Long GRB single frequency light curves due to jets driven by relativistic radiation hydrodynamics in 3D

Francisco Javier Rivera Paleo[1], Francisco S. Guzman[1]

[1]Universidad Michoacana De San Nicolas De Hidalgo, Morelia, Mexico

We carry out an analysis of three-dimensional numerical simulations of jets modelled with Relativistic Radiation Hydrodynamics, that evolve on a stratified surrounding medium. We take into account particular processes of interaction between the fluid and radiation, specifically, Bremsstrahlung emission and Thomson scattering. In this simulations, we assume initially, that the radiation field and matter are in local thermal equilibrium. After initial time, the system loses the local thermal equilibrium during the evolution. We explore a variety of initial conditions, with different radiation energy densities and Lorentz factors of the beam, in particular, mildly and ultra-relativistic gas and radiation pressure dominated scenarios. We find that these jets show a similar morphology to that of the jets propagating in a constant surrounding medium, namely, beam, internal shocks, cocoon, working surface, bow shock and backflow. We compare the morphology of these jets with the morphology of purely hydrodynamical jets that are still in use for modelling high energy processes. We find that in the cases where the radiation pressure is dominant, the morphology of jets is more diffuse than cases where hydrodynamic pressure dominates. We also find that radiation pressure dominated jets propagate faster than gas pressure dominated ones. Finally, we construct the luminosity Light Curves (LCs) associated with all these cases. The LCs are of the same order range of magnitude as the gamma-ray luminosity of a typical Long Gamma-Ray Bursts, that is, 10^{50}-10^{54} erg/s.