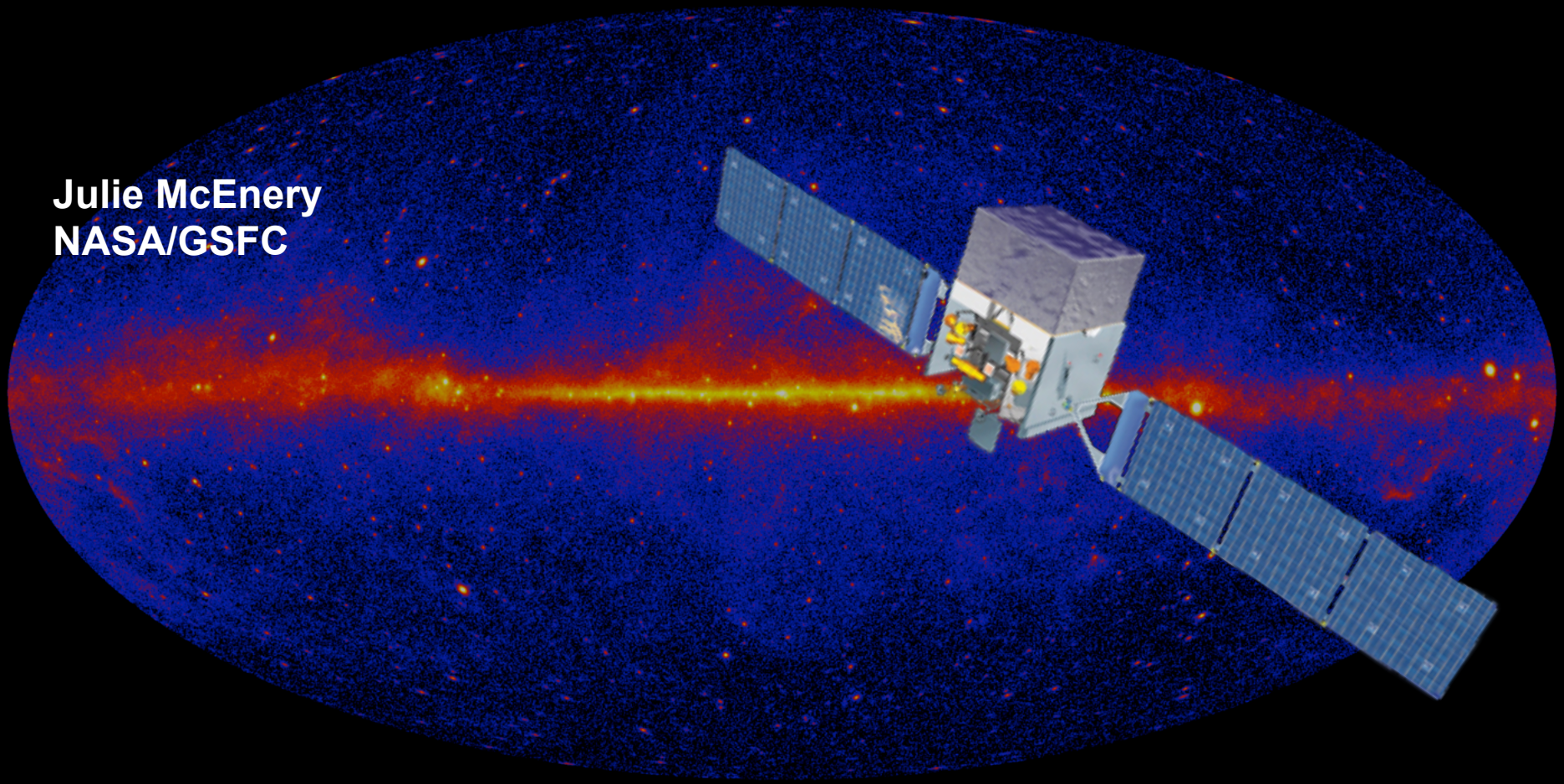
Fermi Gamma-ray Space Telescope



Julie McEnery
NASA/GSFC

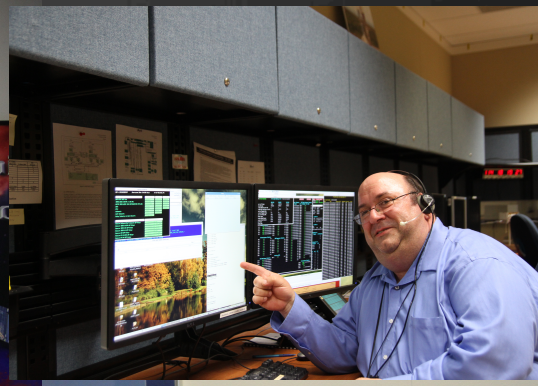
Fermi Launch

- Launch June 11, 2008
- Circular orbit, 565 km altitude, 96 min period, 25.6 deg inclination
- Orbit re-entry in the range 2026 - >2044 (depending on solar activity)
- No consumables
- Science data link via TDRSS Ku-band (40 Mbps, 10-12 contacts per day)
- Onboard GPS for absolute time (<300ns) and orbit location (<20m)
- Propulsion system for deorbit (and for collision avoidance maneuvers)
- >35,000 Orbits in 2322 days

