

Observation multi-longueur d'onde des sursauts gamma

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IRAP



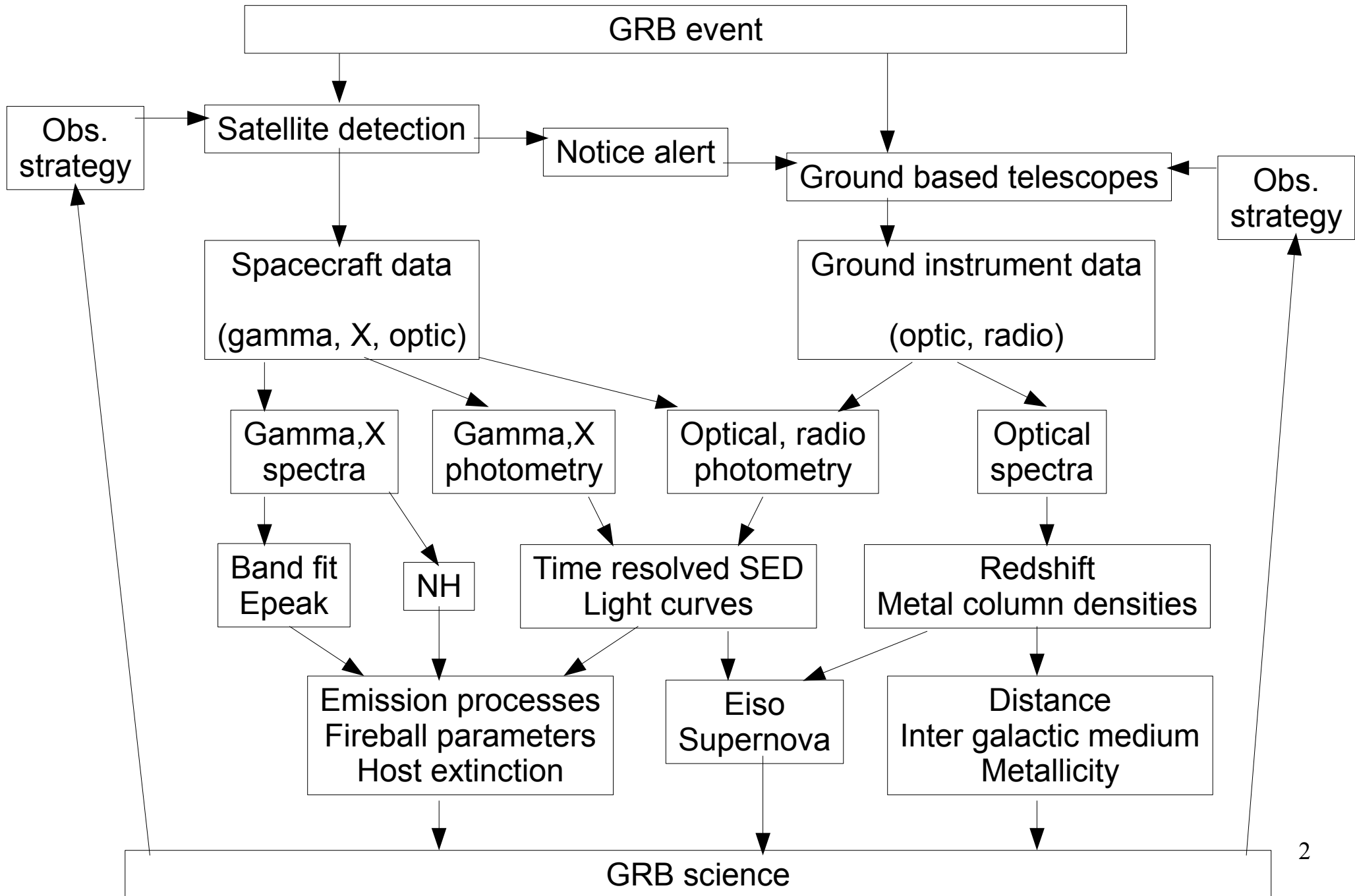
Atelier du groupe Astroparticules du Labex OCEVU
THE PHYSICS OF RELATIVISTIC OUTFLOWS
22 au 24 mars 2016



Origines
Constituants
&
EVolution de l'Univers

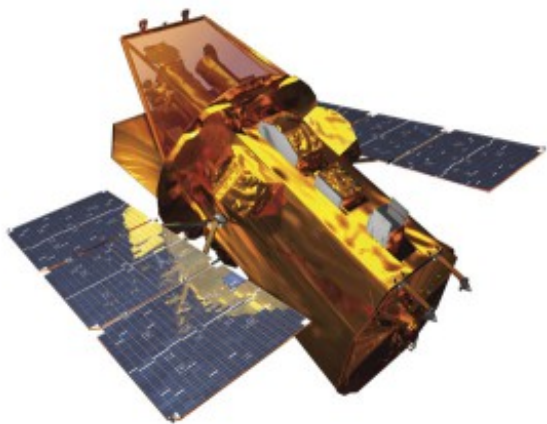


GRBs from events to science



Context of astronomical alerts

Gamma Ray Bursts Triggers



SWIFT 2004-2020 ?
100 GRB/yr

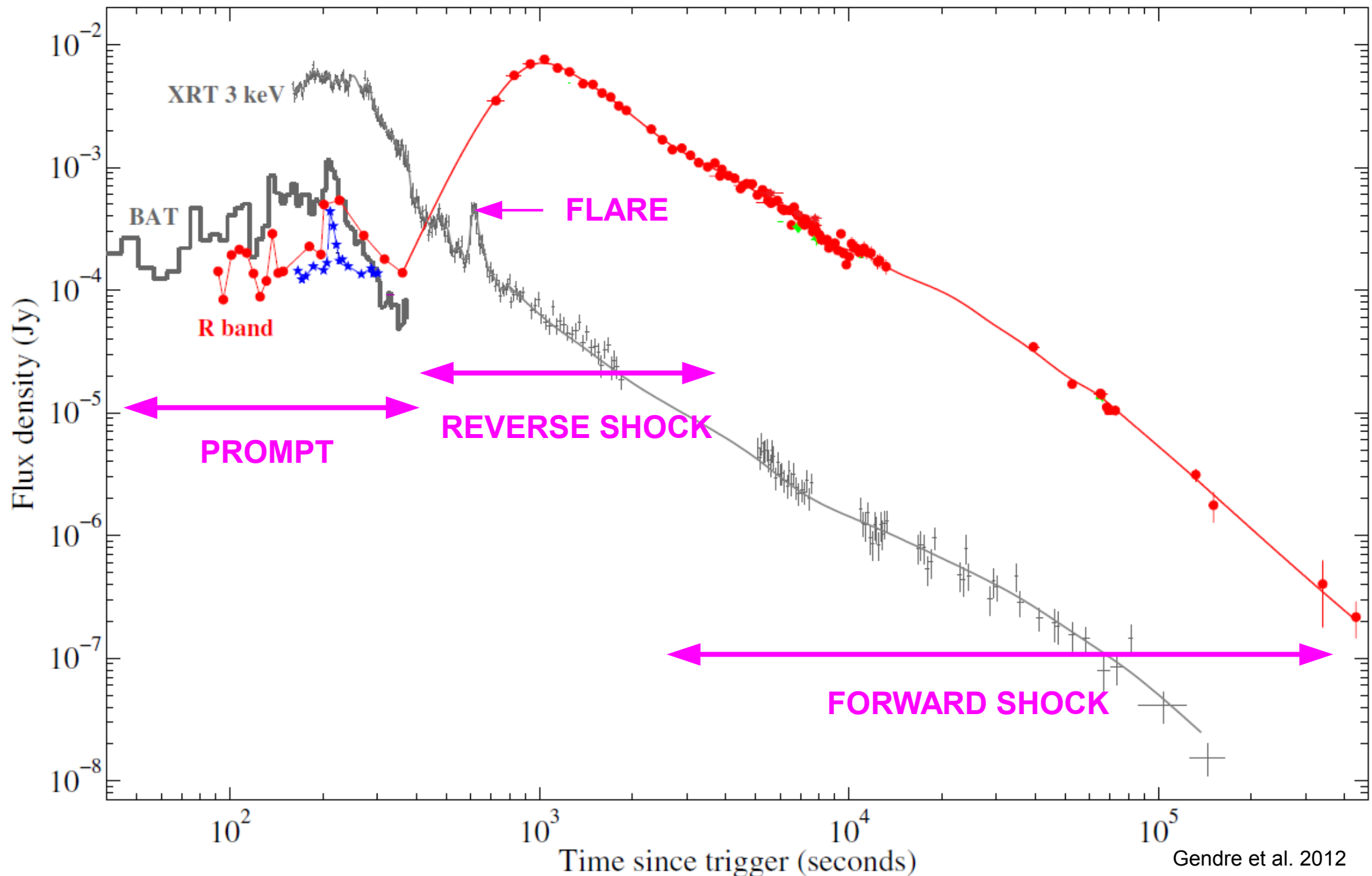
Error box BAT = 6 x 6 arcmin
Error box XRT = 2 x 2 arcsec
Error box UVOT = 1 x 1 arcsec



