Fermi

Gamma-ray Space Telescope

LAT Collaboration Meeting

Mission Status Update

J. McEnery and E. Hays

Status Highlights

- **Observatory is operating smoothly, FOT continues to look for ways to improve operations.**
  - **Implemented rate-limited yaw maneuver (so avoid sun avoidance maneuver in survey mode)**
  - **Battery management**
    - **Tested 45 deg survey profile, reverted back to 50 deg**
  - **Collision avoidance**
    - **Conjunction assessment report, review of thruster control parameters**
  - **Reaction wheels**
    - **Adjusting survey profile to reduce peak wheel speed**
- **Evaluating proposed calibration observations, configuration tweaks**
- **Beth Pumphrey is now Fermi Mission Director!**
- **GI cycle 3, Cycle 4**
- **Data release plan**
- **Data analysis workshops**
- **Press and outreach coordination and planning, tied to major science results releases.**

Observations summary (since last meeting)

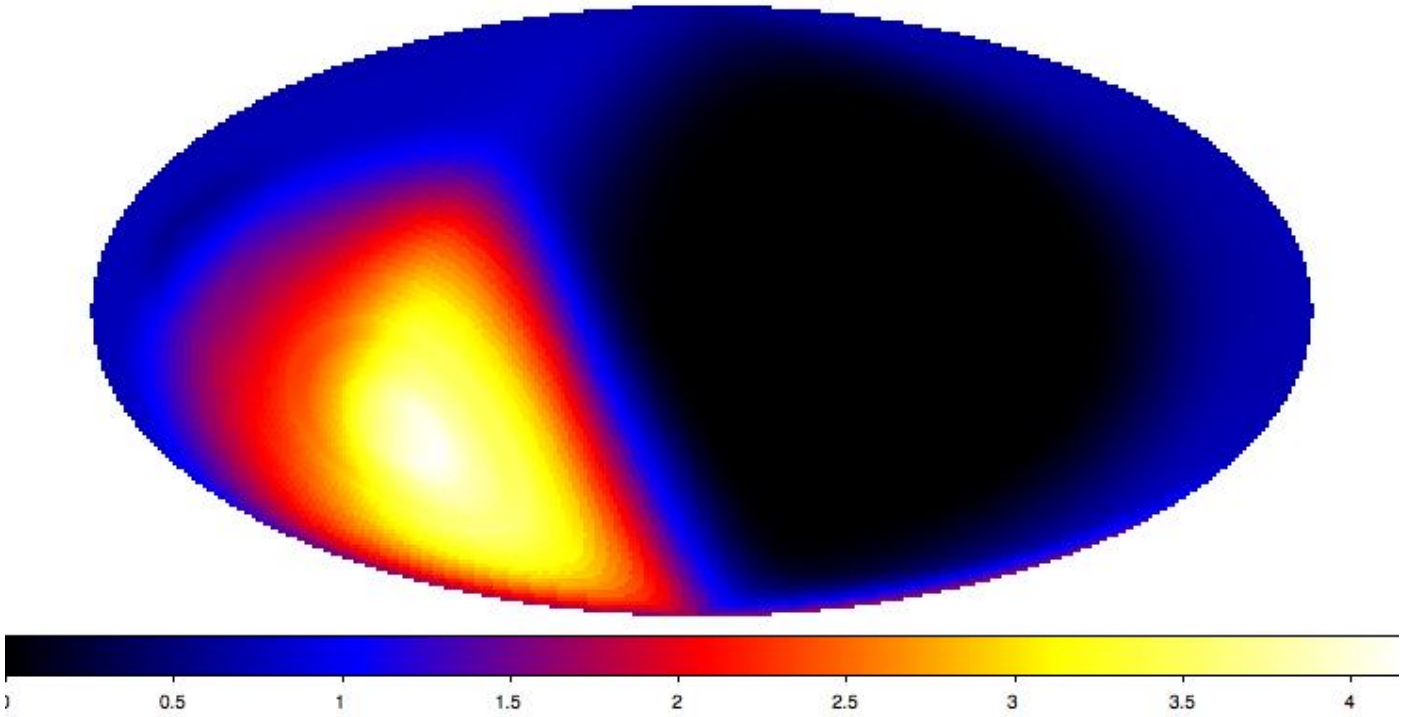
- Almost exclusively in nominal data taking in survey mode
  - 50 deg rocking angle from Sept 2, 2009 - April 29, May 27 onwards
  - 45 deg rocking angle from April 29 - May 27
- 7 ARRs
  - 5 hour pointed mode observations in response to bright GBM detected bursts.
- 1 TOO
  - 200 ks observation at 3C454.3
- Routine LAT Calibrations
  - ~3 hours
- Anomalies/engineering
  - none
- Data recovery efficiency (do all the bytes reach the ground?)
  - 2 packets lost (out of ~1 billion packets since last March)

Target of Opportunity

- First ToO - April 2010 on 3C454.3 (which was flaring brightly)

- Submitted request at 15:35 UT
  - User submits targets, duration and ARR status (normal or off)
  - http://fermi.gsfc.nasa.gov/ssc/resources/observations/too/
- Approved at 16:19 UT, and sent to FOT
  - Coordinates
    - We want to offset the target by 5-10 deg to avoid possible systematics at 0 deg inclination. We chose to move +10 in declination (towards V407 Cyg)
- ToO uplinked and observations begin at 19:38 ut
  - ~58% of previously scheduled Ku contacts over the 200ks would have been lost as a result of the ToO, and needed to be manually rescheduled by the FOT
  - GBM triggers were disabled and re-enabled at ~00:40 UT (April 5)
- http://fermi.gsfc.nasa.gov/ssc/resources/timeline/ for information about planned and past observations.

