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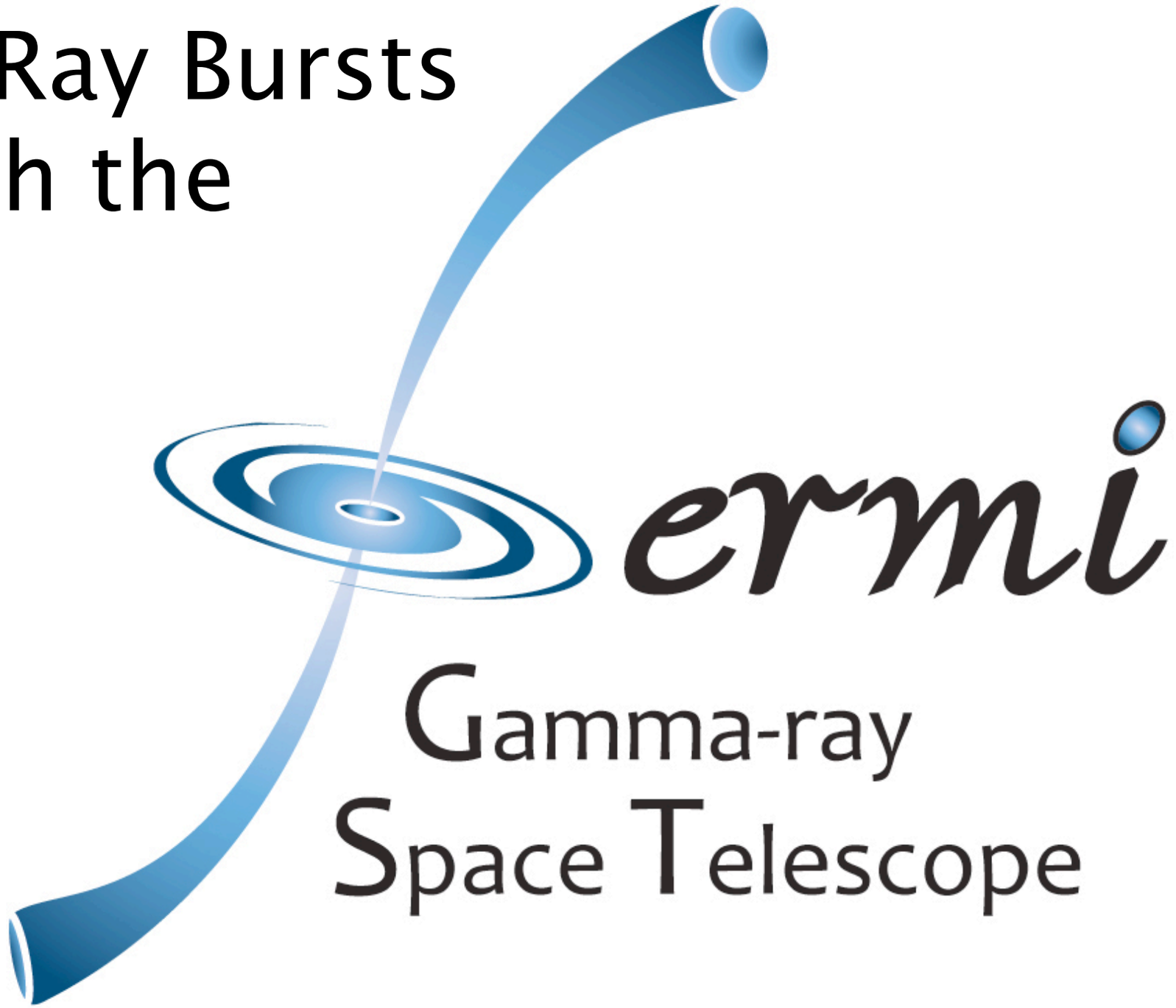
Gamma Ray Bursts with the



Fermi

Gamma-ray Space Telescope

What is a gamma ray burst?

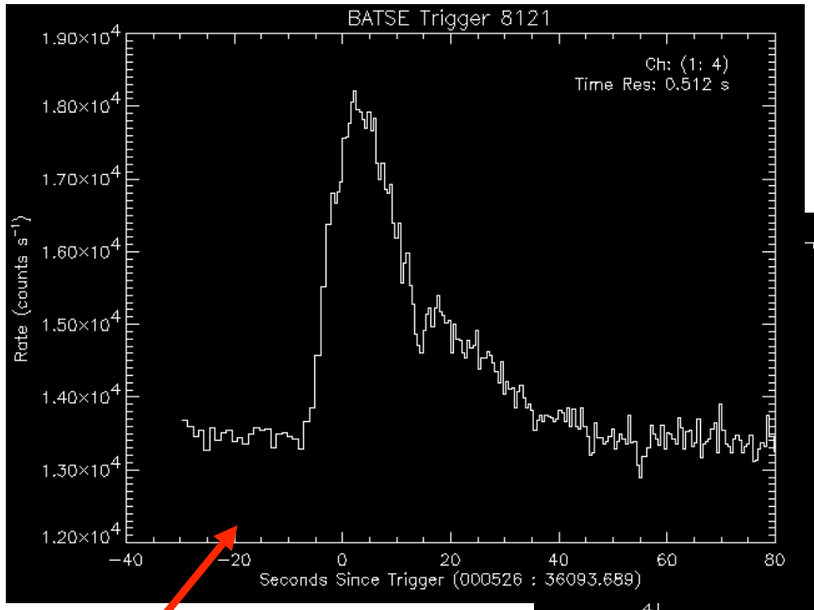
- emission (over seconds) of a large number of high energy (gamma ray) photons

