Fermi

Gamma-ray Space Telescope

Users Group Meeting
June, 2014

Mission Status Update

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Some goals for this meeting

- **Comments and feedback from the users group on:**
  - **Observation strategy**
    - **End of year review**
  - **GI program**
    - **What to do if there are further cuts**
  - **Senior review**

- **Of course, comments on suggestions on any aspect of the mission are welcomed!**

Status Highlights

- **Observations:**
  - **Transitioned to GC modified survey on Dec 4**
    - **Almost immediately (24 hours later) accepted a ToO for Nova Cen**
  - **Switched back to 50 deg survey on April 24 to improve coverage of PSR B1259-63**
  - **Began pointed mode observations on May 30 to further improve coverage of PSR B1259-63**
  - **ToO: Nova Cen, Sun, Crab, M82, 3C279**
- **FOT/engineering activities**
  - **Review/revamp procedures for planning collision avoidance maneuvers**
  - **Review procedures for transition into science operations in the event of reaction wheel failures**
- **OIG audit of operating missions**
  - **Put on hold for now**

Mission Operations

- **Engaged in a ground-system refresh for *Fermi*, which will result in more maintainable system.**
  - **Preliminary design of a multi-mission infrastructure**
  - **Potential to cross train FOT from various missions (WIND, ACE)**
  - **Efficiencies in systems maintenance (patches etc)**

High Level Data Releases

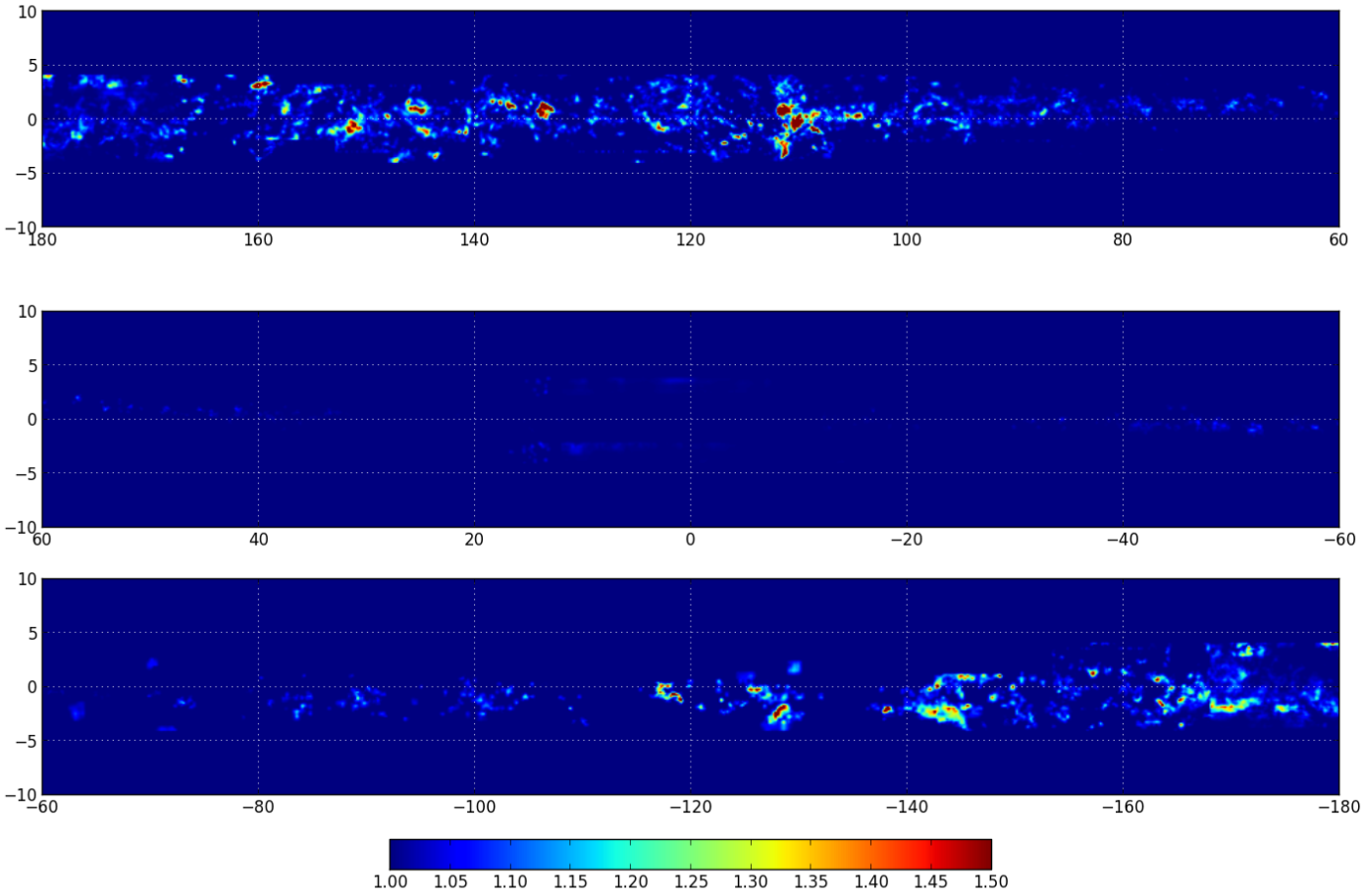
- Updated LAT Galactic diffuse emission model (with associated photon data)
- GBM localization contours for GRB
- Searchable 2nd GBM GRB catalog available from FSSC

