High-energy emission from super-critical particles in relativistic jets

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We show that in various particle acceleration models (in particular, in the converter acceleration mechanism) the energy of radiating particles can be raised above the critical value, defined as the energy at which the radiation length equals to the gyroradius. The emission of super-critical particles has a number of distinctive features. For example, a population of such particles in a relativistic jet produces decollimated radiation, increasing the effective width of the beam pattern for photons in the GeV-TeV energy range. In general, the off-axis emission appears to be brighter, has a much harder spectrum and a much higher cut-off frequency compared to the values derived for the emission of sub-critical particles. The magnitude of these effects depends on the details of particle acceleration mechanisms, what can be used to discriminate between different models. The broadening of beam pattern strongly influences timing properties of transients, such as Gamma-Ray Bursts, and aid in searches for off-axis jet sources.