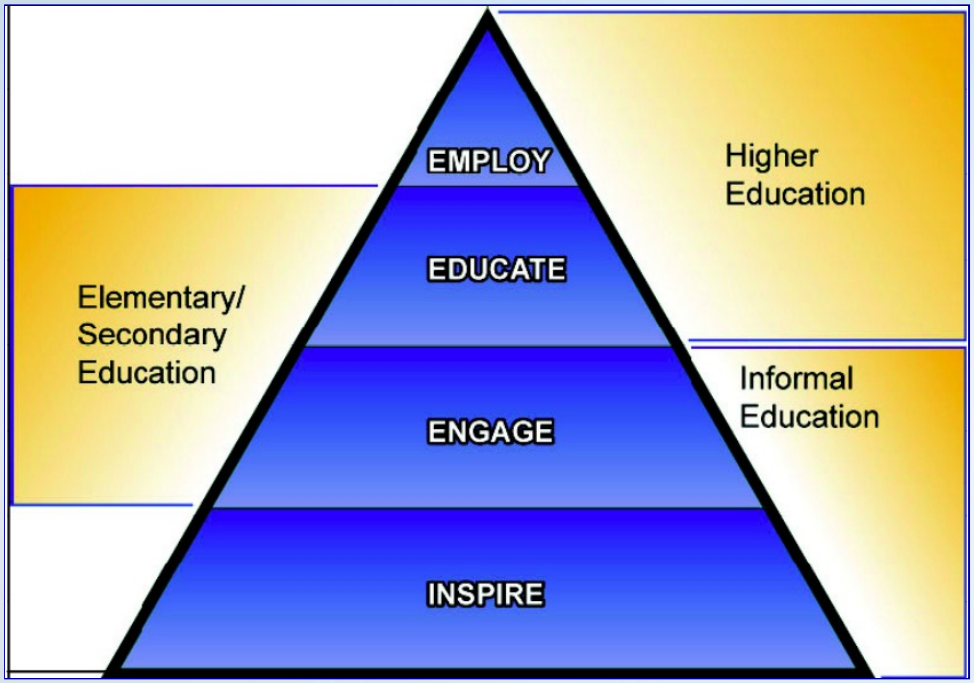
Education and Public Outreach Program Status
Fermi User's Group 8/28/08

Prof. Lynn Cominsky

Sonoma State University

NASA Education Framework



- Informal education and public outreach
- Elementary & Secondary education
- Higher Education

Emphasis on workforce development for under-represented populations

Fermi in the Web 2.0 community

"Yippeee! I am in spaaaaaaaaccccccccccceeeeeeeeeeeeee!"

GLASTCast videos are linked.

Fermi 100 hours of Astronomy site linked.

http://www.myspace.com/glast

Fermi now has 347 friends on MySpace, 583 friends on Facebook, and many of the items at cafepress.com/fermisatellite are newly updated with the new logo

Epo's Chronicles

- Continues weekly
- Special "eposodes" for IYA that feature NASA's monthly "go-observe" objects.
- Lithos with IYA eposodes distributed to Night Sky Network clubs
- Over 5000 lithos sent out to date

Alkina

Epo

Epo's Chronicles (partial July)

Space Mysteries

- http://mystery.sonoma.edu
  - Galactic Doom now in external evaluation by WestEd

Voice of Alkina has been added

Hints for galaxy classification

http://mystery.sonoma.edu/GalacticDoom/spaceMysteries_GalacticDoom.html

365 Days of Astronomy Podcast

- Epo's Chronicles podcast featuring Alkina, Epo and a special IYA-inspired "guest"
- Episode will air on 9/16/09

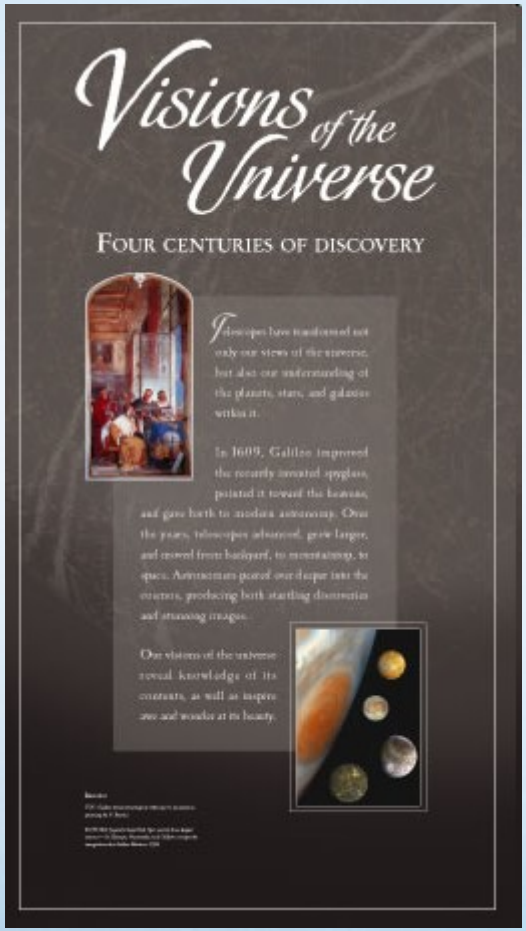
http://365daysofastronomy.org/

IYA activities with other NASA missions

- From Earth to the Universe – SSU created a small traveling exhibit that is roaming the SF Bay Area

IYA activities with other NASA missions

- Visions of the Universe is a Library exhibit that is being supported by the Educator Ambassadors who are doing workshops in mostly rural locations



Supernova Educator Workshops

- Joint XMM-Fermi Educator's Guide
- Approved by NASA product review in 10/08
- Workshop given at CSTA in November 2008
- Approved for CSTA in October 2009

Some (positive) reviews

- The materials emphasize effective instructional practices and provide for an experimental or constructivist approach to learning.
- The materials do a good job of trying to involve a number of different processes (reading, analysis and synthesis).
- The magnetic globe and the “Crawl of the Crab” will engage students at multiple levels.
- The focus on “Data first, conclusions second” is excellent.
- The materials do a good job using learning technologies (Excel, image software, websites and video).