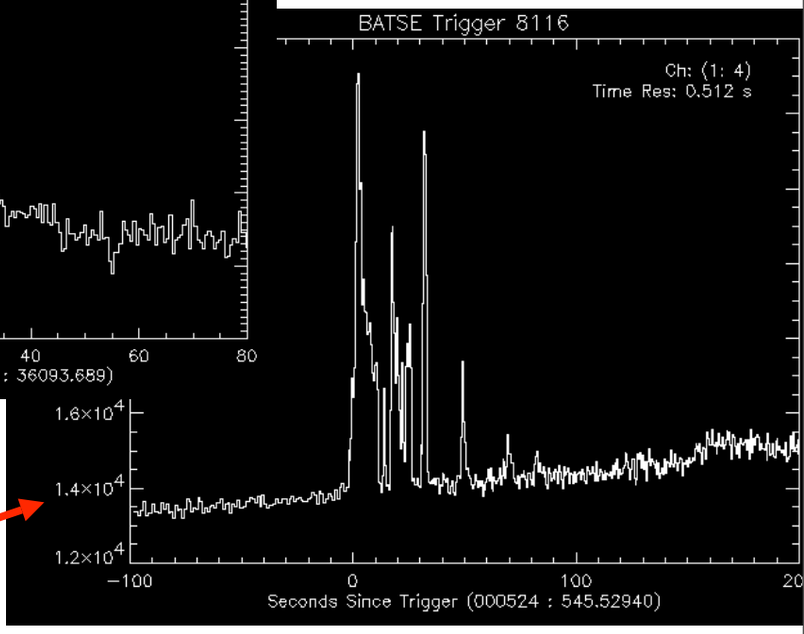
- Named after date: i.e. GRB 081015a – 1st burst on 15 Oct 2008

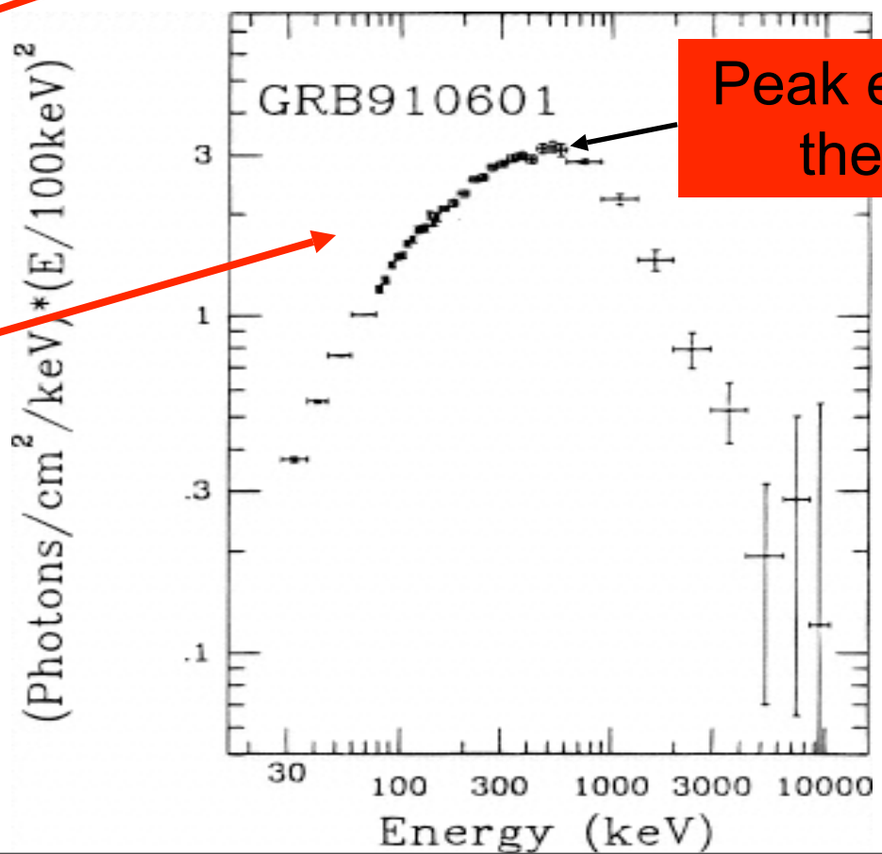
- cosmological origin, from z ~ 0.1 - z ~ 6.7

- temporal structure varies a lot – short, long, spiky, smooth, multiple pulses, quiescent (quiet) phases

