

Mission Status Report

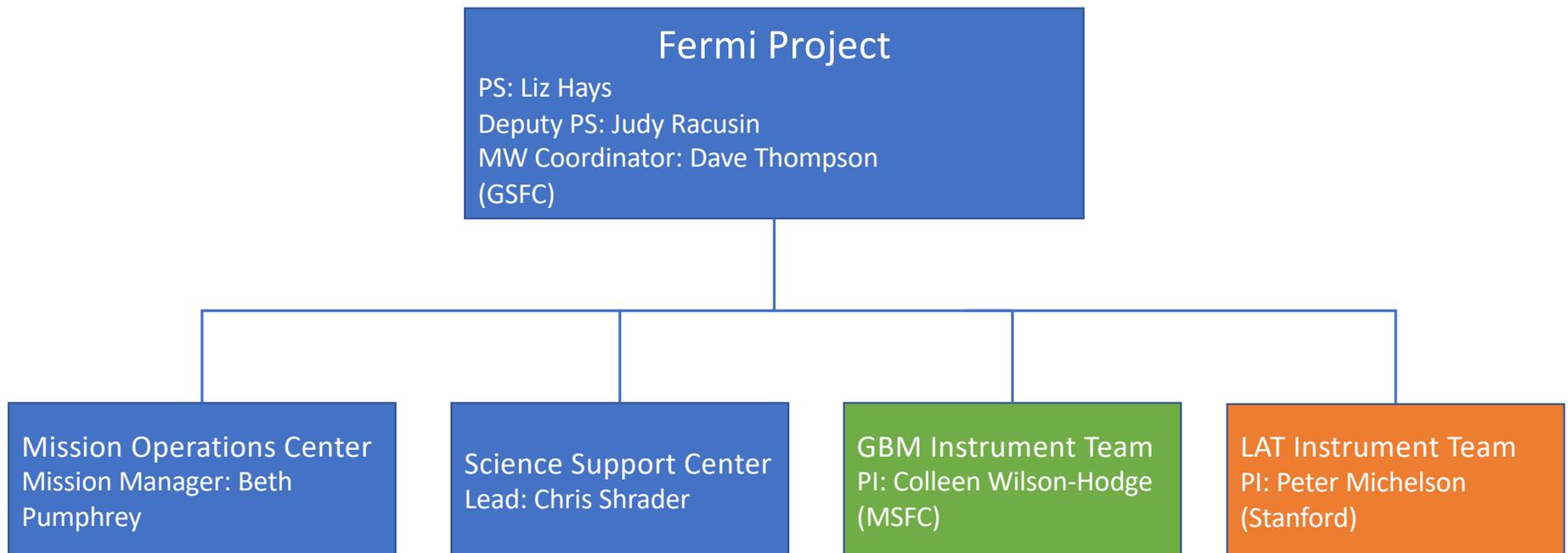
Fermi User's Group meeting
August 19, 2019

