

## Towards Realistic MHD Simulations of Protoplanetary Disks

The gas dynamics of PPD is largely determined by the coupling between the weakly ionized gas and magnetic fields, described by three non-ideal magnetohydrodynamic (MHD) effects. Previous local MHD simulations highlighted the importance of these effects, which largely suppress the disk turbulence, yet also leave several major puzzles related to the kinematics of the gas flow. I will present the first fully global simulations of PPDs that take into account all three non-ideal MHD effects, with physically motivated prescriptions of thermodynamics. I show that the disk interior is largely laminar while exhibits complex flow structures, depending on the polarity of the large-scale poloidal magnetic field (due to the Hall effect). In particular, when the poloidal field is aligned with disk rotation, both inward and outward transport of solids can be achieved depending on the location in the disk. The disk also shows very significant mass loss via a magnetized disk wind. Implications for the transport of chondrules will be discussed.