Summary: the Gamma-ray Perspective

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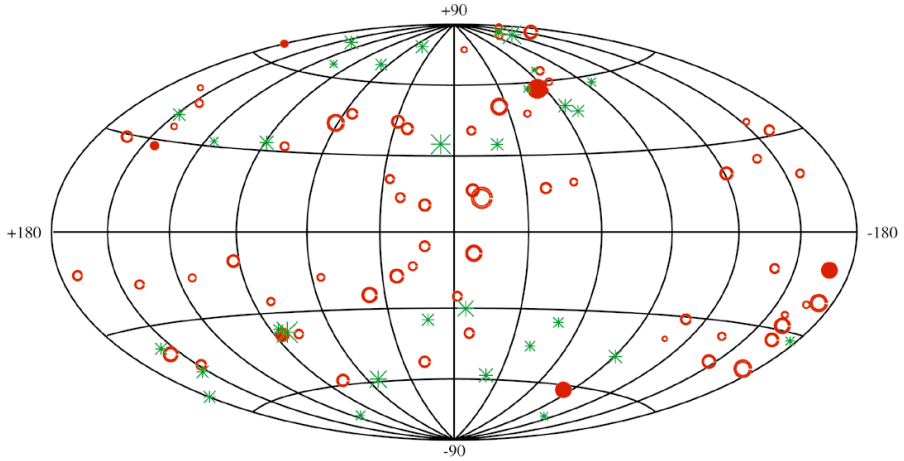
EGRET Gamma-ray observations

- Lots of blazars seen
- Highly variable (factors of 50-100 with doubling/halving times as short as 3-8 hours)
- Some blazars were less variable than others (e.g. 0208-512 and 3C 454.3*)



○ = EGRET blazars seen sometimes

● = EGRET blazars seen always

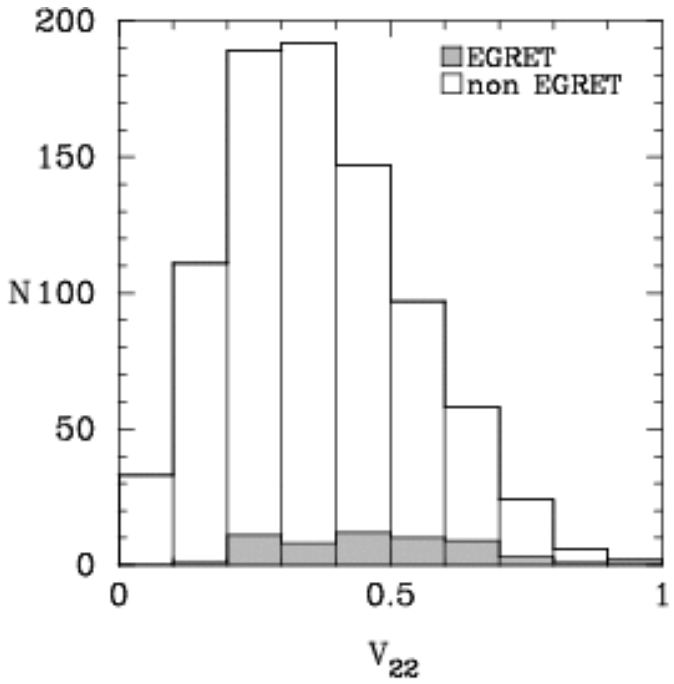
Radio observations of AGN

- Morphology
- Polarization
- Monitoring flux and spectrum

- All of these have been related to the EGRET gamma-ray data, either in population studies (to explore what makes a blazar bright in gamma-rays) or relating radio activity to gamma-ray flares.

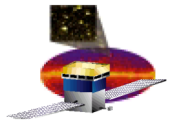
Population studies

- EGRET blazars have
  - faster jets
  - Brighter jet components
  - higher average polarization
  - More variable
  - More compact
  - Harder radio spectra
- Blazars simply classified into gamma-ray bright or not (for correlations studies between gamma-ray and radio properties).



EGRET Gamma-ray flares

- mm wave outburst and superluminal knot ejection occur before peak in gamma-ray flux (Marscher, Valtaoja)
  - Gamma-rays are produced in the knots well beyond broad line emission region
- But not always (Aller)
- Need better sampled data to confirm this.