E. Hays and J. Racusin

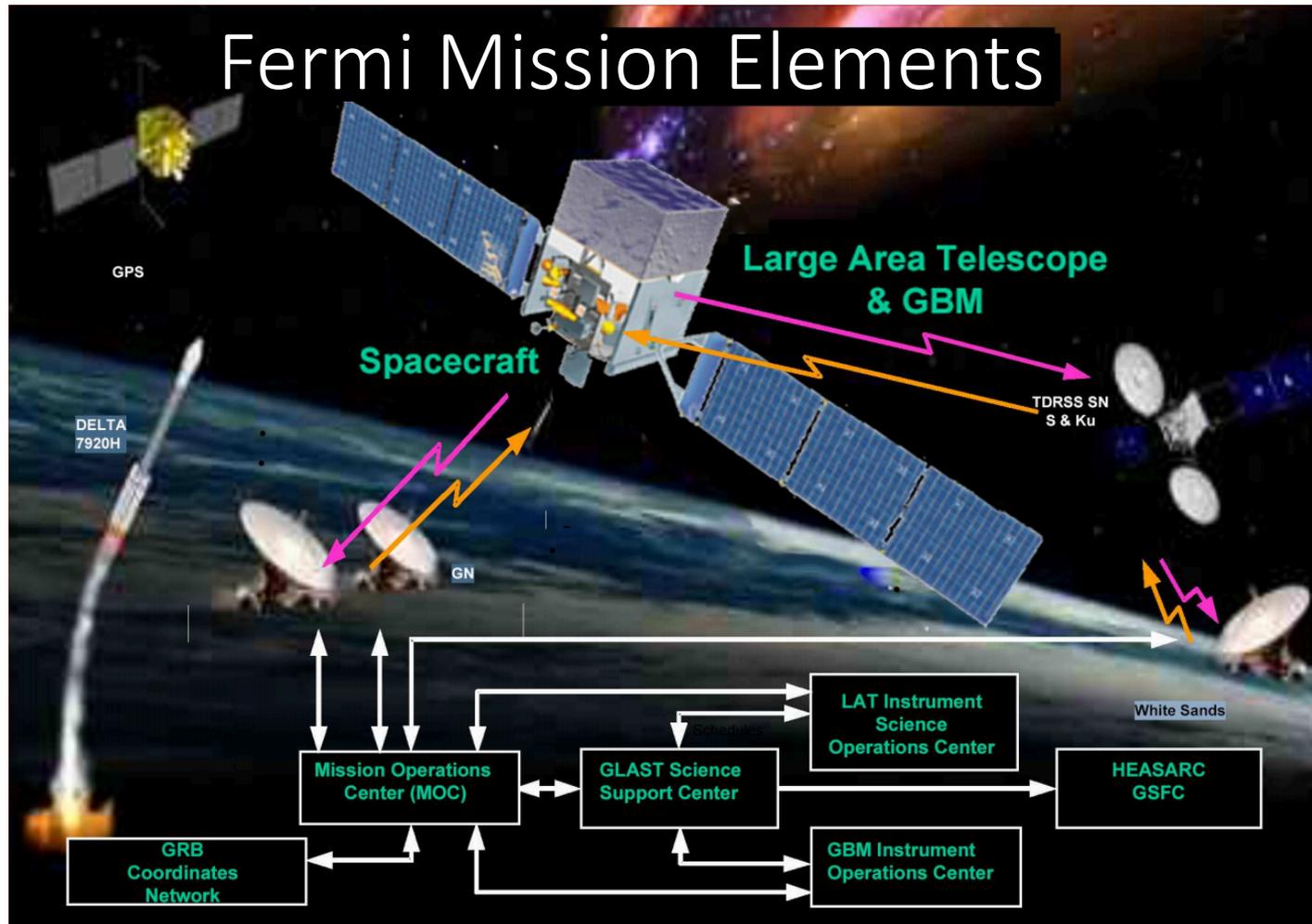
Plan

- Brief Overview of Mission - Welcome new members!
- Status updates from the Project
 - Observatory
 - Releases
 - Press Activities
 - Engagement and Outreach
- Diversity and Inclusion

Fermi Mission Organization



Fermi Mission Elements



Fermi Data Products

Fermi Gamma-ray Space Telescope

Home Support Center Observations **Data** Proposals Library HEASARC Help

Data

- ▶ [Data Policy](#)
- ▶ [Data Access](#)
 - + [LAT Data](#)
 - + [LAT Catalog](#)
 - + [LAT Data Queries](#)
 - + [LAT Query Results](#)
 - + [LAT Weekly Files](#)
 - + [GBM Data](#)
- ▶ [Data Analysis](#)
- ▶ [Caveats](#)
- ▶ [Newsletters](#)
- ▶ [FAQ](#)

Currently Available Data Products

The Fermi data released to the scientific community is governed by the [data policy](#). The released instrument data for the GBM, along with LAT source lists, can be accessed through the [Browse interface specific to Fermi](#). LAT photon data can be accessed through the [LAT data server](#).