More (positive) reviews

- The packet is replete with suggestions of further research opportunities.
- Great emphasis on science as inquiry and problem-centered tasks and very hands on.
- The narrative is well written and represents scientific reasoning in a realistic way.
- Great job of zeroing in on the appropriate age levels for the activities.
- The references are ordered by activities, which is very useful for both the teachers and the students.
- A reviewer noted “Teachers will love the activities and all the explanations. There is a clear explanation on what standards are met with each activity.”

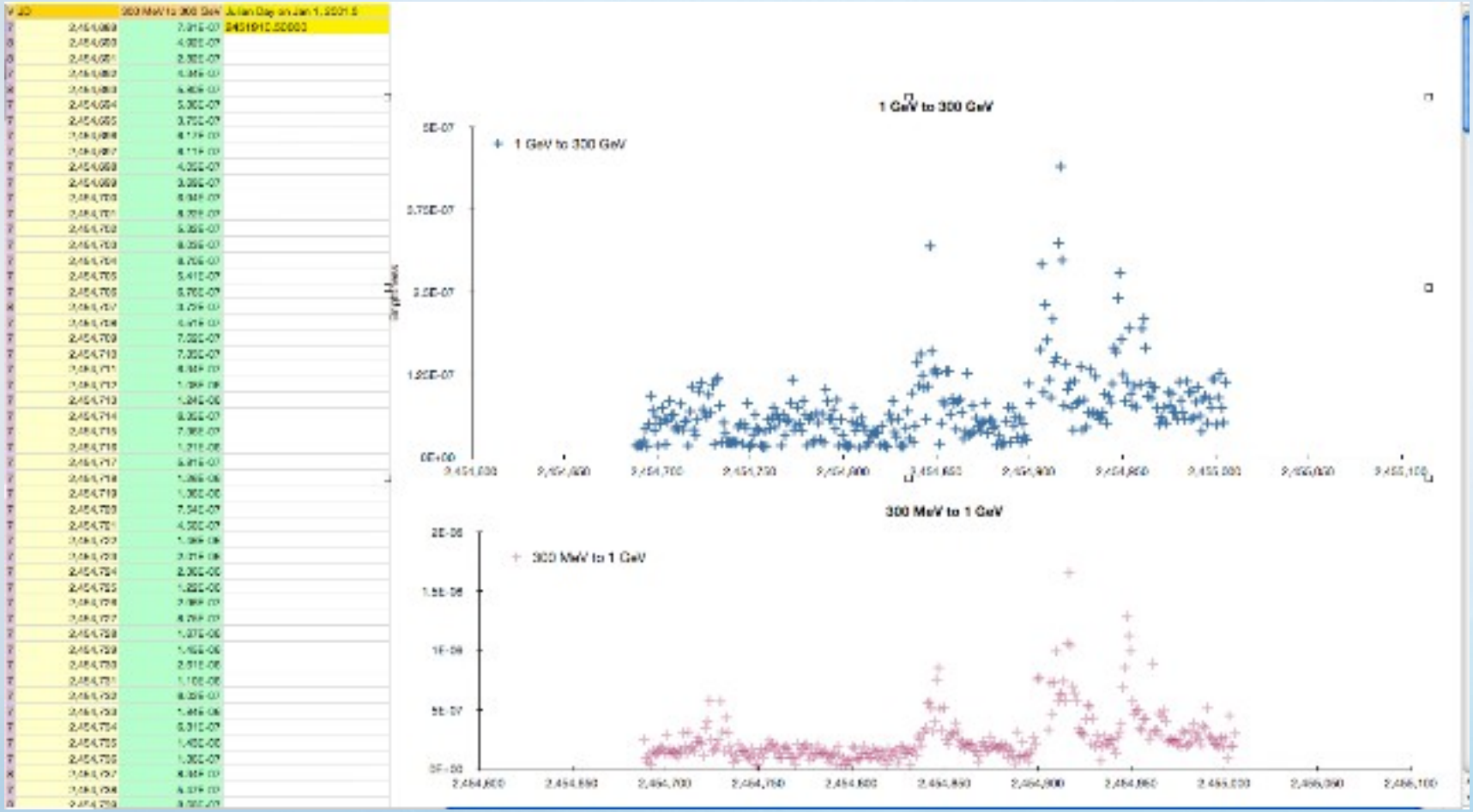
Other Educator Workshops by SSU

- Satellite Educator's Association (LA, August 2009) – Fermi workshop – this is a new conference that we did not know about previously. About 100 pre- and in-service teachers were there.
- Previously their focus was earth and planetary science. We added some astrophysics!

Other Educator Workshops by SSU

- Kevin McLin developed a new workshop using real AGN data for PKS 1510-089, AO 0235+164 and 3C279 in BVRIJHK and gamma rays for the PIMS teachers program at GSFC (July 2009). He worked with 120 teachers from Pennsylvania. They used spreadsheets to study correlations in flares between energy bands. Over the next year, they are supposed to develop their own lesson plans, with advice from Kevin. Eventually this will be part of our GTN Educator's Guide.

