

National Aeronautics and Space Administration



Fermi

Gamma-ray Space Telescope

www.nasa.gov/fermi

Fermi

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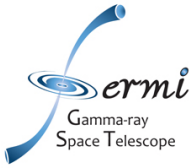
LAT Collaboration Meeting

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.**



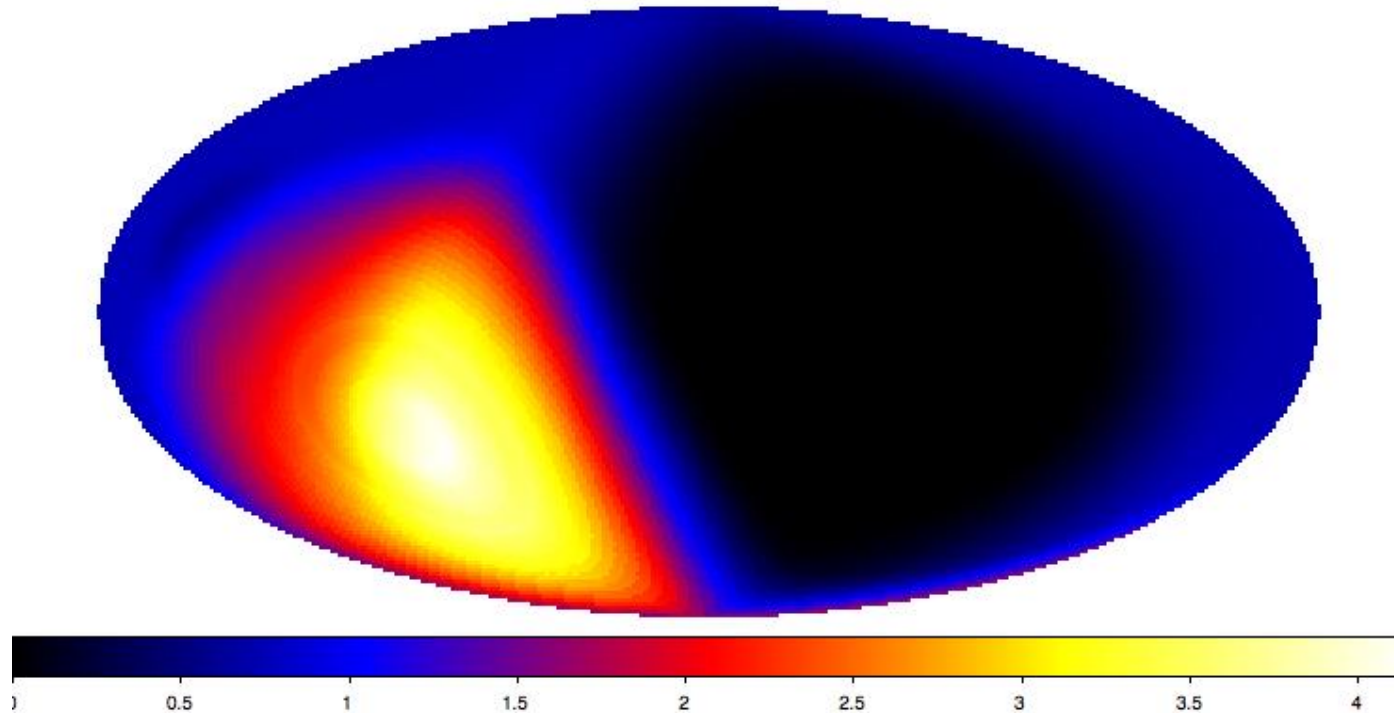
Observations summary (since last meeting)

- **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 ARR**s
 - 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.**

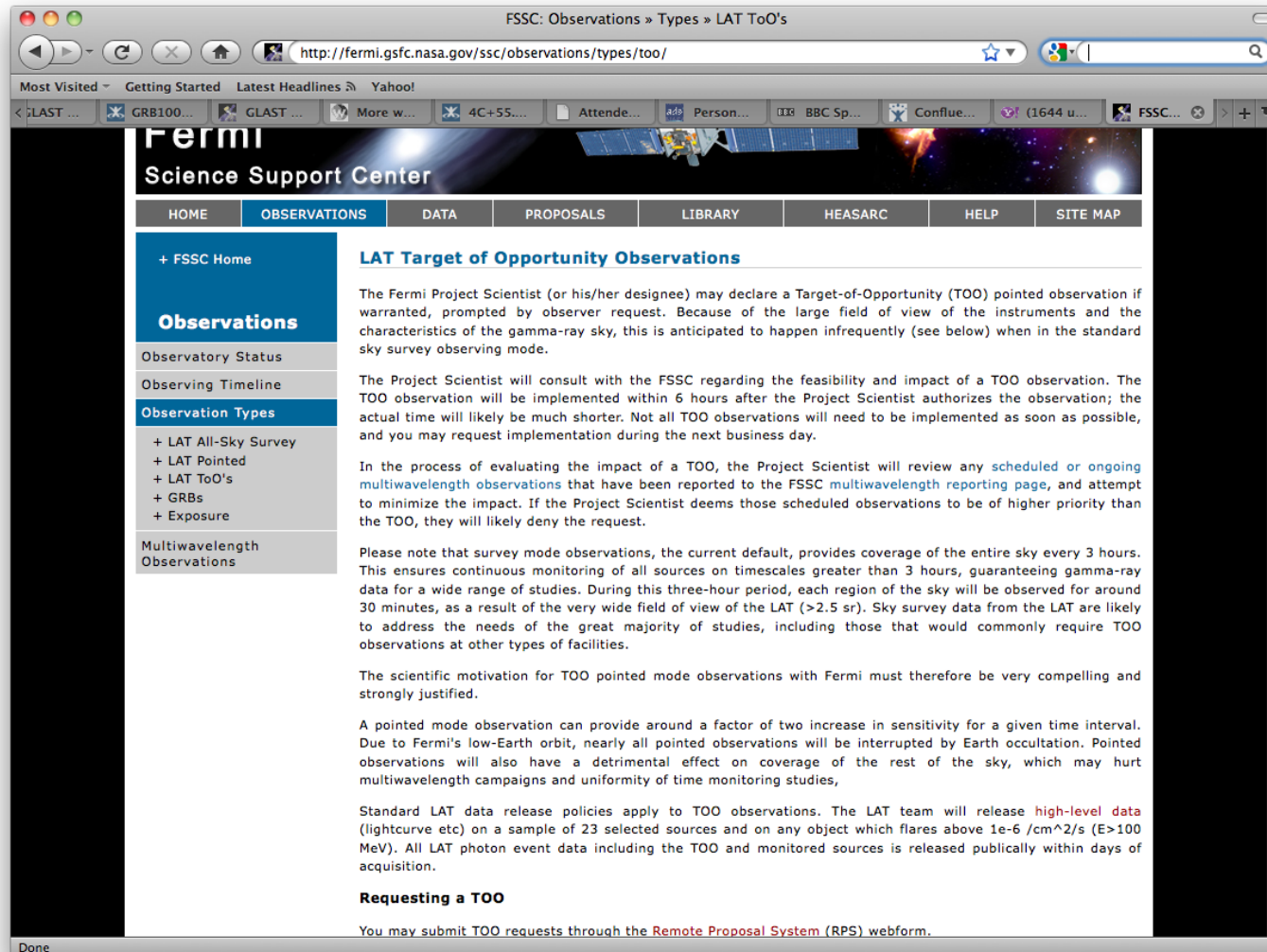
Impact on rest of sky



- **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.