- similar spectral shapes, smooth featureless continuum



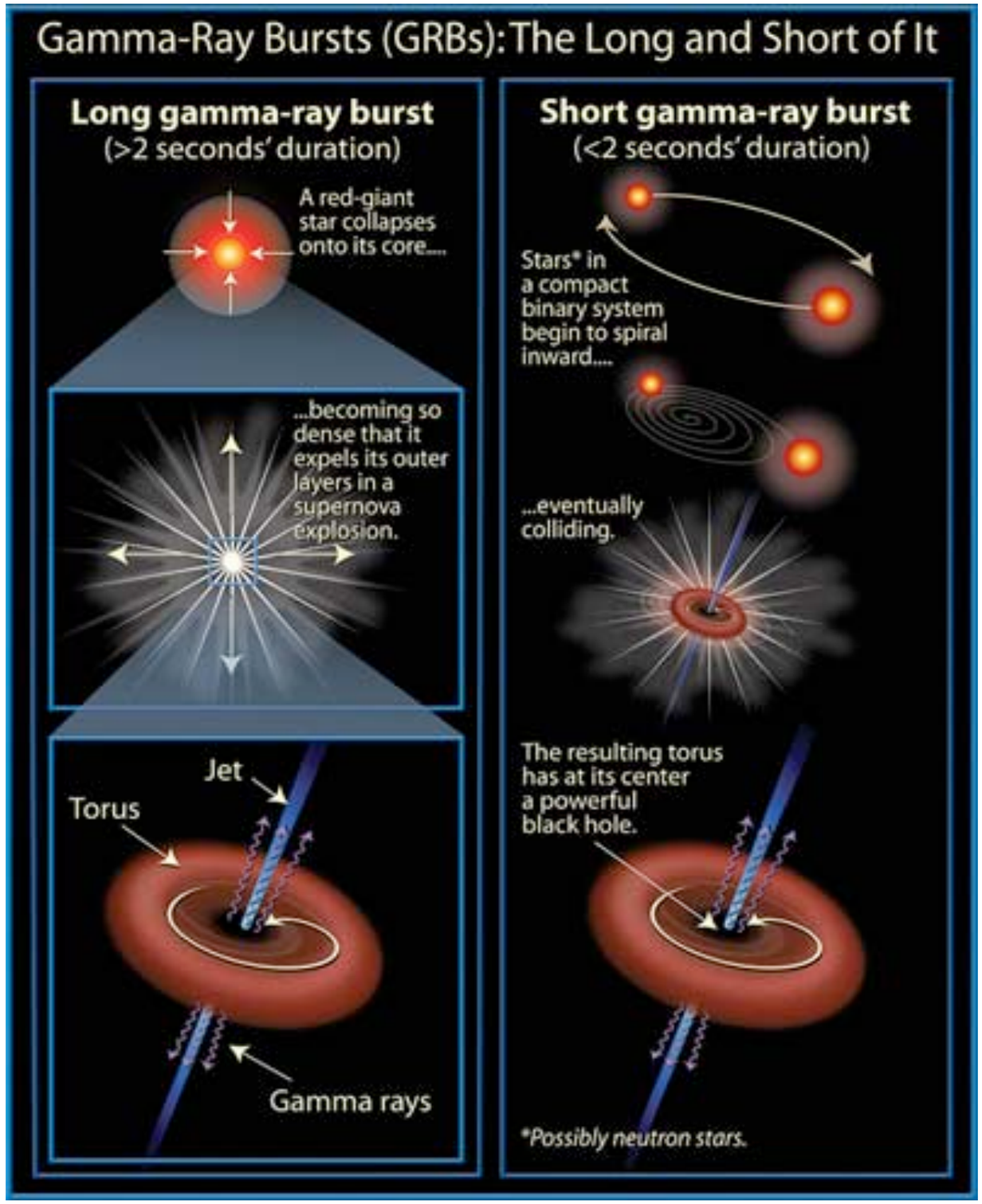


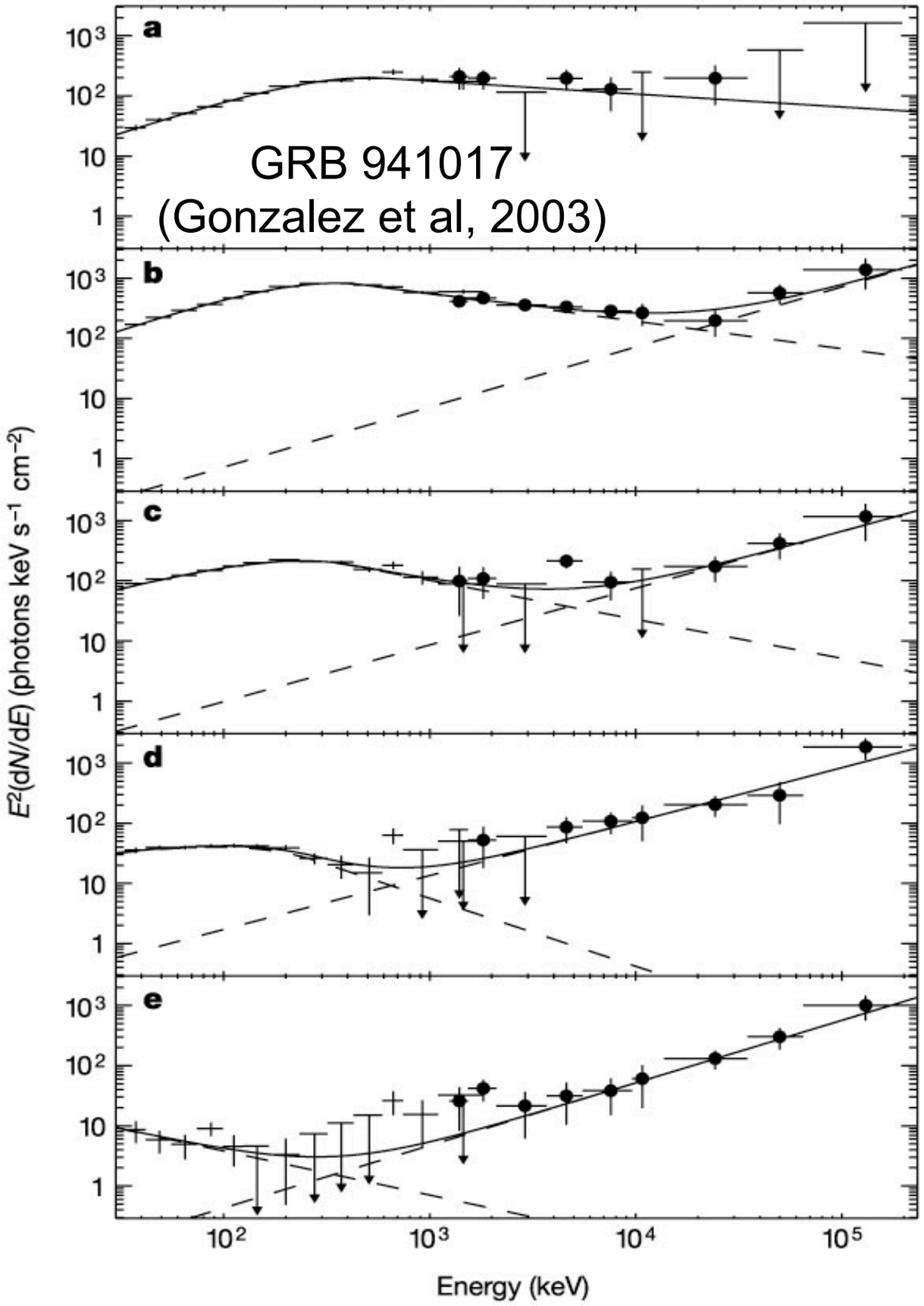


Peak energy of the GRB

What causes a gamma ray burst?

- Long and short bursts have slightly different origins
- caused by the collapse of a massive star (long) or the merger of 2 stellar remnants (short) to a black hole and an accretion disk
- long bursts occur in star-forming regions in a galaxy