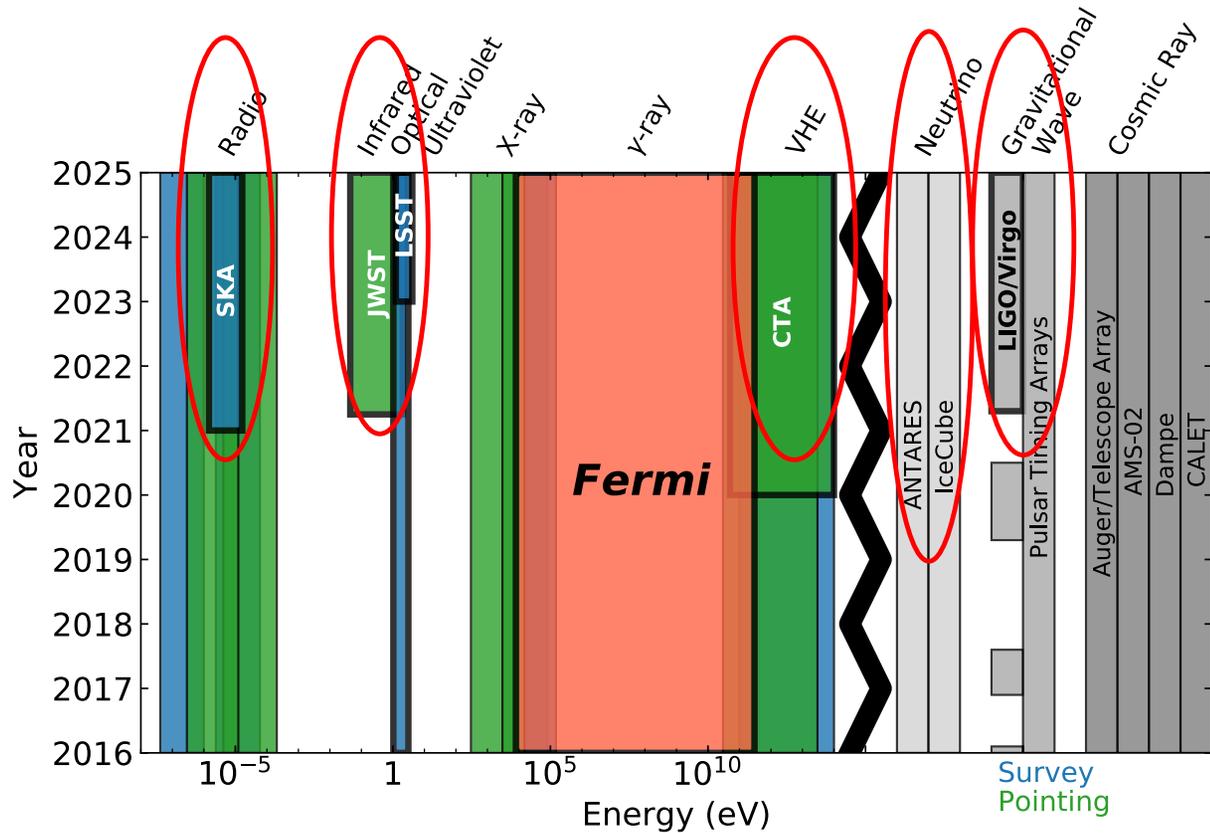
The FITS files can also be downloaded from the [Fermi FTP site](#). The file version number is the 'xx' in the characters before the extension in each filename; you should keep track of the version numbers of files you analyze since the instrument teams may update them.

Note that the LAT and GBM data are accompanied by [caveats](#) about their use.

- LAT Photon and Extended Data
 - [LAT Data Server](#) (updated with P8R3 data 26-Nov-2018)
 - [LAT Low-Energy \(LLE\) Data](#) (Browse table)
 - Products available on the [FTP Site](#) (current processing version of the data).
 - [Weekly Photon Files](#)
 - [Weekly Spacecraft Files](#)
 - [Mission Long Spacecraft File](#)
 - [Weekly 1-second Spacecraft Files](#)
 - [Filtered Weekly Photon Files with Diffuse Response Columns](#)
 - Previous processing versions available on the FTP site
 - [Pass 8 \(P8R2\) Weekly Files](#)
 - [Pass 7 \(V6d\) Weekly Files](#)
 - [Pass 7 \(V6\) Weekly Files](#)
 - [Pass 6 \(V11\) Weekly Files](#)
 - [Pass 6 \(V3\) Weekly Files](#)
 - [ASDC data server](#) (external)
- LAT catalogs and associated products (high-level products only)
 - LAT Source Catalog
 - [LAT 8-year Source Catalog](#) (4FGL)
 - [Preliminary LAT 8-year Source List](#) (FL8Y)
 - [LAT 4-year Source Catalog](#) (3FGL)
 - [LAT 2-year Source Catalog](#) (2FGL)
 - [LAT 1-year Source Catalog](#) (1FGL)
 - [LAT 3-month Bright Source List](#) (0FGL)