The screenshot shows a web browser window displaying the Fermi Science Support Center (FSSC) website. The browser's address bar shows the URL: <http://fermi.gsfc.nasa.gov/ssc/observations/types/too/>. The page title is "FSSC: Observations » Types » LAT ToO's".

The website header includes the Fermi Science Support Center logo and a navigation menu with the following items: HOME, OBSERVATIONS (selected), DATA, PROPOSALS, LIBRARY, HEASARC, HELP, and SITE MAP. A secondary menu on the left includes: + FSSC Home, Observations (selected), Observatory Status, Observing Timeline, Observation Types (selected), + LAT All-Sky Survey, + LAT Pointed, + LAT ToO's, + GRBs, + Exposure, and Multiwavelength Observations.

The main content area is titled "LAT Target of Opportunity Observations". It contains the following text:

The Fermi Project Scientist (or his/her designee) may declare a Target-of-Opportunity (TOO) pointed observation if warranted, prompted by observer request. Because of the large field of view of the instruments and the characteristics of the gamma-ray sky, this is anticipated to happen infrequently (see below) when in the standard sky survey observing mode.

The Project Scientist will consult with the FSSC regarding the feasibility and impact of a TOO observation. The TOO observation will be implemented within 6 hours after the Project Scientist authorizes the observation; the actual time will likely be much shorter. Not all TOO observations will need to be implemented as soon as possible, and you may request implementation during the next business day.

In the process of evaluating the impact of a TOO, the Project Scientist will review any [scheduled or ongoing multiwavelength observations](#) that have been reported to the FSSC [multiwavelength reporting page](#), and attempt to minimize the impact. If the Project Scientist deems those scheduled observations to be of higher priority than the TOO, they will likely deny the request.

Please note that survey mode observations, the current default, provides coverage of the entire sky every 3 hours. This ensures continuous monitoring of all sources on timescales greater than 3 hours, guaranteeing gamma-ray data for a wide range of studies. During this three-hour period, each region of the sky will be observed for around 30 minutes, as a result of the very wide field of view of the LAT (>2.5 sr). Sky survey data from the LAT are likely to address the needs of the great majority of studies, including those that would commonly require TOO observations at other types of facilities.

The scientific motivation for TOO pointed mode observations with Fermi must therefore be very compelling and strongly justified.

A pointed mode observation can provide around a factor of two increase in sensitivity for a given time interval. Due to Fermi's low-Earth orbit, nearly all pointed observations will be interrupted by Earth occultation. Pointed observations will also have a detrimental effect on coverage of the rest of the sky, which may hurt multiwavelength campaigns and uniformity of time monitoring studies,

Standard LAT data release policies apply to TOO observations. The LAT team will release [high-level data](#) (lightcurve etc) on a sample of 23 selected sources and on any object which flares above $1e-6$ /cm²/s ($E > 100$ MeV). All LAT photon event data including the TOO and monitored sources is released publicly within days of acquisition.

Requesting a TOO

You may submit TOO requests through the [Remote Proposal System \(RPS\)](#) webform.

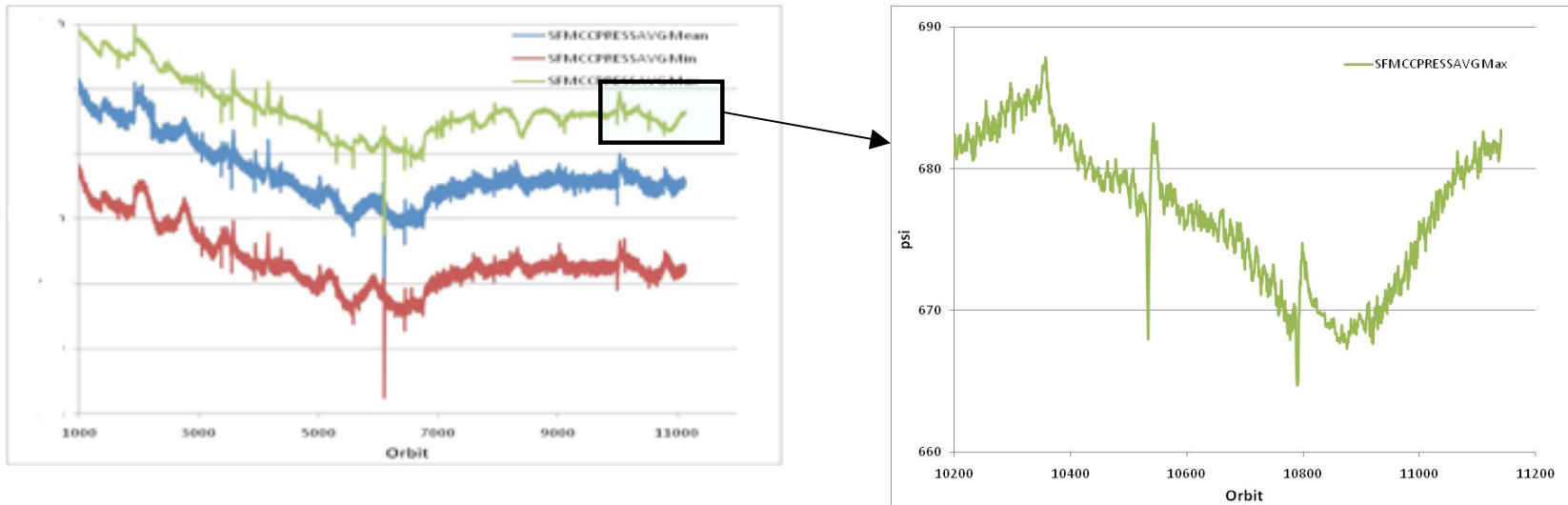
Baseline plan for pointed observations

- **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?