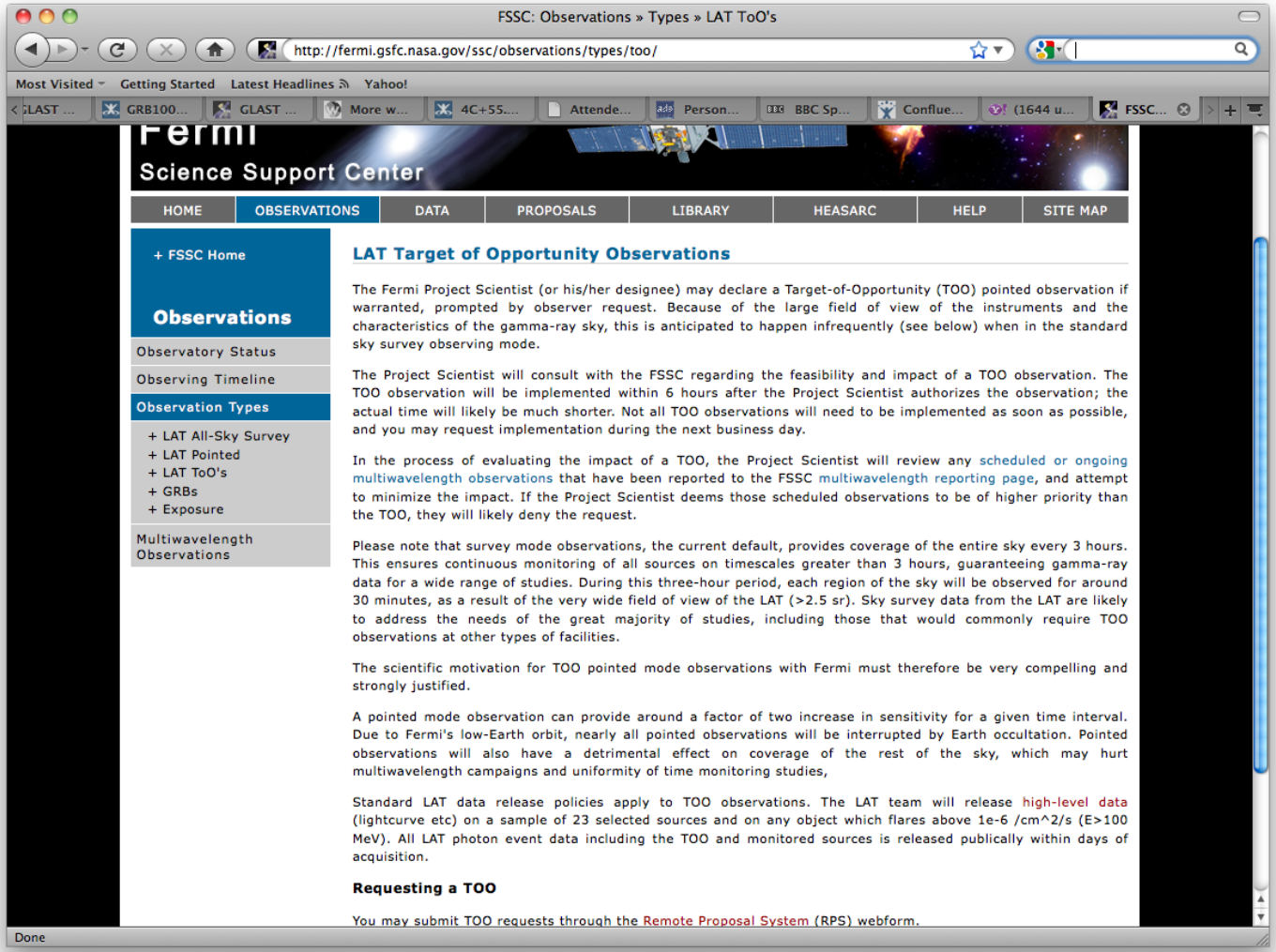
Impact on rest of sky



- **Factor of ~4 exposure at 3C454.3, however large region with no exposure (including M87 which, was flaring at the time)**

Target of Opportunity

TOOs can be requested at the FSSC webpage.



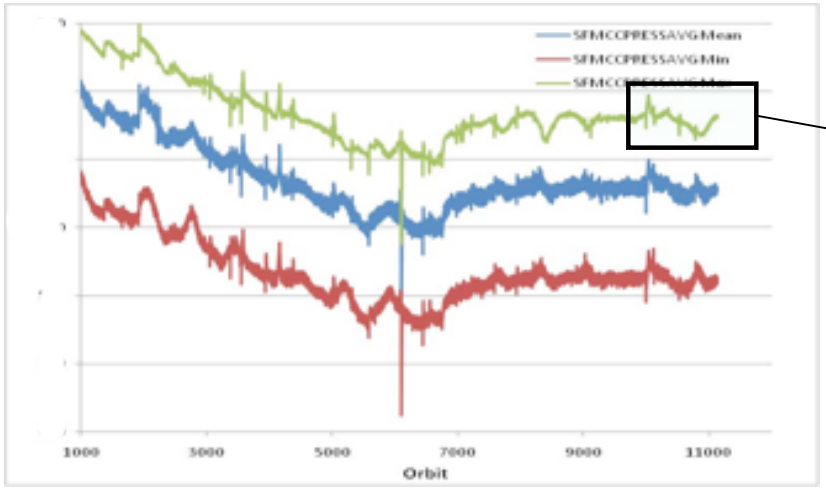
Baseline plan for pointed observations

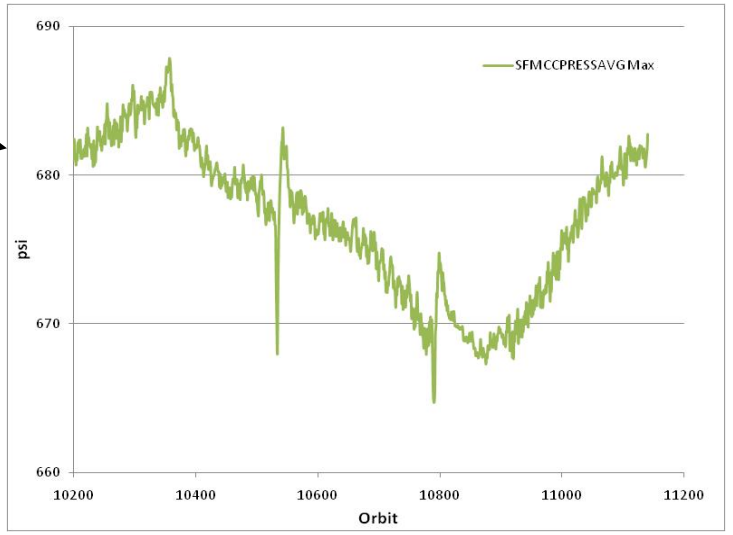
- All pointed mode observations
  - Offset pointing 10 deg towards Dec=0
    - Avoids potential on-axis systematic effects
    - Moves observation closer to orbit equator (minimizes amount of time that Earth limb is in FoV)
    - May choose to move 10 deg in a different direction if there are observations or targets of interest (listed in MW reporting page)
- While occulted - Target of Opportunity
  - Limb following while target is occulted (I.e. take the shortest path around the Earth, 50 deg from limb)
- While occulted - Planned pointed observation
  - Sky survey - maximizes coverage of sky
- A guest investigator may wish to plan and propose a more highly tuned observation (perhaps to maximise coverage of multiple sources simultaneously).
  - We will accept and implement such proposals, but note that the software and responsibility to plan/evaluate these observations lies with the proposer.

Is this approach reasonable? Are there any additional considerations?