SVOM >2021
80 GRB/yr
Error box GBM = 10 x 10 deg
Error box ECLAIRS = 26 x 26 arcmin
Error box MXT = 4 x 4 arcmin
Error box VT = 1 x 1 arcsec

Context of astronomical alerts

Gamma Ray Bursts multi wavelength phenomenology



Context of astronomical alerts

Gamma Ray Bursts & fireball theory

Optical + X ray + gamma
light curves & spectra

E_{iso}, η
 ϵ_B
 ϵ_e
 p

nH

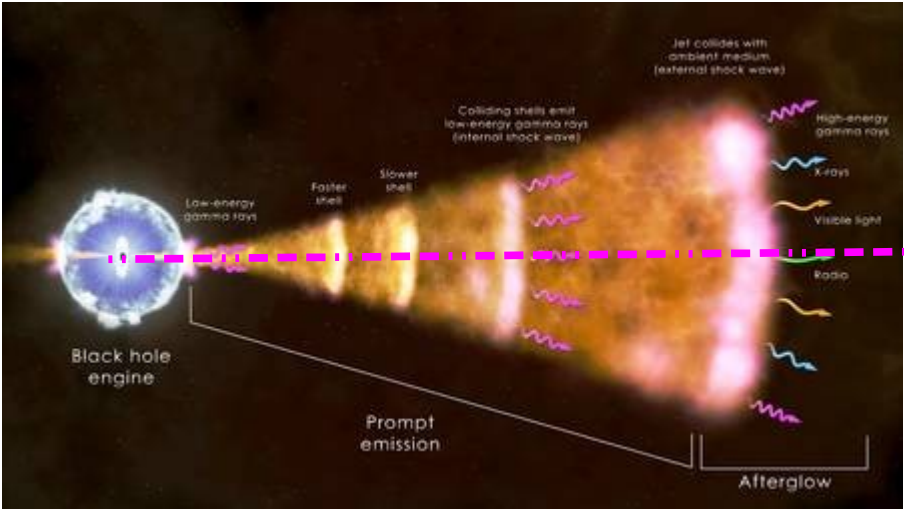
A_v, NH, Z

Z

Optical spectrum

X-ray spectrum

Optical spectrum



host galaxy

inter galactic medium

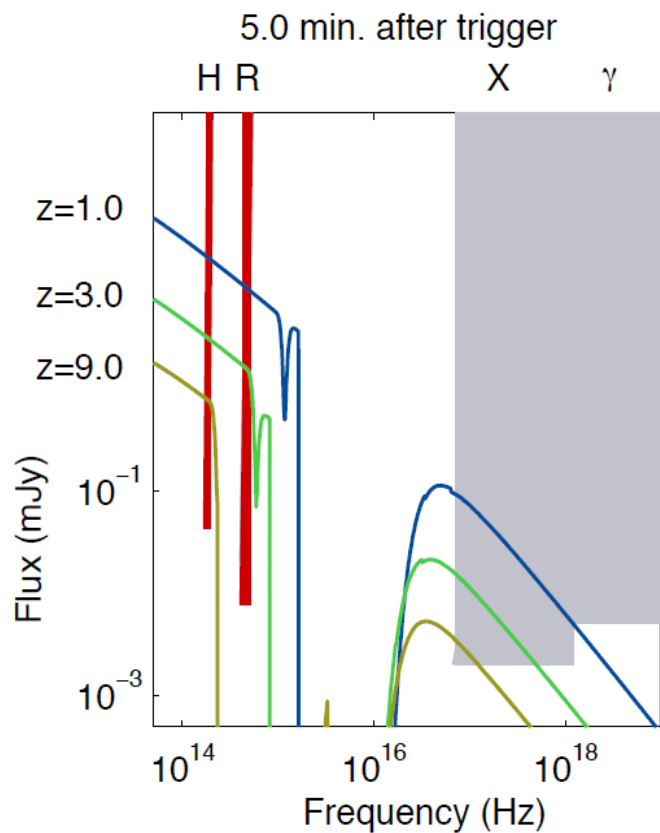


Stellar evolution - Physics

Cosmology

Context of astronomical alerts

Gamma Ray Bursts – Importance of infrared



Optical spectrum

X-ray spectrum

Optical spectrum

A_V , N_H , Z

Z

Cosmology at very high redshifts ($z > 8$) need near infrared detectors (J, H bands)

Physics of the host galaxy ISM: metallicity

Physics of the Universe: Exploring the dark ages, population III stars

Context of astronomical alerts

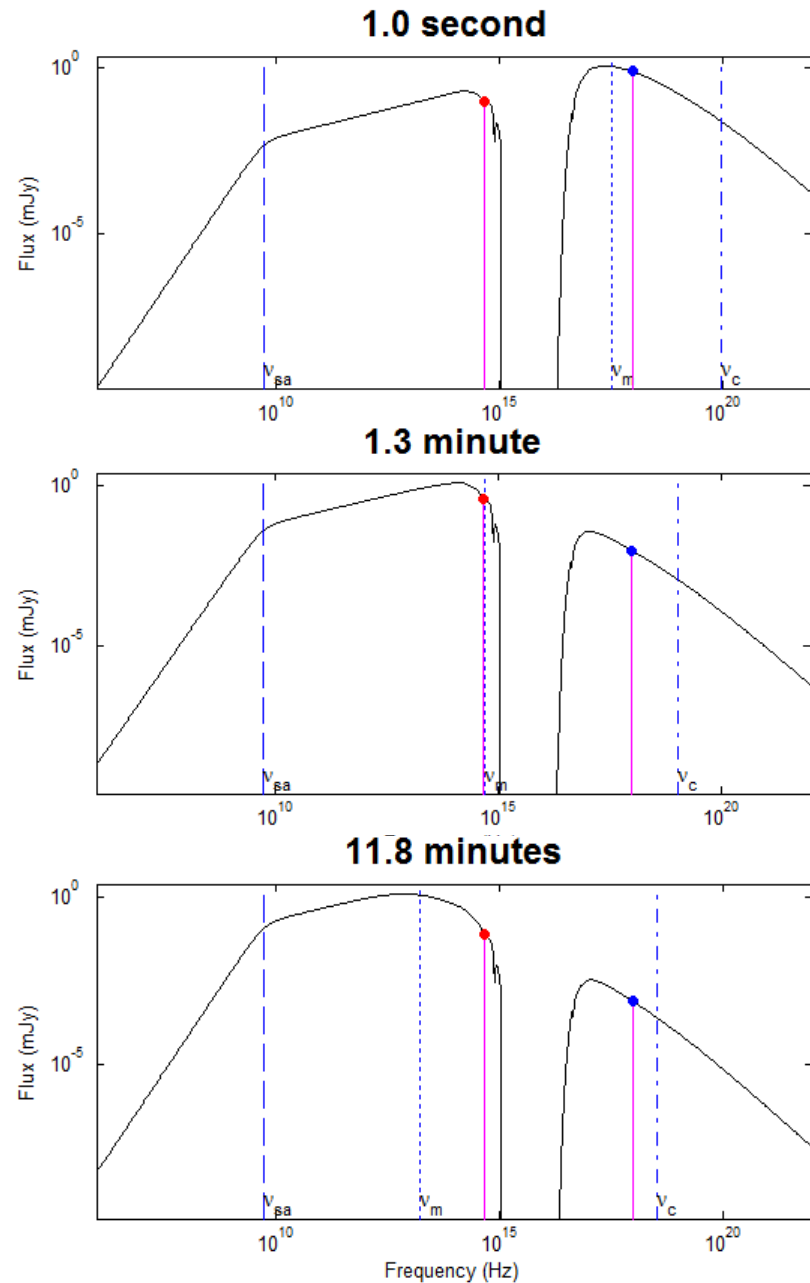
Gamma Ray Bursts – Importance of the early observations

