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ICTS Astrophysics & Relativity Seminar

Title : A unified treatment of mean-field dynamo and angular-momentum transport in magnetorotational instability-driven turbulence

Speaker : Tushar Mondal (ICTS-TIFR, Bengaluru)

Date : Tuesday, 11th July 2023

Time : 03:30 PM (IST)

Abstract : Magnetorotational instability (MRI)-driven turbulence and dynamo phenomena are analyzed using direct statistical simulations. Our approach begins by developing a unified mean-field model that combines the traditionally decoupled problems of the large-scale dynamo and angular-momentum transport in accretion disks. The model consists of a hierarchical set of equations, capturing up to the second-order cumulants, while a statistical closure approximation is employed to model the three-point correlators. We highlight the web of interactions connecting different stress tensors components---Maxwell, Reynolds, and Faraday---through shear, rotation, correlators associated with mean fields, and nonlinear terms. We determine the dominant interactions crucial for the development and sustenance of MRI turbulence. Our general mean-field model for the MRI-driven system allows for a self-consistent construction of the electromotive force, inclusive of inhomogeneities and anisotropies. Within the realm of large-scale magnetic field dynamo, we identify two key mechanisms---the rotation-shear-current effect and the rotation-shear-vorticity effect---that are responsible for generating the radial and vertical magnetic fields, respectively. Notably, both of these mechanisms rely on the intrinsic presence of large-scale vorticity dynamo within MRI turbulence.

Reference: <https://arxiv.org/abs/2307.01281>

Venue : Emmy Noether Seminar Room & Online

Zoom link: <https://icts-res-in.zoom.us/j/88258703652?pwd=OU1ITitYUzhMRG16NU8zYUZ3VFNPOT09>

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