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Mode Converted Electrostatic Nonlinear Ion-Ion Hybrid Mode In Tokamak Plasma

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Mode conversion (MC) process proves to be of prime importance in fusion as well as in magnetospheric plasma [1,2,3]. However, the presence of multiple ion species, even with small concentrations, can lead to the appearance of new and modified resonance, cutoff, and crossover frequencies [4]. Nonlinear effects such as pump self induced filamentation and parametric decays further complicate the MC physics ans associated heating processes [5,6,7,8]. It is generally seen that intense localized electric fields of the soliton form are generated due to the density changes (density cavities) caused by the dominant ponderomotive forces acting on the charged species. It turns out that the nonlinear fate of the mode converted electrostatic wave beyond the MC layer is still an open question. With this motivation, we investigate such a nonlinear state of the mode converted electrostatic ion-ion hybrid wave in the vicinity of the MC layer. In context with it, an exact nonlinear solution of the ion-ion hybrid mode is estimated under the influence of adiabatic perturbations in a Two ion species magnetized plasma. The dominant nonlinearity arises through the ion ponderomotive force term thereby modulating the plasma density profile. The nonlinear equation which has KorteVeg De Vries [KdV] soliton as its solution, represents the nonlinear stage of a purely growing mode. It turns out that these solitons exists only if the wave frequency is lower than the Buschbaum frequency and if the concentration of the lighter ions is less than the heavier one. The resultant ponderomotive expulsion of plasma is discussed in terms of intense localized electric fields and associated density cavities. The application of the theoretical model is discussed in terms of Proton and Tritium minority concentration ratios in Deuterium plasma.

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