Spreadsheet with Gamma Ray Data



Spreadsheet with Visible Data

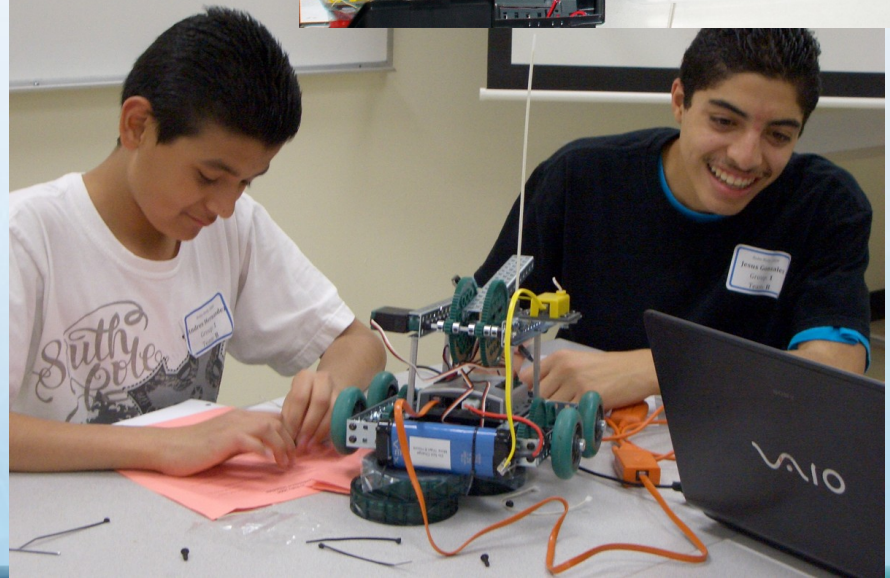
After-school programs

- Roseland University Prep
  - 20+ graduates came to SSU in Fall 2009
  - >90% Hispanic, low-income
  - After-school club since 2005
- MESA Schools Program
  - 2 After-school clubs at Cali
- MESA Engineering Program
  - Now established at SSU
  - Hosted Robotics conference in May 2009

Logan Hill w 4th thru 6th graders at Cali Calmecac

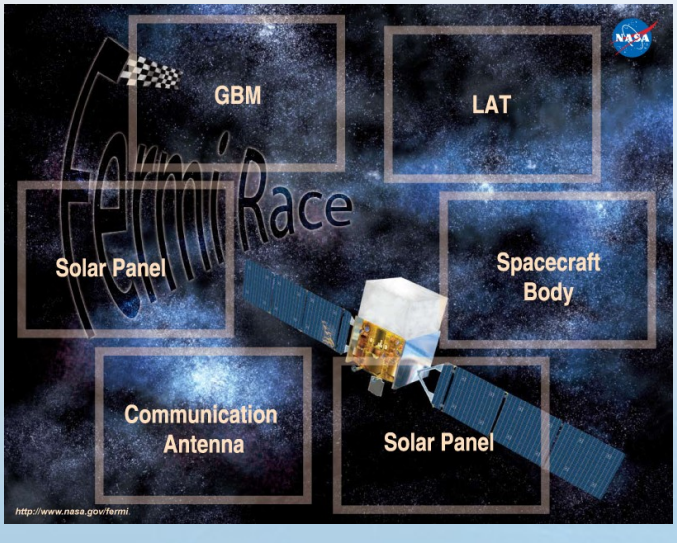
RUP students at MESA day

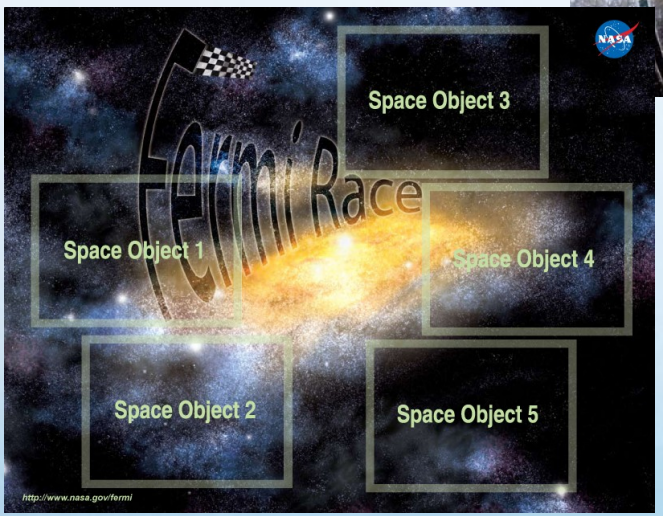
Robo Rally photos



Fermi Race Game

- Approved by NASA Product Review
- Now reprinted!
- Will be handed out at Fermi Symposium to all participants