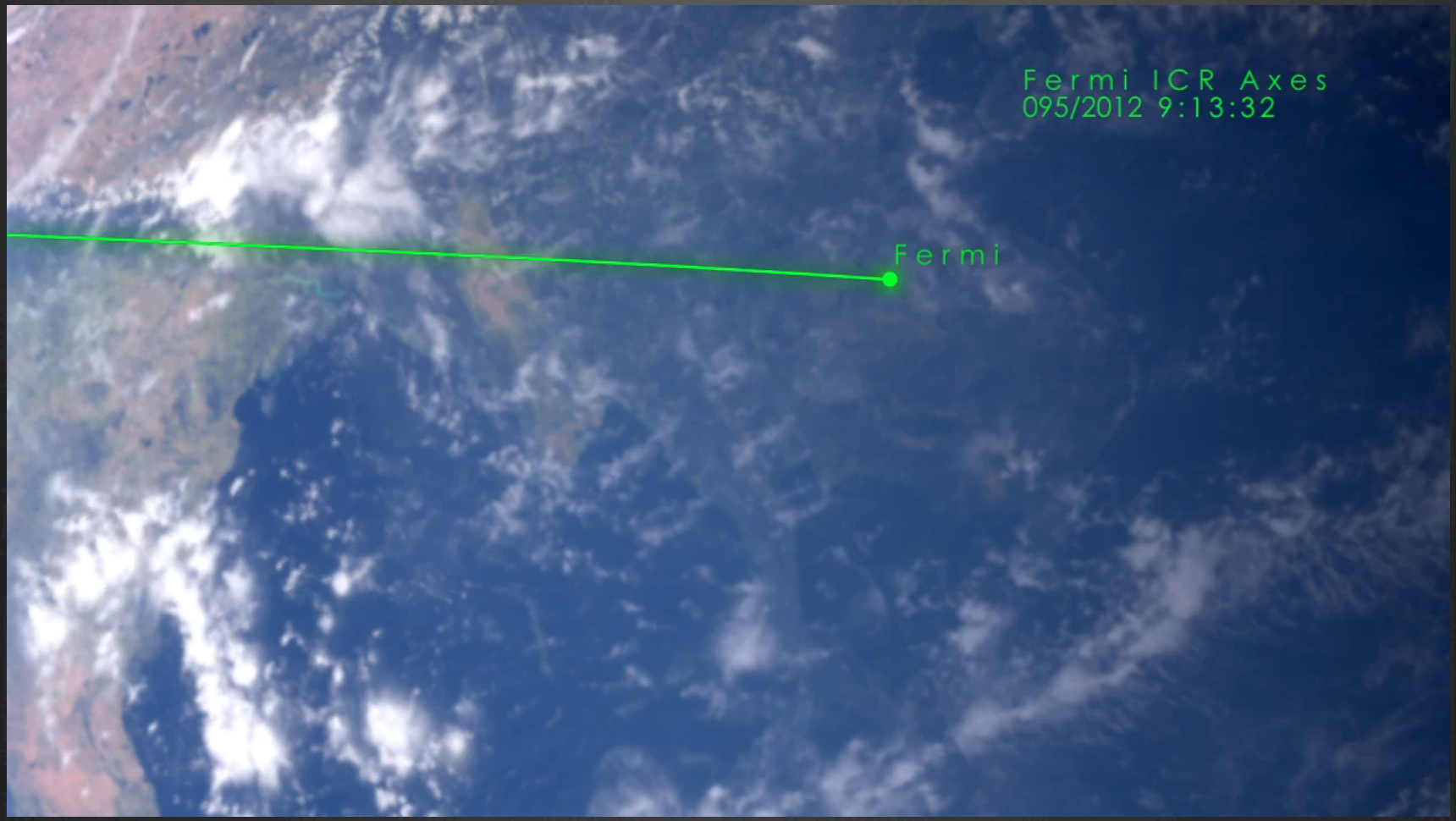
Flight Operations Team

- Scheduled 18358 contacts with TDRSS
- Executed 10218 procedures on the observatory
- Respond to an average of ~10 observatory alerts per day
- Perform daily, weekly and quarterly review of spacecraft and instrument health and safety





