Typical GRB spectra and the peak energy – isotropic energy relation (EpEi or the Amati law) can be observational consequences of the compact GRB model

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The purpose of this report is to formulate the basic assumptions of a GRB source scenario with a rather low total/bolometric energy release ($< 10^{49}$ ergs) [1]: we will try to understand soft (in the meaning of photon energies $\sim$ 1 MeV) observational GRB spectra without involving huge kinematical motions of the radiating plasma *a priori* (or *without* an enormous Lorentz factor $\Gamma \gg 10$). This is another attempt to solve the compactness problem with account for the dependence of the threshold for e^-e^+ pair production on the angle between photon momenta and the dependence of this effective collimation on γ-ray photons energy release: the opacity ($\tau_{e^-e^+}$) is also a sensitive function of the *angular* and *spectral* distribution of the radiation field in the GRB source. We argue that only a small number of collimated hard photons (for GRBs with $z > 1$) or a rather strongly collimated high-energy radiation in the GRB spectra reach near-earth detectors. We consider how a jet arises in a region of size $< 10^8$ cm if the relativistic jet is produced by a powerful light pressure of the collimated/non-isotropic *prompt* radiation of the GRB source. This means that for total/bolometric energies up to $\sim 10^{49}$ ergs the "old" estimate of the source size resulting *directly* from the GRB time variability can be true. The *afterglow* arises in a region around a massive star-progenitor of a GRB source, at a distance of $\sim 10^9$ cm (the typical size of a massive star core) to $r \sim 10^{15}$ cm and further (where stellar wind starts to interact with ambient/circumstellar medium), since there is always a dense or windy medium (an envelope) resulting from the evolution of a massive star. In this model (with $\Gamma \sim 10$ or smaller) the peak energy – the isotropic energy (EpEi or $E_p - E_{iso}$) relation extended down to the total energy $E_{iso} \sim 10^{49}$ ergs (the Amati relation for soft X-ray flashes [2]) can be a natural consequence of the dependence of the threshold for the e^-e^+ pair production on the angle between photon momenta and the direction of collimation (most probably) by the magnetic field on the surface of the GRB source (which is the compact, $< 10^8$ cm, collapsing object).

References

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