- gamma rays are emitted in beamed jets





- Previous high energy observations (EGRET on CGRO) showed extended high energy emission
- What processes are involved?
- Possibly inverse Compton scattering: synchrotron photons scattered by relativistic electrons
- or hadronic - pion decays following the photo-pion interaction of ultrarelativistic hadrons

Instruments on *Fermi*

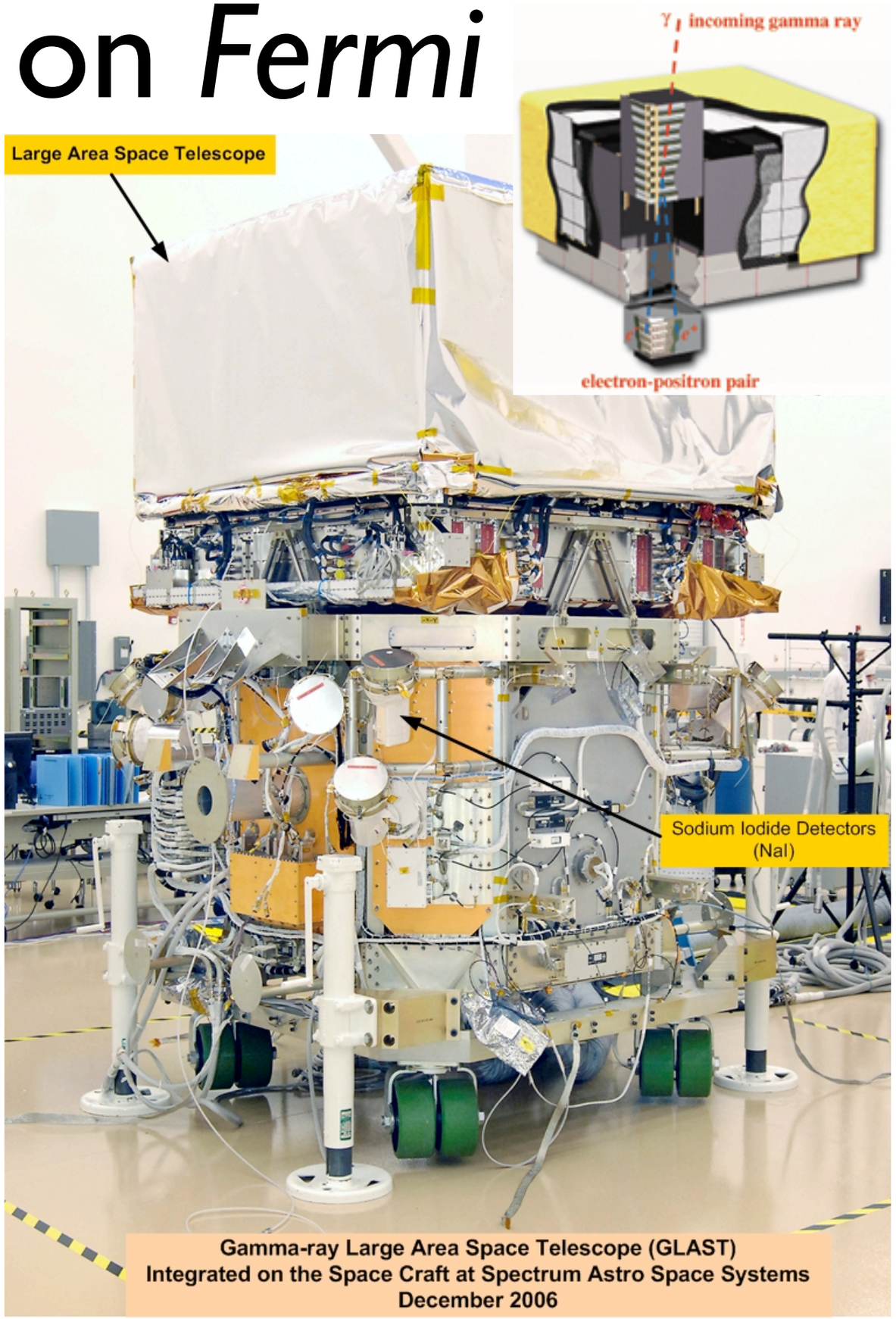
(See also: earlier talk by C. Meurer)

