Subphotospheric Dissipation in GRBs

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Björn Ahlgren

KTH
Oskar Klein Centre
Stockholm, Sweden

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Outline

What is a Gamma-Ray Burst (GRB)?

- Very bright flash of gamma rays
- Short bursts (from binary mergers)
- Long bursts (from exploding stars)
- Prompt emission and afterglow

Prompt emission

- Origin unknown
- Lasts $\sim$ seconds - minutes
- Bulk of the emission in the range tens of keV to hundreds MeV

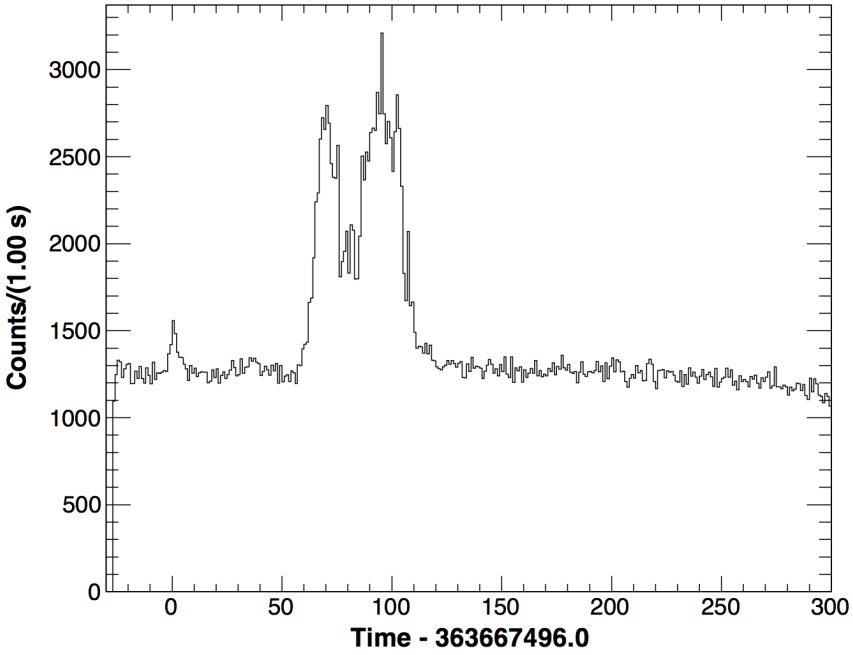


Figure: Prompt emission light curve for GRB120711. GBM data only.

The Band Function

- Empirical function
- Smoothly broken power law
- Characterized by $\alpha, \beta, E_{\mathrm{peak}}$
- Has nothing to do with bands