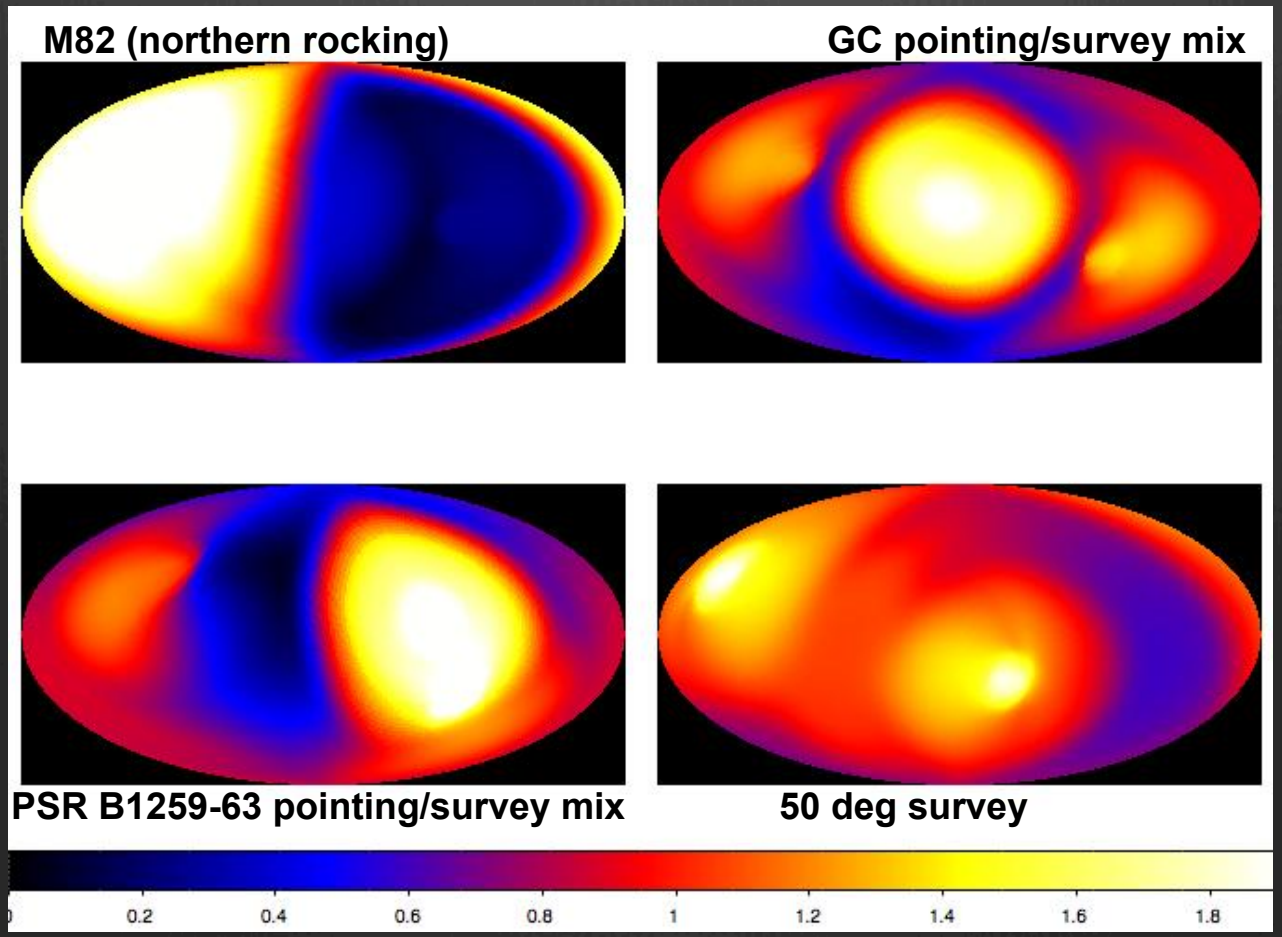

One Collision Avoidance Maneuver



- Predictions indicated that Fermi and Kosmos 1805 would occupy the same point in space within 30 ms (with an uncertainty greater than 30ms!)

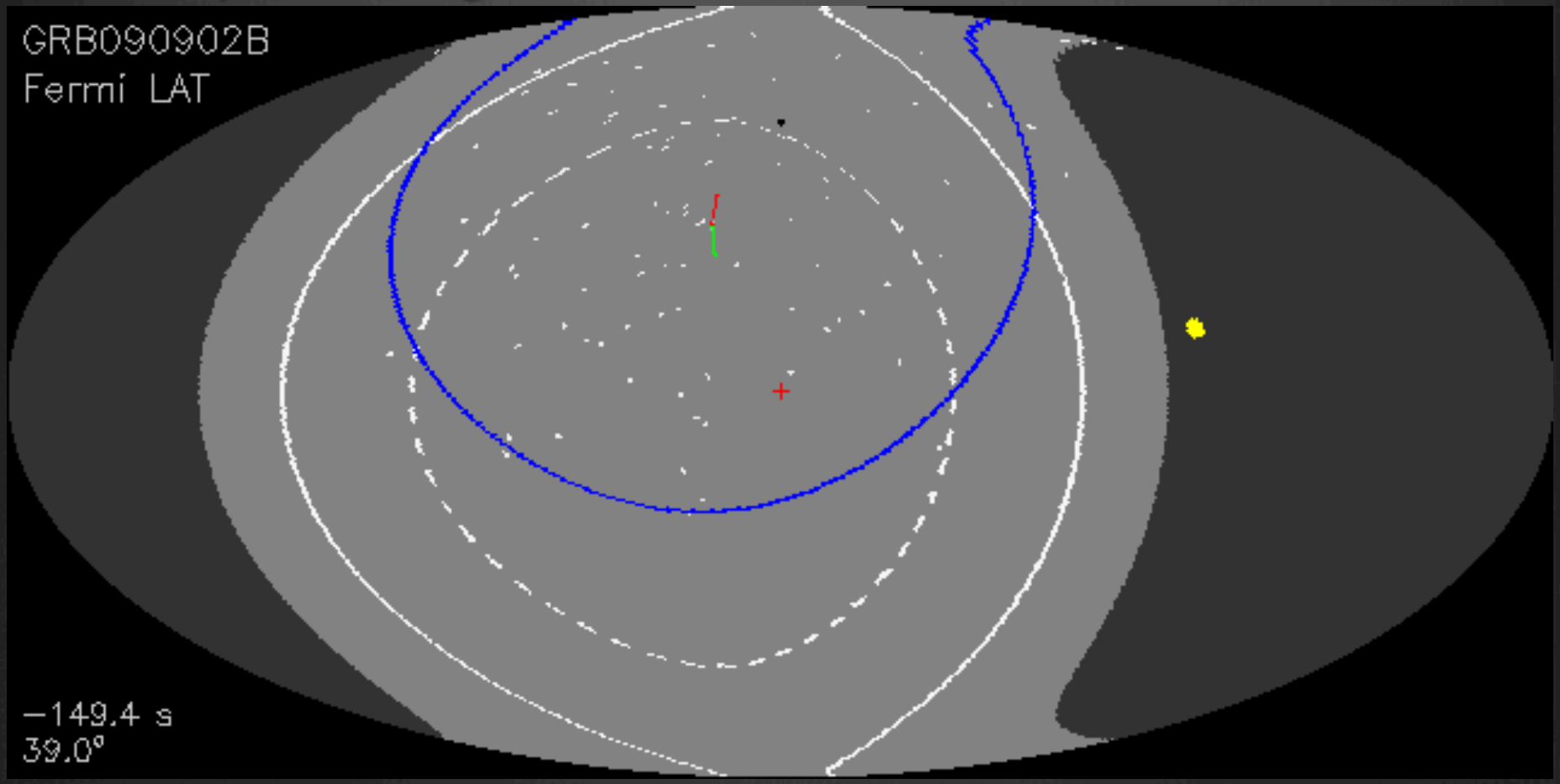
Science Support Center

- Planned >330 observatory timelines
- Responded to 28 ToO requests: Sun, AGN, Crab, Novae, binary systems



