

Collapsar Gamma-ray Bursts Grind their Black Hole Spins to a Halt

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Jetted astrophysical systems typically possess an accretion disk, with the jet-launching compact object at the center. It is now clear that the magnetic field is an important agent in jet launching and acceleration. However, it is a puzzle how the accretion disk manages to transport the magnetic fields from large distances to the compact object.

In the last decade, the Magnetically Arrested Disk (MAD) paradigm has emerged as a possible solution to this problem. Simulations of MADs show magnetic field advection into the black hole until the flux saturates, leading to powerful jets. However, the paradigm MAD still needs to be proven consistent with observations. One way of comparing the MAD paradigm to observations is to look at the imprint it leaves on its black hole. The MAD will torque its black hole leading to a change in its spin, which can be compared with observational constraints on BH spin.

Using 3D GRMHD simulations I will show how MADs spin down their black holes thanks to their strong magnetic fields. I will show that this spin-down is very efficient and only requires a small change in the black hole's mass. Then, using a semi-analytic model, I will use this efficiency to study the change in black hole spin during its birth in a collapsar. Then I will compare the jet power from the semi-analytic MAD model with the ones observed in long GRB populations. Finally, I will show that the obtained low spin is compatible with LIGO/VIRGO/KARGA constraints.