



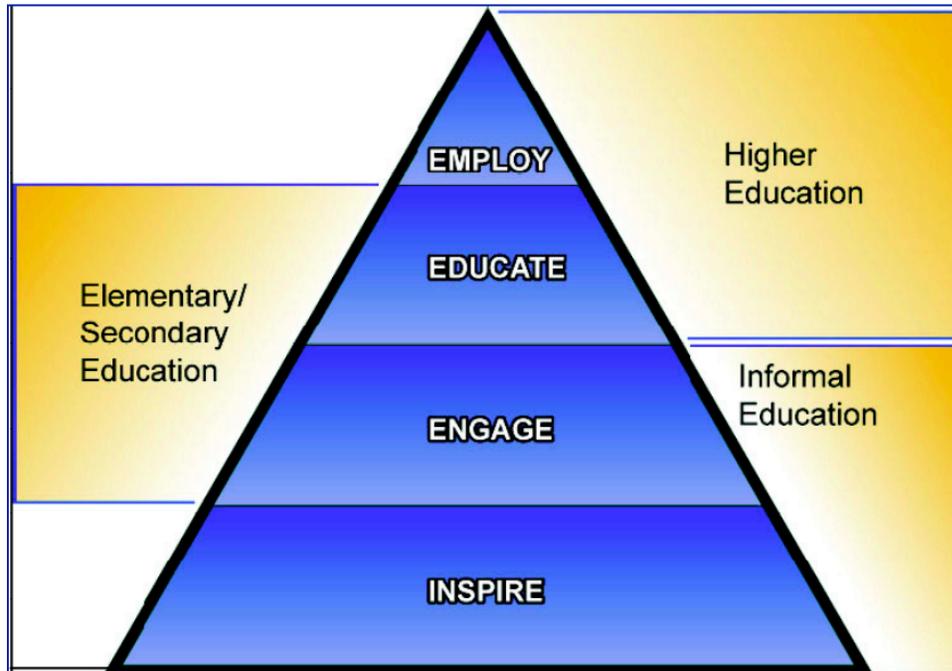
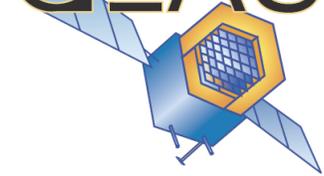
---