Observations

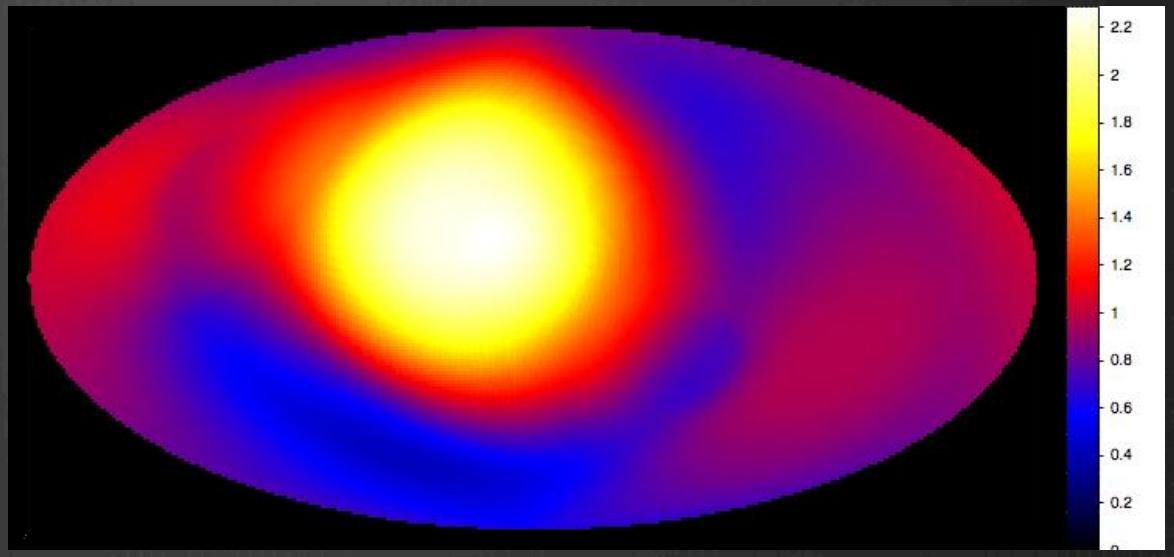
- GBM has issued 124 Autonomous Repoint Recommendations (ARR) in response to bright GRB.



These observations have contributed to the discovery that GRB routinely exhibit temporally extended emission at GeV energies.

Galactic Center Survey

- In Dec 2013, *Fermi* transitioned to a new observing strategy designed to enhance coverage at the Galactic Center while retaining all-sky coverage
- 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



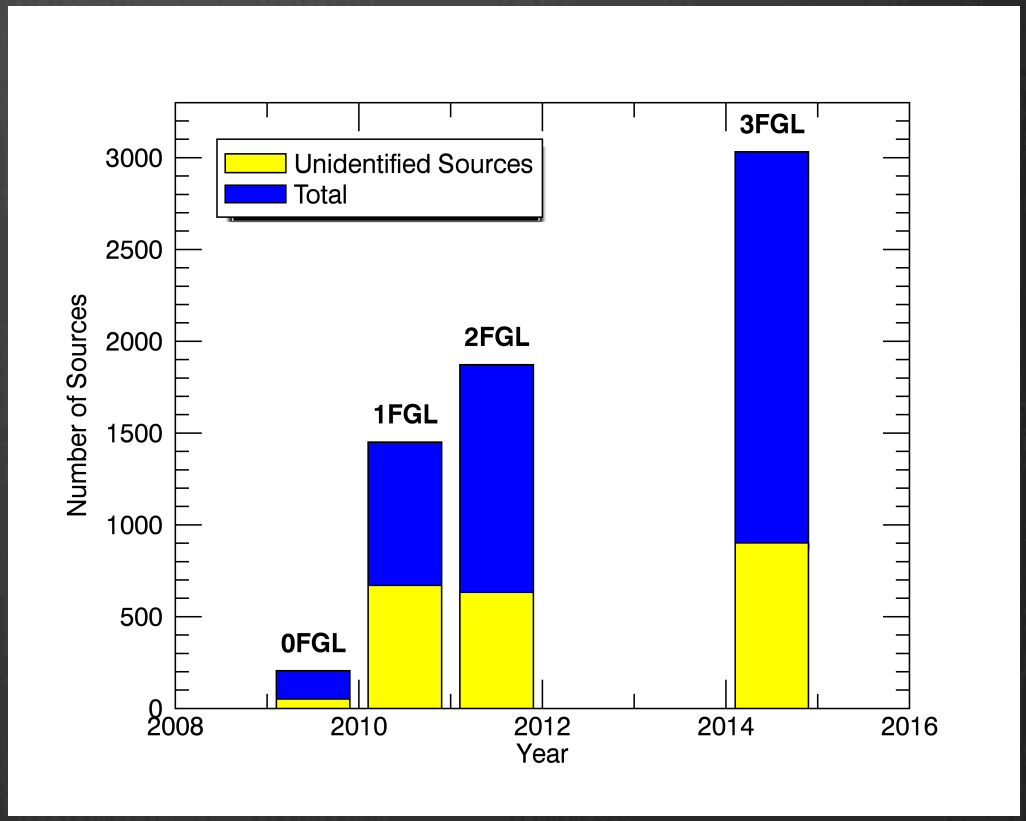
Ratio of exposure in Galactic Center biased survey mode relative to the previous all-sky survey

Stay in this observation mode until December 2014

Large Area Telescope

- Triggered on >380 billion (380,000,000,000) events
- Processed 73,859,565,213 events in ISOC pipeline, > 1.0 PB
  - Hundreds of data quality monitor shifts

