Abstract

Title: *Analytical and Simulation Studies in Complex Plasma Systems*

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In this dissertation a large volume of nonlinear wave phenomena in plasma has been studied. We have carried out investigations pertaining to different wave modes observed in plasma under different configuration. The applicability of such study ranges from laser plasma interaction, astrophysical plasma, magnetospheric plasma, semiconductor plasma etc. We have used analytical and simulation techniques to obtain the results. In the process we have designed some mathematical and simulation tools that will help the future researchers to investigate various other aspects of plasma physics. In the process we have studied KdV equation, Burger's equations, nonlinear Schrodinger equation and also came up with the modified versions. Amplitude modulation and the formation of envelope soliton in quantum plasma have been studied with reference to laser plasma interaction and is presented in chapters 2 and 3. The effects of quantum diffraction and exchange symmetry have been also studied in magnetoplasma, the findings are presented in chapter 4. A semi-Lagrangian method to study the nonlinear electrostatic waves in quantum plasma is presented in chapter 5. We have also studied the dynamical system analysis, bifurcation theory and stability analysis, Lyapunov exponent and chaotic scenario in various plasma configuration and all these are presented in chapter 6. Resonant interaction and its contribution towards harmonic generation in surface plasma waves observed in vacuum-plasma interface has been studied and presented in chapter 7. The chapter 8 deals with the wave-wave interaction in a semiconductor plasma where we have used designed simulation codes. In chapter 9 the nonlinear evolution of stationary structures has been presented in details with limiting and boundary conditions. This is crucial for new researches in this field. Finally, we have summarised our important findings and also pointed out the future prospect of these findings and the scope for application of the new technique developed in the present thesis.

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