

# Senior Review

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- **The Senior Review evaluates proposals for additional funding to continue operations of missions in extended operations phase**
- **Purpose**
  - **Prioritize/rank the operating missions and projects**
  - **Define an implementation approach to achieve astrophysics strategic objectives**
  - **Provide programmatic direction to the missions and projects for 2013 and 2014**
  - **Issue initial funding guidelines for 2015 and 2016**
- **Performance factors include scientific productivity, technical status, data dissemination, future plans and expectations, and budget.**
- **See <http://science.nasa.gov/astrophysics/2010-senior-review/> for more details on the last senior review.**

# Senior Review

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- **Proposals are focused on the science, both a review of what has been done and (more importantly) what new things we can do with 4 more years of observations**
- **We can propose new initiatives to enhance science return from Fermi**
- **Proposals are usually written with input from the user community**
  - **E.g. the Chandra, Swift, Suzaku, RXTE etc users groups play major role in writing the proposal (and the proposals generally state that they were prepared by the users group)**
  - **Some modifications needed in the case of Fermi because a large fraction of the Fermi user community are affiliated with the LAT or GBM instrument team**
    - **Plan to coordinate proposal development jointly with FUG, GBM and LAT (likely with a steering group involving people from each group)**
    - **Important to convey the impression that the Fermi user community is significantly broader than the instrument teams**



# Senior Review

Prime mission phase



Extended phase

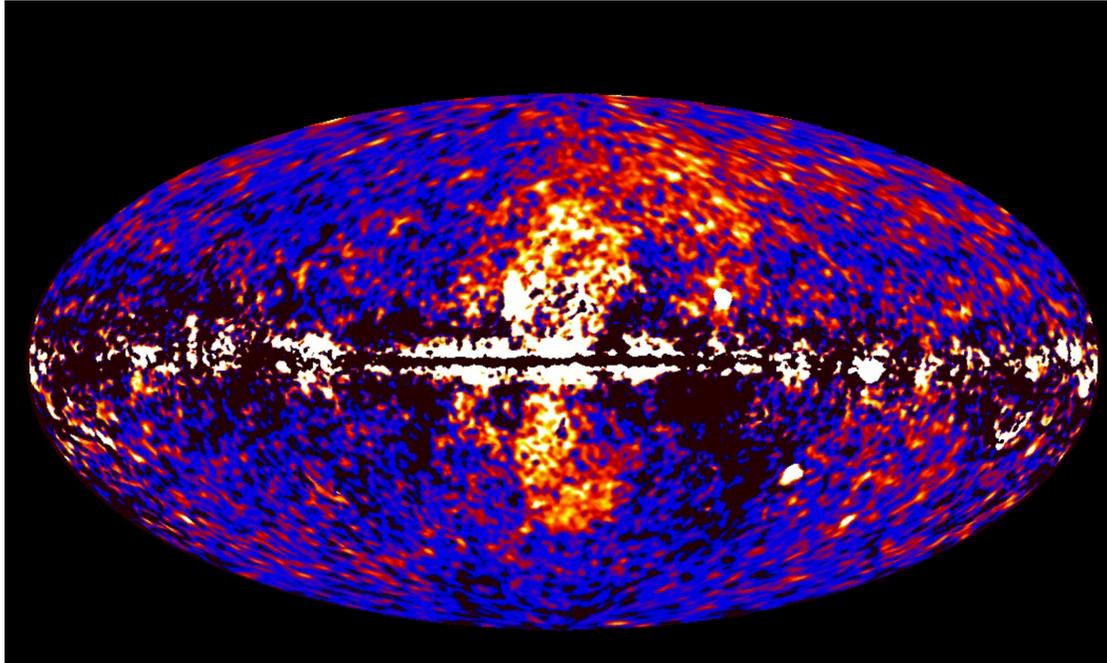
- **Senior review is a NASA review that evaluates proposals for missions to continue operating beyond prime phase.**
  - **All operating missions in extended phase are included**
- **Senior review happens every 2 years, next one is 2012**
  - **Provides recommendations on operations for 2013 and 2014**
  - **Issues initial funding guidelines for 2015 and 2016**
- **Fermi needs approval from the senior review to operate past 2013**
- **Outline:**
  - **subsection for each topical science area summarizing progress to date and highlighting expectations/possibilities for next 4 years.**
  - **Planned operational/analysis/data processing improvements and associated science benefits**
  - **Metrics demonstrating science achievements and operational performance**