- 3033 sources in 3rd Fermi LAT source catalog
- 160 Pulsars
- >1500 AGN



LAT- Calibrations

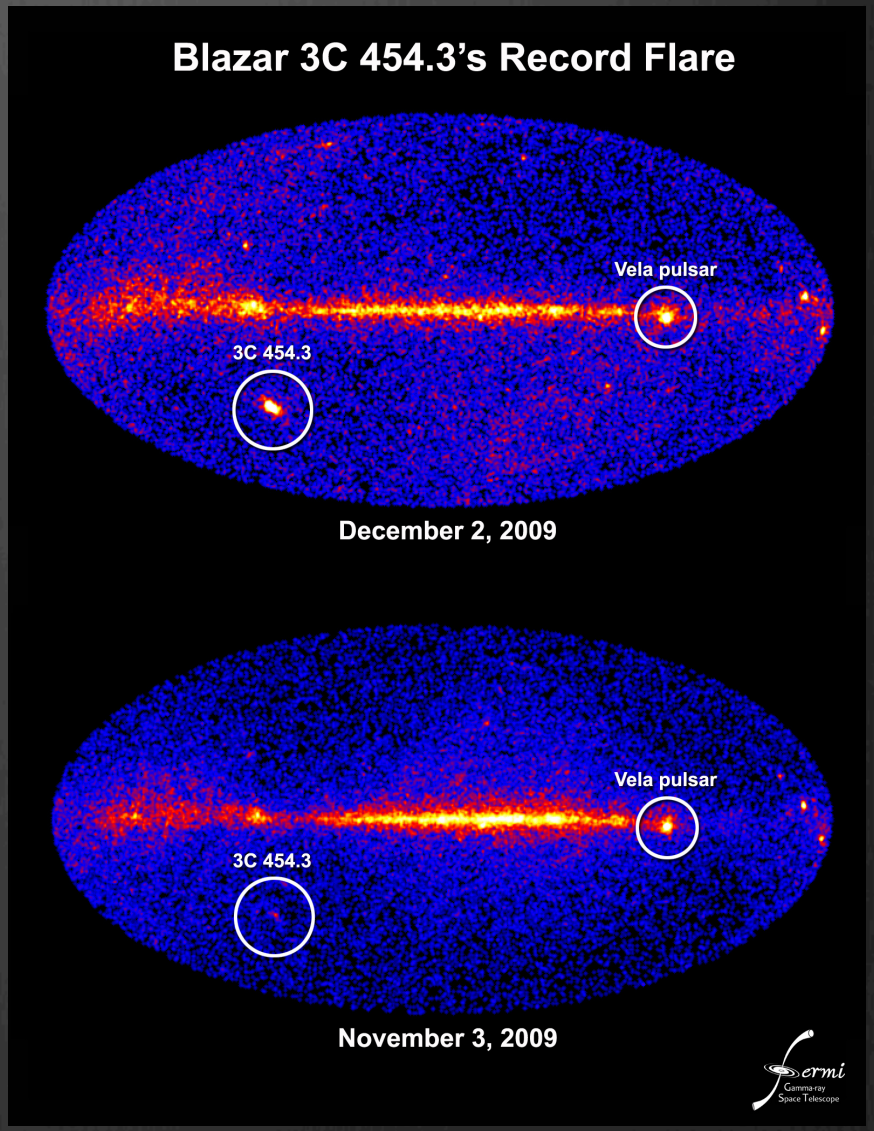
- The LAT is a complex instrument – large number of signal channels (>800,000 tracker, ~6000 calorimeter)
  - Monitoring non-trivial
- Regular updates necessary to counter expected degradation
  - Updated tracker hot strip list 26 times
  - Updated calorimeter calibration applied retrospectively to data (P7REP), now routinely updated as needed
  - Regular updates of ACD calibrations
- Very significant ongoing effort!

Fermi-LAT Data and IRFs

- Prelaunch event classification and instrument response (P6V1)
- Updated instrument response to account for "ghost" events, some loss in Aeff at low energies (P6V3)
- Aug 2009: Fermi-LAT data become public
- May 2011: updated data-derived PSF, using observations of point sources to define the PSF (P6V11)
- August 2011: Retune event selections to account for presence of "ghosts" (recover effective area at low energy) (P7V6)
- June-Aug 2013: Reprocess data with improved calorimeter calibrations (improve PSF, small shift in energy scale) (P7REP)
- 2015: Complete revamp of low level recon algorithms, dramatic improvements in performance (Pass 8)

