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Recovering the Fundamental Plane of Black Hole activity using GRMHD simulations

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Accreting black holes span a wide range of regimes, from stellar-mass X-ray binaries to supermassive AGN, and they operate across very different accretion states. These systems are often modeled separately, and a key goal of our work is to test whether a single physical framework can describe these systems across both mass and accretion scales.
The fundamental plane of black hole activity—a correlation between radio and X-ray luminosities in sub-Eddington systems—implies that similar physical processes may operate in XRBs and AGN. To investigate this, we use scale-free GRMHD simulations together with the GRRT code RAPTOR (Bronzwaer et al. 2020) to compute synthetic radio and X-ray luminosities and derive the corresponding correlations.
Early results are promising: the simulations reproduce the expected fundamental-plane trend and show indications of additional dependencies, such as inclination angle. This approach also provides a natural framework to explore potential spin-related effects in future work.

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