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Probing the dynamics of AGN jets with advanced semi-analytical modelling

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The jets launched by accreting super-massive black holes can be some of the brightest sources in the high-energy sky; despite being discovered decades ago, their physics and energetics are still poorly understood. The past decade has seen a dramatic improvement in the quality of available data, particularly in the X-ray and γ -ray bands. However, the semi-analytical modelling of jets has advanced slowly, and simple one-zone models are still the preferred method of interpreting data, in particular for AGN jets. These models can roughly constrain the properties of jets but they can not unambiguously couple their emission to the launching regions and internal dynamics, which are usually probed with simulations. However, simulations are not easily comparable to observations because they cannot yet self-consistently predict spectra. I will discuss our group's ongoing efforts to develop an advanced semi-analytical model which accounts for the dynamics of the whole jet, starting from a simplified parametrization of Relativistic Magnetohydrodynamics in which the magnetic flux is converted into bulk kinetic energy. We apply our model to state-of-the-art datasets of the BL Lac PKS 2155–304 and of the radio galaxy M87 together with a thorough exploration of parameter space. Compared to previous modelling efforts this approach produces some of the best SED fits for these sources to date and provides stronger constraints on jet physics.

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