- In the works (within a month or two)
  - 1s spacecraft file (higher time resolution compared with default from dataserver)

Galactic Diffuse Model

- **The new version, gll_iem_v05_rev1, corrects a bug in gll_iem_v05 that was built with anomalously low molecular hydrogen emissivities in the outer Galaxy.**

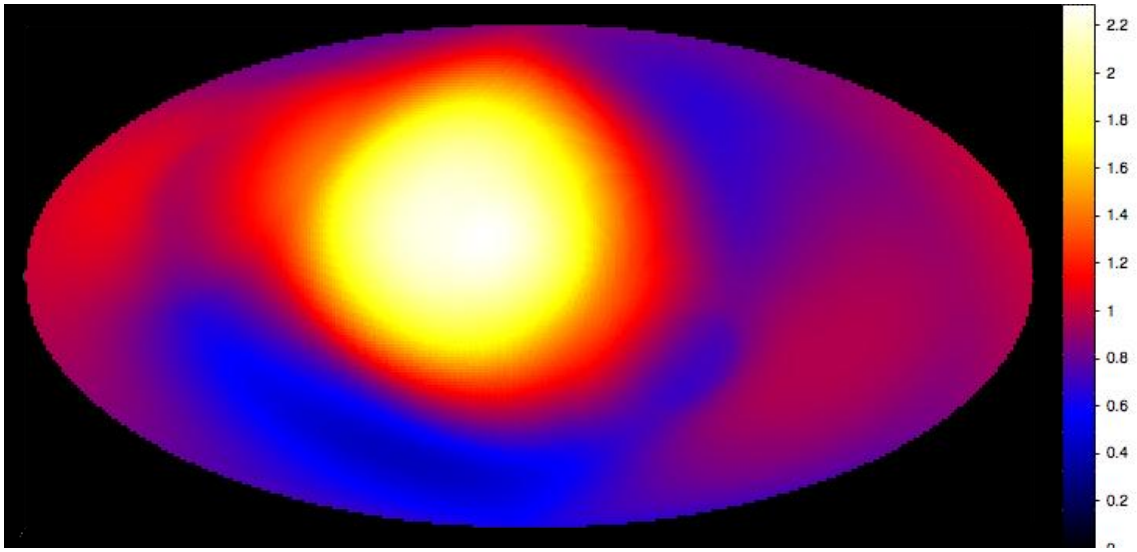
Difference between gll_iem_v05 and gll_iem_v05_rev1