- Aperture Photometry Light Curves
 - [Aperture Photometry Light Curves for LAT 4-year Catalog Sources](#) (Updated Weekly)
 - [Flaring Sources in the LAT 4-year Aperture Photometry Light Curves](#) (Updated Weekly)
 - [Aperture Photometry Light Curves for the LAT 2-year Source Catalog](#)
 - [Flaring Sources in the LAT 2-year Aperture Photometry Lightcurves](#)
- LAT High Energy Source Catalog
 - [LAT Third High Energy Source Catalog](#) (3FHL)
 - [LAT Second High-Energy Source Catalog](#) (2FHL)
 - [LAT First High-Energy Source Catalog](#) (1FHL)
- [LAT Monitored Source List Light Curves](#)
- [LAT GRB Catalog](#)
- [Extended Sources in the Galactic Plane](#) (FGES)
- [Second Fermi All-sky Variability Analysis Catalog](#) (2FAV)
- [1st Fermi-LAT SNR Catalog](#)
- [LAT 3-year Catalog of Gamma-ray Pulsars](#)
- Other useful LAT related products
 - [List of LAT GRBs announced via GCN notices](#) (external)
 - [List of LAT Sources announced via ATels](#)
 - [LAT List of Detected Gamma-Ray Pulsars](#) (updated frequently)
 - [LAT Pulsar Ephemerides from Publications](#)
 - [LAT Background Models](#)
 - [List of time gaps in LAT data](#)
- GBM Data
 - [GBM Trigger Catalog](#) (Browse table)
 - [GBM Burst Catalog](#) (Browse table)
 - [GBM Daily Data](#) (Browse table)
 - [GBM Continuous Data](#) (FTP archive)
 - [GBM Terrestrial Gamma-ray Flashes \(TGF\) Catalog](#)
 - [Untriggered GBM Short GRB Candidates](#) (external)
 - [GBM Earth Occultation Light Curves](#) (external)
 - [GBM Pulsar Spin Histories](#) (external)
 - [List of GBM GRBs announced via GCN notices](#) (external)
- Additional Data
 - [Predicted Spacecraft Pointing \(FT2\) Files](#)
 - [Multiwavelength Programs Supporting Fermi](#)
 - [Fermi Solar Flare Observations](#)