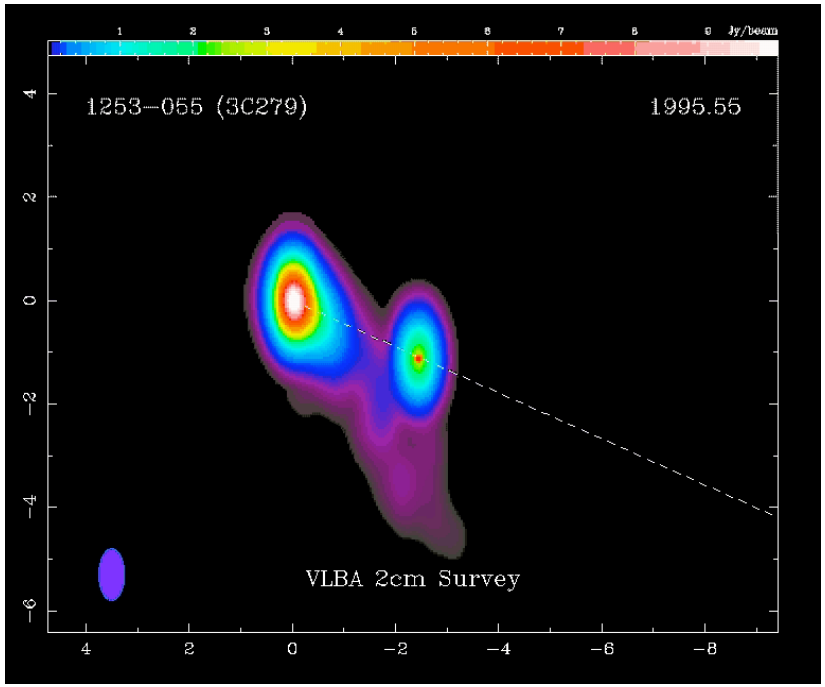
Some thoughts

- **EGRET/radio studies: Very detailed radio data/analysis, fairly simple gamma-ray information**
  - **Was it an EGRET source or not?**
  - **When did gamma-ray flares occur?**
- **Possibly some selection effects/biases in both of these.**
  - **Gamma-ray source id has a built in assumption that flat spectrum radio sources are likely counterparts.**
  - **In some cases ToO gamma-ray observations are triggered when a source is active.**
- **Lots of possibilities for including more detailed gamma-ray properties**

Current radio observations

- **Observations of phenomena that may have implications for the gamma-ray emission**
- **Baseline observations of many objects likely to be GLAST sources**

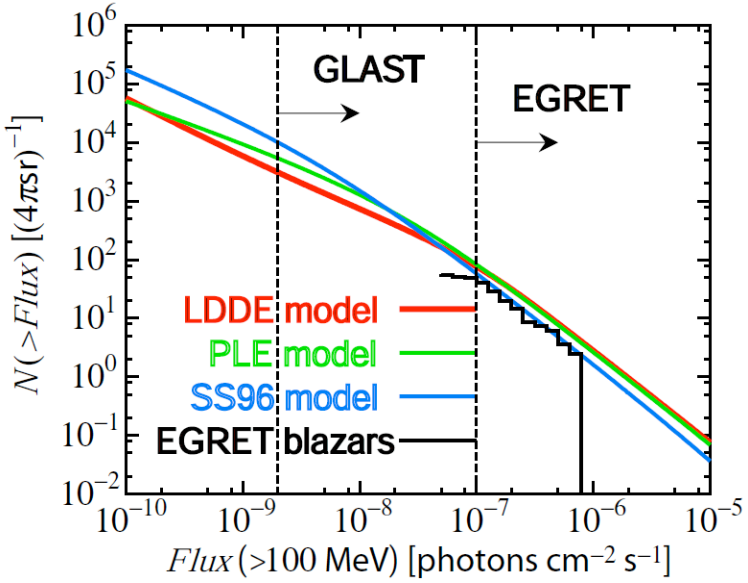
Collimation event



- **Plenty of ideas for new things to look for. (eg circular polarization variations correlated with gamma-ray flux)**
- **Gamma-ray behaviour during "collimation" events.**

GLAST Observations - 1

- **GLAST will provide dramatic improvements in gamma-ray data.**
- **Greater sensitivity**
  - **Thousand(s) more AGN**
  - **More objects detected all the time (greater dynamic range).**
  - **More classes of gamma-ray objects (radio galaxies, seyferts)**



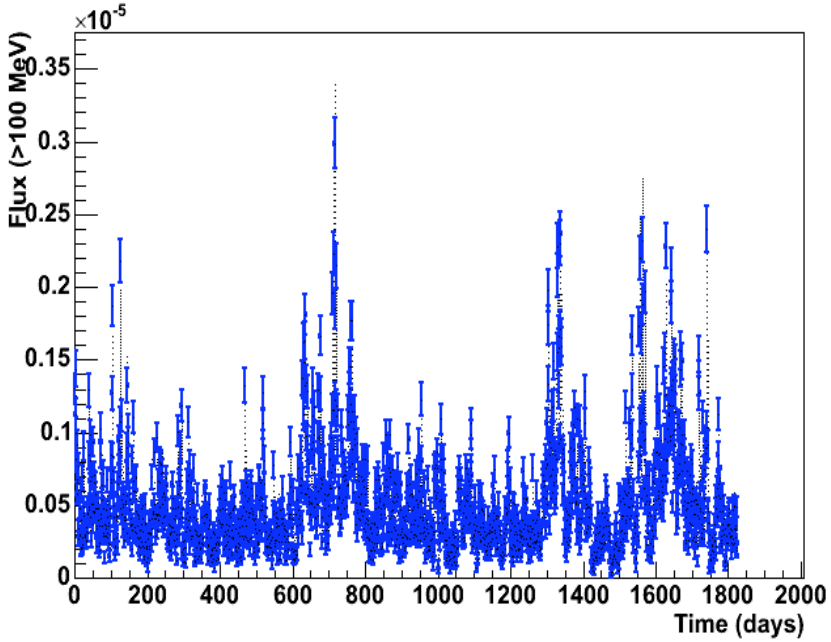
Narumoto and Totani 2005

Much better statistics for population studies

Likely to still be the case that many objects will only be detected during flares.

