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Magnetohydrodynamics in a Weakly Collisional Intracluster Medium

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The intracluster medium (ICM) of galaxy clusters is a weakly collisional plasma in which the transport of heat and momentum occurs primarily along magnetic-field lines. Anisotropic heat conduction allows convective instabilities to be driven by temperature gradients of either sign: the magnetothermal instability (MTI) in the outskirts of clusters and the heat-flux buoyancy-driven instability (HBI) in their cooling cores. We report on several recent studies we have performed to investigate the MHD of cluster gas in this regime. These include (1) a study of the effect of both anisotropic conduction and viscosity on the nonlinear regime of the MTI and HBI, (2) a study of the role of anisotropic viscosity in inhibiting fluid instabilities at sloshing cold fronts observed in merging clusters, and (3) a study of the saturation of firehose and mirror instabilities in shearing plasmas, which is relevant to the turbulent tangling of magnetic field at microscopic scales (which, in turn, may affect anisotropic transport at macroscopic scales).

Primary author: Prof. STONE, James (Princeton University)

Presenter: Prof. STONE, James (Princeton University)

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