Theoretical and Numerical Study of Stimulated Raman Scattering in a Finite Plasma

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In a one-dimension, finite-length plasma, the behavior of stimulated Raman scattering(SRS) is performed by three-wave-interaction and Vlasov simulation. Via two-scale expansion, the analytical dispersion relation for absolute instability in a finite-length plasma system is derived and validated by linear growth rate with three-wave-interaction(TWI) simulation. The scaling of the linear growth rate of the scattered wave with the system length(L) and pump intensity(A_0) has been examined and demonstrated. The linear and nonlinear behavior of SRS has been also studied by the TWI simulation. In the nonlinear region, the pump depletion plays an important role in SRS, which results in the contraction of the field profile of the scattered wave. The start oscillation and the stationary oscillation can be achieved while the finite system reaches the energy balance condition. By considering a kinetic effect, such as Landau damping and Wave breaking, the Vlasov simulation is developed. In the Vlasov simulation, the wave breaking breaks the stationary oscillation of SRS. Via Vlasov simulation, the difference between wave-breaking threshold in theory and simulation varies by changing the plasma length. The Landau damping has also been studied in Vlasov simulation and examined in different plasma lengths. In this poster, we point out the plasma length changes the linear growth rate, field profile contraction in the nonlinear region, and the wave breaking threshold.

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