Fermi is unique in spectral coverage

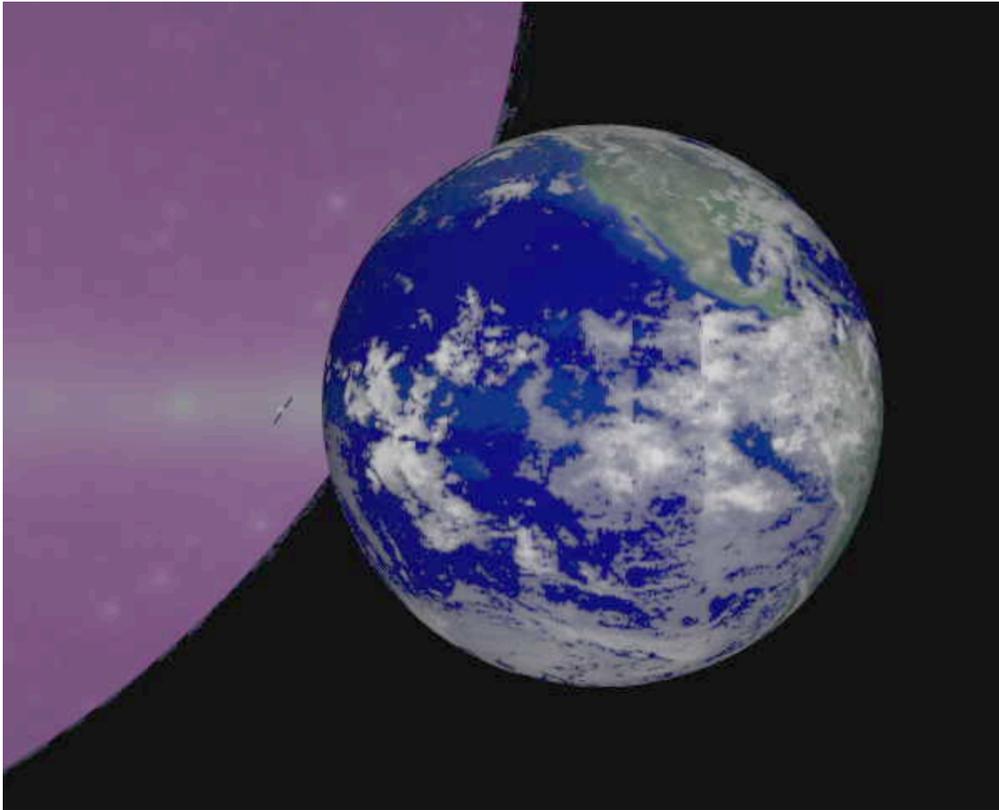


8 decades of the electromagnetic spectrum.

Only mission in its waveband for the foreseeable future.

Opportunities are growing!

And in sky coverage



Fermi GBM covers the entire sky every ~ 1.5 hours.

Fermi LAT covers 80% of the sky every ~ 1.5 hours or the entire sky every ~ 3 hours.

The GI program is the heart of *Fermi* science

- *Fermi* is the only mission supporting the analysis of high-energy gamma-ray data
- Provides financial support for
 - Data analysis and correlated studies including development of methodology and software tools
 - Multiwavelength data collection and reduction
 - Theoretical studies
- Science topics continue to increase
 - New and upgraded facilities
 - New questions in astrophysics
 - New gamma-ray discoveries
- Analysis gets harder as data sets deepen
- Users of *Fermi* data have been increasing with time, especially with rise of multimessenger astrophysics
- Question for the user's group: What are barriers for users? How can we reduce those barriers?

Growing the GI Program

- Joint Programs
 - Currently NRAO, NOAO, VERITAS, INTEGRAL – see presentation from Chris
- User support
 - Is there value in doing a Community workshop to support new/newer proposers to the GI program during telework?
 - How do most proposers get their information about the GI Program?
 - What is the best way to engage and answer questions in the absence of face-to-face venues like the January AAS?

Great progress on Mission Objectives from last Senior Review

PMO/Goal in 2019 Proposal

PMO: Multimessenger Astrophysics

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;

Reduce the latency of GBM sub-threshold triggers

Automate joint GBM/LIGO/Virgo localizations

Resolve emission mechanisms in blazars by finding γ -ray flares in coincidence with ultra-high-energy neutrinos detected by IceCube.

Establish and maintain a library of γ -ray source light curves on timescales of days, weeks, and months, updated as new data become available.

PMO: Time-Domain Astrophysics

Resolve the physical processes in super-Eddington γ -ray novae and other Galactic binaries by measuring simultaneous multiwavelength light curves of bright novae and extending the observations of long-period binaries;

Explore and interpret the growing diversity of γ -ray pulsar systems with continued observations and extensive modeling of their temporal and spectral characteristics, as well as adding new millisecond pulsars to pulsar timing arrays;

Identify new temporal behavior only measurable with long baselines, such as binary supermassive black holes.

Increase prompt alerts for TeV observations of events (e.g., GRBs, AGN flares) that probe the EBL by implementing a spatial/temporal clustering search for >10 GeV γ rays;

Constrain accreting pulsar geometries via simultaneous timing and spectroscopy in cooperation with NICER and NuSTAR;

Transform the exploration of optical/ γ -ray transients with the opportunities provided by new large optical surveys (e.g., ZTF, LSST);

Enhance pulsar timing array gravitational wave searches and knowledge of neutron star physics by expanding the number and the variety of γ -ray pulsars in cooperation with the FAST and SKA pathfinder radio telescopes.

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High-risk/high-return objectives

Neutron Star Physics with Giant Magnetar Flares

Axion Dark Matter Searches with Supernovae.

