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Interaction Of Electron Acoustic Waves In Relativistic Quantum Plasmas

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Electron acoustic waves exist in two temperature electron plasma. These are the high frequency electrostatics waves in plasmas where, minority of inertial cold electrons oscillate against a dominant thermalized background of inertialess hot electrons providing restoring force. Electron acoustic waves (EAWs) are also generated by electron and laser beams. The phase speed of electron acoustic waves is much larger than the thermal speeds of cold electrons and ions [1]. In recent years, a great deal of attention has been made in many studies on the propagation of electron acoustic waves not only because they are excited in space and laboratory plasmas, but also because of their potential importance in interpreting electrostatic component of the broadband electrostatic noise (BEN) observed in cusp region of the terrestrial magnetosphere in geomagnetic tail, in the day side auroral acceleration region [2]. The propagation properties of electron acoustic waves are investigated in unmagnitized as well as magnetized plasmas in the frame work of different velocity distribution by employing reductive perturbation method and Sagdeev potential method [3,4]. The study of electron acoustic waves has been performed mostly in the non-relativistic and weakly relativistic limits. The significance of considering the relativistic dynamics of electrons arises due to the fact that the effect of relativistic streaming electrons on the large electric field observed in the polar cusp regions of the pulsar magnetosphere can make the cold electron species to achieve relativistic velocities. Most of the space and astrophysical environments confirm the existence of superthermal particles which are well modeled by kappa distribution function. It is believed that kappa distribution is more appropriate to fit the data of the different satellite missions obtain from the space/astrophysical observations. In most of plasma environments, the wave-waves interaction is a leading non-linear phenomenon. It is divided on the basis of inverse scattering and a head-on collisions. The head-on collisions may provide two effects. i.e; phase shifts and trajectories. In this investigation , we have studied head on collisions among multi electron acoustic solitons (EASs) in a magnetized qunatum relativistic plasma containing two temperature electrons (cold inertial and hot) and stationary ions. Both cold and hot electrons are taken as inertial. By employing extended Poincaré-Lighthill-Kuo method, two Korteweg-de Vries (KdV) equations are derived. The Hirota direct method is used to obtain multisoliton solutions for each KdV equation and all of them move along the same direction where the fastest moving soliton eventually overtakes the others. The analytical phase shift after a head-on collision of EASs are also obtained. We have analyzed the influence of different plasma parameters on the phase shift occurred after the interaction of multi-solitons. Our findings may have applications in understanding a head-on collision between two electron acoustic waves (EAWs) in astrophysical and laboratory plasmas, especially Van Allen radiation belts, plasma sheet boundary layer of Earth's magnetosphere and pulsars, etc.

References

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