



Fermi
Gamma-ray Space Telescope



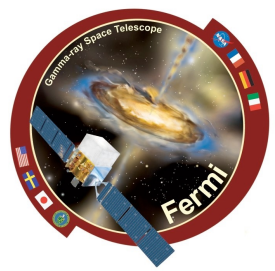
Fermi Senior Review 2025

Fermi Users Group
29 August 2024

Liz & Judy

Mini-agenda for rest of meeting

- Mission presentation on Senior Review progress and plans
- LAT presentation
- GBM presentation
- Brainstorming and discussion

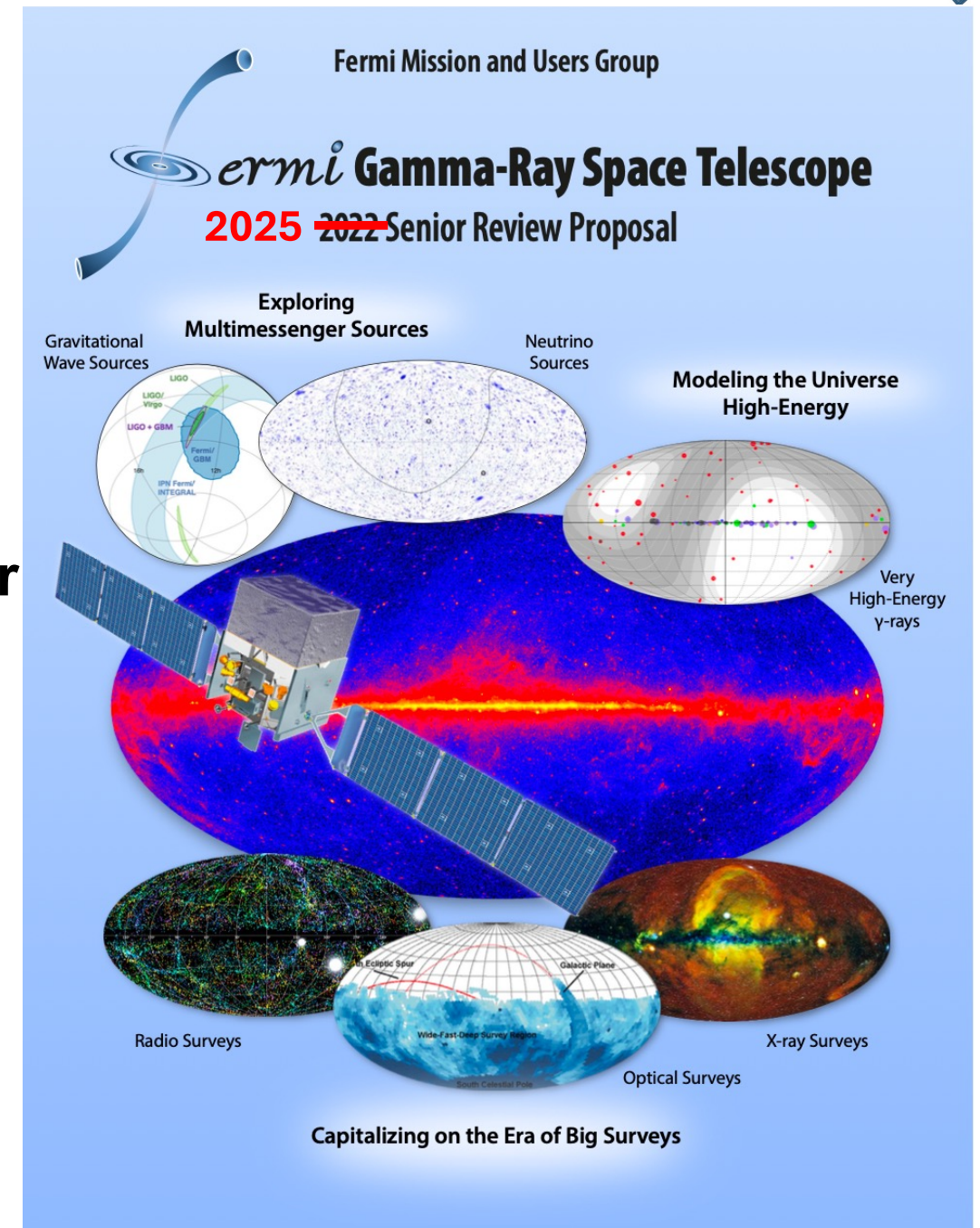


- **“NASA’s Science Mission Directorate (SMD) periodically conducts independent, comparative reviews of its operating missions. NASA uses the findings from these reviews to define an implementation strategy and give programmatic direction to the missions and projects concerned for the next five fiscal years.”**
 - <https://science.nasa.gov/astrophysics/resources/documents/2025-senior-review-of-operating-missions/>
- **Determines the continuation and future funding of missions through evaluation of scientific merit, relevance and responsiveness to the division’s strategic goals, and technical capability and cost reasonableness**
- **Currently conducted every 3 years**
 - **Fermi participated in 2012, 2014, 2016, 2019, 2022**
 - **Other missions evaluated in the 2025 Senior Review are Chandra, Hubble, IXPE, NuSTAR, Swift, TESS, and XMM-Newton (NICER undergoing repair operation this fall)**
 - **In 2022 Fermi was ranked in Tier 3**
 - **2025 Review covers 2026-2028, with notional funding profile for 2029-2030**
- **Fermi Senior Review Content: <https://confluence.slac.stanford.edu/display/FSR/Home>**
 - **All drafts will be posted here**



- Draft Call for Proposals: July, 2024
- **Proposal Outline: August 2024**
- Final Call for Proposals: August 2024
- **First draft of SR proposal: September 2024**
- Additional Drafts: September-November
- **Internal review by LAT, GBM, FUG: October-November**
- Goddard Red Team Review: mid-November 2024
- SR Proposals Due: December 12, 2024
- Senior Review panel meets: Dec.-Feb. 2025
- Panel Report: March 2025
- HQ Response to Panel Report: March 2025

FUG input most critical now during draft development and to prepare for red team review.



