Abstract

This thesis is devoted to the study of the nature of envelope solitons generated in an intense electromagnetic pulse interaction with a plasma. The analysis is based on the fluid description of the plasma in which extensive numerical and analytical investigations are carried out. The envelope solitons of interest are the modulated nonlinear waves in which the vector potential of the light wave and the associated plasma wave form a coupled entity. The spectral characteristics of these coherent structures can be described by their group velocity and the eigenvalues which determines the frequency.

In the simplest model of a cold plasma with electrons and ions, questions related to the existence and the nature of the bright single peak solitons, as well as the connection between the stationary and the moving structures are addressed. An analytical description for a class of solitons having multiple peaks in the light wave field is provided. In the case when the ion dynamics is included, a new class of solitons with a *flat-top* is identified. For solitons propagating with slow group speeds, validity of the cold plasma model is addressed by using a more realistic model involving effects arising due to electron temperature and ion dynamics. In the case of small amplitude, single peak structures that are quasineutral are studied, different regions of existence of bright and dark classes of solitons are delineated. The complete spectral characteristics of the arbitrary amplitude solitons having subsonic speed are investigated. The effect of a new parameter describing the ratio of ion density to the electron density in the equilibrium composition, on the envelope solitons is studied in a three component electron-positron-ion admixture plasma. Such a study has relevance in the context of astrophysical phenomena. Further, in the case of electron-ion plasma, new classes of solitons such as embedded solitons, solitons with multiple humps in the space charge potential are identified. Their spectral characteristics reveal that these solitons undergo breaking at a critical value of the group speed.