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Magnetized Accretion-Ejection Structures, or how to go from JEDs to MADs.

Jet emitting disks (JEDs) provide the theoretical framework of mathematically exact steady-state accretion and ejection solutions. A large-scale vertical magnetic field threads a turbulent, strongly magnetized, accretion disk driving laminar, bipolar, super-Alfvénic jets. In previous treatments of JEDs, turbulence has been considered to provide only anomalous transport coefficients, namely magnetic diffusivities and viscosity. However, 3D numerical MHD experiments show that turbulent magnetic pressure also sets in.

It will be firstly shown how this turbulent pressure deeply affects the overall accretion-ejection behavior. The disk becomes puffier and less electrically conductive, causing radial and toroidal electric currents to flow at the disk surface. This is in close agreement with numerical experiments, such as the inadequately called magnetically arrested disks (MADs).

Then, I will report 2D simulations done with the MHD code PLUTO. While the are key to reproduce systems on both, astrophysically relevant, spatial and temporal scales, turbulence in 2D simulations must be introduced with prescriptions and their accuracy remain an open issue. It will be shown that analytical JED solutions reproduce perfectly 2D numerical simulations. This cross-validation opens up the route for educating 2D simulations with local turbulence prescriptions derived from costly 3D simulations.

It will be finally argued that hybrid disk configurations are unavoidable. A JED/MAD innermost region, where the disk magnetization is near unity, settles in, leaving an outer zone with a much smaller disk magnetization. This outer region is best described as a wind emitting disk (WED), since it undergoes a massive mass loss as slow winds.

Contribution

Oral talk

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