Astrophysics > High Energy Astrophysical Phenomena

Do Fermi-LAT observations imply very large Lorentz factors in GRB outflows ?

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Recent detections of GeV photons in a few GRBs by Fermi-LAT imply huge bulk Lorentz factors to avoid a large gamma gamma optical depth at high energy. Estimates can be as high as Gamma ~ 1000 in the most extreme cases. This puts severe constraints on models of the central engine and the jet acceleration in GRBs. These estimates are however obtained from a simplified single zone model. We present here a more realistic calculation which takes into account the time, space and direction dependent photon field existing in an outflow with several relativistically moving emitting zones. The formalism is general and can be applied to many models of the prompt GRB emission. We present results obtained for a numerical implementation in the framework of the internal shock model. We show that (i) the minimum Lorentz factor Gamma_min in bright LAT GRBs is reduced by a factor ~ 2-3 compared to previous estimates if the GeV and MeV emission are produced in the same region, and by an additional factor ~ 2-8 if the GeV emission is produced at larger radii. We provide an improved approximate formula for Gamma_min which is in good agreement with our numerical results and can be directly applied to LAT GRB data; (ii) a delayed GeV onset can be due to the time evolution of the opacity. As an illustration of these two first results, we present a synthetic GRB that reproduces most features of GRB 080916C with a mean Lorentz factor of ~ 340, an optically thin regime for gamma gamma opacity at 3GeV in bin 'b', a variability timescale of 0.5s in the MeV lightcurve and a delayed onset of ~ 5s of the GeV emission; (iii) the gamma gamma opacity can smooth the short timescale variability in the GeV lightcurve. This last result implies that the observed variability at high energy is not necessarily a good test to distinguish between an internal and an external origin for the GeV emission in GRBs. [abridged]

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