Optical + X ray + gamma
light curves & spectra

E_{iso}, η
 ϵ_B
 ϵ_e
 p

nH

Determination of the parameters
is done unambiguously
only with data acquired
during **the ten first minutes**



Context of astronomical alerts

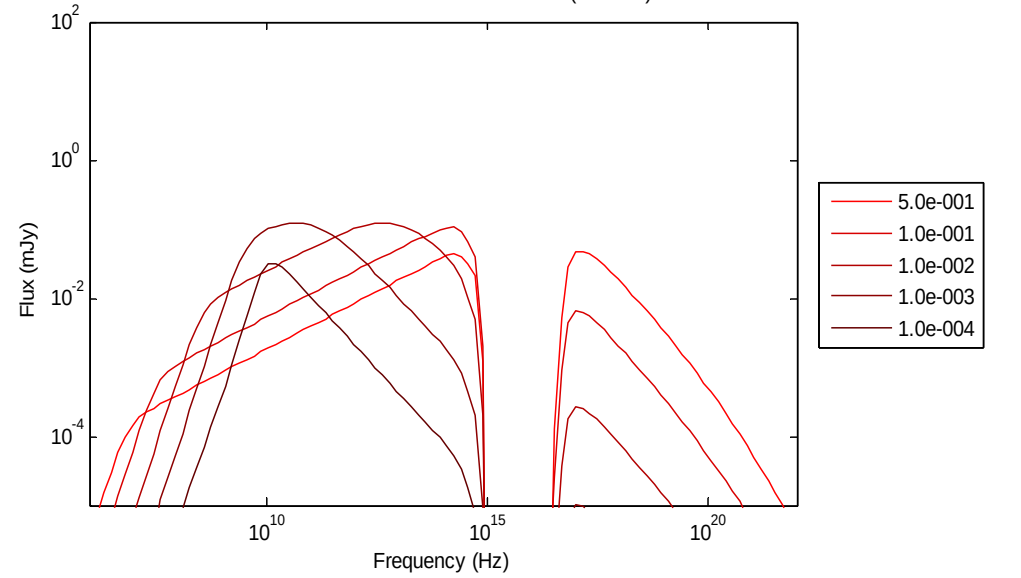
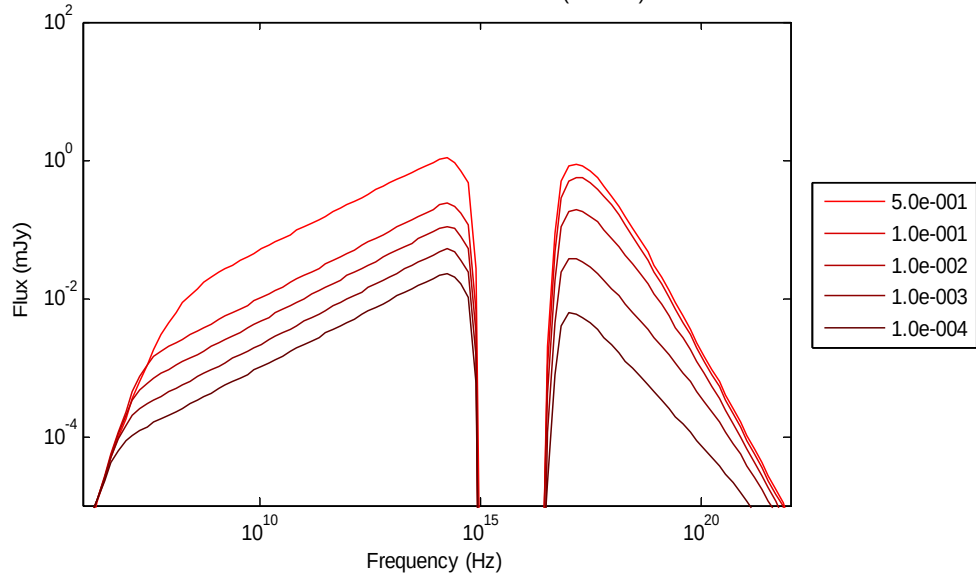
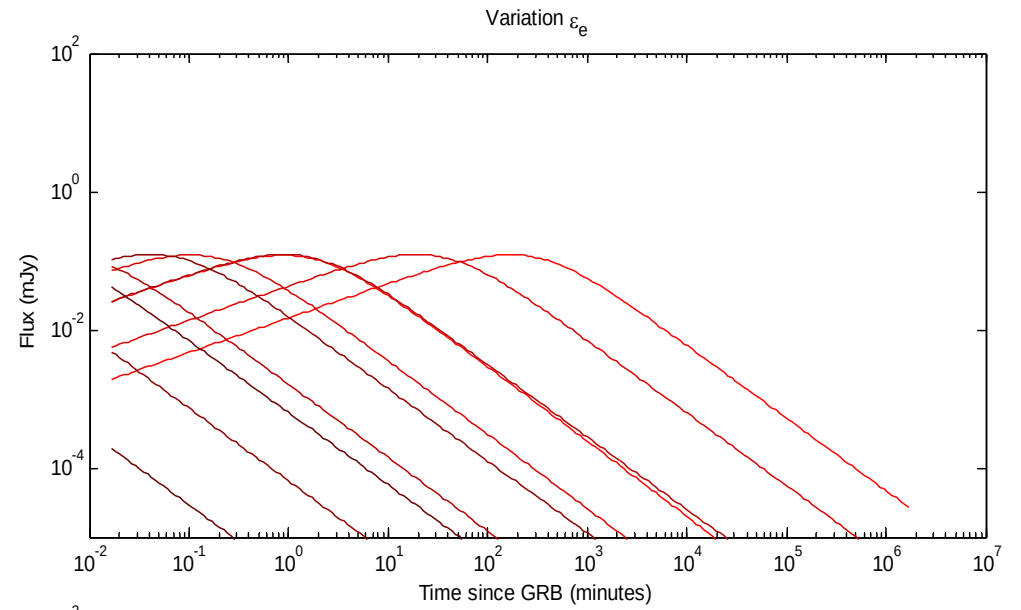
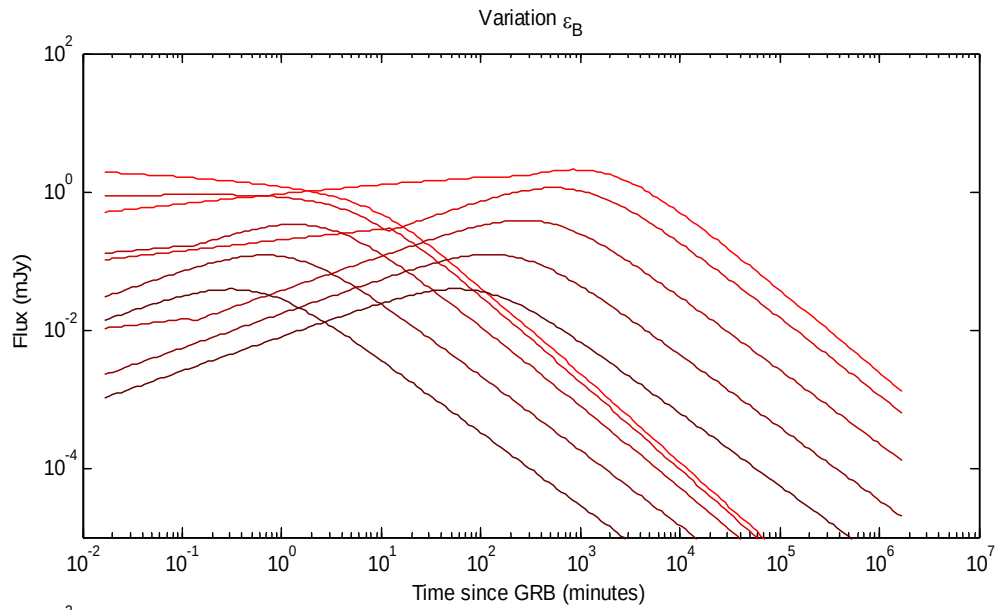
Gamma Ray Bursts – Importance of the early observations

