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Simulation studies of global resistive MHD accretion flows around spinning AGNs: the impact of resistivity on the MAD state

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We investigate the effect of resistivity on the dynamics of accretion flow using a global simulation model. Our approach involves employing a resistive magnetohydrodynamic model (Res-MHD) around spinning active galactic nuclei (AGNs). We conduct a comparative study of 2D and 3D resistive models surrounding black holes. In our analysis, we examine the dynamics of accretion flow while considering globally uniform resistivity values that range from approximately 0 to 0.1. We observe that the mass accretion rate is quite similar during the initial phases of the simulation for both the 2D and 3D models. However, as the flow becomes more turbulent, multi-dimensional effects start to dominate, leading to differences in the mass accretion rates between the 3D and 2D models. All the resistive models in a highly magnetized flow fall into the Magnetically Arrested Disk (MAD) state. We find that high-resistivity flow reduces magnetorotational instability (MRI) turbulence in the accretion flow, while the turbulent structures remain qualitatively similar in low-resistivity flows. Additionally, we observe signs of plasmoid formation in low-resistivity flows compared to those with high resistivity. Furthermore, we do not find a clear correlation between the variability of accretion flow and resistivity. Lastly, our findings indicate that low-resistivity models produce jets with higher power than those with higher resistivity.

Section

Galaxy/Extragalactic

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