Battery Status

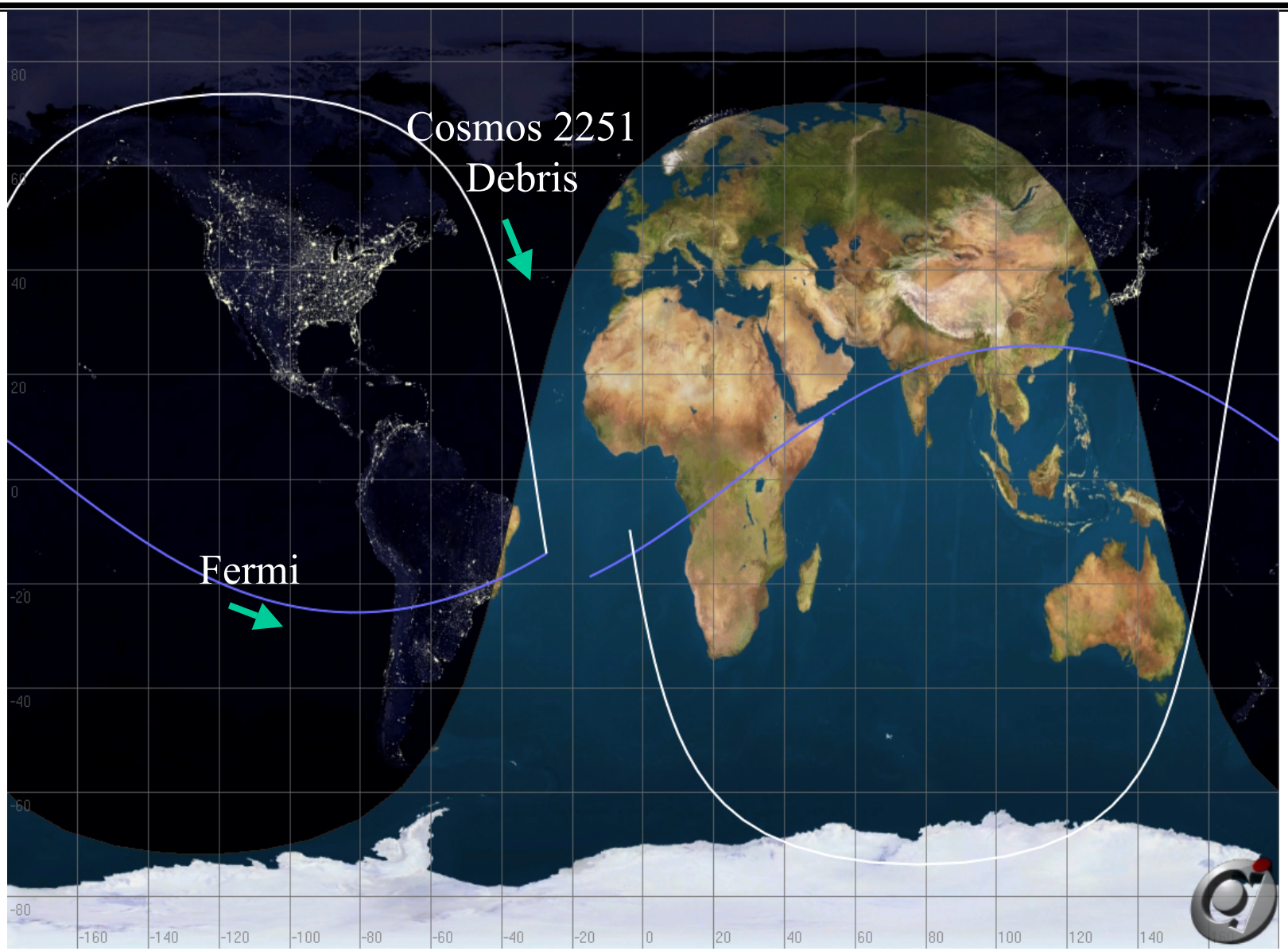
Pressure





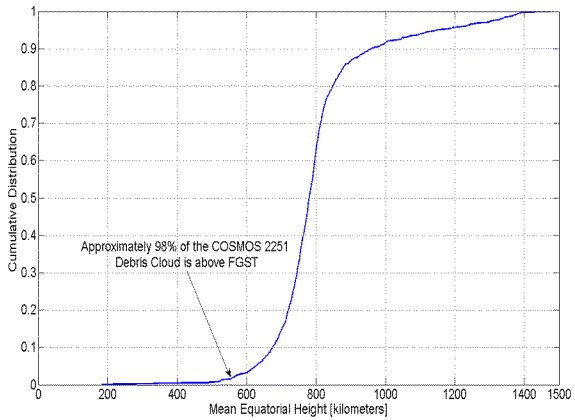
- **Transitioned to 45 deg rocking profile on April 29 to explore stability at a slightly more scientifically beneficial survey profile.**
- **Transitioned back to 50 deg on May 27.**
- **The battery performance is optimal at 50 deg rocking angle.**

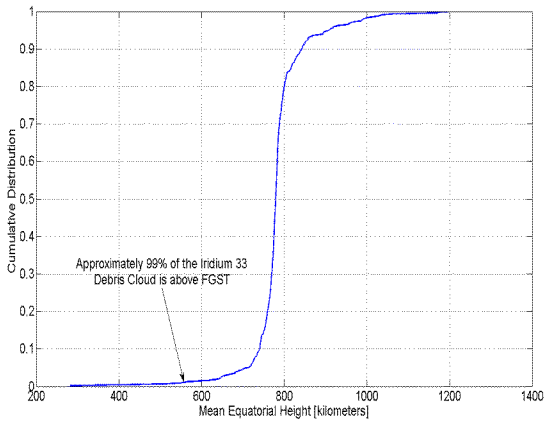
Conjunction Assessment

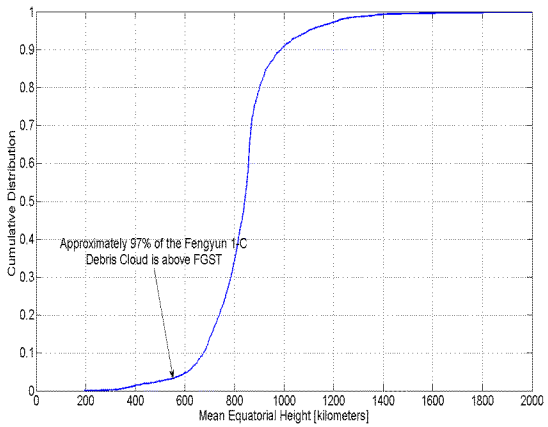


Conjunction Assessment

- **Local Debris Environment Characterization**







- **~20% of our current events are from 3 new debris clouds, >97% of the debris still lies above us and will move to lower altitudes in the next few years**
- **Make an estimate of the evolution of 3 large debris clouds: Fenyun 1-C, Irridium 33 and COSMOS 2251.**
- **Use this to come up with an estimate of the likelihood of needing to do a maneuver over the Fermi mission lifetime**

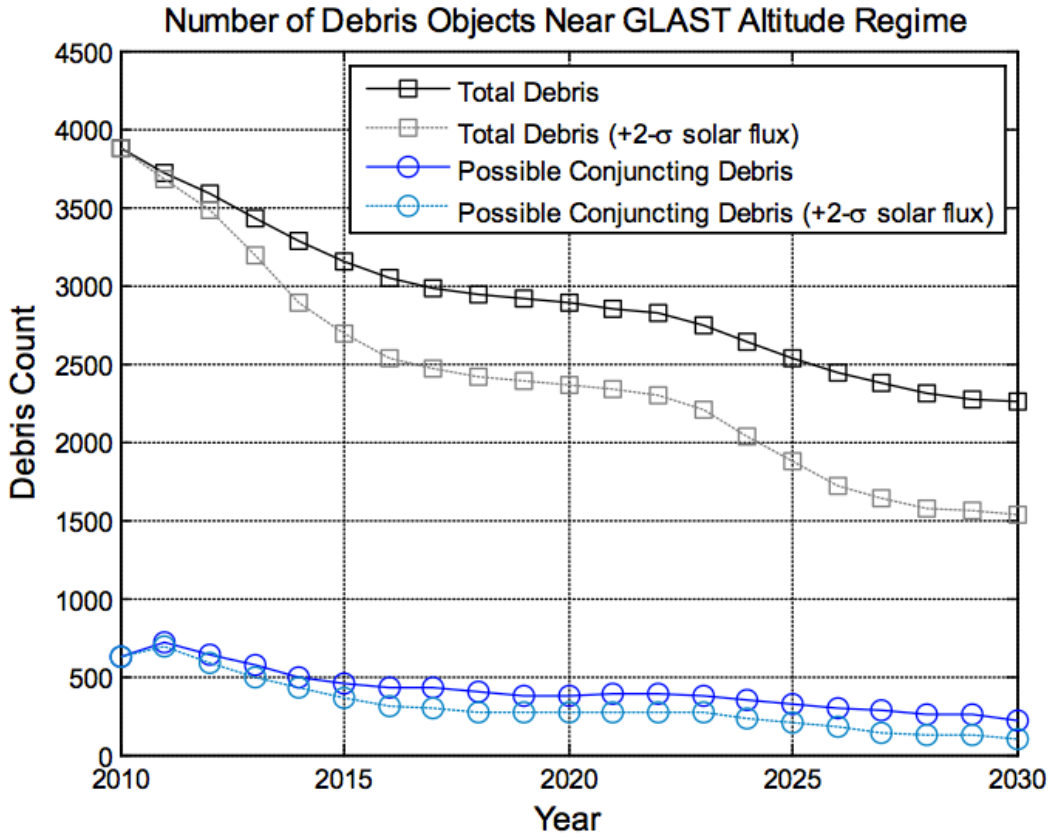
Modeling propagation of debris fields

- **High fidelity force modeling that includes the Earth geopotential, luni-solar gravity, and atmospheric drag**