- Formerly known as *GLAST* (Gamma-ray Large Area Space Telescope), renamed *Fermi* after launch

- Large Area Telescope (LAT): energy range 20 MeV - 300 GeV, 4x4 tracker array with calorimeters

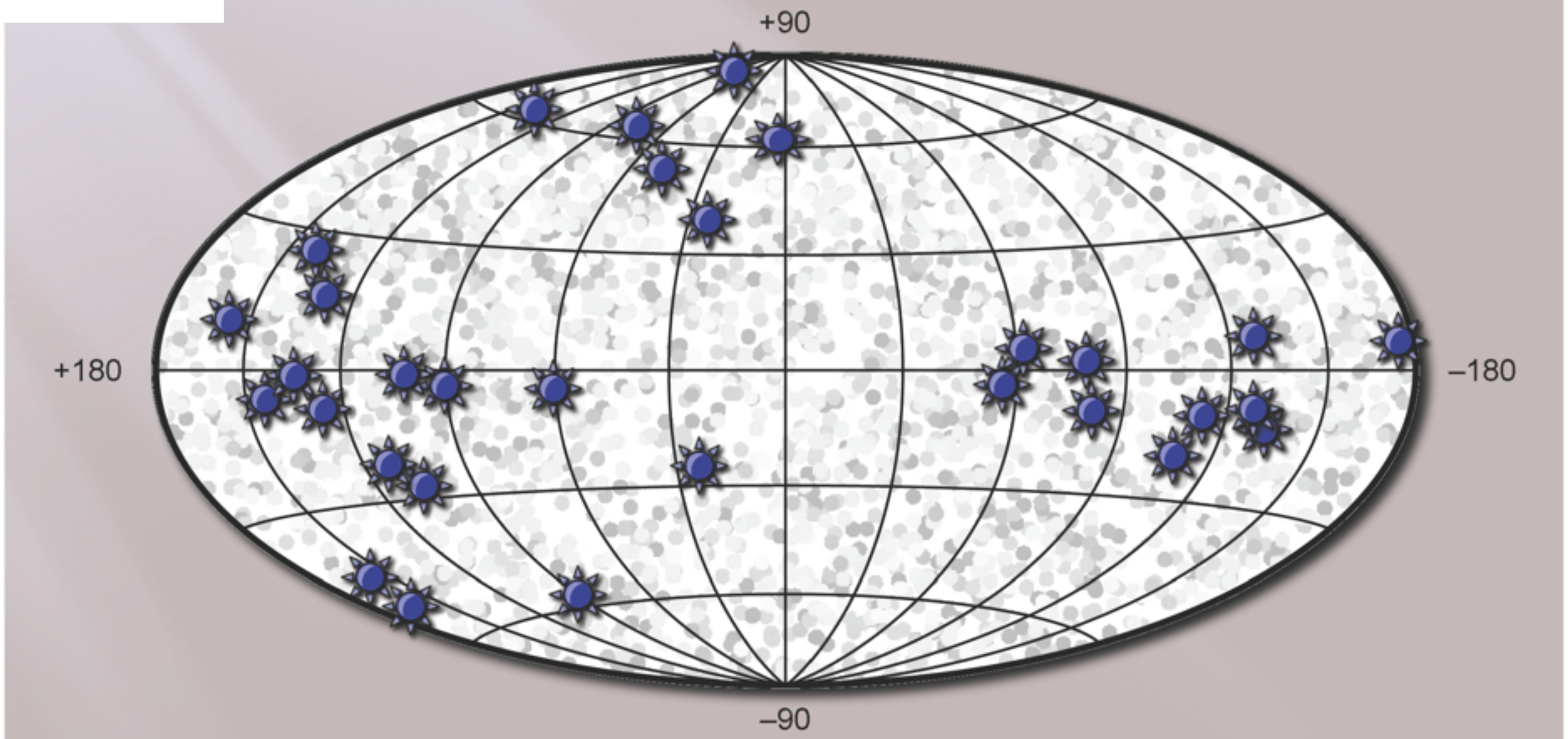
- Gamma Ray Burst Monitor (GBM): energy range 8 keV - 30 MeV, 12 NaI/ 2 BGO scintillator detectors

- Both instruments can be triggered by a GRB, but currently only GBM trigger is operational