Galactic Center Survey

- **All sky survey biased towards the galactic center (mix of pointed and survey mode each orbit).**
  - **>2x improvement in exposure at Galactic Center**
  - **Maintain all-sky coverage every 3 hours**

- Scientific goals include:
  - Discover new pulsars in the Galactic Center region
  - Search for gamma-ray flares as the gas cloud, G2, passes near Sgr A*
  - Enhance dark matter searches in the inner Galaxy



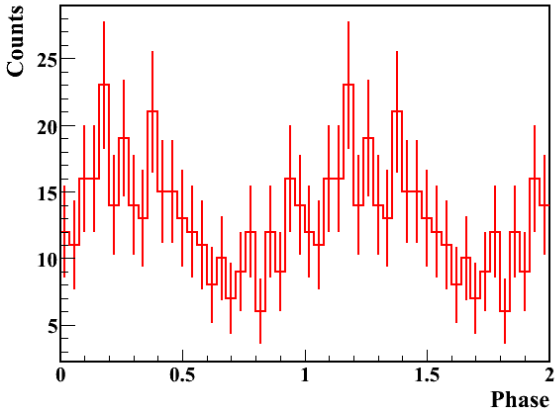
Ratio of exposure in Galactic Center biased survey mode relative to the previous all-sky survey

Review observing mode plan by Dec 2014

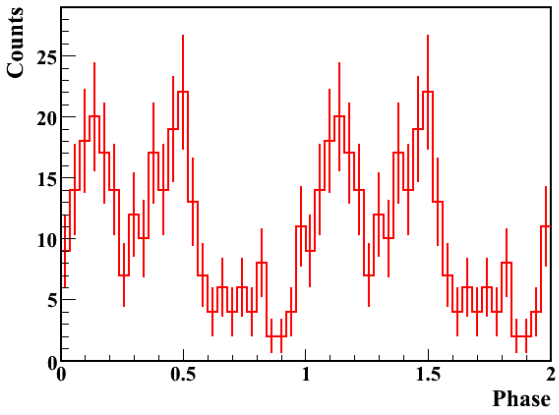
Pulsars near the Galactic Center

- Increasing the sensitivity
  - New observing strategy – higher photon rate helps overcome orbital motion and spindown noise
- Science
  - Determine the pulsar fraction of the Galactic center gamma-ray signal
  - More speculatively, discover a pulsar closely orbiting Sgr A* which would test fundamental properties of the black hole (c.f. Liu et al. 2012)

Example: PSR J1732-3131
gamma-bright, radio-quiet
pulsar 3.8° from Sgr A*



7 weeks of survey mode.
Search in (F0, F1).
P-value = 5.84e-2.



3 weeks of the new observing strategy.
P-value = 2.37e-8.

A minor wrinkle

- PSR B1259 reaches periastron in April/May 2014
- Eta Car reaches periastron in summer 2014

- Both are in a region of the sky disfavored by the new strategy, but timing of cycle 7 GI program is too late to allow observing proposals for these events.

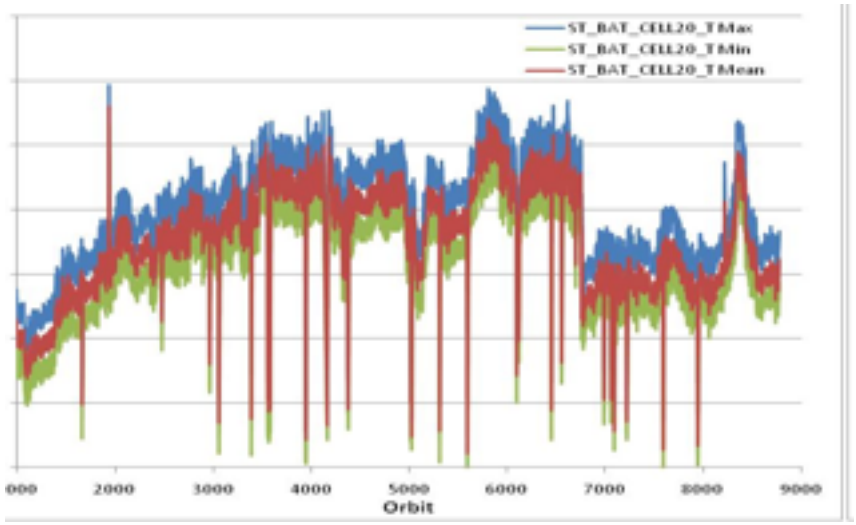
- Consider transition back to regular survey mode, or modified modes favoring those regions?