Parameter	Modeling
Earth Geopotential model	4x4 Joint Gravity Model (JGM)-2
Non-Central Bodies	Sun, Moon (JPL DE200 Ephemeris File)
Atmospheric Density Model	Iacchia Roberts
Solar Radiation Pressure model	Thin plate model

- **Output is the evolution of orbit inclination and altitude (apogee and perigee) of >3800 components of the 3 debris fields.**

The bottom line



- **The rate of close approaches is predicted to be stable/mild decrease through the mission life.**
  - **Likelihood of a collision avoidance maneuver will not increase.**

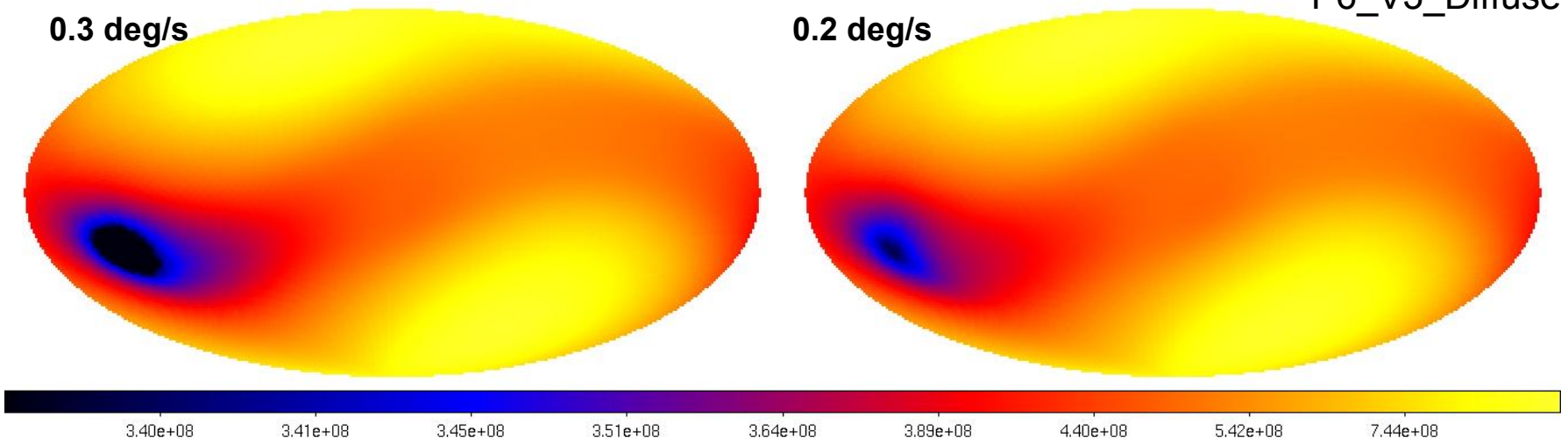
Reaction Wheels

- **Continuing to monitor RWA performance closely.**
  - **Received a report from the manufacturer listing the risk factors associated with the onboard failures experienced by several missions.**
  - **The main factor that we can control is peak wheel speed.**
    - **Sun avoidance/Yaw maneuvers**
    - **Rocking during survey mode**
      - **Looking at small modification to shape of survey profile to reduce the peak wheel speeds during initial acceleration.**
        - » **Reduced acceleration during onset of slew (done)**
        - » **Reduce peak slew speed during rocking maneuver from 0.3 to 0.2 deg/s**

50 deg survey profile

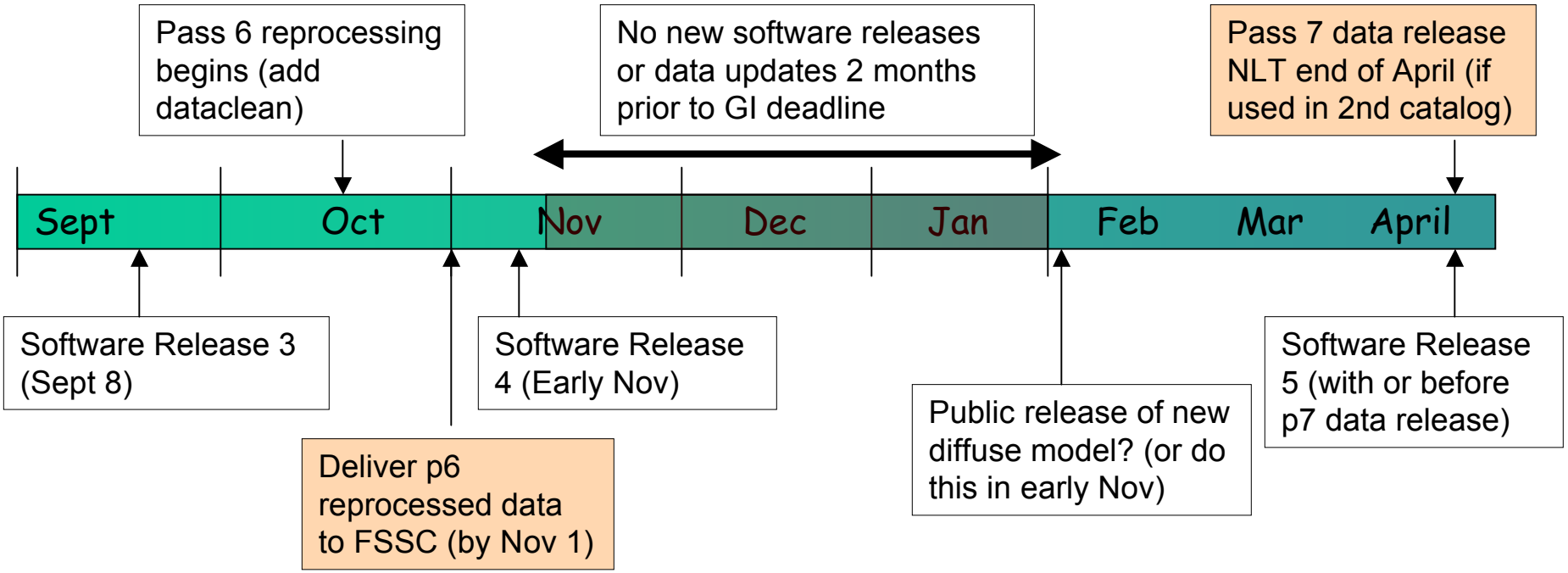
- **Exposure asymmetry is dominated by the over exposure of the orbit poles.**
- **Reducing the slew speed (and thus spending less time at 50 deg rocking angle), tends to even out the asymmetry.**

Exposure for week integration, 1 GeV P6_V3_Diffuse



Exposure uniformity for 50 deg survey profile is slightly better for the 0.2 deg/s case. So even though our motivation for the change was to reduce peak wheel speeds, it is also a better science profile.

