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Regular Session:

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Title: *Time-dependent Trapped Plasma Nonlinear Dynamics*

Abstract: We investigate the nonlinear dynamics of a single-component plasma confined in a time-dependent harmonic trap. The system is described as a fluid in a hydrodynamic framework, incorporating electrostatic and thermal effects. By applying a time-dependent variational method, with a Gaussian ansatz for the number density distribution, we reduce the plasma complexity to that of a system of ordinary differential equations and follow up with a consistent analysis of the corresponding Noether symmetries in three distinct regimes: electrostatic, thermal, and combined effects. For each studied case, proper conserved quantities are identified, including a generalized Ermakov-Lewis invariant. The plasma dynamics is captured by a reduced set of ordinary differential equations derived from variational principles, in which the Lagrangian formulation naturally incorporates electrostatic self-interactions and thermal pressure effects, while preserving relevant dynamical features and offering a powerful framework for identifying symmetries, conserved quantities, and invariants. The obtained conserved quantities capture an interplay between the internal plasma dynamics and the time modulation of the trap in an integrable way, resulting in a rigorous restriction for the system evolution in all considered regimes. The presence of the invariants highlight the fundamental relationship between the symmetry, conservation laws and integrability present in the single-component plasma dynamics.