Panchromatic analysis from the X-ray to the optical to characterize GRBs and their hosts: SVOM/COLIBRI synergy

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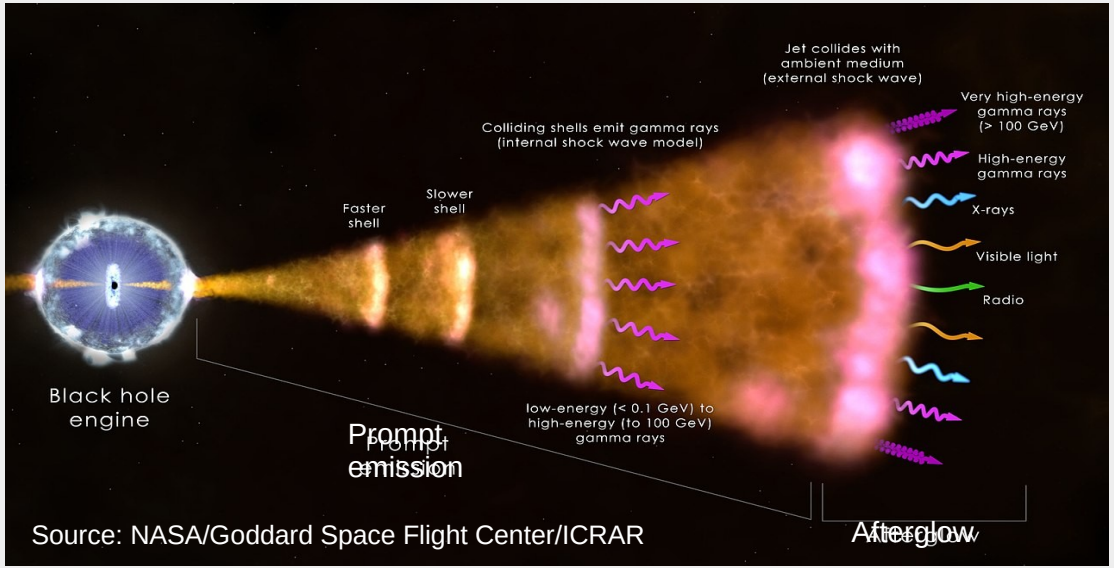
Astrophysical context



Progenitors:

- **Collapsar: Long GRB (>2s)**
- NS/BH, NS/NS mergers: Short GRB (<2s)

Afterglow:

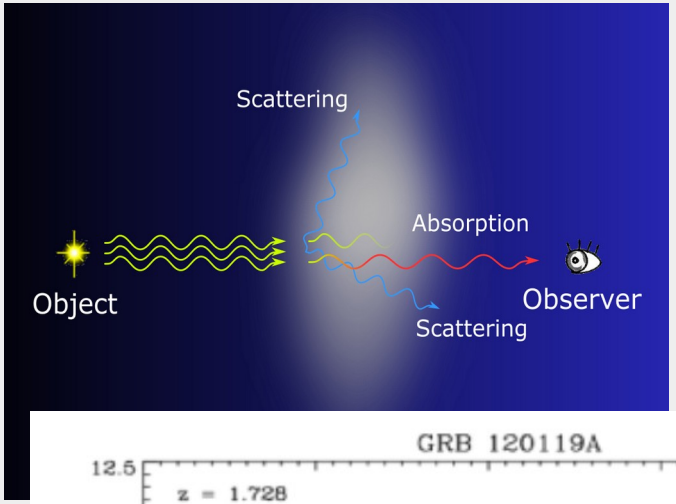
- Simple power law model
- Synchrotron model (Granot et Sari, 2002)

Fireball model:

- Prompt emission: Intense bursts of γ-ray produced by synchrotron
- **Afterglow emission**: X-ray, optical, radio synchrotron emission produced by the Interstellar Medium electron acceleration in the external shock region between the ejecta and the ISM

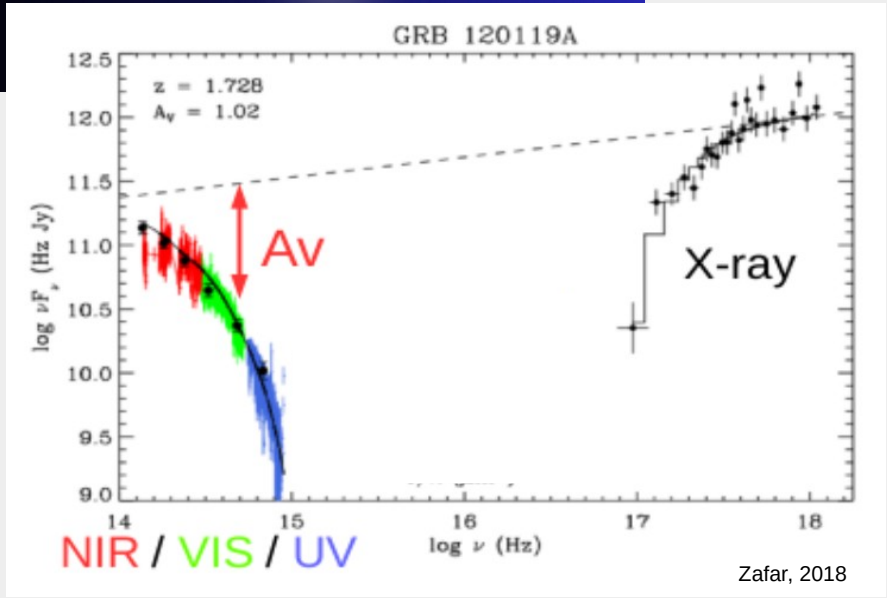
Simple power law (SPL) model: $F(\nu,t) \propto \nu^{\beta} t^{-\alpha}$ ⇒ Study the host galaxy properties

