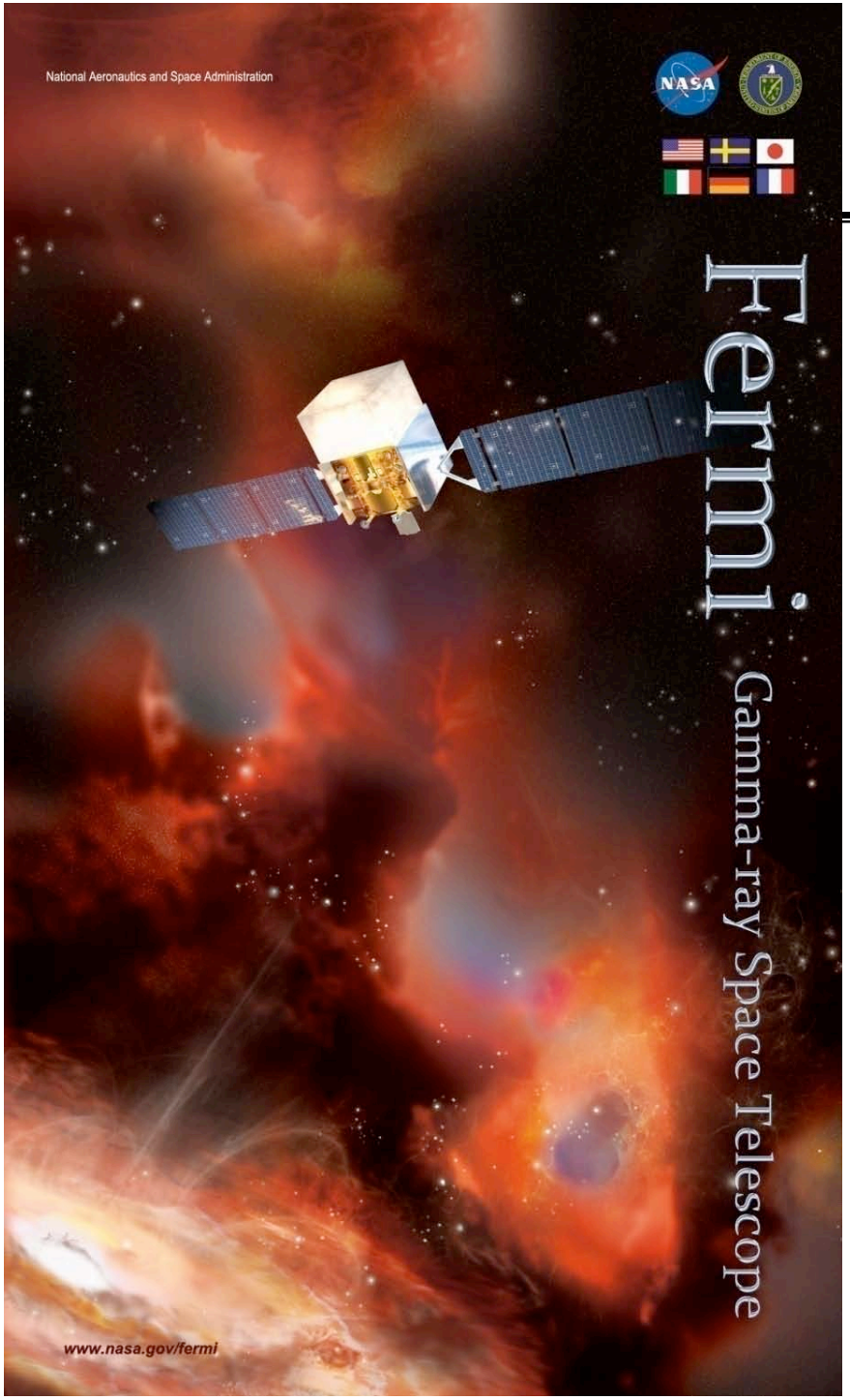
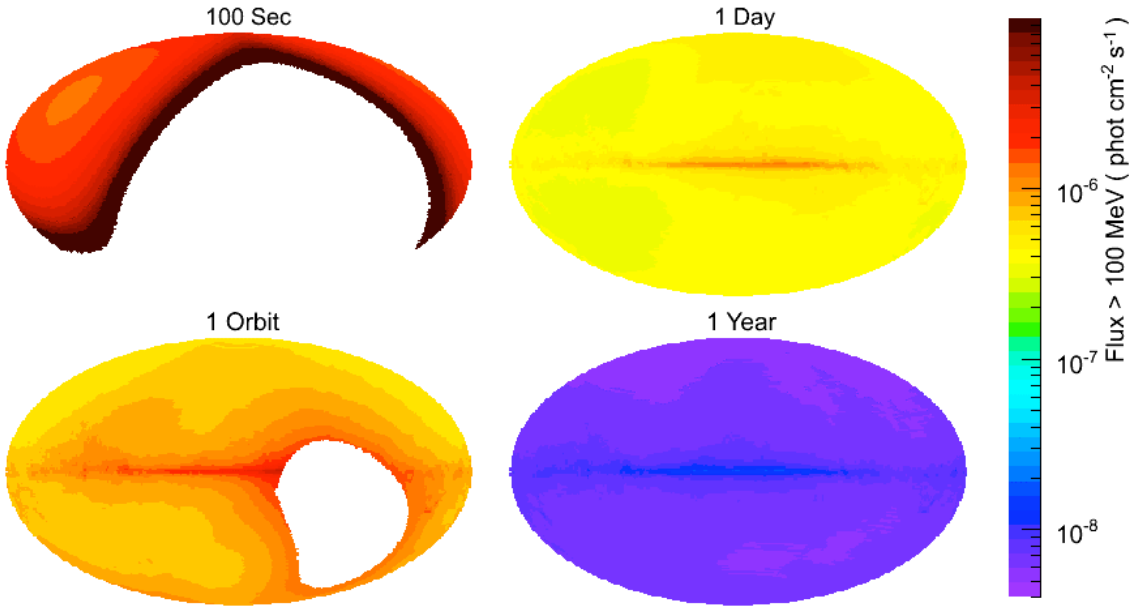


