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3D PIC Simulations for Relativistic Jets with a Toroidal Magnetic Field[1] KENICHI NISHIKAWA, Alabama AM University, ATHINA MELI COLLABORATION[2] — We have investigated the evolution of relativistic jets self-consistently with Particle-in-Cell simulations. An important key issue is how a toroidal magnetic field affects the evolution of an $e^{\pm}$ and an e^{-}-p+ jet, how kinetic instabilities such as the Weibel instability (WI), the mushroom instability (MI) and the kinetic Kelvin-Helmholtz instability (kKHI) are excited, and how such instabilities contribute to particle acceleration. We present that WI, MI and kKHI excited at the linear stage, generate a quasi-steady __-component of electric field which accelerates and decelerates electrons. In this talk, we use a new jet injection scheme where an electric current is self-consistently generated at the jet orifice by the jet particles. We inject both $e^{\pm}$ and and e^{-}-p^{+} jets with a toroidal magnetic field (with a top-hat jet density profile) and for a sufficiently long time in order to examine the non-linear effects of the jet evolution. We find that different jet compositions present different strongly excited instability modes. The magnetic field in the non-linear stage generated by different instabilities becomes dissipated and reorganized into a new topology. The 3D magnetic field topology indicates possible reconnection sites and the accelerated particles are significantly accelerated in the non-linear stage by the dissipation of the magnetic field and/or reconnection. This study will shed further light on the nature of astrophysical relativistic magnetized jet phenomena.

[1]3D PIC Simulations for Relativistic Jets with a Toroidal Magnetic Field
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