The movie

**Afterglow emission
Fireball theory
from Granot & Sari (2002)**

Fireball theory - From observations to parameters

Afterglow emission Fireball theory from Granot & Sari (2002)



GRB multiwavelength

Difficulties to determine fireball parameters

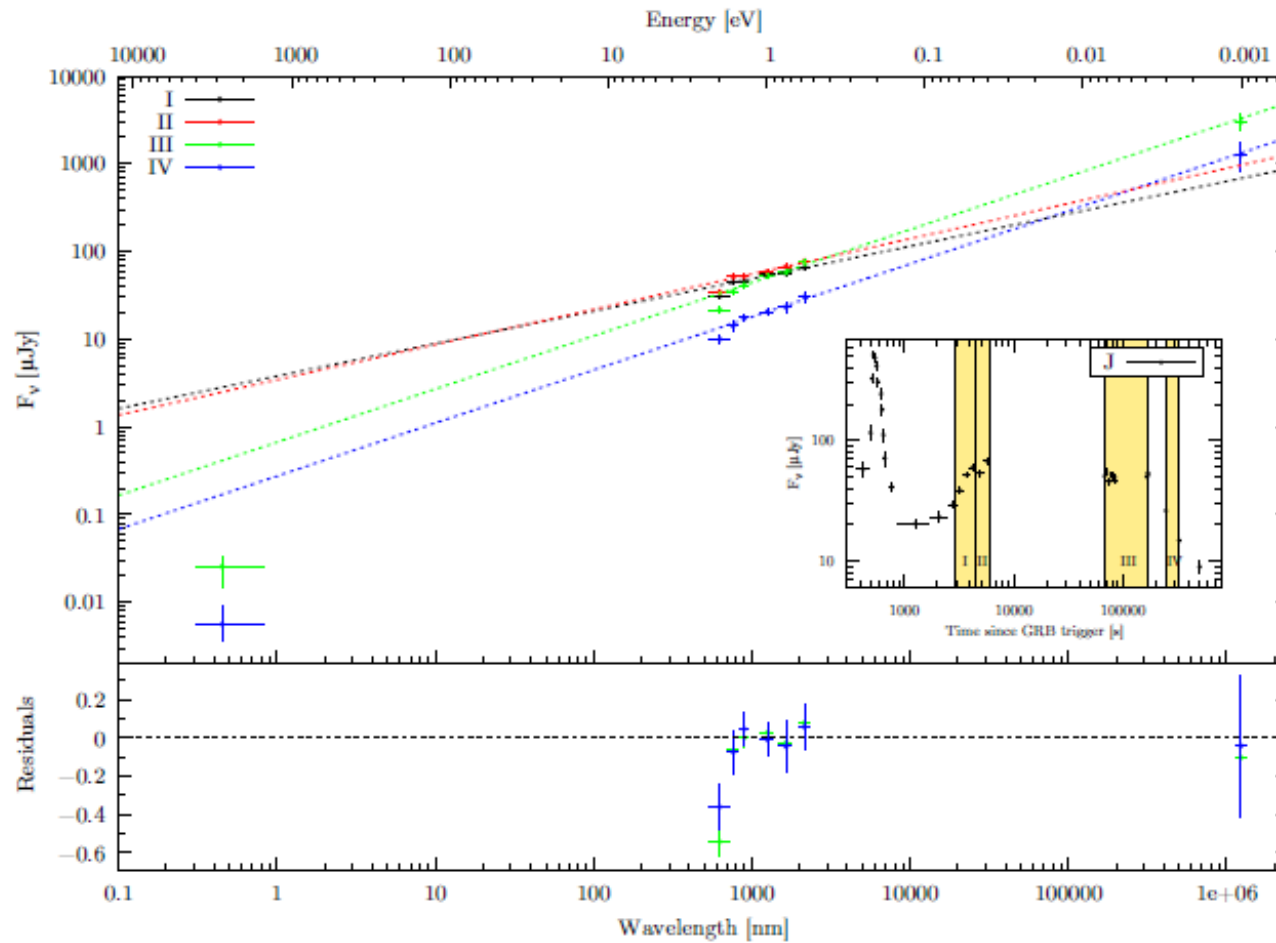
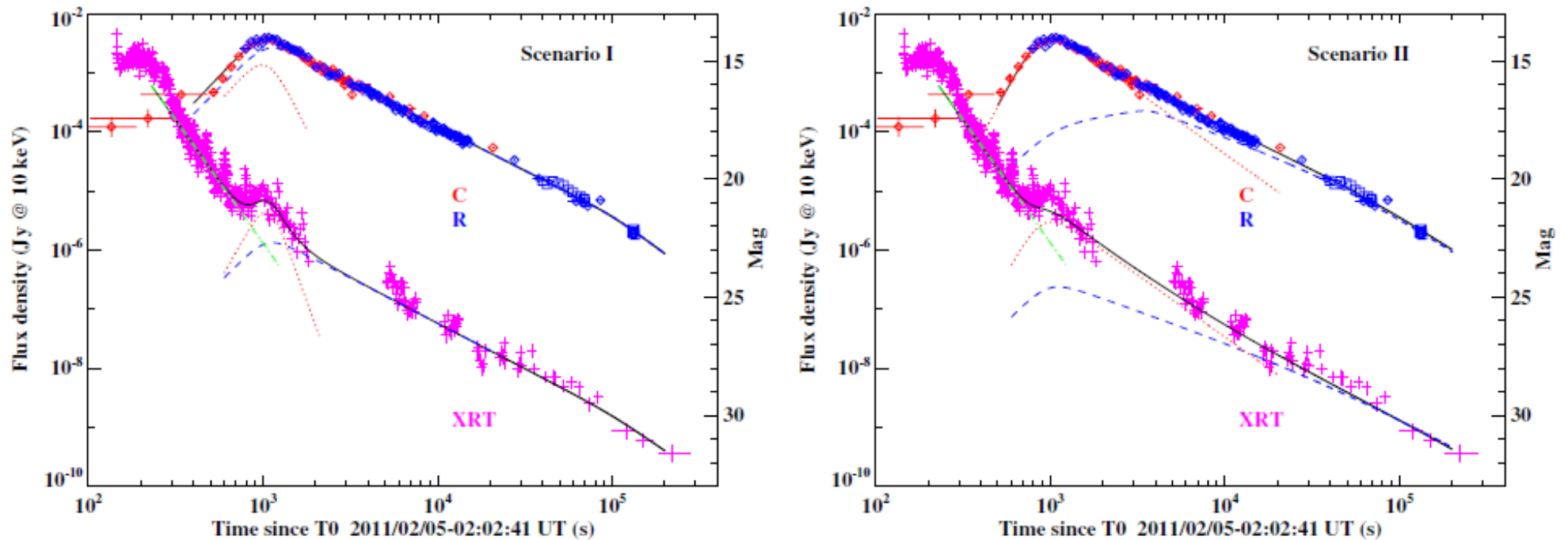


Fig. 4.— Broad-band spectrum of GRB 080129 at different epochs (see inset and legend), combining GROND data (center) with Swift/XRT (left) and MAMBO (top right). The best-fit photon indices are 2.66 ± 0.12 at wavelengths shorter than 400 nm, and 1.62 ± 0.03 above. The best-fit extinction of the optical/NIR fluxes is $A_V = 3.4 \pm 0.1$ mag, and the neutral hydrogen absorption $N_H = 6 \times 10^{21} \text{ cm}^{-2}$ which are nicely consistent with the canonical galactic conversion. The X-ray data are a factor ~ 10 below the power law connecting GROND and MAMBO, and thus a break in the spectrum is required.