# Initial thoughts on proposal format

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- **Science (~10-12 pages)**
  - **Introduction/overview**
  - **Subsection for each major topical area summarizing achievements over past 3 years and highlighting expectations/possibilities for the next 4 years.**
  - **Planned operational/analysis/data processing improvements and associated science benefits**
- **Technical (~3-5 pages)**
  - **Status of observatory and ground system**
  - **Data archiving/processing**
  - **GI program**
- **It will be important to define metrics to demonstrate Fermi's success: publications, citations, press releases, data downloads etc**

# High Energy Gamma-ray Astrophysics



(Finkbeiner et al)

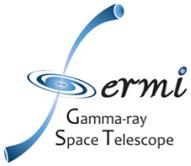
Detailed study of the spatial structure of the Fermi lobes is directly related to a study of the background model

- Fermi operates in survey mode. All sky exposure deepens and sensitivity to faint sources improves as mission progresses.
- Galactic diffuse emission dominates the gamma-ray sky
  - Needs to be modeled and characterized to allow study of discrete gamma-ray sources.
    - Improved accuracy combined with increasing exposure opens a study of faint flux sources.
- Similarly, catalog production becomes harder, and more important with time.

# Timeline

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- **Dates not yet set for proposal deadline, but likely mid-Jan for science proposal, mid-Dec for EPO proposal**
- **Outline will be discussed at Fermi Users Group meeting (Mid - June)**
- **Likely to be a F2F meeting between mid-Aug to mid-Sept**
- **First complete draft Oct (to allow ample time for review)**
  - **Internal review by LAT, GBM, FUG**
  - **Possibly also external “red team” review at Goddard**
- **Presentation to senior review panel Feb-March 2012.**



# General discussion on performance benefits of extending the mission as is:

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- **Increased exposure -> Improved sensitivity**
  - **New source classes**
    - Galaxy clusters? What else?
  - **Sensitivity improves faster at high energies**
    - Better overlap between GeV and TeV for steady sources
    - Improved spatially resolved studies (e.g. SNR above 5 GeV)
    - Increase dark matter search range?
    - What else?
- **Longer mission -> longer baseline for variability studies**
  - **Long period binaries (PSR B1259), putative binary BH in AGN**
  - **High level variability analysis - look for turnover in structure function at low frequency end (tie in to connection between binaries and AGN)**
  - **New surprising transients c.f. V407 Cyg, Crab**
    - Additional examples of relatively rare astrophysical transients that we might see with Fermi?

# Performance in Extended Mission

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- **Plots to illustrate performance over next 2-4 years using \*currently available\* recon/analysis**
  - **Differential sensitivity vs energy for 1, 5, 7 and 9 years (could also include a version with expected pass 8 performance)**
  - **What other science plots would look noticeably improved comparing 5 with 7 or 9 years?**
    - **Simulated SNR or LMC spatially resolved**
    - **Simulated 5, 7, 9 year AGN structure function?**

# Synergies with other Observatories

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- **Advanced LIGO**
  - **GBM most prolific detector for GRB (especially short GRB)**
  - **Significantly improve ALIGO sensitivity (by providing trigger time, localisation) - need to quantify this; and quantify the rate of short GRB within LIGO FoV**
  - **Huge science breakthrough with joint GW, EM observations of GRB**
- **Wide field survey instruments (Fermi is a wide field instrument ready to join with the upcoming bonanza of wide-field field instruments)**
  - **SKA/LOFAR - science case?**
  - **Pan-STARS, SKYMAPPER, LSST - science case?**
  - **SVOM, Swift BAT**
  - **HAWC**
  - **What else?**
- **TeV Observatories (H.E.S.S. II, MAGIC II, CTA, VERITAS)**
- **Operating observatories**
  - **Unique spot in the EM spectrum (only GeV instrument for the foreseeable future),**
  - **Role of Fermi within the portfolio of current missions and observatories - Chandra, HST, Swift, VLBA etc (what new things can we do in the future?)**



# Operations and Analysis Initiatives

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- **LLE**
  - **Dramatic improvement in low energy response of LAT, greatly improving overlap with GBM and allowing very productive broad band gamma-ray spectral fitting**
    - **Illustrate with work from upper limit, catalog, physical model etc papers**
- **Recon/classification improvements pass7/pass8**
- **Explore increasing fraction of time that GBM collects TTE data**
  - **Improve search for sub threshold short transients (TGF, short GRB - ALIGO, X-ray bursts)**
- **New observing modes**
  - **Ideas?**
- **What other changes or improvements should we consider?**

