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Science of the Cosmos

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General Relativistic Simulation of Quasi-Spherical Accretion Flows in Dark Matter Halo

We have investigated the influence of dark matter halos on quasi-spherical accretion onto supermassive black holes (SMBHs) using general relativistic hydrodynamic (GRHD) simulations. By incorporating Hernquist and NFW halo profiles into the BHAC code, we model accretion flows with zero and low angular momentum across a range of halo-to-BH mass ratios up to 10. Our results show that the presence of a DM halo can enhance the mass accretion rate and significantly alter the flow morphology, including density, velocity, and temperature structure. We also explore how rotation interacts with DM gravity to regulate inflow and outflow dynamics. These findings provide insights into SMBH feeding in DM-rich environments, especially relevant for high-redshift quasars, and emphasize the need to account for halo gravity in modeling black hole growth.

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