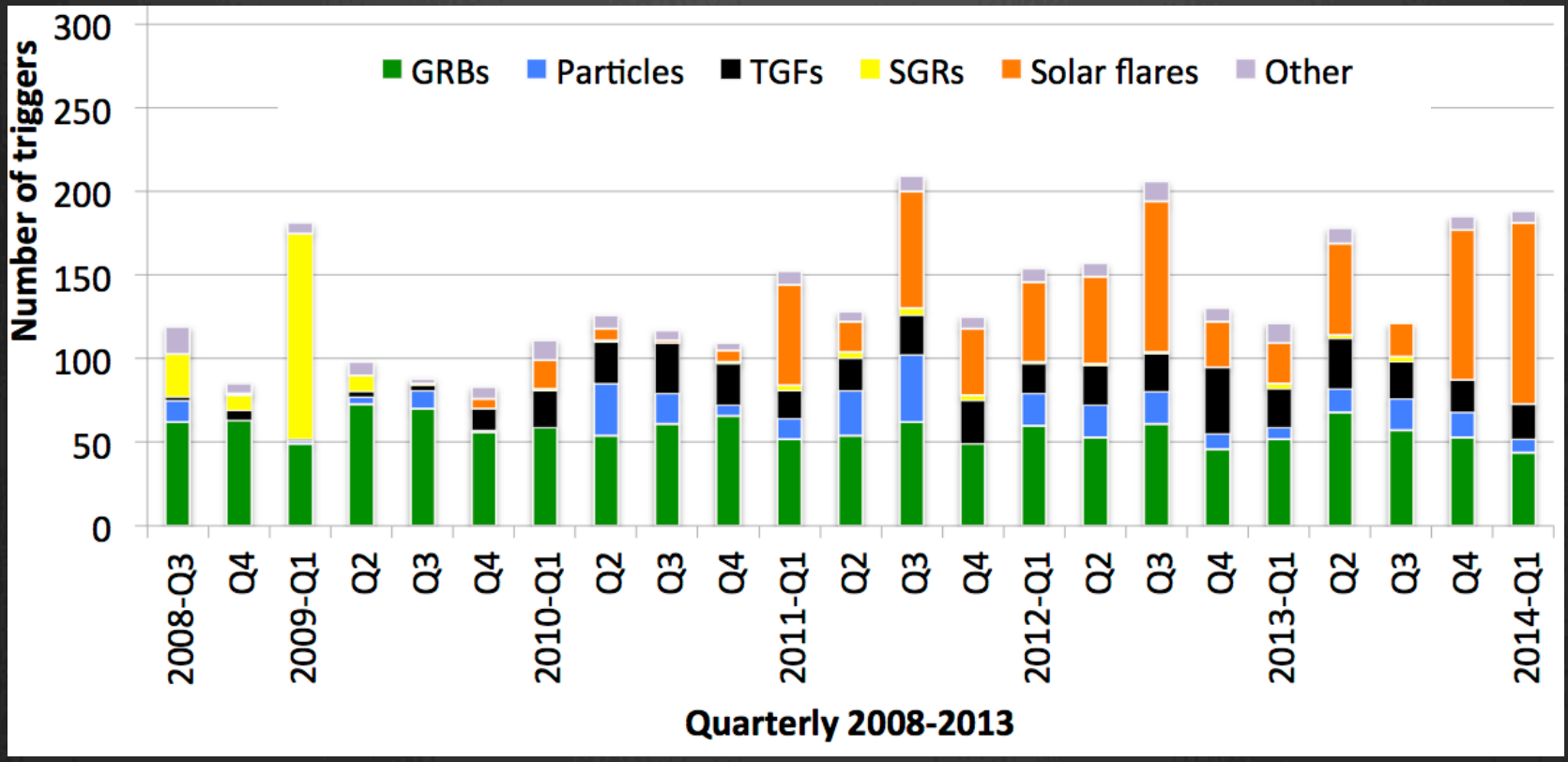
Monitoring the sky

- Automated search for flaring and transient sources on timescales from less than one second to more than one week
  - Followed up by LAT burst advocate and LAT Flare advocate
- 301 Astronomers Telegrams
  - Including first LAT science result on July 24
- 92 GCN circulars from LAT team



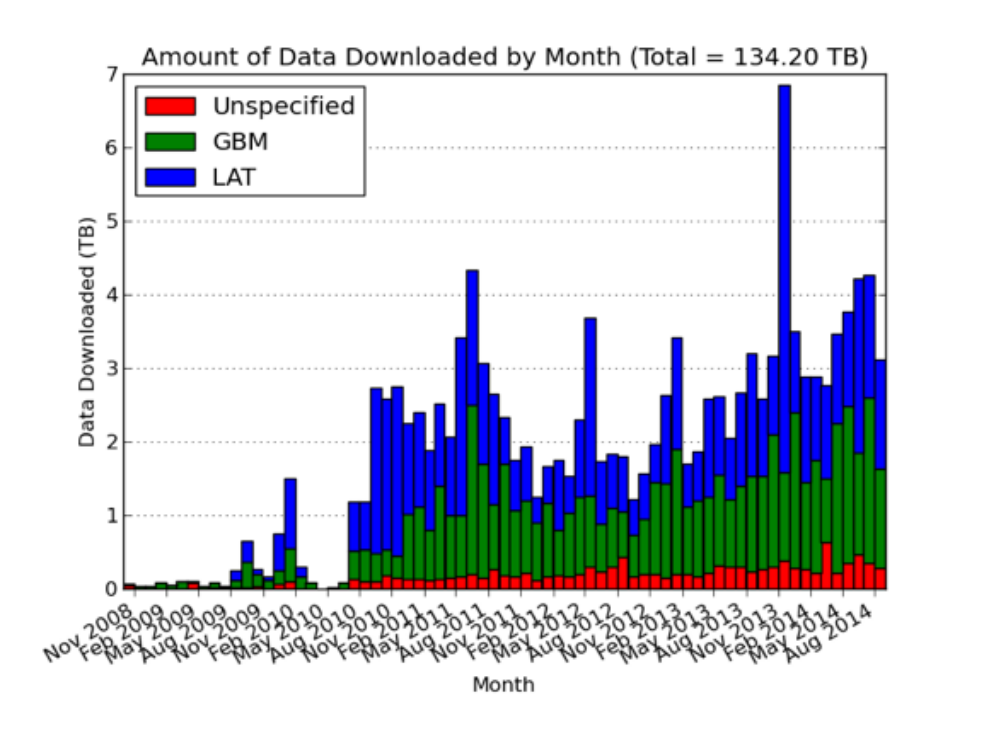
GBM

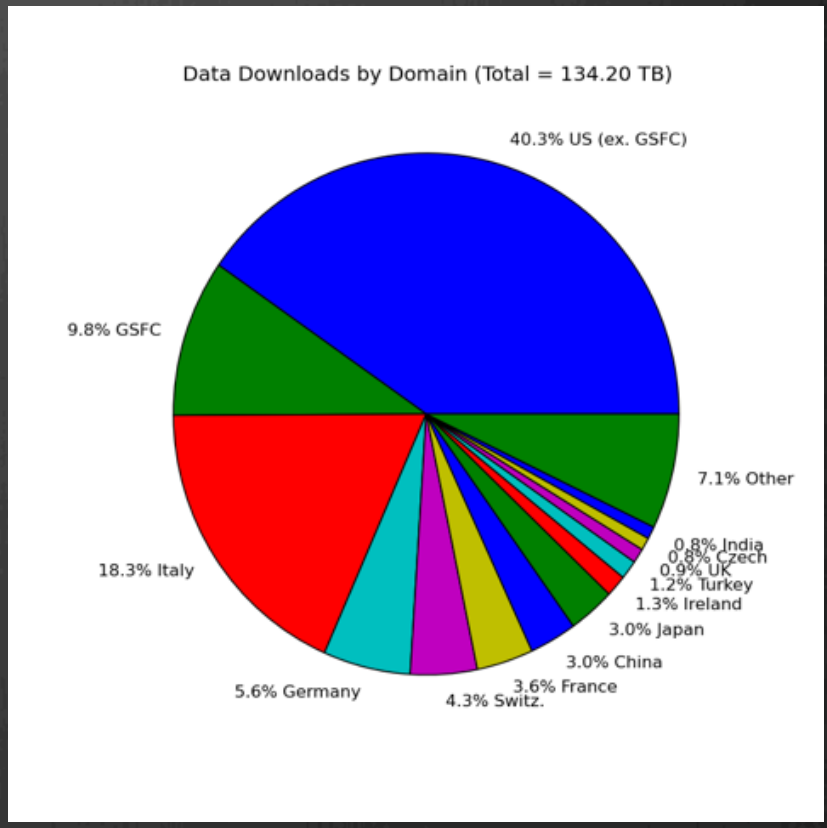
- 2 x10^{12} detector counts resulted in 3469 transient triggers
  - 1491 GRB, 510 TGF, 178 SGR bursts, 829 solar flares
  - >4500 GBM BA shifts by ~40 member team
  - 539 GCN circulars