Double-sided game board

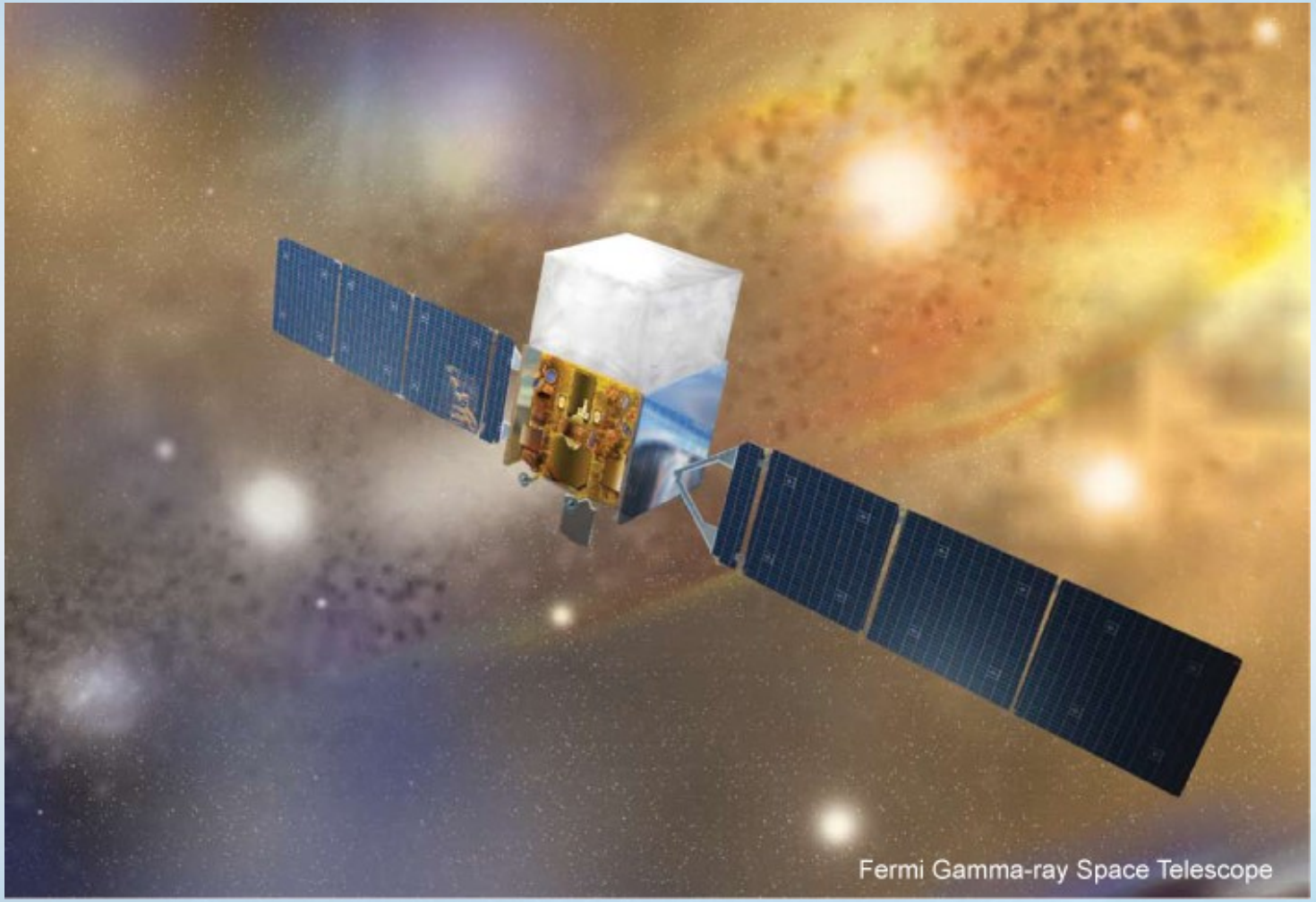
Global Telescope Network 8/09

- GTN website now approved by NASA Product Review
- 28 Member Institutions (five new since last year)
- Extensive work this summer on a simplified calibration pipeline for high school students and teachers. Also help from two amateur astronomers on the photometry pipeline.
- Two high school interns worked analyzing archival and new data on OS 319 and Mkn 501
- SSU summer student worked on many other objects, will continue next year.

Conference Presentations by SSU group

- “The Global Telescope Network,” K. McLin, G. Spear & L. Cominsky, in *EPO and a Changing World: Creating Linkages and Expanding Partnerships ASP Conference Series, Vol. 389,* proceedings of the conference held 5-7 September 2007, in Chicago, Illinois, USA. Edited by Catharine Garmany, Michael G. Gibbs, and J. Ward Moody. San Francisco: Astronomical Society of the Pacific, 2080., p.89, 2008ASPC..389...89M
- “Epo's Chronicles: A Weekly Webcomic That Teaches Space Science,” L. Cominsky, K. Prasad, A. Simonnet, K. John, K. McLin & L. Hill, *BAAS,* 2009AAS...21346407C
- “Transforming Introductory Astronomy in the Urban University,” Kimberly A. Coble, M. Sabella, D. Larrieu, J. McDowell, R. Orlanzino, L. Cominsky & K. McLin, *BAAS,* 2009AAS...21346206C
- “Undergraduate Research Experiences with the Global Telescope Network,” K. McLin, K. Wyman, N. Broughton, K. Coble, & L.R. Cominsky, *BAAS,* 2009AAS...21346102M