Correlations with Ultra High Energy Cosmic Rays (UHECRs)

Observatory Highlights

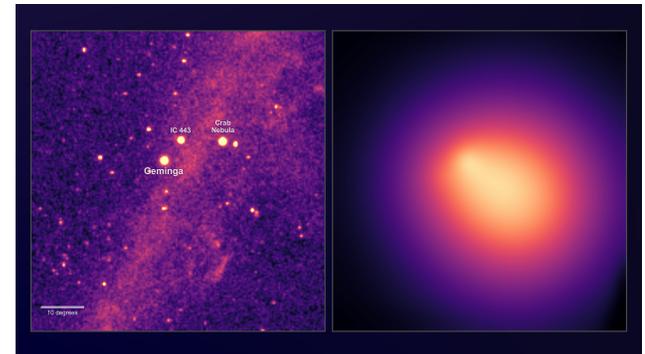
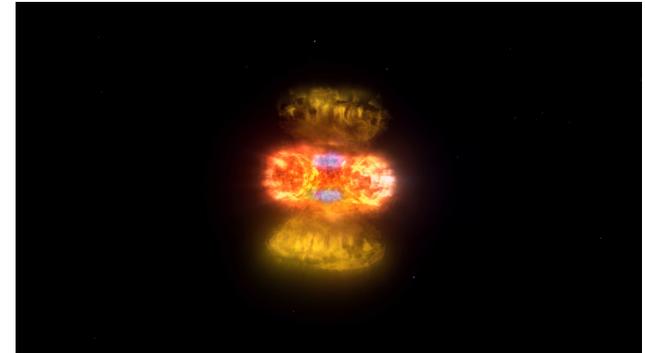
- Status
 - No issues (Boring is good!)
- Observations
 - Mix of traditional and modified sky survey since beginning of 2019. Accommodates fixed solar array panel.
 - Autonomous repoints (ARRs) are disabled.
 - Not accepting TOOs, but still want to know about planned multiwavelength campaigns as input to scheduled calibrations and engineering activities
- FOT and Engineering Activities
 - COVID 19 Impacts
 - Transitioned most operations to remote in response to the pandemic
 - Very few activities require personnel onsite at Goddard. When needed this can be done safely.
 - Some spring calibration and monitoring activities were delayed, but have now been completed.
 - Update to flight software underway that will prevent future occurrences of the alignment anomaly from last August that placed the observatory in sun point (workarounds have been in place.)

Data and Catalog Releases

- Data
 - Update to spacecraft files to include velocity vectors pending
- Software
 - GBM Data Tools released – python interface for GBM data
 - Custom pulsation searches for GBM catalogued and non-catalogued sources available
 - Software fixes and added features
- Catalog highlights
 - GBM GRB catalog published
 - Incremental update of the 8-year catalog, 4FGL-DR2, based on 10 years of data, 5787 sources from 50 MeV to 1 TeV

Press Releases

- April 2020: NASA Missions Help Reveal the Power of Shock Waves in a Nova Explosion
 - <https://www.nasa.gov/feature/goddard/2020/nasa-missions-help-reveal-the-power-of-shock-waves-in-a-nova-explosion>
- Dec 2019: NASA's Fermi Mission Links Nearby Pulsar's Gamma-ray 'Halo' to Antimatter Puzzle
 - <https://www.nasa.gov/feature/goddard/2019/nasa-s-fermi-mission-links-nearby-pulsar-s-gamma-ray-halo-to-antimatter-puzzle>
- Nov 2019: NASA's Fermi, Swift Missions Enable a New Era in Gamma-ray Science
 - <https://www.nasa.gov/feature/goddard/2019/nasa-s-fermi-swift-missions-enable-a-new-era-in-gamma-ray-science>



Diversity and Inclusion

- Equity, Diversity, and Inclusion is a priority for Fermi Mission and Instrument Teams
 - Values are reflected in leadership development, symposia organization and speaker selection, as well as code of conduct
- Fermi is part of the Multimessenger Diversity Network
 - NSF INCLUDES-funded community of representatives from multimessenger research collaborations, including IceCube, LSST, LIGO, NANOGrav, Swift and VERITAS.
 - Astro 2020 State of the Profession white paper “Pursuing diversity, equity, and inclusion in multimessenger astronomy collaborations over the coming decade”.
<https://arxiv.org/abs/1907.06970>
 - Information shared from Fermi teams includes code of conduct and ombuds program

