

Simulating Synchrotron Light: Bridging RMHD Jets and Polarimetric Data

Relativistic jets from black holes—spanning X-ray binaries to AGN—are natural laboratories for studying high-energy particle acceleration. Yet, how these systems convert bulk kinetic energy into nonthermal particle populations remains a central open question.

My work combines 3D RMHD simulations with polarized radiative transfer to model synchrotron and inverse Compton emission across the electromagnetic spectrum. Using PLUTO with a Lagrangian particle module and post-processing tools like RADMC-3D and 3DPol, I generate synthetic Stokes maps and SEDs for direct comparison with VLBI, IXPE, and Fermi data.

In AGN such as 3C 84 and BL Lac, I explore how magnetic topology and shock dynamics shape polarization and γ -ray flares. I also model SS 433's eastern lobe, recently identified as a TeV acceleration site, probing X-ray synchrotron emission from recollimation shocks.

This multi-scale approach connects microquasars to blazars, supporting a unified framework for jet-driven particle acceleration in the multi-messenger era.

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