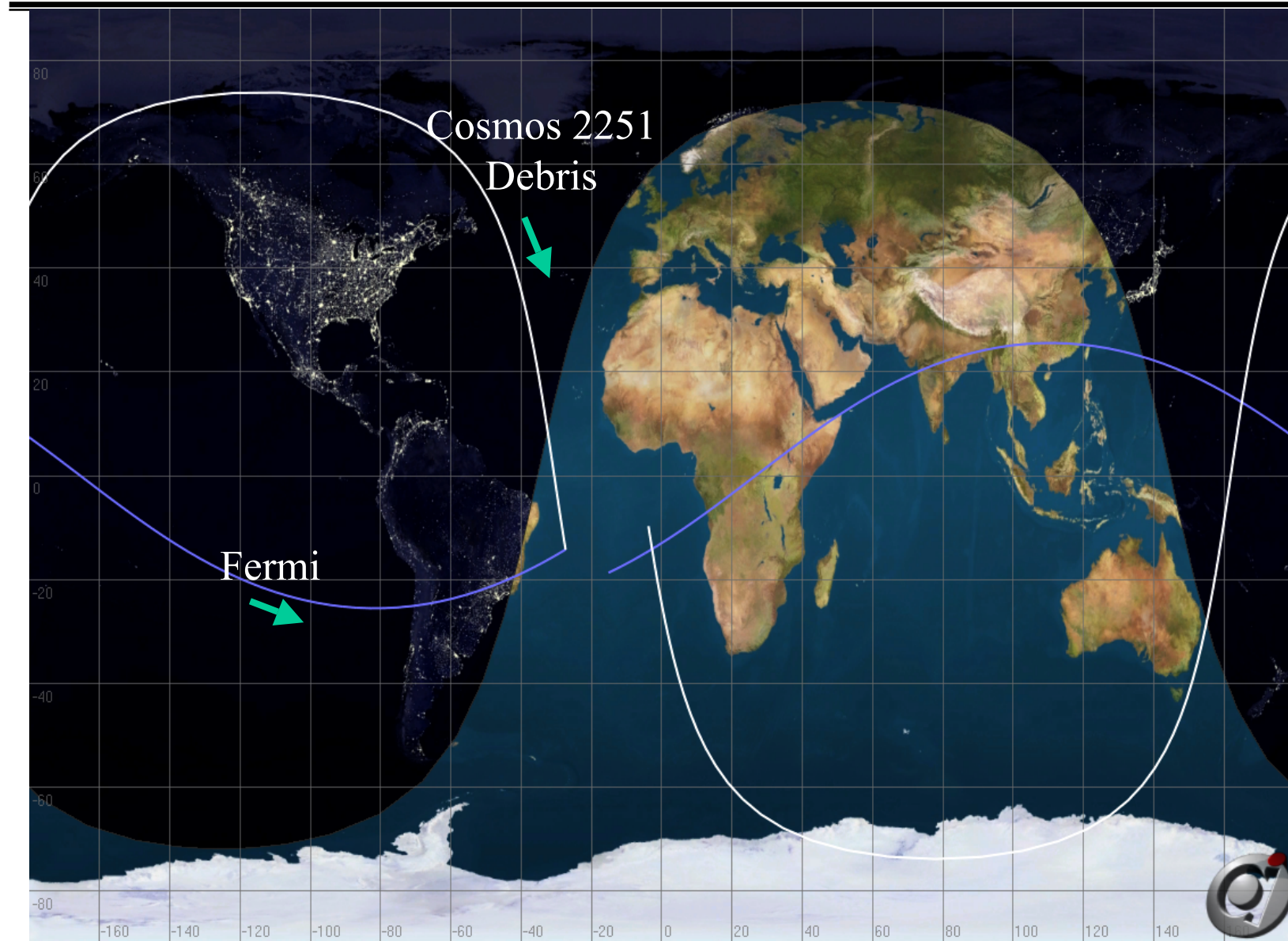
Battery Status

Pressure



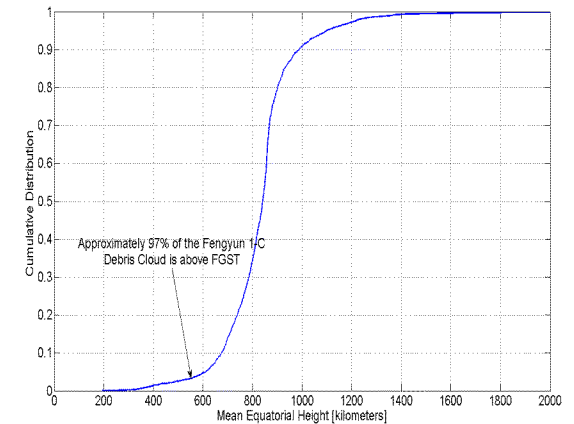
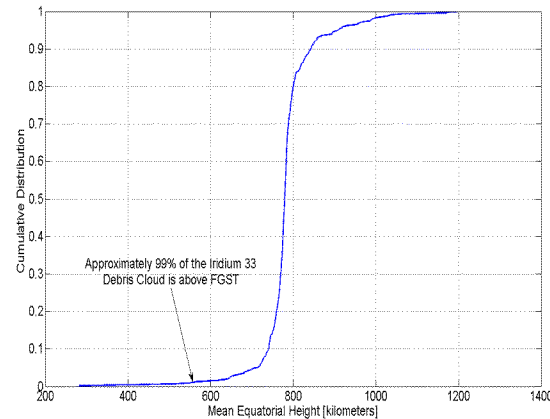
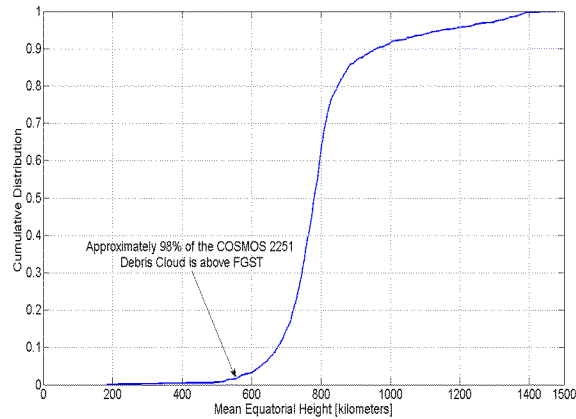
- **Transitioned to 45 deg rocking profile on April 29 to explore stability at a slightly more scientifically beneficial survey profile.**
- **Transitioned back to 50 deg on May 27.**
- **The battery performance is optimal at 50 deg rocking angle.**

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: Fengyun 1-C, Iridium 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