Observing strategies with Fermi

Julie McEnery
NASA/GSFC

Survey mode



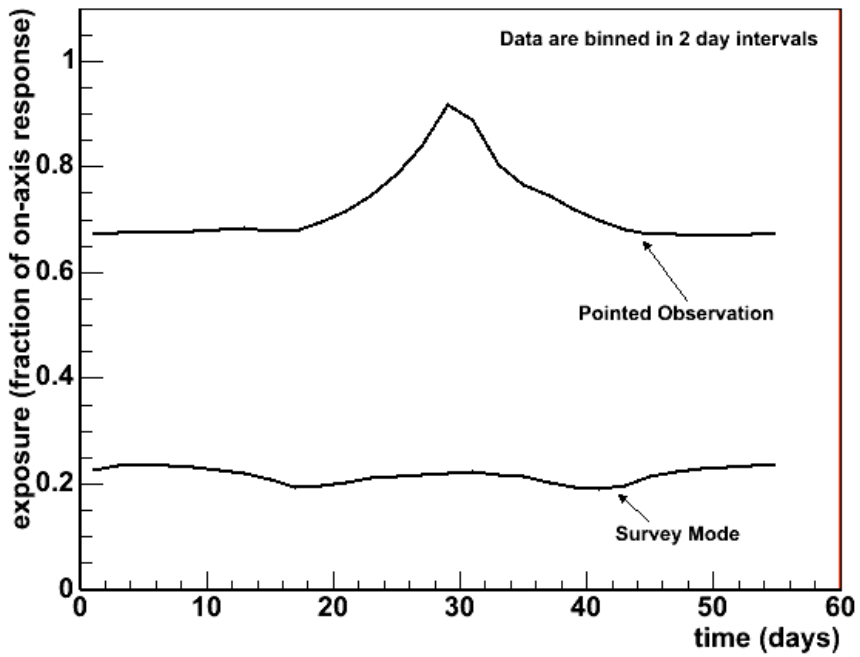
LAT sensitivity on 4 different timescales: 100 s, 1 orbit (96 mins), 1 day and 1 year

- **In survey mode, the LAT observes the entire sky every two orbits (~3 hours), each point on the sky receives ~30 mins exposure during this time.**
- **GBM sees entire unocculted sky.**
- **Multiwavelength observations in coordination with the LAT will be limited only by the ability to coordinate to other observations in other wavebands.**

Pointed mode observations

- **Two kinds of pointed mode observations**
  - **Planned (scheduled or as a ToO)**
  - **Autonomous (in response to an onboard trigger)**
- **The earth covers 30.5% of the sky at any time and 92% over an orbit.**
  - **Nearly all pointed observations will be interrupted by Earth occultation**
- **Pointed observations can provide around a factor of three in exposure (which corresponds to a factor of ~two increase in sensitivity)**

Comparison of 55 day pointed and survey mode observation at the location of Mrk421.