From Dec 2013 FUG meeting

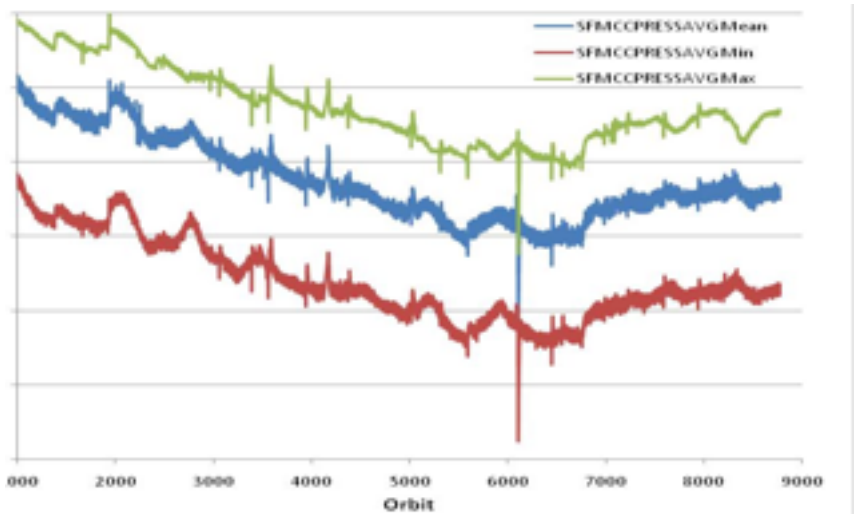
* Recommendation from FUG that we work with users to plan observations.
* After discussions, we decided to do nothing for Eta Car, make changes for PSR B1259-63

Battery Status

Temperature (2008-2010)



Pressure (2008-2010)

