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Temperature Fluctuations and Current Sheets in Protoplanetary Disks

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The magnetorotational instability (MRI) drives magnetized turbulence in sufficiently ionized regions of protoplanetary disks, leading to mass accretion. The dissipation of the potential energy associated with this accretion is a component of the balance which determines the thermal structure of the disk. This is expected to be most significant in the inner regions, at the midplane inside the inner edge of the dead zone. To model the resulting thermal structure of the disk, it is critical to recognize that magnetized turbulence dissipates its energy intermittently in current sheet structures. I will discuss our recent study of this intermittent energy dissipation using high resolution numerical models including a constant resistivity and radiative thermal diffusion in an optically thick regime. Our models predict that these turbulent current sheets drive order unity temperature variations even where the MRI is damped strongly by Ohmic resistivity (McNally et al. 2014). I will also discuss the impacts of variable resistivity, including the possibility of the development of 'short-circuit'modified current sheets (Hubbard et al. 2012, McNally et al. 2013). The temperature fluctuations that can be driven by magnetic dissipation have the possibility of being responsible for the remelting of CAIs, melting of chondrules, and thermal processing of other solid components of the disk.

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