Balance between Survey/pointed

	Frequency (year 1)	Frequency (later years)	Duration	Total to date (as of 1/1/09)
Sky Survey	**> 80%**	**> 70%**		**Default**
Pointed - scheduled	**Early Ops**	**5-20 per year**	**1-few weeks**	**2 weeks**
Pointed - TOO	**Rarely**	**5-20 per year**	**1-few weeks**	**none**
ARR	**~1 per week**	**~1 per week**	**5 hours**	**20 hours**

- **Pointed mode observations provide a relatively modest improvement in sensitivity (factor ~<2) compared with survey mode.**
- **The entire allotment of pointed mode observations does not equal the sensitivity obtained from first year sky survey**
  - **Pointed mode observations are really best justified for time-critical observations.**

Science Cases for pointed mode observations

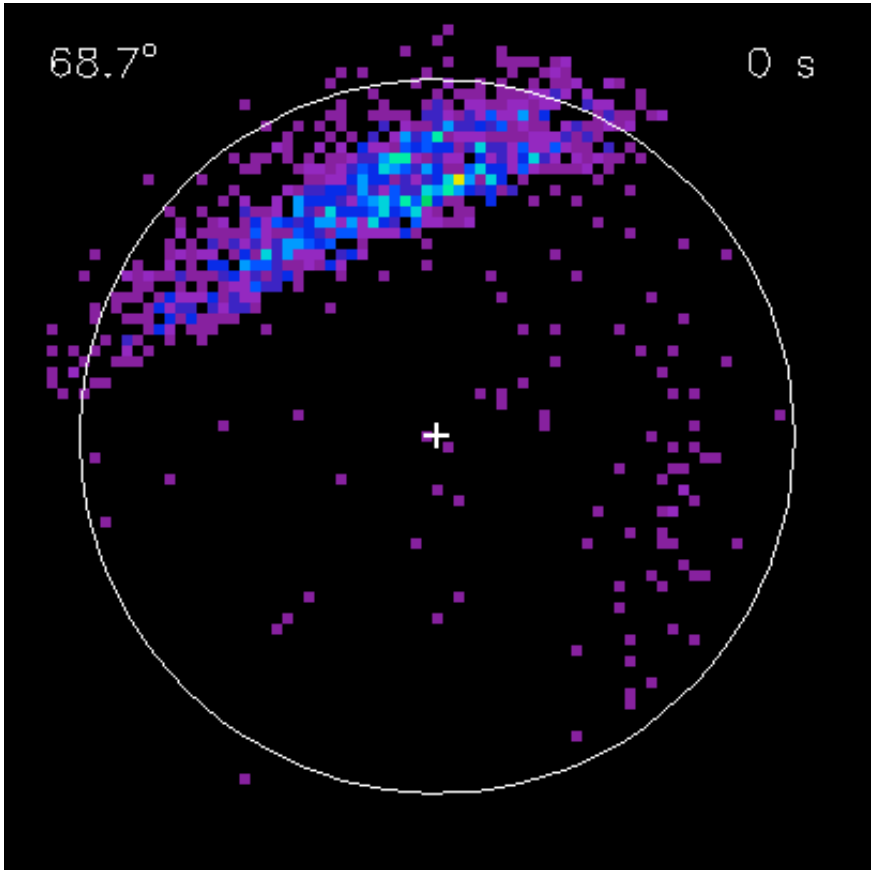
- **Pointed observations to maximize exposure**
  - **Blind pulsation searches for candidate pulsars (eg 1835+59). Collecting the flux needed to determine the pulse period as quickly as possible is good as it minimizes the systematic uncertainly introduced by not knowing pdot, glitches, accurate position etc. (it also reduces the computational power needed to perform the analysis).**
  - **Resolve rapid, low-amplitude flares in AGN. May also help to extend the structure function of selected AGN to smaller timescales.**
- **Pointed observations to maximize time on source (particularly relevant when we are interested in timescales<~3 hours).**
  - **GRB afterglows**
  - **Binary systems near periastron (eg PSR B1959-63, where we have a specific time where we know something interesting might happen.)**
  - **Binary systems with periods of ~hours.**
- **With the exception of GRB afterglows, these scenarios might not be very common**

