

Particle Acceleration and Emission in Blazar Jets

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In the internal shock scenario, we argue that electrons in most kiloparsec-scale (or even larger) jets can be accelerated to energies high enough to emit synchrotron X-rays, if shocks exist on these scales. These high-energy electrons emit synchrotron radiation at high frequencies and cool as they propagate downstream along the jet, emitting at progressively lower frequencies and resulting in time lags and hence radio/X-ray (and optical/X-ray if the optical knot is detectable) offsets at bright knots, with the centroids of X-ray knots being closer to the core. We simulate the emission of these relativistic electrons, assuming that the magnetic field decreases transversely with respect to the jet axis.

Taking into account the strong effects of jet expansion (electron escape), the behavior of radio/X-ray and optical/X-ray offsets at bright knots in M87, Centaurus A, 3C 66B, 3C 31, 3C 273, and PKS 1127-145 is consistent with that of synchrotron time lags due to radiative losses. This suggests that the large-scale X-ray and optical jets in these sources are due to synchrotron emission. Model simulations show that jet expansion also weakens the optical/UV emission in most extragalactic jets.