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Time-dependent evolution of magnetic accretion flow with radial viscosity

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Abstract

In this study, we have considered time dependent evolution of advection dominated accretion flow (ADAF) in the presence of the toroidal magnetic field and radial viscosity. We have used time-dependent self-similar solutions for solving the 1D MHD equations in the spherical coordinates in the equatorial plane ($\theta = \pi/2$) and we have neglected terms with any θ and φ dependence. While the azimuthal viscosity υ as the turbulence factor in transporting the angular momentum and α-prescription for kinematic coefficient of viscosity is used in the most previous studies, recent studies show the disc structure can also be affected by the radial viscosity υ_r. In this work, we have assumed that the ratio ν_r/ν is a dimensionless parameter ξ. We use ξ and β variables as free parameters to consider the effects of magnetic field and radial viscosity. The solutions indicate a transonic point in the accretion flow. This point approaches to outward by increasing the magnetic field and radial viscosity. Also, by adding strength of the magnetic field, the radial-velocity of the disc decreases and the disc compresses. Also, the flow is sub-Keplerian at all radii. The ξ parameter has the same behavior in the inner and intermediate regions of the flow but in the outward of the flow, by adding the ξ parameter, accretion rate increases and hence, it is expected that the disc has a shorter lifetime with radial viscosity.

keywords: accretion, accretion disc, magnetic field.

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