Hydrodynamic study of Gamma Ray Burst Afterglow emissions

Abstract

GRB are still a mysterious science, Its discovery for the first time almost led to an outbreak of a world war. It has been attracting attention of scientists mainly for analysis of the observed data. In this thesis, we are interested in modeling the GRB afterglow emissions. Which is defined as the delayed emission of the prompt GRBs, and in which we adopted the duality of fireball blast-wave model of the accelerating relativistic jet.

In this work we compare three models: Chiang model 1999, where he took a differential expression, which is the only model whose solutions are not compatible with Sedov's solution in which the jet velocity is proportional to the distance by $-3/2$, also does not respect the principle of energy conservation in adiabatic process. On the contrary, Huang model 1999 adopted the integrative form, which produces a different hydrodynamic equation with constant radiation efficiency for all phases of the jet evolution. On the other hand, Fang model 2002 took in his consideration the fact that the efficiency coefficient is not constant during the time scales of synchrotron emission and external shock, after all a new definition of the internal energy remaining in the fireball had been proposed. Based on the same principle of energy conservation, we propose a new term for the radiated energy, especially this new model presents new behaviors, such as the prediction of the beginning of the X-ray plateau of gamma ray burst afterglow. This is achieved by writing a Fortran code for the computation of light curves on the basis of synchrotron emission, and the effects of the synchrotron self absorption. We end up with simulating some data of $XRT - Swift$ satellite.

Keywords: GRB-afterglows, Synchrotron radiation, Fireball, Hydrodynamic, Modeling.