PIC Simulation of nonlinear Landau damping in the collisionless and collisional plasma

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Abstract
In this article, non-linear Landau damping and generation of BGK mode in non-magnetized plasma are studied by using particle simulation. As plasma environment consists of electrons and ions, it is simulated by particle method and it is supposed that ions are considered as a motionless background. On the other hand, electron’s dynamic is obtained from solving Newton’s equation and the electrons are supposed as particles. In the non-linear region, trapping of particles in potential well is investigated. These trapped particles account for stopping linear landau damping and entering to the non-linear region, and as a result of this process, the amplitude of electrostatic wave oscillates around an approximately constant magnitude. The effect of collision between particles has been studied with the help of a simple model for the collision term in the simulation code and the result of the simulation code with the theoretical result is compatible. For this purpose, it is expected that the exponential damping of electrostatic waves is due to the collision, and the ratio of this damping is in proportion with collision frequency.

Keywords: nonlinear Landau damping, non-magnetized plasma, particle simulation

For full article, refer to the Persian section