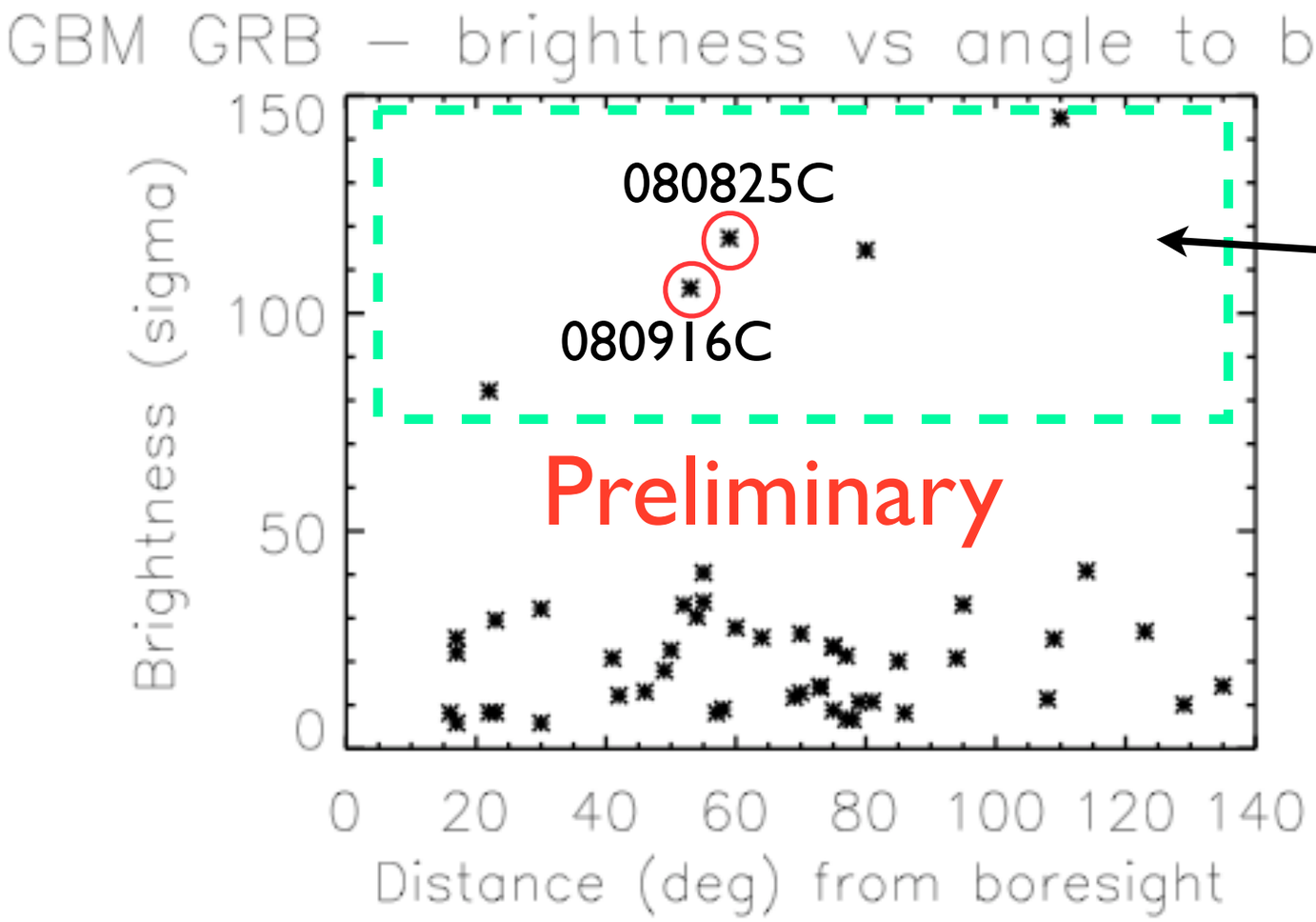


Fermi
Gamma-ray
Space Telescope

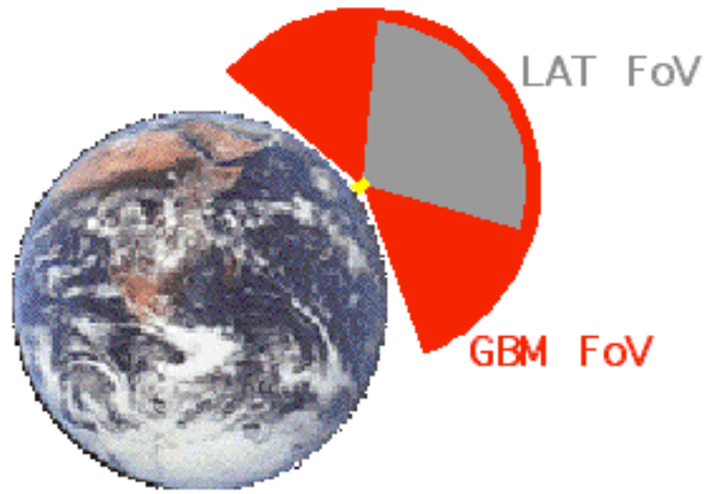
GBM Spots Gamma Ray Bursts Daily



- 31 GRBs seen in first month of operations
- Activation phase complete; all working well
- Sensitivity as predicted
- GRB locations within a few degrees of Swift calculations



