Propagation characteristics of nonlinear ion-acoustic solitary waves in space plasmas

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Sagdeev pseudo-potential theory is well known for its applicability in the study of electrostatic solitary waves in space plasma. This nonlinear fluid theory provide stationary solutions, which represents either electron or ion acoustic solitary waves and hence do not provide their time evolutionary information. To overcome this inadequacy, we perform one dimensional fluid simulation of ion acoustic solitary waves in an unmagnetized electron-ion plasma. A standard KdV soliton- and the Gaussian-type perturbations are used to model the initials localized density perturbation. Such localized density perturbations evolve into ion acoustic solitary structures, which is in general agreement with nonlinear fluid theory. Simulation results show that these solitary structures are considerably stable for a long time during their propagation. Various characteristics of these ion-acoustic solitary structures like speed, width and amplitude are estimated from the simulation, and compared with the nonlinear fluid theory. The results obtained from simulation are consistent with those obtained from the nonlinear fluid theory.