GAMMA-RAY BURSTS

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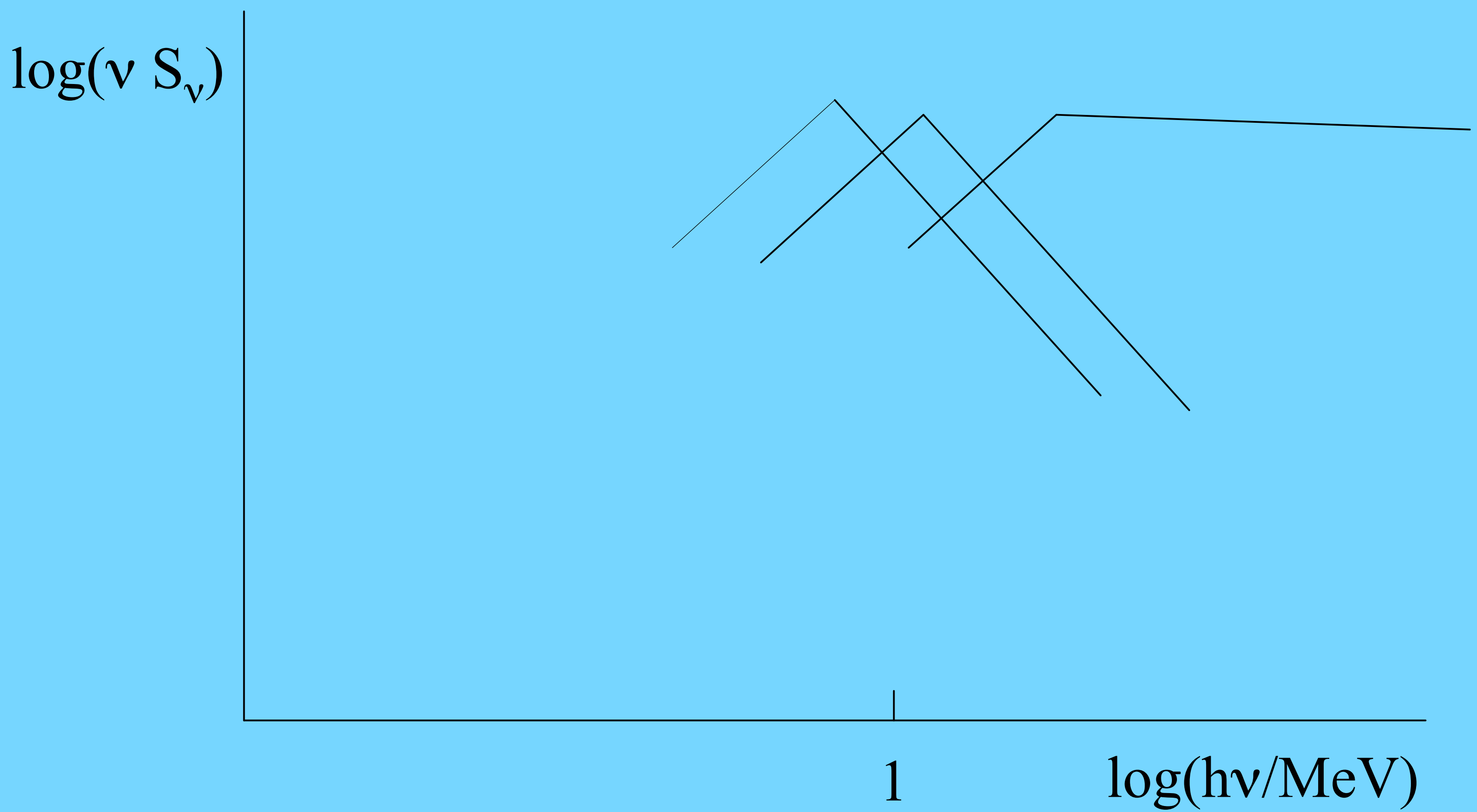
HISTORY

- FIRST DETECTION: 2 July 1967
- FIRST CONFERENCE: X-mas 1974
- FIRST REPEATER: 5 March 1979
- CONSENSUS (1980s): Galactic n**
- PRESENT MODELS: Fusing binary neutron stars or black holes at cosmic distances, without further detail
- PREFERRED MODEL: as during 80s

Burst Spectra



CONSTRAINTS

- No Pair Formation at Source: d < 10 kpc $/\sqrt{S_{-6}}$
- Neutron-star Energetics: d < kpc $\gamma\ \sqrt{L_{38}}$
- Afterglow Brightness (at low $\wp$): d < kpc $\sqrt{S_{-4}}$
- Modest Proper Motion of SGR (& radio lobe): d ℵ 30pc
- Tolerable Luminosity of SGR (k-Eddington): d ℵ 30pc
- Resolved X-ray Afterglow (growing concentric rings)!?
- No Long-Distance travel signatures!? [Mitrofanov, 96]
- ∃ Pre- and Post-cursors (offset by ℵ hour)!?

CONSTRAINTS ctd.

- Accreting Galactic dead-pulsar population should be detected (10^{-17} $M_{|}$/yr n*) !
- Thin-shell energy distribution: $\langle d_{max}/d_{min} \rangle = 2$!
- No-Host dilemma: Brad Schaefer et al, [97, 99]
- Brightness Excess at high z (ℵ 7): B. Schaefer [07]
- Hardness Excess (ℵ 10^{13} eV) !
- Duration Excess (ℵ hour) !
- Afterglow Brightnesses are z-independent !?
- L(afterglow) ≈ L(prompt): no beaming ?!

CONSTRAINTS ctd.

