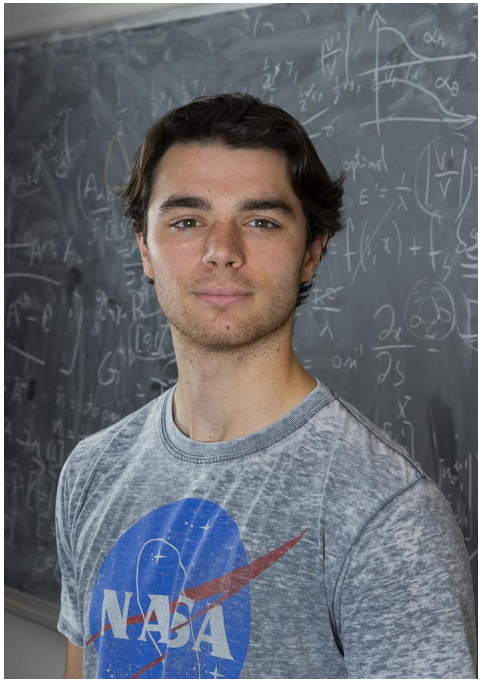
UCLA

Plasma Physics Seminar

Physics & Astronomy Building (PAB) Room 4-330
Via Zoom: https://ucla.zoom.us/j/92785449357?pwd=SVBTSko3bTdEUW03dzQwNks1Q2lKZz09
Friday, July 12, 2024 at 12:30PM
Lunch will be served at 12:00PM

Self-organization in collisionless, high-beta turbulence



Stephen Majeski (Princeton)

Abstract: Owing to their simplicity, the MHD equations have enjoyed a long tenure as the go-to model for describing turbulence in astrophysical environments ranging from the solar wind to the intracluster medium of galaxy clusters (ICM). Unfortunately, the vast majority of these astrophysical plasmas can only be considered weakly collisional at best, meaning significant deviations from the MHD assumption of local thermodynamic equilibrium are not only possible but common. Additionally, recent studies have increasingly found that the various nonequilibrium- and micro-physics of the weakly collisional regime can fundamentally transform the global evolution of such astro-plasmas, especially when the plasma beta is of order unity or larger. In this talk, I will explore the consequences of micro-instabilities and anisotropic pressure-stress on collisionless, high-beta turbulence to distinguish what essential physics of the MHD model remains, and what must change. This will be accomplished through analytical and numerical means, beginning with an examination of the individual waves that form the foundation of collisionless plasma turbulence, and ending with the collective, self-organization effect known as ‘magneto-immutability’. Some of the novel findings that will be covered include modifications to the interaction of hydromagnetic waves, a surprisingly low but highly intermittent volume filling fraction of turbulence-driven microinstabilities, and inertial-range suppression of turbulent perturbations to the magnetic-field strength. The application of these results to turbulence and cosmic-ray diffusion in the ICM will be discussed.