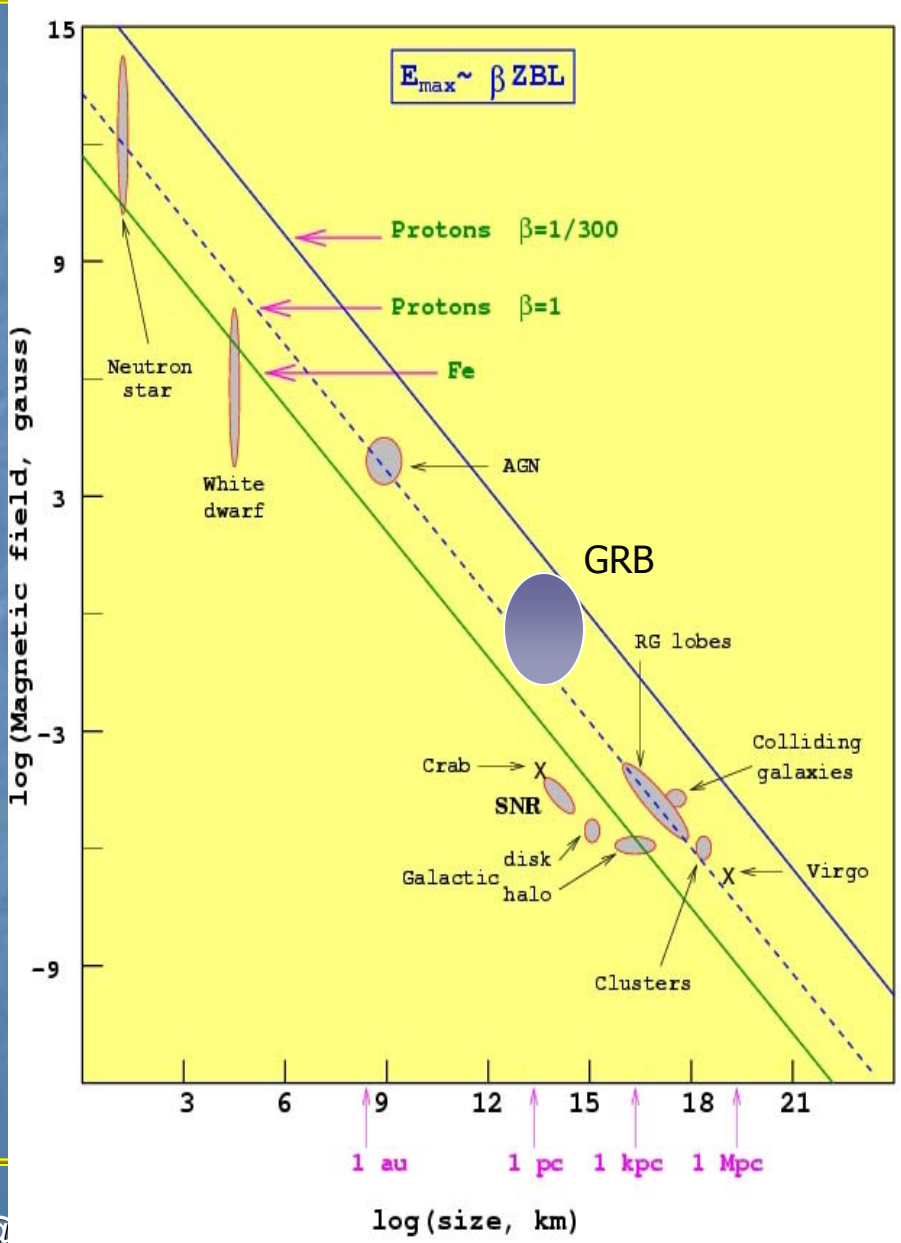
Various GRB Stuff

- Theories about Magda's burst and implications for Milagro
- IPN bursts from GCN Circulars
- New way to think about Milagro sensitivity
- SWIFT Proposal