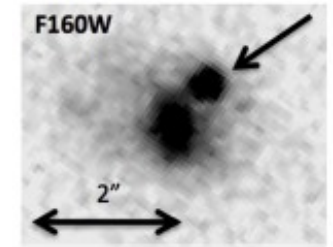
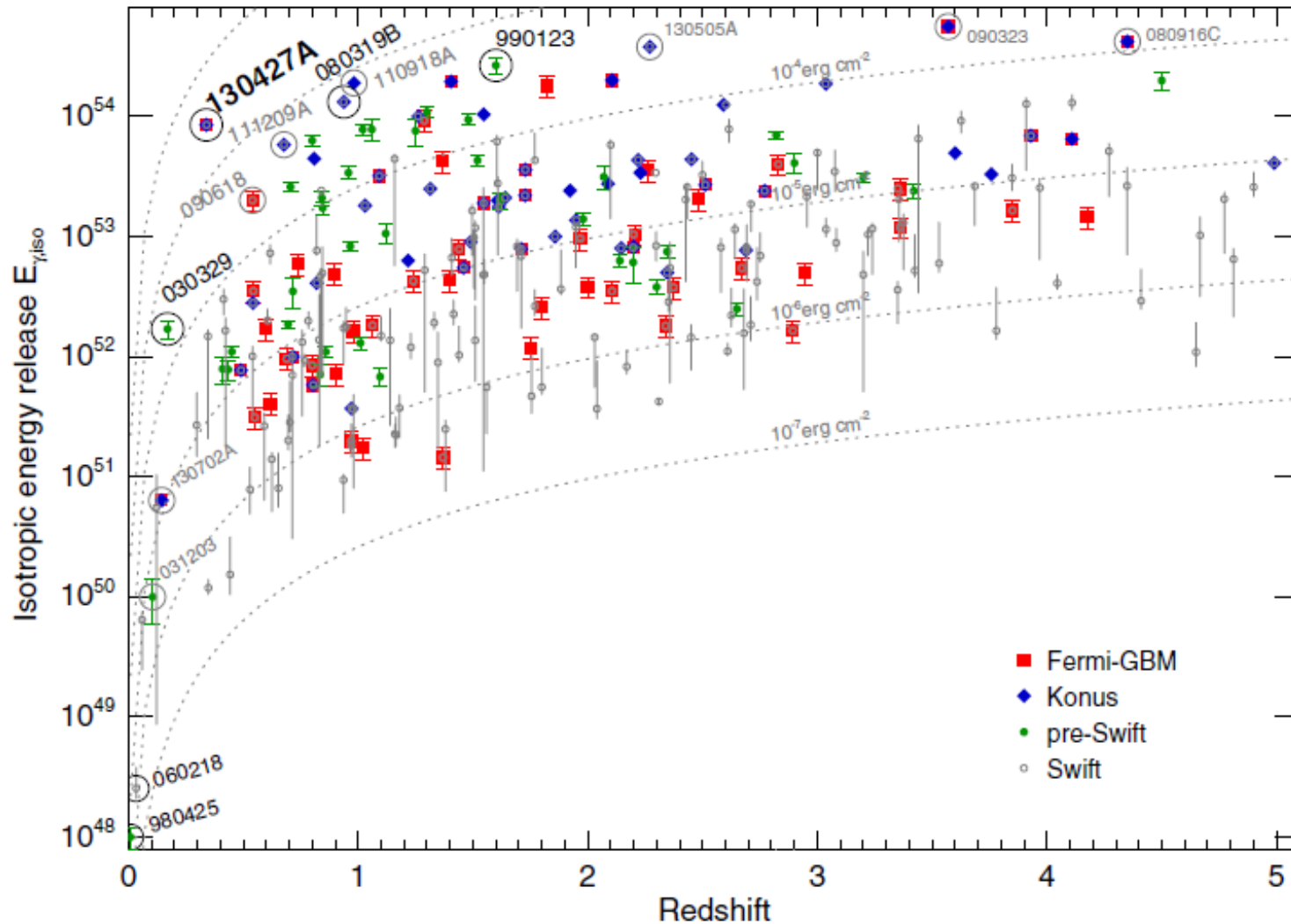
GRB 110205A – A bright burst that follows the fireball theory



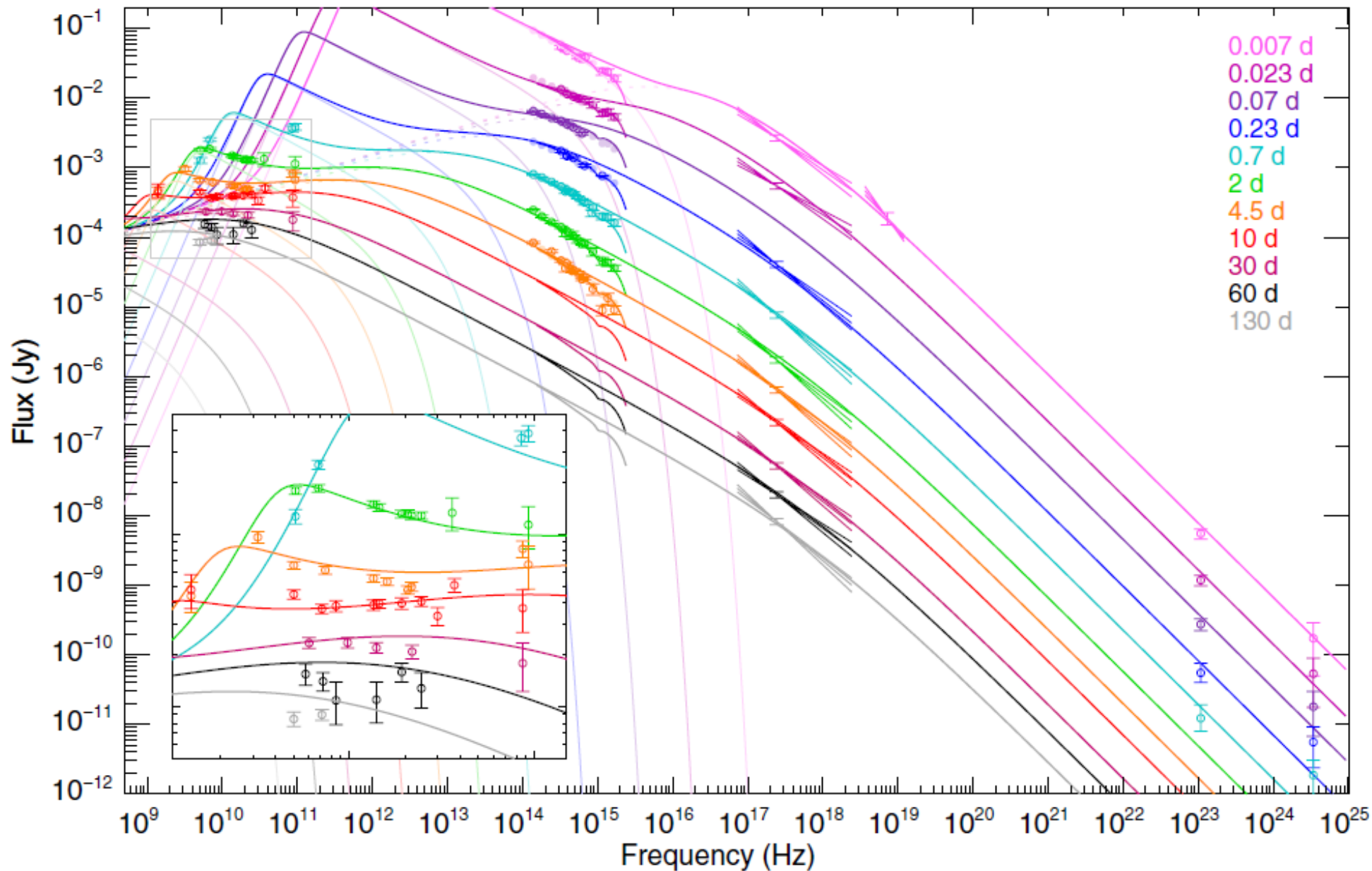
The rich data in both the prompt emission and afterglow phase make GRB 110205A an ideal burst to study GRB physics, to allow the study of the emission mechanisms of GRB prompt emission and afterglow, and to constrain a set of parameters that are usually difficult to derive from the data. It turns out that **the burst can be well interpreted within the standard fireball shock model**, making it a “textbook” GRB.