## **GLAST E/PO Program Status**

**GLAST User's Committee 3/3/08**

Lynn Cominsky  
Sonoma State University

# GLAST New NASA Education Framework



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

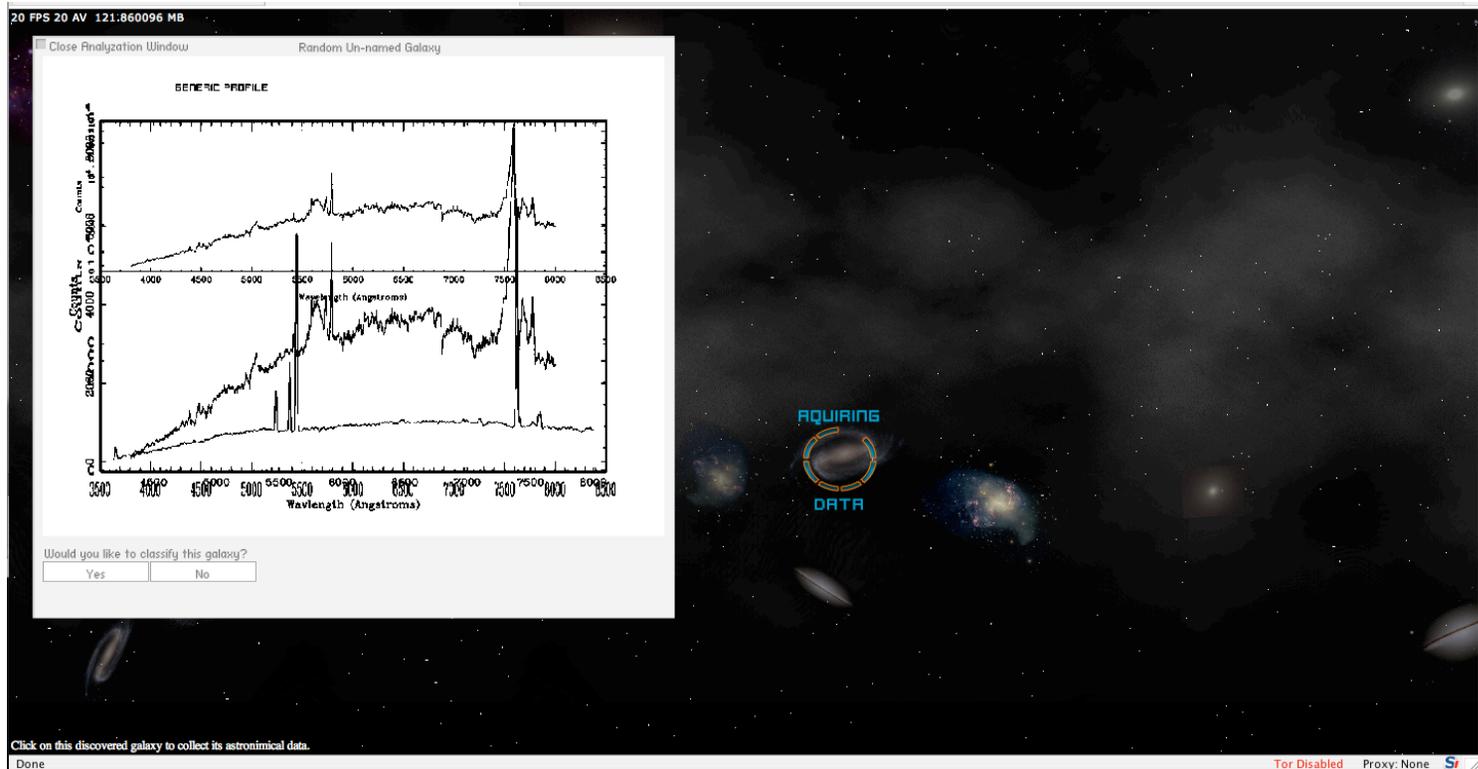
Emphasis on workforce development for under-represented populations



# Space Mysteries



- <http://mystery.sonoma.edu>
  - Galactic Doom Space Mystery still being reworked





## GLAST in the MySpace community

---

### GLAST



"Can't Wait 'till Launch!"

Male  
20 years old  
ROHNERT  
PARK,  
CALIFORNIA  
United States



<http://www.myspace.com/glast>

GLAST now has 235  
friends, and a blog

Latest blog entry – rocket  
arrives at KSC

---

**GLAST**



## Night Sky Network Toolkit

---

- SUPERNOVA!
- Joint with Swift, XMM-Newton and Suzaku
- Developed by Astronomical Society of the Pacific
- Final testing now in progress