Ultra-High Energy Cosmic Rays

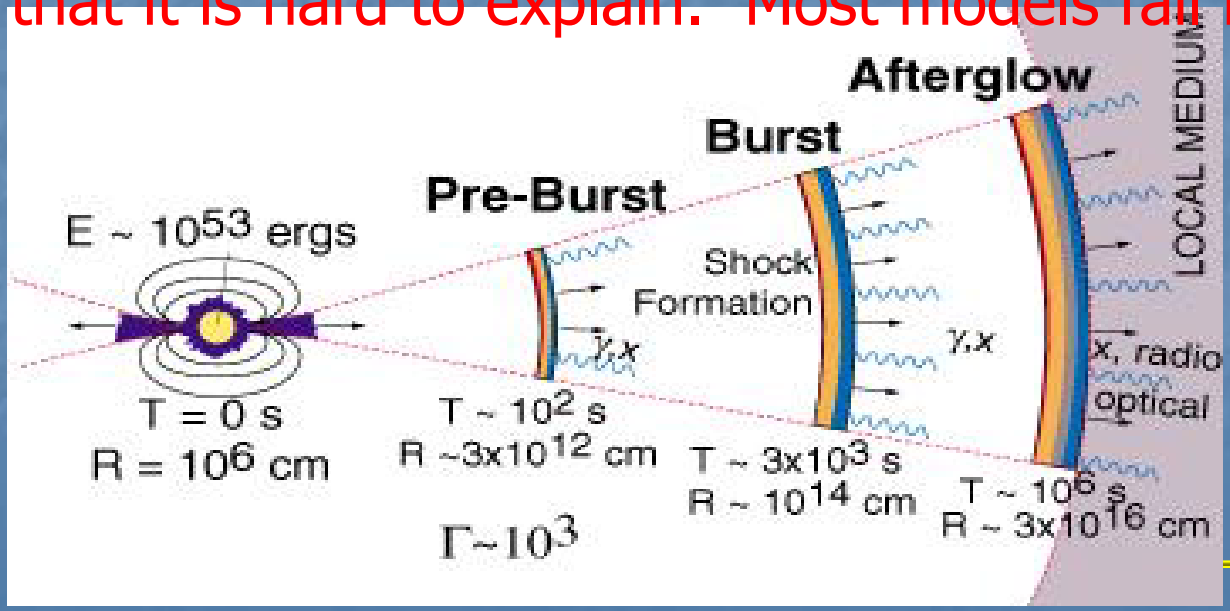
- Difficult to have the same particles producing the two different time signatures of the two components
- GRBs have capability to accelerate UHECR
- Dermer & Atoyan (soon to be on astro-ph)
  - $p(>10^{16}$ eV) + γ -> n (~same energy as p) + …
  - $n(>10^{16}$ eV) + γ -> π -> μ -> e (~ 5% energy of π)
  - Electron synchrotron radiates ASAP so still in jet angle
  - Produces E^{-1} differential photon spectrum up to ~100 MeV independent of B field and $E^{-1.5}$ above 100 MeV



Reverse Shocks

Granot & Guetta (astroph and accepted in ApJ)

- Higher Energy Component due to Synchrotron Self Compton of Reverse Shock
- Lower Energy Component due to Synchrotron Self Compton of Forward Shock in contrast with most GRBs that are believed to be due to synchrotron not SSC
- Therefore this type of emission is rare
- "… find that it is hard to explain. Most models fail badly."