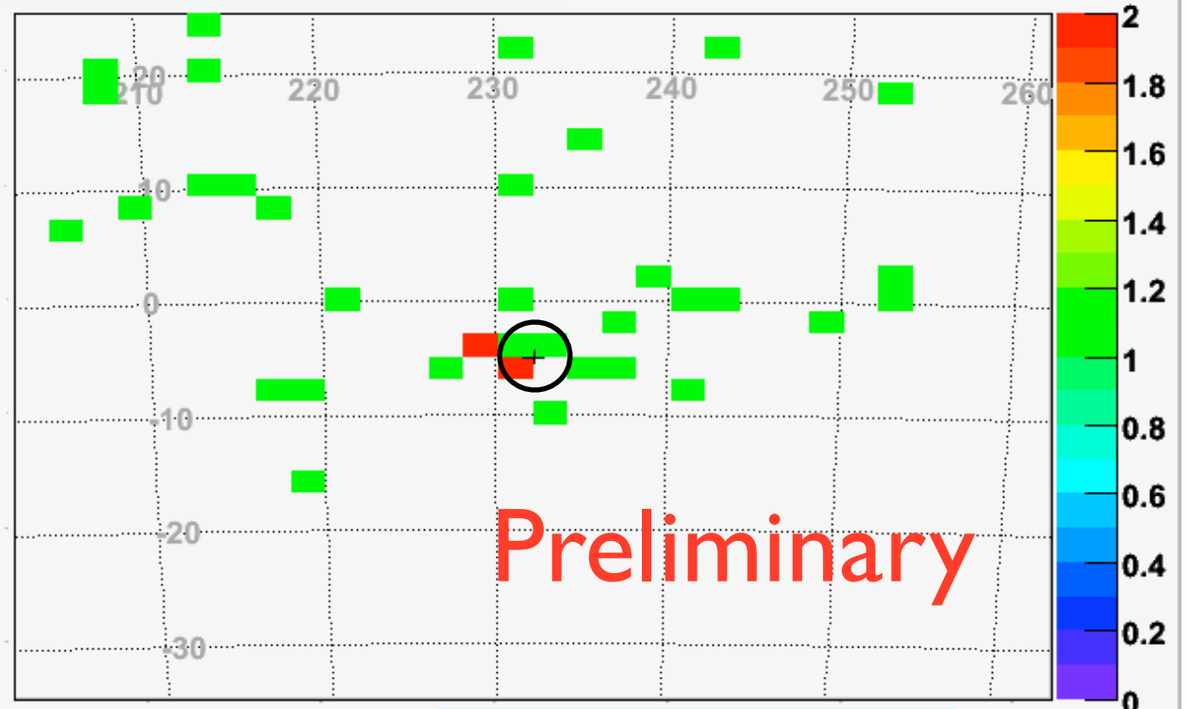
Bright bursts, expect LAT to see these



- Several GBM bursts too far off axis for LAT to see
- LAT has observed 2 bursts so far, 080825c and 0809l6c, out of ~70 GBM triggers in total

GRBs observed by LAT

080825c counts map



GBM location in circle

[080825c:](#)

RA = 232.2, Dec = -4.6 deg

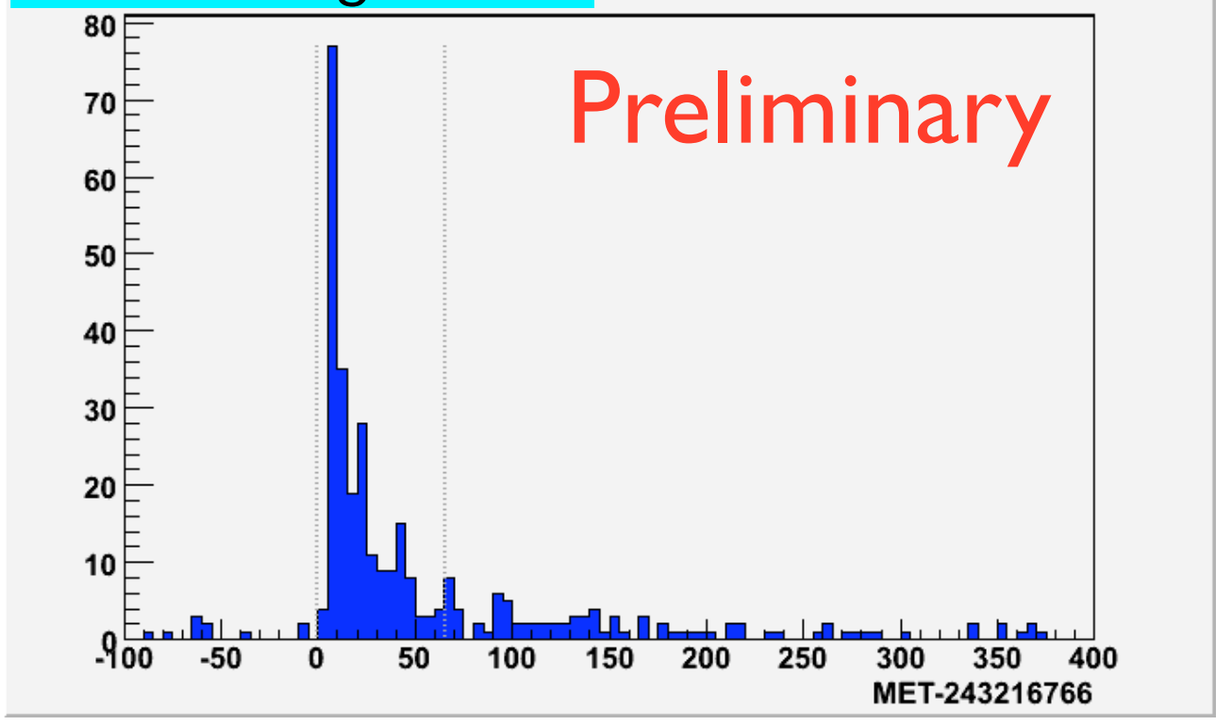
~ 20 photons seen in LAT

[080916c:](#)

