations of the dust concentration reach extremely high values, where the collapse of the surface dust sound waves occurs. The estimations have demonstrated that the pointed above phenomena can be observed in fumaroles under volcano eruptions.