Ion-acoustic nonlinear structures in electron-beam superthermal plasmas

Nareshpal Singh Saini
Guru Nanak Dev University, Amritsar, India

A number of satellite observations have confirmed the presence of electron beam in the upper layer of the Earth's magnetosphere, where a coexistence of two different temperature electron populations occur. In the presence of electron beam, stationary nonlinear localized electrostatic structures are excited in a plasma system. Numerous theoretical investigations have confirmed the existence of nonlinear electrostatic structures in various space and astrophysical environments in the presence of electron beam. It has also highlighted in different findings that the nonlinear potential structures (solitons, shocks, double layers, freak waves etc.) are significantly modified by the presence of electron beam and other plasma parameters. It has been reported that the investigation of the velocity distributions observed in the solar wind, planetary magnetosphere and magneto-sheath by the spacecraft showed that superthermal distribution of charged particles is very common. Owing to the existence of electron beam and superthermal particles in different space environments, it is interesting to derive nonlinear equations taking into account presence of electron beam and derive their solutions for study of nonlinear solitary structures. Main focus of this talk is to discuss about study of investigation of various kinds of nonlinear structures (viz. solitons, Freak waves, and Peregrine solitons) in multicomponent space plasma having species (cold electrons, ions, hot electrons) obeying kappa distribution and embedded with electron beam. The reductive perturbation method is employed to derive Korteweg-de Vries (KdV) equation and nonlinear Schrodinger equation. Further, using single variable transformation, solutions of these equations have been derived to study the characteristics of KdV solitons and freak waves as well as Peregrine solitons. It is observed that various plasma parameters have great influence on the propagation properties of solitons, freak waves and Peregrine solitons. This study may have variety of potential applications for better understanding of nonlinear phenomena in various space/astrophysical environments.