Zheng et al. 2012

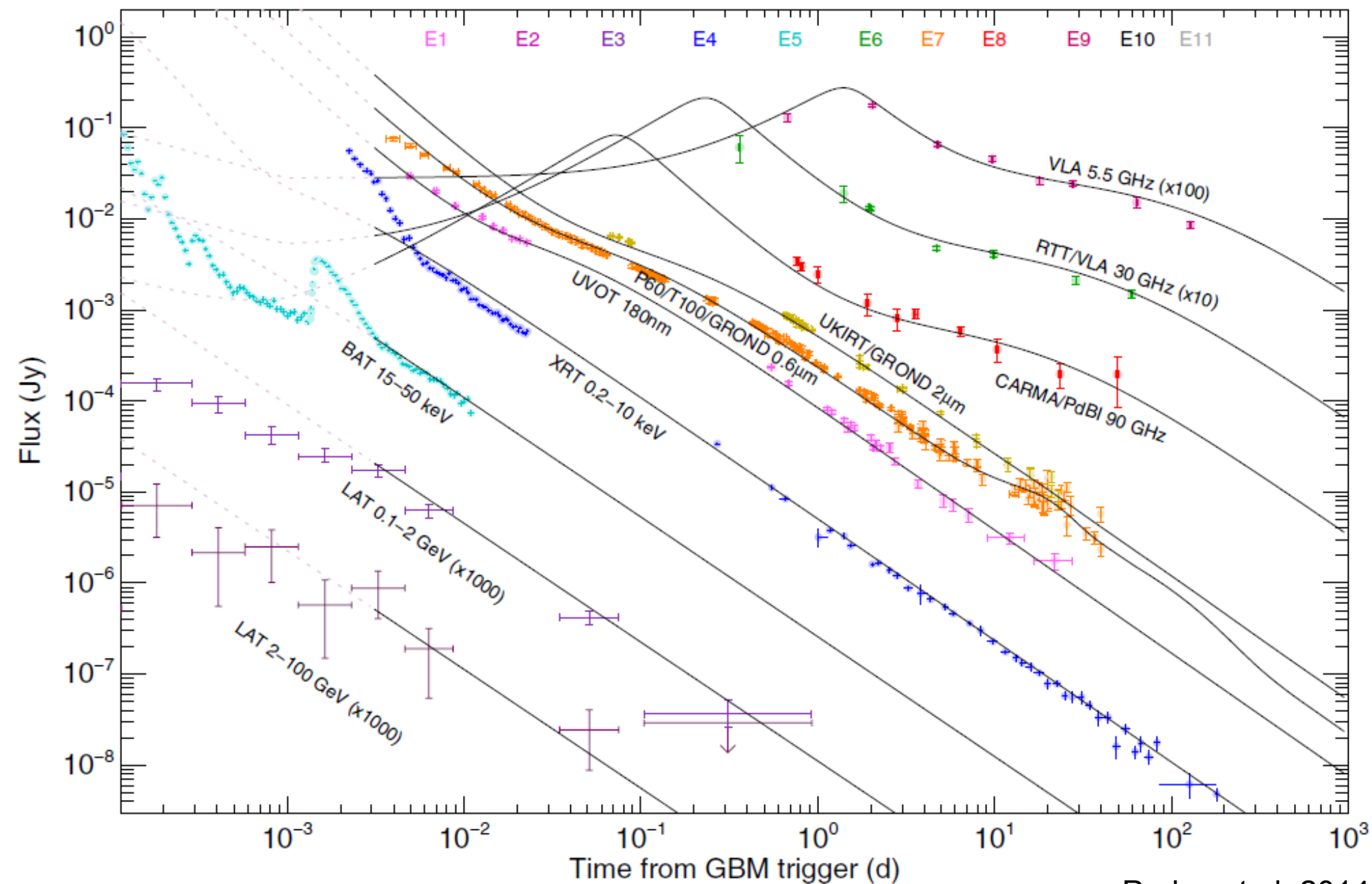
GRB 130427A – The apparent brightest burst