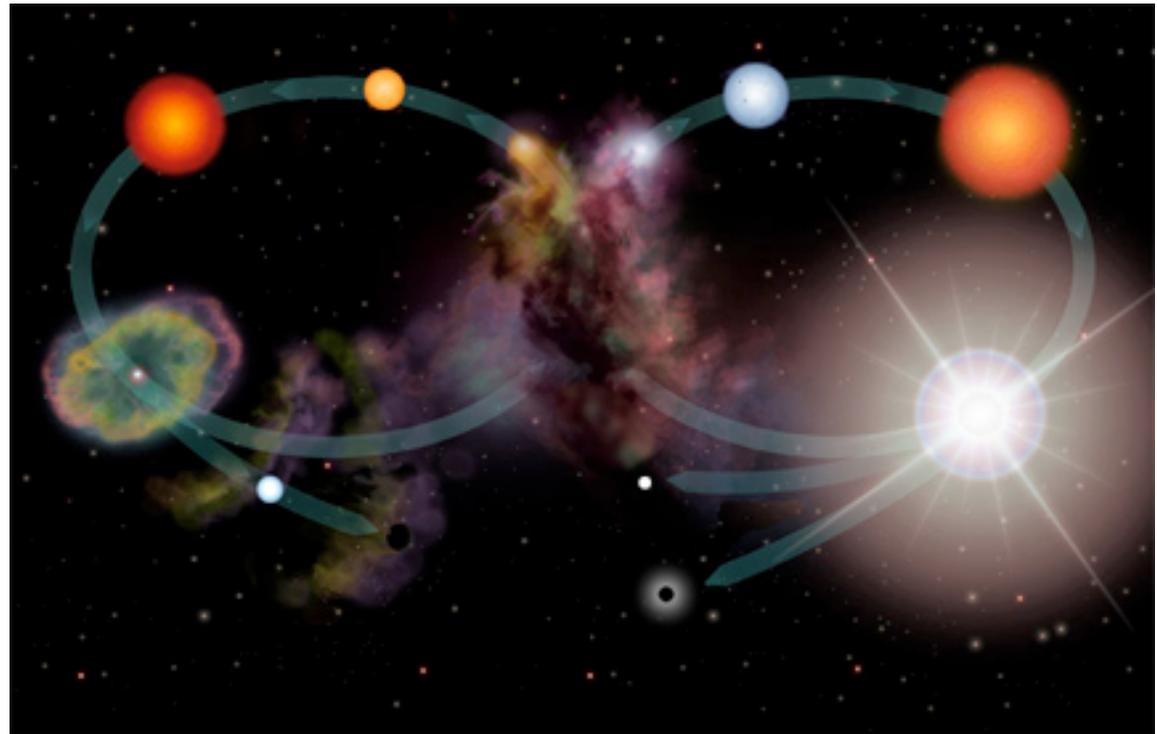




## Supernova! Activities

---

- Supernovae in the Lives of Stars
  - Life Cycles of Stars poster
  - Let's Make a Supernova
  - Star Maps: Stars Likely to Go Supernova