Study of the interstellar dust medium in high-*z* galaxies



- Deviation from the SPL due to dust
- Dust absorbs and scatters UV/NIR and re-emits in FIR

⇒ Dust extinction represented by extinction curve (λ dependent, dust size and composition)



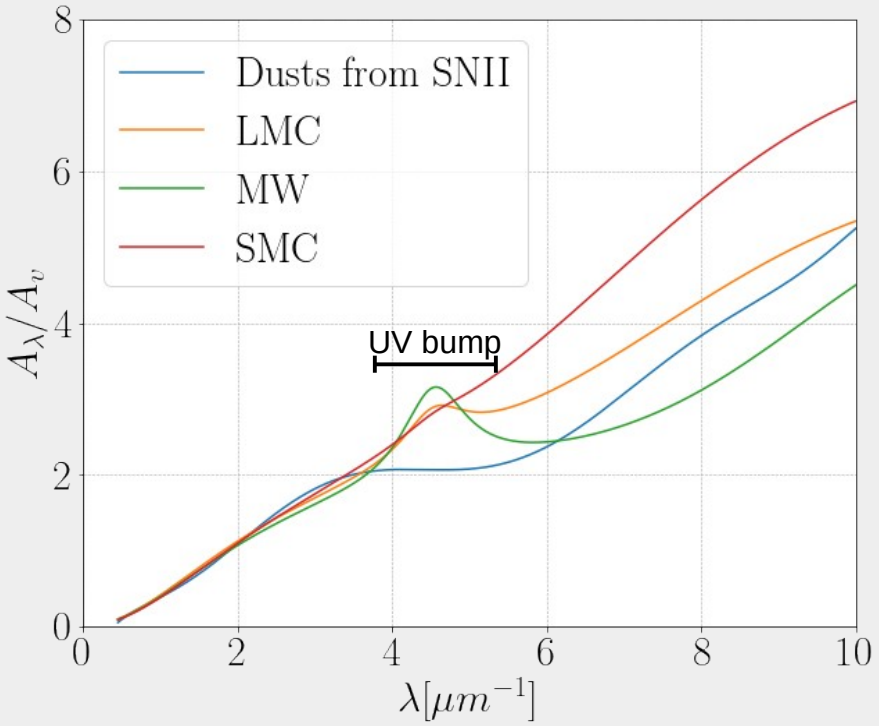
- X-ray: Photoelectric absorption from $N_{H,X}$

⇒ Attenuation of the spectrum:

Soft X-ray = 124 eV < *E* < 5 keV

⇒ Negligible in hard X-ray = *E* > 5-10 keV

Dust extinction laws

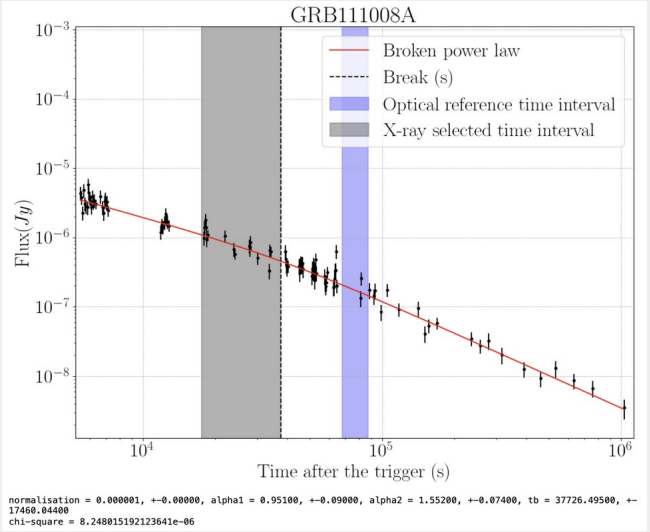


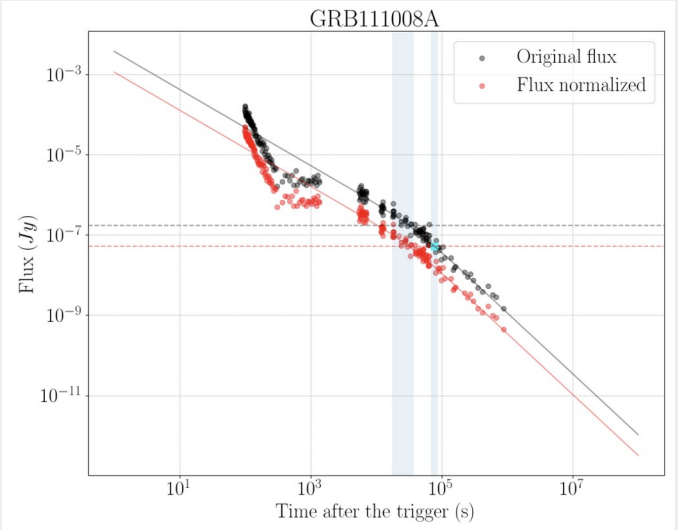
- **SMC, LMC, MW** extinction curves (Pei, 1992), **starbusts galaxies** (Calzetti et al. 2000), **supernovae dusts** (Maiolino et al, 2004)
- Laws considered: MW UV bump 217.5 nm, featureless SMC in most cases, compromise law of LMC, plateau region 170-300 nm Sne
- Sne (Maionilo, 2004): Polynomial fit and SMC curve < 100 nm

Goals:

- Use GRBs to determine the dust extinction law parameters of high-*z* galaxies
- Construct the Spectral Energy Distribution from X to NIR of a large samples of GRBs
- Test and study statistically the different models of dust extinction laws at high-*z*
- Under the context of the COLIBRI/SVOM mission

Challenge now

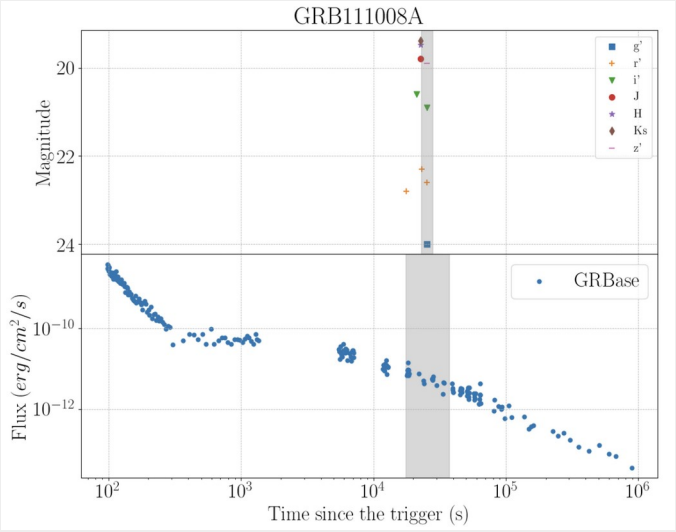


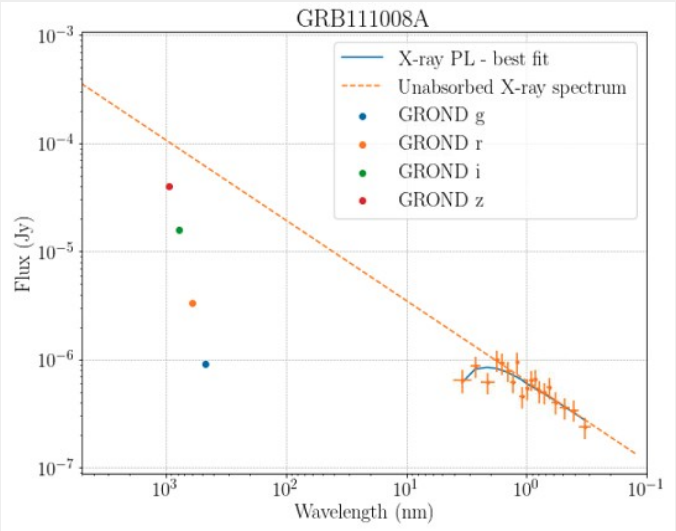


- Problem: X-ray and optical data are not simultaneous
- Fit X-ray light curve to a reference time = Optical reference time
- Find flux weighted mean time

$$F_m = \frac{\int_{t_1}^{t_2} F_x\, dt}{\Delta t} \quad \text{so we can have } t_m\text{: Weighted mean time} \neq (t_1 + t_2)/2$$

First tests with GRBase (Turpin et *al*) and SWIFT (Evans, 2009)





- **GRBase**: Database of multiwavelength GRB light curves
- 591 GRBs from 970228-190219A and 221009A
- **SWIFT**: Reference for X-ray data (> 1500 GRBs)

- From light curves to spectra
- Next: Fit extinction laws