Electrostatic structures associated with dusty electronegative magnetoplasmas

Abstract:

By using the hydrodynamic equations of positive and negative ions, the Boltzmann electron density distribution and the Poisson equation with stationary dust, a three-dimensional (3D) Zakharov–Kuznetsov (ZK) equation is derived for small but finite amplitude ion-acoustic waves. However, the ZK equation is not appropriate to describe the system either at critical plasma compositions or in the vicinity of the critical plasma compositions. Therefore, the modified ZK (MZK) and extended ZK (EZK) equations are derived. The generalized expansion method is used to analytically solve the ZK, MZK and EZK equations. A new class of solutions that admits a train of wellseparated bell-shaped periodic pulses is obtained. In certain conditions, the latter degenerates to either solitary or shock wave solutions. The effects of the physical parameters on the nonlinear structures are examined in many plasma environments having different negative ion species, such as D- and Fregions of the Earth's ionosphere, as well as in laboratory plasma experiments.