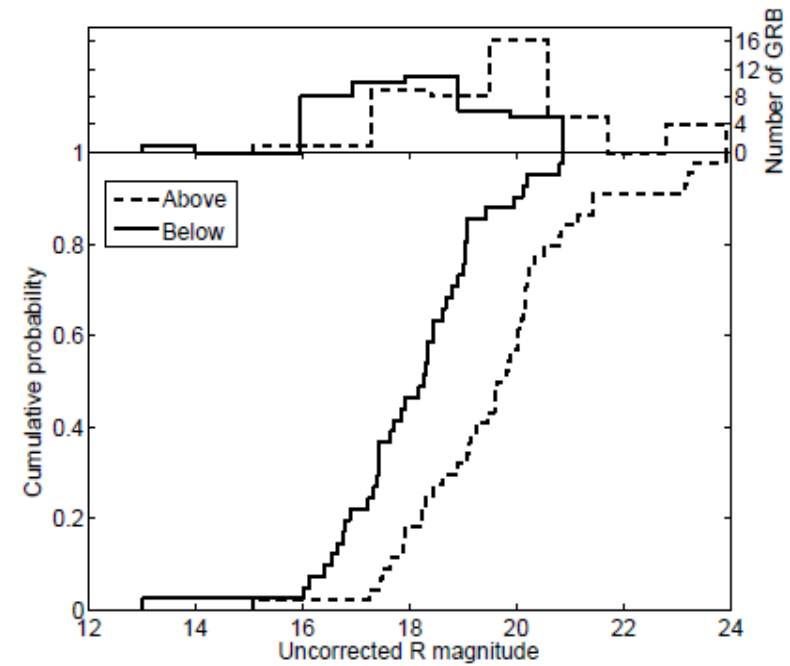
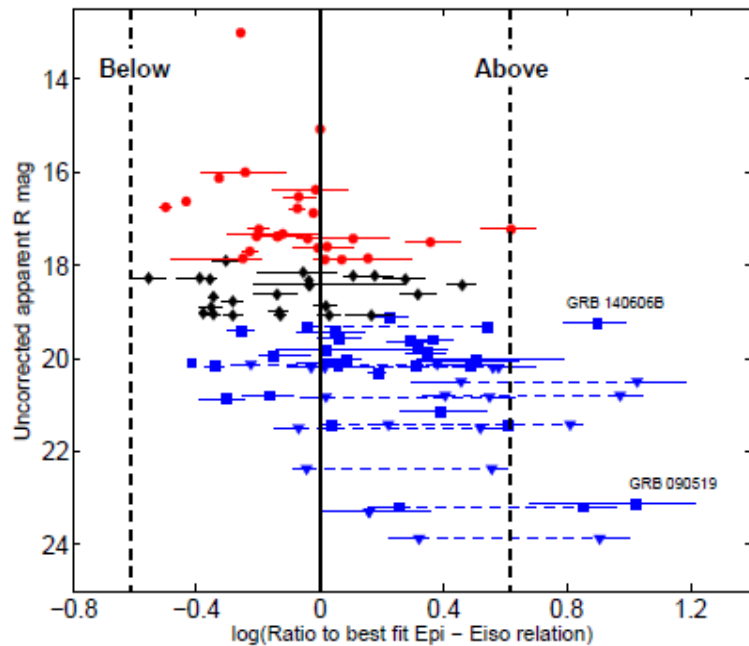
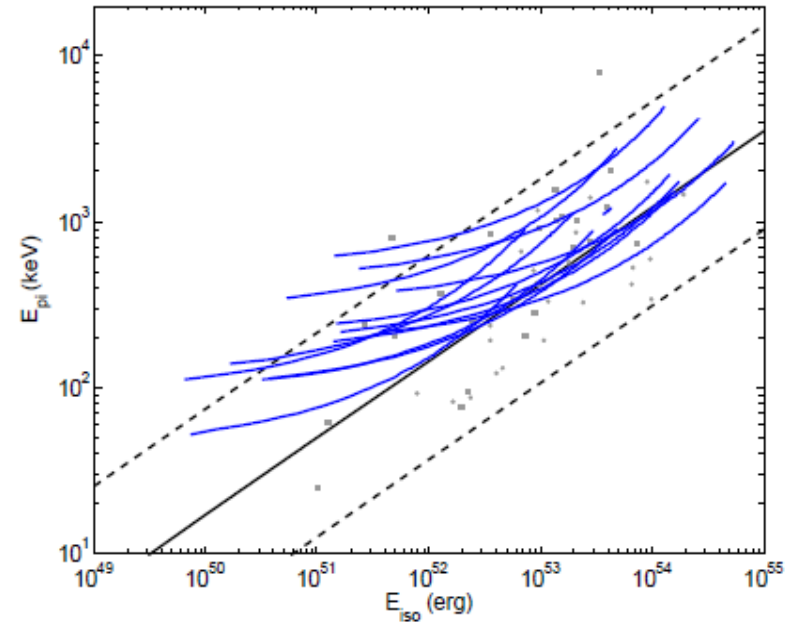
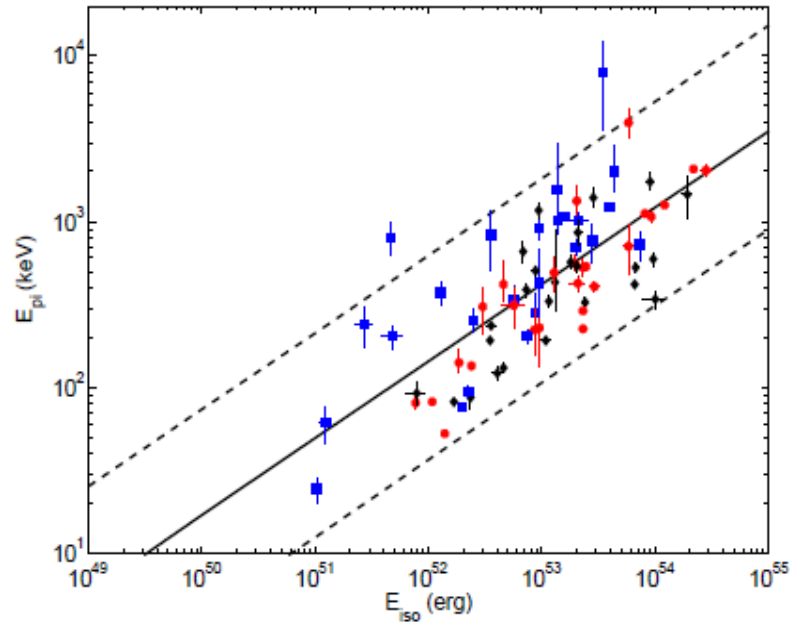
GRB 130427A – The temporal SED



GRB 130427A – The multiwavelength light curves



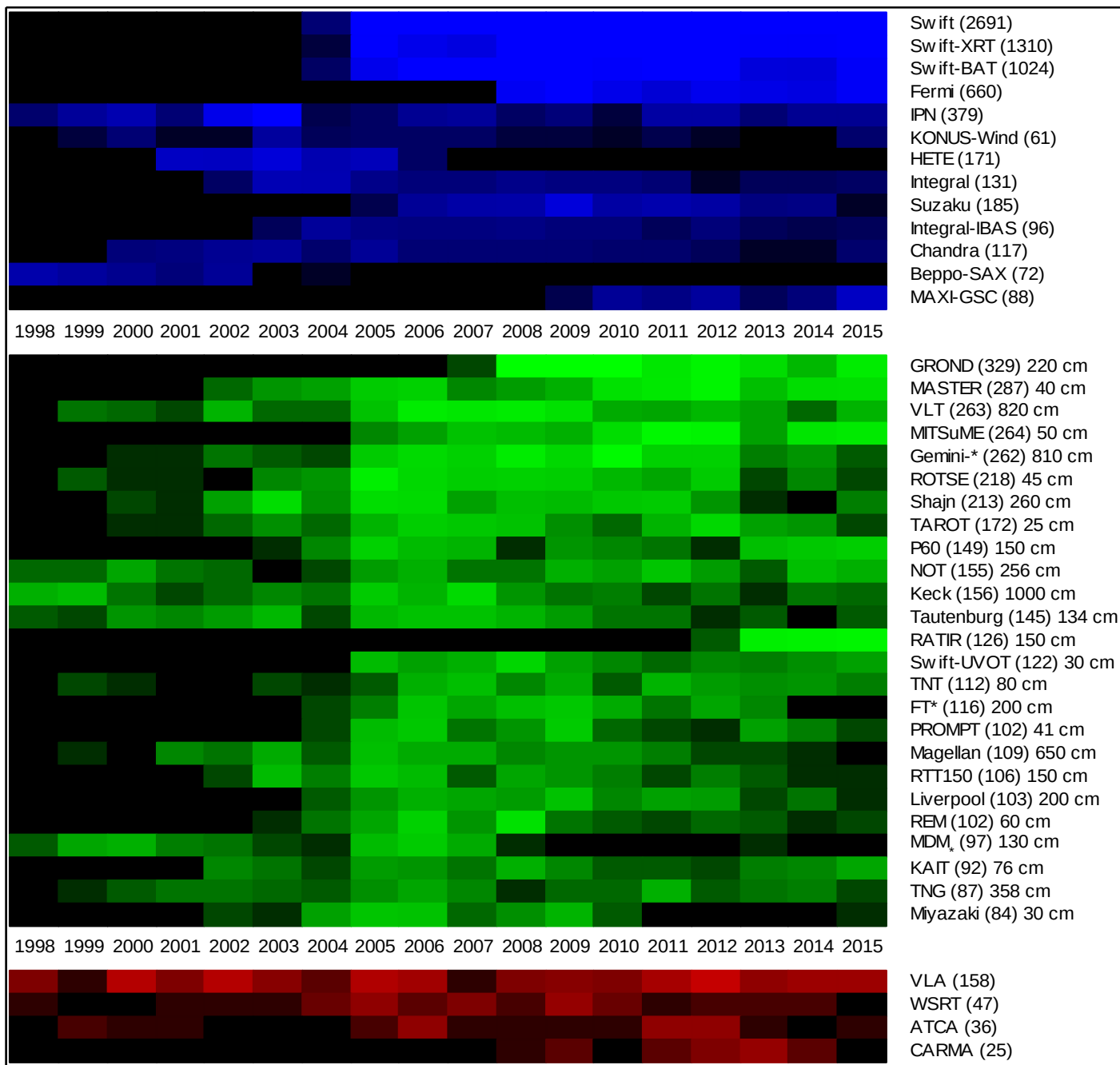
Statistics – The link between prompt and afterglow phases