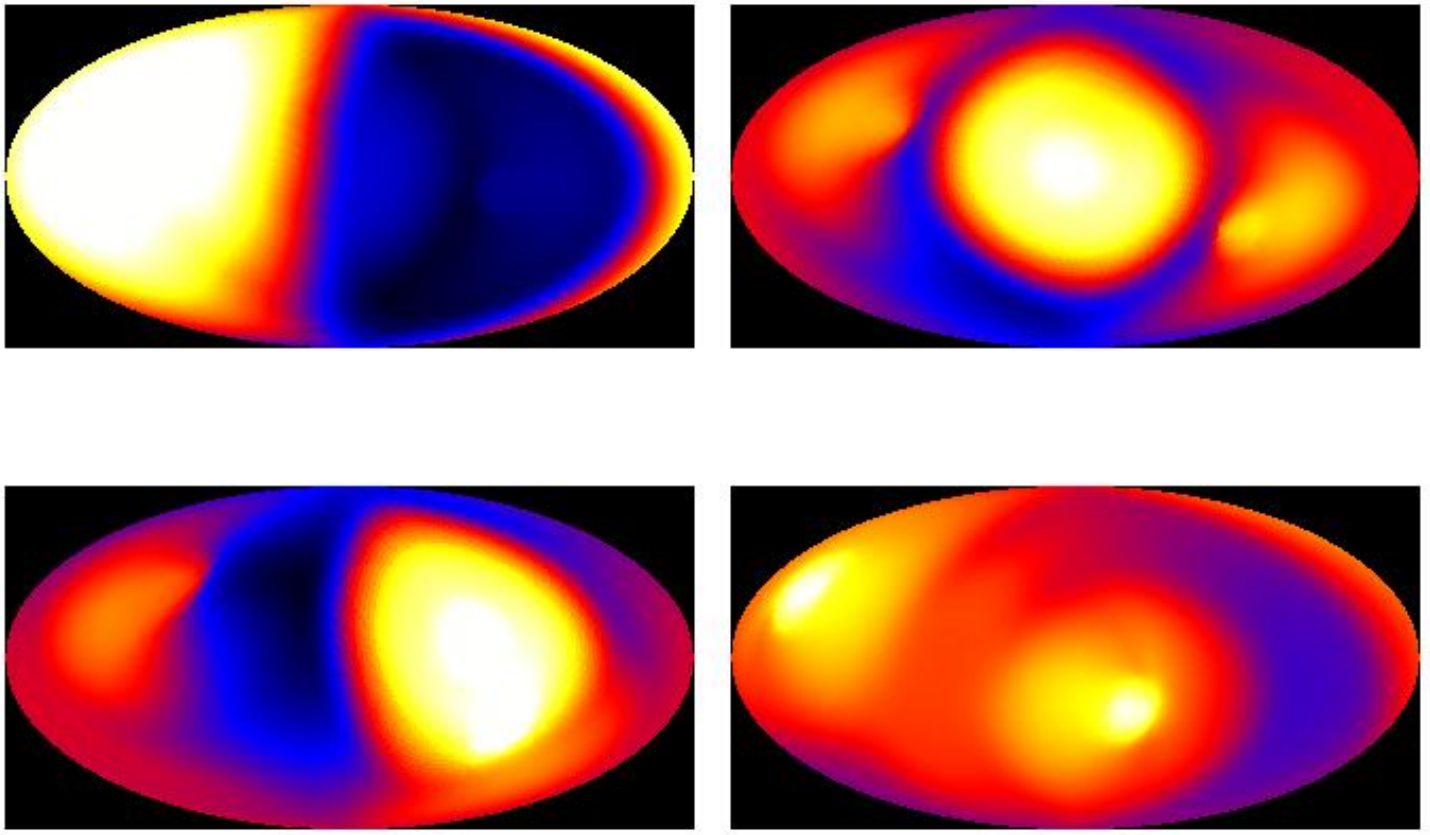


- **Increase in battery temp causes decrease in battery capacity**
- **Move from 35 to 50 deg rocking angle on orbit 6760 was extremely successful and over the next couple years regained the battery pressure**
- **Modified GC observations in April 2014**
  - **Battery reached record high temperature**
  - **Rate of loss of battery pressure faster than 35 deg rocking**

Observations

M82 (northern rocking)

GC pointing/survey mix



PSR B1259-63 pointing/survey mix

50 deg survey

- **Exposure at 10 GeV for selected observations in 2014**

End of Year Observation Strategy Review

- **Revert back to 50 deg sky survey, or**
- **Continue Galactic Center biased survey**

- **Users group review and provide recommendation in early Nov 2014?**
- **What information can the Fermi project provide to help with the discussions?**

Analysis workshops

- **Fermi/VERITAS/HAWC, Feb 2014 at UMD**
  - **Goal to optimize how we work together**
    - **Joint analysis techniques**
    - **Share operations experience etc**
    - **Very successful, planning next meeting in Oct at UW, Madison**
- **Fermi Summer School, Lewes DE (May 27-June6)**
  - **Focus on Galactic Center**

Public Outreach

- iPad App development continues
- Press releases
  - Black Hole ‘Batteries’ Keep Blazars Going and Going
  - Violent Gamma-Ray Outbursts Near Supermassive Black Holes (MPIfR)
  - Fermi Data Tantalize With New Clues To Dark Matter
  - With A Deadly Embrace, 'Spidery' Pulsars Consume Their Mates
  - NASA Spacecraft Take Aim At Nearby Supernova
- Upcoming press releases
  - Gamma-rays from stellar novae

Fermi Gamma-ray Space Telescope

Questions?

