Ion-Acoustic Rogue Waves In Multicomponent Plasma In The Presence Of Positrons

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An electron-positron plasma, a fully ionized gas composed of electrons and positrons having equal masses and charges with opposite polarity, is considered not only as a building block of our early universe, but also as an omnipresent ingredient of a number of astrophysical objects, such as active galactic nuclei, pulsar magnetospheres, solar flares, fireballs producing-ray bursts, etc.[1]. Because of long lifetime of positrons, most of the astrophysical and laboratory plasmas become an admixture of electrons, positrons, and ions.

Two-electron temperature distributions are very common in the laboratory, as well as in space plasmas. Shatashvili *et al.* [2] have reported that out flows of the electron-positron plasma from pulsars entering an interstellar cold, low-density electron-ion plasma form two-temperature EPI plasma. Most of the space and astrophysical plasma environments show the existence of superthermal electrons/ions, i.e., the particles are obeying kappa distribution[3].

We present an investigation for the generation of planar and nonplanar (cylindrical and spherical) ion acoustic rogue waves in an electron-positron-ion (EPI) plasma with two temperature superthermal electrons and superthermal positrons. The reductive perturbation technique is used to obtain a modified nonlinear Schrodinger equation, which includes a damping term that account for the geometrical effect for ion acoustic rogue waves. From the coefficients of nonlinearity and dispersion, we have determined the critical wave number threshold at which modulational instability sets in. This critical wave number depends on various plasma parameters *viz.* superthermality of electron (cold and hot) and positron concentration. Within the modulational instability region, a random perturbation of amplitude grows and thus creates ion acoustic rogue waves. Further, it is seen that there is a modulation instability period for the cylindrical and spherical wave modulation, which does not exist in the one dimensional case [4].

[1] *The Very Early Universe*, edited by G. W. Gibbons, S. W. Hawking, and S. Siklos, Cambridge University Press, Cambridge, 1983; R. Schlickeiser and P. K. Shukla, *Astrophys. J.* **599**, L57 (2003).
[2] N. L. Shatashvili, J. I. Javakhishvili, and H. Kaya, *Astrophys.Space Sci.* **250**, 109 (1997).
[3] V. M. Vasyliunas, *J. Geophys. Res.* **73**, 2839, *doi: 10.1029/JA073i009p02839* (1968).
[4] R. Sabry, W. M. Moslem, P. K. Shukla, and H. Saleem, *Phys Rev. E*, **79**, 056402 (2009).