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Characteristic multi-wavelength emission signatures from strong shock-shock interactions in perturbed relativistic jets

The diffusive shock acceleration of a population of relativistic electrons on internal shocks is one of the main scenarios to account for the multi-wavelength (MWL) flux variability observed in relativistic jets of active galactic nuclei. In addition to observations of flux variability, constraints are also provided by very-long-baseline interferometry (VLBI), which shows a large variety of moving and standing emission zones with distinct behavior.

We will present a model combining relativistic magneto-hydrodynamic jet simulations (MPI-AMRVAC code) with radiative transfer (RIPTIDE code). We simulate the evolution of standing and moving emission zones in the jet and study their MWL signatures from the radio to the very-high-energy (VHE) gamma-ray band by taking into account relativistic effects (Doppler beaming and light crossing time).

We focus our attention on strong interactions between a fast moving shock and stationary recollimation shocks, to study how such events lead to a significant perturbation of the stationary jet structure. Various jet geometries and large-scale magnetic field structures are tested.

Sufficiently strong shock - shock interactions are shown to lead to the appearance of trailing components, which appear in the wake of the leading moving shock. We characterize such relaxation shocks by two observational markers, one in the radio band in the time-distance plot of bright VLBI components and one at higher frequencies under the form of « flare echoes ». Our results provide a coherent interpretation of radio VLBI observations in several radio galaxies.

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