Astro Interview Seminar

李政道研究所
TSUNG-DAO LEE INSTITUTE

Ka Ho Yuen

Los Alamos National Laboratory

Cold Atomic Hydrogen Filaments in Turbulent Interstellar Medium

Time: 10:00-11:00, 10 December (Tuesday), Shanghai time

Venue： Online

Host: Dong Lai (赖东）

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Abstract:

Atomic hydrogen (HI) plays a pivotal role in the evolutionary cycle of the multi-phase interstellar medium (ISM) in the Milky Way. Following supernova explosions, warm turbulent gases cool down into cold HI gases through radiative cooling, subsequently recombining into cold hydrogen molecules via dust catalysis, and ultimately fueling new star formation. Observationally, the cold HI phase is magnetically aligned with the magnetic field, supersonic turbulent, highly filamentary, and accounts for half of the ISM's HI mass fraction. Given its ubiquity and key role in star formation, understanding the physics of the cold HI phase is essential. Unfortunately, the physical processes in the ISM are very complex and hard to separate, such as magnetized turbulence, shocks, gravity, thermal instability, and the interplay with cosmic rays. Recent advancements in turbulence theory, state-of-the-art numerical simulations, and high-resolution interferometric observations have made modeling cold filaments in the ISM feasible. This presentation will discuss the most recent analytical models of the cold atomic phase in the ISM, present some of the largest to-date fully resolved ISM multiphase multiphysics simulations, and compare these models to observational data, and highlight emerging research directions. In particular, I will highlight some frontier research related to magnetic field diagnostics in molecular clouds and star formation, cosmic ray transport and feedback due to cold filaments, and cosmological foreground predictions that my team recently made.

Biography:

Ka Ho Yuen is the J.R. Oppenheimer Distinguished Postdoctoral Fellow at Los Alamos National Laboratory, working on theoretical and computational plasma physics. After receiving his Ph.D. in Astronomy from the University of Wisconsin-Madison in 2022, he has focused on understanding magnetohydrodynamic turbulence through both analytical theory and large-scale numerical simulations. His research spans multiple areas of astrophysics and space physics, including the development of magnetic field mapping techniques, studies of star formation in the interstellar medium, and analysis of cosmic ray transport. He currently leads several computational projects on national supercomputing facilities to study cosmological foreground emissions and space plasma dynamics. His work has resulted in ~40 peer-reviewed publications, including papers in Nature and Nature Astronomy. Recent projects include the largest-to-date simulations of dust foreground modeling, cosmic ray feedback to interstellar turbulence and investigations of turbulence cascades in magnetosheaths.

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