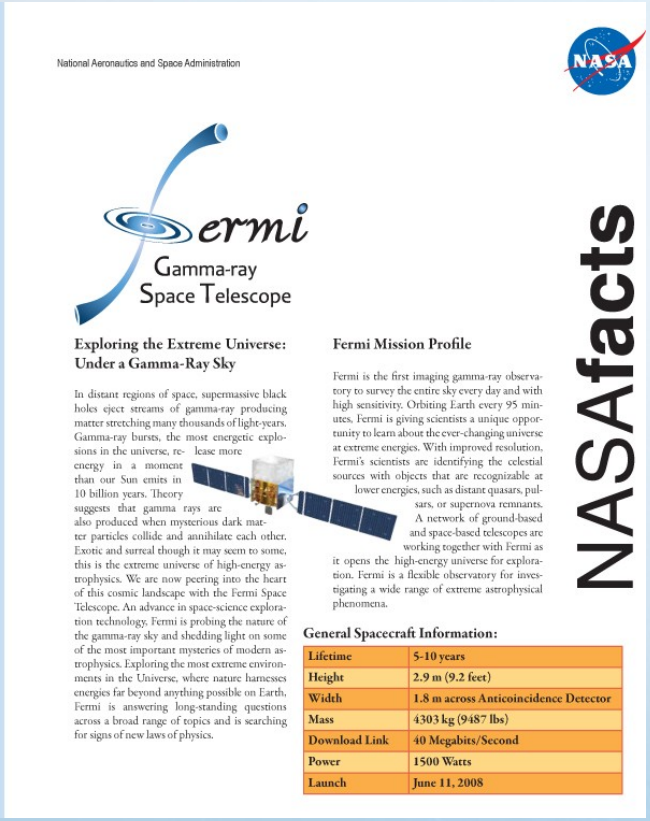
Fermi Litho



Approved litho has now been updated for Fermi

Fermi FactSheet

- Approved factsheet now updated for Fermi
- Has 9 month skymap and 10 “notable” sources



National Aeronautics and Space Administration

NASA

Fermi
Gamma-ray
Space Telescope

NASAfacts

Exploring the Extreme Universe: Under a Gamma-Ray Sky

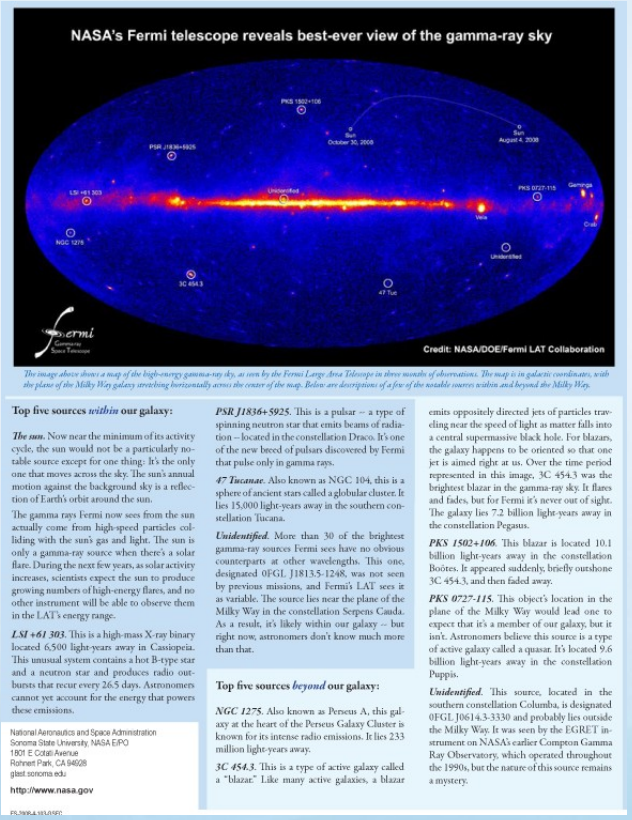
In distant regions of space, supermassive black holes eject streams of gamma-ray producing matter stretching many thousands of light-years. Gamma-ray bursts, the most energetic explosions in the universe, release more energy in a moment than our Sun emits in 10 billion years. Theory suggests that gamma rays are also produced when mysterious dark matter particles collide and annihilate each other. Exotic and surreal though it may seem to some, this is the extreme universe of high-energy astrophysics. We are now peering into the heart of this cosmic landscape with the Fermi Space Telescope. An advance in space-science exploration technology, Fermi is probing the nature of the gamma-ray sky and shedding light on some of the most important mysteries of modern astrophysics. Exploring the most extreme environments in the Universe, where nature harnesses energies far beyond anything possible on Earth, Fermi is answering long-standing questions across a broad range of topics and is searching for signs of new laws of physics.

Fermi Mission Profile

Fermi is the first imaging gamma-ray observatory to survey the entire sky every day and with high sensitivity. Orbiting Earth every 95 minutes, Fermi is giving scientists a unique opportunity to learn about the ever-changing universe at extreme energies. With improved resolution, Fermi's scientists are identifying the celestial sources with objects that are recognizable at lower energies, such as distant quasars, pulsars, or supernova remnants. A network of ground-based and space-based telescopes are working together with Fermi as it opens the high-energy universe for exploration. Fermi is a flexible observatory for investigating a wide range of extreme astrophysical phenomena.

General Spacecraft Information:

Lifetime	5-10 years
Height	2.9 m (9.2 feet)
Width	1.8 m across Anticoincidence Detector
Mass	4303 kg (9487 lbs)
Download Link	40 Megabits/Second
Power	1500 Watts
Launch	June 11, 2008



NASA's Fermi telescope reveals best-ever view of the gamma-ray sky

The image above shows a map of the high-energy gamma-ray sky, as seen by the Fermi Large Area Telescope in three months of observations. The map is in galactic coordinates, with the plane of the Milky Way galaxy stretching horizontally across the center of the map. Below are descriptions of a few of the notable sources within and beyond the Milky Way.

Top five sources *within* our galaxy:

The sun. Now near the minimum of its activity cycle, the sun would not be a particularly notable source except for one thing: It's the only one that moves across the sky. The sun's annual motion against the background sky is a reflection of Earth's orbit around the sun.

The gamma rays Fermi now sees from the sun actually come from high-speed particles colliding with the sun's gas and light. The sun is only a gamma-ray source when there's a solar flare. During the next few years, as solar activity increases, scientists expect the sun to produce growing numbers of high-energy flares, and no other instrument will be able to observe them in the LAT's energy range.