Senior Review

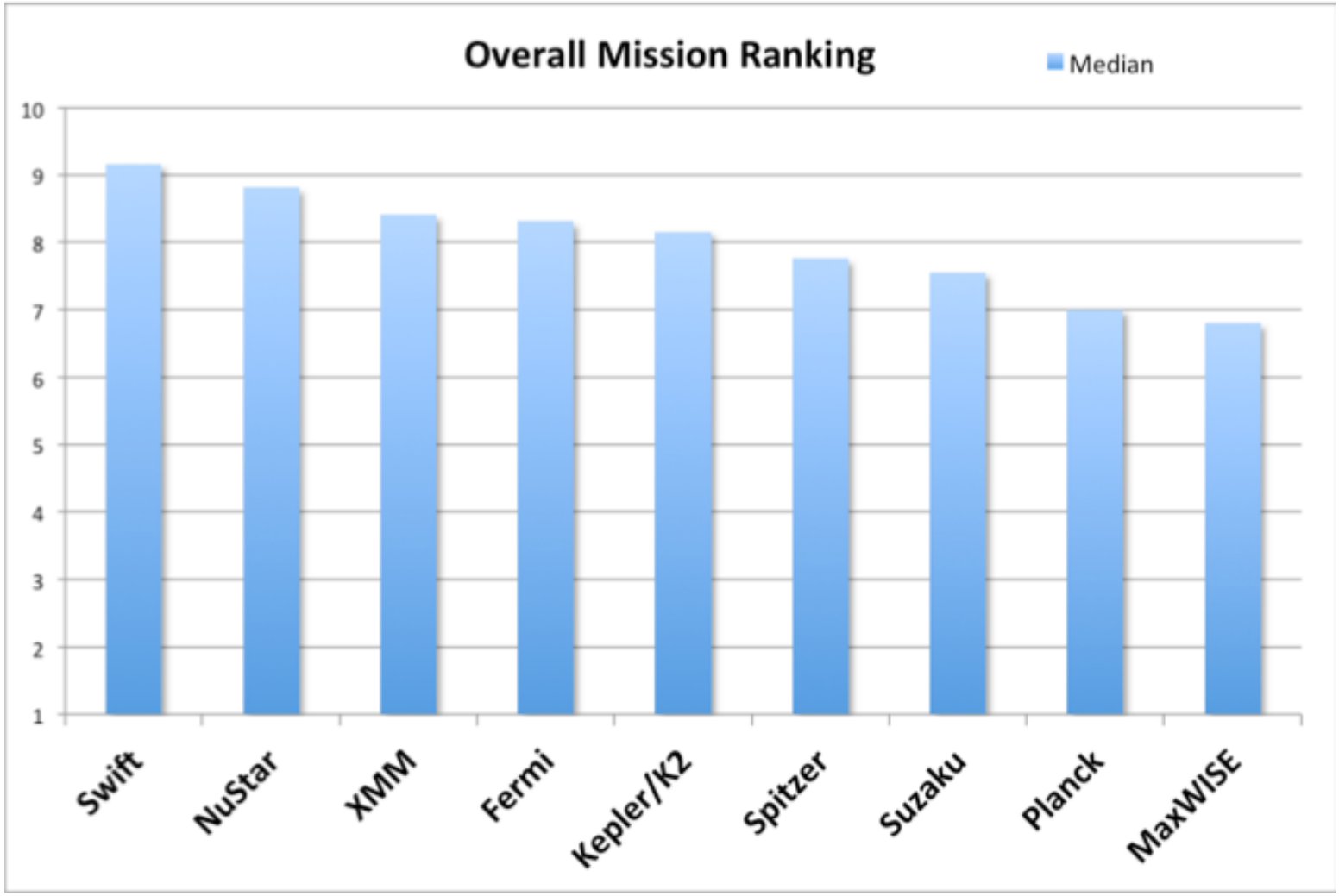
Key dates:
Proposal deadline – Jan 31
Panel presentation – April 1 (60 min presentation + 30 min discussion)