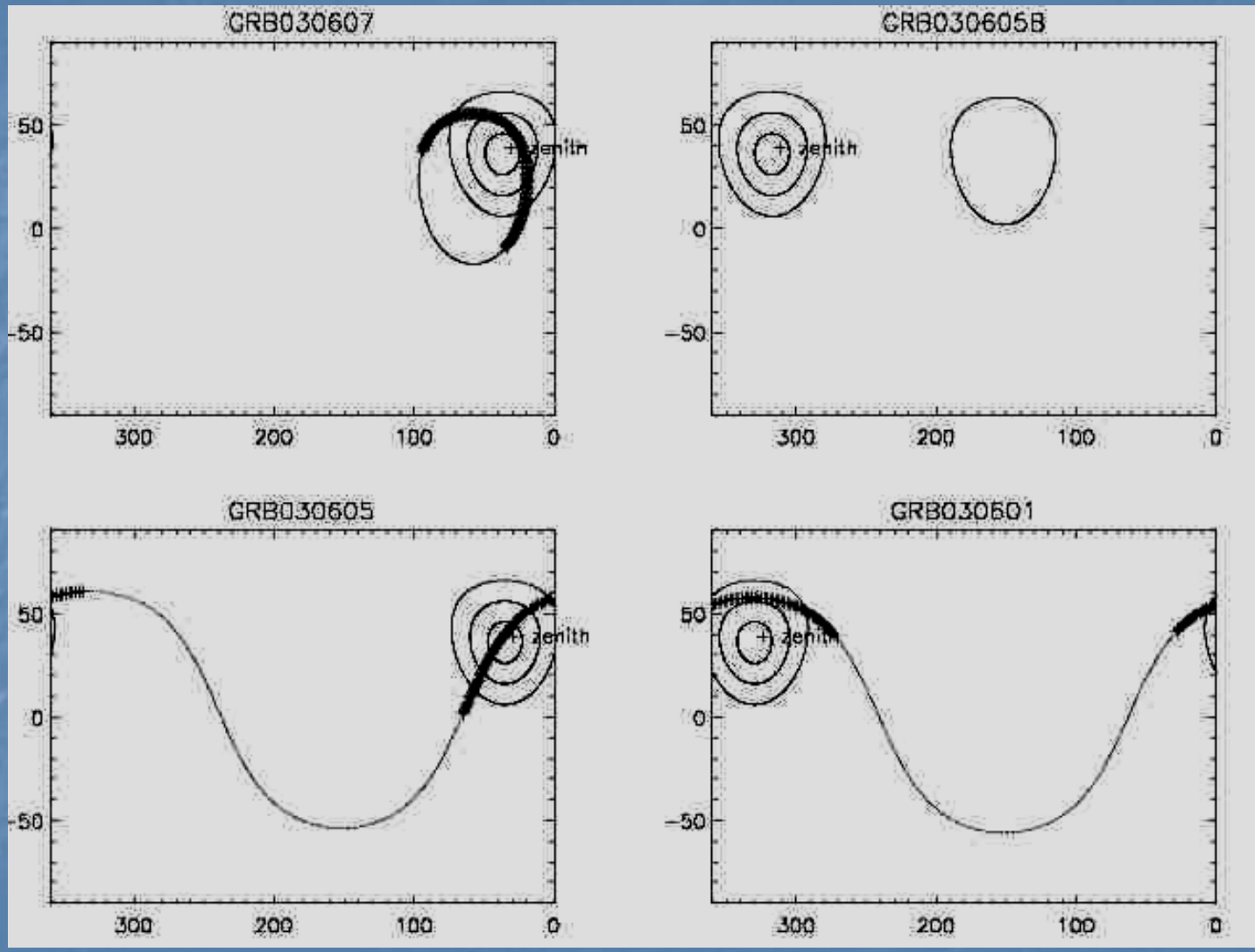


IPN Bursts

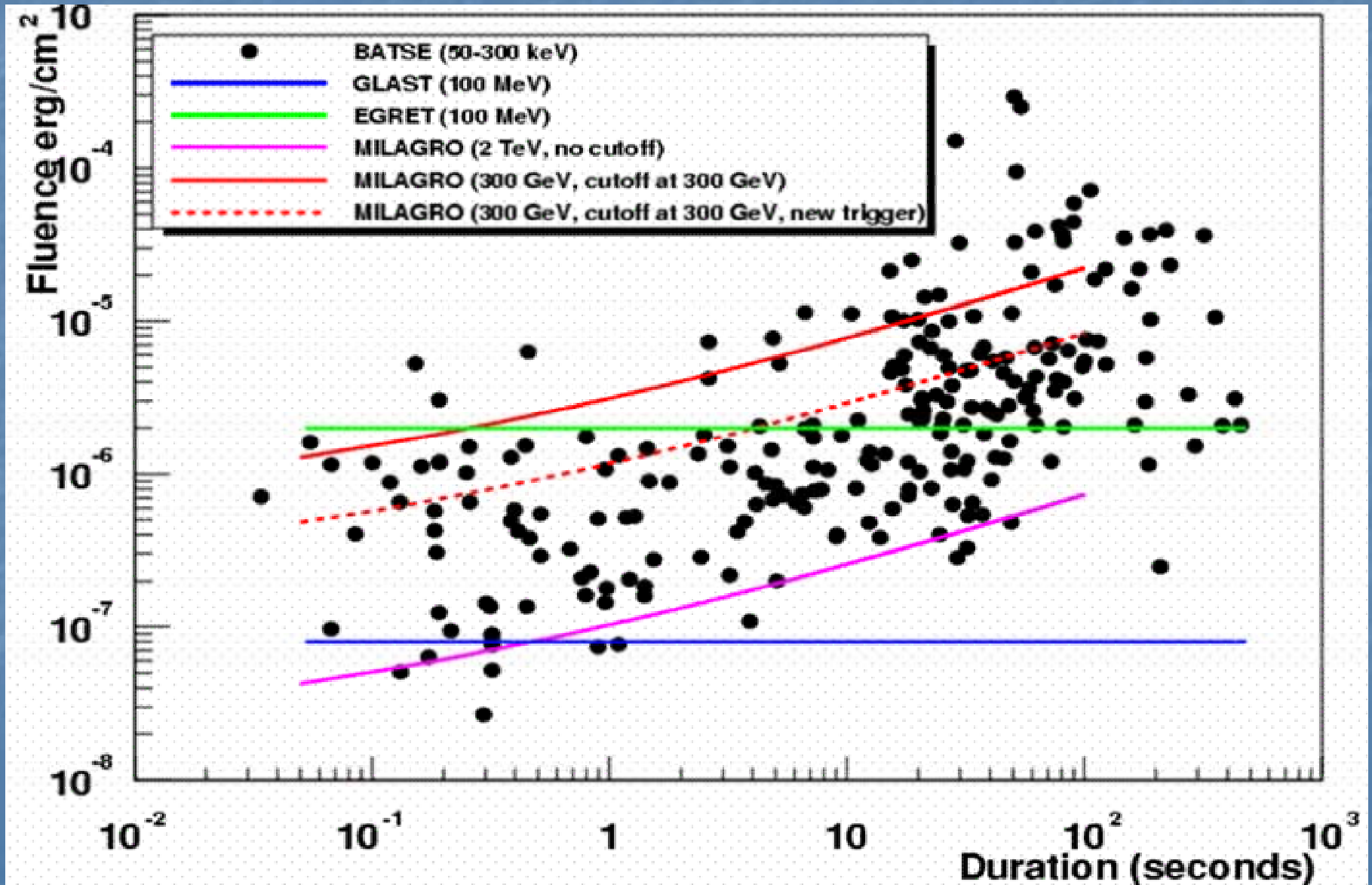
- Announced in nonparsable format via GCN circulars (not GCN Notices)
- Typically a few days late due to travel time from satellite to Earth
- Arc positions ~ 2-3 week of which ~ half intersect Milagro fov with a region of typically 40º x 0.1º or 4 square degrees
- Error boxes of order 1 square degree ~ 2-3 /year