LSI +61 303. This is a high-mass X-ray binary located 6,500 light-years away in Cassiopeia. This unusual system contains a hot B-type star and a neutron star and produces radio outbursts that recur every 26.5 days. Astronomers cannot yet account for the energy that powers these emissions.

PSR J1836+5925. This is a pulsar -- a type of spinning neutron star that emits beams of radiation -- located in the constellation Draco. It's one of the new breed of pulsars discovered by Fermi that pulse only in gamma rays.

47 Tucanae. Also known as NGC 104, this is a sphere of ancient stars called a globular cluster. It lies 15,000 light-years away in the southern constellation Tucana.

Unidentified. More than 30 of the brightest gamma-ray sources Fermi sees have no obvious counterparts at other wavelengths. This one, designated 0FGL J1813.5-1248, was not seen by previous missions, and Fermi's LAT sees it as variable. The source lies near the plane of the Milky Way in the constellation Serpens Cauda. As a result, it's likely within our galaxy -- but right now, astronomers don't know much more than that.

Top five sources *beyond* our galaxy:

NGC 1275. Also known as Perseus A, this galaxy at the heart of the Perseus Galaxy Cluster is known for its intense radio emissions. It lies 233 million light-years away.

3C 454.3. This is a type of active galaxy called a "blazar." Like many active galaxies, a blazar emits oppositely directed jets of particles traveling near the speed of light as matter falls into a central supermassive black hole. For blazars, the galaxy happens to be oriented so that one jet is aimed right at us. Over the time period represented in this image, 3C 454.3 was the brightest blazar in the gamma-ray sky. It flares and fades, but for Fermi it's never out of sight. The galaxy lies 7.2 billion light-years away in the constellation Pegasus.

PKS 1502+106. This blazar is located 10.1 billion light-years away in the constellation Boötes. It appeared suddenly, briefly outshone 3C 454.3, and then faded away.

PKS 0727-115. This object's location in the plane of the Milky Way would lead one to expect that it's a member of our galaxy, but it isn't. Astronomers believe this source is a type of active galaxy called a quasar. It's located 9.6 billion light-years away in the constellation Puppis.

Unidentified. This source, located in the southern constellation Columba, is designated 0FGL J0614.3-3330 and probably lies outside the Milky Way. It was seen by the EGRET instrument on NASA's earlier Compton Gamma Ray Observatory, which operated throughout the 1990s, but the nature of this source remains a mystery.

National Aeronautics and Space Administration
Sonoma State University, NASA E/PO
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Rohnert Park, CA 94928
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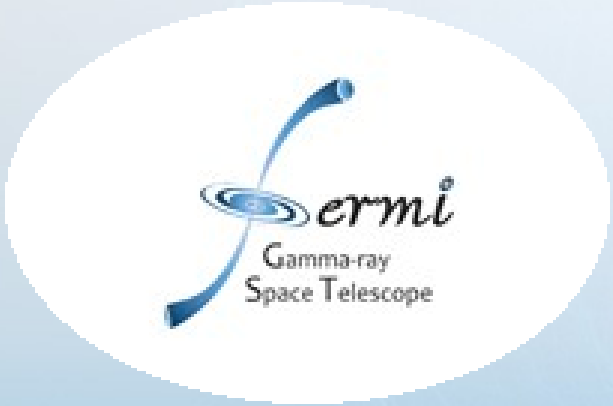
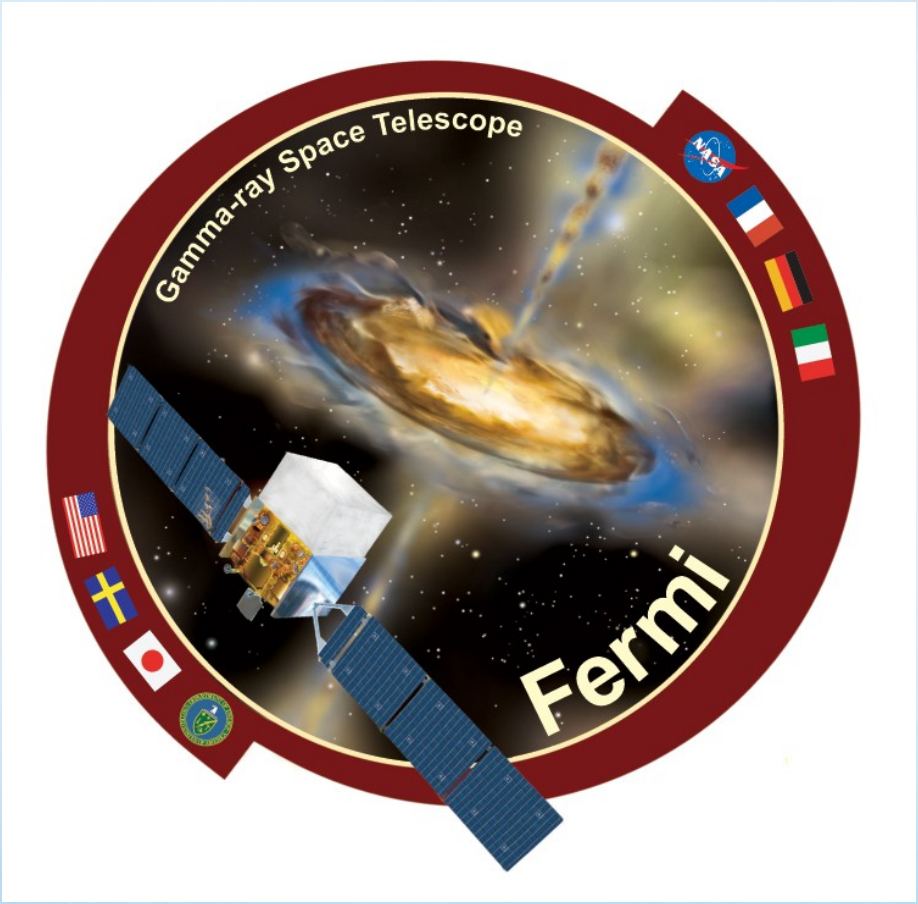
http://www.nasa.gov