Panelists
Chair: Ben R. Oppenheimer (American Museum of Natural History)
Joel Bregman (University of Michigan)
Edward Guinan (Villanova University)
Martin Harwit (Cornell University)
Sebastian Heinz (University of Wisconsin—Madison)
Kenneth Johnston (U.S. Naval Observatory)
David Kieda (University of Utah)
H. Richard Miller (Georgia State University)
Richard Rothschild (University of California—San Diego)
David Sanders (University of Hawaii)

Evaluation Criteria

- **Science Program**
  - Uniqueness and overall strength of the science case (1.0)
  - Responsiveness to the Astro2010 and NASA Astrophysics Division priorities (0.20)
  - Synergy with other missions (0.3)
  - Quality of archiving plans (0.3)
- **Cost Elements**
  - Cost efficiency in terms of meeting proposed goals (0.5)
  - Adequacy of Science Support Program(s), including GO/GI elements or others (0.5)
- **Responsiveness to NASA Senior Review Process**
  - Assessment of meeting goals set or recommended in the 2012 Senior Review (0.25)
  - Quality of PMO description and goals for the 2016 Senior Review (0.25)

Final Ranking



- **We did ok…**

Recommendations

- **Case 1**
- Fermi: Fermi continues to be one of the most expensive missions in the portfolio, but it is also extremely productive. The SRP recommends continuation of the Fermi extended mission through FY18, but at a modestly reduced funding level. We recommend that this funding reduction be accommodated through additional efficiency gains in Science Operations and Data Analysis, including strategic reduction in FTEs which preserves core LAT science. As discussed in the 2012 Senior review report, a reduction in FTEs is a natural result of a mission in extended phase. We expect some additional reductions beyond FY16 with the completion of the Pass 8 analysis and the release of the 5 year LAT source catalog. Additional cost savings can be achieved through a reduction in the average size of the GI award funding.
- **Case 2**
- Fermi: SRP recommends an additional cut from the Case I recommendations of about 7%.

Selected comments from the report

- **Fermi provides an exceptional combination of broad high-energy gamma-ray sensitivity, wide field of view, excellent angular resolution, and source monitoring capability on time scales ranging from 10 microseconds to years. This combination of capabilities has opened up a new window on the astrophysical universe in Time Domain Astronomy (TDA), and provided pathfinder capability for rapid follow-up by multi-wavelengths satellite and ground-based observatories.**
- **The science impact of the proposed PMOs is exceptionally strong. The mission extension will provide legacy-level data products (Fermi all-sky catalog, GRB catalog) from the instrument team combined with strong collaborative science contributions enabled by the successful GI program.**

More excerpts

- The average Cycle 6 GI award is approximately $78k/year, which provides sufficient support to fund the full cost of a graduate student. While the SRP was supportive of this strong commitment to the GI program, **the SRP is recommending the average GI support be reduced to $40- 50k/year.** This level of support will allow an increased amount of GI participation in Fermi science under the existing budget constraints, and it is more in line with other extended mission GI programs.
- During the past two years the Fermi team has succeeded at reducing their operational budget by 27% while maintaining a strong GI program, according to Table 1 of the proposal**. However, the identical table in the Fermi proposal for the 2012 SR indicated a substantially lower number of FTE during 2012 Fermi Prime phase compared to the same column in the 2014 SR proposal.** Compared to the Fermi 2012 SR proposal, the Fermi team has met the expected FTE reduction for MO and for LAT activities, but has not met this goal for the GBM and FSSC.

Final outcome

- **~10% budget cut in FY15**
- **Further reduction in FY16**