Fermi Mission and Users Group

ermi Gamma-Ray Space Telescope
2025 ~~2022~~ Senior Review Proposal

Exploring Multimessenger Sources

Gravitational Wave Sources

Neutrino Sources

Modeling the Universe High-Energy

Very High-Energy γ -rays

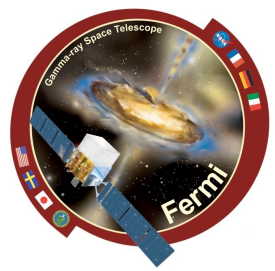
Radio Surveys

Wide-Fast-Deep Survey Region

Optical Surveys

X-ray Surveys

Capitalizing on the Era of Big Surveys



- **Prioritized Mission Objectives**

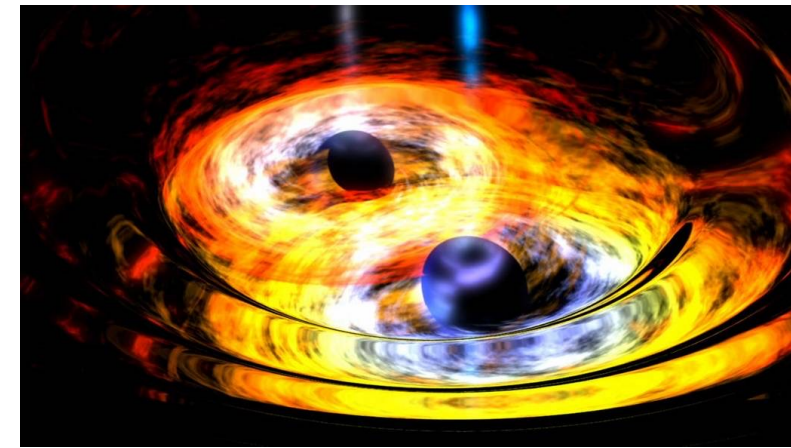
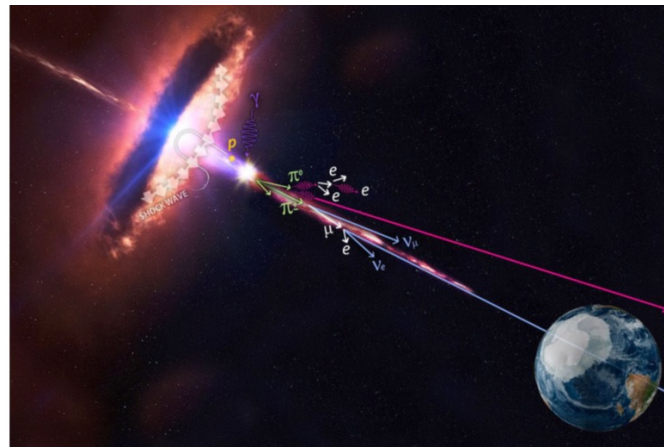
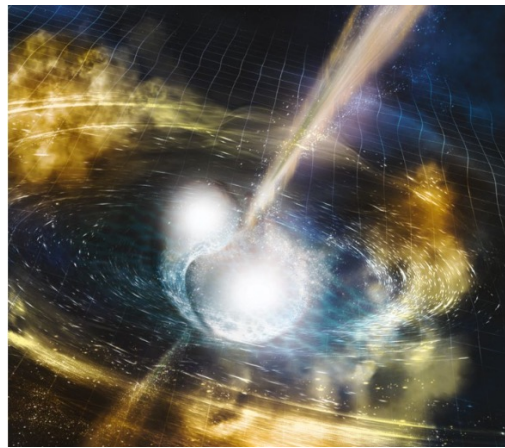
- For this review, projects are required to submit plans containing a set of Prioritized Mission Objectives (PMOs) for FY26-FY28, with a possible extension to FY29-FY30.
- These PMOs should elucidate the scientific, technical, and/or budgetary priorities for the upcoming five-year planning cycle and allow the Senior Review Panel to make a comparative analysis of divergent mission needs and priorities for allocating available funding.

- **Proposal Sections**

- 1) Science and Implementation
 - 2) Technical (including Health and Safety)
 - 3) Management
 - 4) Budget
 - 5) Project Data Management
 - 6) Appendices
- Inclusion goes here
- Sections cover 7 focus areas on future productivity; achievements and impacts; plans for inclusion; accessibility, usability, and utility of the data (FAIR); progress on 2022 PMOs; observatory stewardship; and spacecraft and instrument health and safety (details from he call in back-up slides)

Reminder of Science Themes from Senior Review 2022

- **Mission science objectives leverage Fermi's unique roles in multimessenger and time-domain astrophysics**
 - Exploring multi-messenger sources – sources of both gravitational waves and neutrinos, and with Fermi as a gamma-ray pulsar timing array to detect low frequency GW
 - Capitalizing on big surveys from radio to optical and beyond
 - Modeling the high energy universe to probe the workings of AGN, GRBs and PeVatrons
- Fermi capabilities are key for making new discoveries within the Astro2020 Decadal Survey theme of *New Messengers and New Physics*





- **PMO: Multimessenger Astrophysics**
 - **Pending event**
 - Disentangle emission structure, dynamics and viewing geometry of neutron star-neutron star mergers with detections of additional sGRB-GW counterparts.
 - Use sGRB-GW time delays as probes of cosmology, fundamental physics, and neutron star physics.
 - **Ongoing**
 - Probe the nature of neutrino-producing AGN, by correlating γ -ray activity with detections by current and new neutrino telescopes.
 - Provide an independent measurement of the gravitational wave background via pulsar timing, to strengthen or challenge the potential signal measured by the radio PTAs.
- **PMO: Era of Big Surveys**
 - **Complete**
 - Provide clarity on FRB-SGR connection by monitoring magnetar activity
 - Use periodicity and flaring activity of AGN to determine the physical conditions in jets, including multiwavelength surveys to model the variability
 - Leverage the extensive simultaneous multiwavelength observations to determine the nature of shock processes in novae