## Science case - possible sections

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- **Gamma-ray bursts**
- **Active Galaxies (blazars, radio galaxies, NLS1 etc)**
- **Galaxies - Milkyway, local group, starbursts**
- **Pulsars, including GBM observations/prospects for SGRs**
- **Binary systems (including eta car, GBM X-ray bursts, GBM accreting pulsars?)**
- **SNR/PWNe**
- **Intergalactic space - EBL, isotropic gamma-ray, IGM, LIV?**
- **Dark Matter and New Physics**
- **Solar studies (nuclear lines, GeV emission from flares, quiescent emission)**
- **Catalogs, new populations?**
- **Other (TGFs, other solar system bodies etc)**

# Science sections

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- **For each science topic:**
  - **What were the key science questions pre-launch?**
    - **Did we do/find what we expected?**
    - **What were the unexpected/surprising finds?**
  - **What major theory/modeling ideas have emerged in response to the Fermi results. E.g.**
    - **magnetically dominated flows in GRB**
    - **Pulsar models**
  - **What major experimental/observational impacts have resulted from Fermi results/observations. E.g.**
    - **MSPs and NANOGRAV**
  - **What are the updated key science questions?**
  - **What new breakthroughs can we expect from Fermi based on**
    - **1. Extended observations/increased exposure**
      - **Can include observation of uncommon events (e.g. early afterglow simultaneously at GeV and X-ray/optical energies)**
    - **2. New and existing MW observatories**
    - **3. Proposed operational/analysis changes/improvements**

# Metrics

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- **Fermi Papers in refereed journals per month**
  - **2008 to 2010 are here:**
    - [http://adsabs.harvard.edu/cgi-bin/nph-abs\\_connect?library&libname=Fermi\\_2008&libid=4bedb2e13a](http://adsabs.harvard.edu/cgi-bin/nph-abs_connect?library&libname=Fermi_2008&libid=4bedb2e13a)
    - [http://adsabs.harvard.edu/cgi-bin/nph-abs\\_connect?library&libname=Fermi\\_2009&libid=4bedb2e13a](http://adsabs.harvard.edu/cgi-bin/nph-abs_connect?library&libname=Fermi_2009&libid=4bedb2e13a)
    - [http://adsabs.harvard.edu/cgi-bin/nph-abs\\_connect?library&libname=Fermi\\_2010&libid=4bedb2e13a](http://adsabs.harvard.edu/cgi-bin/nph-abs_connect?library&libname=Fermi_2010&libid=4bedb2e13a)
  - **Additional publication resources at FSSC**
- **Student theses based on Fermi**
- **Fermi papers in top 20 most cited list for 2008, 2009, 2010, 2011**
- **Need metrics on GI program impacts**

## Additional things to discuss

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- **Wiki to collect inputs?**
  - **Open/public or closed/private?**
- **F2F meeting of people working on senior review proposal to discuss senior review inputs, coordinate writing and contributions**
  - **Two day meeting in week of Aug 22 or week of Sept 12?**

# Backup

## Evaluation criteria

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- **(1) Rank the scientific merit of each project on a science per dollar basis (based upon expected returns during 2013 and 2014) in the context of science goals, objectives and research focus areas described in the SMD Science and Strategic Plans**
- **(2) Assess the cost efficiency, technology development and dissemination, data collection, archiving and distribution, and education/outreach as secondary evaluation criteria, after science merit/usefulness.**
- **(3) Based on (1) through (2), provide findings to assist with an implementation strategy for Astrophysics Division support of missions in extended operations for 2013 and 2014, including an appropriate mix of**
  - **Projects continued as currently baselined;**
  - **Projects continued with either enhancements or reductions to the current baseline;**
  - **Project terminations.**

# Budgets

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- **Proposals typically have two tiers: one that follows the existing NASA budget guideline for the period under review, and an augmented tier which allows for a budget greater than the guideline to address specific additional tasks or science products.**
  - **The HQ guidance, to be developed by the Astrophysics Division and communicated to each project, serves as the budget guideline for the proposals.**

# Proposal format

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- **Science+technical+budget - 15 pages**
  - **Science**
    - The science proposal should list the current science objectives for the mission, and a summary of what has been accomplished to date, focusing principally on advances accomplished in the past two to three years. The reporting of results to the scientific community via refereed journal articles and other means should be summarized in a way that makes it possible to assess the productivity over the last few years.
  - **Technical/Budget**
    - provide descriptions and a cost summary of an in-guide Scenario and an Augmented Scenario.
      - Describe the science returns from the in-guide and augmented scenario
- **EPO - 4 pages**