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Stationary shocks in HBLs, a solution to the bulk Lorentz factor crisis

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Most of the TeV high-frequency-peaked BL Lacs (HBLs) show stationary or slow motions of their VLBI radio-knots, in stark contrast with their fast variability.

This problem, known as “the bulk Lorentz factor crisis,” indicates that the VLBI motions of these sources are not showing the real flow propagation of the jets. I will present evidence that these stationary radio knots are recollimation shocks, through which material is flowing with much larger velocity than inferred from apparent motion of the knots. Focusing on the well known HBL Mrk 421, I will describe an innovative way to measure the actual apparent flow speed from the study of long-term X-ray lightcurves. Finally, I will show the promising future applications of the multiple-shocks scenario, in terms of size and speed of jet perturbations and the possibility of particle re-acceleration.

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