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Exploring the Dynamics of Magnetically Arrested Disks: The Role of Radiative Cooling

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Accretion disks are essential for understanding the dynamics of gas around black holes. The magnetically arrested disk (MAD) state, where the magnetic flux near the event horizon becomes saturated, has garnered significant attention following observations of supermassive black holes in M87 and Sagittarius A*by the Event Horizon Telescope (EHT) collaboration, which suggest that this is the preferred accretion state for such systems. In particular, low-luminosity systems like Sagittarius A* are significantly influenced by radiative cooling processes, which profoundly affect the thermal, magnetic, and dynamical properties of the accretion disk. In this talk, I will describe how radiative cooling impacts the structure and behavior of MADs at sub-Eddington accretion rates. We analytically identify a critical mass accretion rate below which synchrotron radiation becomes a dominant cooling mechanism, altering the disk's thermal equilibrium and the MAD parameter. Using general relativistic magnetohydrodynamic (GRMHD) simulations from our massively parallel code cuHARM, I will explore how these cooling effects influence force balance, magnetic saturation, and jet efficiency for a range of black hole spins and accretion rates.

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