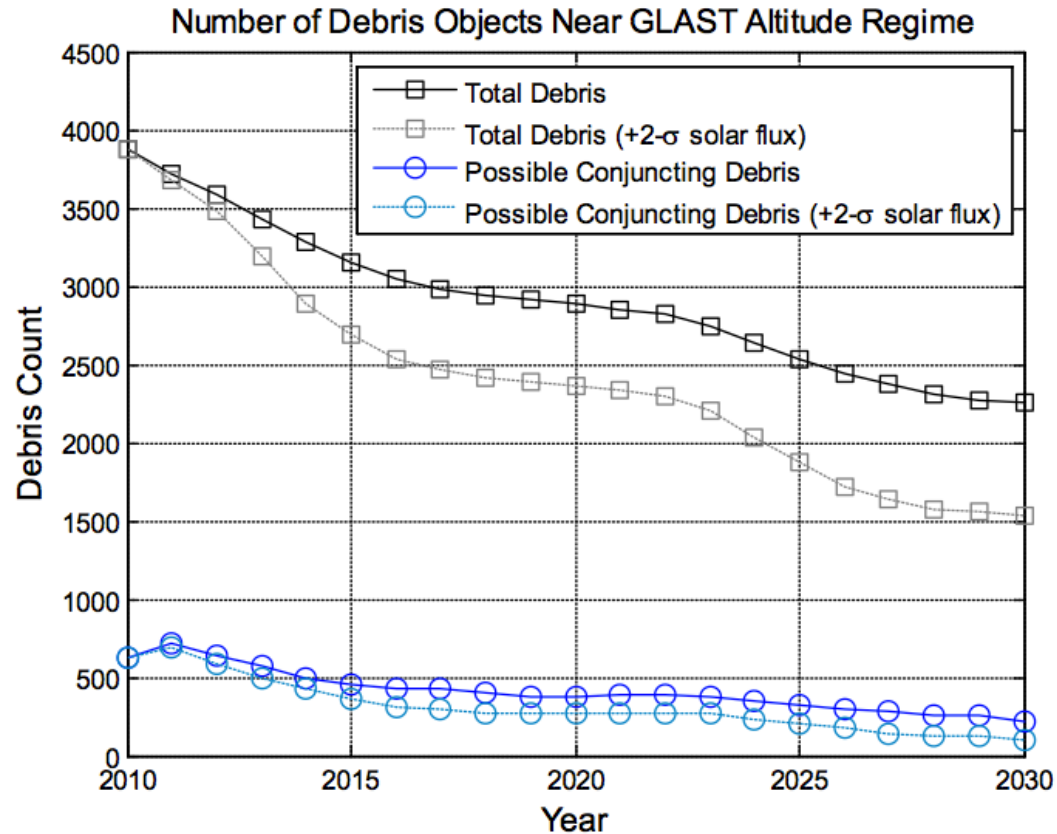
Modeling propagation of debris fields

- **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



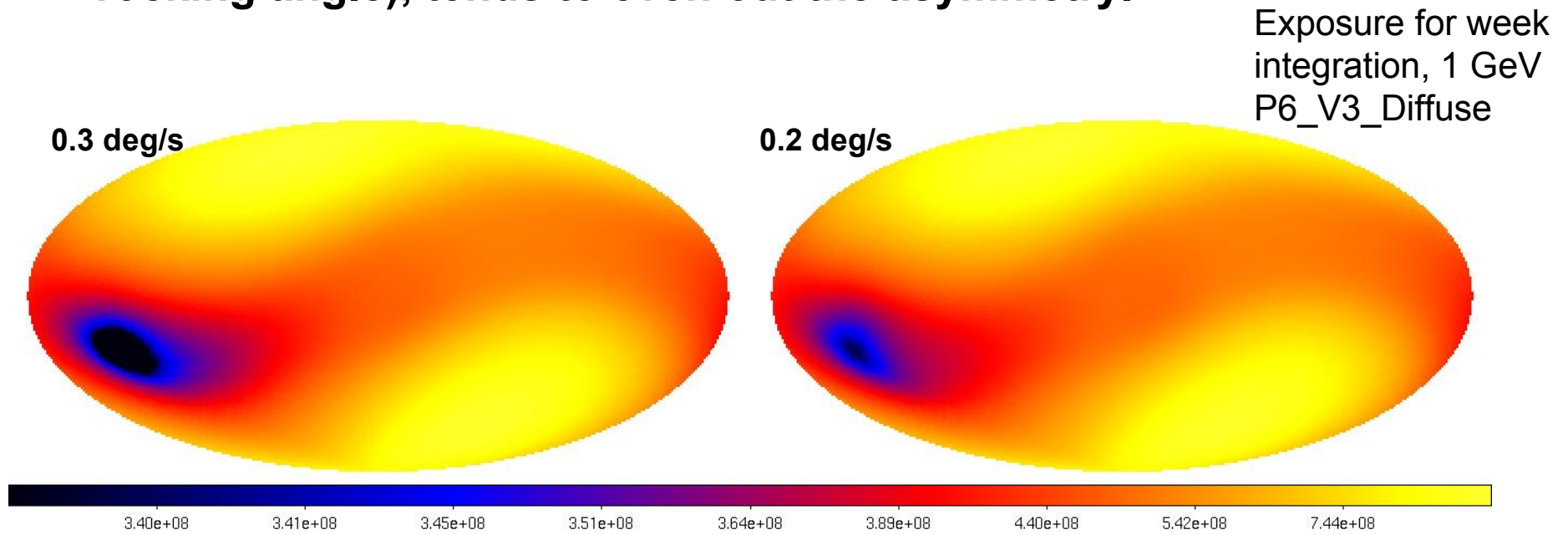
- The rate of close approaches is predicted to be stable/mild decrease through the mission life.
 - Likelihood of a collision avoidance maneuver will not increase.

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**

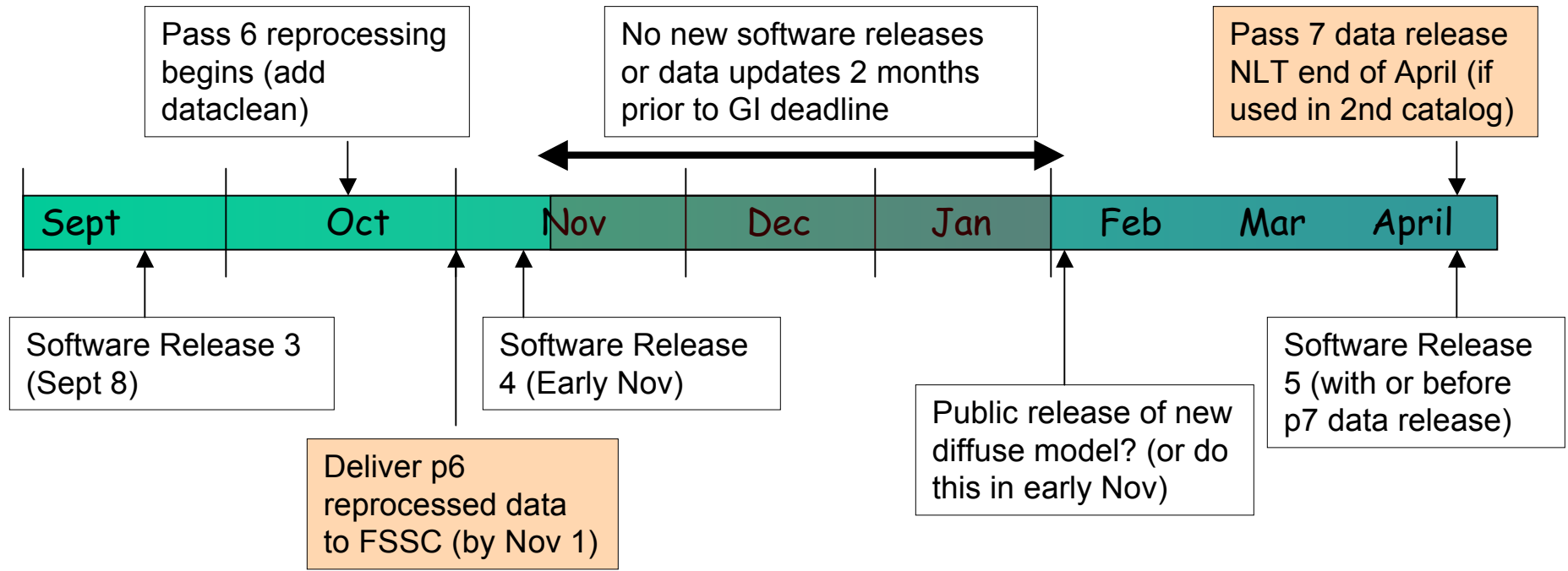
50 deg survey profile

- 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 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

