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3D GRMHD Simulations of Tilted Disks: Magnetically Driven Retrograde Precession

Accretion disks around black holes are generally thought to be misaligned with the black hole’s spin axis due to the random angular momentum of infalling gas. In such systems, the black hole’s rotation twists the surrounding spacetime, influencing the dynamics of the accretion flow and its magnetic fields. The precession of tilted disks is commonly attributed to the Lense Thirring effect. However, in magnetically arrested disks (MADs), which are considered the prevailing accretion flow model for both Sagittarius˜A* and M87*, Lense Thirring precession is not prominent due to the large scale of the flow. In this work, we identify magnetically driven retrograde precession in strongly magnetized accretion flows. This precession arises from a magnetic torque generated by the alignment of poloidal magnetic fields with the black hole’s rotation, opposing the Lense Thirring torque. In strongly magnetized flows, the magnetic torque dominates and drives the retrograde precession.

In MAD flows, magnetically driven retrograde precession exhibits a significantly higher precession rate compared to the precession driven by the LT effect, which offers a new perspective on the observed precessing jet and disk systems.

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