Chaotic Evolution of Shock Waves, Solitons, and Solitary Shocks in a Degenerate Quantum Plasma with Adiabatically Trapped Electrons

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Nonlinear coupled drift ion acoustic wave in quantum degenerate plasmas with adiabatically trapped electrons is of importance in both compact astrophysical objects and laboratory plasmas created under extremely low temperatures. The study focuses on understanding the evolution of Nonlinear coupled drift ion acoustic wave through the nonlinear dynamical analysis involving the Burgers equation, Korteweg–de Vries (KdV), and KdV-Burgers equations as well as the influence of external periodic force in QDP. The Magnetohydrodynamic model is used to derive the nonlinear wave equation with fractional (3/2 power) nonlinearity. Various analytical tools such as phase plane theory, Sagdeev potential, fast Fourier transform, sensitivity analysis, Lyapunov exponent, and bifurcation analysis are applied within the frameworks of above-mentioned equations to analyze the nonlinear dynamics of NCDIAWs under different plasma parameters, specifically in the context of white dwarfs. The introduction of external periodic force into the derived planar dynamical system facilitates the investigation of quasiperiodic, aperiodic, and chaotic behavior of the system. It is observed that the solutions of the Burgers equation exhibit a pair of shock waves, the KdV equation features compressive solitons, and the KdVB equation features solitary-shock waves, all within the defined plasma parameters of white dwarfs. Additionally, the response of the perturbed system is investigated by varying the external periodic force frequency, ω, and amplitude, f_0. It is observed that the external periodic force frequency, ω, plays a critical role in determining the transition from quasiperiodic to chaotic behavior. Specifically, EPF frequency, ω, significantly lower or higher than the system's resonant region results in quasiperiodic behavior. In contrast, sweeping the external periodic force frequency near

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