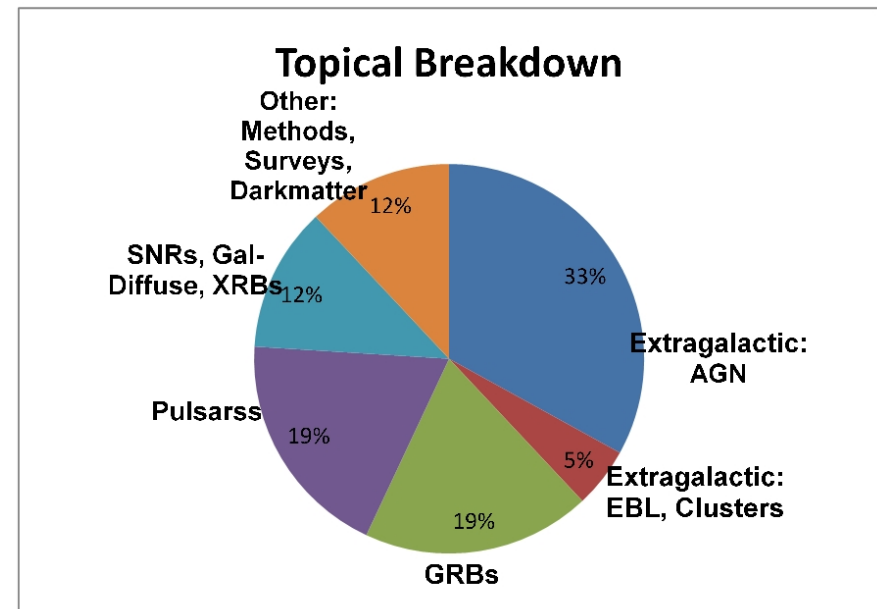
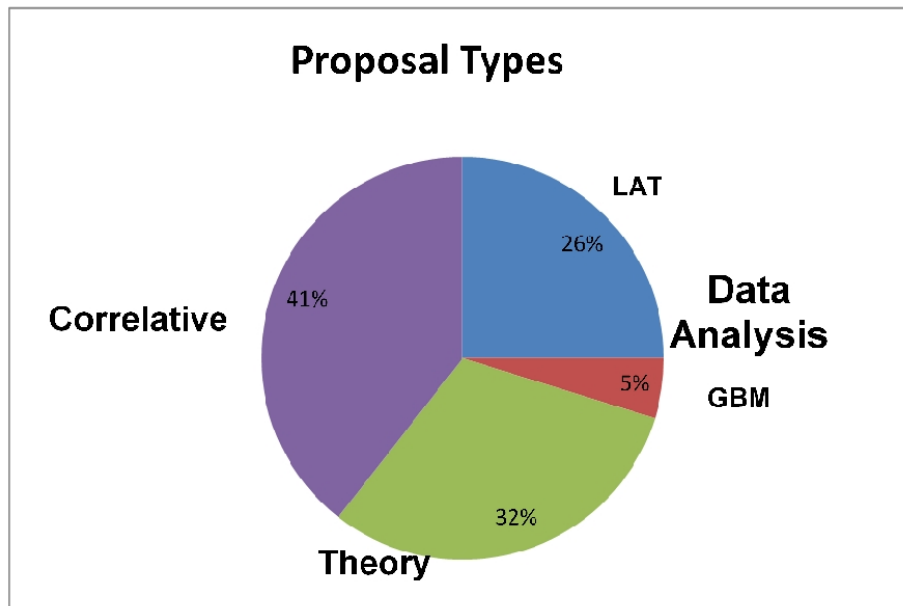
Software release 3	Sept 8	P6V1, P6V3
Software release 4	Early Nov	P6V1, P6V3, P6V3_dataclean, P6V11 (if available)
Software release 5	April 2010	P6V1, P6V3, P6Vfinal, P7

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

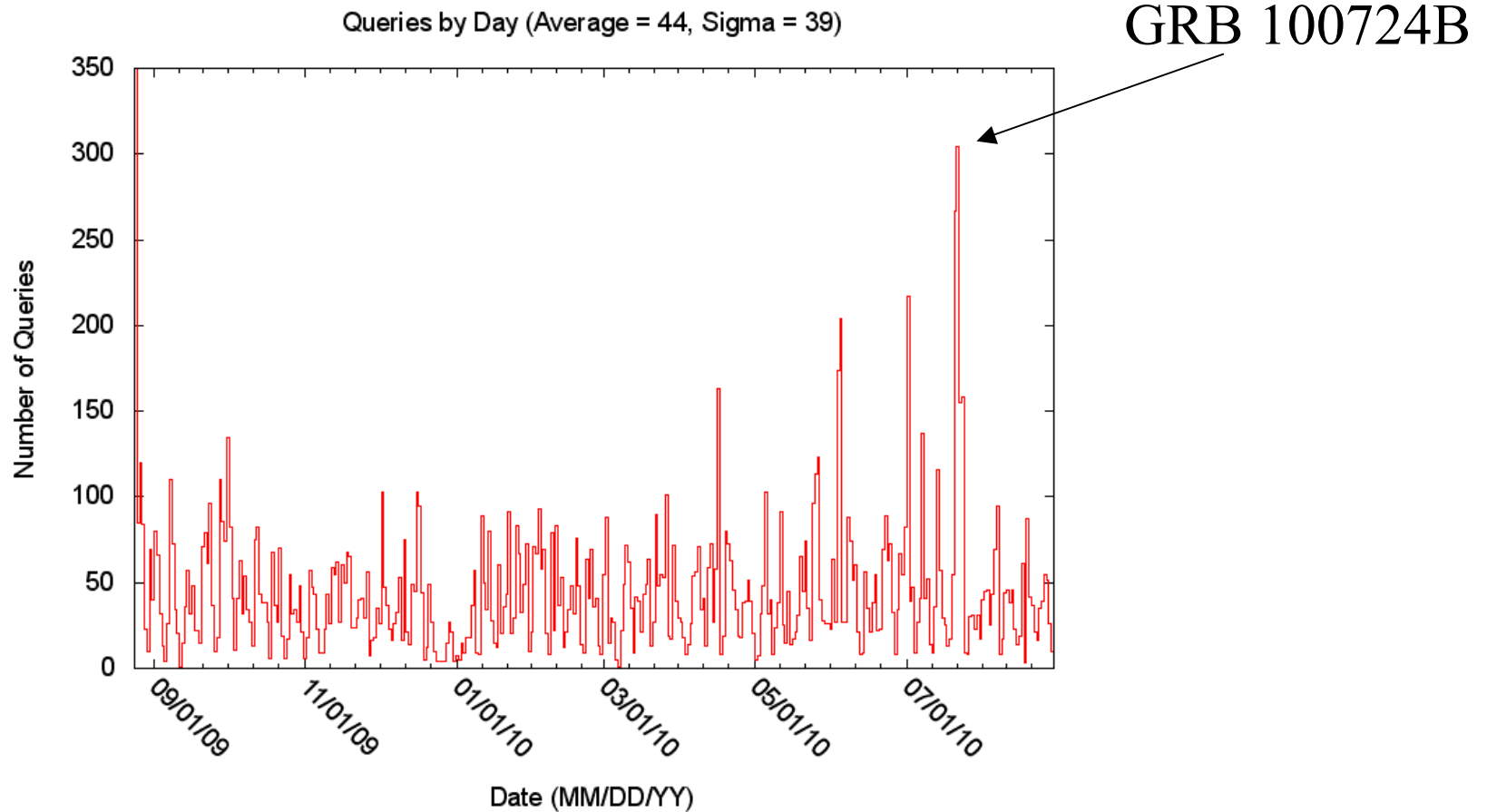
- **GBM data analysis tool (*RMFIT*) released in May as user-contributed tool with tutorial**
- **Continued improvements to web support and resources for users**
 - **FSSC Library <http://fermi.gsfc.nasa.gov/ssc/library>**
 - **Archive of analysis workshop presentations**
 - **Fermi-related publications**
 - **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)**