Example of IPN Arcs

- RA and Dec plot of IPN arc and Milagro's 0, 10, 20, and 30° from zenith region
- Many IPN arcs are restricted due to Earth blockage, but this isn't always announced, but can be obtained if we find an interesting burst

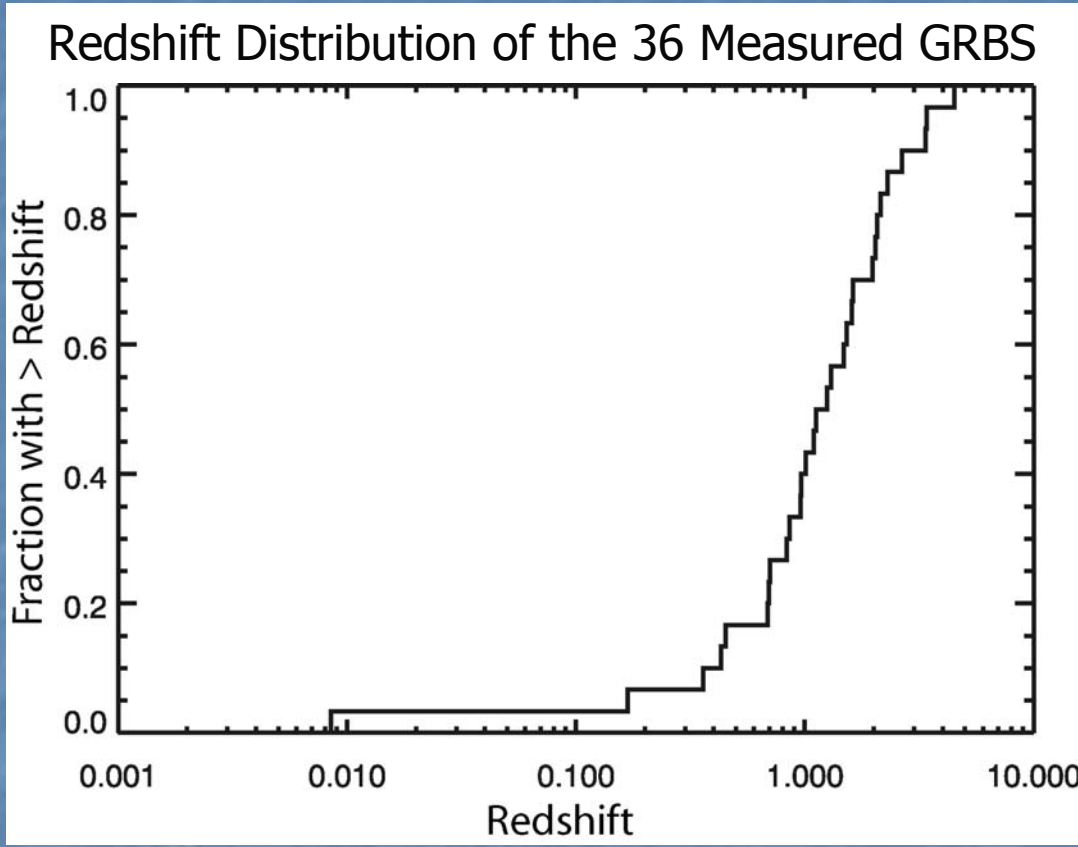


Milagro Burst Sensitivity



Are GRBs near enough?