Public Releases Timeline



- **Note: This lags the LAT team internal schedule by a couple of months (to allow the collaboration time to evaluate the updated data)**

Data/software releases and IRFs

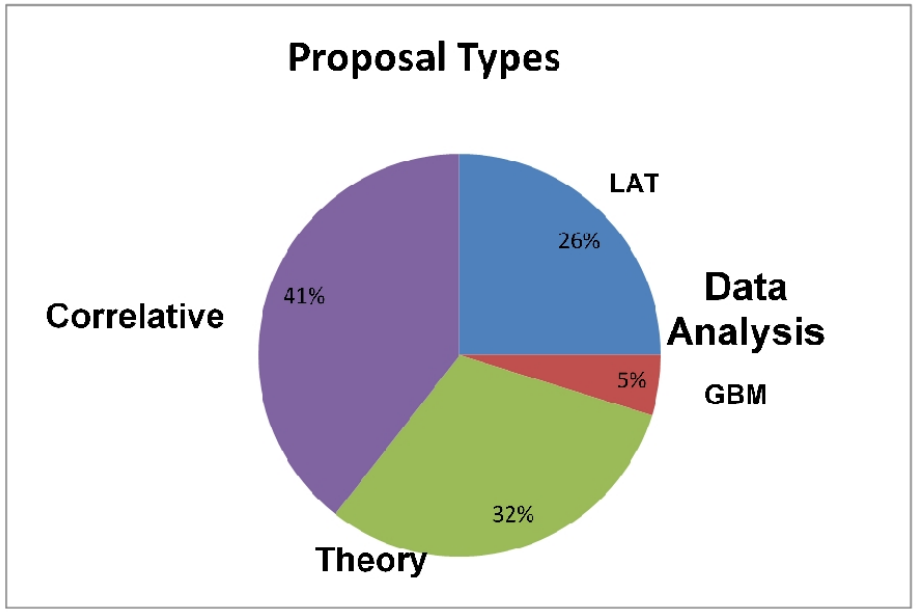
Software release 3	Sept 8	P6V1, P6V3
Software release 4	Early Nov	P6V1, P6V3, P6V3_dataclean, P6V11 (if available)
Software release 5	April 2010	P6V1, P6V3, P6Vfinal, P7

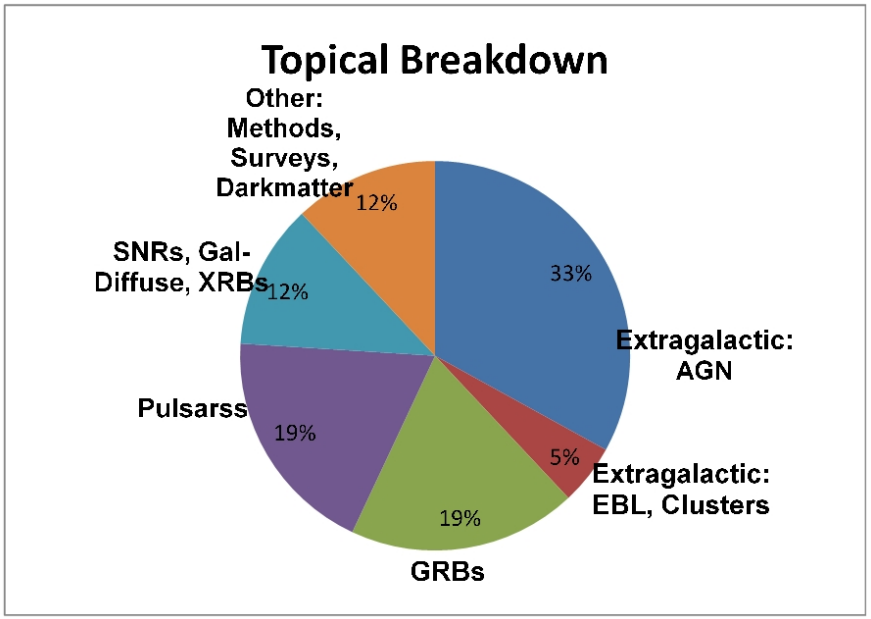
Data release 2	Early Nov	Add P6 dataclean event class, update alignment calibration?
Data release 3	NLT late April	P7 event classification, P7 diffuse responses.

- Data release 2 can contain diffresp for flight corrected IRFs if they are ready by mid-Oct.
- Deadline of late April for pass 7 data release only applies if pass 7 was used for 2nd catalog.

Cycle 3 GI Program

- 192 proposals, 79 selected, 28 have LAT or GBM team member as PI, 53 have LAT or GBM team as PI or CO-I
- 10% first time Pis
- NRAO
  - ~885 hours awarded over 3 facilities, 20 requests, 11 selections , ~50% maximum Fermi allotment , 215/360/310 hrs on VLA/VLBA/GBT
- NOAO
  - NOAO: 89 hours , 5 requests, 3 selections, ~60% of allotted time





Cycle 4 GI program

- **Proposal deadline TBD (between Jan 15 - Feb 5)**
- **Some changes:**
  - **Joint program with Suzaku**
    - **Upto 250ks can be awarded by the Fermi GI program on targets that do not conflict with an existing Suzaku program and are technically feasible.**
  - **Regular proposals can now cover one or two years (cap per year remains $100k)**
    - **Progress report due with 2nd year budget.**
  - **Large proposals continue as before**

FSSC: personnel

- **Personnel**
  - **Goodbye and many thanks to John Vernaleo for keeping a vigilant eye on the data server**
  - **Welcome to Jeremy Perkins**
  - **Welcome back to Tom Stephens**

FSSC: software release

- Next software release is ready to go
  - Third software release since launch
  - Internal target date September 8
    - Testing cycle complete for build with P6_V3 as default IRF set (CALDB also includes P6_V1 as in previous release)
  - Based on Science Tools v9r17p0
    - Expanded platform support!
      - SL 5, Ubuntu 9.10, 10.04 and Fedora 13 (32 and 64 bit versions)
      - Mac leopard and snowleopard (OSX 10.5 & 10.6)
- Future releases
  - Blackout period for software releases around the Cycle 4 GI deadline means release material needs to be in hand before November to be released in this calendar year