- **PMO: Modeling the High Energy Universe**
 - **Complete**
 - Constrain the emission mechanisms of GRBs with broadband prompt and afterglow modeling including especially VHE
 - **Ongoing**
 - Measure the intergalactic magnetic field with broadband observations of blazars over the entire HE to VHE bands, enabled by new VHE facilities;
- **Low-Probability/High-Reward objectives**
 - **Pending event**
 - Set tight constraints on axion-photon coupling from non-detection of prompt γ -ray emission from a supernova in the Milky Way;
 - Detect a GRB associated with a high- energy neutrino
 - **Ongoing**
 - Find spatial or temporal association between UHECRs and LAT flaring or steady sources



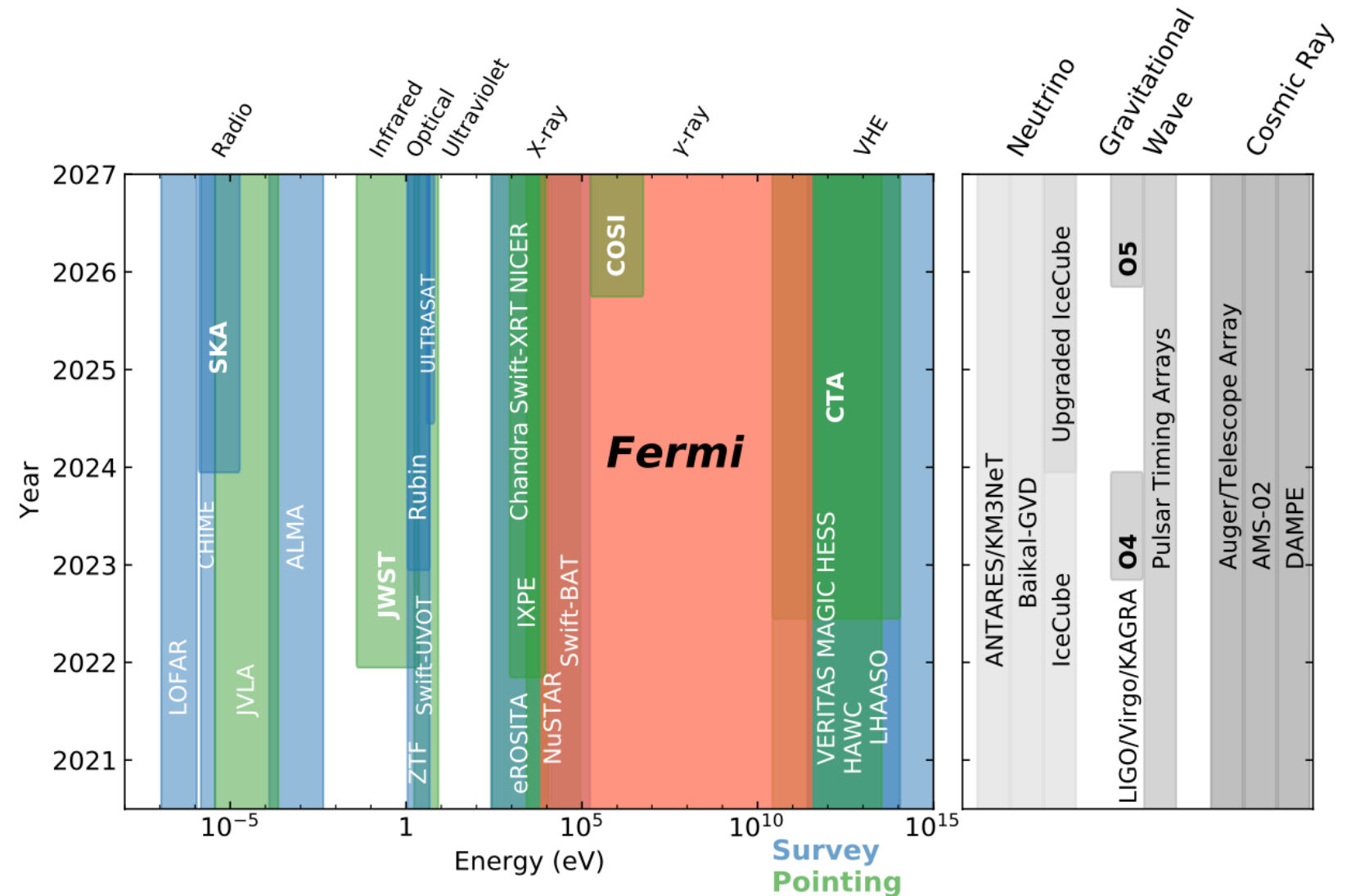
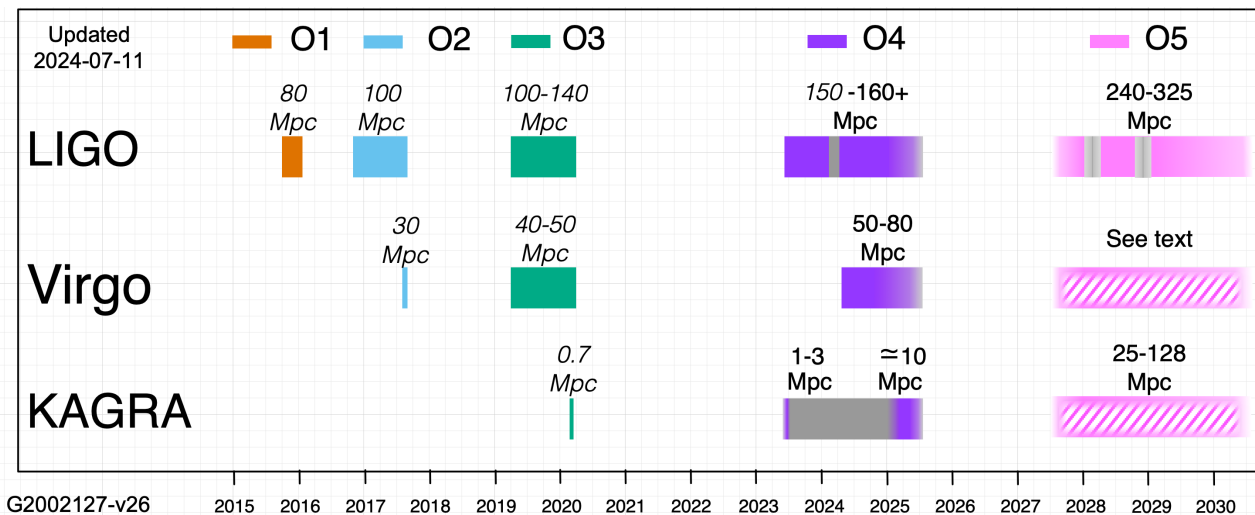
Transient Searches and Finding Counterparts	Pulsar Portal	Broadening the Accessibility to <i>Fermi</i> Data
<ul style="list-style-type: none"> • LCR Time-series analysis • Transient Alert Technology • Automating GBM Targeted Search (GRBs, FRBs, neutrinos) • Onboard GBM Threshold Reduction Testing • Flare Advocate Portal • Enhanced Data Server 	<ul style="list-style-type: none"> • Photon lists with pre-computed spin phases • Photon weights 	<ul style="list-style-type: none"> • LCR Time-series analysis • Flare Advocate Portal • Enhanced Data Server • Community software interfaces: 3ML, gammapy

