Effects of external periodic force on electron acoustic waves in a magnetized plasma

Rajneet Kaur[1], N. S. Saini[1]

[1]Department of Physics, Guru Nanak Dev University, Amritsar-143005, India

e-mail: rajneetkaur909@gmail.com

The space and astrophysical environments witness the existence of different kinds of species, viz. two temperature electrons, ions and dust grains. The electron acoustic wave (EAWs), which is one of the fundamental, is a high-frequency wave in a plasma having, two-temperature electrons are present in addition to positively charged ions. The inertial electrons, which are comparatively cold, oscillate against a thermalized background of hot inertialess electrons, which provides the required restoring force. The phase velocity of EAWs is normally between the thermal velocity of the cool and hot electrons. It has been noted that the EAWs can only propagate in a specific range of physical parameters, namely when the hot-to-cool electron temperature ratio is larger than 10 and the hot-to-cool electron number density ratio is between 1/4 and 4. The ions typically act as a neutralising background in the plasma and may not have a significant impact on the electron acoustic wave because frequency of electrons is significantly higher than that of the ion plasma. Electron acoustic wave has many applications in various satellite observations in different parts of earth's magnetosphere. High frequency part of broadband electrostatic noise (BEN) emissions observed by Fast Auroral Snapshot (FAST), Viking satellite near auroral region and POLAR satellite. EAWs also important for interpreting BEN at the boundary of the terrestrial magnetosphere, in the auroral zone, and in the geomagnetic tail. Numerous wave emissions in various parts of the Earth's magnetosphere have been explained by the electron acoustic mode. Additionally, the hiss observed in the polar cusp region has been interpreted using the electron acoustic mode. Both theoretically and experimentally, the study of nonlinear wave propagation in a magnetised plasma is quite interesting. In comparison to unmagnetized plasma, the presence of a magnetic field in a plasma system can completely alter the dynamics of a wave by creating a distinct space and time scale. It is important to note that the effect of external periodic perturbation is present in some real physical situations and the types of these external periodic perturbations can differ significantly depending on physical conditions. In Recent years, authors have shown a lot of interest in the study of nonlinear travelling wave solutions taking an external periodic perturbation into account. In this present investigation, characteristic properties of electron acoustic waves (EAWs) are investigated in the presence of periodic force for magnetized plasma consisting of cold electron fluid, stationary ions and non-maxwellian hot electrons. The damped forced modified Zakharov-Kuznetsov (DFMZK) equation is derived by using the reductive perturbation technique (RPT), and analytical solution of the damped forced modified Zakharov-Kuznetsov equation is obtained. The solution is valid for very small values of perturbed damping and forcing term. The effects of various plasma parameters such as hot-to-cold electrons density ratio, temperature ratio and external periodic force on the characteristics of EAWs are analysed. The findings of the current study could be helpful in understanding how nonlinear excitations originate in space and astrophysical plasma environments in space where two temperature electrons are present.

References:

[1] S. Devanandhan, *et al*. Phys. Plasmas **19**, 082314 (2014).

[2] M. Dutta, *et al*. Phys. Plasmas **20**, 122112 (2013).

[3] R. Ali, *et al*. Phys. Plasmas **24**, 122106 (2017).

[4] S, Sultana, *et al.* Eur. Phys. J. D **73**, 220 (2019).