GLAST Observations - 2

- **GLAST is more than a more sensitive EGRET.**
- **Sky survey mode provides continuous (down to timescales of hours) gamma-ray observations of all objects.**
- **Resolve variability to shorter timescales and fainter fluxes.**

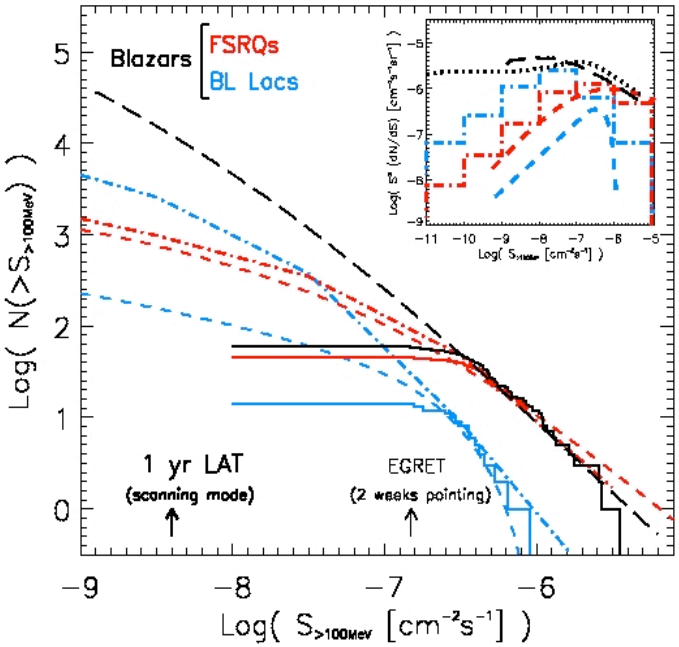


Multiwavelength observations or campaigns involving the LAT only require coordination of the lower frequency data - the LAT data will be waiting.

Can calculate variability indices (and higher level variability parameters such as structure functions) for all objects.

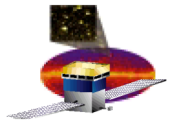
GLAST Observations - 3

- **GLAST LAT has broad energy (frequency) coverage. 20 MeV - >300 GeV (c.f. 30 MeV - 30 GeV with EGRET).**
  - **More fully explore the shape high energy component**
  - **Energy range + increased sensitivity implies that GLAST blazar sample may not be the same as the EGRET sample.**



Time	FSRQ	BLLac
1 d	~60	~15
1 w	150-200	50-150
1 m	250-400	70-500
1 y	800-1000	200-2000

A. Reimer & C. Dermer



GLAST Observations

- **We don't yet know what the GLAST observations will find.**
- **Many more blazars + more gamma-ray info about each one will allow much more sophisticated population studies.**
  - **Gamma-ray selected sample?**
    - **Peak energy of high energy component (c.f. LBL and HBL)**
    - **Average flux (weak/strong)**
    - **Variability (steady/variable)**

MW Info and Coordination

- **Multiwavelength observations are key to many science topics for GLAST.**
  - **GLAST welcomes collaborative efforts from observers at all wavelengths**
    - **The LAT has a single point of contact for multiwavelength coordination.**
    - **For campaigners' information and coordination, see** *http://glast.gsfc.nasa.gov/science/multi*
    - **To be added to the Gamma Ray Multiwavelength Information mailing list, contact Dave Thompson,** *djt@egret.gsfc.nasa.gov*
      - **Feel free to use this list!**

Radio Observations

- **Flux/spectrum monitoring**
  - **OVRO, Effelsberg, Metsahovi, RATAN-600, UMRAO, SMA**
- **VLBI programs**
  - **MOJAVE, VIPS, mm VLBA, Global/EVN/GMVA**
- **Compared with observations in ‘90s:**
  - **Improved sensitivity/capabilities**
  - **More organised campaigns (better sampling)**
- **Lots of variation in #objects, sampling frequency, observation frequency etc**
- **Might be useful to compile a list of who is observing what and with which waveband and sampling frequency (Tosti)**

Challenges

- **We will be faced with a large amount of gamma-ray and radio data.**
  - **Will require organisation, planning and communication to make the most of it.**
  - **Focus on a small number of sources?**
  - **Be prepared to develop an interest in different classes of objects (weak AGN - low luminosity radio galaxies, seyferts; kpc scale jets; HBLs etc)**
  - **Need ways to identify objects that are interesting in radio or gamma-ray wavebands and communicate these to one another.**
  - **The more detailed gamma-ray observations may result in a need for more care in understanding biases.**