RA = 119.9, Dec = -56.6 deg

Enough counts to perform time-resolved spectral analysis

080916c lightcurve



Timeline

We are ~here

LAT, GBM turn-on check out

"first light" whole sky

spacecraft turn-on checkout

Observatory renaming

pointed + sky survey tuning

Start Year 1 Science Ops

Start Year 2 Science Ops

sky survey + ~weekly GRB repoints + extraordinary TOOs

week | week | week | week | month | 12 months

LAUNCH

L+60 days

2nd GLAST Symposium

initial tuning/calibrations

in-depth instrument studies

Tuning LAT hardware, on-board selection, on-ground event reconstruction, background rejection, Measure LAT response function

Release Flaring and Source monitoring

GBM and LAT GRB Alerts

photon data as processed

GI Cycle 1 Funds Release

Fellows Year 1 Start

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LAT 6-month high-confidence sources, GSSC science tools advance release

LAT 1 Year photons + catalog + interstellar model

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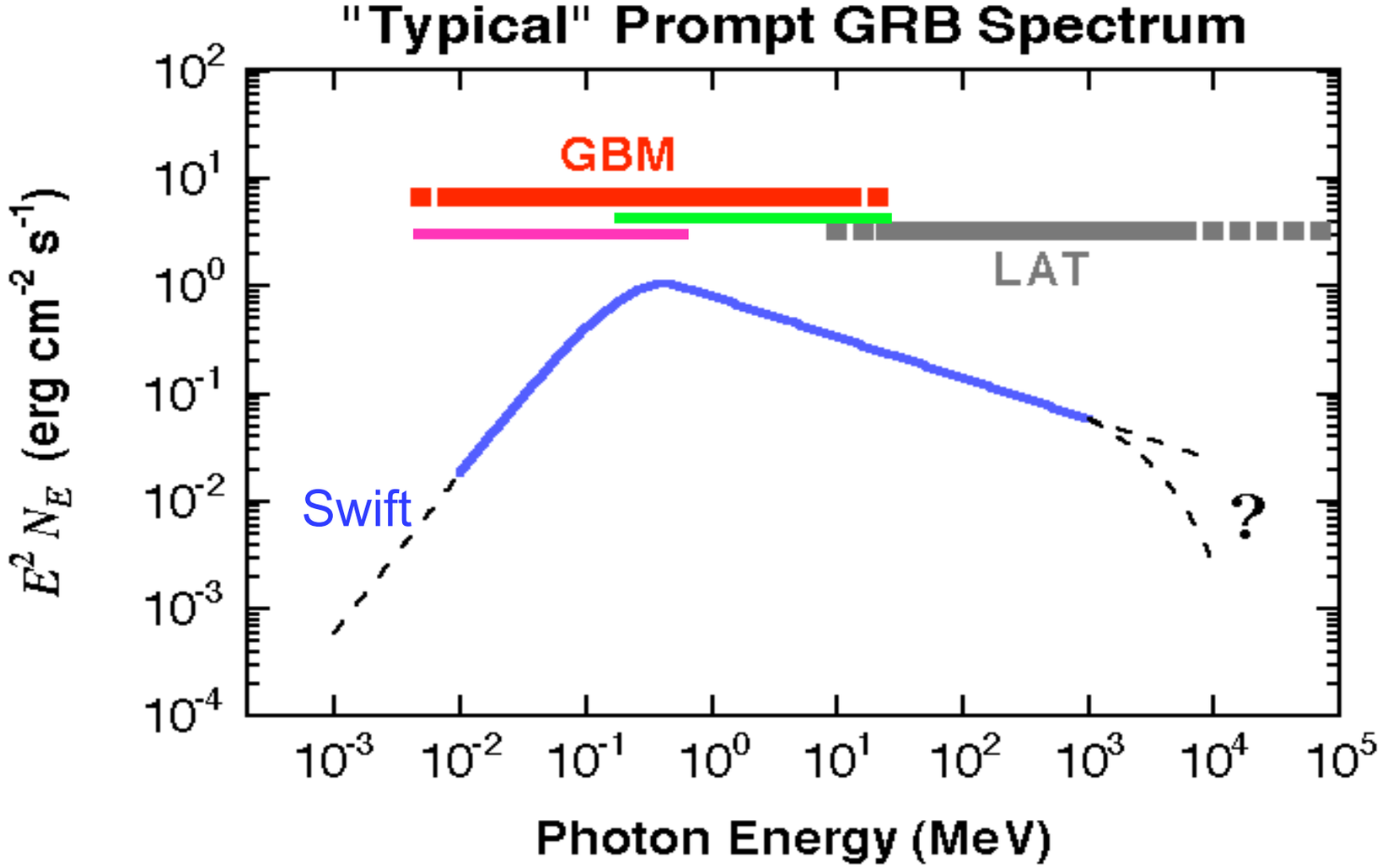
Conclusions:

- Instruments working extremely well so far
- 2 GRBs observed with LAT to date, more expected!
- More systematic testing needed, event selections, optimisation of background selection etc
- Many exciting results to come...



- *Fermi* is able to detect emission from the prompt and afterglow phase of GRBs
- Can follow up high energy emission of GRBs from other instruments, joint spectrum over 7 decades of energy
- High resolution at very high energies - helps to constrain spectral models & emission mechanisms