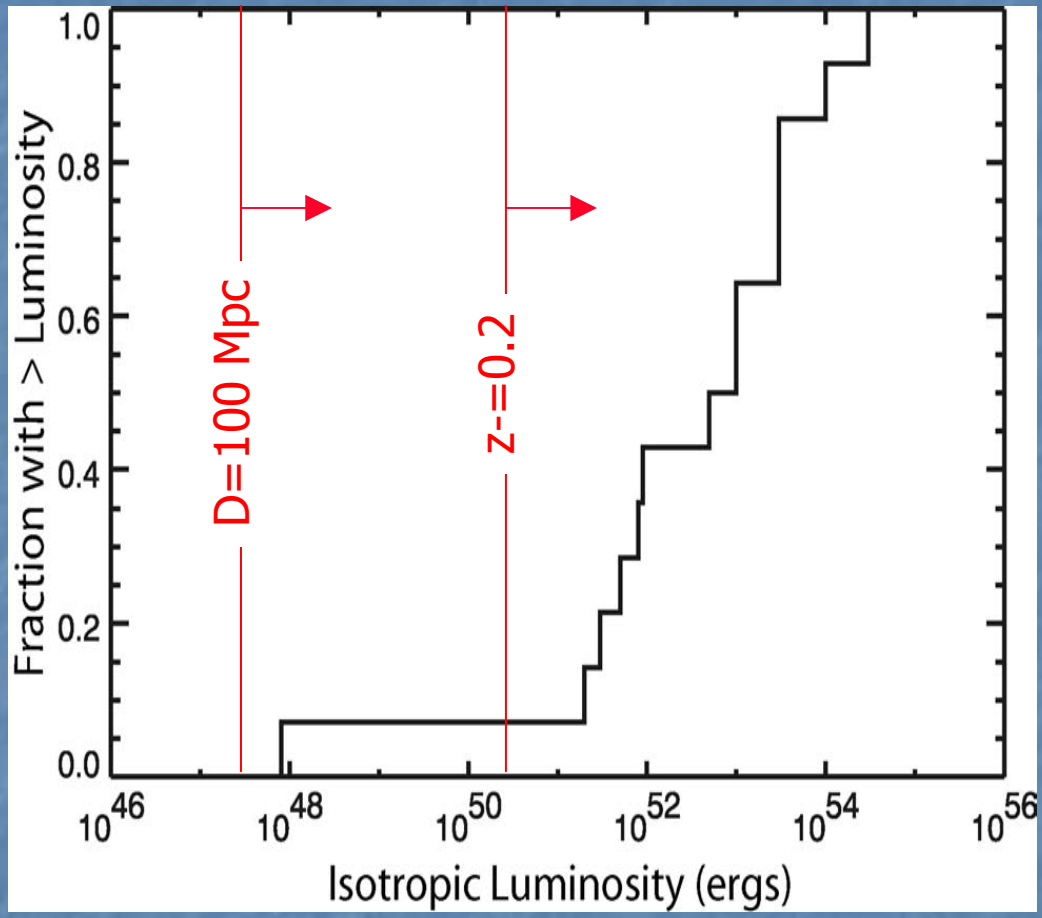
- % of GRBs near enough for TeV observations is uncertain
- Plus more than one population of GRB sources may exist with different distance distributions
  - Short bursts are likely different astrophysical sources
  - Also, population of long bursts in the SuperGalactic plane