Potential disadvantages

- Increased systematic uncertainties due to time variable background from Earth albedo.
- Loss/degradation of all-sky monitoring for the duration of the pointed observation. This could a big impact on multiwavelength campaigns which expect to get survey observations of their sources.
- Non-uniform sky coverage may introduce biases/difficulties for population studies
- ~50% chance of missing a TDRS contact for an autonomous repoint and some ToOs -> increases data latency by 3 to 6 hours.

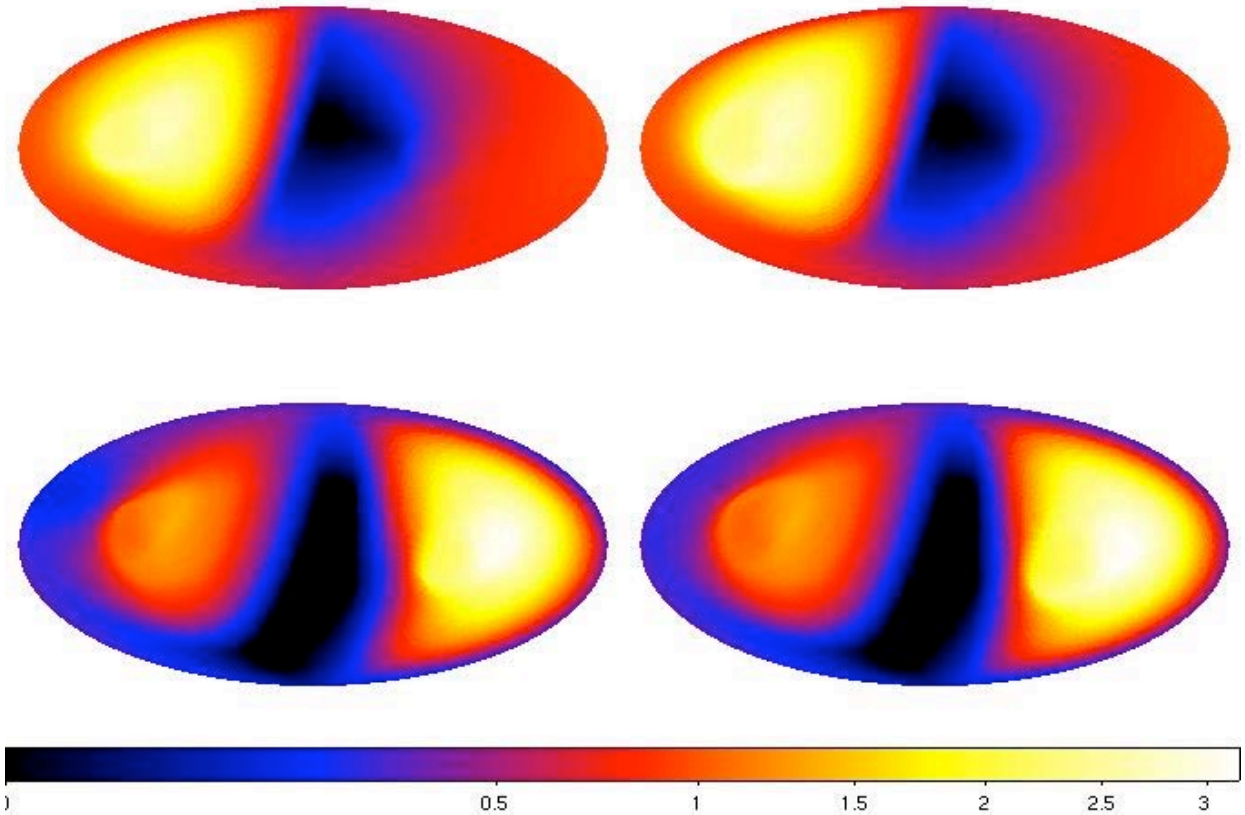
The Earth is Bright!

