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ORIGINAL ARTICLE

Obliquely propagating solitary wave structures in nonextensive magneto-rotating plasmas

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Abstract The propagation of the nonlinear electrostatic ion acoustic solitary wave structures in two component, non relativistic, homogenous, magneto rotating plasma are studied. The inertialess electrons are assumed to follow nonextensive q velocity distribution. Small amplitude reductive perturbation technique is applied to derive Korteweg de Vries (KdV) equation and its analytical solution is presented. The effects of variation of different plasma parameters on propagation characteristics of solitary wave structure in the presence of the Coriolis force are discussed. It is observed that nonextensive parameter q modifies the structure of solitary wave structures in rotating plasmas.

Keywords Nonextensive · Solitons · Nonthermal · q-Distribution · Rotation

1 Introduction

The ion acoustic is a fundamental mode of wave propagation in plasmas. In this electrostatic mode, ion mass provides the inertia, while the restoring force comes from the pressure of the electrons. Nonlinear ion acoustic wave structures such as solitons, envelope holes, vortices, shocks and double layers are studied in plasmas due to their importance in laboratory as well as in astrophysical situations. These structures are excited in plasmas when a balance between nonlinearity, dispersion and dissipation occurs and a stable structure is formed. When wave steeping due to nonlinearity in the system balances the wave dispersion then the solitary structures are excited (Washimi and Tanuiti 1966). Ion acoustic electrostatic solitary structures are often observed in the laboratory (Alexeff et al. 1968; Lee et al. 1996; Ikezi et al. 1970) and space plasmas (Lotko and Kennel 1983; Mahmood and Saleem 2002; Main et al. 2012; Hussain and Akhtar 2013; Hussain et al. 2013)

It is well known that the Maxwellian distribution with Boltzmann-Gibbs (B-G) statistics is considered valid universally for the macroscopic equilibrium systems when microscopic interactions and memories are short ranged. On the other hand where the systems subject to the long-range interactions, such as plasma and gravitational systems, are related to the nonextensive statistics where the standard B-G statistics and its Maxwellian distribution does not apply. Therefore in order to study such plasma system Renyi (1955) and subsequently proposed by Tsallis (1988), to study nonextensive case where one particular parameter, the entropy index q, characterizes the degree of nonextensivity of the considered system. Nonextensive statistics (q-distribution) was successfully applied to a number of astrophysics and cosmological scenarios (Alinejad and Shahmansory 2012). Those include stellar polytropes (Plastino and Plastino 1994) solar neutrino problem, (Kaniadakis et al. 1996) peculiar velocities of galaxy clusters, (Lavagno et al. 1998) cosmic ray, cosmology, and systems with long range interactions. Tribeche et al. (2010) studied the arbitrary amplitude ion-acoustic solitary waves in a two-component plasma with a q-nonextensive electron velocity distribution. They revealed the fact that amplitude of electrostatic wave structures in such plasma system depends on the q-nonextensive parameter. Roy et al. (2012) studied the effect of the ion temperature on ion acoustic solitary wave

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