GRB alert observatories

Gamma ray burts Coordinate Network Circular production

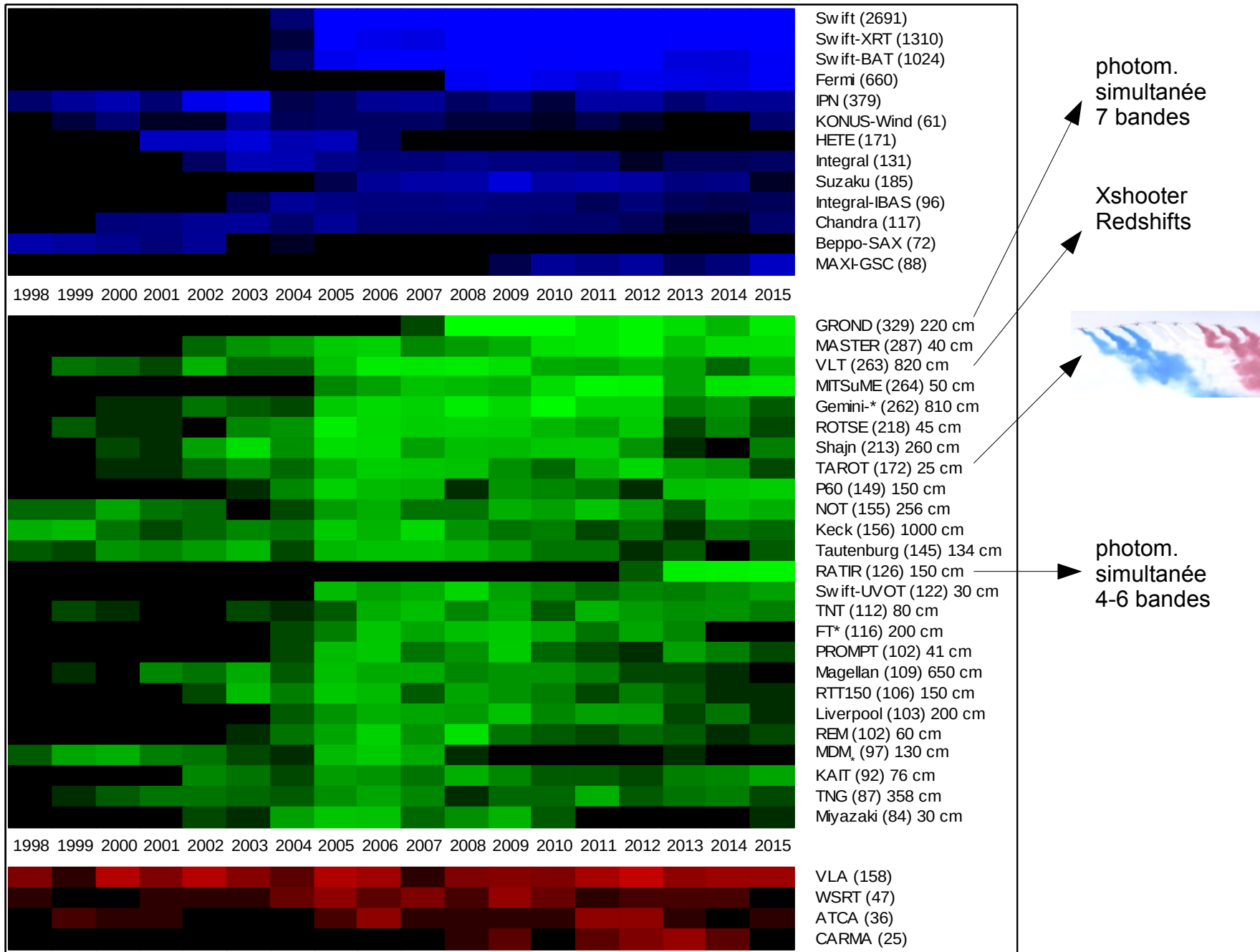
GCN circular productions



GRB alert observatories

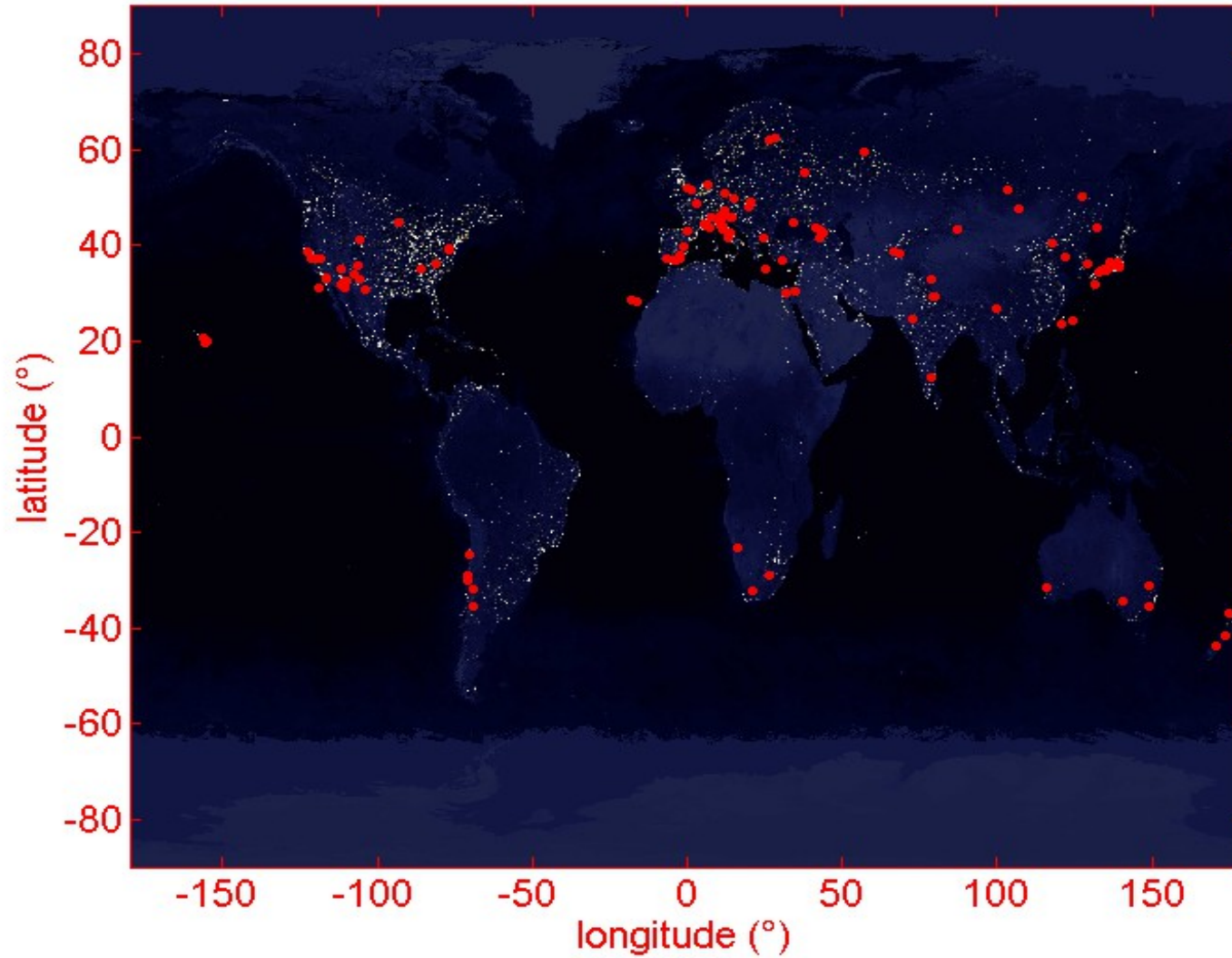
Gamma ray burts Coordinate Network Circular production

GCN circular productions



GRB alert observatories

World map showing clusters and gaps



GRB alert observatories

GFT: A telescope designed for SVOM

OCEVU + UNAM + CNES + ...
Funds

RATIR
Detectivity multiband
Near infrared

TAROT
Fast slewing



The best
optical telescope
for GRB science

rapid localization
high redshifts
prompt emission
faint emissions

SVOM
ECLAIRs unit few keV

GRB alert observatories

GFT: A telescope designed for SVOM