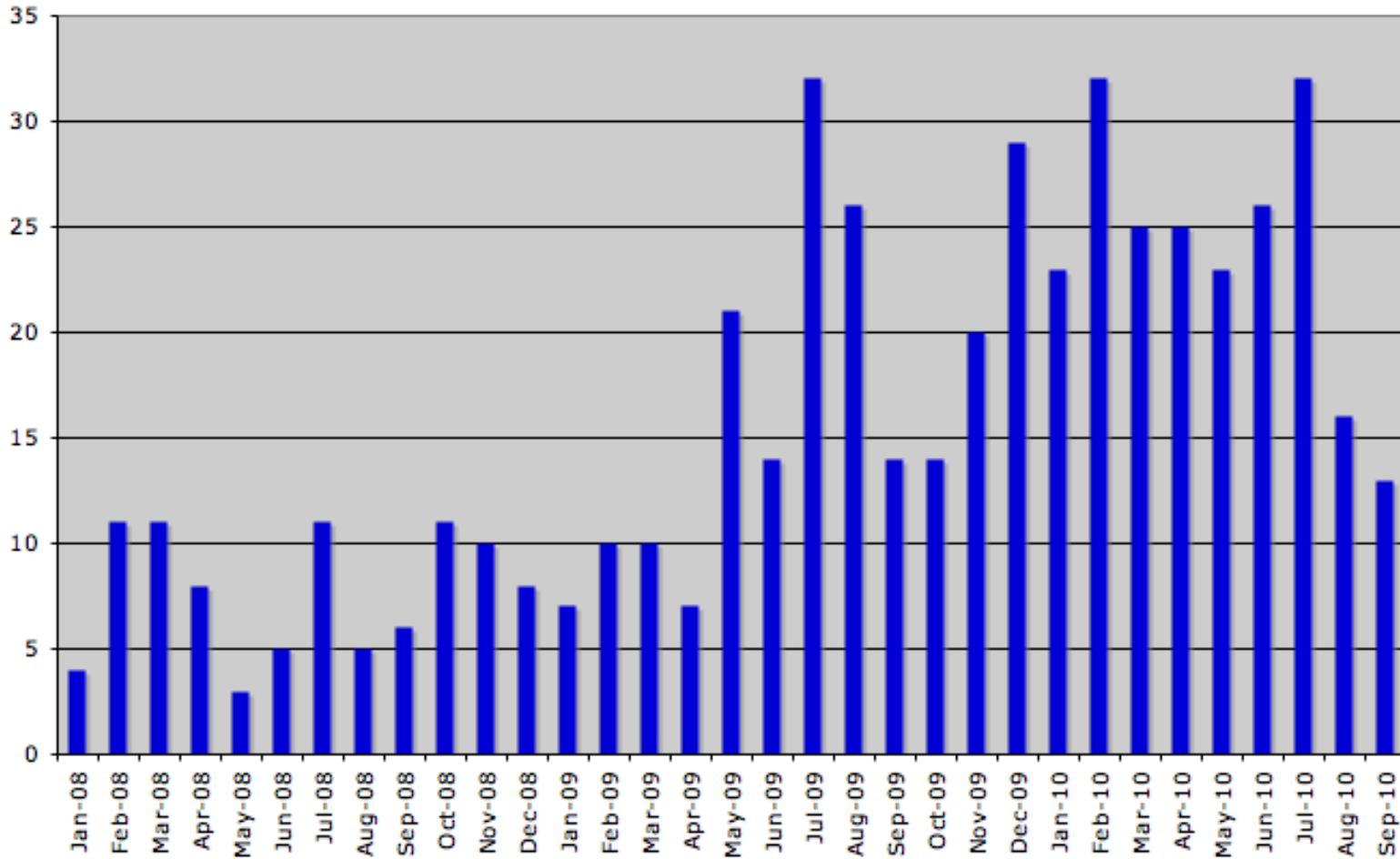
Data server

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

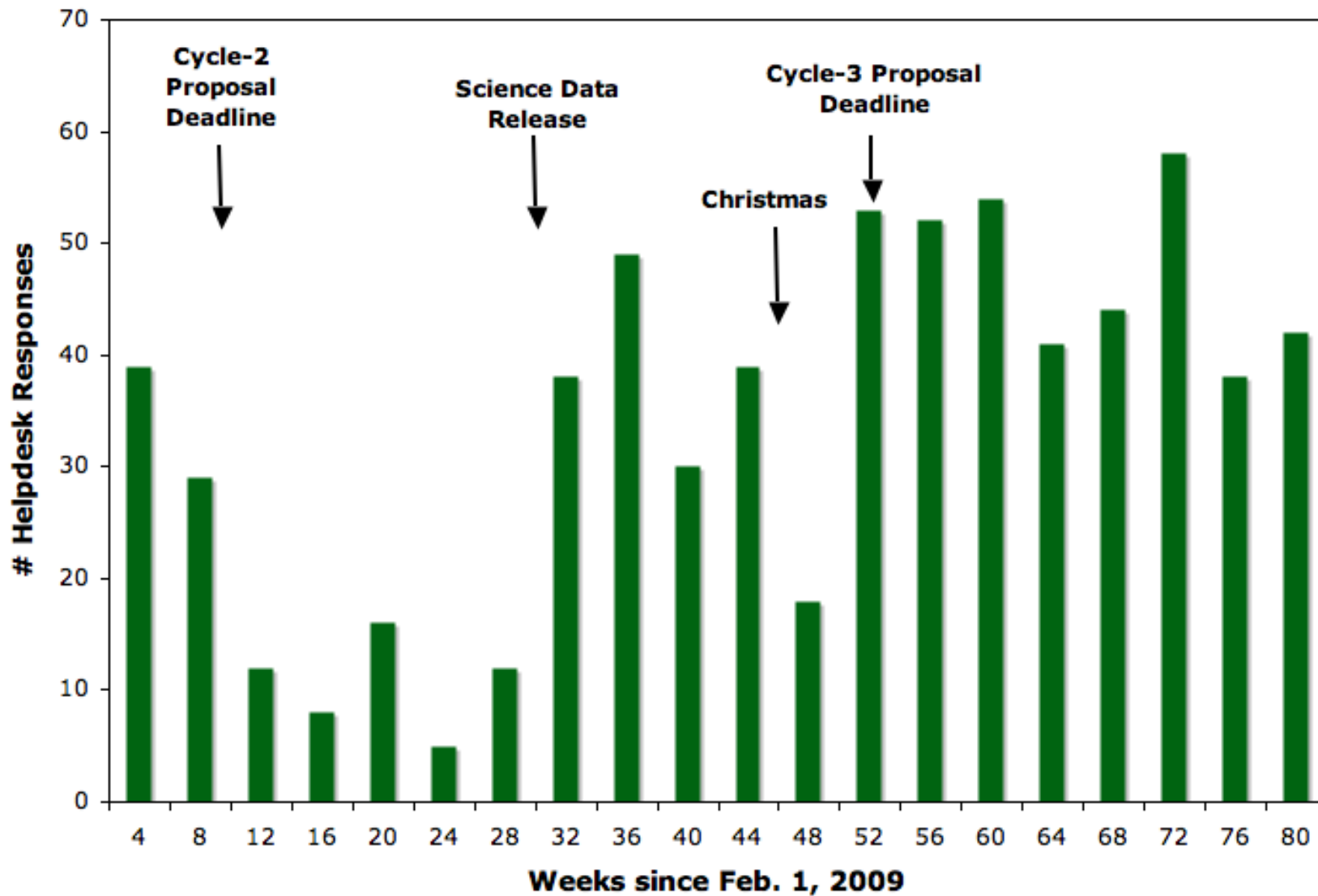


Papers in Referred Journals

Fermi Papers by Month

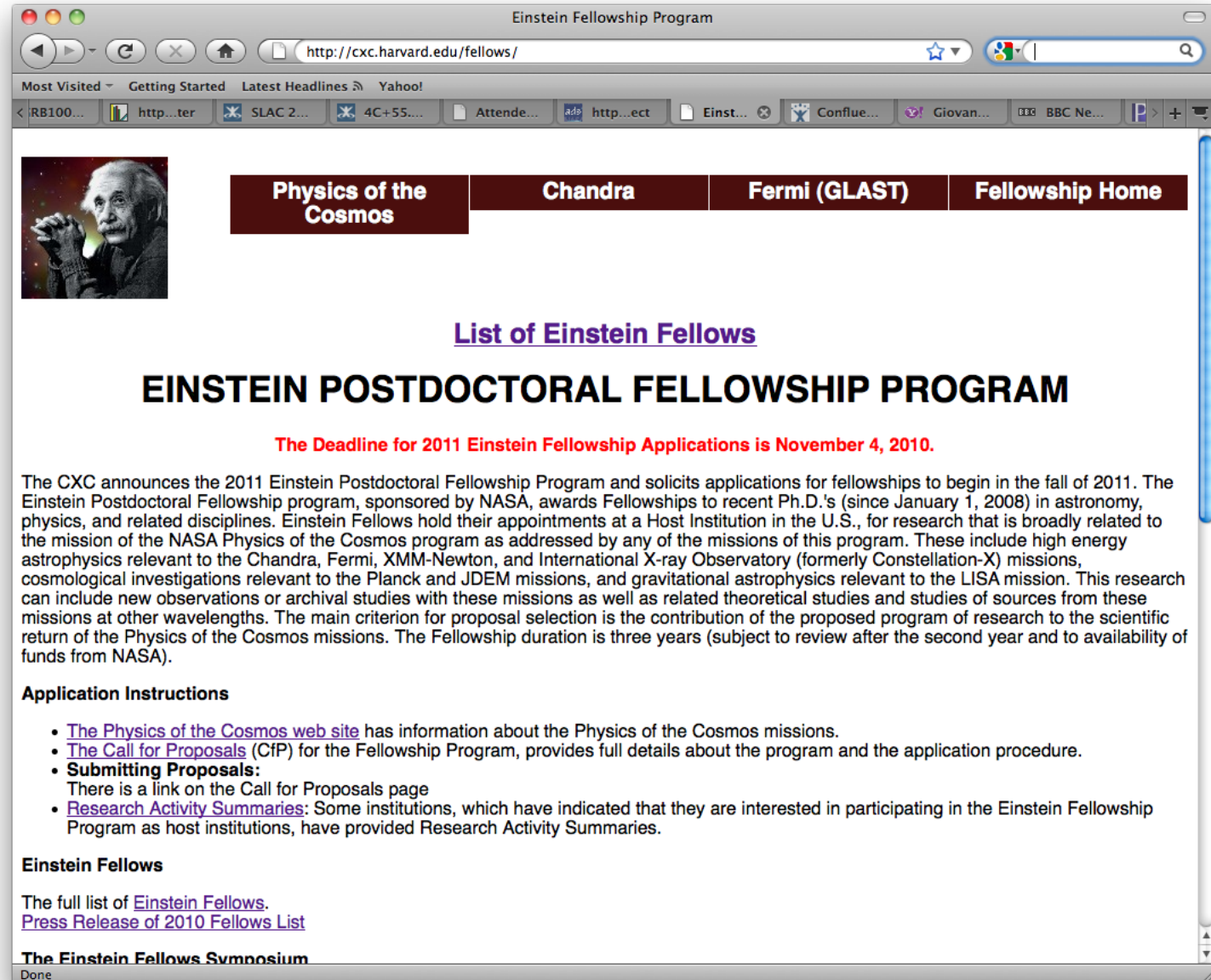


Fermi Helpdesk Queries



Einstein Fellowship Program

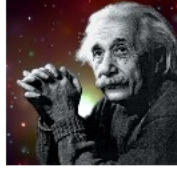
Deadline is Nov
4!



The screenshot shows a web browser window titled "Einstein Fellowship Program" with the URL "http://cxc.harvard.edu/fellows/". The browser's address bar and tabs are visible. The website content includes a navigation menu with links for "Physics of the Cosmos", "Chandra", "Fermi (GLAST)", and "Fellowship Home". A portrait of Albert Einstein is displayed on the left. The main heading is "EINSTEIN POSTDOCTORAL FELLOWSHIP PROGRAM", followed by a red announcement: "The Deadline for 2011 Einstein Fellowship Applications is November 4, 2010." Below this is a detailed paragraph about the program, followed by "Application Instructions" with a bulleted list of links and information. At the bottom, there are sections for "Einstein Fellows" and "The Einstein Fellows Symposium".

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 **Physics of the Cosmos** **Chandra** **Fermi (GLAST)** **Fellowship Home**

[List of Einstein Fellows](#)

EINSTEIN POSTDOCTORAL FELLOWSHIP PROGRAM

The Deadline for 2011 Einstein Fellowship Applications is November 4, 2010.