Distributing >130 TB of Fermi Data

- Over 130 TB of data downloaded from FSSC
  - Half from US

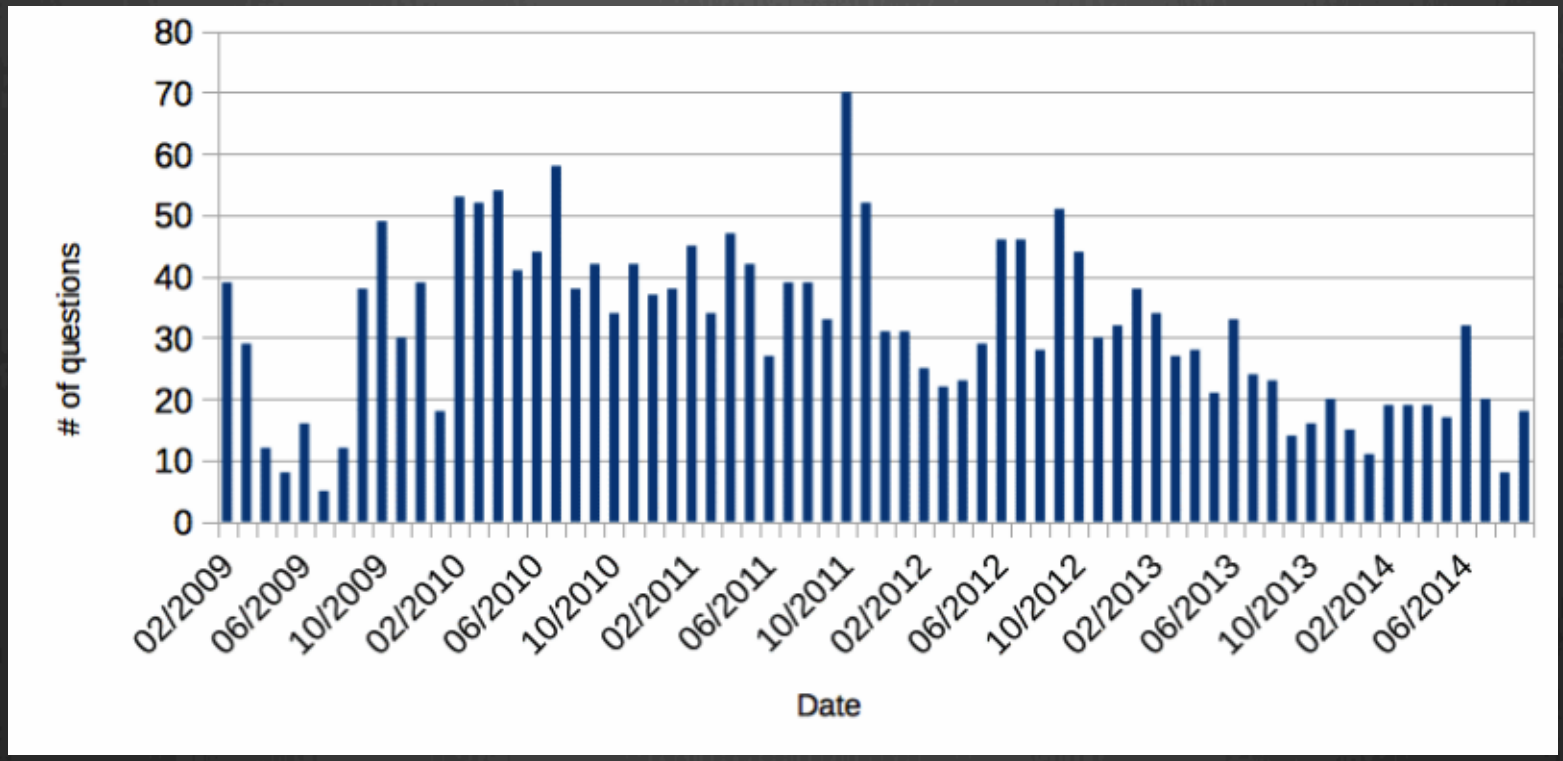




Four Fermi Summer Schools

- Gamma-ray (and cosmic-ray) science topics, analysis, detector simulation and some hardware projects/demonstration

FSSC - helpdesk



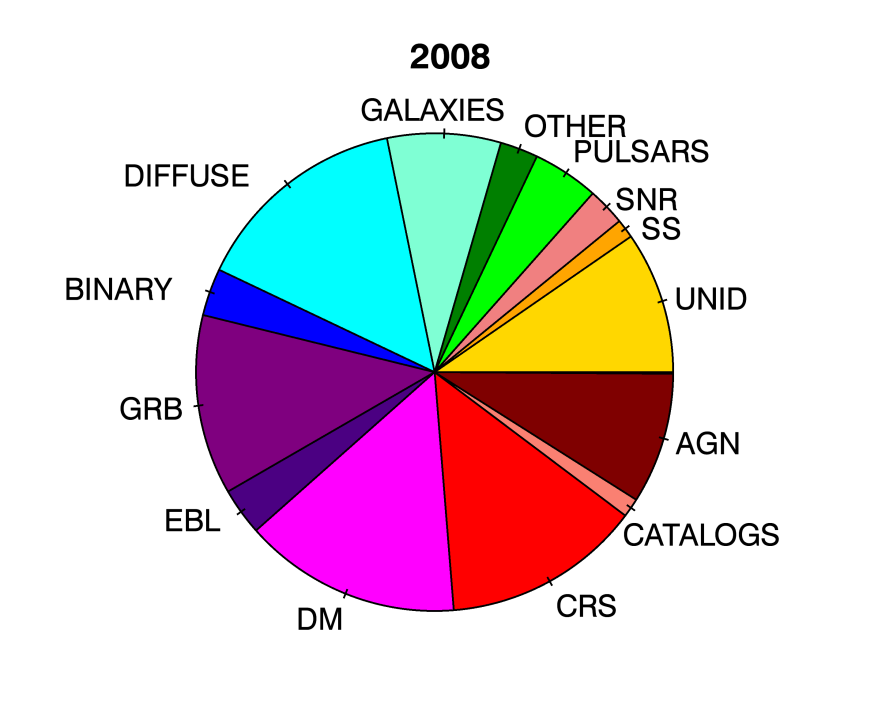
- The Fermi Science Support Center addresses questions help requests from users around the world