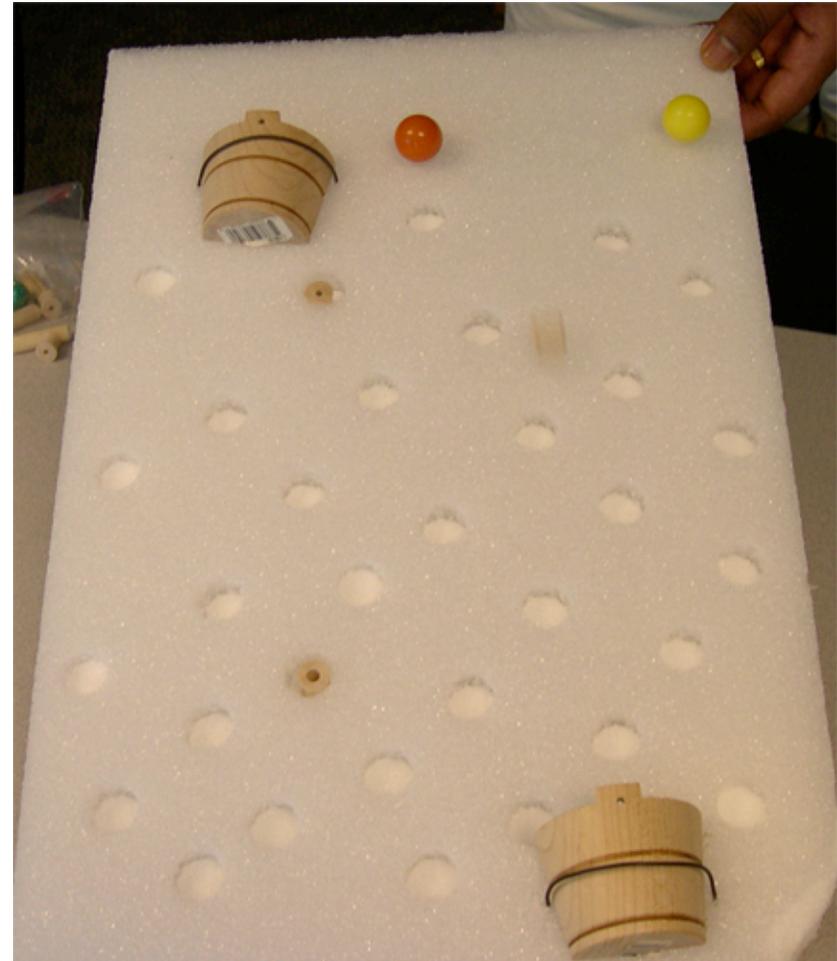




## Supernova! Activities

---

- Protecting the Earth from Cosmic Radiation
  - Nuclear Fusion, Cosmic Radiation and Supernovae
  - Protecting the Earth Activity
  - Air as a Shield
  - Gamma-ray Bursts





# Supernova! Activities

- Universe without Supernovae
  - Cosmic Connection to the Elements (GSFC)
  - Activity, Guide and Poster

**A Universe without Supernovae**

If supernovae never occurred in our universe to disperse the elements made in stars, what would be left in the universe?

**Basic Elements in the Universe**  
(originated in Big Bang)  
Hydrogen, Helium

**Common Elements originating from small stars**  
Nitrogen  
Carbon  
Lithium

**Common Elements whose primary source is from stars that go supernova**  
Aluminum  
Calcium  
Carbon  
Chlorine  
Copper  
Gold  
Iron  
Magnesium  
Mercury  
Nickel  
Oxygen  
Phosphorus  
Platinum  
Potassium  
Silicon  
Silver  
Sodium  
Sulfur  
Titanium  
Uranium  
Zinc

**Some of the elements found in:**

**Diamond rings:** Carbon, Gold  
**Computers & Cell Phones:** Silicon (computer chips), Carbon, Hydrogen, Oxygen, Sulfur (plastics)  
**Buildings:** Iron (in steel), Calcium, Silicon, Oxygen (in concrete)  
**Plants, Animals, and People:** Carbon, Hydrogen, Nitrogen, Oxygen, Sodium, Magnesium, Phosphorus, Sulfur, Potassium, Calcium, Iron, Zinc  
**Atmosphere:** Nitrogen, Oxygen  
**Earth:** Iron, Oxygen, Silicon, Aluminum, Calcium  
**Sun:** Hydrogen, Helium

www.nasa.gov



## 1<sup>st</sup> AstronomyCast questions show online

---

- Questions in first show from Farmersburg School
  - The Sky (2)
  - Optics (2)
    - Light as a Particle (2)
  - Stars and Stellar Evolution (4)
  - Understanding by Starlight (3)
    - Light and Color (1)
    - The Earth's Atmosphere and the Electromagnetic Spectrum (2)
  - Stellar Evolution II: High mass stars (1)
    - Limits on Maximum Star Size (1)
  - Extragalactic Astronomy and Cosmology (3)
  - Bonus: Black Holes, Redux (3)
    - Blackhole Feeding Habits (2)
    - Detecting Blackholes (1)



<http://astronomycast.com/educate>

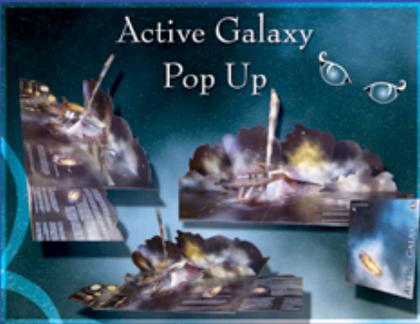
---

**GLAST**



## Black Holes update

- Black Holes: The Other Side of Infinity
  - Will be starting at the National Air and Space Museum in March
- Pop-up book classroom presentations