Progress on 2022 Technical Initiatives

Technical Initiative	Group	Status
II.1.1 Updating transient alert technology (KAFKA via GCN)	GBM, LAT	In progress
II.1.1 Automation of the targeted search	GBM	Done
II.1.1 Onboard threshold reduction tests	GBM	Done
II.1.2/II.2.2 Improvement of the Light Curve Repository (LCR)	LAT	In progress
II.1.2 LAT data server improvements	FSSC	Testing
II.1.2 Efficiency improvements in transient source monitoring	LAT FA	In progress
II.1.3 The LAT Pulsar Portal	LAT 3PC	Done
II.2.1 GBM Targeted Search Automation for FRBs	GBM	Done
II.3.1 Support connection of VHE tools to fermitools and fermipy.	LAT, FSSC	In progress



- What will enable high impact future observations?
- What is the most important science Fermi can do because these other facilities are coming?
- What's on the 2026-2030 horizon?
 - GW: IGWN O5
 - Neutrinos: IceCube Gen2, KM3NET
 - Optical/IR Surveys: Rubin, Roman
 - Radio Surveys: SKA
 - VHE: CTA, SWGO
 - What else?





- **New discoveries & new understanding of origins and mechanisms of gamma-ray transients**
- **Science exploration using contemporaneous multimessenger and multiwavelength observations**
- **New opportunities: Survey synergies with new facilities (NASA and ground, e.g. Rubin, Roman, SKA, CTA...)**
- **Understanding black hole activity across scales through variable and cyclic signatures**
- **Neutron star science (magnetars, pulsars, mergers...)**
- **Unassociated gamma-ray sources – what do we learn from new observations?**
- **Fermi mission legacy: Understanding the gamma-ray sky**



Find past proposals, drafts and comment pages here:

<https://confluence.slac.stanford.edu/display/FSR/Fermi+Senior+Review+2025>

Looking forward to your ideas and input!

For reference: Senior Review 2022 Results

- **The panel report recognized Fermi’s critical role in astrophysics and its strong support of the user community.**
 - **“Fermi provides unique access to the gamma-ray portion of the electromagnetic spectrum and the largest simultaneous field-of-view of any space telescope. Its data give us a time-domain view of the entire gamma-ray sky and are a crucial asset for gravitational-wave and multi-messenger astrophysics.”**
 - **“Strong synergies with other surveys, in particular new surveys that represent new technical capabilities, has and will continue to be a significant strength of the Fermi mission.”**
 - **“The usability of Fermi data and user support for data analysis are strong.”**
- **Mission Extension covers FY23 - FY25 with guidelines for FY26 - FY27 subject to the next Senior Review in 2025.**
- **[Rest of Missions Panel Report link](#)**
- **[APAC Subcommittee Report link](#)**

For Reference: Proposal Focus Areas



1. The promise of future impact and productivity, based on the scientific merit of the project, its unique capabilities, and its relevance to the vision of the Astrophysics Division, the goals of the SMD Science Plan, and the priorities of the 2020 Astrophysics Decadal Survey. Missions with GO/GI programs should discuss the promise of those programs. Missions with multiple instruments should address the future impact and productivity of each one;
2. Mission achievements since the 2022 Senior Review, and impact of past scientific results as evidenced by publications and citations (and other means), showing how these demonstrate the potential for future progress;
3. Plans to create an inclusionary environment across the project, within project leadership and the project's user community. Preparation for the future by succession planning, by providing training, mentoring and leadership opportunities to expand the skills of project staff, and by broadening the community of users and training a diverse community of astronomers to make effective use of space-based astrophysics data;
4. Broad accessibility, usability, and utility of the mission data, considered both as a unique mission, and in synergy with other missions in the Astrophysics portfolio, focusing on the cost efficiency, collection, archiving, and distribution of data, software, and publications;
5. Progress made toward achieving the PMOs identified in the 2022 Senior Review proposal (for missions that were subject to the 2022 Senior Review);
6. Level and quality of observatory stewardship (e.g., maximizing the scientific return while minimizing the costs and risks); and
7. Spacecraft / Platform and instrument health and safety. List mission risks and proposed mitigations. Projects should explain what degradation has occurred since FY22, and how that has affected the quality and quantity of science observations.