RELATIVISTIC PARTICLE-IN-CELL SIMULATION STUDIES OF RELATIVISTIC JETS

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Nonthermal radiation observed from astrophysical systems containing relativistic jets and shocks e.g. active galactic nuclei (AGNs), gamma-ray bursts (GRBs) and microquasars commonly exhibit power-law emission spectra. Recent PIC simulations of relativistic electron-ion (or electron-positron) jets injected into a stationary medium show that particle acceleration occurs within the downstream jet. In collisionless relativistic shocks particle (electron, positron and ion) acceleration is due to instabilities (e.g. the Weibel (filamentation) instability) created in the shock region. The simulations show that the Weibel instability is responsible for generating and amplifying highly non-uniform small-scale magnetic fields. These fields contribute to the electron's transverse deflection behind the jet head. The resulting "jitter" radiation from deflected electrons has different properties compared to synchrotron radiation which assumes a uniform magnetic field. Jitter radiation may be important for understanding the complex time evolution and/or spectra in gamma-ray bursts, relativistic jets in general and supernova remnants.