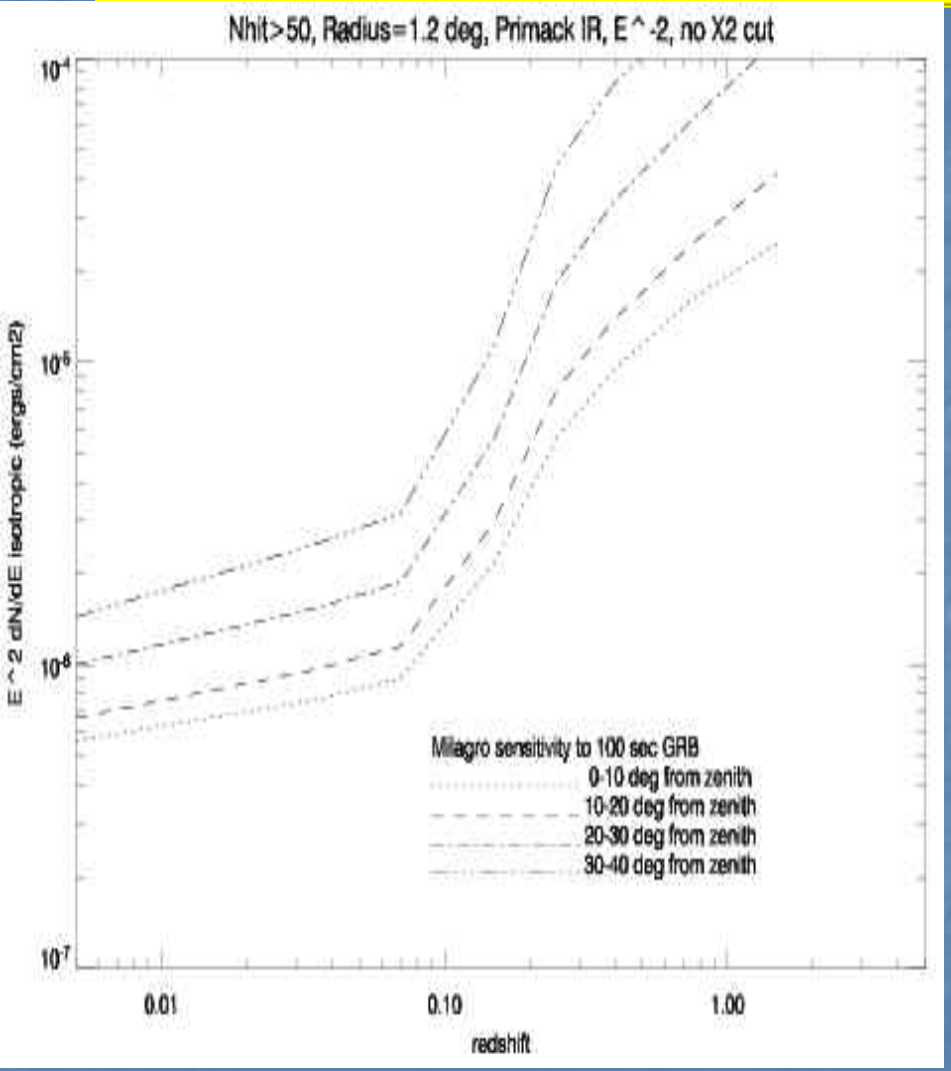
Milagro Fluence Sensitivity

- At **z=0.2** most of the γ-ray flux is attenuated above 300 GeV, so in order for Milagro to not detect a **10 second** GRB, the fluence must be **$<3\times10^{-6}$ ergs/cm^2** and isotropic energy of **$< 3\times10^{50}$ ergs**

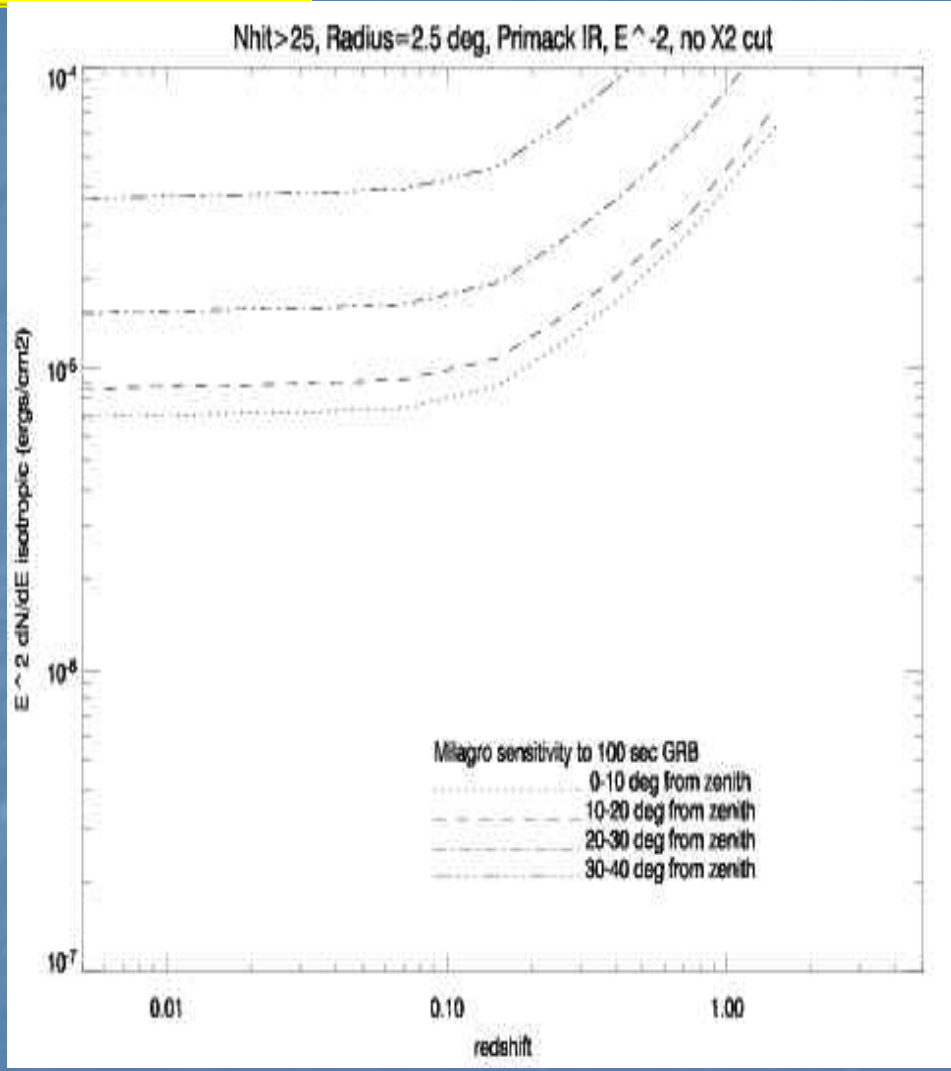
- Nearby bursts are not attenuated by extragalactic background light so the TeV fluence is **$<3\times10^{-7}$ ergs/cm^2** and the isotropic energy is **$<4\times10^{47}$ ergs** at a distance of **0.1 Gpc**



