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Symbolic Simulation Technique to Study the Nonlinear Evolution of Envelop Soliton during Intense Laser Plasma Interaction

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In this work, we have analyzed the effects of laser beam on a dense quantum plasma. We can summarize our work in the following manner: We have considered a quantum hydrodynamic model to study the quantum effects on electrons and positrons within the plasma. A weak relativistic degenerate equation of state has been used for such dense particles. This pressure is explained on the basis of Pauli's exclusion principle according to which no two Fermions can remain in the same quantum state. It is independent of temperature. Studying the interaction of laser's electric and magnetic field with the plasma, we have obtained the general dispersion relation for the plasma system. Here, we have constructed homotopy from the governing equations and carried out a symbolic simulation study to obtain density volume plots, velocity streamlines, electric field profiles and envelop solitons. The range of plasma and laser settings where nonlinearity is substantial was established. The discoveries will help researchers better understand a variety of phenomena that arise in laser plasma interaction and plasma astrophysics, where shocks, solitons, and other phenomena in dense hot plasma may be studied at laboratory scales. The envelope's evolution is obtained which was constructed utilizing our unique Homotopy aided Symbolic Simulation (HASS) method. This technique holds potential to explore more nonlinear aspects of plasma physics.

References

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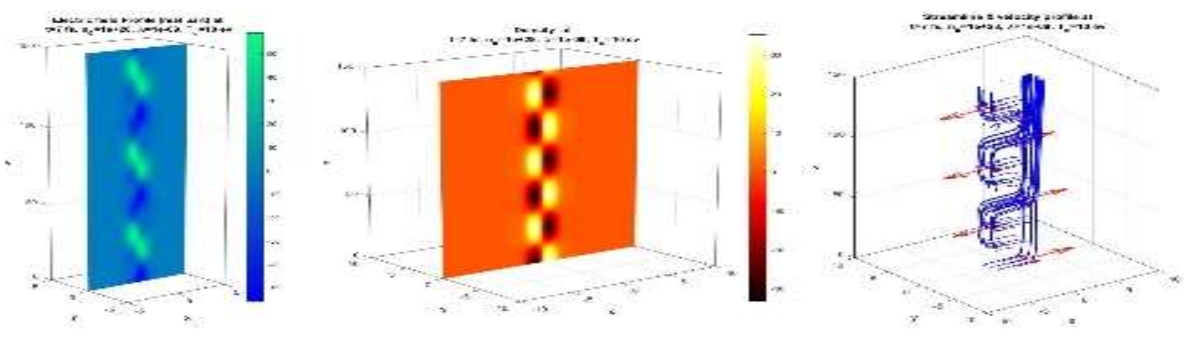
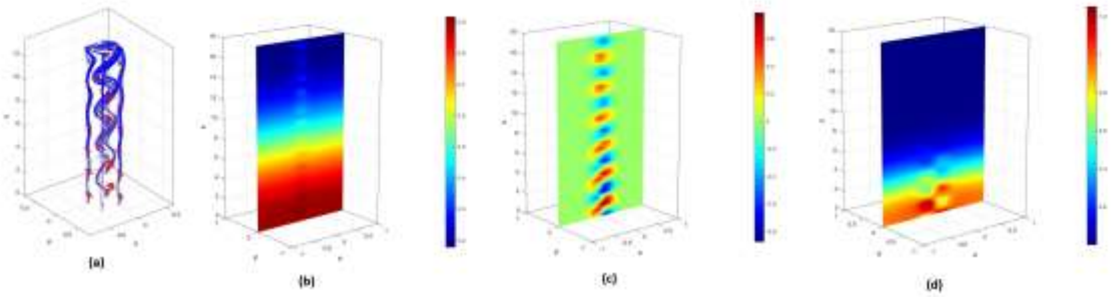


(a) Electric potential, (b) density (c) velocity profile slices at t=7 fs for $n_0=10^{28}/m^3$, wavelength = 10^{-9} m, T=10 eV



(a) Streamline, (b) velocity profile (c) electric field and (d) density slices at t=1 fs for $n_0=10^{28}/m^3$, wavelength = 10^{-8} m, T=20 eV