- X-ray Afterglows don´t evolve (increasing ionization!)
- X-ray Afterglows can fade slowly ($\aleph$125 d) !
- All host galaxies are peculiar, as a class !
- No Orphan Afterglows have been detected !
- Cavallo-Fabian-Rees limit on $\Delta L/\Delta t$
- L(after)/L(prompt) $\Im$ 1 for GRB 060729 !
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References

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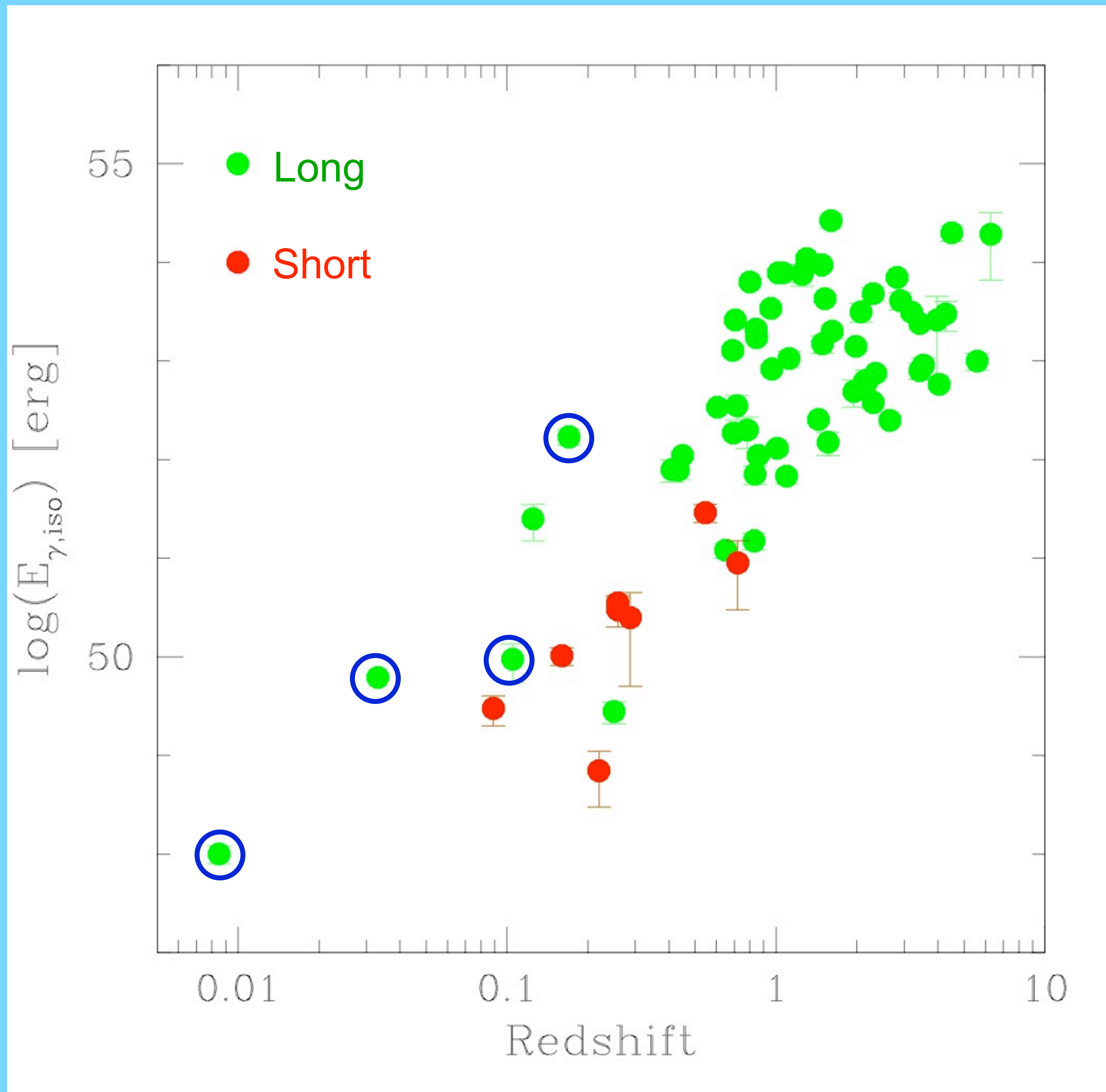
Long
Short
55
50
log(E_γ,iso) [erg]
0.01
0.1
1
10
Redshift

PREFERRED MODEL

- Most GRBs come from (n*s at distances) $d \in (0.1 , 0.2)$ kpc.
- The nearest bursts, the SGRs, have distances $d \Im 10$ pc.
- The GRBs are emitted by throttled pulsars, whose magnetosphere is deeply indented by a low-mass accretion disk assembled from its CSM. These disks tend to be $\perp$ the Milky Way. Their (anisotropic) emissions – by ricocheting, accreting `blades´ – peak near their disk plane, strengthening an isotropic appearance of the bursts in the sky.
- The afterglows are light echos, or transient reflection nebulae.
- Centrifugally ejected ion clouds escape transluminally, and show up redshifted in absorption (due to the transverse Doppler effect). In extreme cases of large mass ejections (at small speeds), the afterglows can look like SN shells, by acting as photon bags.

PREFERRED MODEL, ctd.

- The short GRBs, of peak duration < 2 sec, result by accretion of a single blob (blade), of size of a terrestrial mountain; they are modulated by the throttled pulsar's spin (of period 5s to 10s), and soften and tail off within some 10^2 sec.
- The long GRBs are superpositions of short GRBs, cf. the July 1994 accretion by Jupiter of comet Shoemaker-Levy.
- Occasionally, accretion onto a throttled pulsar can trigger additional high-energy activities, of much longer duration (than 10^2 sec).