The CXC announces the 2011 Einstein Postdoctoral Fellowship Program and solicits applications for fellowships to begin in the fall of 2011. The Einstein Postdoctoral Fellowship program, sponsored by NASA, awards Fellowships to recent Ph.D.'s (since January 1, 2008) in astronomy, physics, and related disciplines. Einstein Fellows hold their appointments at a Host Institution in the U.S., for research that is broadly related to the mission of the NASA Physics of the Cosmos program as addressed by any of the missions of this program. These include high energy astrophysics relevant to the Chandra, Fermi, XMM-Newton, and International X-ray Observatory (formerly Constellation-X) missions, cosmological investigations relevant to the Planck and JDEM missions, and gravitational astrophysics relevant to the LISA mission. This research can include new observations or archival studies with these missions as well as related theoretical studies and studies of sources from these missions at other wavelengths. The main criterion for proposal selection is the contribution of the proposed program of research to the scientific return of the Physics of the Cosmos missions. The Fellowship duration is three years (subject to review after the second year and to availability of funds from NASA).

Application Instructions

- [The Physics of the Cosmos web site](#) has information about the Physics of the Cosmos missions.
- [The Call for Proposals \(CfP\)](#) for the Fellowship Program, provides full details about the program and the application procedure.
- **Submitting Proposals:**
There is a link on the Call for Proposals page
- [Research Activity Summaries](#): Some institutions, which have indicated that they are interested in participating in the Einstein Fellowship Program as host institutions, have provided Research Activity Summaries.

Einstein Fellows

The full list of [Einstein Fellows](#).
[Press Release of 2010 Fellows List](#)

The Einstein Fellows Symposium

Done

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.

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.



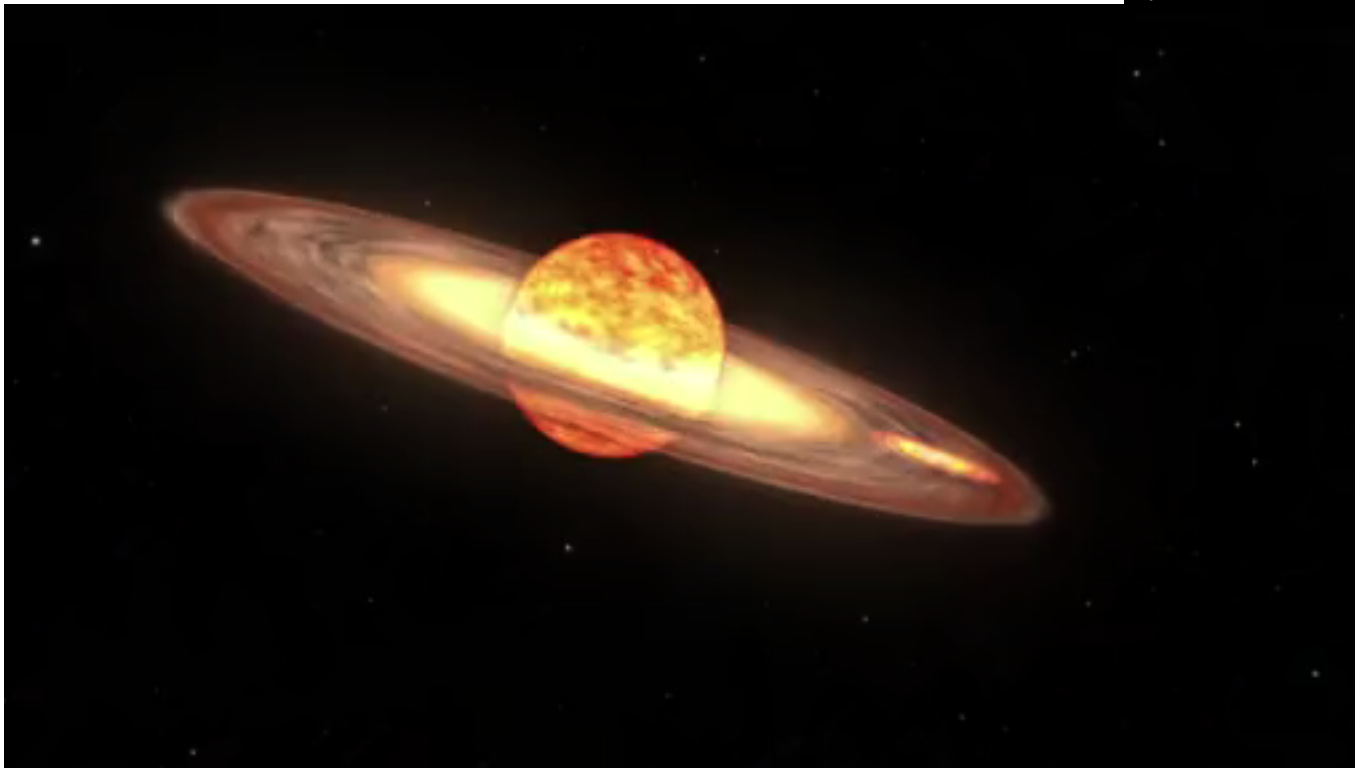
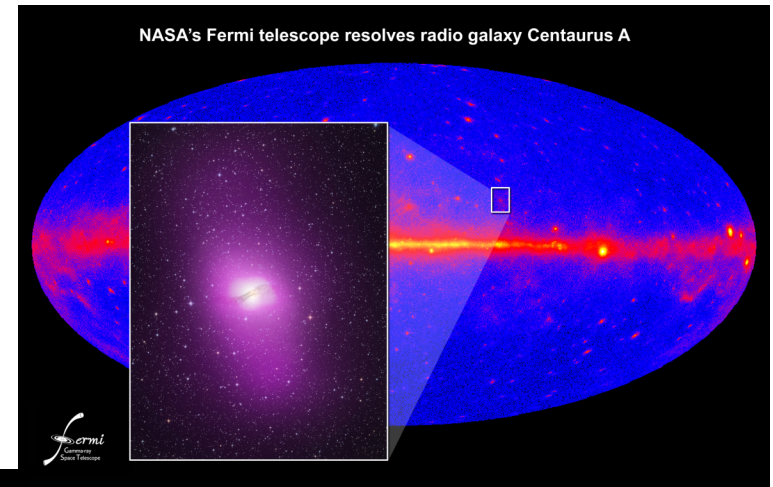
Educator Ambassadors build Galileoscopes. EA Rob Sparks (NOAO) led this activity.



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

Press Activity

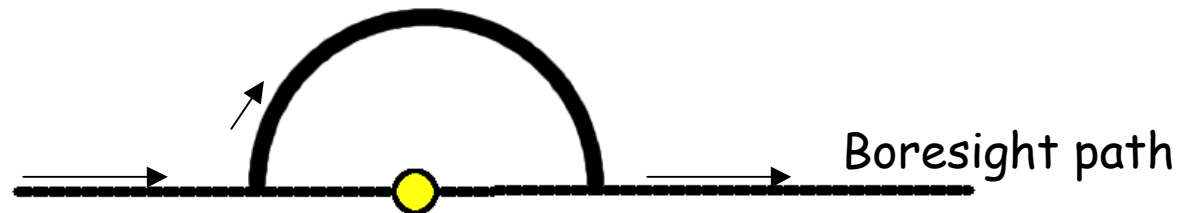
- **Biweekly telecons**
 - **Press representatives from partner agencies**
 - **Good input from LAT and GBM collaborations on upcoming pressworthy science topics.**



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).