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Relativistic MHD Simulations of Ponyting Flux-Driven Jets

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Relativistic, magnetized jets are observed to propagate to very large distances in many Active Galactic Nuclei (AGN). We use 3D relativistic MHD (RMHD) simulations to study the propagation of Ponyting flux-driven jets in AGN. These jets are assumed already being launched from the vicinity (~10^3 gravitational radii) of supermassive black holes and we follow the propagation of these jets to ~ parsec scales. We find that these current-carrying jets are collimated and mildly relativistic. When alpha, the ratio of toroidal-to-poloidal magnetic flux injection, is large the jet is subject to strong non-axisymmetric current-driven instabilities (CDI) which leads to substantial dissipation and reduced jet speed. However, even with the presence of instabilities, the jet is not disrupted and will continue to propagate to large distances. We present the detailed jet properties and show that far from the jet launching region, a substantial amount of magnetic energy is transformed into kinetic energy and thermal energy, producing a jet magnetization number sigma « 1. We note that jet collimation, CDIs, and the subsequent energy transitions are intrinsic features of current-carrying jets, and even in the toy model with a gas disk, we observe qualitatively similar jet behaviors.

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