- **Two analysis approaches:**
  - **Require that the limb is always outside the nominal FoV (rocking angle <47 deg AND zenith cut of 105 deg**
  - **OR, eliminate all times where the Earth limb comes within 8 deg of the edge of the region used in the analysis (typically 15-25 deg)**



Some examples

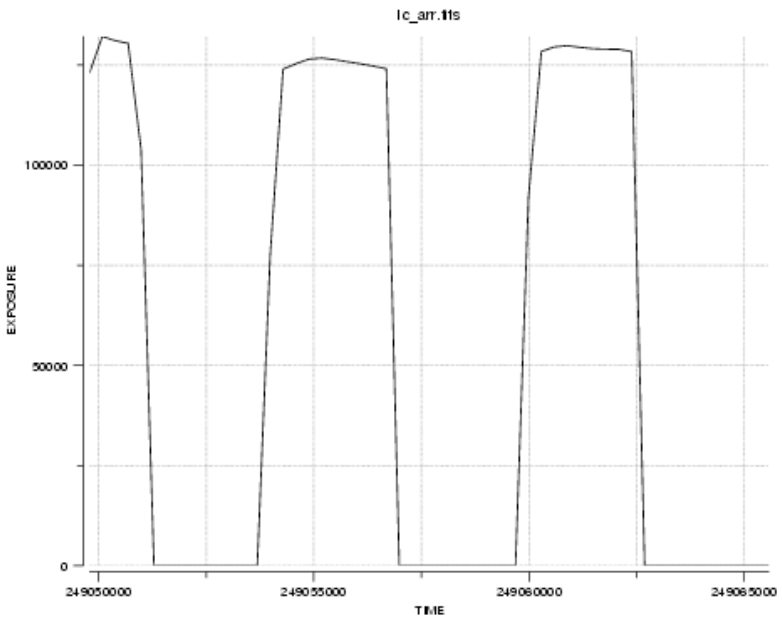
- **Pointed mode observations during LEO: 3EG 1835 and Vela**



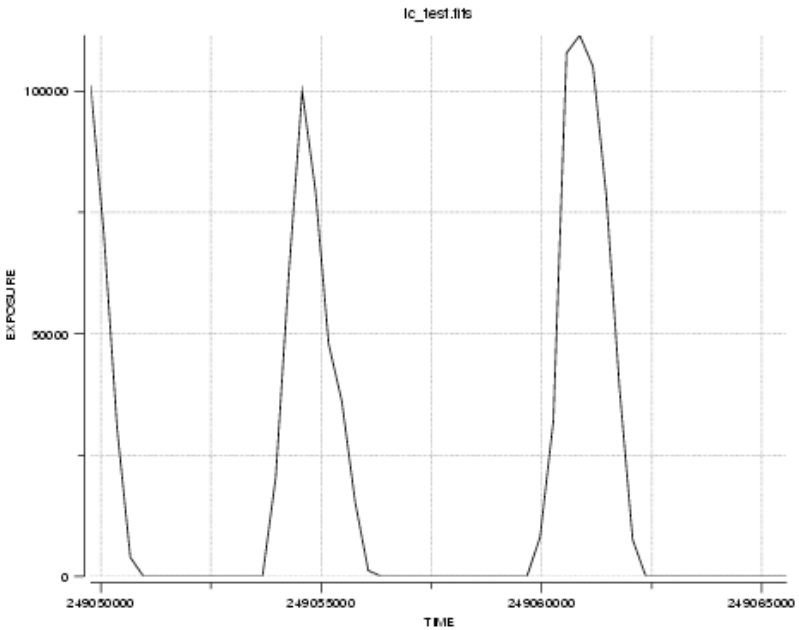
Enhanced exposure at target locations, but severe degradation on the rest of the sky (no exposure at Galactic center.

A 5 hour GRB afterglow observation

- GBM triggered on a bright gamma-ray burst at 12:28:12.21 UT on Nov 22.
- This triggered an autonomous repoint recommendation at ra, dec of 339.150, 33.85. Best fit ground location was RA = 338.7, DEC = +38.4
- The burst was already at 21 degrees to the LAT boresight (well within the FoV), so the effect of the ARR was to move the burst closer to the center of the FoV and keep it there.