FSSC: user support

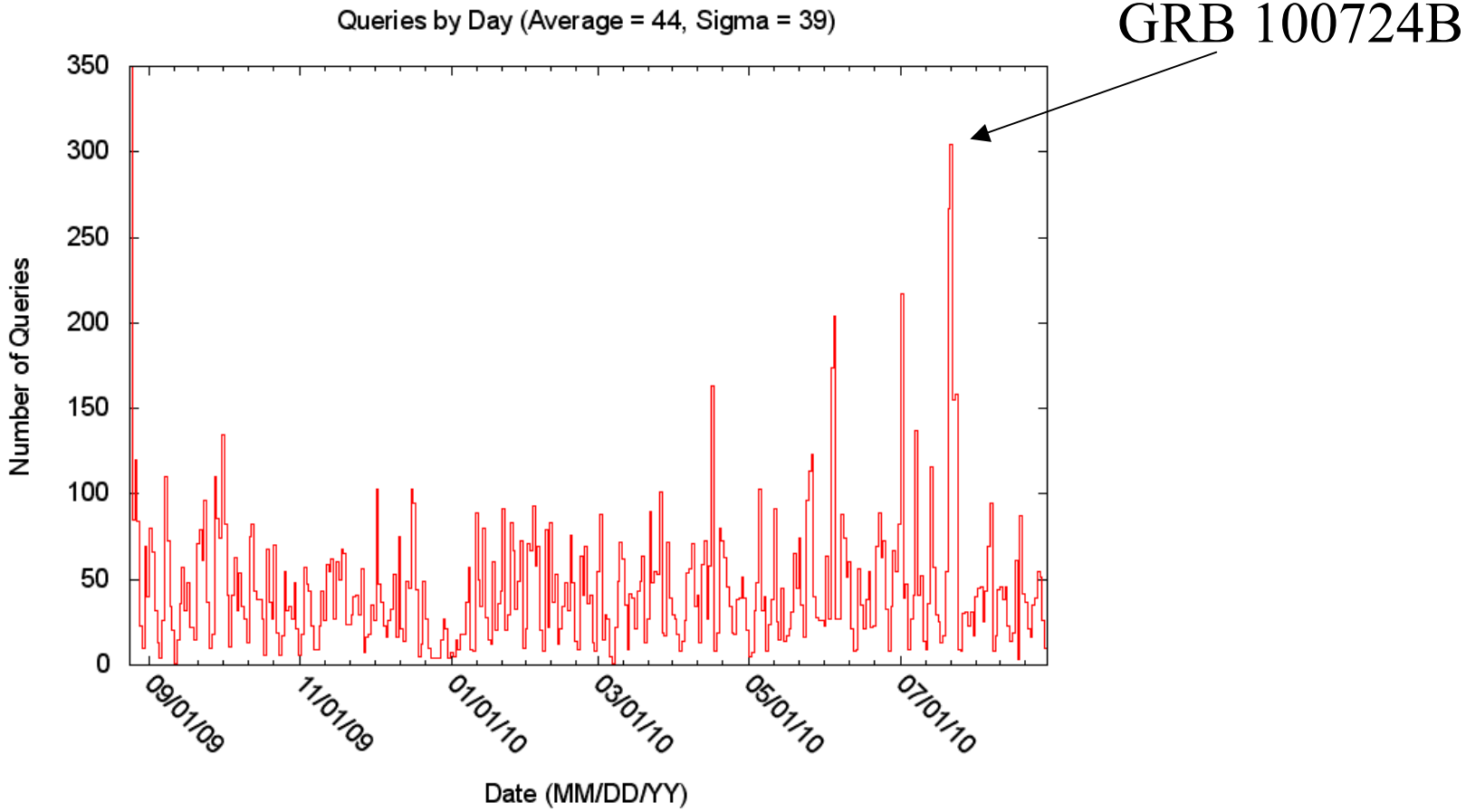
- GBM data analysis tool (*RMFIT*) released in May as user-contributed tool with tutorial
- Continued improvements to web support and resources for users
  - FSSC Library http://fermi.gsfc.nasa.gov/ssc/library
    - Archive of analysis workshop presentations
    - Fermi-related publications
    - Users group activities
- Documentation http://fermi.gsfc.nasa.gov/ssc/data/analysis/documentation
  - New analysis threads in development
    - *pyLikelihood* - significant expansion of tutorial to recreate results of PG 1553 publication
    - LS 5039 binary orbital lightcurve example using *gtsrcprob* weighting

Data analysis workshops

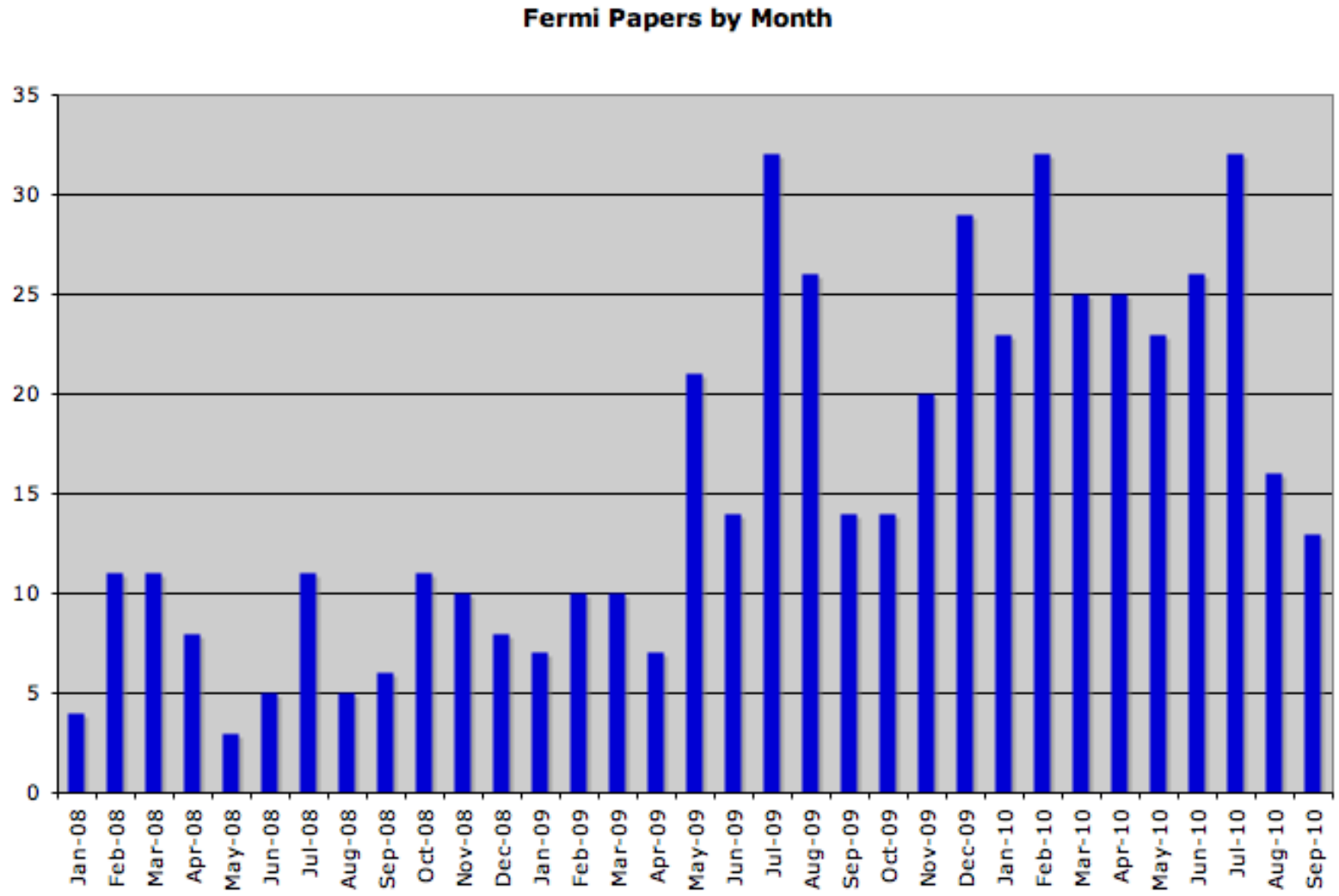
- **The FSSC sequence of regional data analysis workshops will be repeated this year.**
  - **Increase to 2-day workshop**
    - **1-day, focus on hands-on activities**
    - **1-day science and proposal guidance/help**
- **Additional workshops are organised by LAT, GBM, FSSC, Project and external partners**
  - **Fermi+Swift GRB analysis workshop (Nov 8-12) at Goddard**
  - **2-week Fermi gamma-ray school (May-June 2010, Eastern Shore, Delaware)**
  - **Trieste (Sept 2010)**