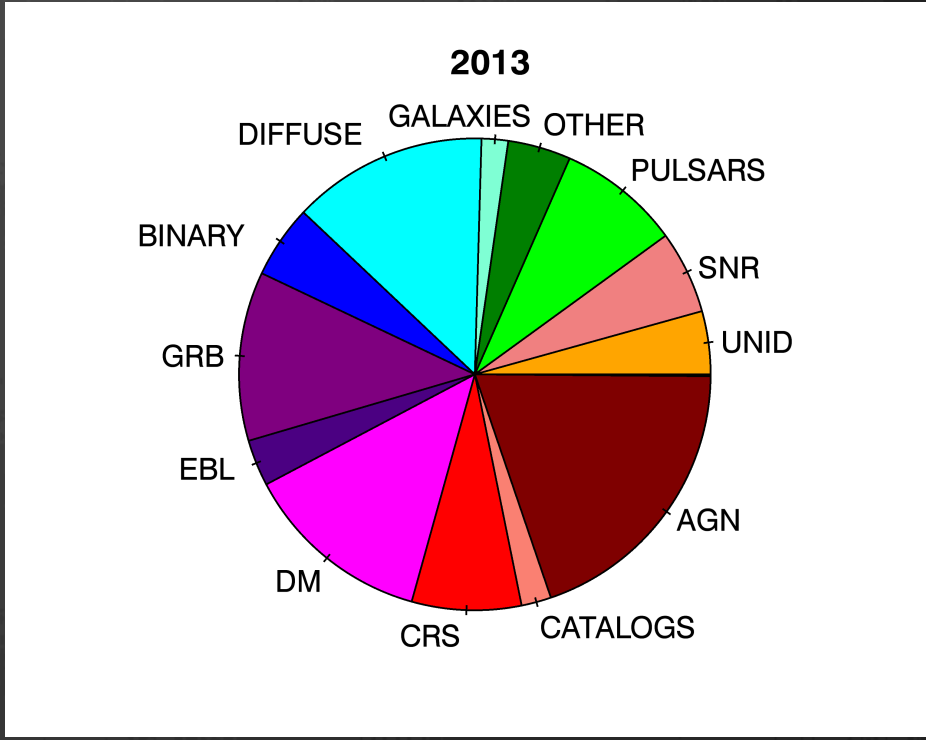
61 Fermi/Einstein Fellows

- Fermi and Chandra fellowship programs merged in 2009 to form Einstein fellowship program
- This year's deadline for Einstein fellowship applications is Nov 6th

Publications

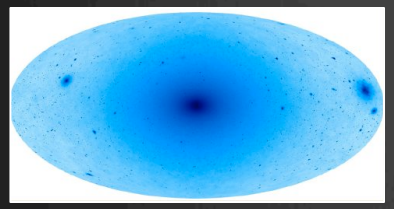
- 1614 papers since 2008 with combined 46121 citations
- Most cited results paper is the electron spectrum measured by LAT

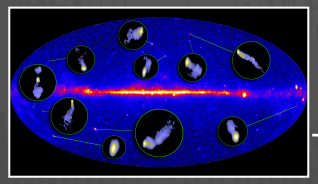


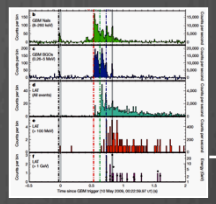


57 NASA press releases, over 15 million youtube/svs hits on Fermi animations

Dark Matter searches

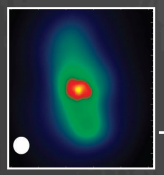




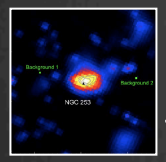


GRBs

Blazars

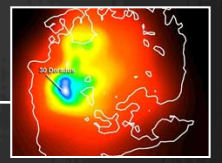


Radio Galaxies

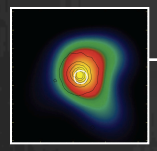


Starburst Galaxies

Extragalactic

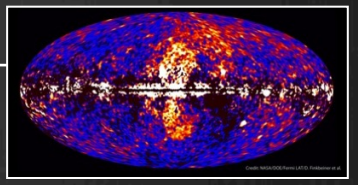


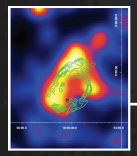
LMC & SMC



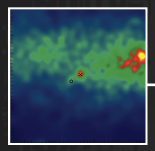
Globular Clusters

Fermi Bubbles



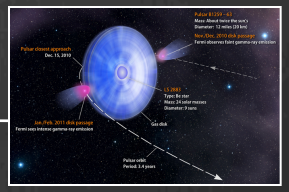


SNRs & PWN

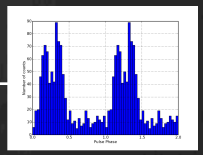


Novae

γ-ray Binaries

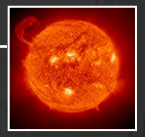


Pulsars: isolated, binaries, & MSPs



Galactic

Sun: flares & CR interactions



Terrestrial γ-ray Flashes

Unidentified Sources