From below 10^{-7}K to above 10^{+7}K: quantum turbulence, plasma waves and beyond

Abstract:

In this talk I am going to present two projects I have been actively involved in: quantum turbulence and the instability of magnetic confined plasma.

At zero temperature, weakly coupled Bose-Einstein condensation can be described by the mean-field model — the Gross-Pitaevskii equation. If interatomic force is repulsive, vortex solution is admitted. A system of multiple quantum vortices in two dimension is studied numerically through a unitary algorithm: Quantum Lattice Gas. A parameter range is discovered in which a short Poincaré recurrence time exists. It is also observed that quantum vortices can be generated via Kelvin-Helmholtz instability. The energy cascade is also examined for the weakly coupled quantum turbulence. In contrast to classical turbulence, no dual cascade is observed.

In magnetically confined plasma, Toroidal Alfvén Eigenmodes (TAE) plays an import role in the developing of instability driven by energetic particles. Relative harmonic levels of TAE with prescribed eigenmodes as driving source are simulated. The simulation is conducted via extended AEGIS solver under realistic Tokamak geometry. The second harmonic signal obtained qualitatively agrees with experimental observations. Attempt is being made to analyzing the dynamics of plasma waves in slab geometry under a chirping source. Small scale oscillation is observed at the continuum crossing region, which is in good agreement with theoretical prediction.