Data server

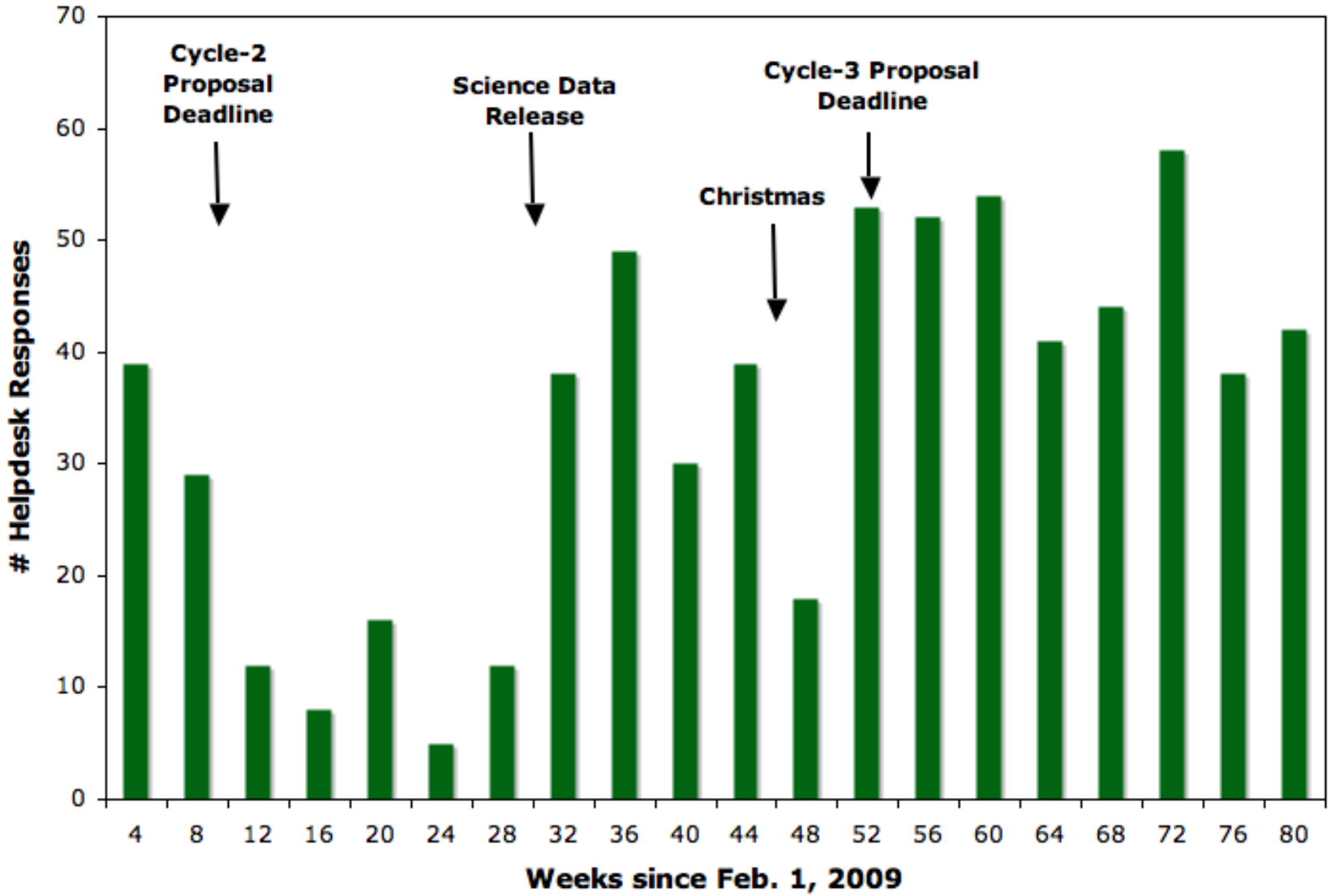
- **Dual ingest capability added to support release of reprocessed data**
- **Server continues to run with high uptime**
  - **Monthly average 1000 - 2000 queries**



Papers in Referred Journals

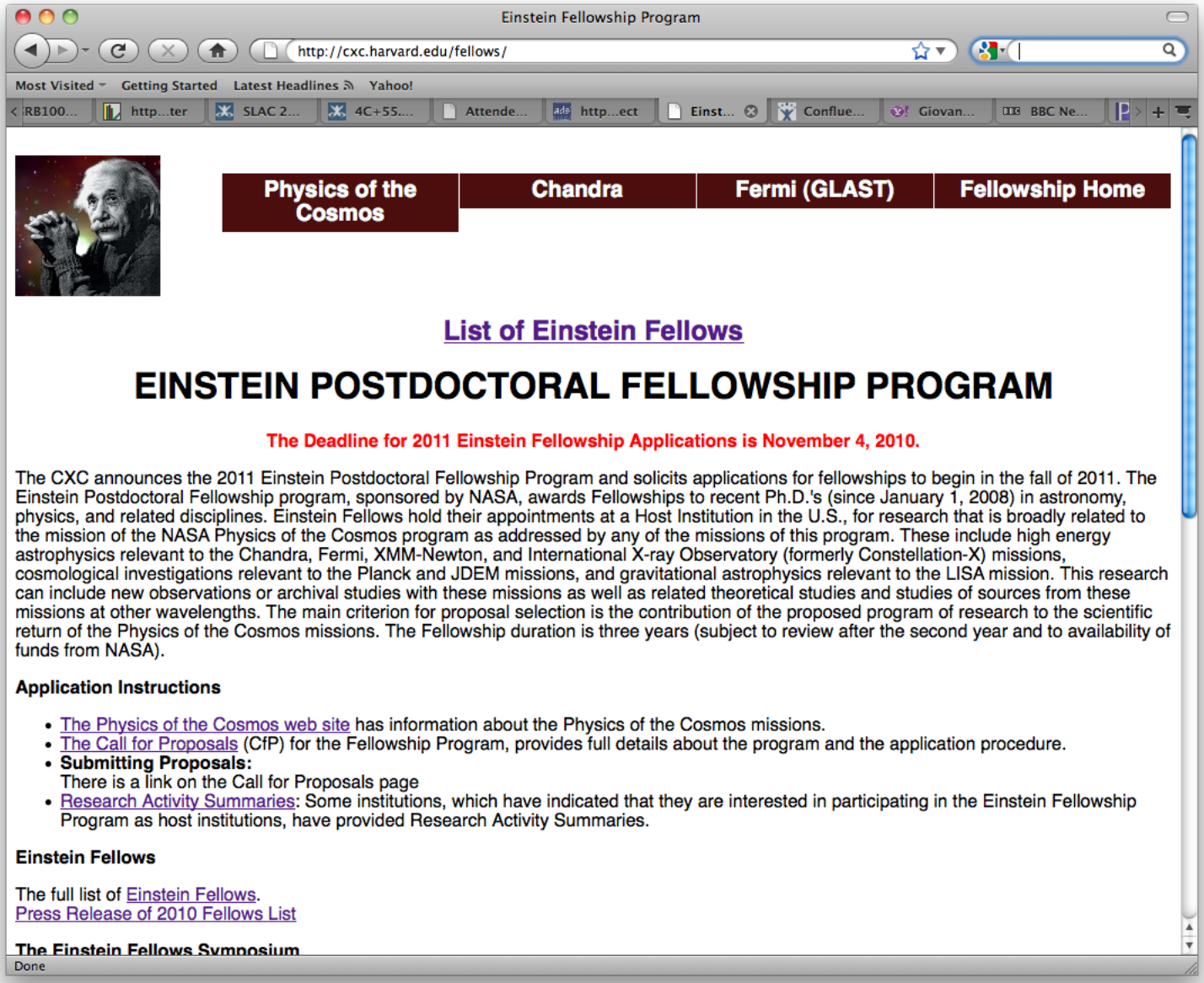


Fermi Helpdesk Queries



Einstein Fellowship Program

Deadline is Nov 4!