New stickers

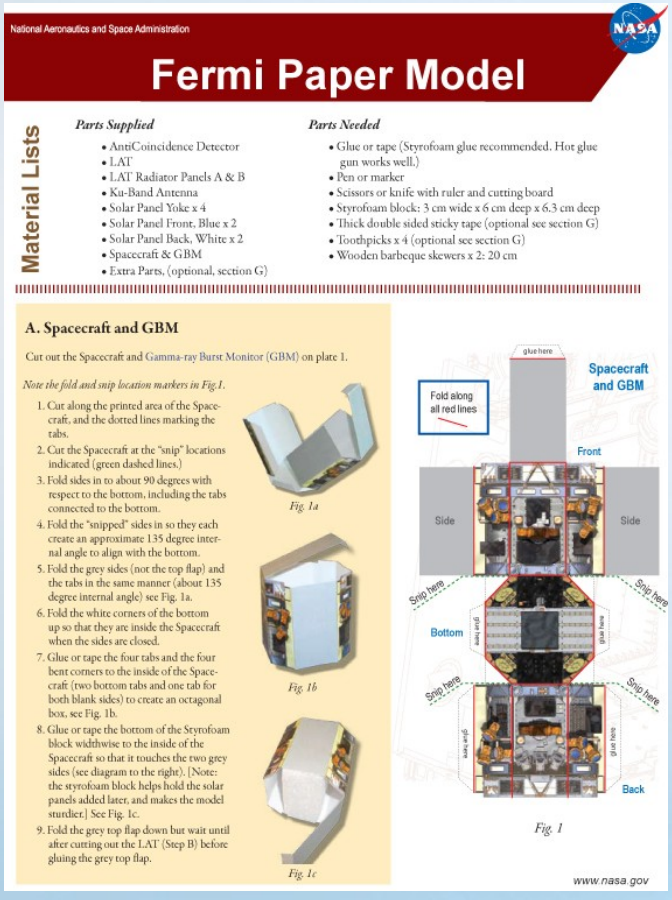
- Sticker text revised for Fermi
- Both styles now on order





Fermi paper model

- Approved model now updated for Fermi
- On order



National Aeronautics and Space Administration

Fermi Paper Model

Material Lists

Parts Supplied

- AntiCoincidence Detector
- LAT
- LAT Radiator Panels A & B
- Ku-Band Antenna
- Solar Panel Yoke x 4
- Solar Panel Front, Blue x 2
- Solar Panel Back, White x 2
- Spacecraft & GBM
- Extra Parts, (optional, section G)

Parts Needed

- Glue or tape (Styrofoam glue recommended. Hot glue gun works well.)
- Pen or marker
- Scissors or knife with ruler and cutting board
- Styrofoam block: 3 cm wide x 6 cm deep x 6.3 cm deep
- Thick double sided sticky tape (optional see section G)
- Toothpicks x 4 (optional see section G)
- Wooden barbeque skewers x 2: 20 cm

A. Spacecraft and GBM

Cut out the Spacecraft and Gamma-ray Burst Monitor (GBM) on plate 1.

Note the fold and snip location markers in Fig.1.

1. Cut along the printed area of the Spacecraft, and the dotted lines marking the tabs.
2. Cut the Spacecraft at the "snip" locations indicated (green dashed lines.)
3. Fold sides in to about 90 degrees with respect to the bottom, including the tabs connected to the bottom.
4. Fold the "snipped" sides in so they each create an approximate 135 degree internal angle to align with the bottom.
5. Fold the grey sides (not the top flap) and the tabs in the same manner (about 135 degree internal angle) see Fig. 1a.
6. Fold the white corners of the bottom up so that they are inside the Spacecraft when the sides are closed.
7. Glue or tape the four tabs and the four bent corners to the inside of the Spacecraft (two bottom tabs and one tab for both blank sides) to create an octagonal box, see Fig. 1b.
8. Glue or tape the bottom of the Styrofoam block widthwise to the inside of the Spacecraft so that it touches the two grey sides (see diagram to the right). [Note: the styrofoam block helps hold the solar panels added later, and makes the model sturdier.] See Fig. 1c.
9. Fold the grey top flap down but wait until after cutting out the LAT (Step B) before gluing the grey top flap.

Fig 1a

Fig 1b

Fig 1c

Fig. 1

www.nasa.gov

Fermi Instruments

Find out more about what you've built!

Here are short descriptions of a few components of the Fermi satellite.

Section B

The **LAT, or Large Area Telescope**, is the primary instrument on Fermi and is able to detect the direction and energy of gamma rays. It has four main parts. 1) The Precision Tracker, composed of 16 towers (see model), tracks the direction from which the gamma rays are coming. 2) The Calorimeter, which sits at the base of the Precision Tracker, measures the amount of energy in each gamma ray. 3) The Data Acquisition System (DAQ) is the computer that analyzes the information from the Precision Tracker and Calorimeter. The DAQ is also responsible for determining whether the gamma ray was real or if it was a false signal, using information provided by the 4) AntiCoincidence Detector (see section D for more information).

http://www-fermi.stanford.edu/index.html

Section D

The **AntiCoincidence Detector or ACD** is actually a part of the LAT and sits over the Precision Tracker. It is designed to filter out cosmic rays (particles) from gamma rays (light) so that the cosmic rays are blocked from being counted by the Precision Tracker.