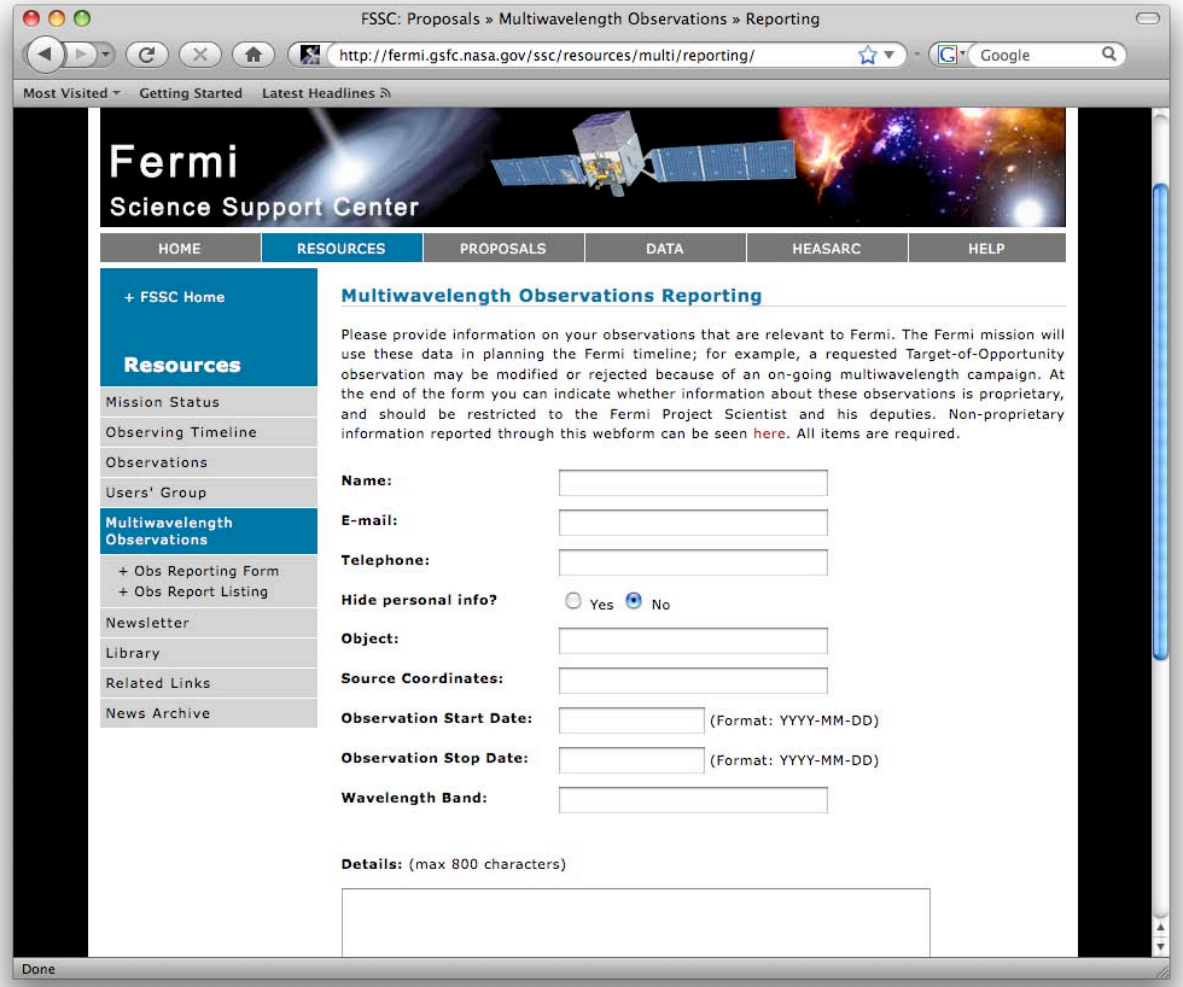


Actual



planned

Reporting MW observations



Please let us know about planned MW observations! We use this information to avoid conflicts when scheduling calibrations.

Conclusions

- **Most Fermi science can be addressed by survey mode observations.**
  - **You can specify a time period for planned MW campaign (or other special time) to request that we stay in survey mode and not schedule calibrations or pointed mode observation.**
- **You can propose for pointed mode observations, but the amount of time available for these observations is limited**
  - **Need a strong justification for why these studies cannot be performed using survey mode data.**
- **For more details see:** http://fermi.gsfc.nasa.gov/ssc/proposals/pointing_analysis/