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GRMHD simulations of accretion disks: QPOs, truncated disks and QPOs from truncated disks

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Black hole X-ray binaries (BHXRBs) and Active Galactic Nuclei (AGN) transition through a series of accretion states in a well-defined order. The accretion states, each associated with different luminosities, spectral and variability characteristics, quasi periodic oscillations (QPOs) and outflow properties, are thought to be triggered by physical changes in the accretion disk around the central black hole.The mechanisms behind state transitions, the geometry of transitional disks and the physical mechanisms driving the emission characteristics we observe remain highly debated.

General relativistic magneto-hydrodynamic simulations (GRMHD) are increasingly providing crucial insights into the accretion process, the launch of outflows and the physical processes driving state transitions in BHXRBs and AGN. Using GRMHD simulations conducted with the H-AMR code I: 1) Discuss how high and low-frequency QPOs can be produced by a highly tilted, geometrically thin accretion disk. 2) Present the first GRMHD simulation showing the self-consistent formation of a truncated accretion disk–a proposed disk model for the hard intermediate accretion state, in which the accretion flow is thick and hot close to the black hole, while the outer regions of the flow are thin and cool. 3) Describe how QPOs can be generated at the truncation radius (the radius at which the disk transitions from thick to thin) in a truncated accretion disk.

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