Section A

The **Gamma-ray Burst Monitor or GBM**, studies gamma-ray burst sources by detecting a wide energy range of gamma rays over an all-sky field of view. The GBM includes 12 sodium iodide scintillation detectors and 2 bismuth germanate scintillation detectors.

http://gammaray.msfc.nasa.gov/gbm/

Section F

The **Ku-Band Antenna** relays information between Fermi and the ground stations monitoring the satellite.

The Fermi Space Telescope is an international and multi-agency mission that launched on June 11 2008. It studies the cosmos looking at objects that emit high energy wavelengths of light. This model is designed to further educate the public about the Fermi mission and the instruments on board the spacecraft.

http://fermi.sonoma.edu/materials.html

GeoDome

- Large enough for adults
- Digital projection system and sound
- Just purchased by NASA Goddard and at SSU for development of eXtreme Universe show

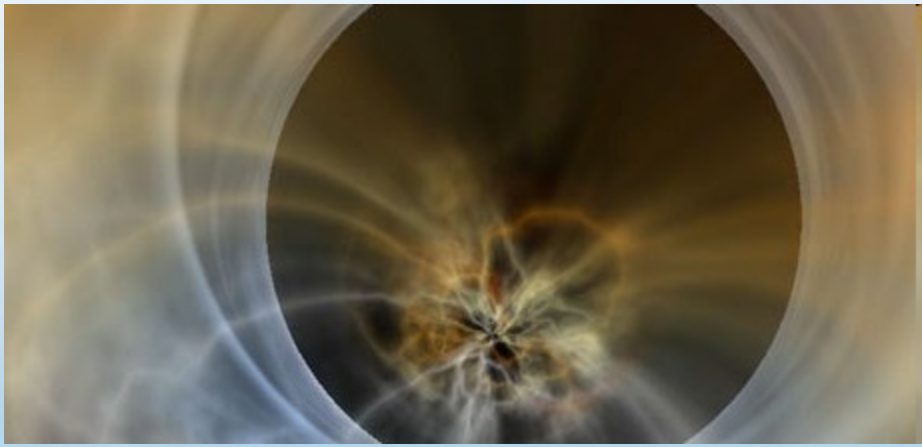
eXtreme Universe Show

- Joint project with XMM-Newton E/PO
- We have tried (and failed) to do this with two previous technologies
- Now underway with Uniview for GeoDome – expect success!
- Teacher's manual drafted years ago
- Now will feature Fermi LAT as well as X-ray sky.

Black Hole Show for the GeoDome?

- We can buy a permanent license for the Black Holes: the Other Side of Infinity show for the Geodome for $5000
- We can then do workshops for teachers and museum professionals using the GeoDome at various venues

Please advise – should we do this?



Next E/PO Plans

- Black Hole (?) and eXtreme Universe show for GeoDome and teacher workshops
- New litho set featuring first sky map and discoveries for each type of object
- Cosmology on-line course (?)
  - Needs additional funding (NASA proposal resubmitted)
  - Has publisher support (Kendall-Hunt)
- Fermi data into WWT (tours), Google Earth in time for October press conference
- AER publications in progress: Cosmology Understanding, Educator Ambassador program, Black Hole show audience learning

PR Update

Press releases and web features since last FUG (9/08):

- NASA'S Fermi Telescope Discovers First Gamma-Ray-Only Pulsar (10/16/08)
- NASA'S Fermi Telescope Unveils a Dozen New Pulsars (1/06/09)
- NASA's Swift, Fermi Probe Fireworks From a Flaring Gamma-Ray Star (2/10/09)
- NASA's Fermi Telescope Sees Most Extreme Gamma-ray Blast Yet (2/19/09)
- Fermi's Best-Ever Look at the Gamma-Ray Sky (3/11/09)

PR Update (continued)

- NASA's Fermi Mission, Namibia's HESS Telescopes Explore a Blazar (3/18/09)
- Active Galaxies Flare and Fade in Fermi Telescope All-Sky Movie (4/3/09)
- Continent-sized Radio Telescope Takes Close-ups of Fermi Active Galaxies (4/22/09)
- NASA's Fermi Explores High-energy "Space Invaders“ (5/4/09)
- NASA's Fermi Finds Gamma-ray Galaxy Surprises (5/29/09)
- NASA's Fermi Telescope Probes Dozens of Pulsars (7/3/09)

"Exploring the Extreme Universe with Fermi" Public Lectures by LRC Since 9/08

- SETI Institute (8/27/08)
- Women's Interchange at SLAC (9/24/08)
- Santa Rosa Kiwanis Club (3/17/09)
- City College of San Francisco Astronomy Lecture Series (3/18/09)
- SSU What Physicists Do Colloquium Series (3/23/09)
- Sons in Retirement (Oakmont) Club (4/22/09)
- Mt. Tamalpais Lecture Series (6/27/09)
- Women in Science & Culture Lecture Series at the Science Buzz Café (8/13/09)

Science Magazine Cover Art by Simonnet

- August 17, 2009 issue with three LAT papers about pulsars

PR and E/PO Summary

- Many successful IYA-related outreach activities last year
- After school clubs and high school partnerships are thriving
- Emphasis will shift back to Fermi science workshops in future years
- Press activities need better understanding by team
- Increased penetration into the Web 2.0 world using Fermi data – WWT, Google Earth in conjunction with press activities