Popup 3D Galax

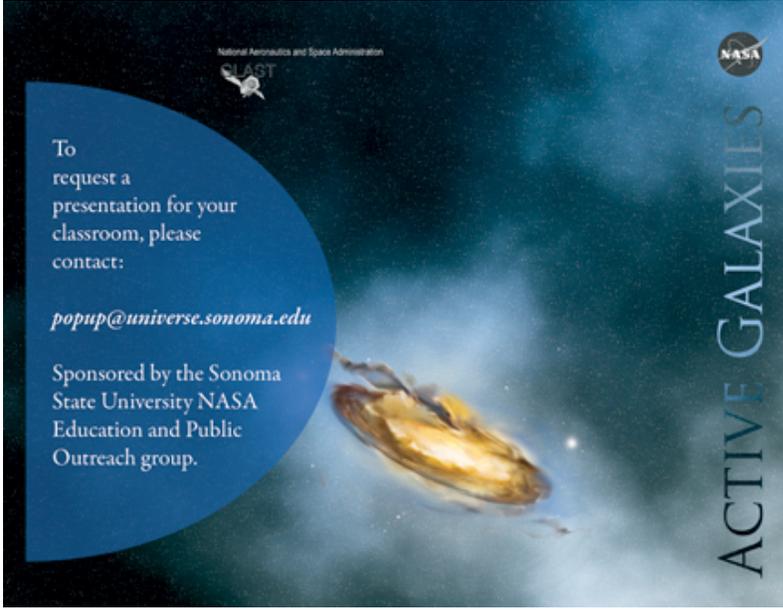
Tasty Active Galax

How the Galaxy Got Its Jets

Active Galaxy Pop Up

This short, innovative book for ages 8-12 includes a popup 3D galaxy showing its features, the "Tasty Active Galaxy" activity where kids make their own edible galaxy, and a whimsical story about super-massive black holes called "How the Galaxy Got Its Jets." Although designed for younger children, it can be enjoyed by people of all ages!

<http://glast.sonoma.edu/teachers/teachers.html>

The image shows the cover of the "Active Galaxy Pop Up" book. The cover is dark blue with a central illustration of a galaxy. The text on the cover includes "Popup 3D Galax", "Tasty Active Galax", "How the Galaxy Got Its Jets", and "Active Galaxy Pop Up". A small illustration of a pair of glasses is also visible. Below the main title, there is a paragraph describing the book's content and a URL: <http://glast.sonoma.edu/teachers/teachers.html>.

National Aeronautics and Space Administration

GLAST

To request a presentation for your classroom, please contact:

[popup@universe.sonoma.edu](mailto:popup@universe.sonoma.edu)

Sponsored by the Sonoma State University NASA Education and Public Outreach group.

ACTIVE GALAXIES

The image shows a presentation slide for "Active Galaxies". The slide has a dark blue background with a large, glowing galaxy in the center. The text on the slide includes "National Aeronautics and Space Administration", "GLAST", "To request a presentation for your classroom, please contact:", "[popup@universe.sonoma.edu](mailto:popup@universe.sonoma.edu)", "Sponsored by the Sonoma State University NASA Education and Public Outreach group.", and "ACTIVE GALAXIES" written vertically on the right side. There is also a NASA logo in the top right corner.