Milagro Fluence Sensitivity vs Redshift

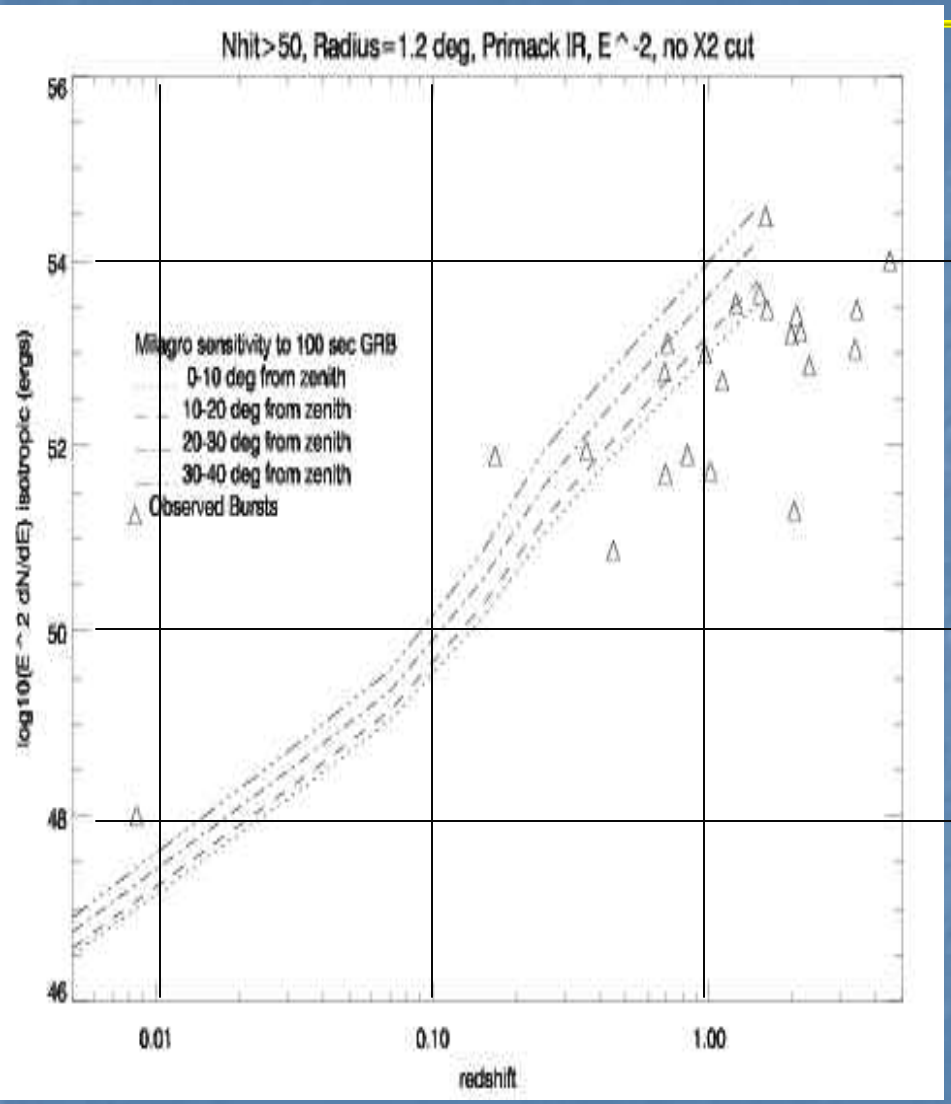


0.1 to 100 TeV

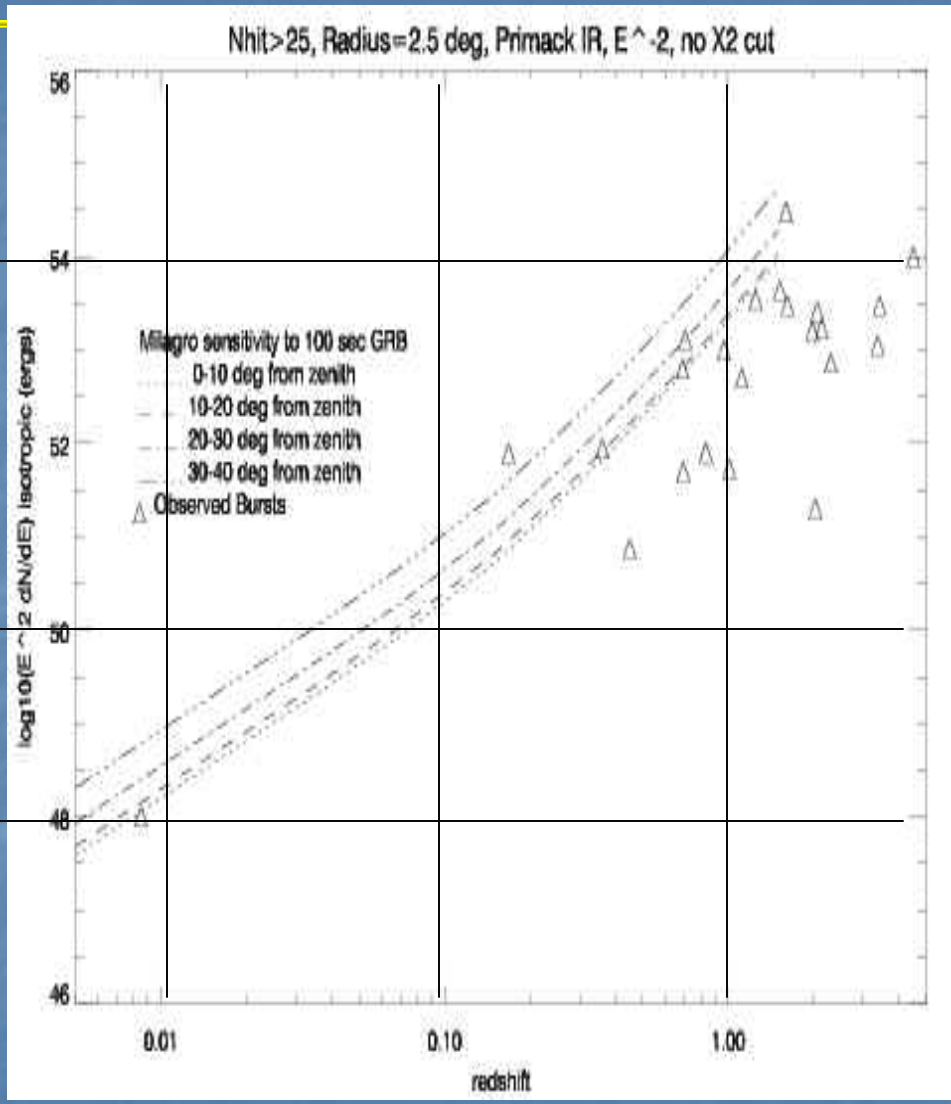


0.05 to 0.5 TeV

Milagro Luminosity Sensitivity vs Redshift



0.1 to 100 TeV



0.05 to 0.5 TeV

SWIFT Proposal

- Due December 1
- ~30 proposals will be accepted with $1M combined funds
- Propose Milagro observations of SWIFT GRBs
- Search T90 and longer times (we need to predefine this search)
- Mention we have own search and will approach PI (Neil Gehrels) for SWIFT observations of improbable event
- Outline of 4-5 page proposal

I. Scientific Motivation

TeV constrains models, Magda's burst, IR absorption

II. Technical

Milagro sensitivity, Analysis technique, Rapid Alert

I. Management

Funds (~$30K) for personnel