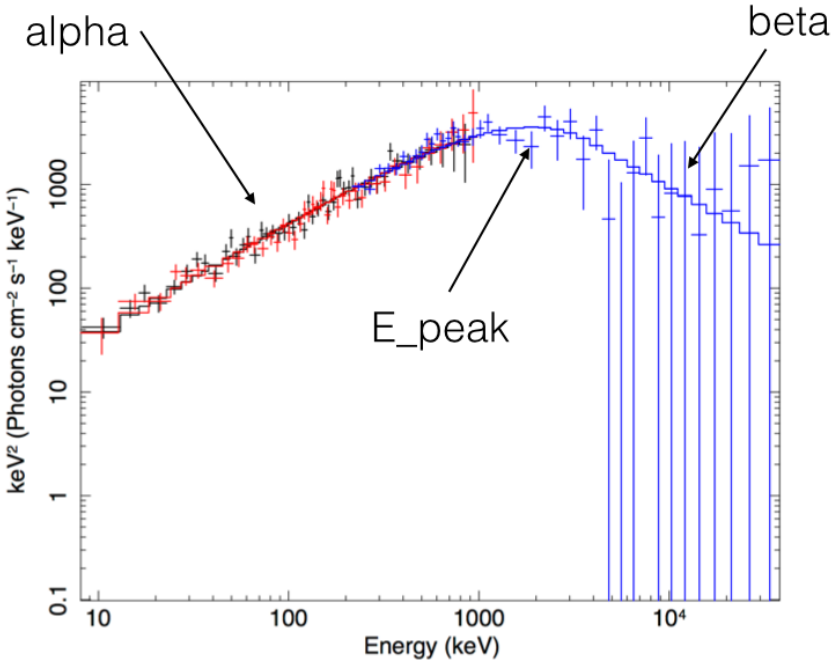


Figure: Plot of a Band-function fit of GRB120711

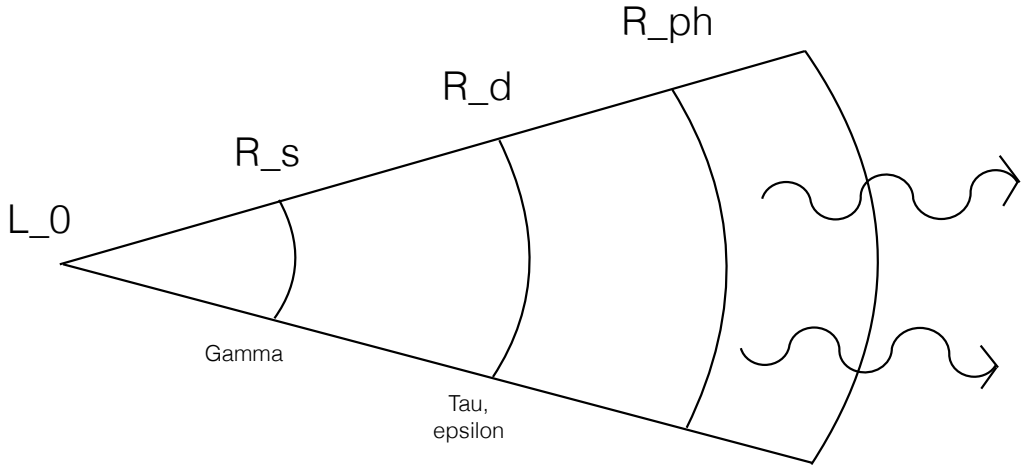
Proposed physical models

- Synchrotron, Tavani (1996)
- Synchrotron + black body emission, Meszaros et al. (2002), Burgess et al. (2013)
- Magnetic dissipation Giannios (2010)
- Photosphere + geometrical effects (Lundman et al. 2013)
- Subphotospheric dissipation Rees & Meszaros (2005) Peer et al. (2005), Beloborodov (2011)

Fitting Without the Band Function

Use a model based on subphotospheric dissipation in a relativistically expanding fireball from Pe'er et al. (2006).

- Characterized by $\tau, \Gamma, L, \epsilon$
- Kinetic energy in bulk flow is dissipated to the electrons at some radius $R_d(\tau, \Gamma, L)$
- Thermal seed photons and electrons interact and electrons cool



Preliminary results

- Spanned parameter grid to create table models
- Can fit to data with fit quality comparable to Band's function (same number of free parameters)

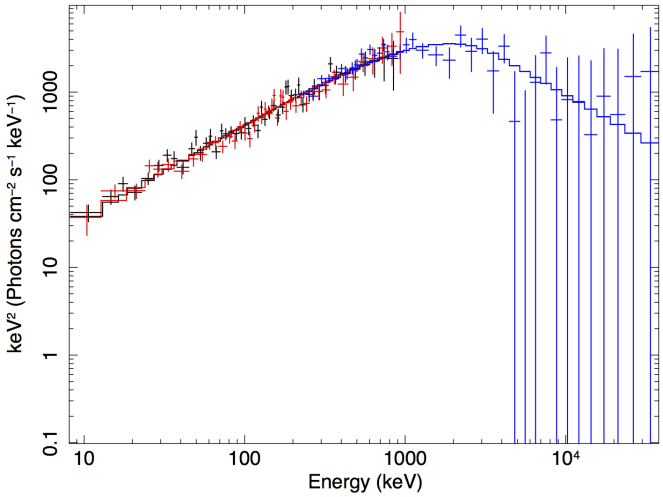


Figure: Band's function

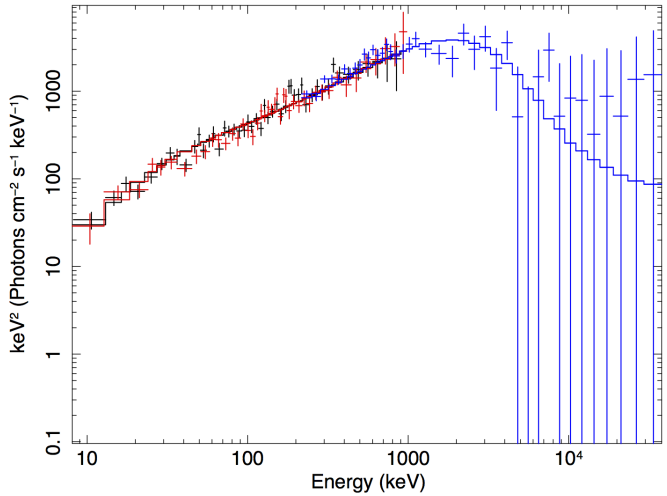


Figure: Subphotospheric dissipation model

Outlook

- Assuming this physical scenario, properties of the jet can be derived
  - Arrive at reasonable parameter values for studied cases
- Results are promising
- For a sample of bright bursts with known redshift, a fit with quality comparable with that of a Band function fit is found
- Time to move on from empirical models