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Evolution of MHD Torus and magnetically driven mass outflows around spinning AGN

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We perform axisymmetric two-dimensional magnetohydrodynamic simulations (MHD) to investigate accretion flows around spinning supermassive black holes (SMBHs). To mimic the space-time geometry of black holes, we consider effective Kerr potential (Dihingia et al., 2018), and the mass of the black holes is $10^8 M_\odot$. We initialize the accretion disc with a magnetized torus by adopting the toroidal component of the magnetic vector potential. The initial magnetic field strength is set by using the plasma beta parameter (β), i.e., the ratio of the gas pressure to the magnetic pressure. We observe self-consistent turbulence generated by magnetorotational instability (MRI) in the disc. The MRI turbulence transports angular momentum in the disc, and the angular momentum distribution becomes near the Keplerian distribution. We investigate the effect of the magnetic field on the dynamics of the torus and associated mass outflow from the disc around a maximally spinning black hole ($a_k = 0.99$). We find that mass outflow rates are significantly enhanced with the increased magnetic field in the disc. We also investigate the effect of black hole spin on the magnetized torus evolution. However, we have not found any significant effect of black hole spin on mass outflows in our model. Finally, we discuss the possible astrophysical application of our simulation results.

Primary author: Dr AKTAR, MD RAMIZ (Department of Physics and Institute of Astronomy, National Tsing Hua University, 30013 Hsinchu, Taiwan)

Co-authors: Prof. PAN, Kuo-Chuan (Department of Physics and Institute of Astronomy, National Tsing Hua University, 30013 Hsinchu, Taiwan); Prof. OKUDA, Toru (Hakodate Campus, Hokkaido University of Education, Japan)

Presenter: Dr AKTAR, MD RAMIZ (Department of Physics and Institute of Astronomy, National Tsing Hua University, 30013 Hsinchu, Taiwan)

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