CONSTRAINTS ON THE VERY HIGH ENERGY GAMMA-RAY EMISSION FROM GRB 170206A WITH HAWC

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Gamma-ray bursts (GRBs) are among the most luminous sources in the universe. The nature of their emission at TeV energies is one of the most relevant open issues related to these events. The temporal and spectral features inferred from the early and late emissions usually known as prompt and afterglow, respectively, can be interpreted within the context of the fireball model [1,3]. In particular, in the fireball model, the synchrotron radiation is considered the cooling mechanisms responsible of the afterglow emission. Very-high-energy emission, delayed and longer than the prompt emission, is predicted as result of synchrotron self-Compton (SSC) process in external forward shocks. Observations of GRB 180720B and GRB 190114C by HESS and MAGIC observatories [4, 5] agree with the expectations.

In this work, we focus on short GRBs which have an average redshift of 0.48. We obtain expressions for light curves of the afterglow emission in the SSC model assuming a homogeneous medium. We explain how these light curves can be compared with observed upper limits to restrict the microphysical parameters as in the different cooling phases.

We calculate the theoretical light curves varying the parameters fraction of energy given to the magnetic field ϵ_B and electrons ϵ_e, and the density of surrounding medium (n) within the ranges of $[10^{-6},10^{-1}]$, $[10^{-2},10^{-1}]$ and $[10^{-6},10^{3}]\mathrm{cm}^{-3}$

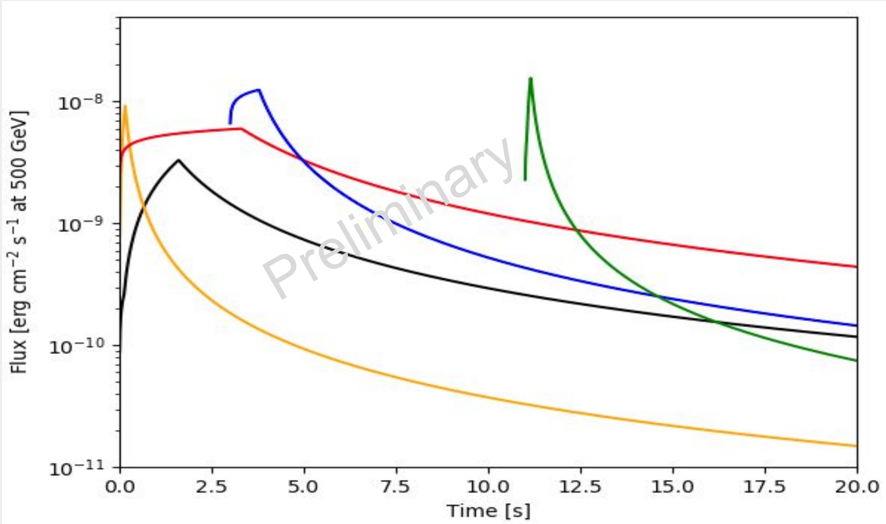
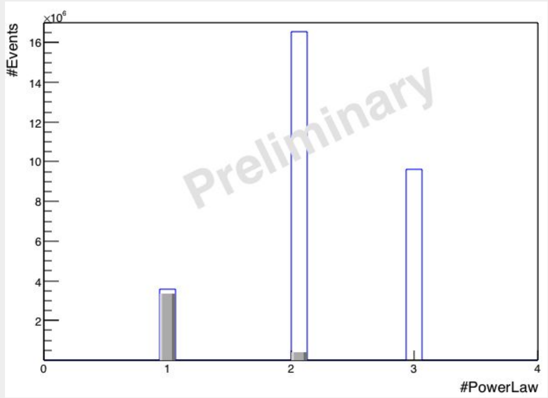


