

Angular Momentum Flux Transport and Torques in Different Accretion States from GRMHD simulations

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In accretion disks, turbulent magnetic fields traditionally drive the inward flow of matter by transporting angular momentum outward through chaotic, viscous-like processes. However, this picture becomes more complex when powerful, organized magnetic fields permeate the disk structure, creating different accretion states. These large-scale magnetic fields can launch outflows—winds that carry both mass and angular momentum away from the system—creating alternative pathways for driving accretion. Using General Relativistic Magnetohydrodynamic (GRMHD) simulations, we examine angular momentum flux transport and major torques across different accretion configurations to establish an Intermediate state as distinct from Magnetically Arrested Disks (MAD) and Standard and Normal Evolution (SANE) states. By systematically analyzing how angular momentum moves through these systems, we demonstrate that both turbulent mixing within the disk and organized outflows work together to extract angular momentum, with magnetic stresses acting as an effective viscosity. This dual mechanism reveals that accretion is governed not just by chaotic turbulent forces, but also by more orderly, laminar processes, and that the interplay between the disk, its winds, and any jets creates a complex three-way exchange of angular momentum that varies depending on the accretion state of the system.