## Launch Education Plans

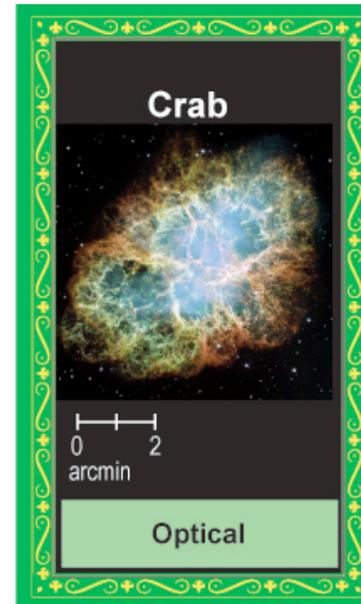
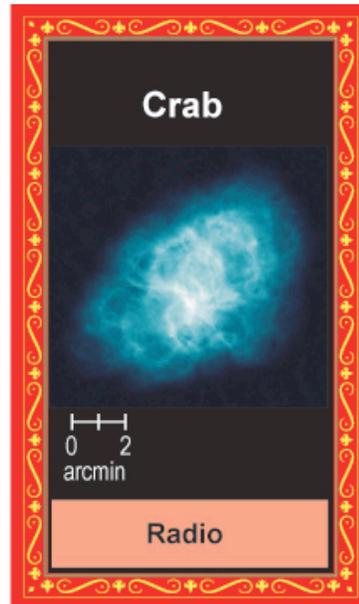
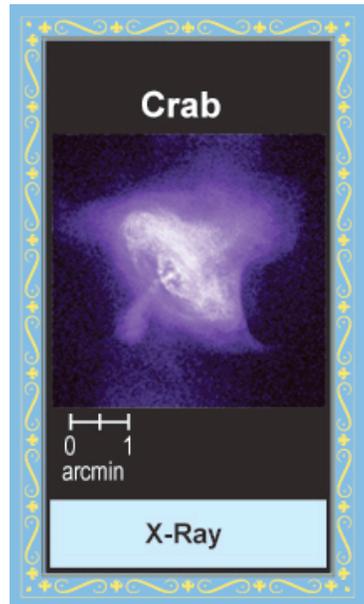
---

- ~~• Working on a webcast of launch with various science museums~~
- May still do limited webcast with Adler
- Looking into organizing teacher's workshop at KSC with EAs
- 5-min video being produced by E/PO add-on grant, will be released in time for launch on PBS, YouTube, etc.



# Supernova Educator Unit – with XMM

- **3 activities now in guide**
  - Fishing for Supernovae
  - Crawl of the Crab
  - Magnetic Poles and Pulsars
- **+ Science literacy activity**
  - Two news articles from XMM
  - Compare measurements of pulsar magnetic fields





## After-school programs

- **Roseland University Prep**
  - 2/3 of seniors now admitted to 4-year college for F2008
  - >90% Hispanic, low-income
  - After-school club since 2005
- **MESA Schools Program**
  - Opened center at Cali Calmecac
- **MESA Engineering Program**
  - In progress at SSU