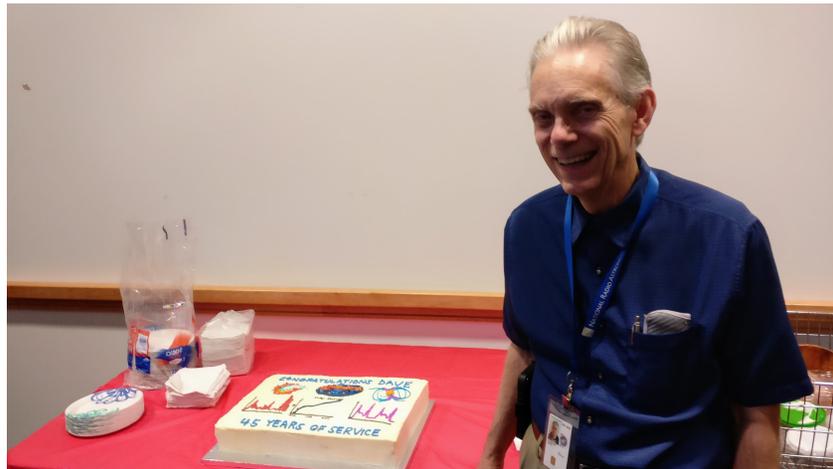
Outreach and Development Activities

- Fermi Summer School postponed due to COVID-19. Planning some remote content in the coming months to aid students and post docs working on Fermi analysis.
- Social media – See presentation from Roopesh
- Fermi Coloring Booklet released last week with translations in 13 languages
 - https://imagine.gsfc.nasa.gov/features/coloring_pages/fermi/
- Considering how best to reach out science community during the pandemic. Input welcome.

Fermi Stained Glass Coloring Booklet



Thank you to Dave Thompson!



Dave Thompson retired in January. He remains active as an emeritus in supporting multiwavelength science coordination and in LAT science and publications.

Thanks to Dave for his many years of service to gamma-ray science and contributions to founding new areas of study. The Fermi Mission is a broader and more dynamic mission because of his efforts.

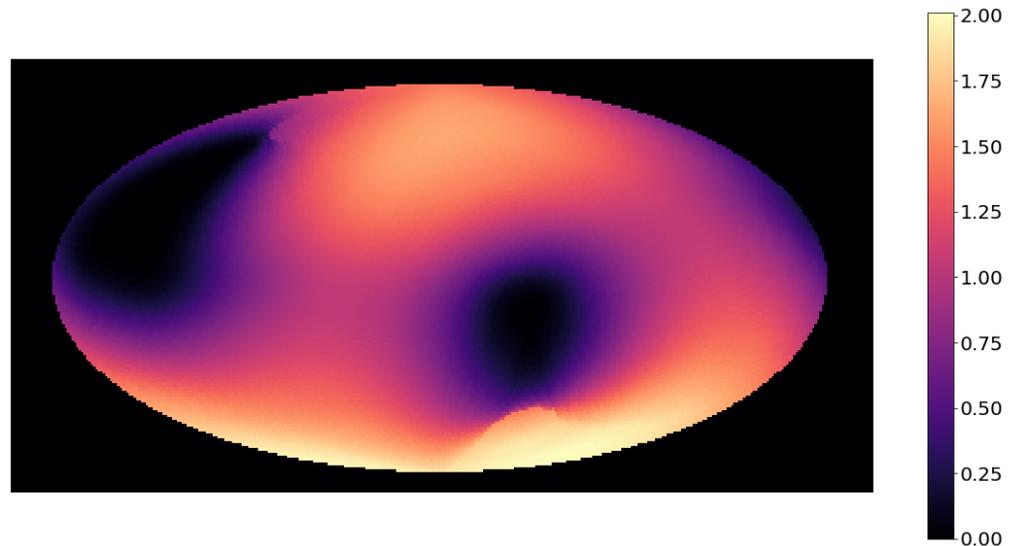
Covid-19 Impacts

- Fermi Symposium postponed
- Fermi Summer School cancelled
- GI proposal review conducted virtually
- Additional remote MOC capabilities enabled
- Flight software update delayed
- Calibration activities delayed

Fermi observational efficiency undiminished with one stationary solar array

New sine-modified profile used
~34% of the time instead of
traditional sky survey.

- No impact to GBM
- No reduction in LAT instantaneous sky coverage
- LAT survey is less uniform on short time scales, but cadence for ~85% of the sky is 1.5 hours instead of 3 hrs



All-sky coverage reached in ~1 week for sine-modified profile observations