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A Tale of Two Instabilities: Simulation of Buoyancy Instabilities in the Intracluster Medium[1]

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In many dilute astrophysical plasmas, the mean free path along magnetic field lines can be very large compared to the gyroradius. As a result, thermal conduction is anisotropic along, but not across, magnetic field lines. In this regime, the condition for convective stability is significantly modified by the anisotropic heat flux, resulting in two buoyancy instabilities: the magnetothermal instability (MTI) and the heat-flux-driven buoyancy instability (HBI). Using MHD simulations with anisotropic thermal conduction, I demonstrate that these instabilities drive a magnetic dynamo, realign magnetic fields, and enhance or suppress thermal conduction, respectively. I discuss the application of these instabilities to the intracluster medium of clusters of galaxies in relation to their large-scale thermal structure, magnetic fields, and cooling flows. I also briefly discuss the relevance of the HBI to cold fronts in the ICM, such as in Abell 3667. Finally, I will briefly mention some ongoing work on heating of cooling cores with buoyant bubbles and discuss the long-standing cooling flow problem.

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