Astrophysics Educator Ambassador Training

Every two years, E/PO staff at Sonoma State University train the Educator Ambassadors. In turn, the EAs help SSU develop, test and disseminate NASA-funded educational materials through educator workshops nationwide.

Stanford physicist Prof. Helen Quinn demonstrates how particle scattering can be used to learn about unseen objects.

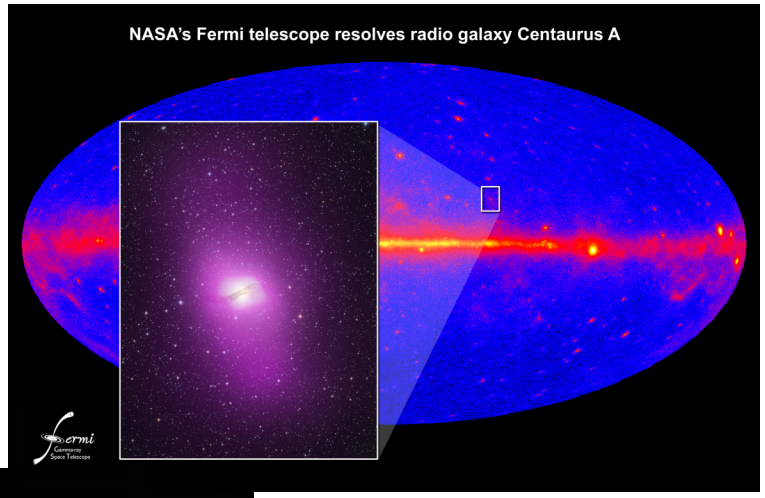
Educator Ambassadors build Galileoscopes. EA Rob Sparks (NOAO) led this activity.

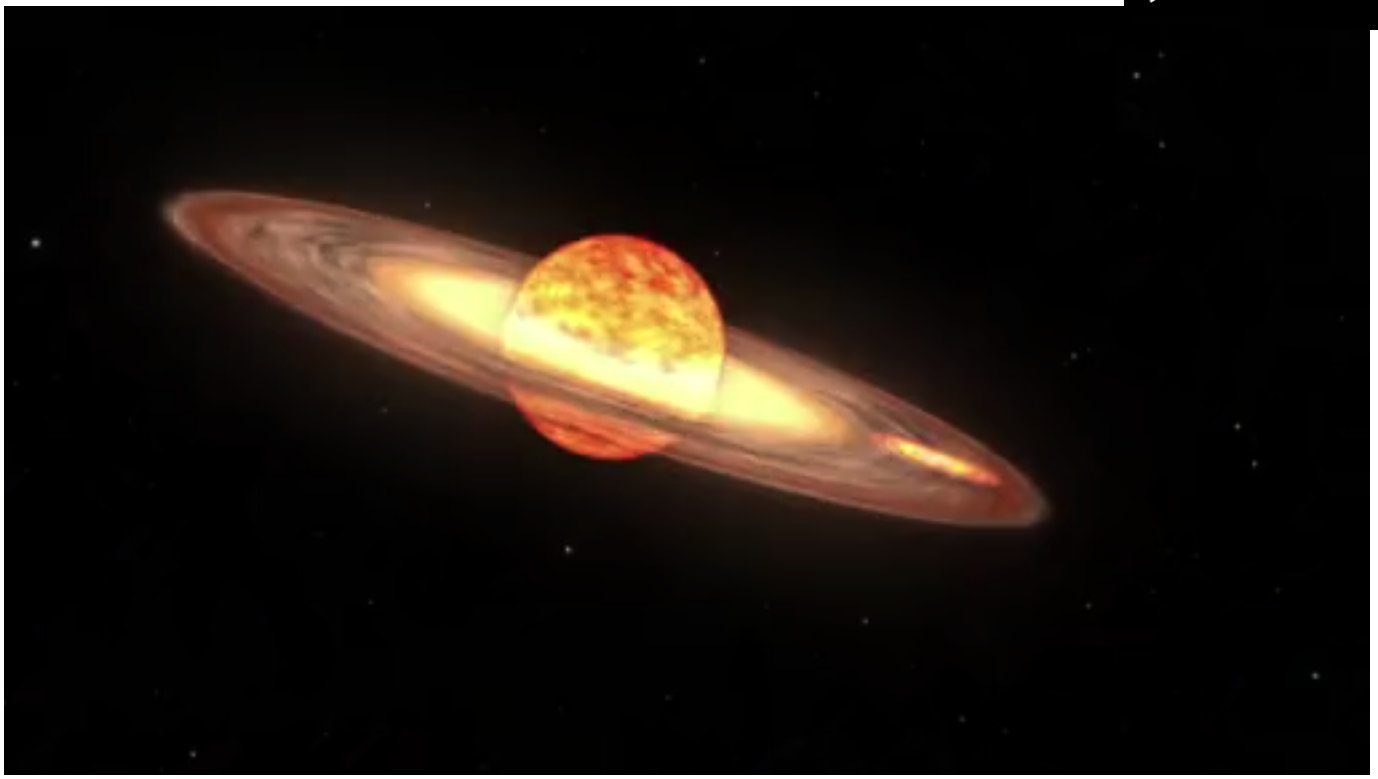
During July 26-30, 16 Astrophysics Educator Ambassadors were trained at SSU. By request, we featured a two-day "mini-course" on particle physics, as well as many hands-on activities led by the EAs themselves. We also had guest presentations by Alan Gould (Kepler), Bryan Mendez (WISE) and physicist-author Ransom Stephens ("The God Patent"). EAs are funded by the Fermi, Swift, XMM-Newton and NuSTAR missions. This is the 10th year of the program, through which over 45,000 teachers have been directly trained.

EAs look at images projected inside a home-made planetarium dome. EA Jeff Adkins (Deer Valley HS) led this activity.

Press Activity

- **Biweekly telecons**
  - **Press representatives from partner agencies**
  - **Good input from LAT and GBM collaborations on upcoming pressworthy science topics.**



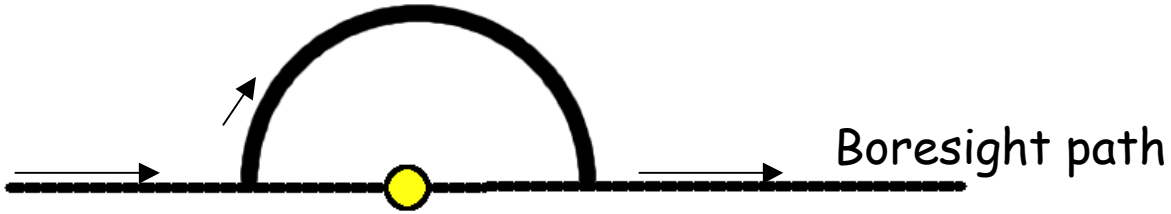


Fermi Gamma-ray Space Telescope

Questions?

Sun avoidance maneuver

In sky survey mode the Sun is constantly moving w.r.t. the spacecraft frame. The Sun has to stay on the +X side of the observatory, so two times per orbit we rotate by 180 deg.



- **The required speed of the rotation depends on how close the Sun is to the Z-axis.**
  - **If the sun is directly on-axis, the rotation would need to be ~infinitely quick to satisfy the constraints on Sun on LAT radiators.**
    - **To address this we set a minimum angle between the Sun and the LAT boresight while performing the flip to keep the sun on the +X face.**
    - **However, there is another mode, which does not cause excursions and caps the slew rate to something manageable**
      - **The price is additional sun on the LAT radiator, but there are many advantages so we plan to implement this (as a trial) at the next sun avoidance season (june).**