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Simulating Bondi-Like Accretion Flow Around Black Holes

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While black hole accretion flow simulations usually start from gas disks with relatively large angular momenta, many important black hole astrophysical systems are believed to be fed by gas with low angular momenta, such as tidal disruption events, long gamma-ray bursts and wind-fed high mass X-ray binaries. We carry out 3D general relativistic magnetohydrodynamic (GRMHD) simulations of accretion flows with zero or very low specific angular momenta around rapidly spinning black holes. We thread the flows with large amounts of large-scale ordered magnetic fields. The results show that such accretion flow needs to initially have a specific angular momentum above a certain threshold to eventually reach and robustly sustain the magnetically arrested disk (MAD) state. If the flow can reach the MAD state, it can launch very powerful jets. Furthermore, we realize that even when the accretion flow has initial specific angular momentum below the threshold, it can still launch episodic jets with an average energy efficiency of $\sim 10\%$. However, the accretion flow has non-typical and interesting behaviours in this situation. Our results give an insight into the behaviour of the accretion flow and the production of relativistic jets in various astrophysical systems in which the accretion flows likely have low specific angular momenta.

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