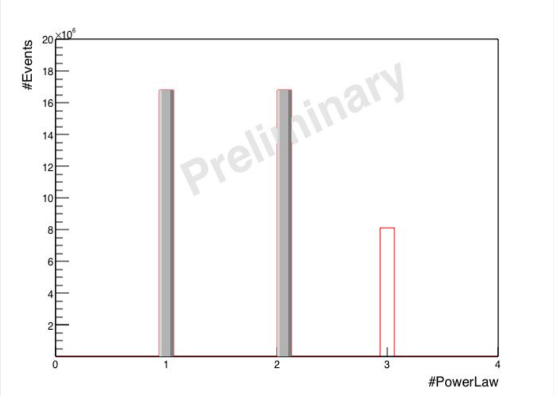
Fig. 1. The flux as a function of time predicted by the SSC model as described in red, blue and green lines show the theoretical light curves in the fast cooling regime, and black and orange the theoretical light curves in the slow cooling regime assuming different combination of microphysical parameters.

We show results for a hypothetical burst observed by Fermi-GBM and the HAWC observatories, with X-ray fluence of 5×10^{-7} erg cm^{-2} and an upper limit for the VHE fluence in the energy range of hundreds of GeV of 1×10^{-6} erg cm^{-2} (see fig. 4). The most restrictive results are obtained for the fast cooling regime.

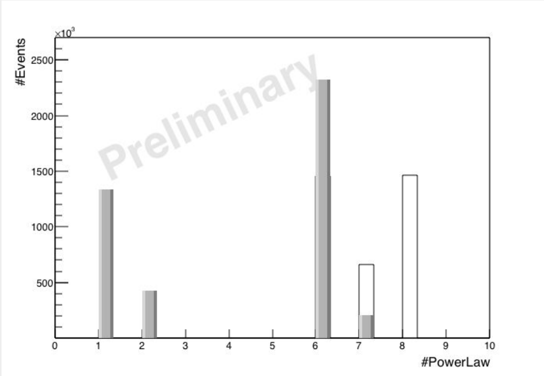
Fast Cooling



Slow Cooling



Transition of fast to slow cooling



- The transparent bar represents all cases(blue, red, black).
- The gray bar represents the allowed cases (Upper limits, Klein Nishina energy break).

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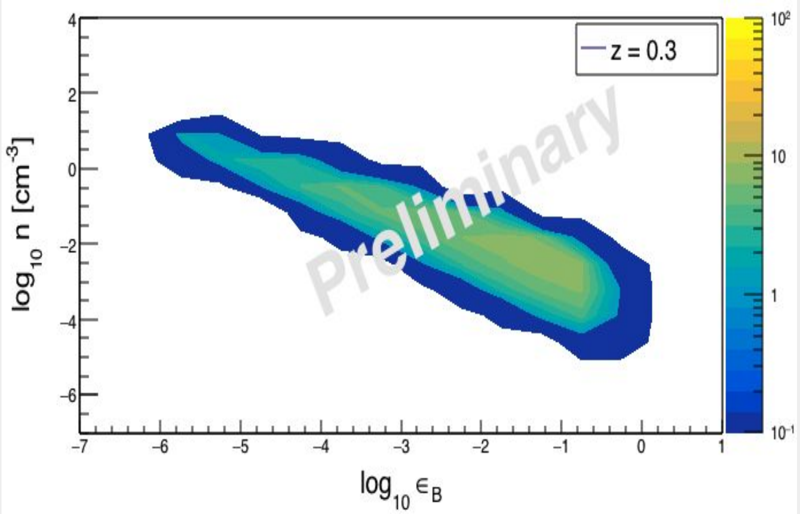

Fig. 6. Shows the values for the density of the external medium (n) and the microphysical parameter the fraction of magnetic energy (ϵ_B) considering all the possible spectral phase in the fast cooling regime.

Summary

- We have presented theoretical SSC light curves when the relativistic outflow decelerates in a homogeneous medium.
- We found that the parameter space is mostly constrained for the middle- and high-energy power law of the fast cooling regime.
- The SSC model allows you to find the parameter space for any GRB.

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