Lynn and Aurore at Cali Calmecac



RUP student working on college applications



## RUP Summer Experience

---



Last  
summer's  
group

Will do  
this again  
in June,  
2008 for  
rising  
seniors



## Global Telescope Network 2/08

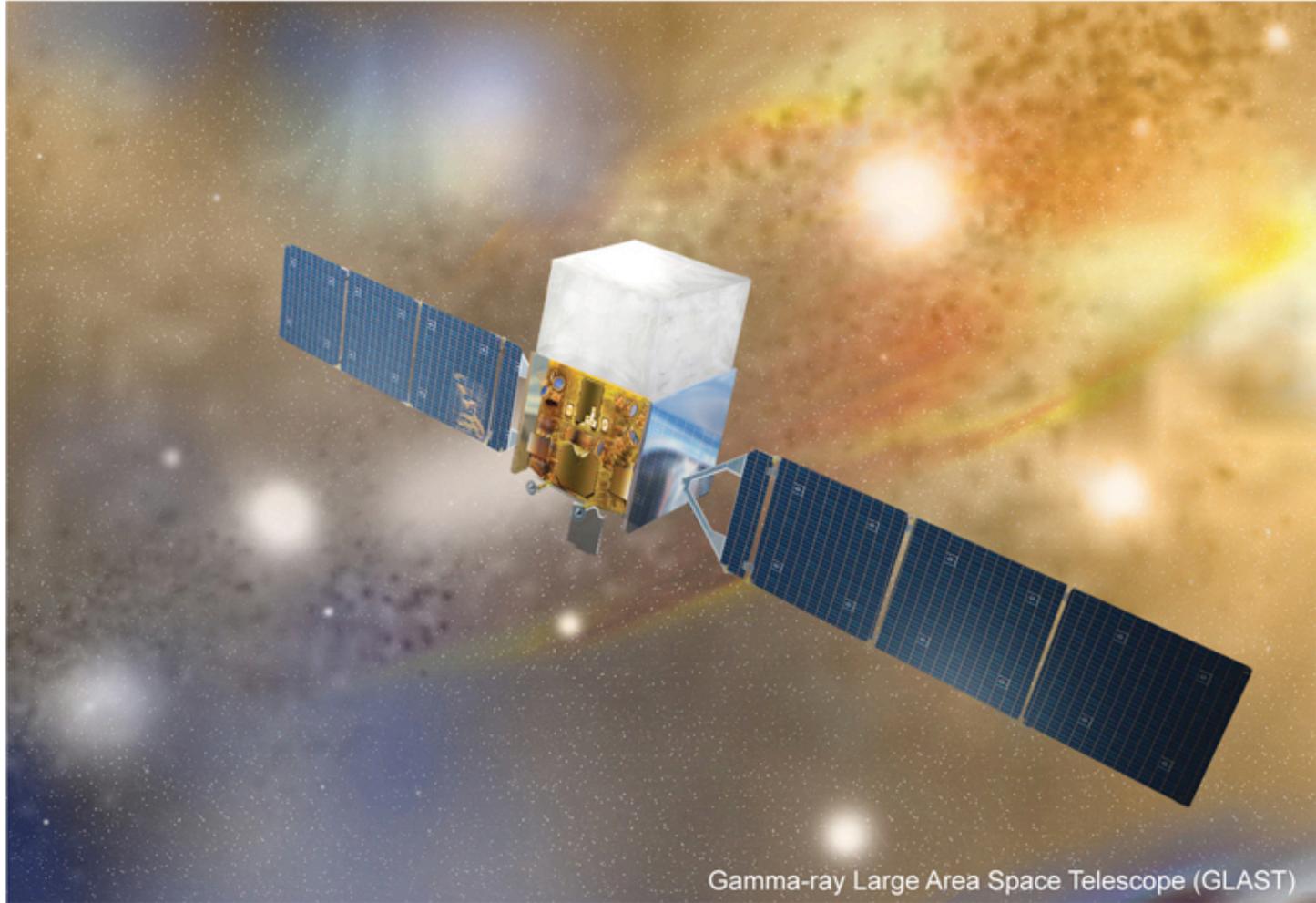
---

- New website about to debut
  - <http://gtn.sonoma.edu:81> right now
- 24 Member Institutions
- Jeff Adkins at Deer Valley High School is doing blazar monitoring project with students
- New partnership with Dr. Kim Coble at Chicago State University to develop college curriculum and work with African-American students
- Will try to track career outcomes of students





## GLAST Litho (awaiting GSFC number)



Gamma-ray Large Area Space Telescope (GLAST)

**GLAST**



# GLAST Litho (back)

## Exploring the Extreme Universe

Launch: 2008

### GLAST Mission Science

Gamma rays are the most energetic form of electromagnetic radiation, typically a million or more times more energetic than visible light. They are produced by some of the Universe's most powerful and exotic phenomena including flares on the Sun, pulses from rapidly spinning neutron stars and super-massive black holes at the centers of galaxies. In these sources and many others, the exact mechanisms that produce the gamma rays are not known, in part, because the enormous energies of gamma rays inhibit our ability to study them. The fact that gamma rays in GLAST's energy band are absorbed in our atmosphere and never reach the Earth's surface means we must send instruments above the atmosphere in order to detect these gamma rays from the extreme Universe.

### On the Shoulders of Giants...

In an effort to better understand celestial gamma rays, an international group of scientists has built a next-generation space telescope that will detect gamma rays with unprecedented sensitivity. The Gamma ray Large Area Space Telescope, or GLAST, is the successor to the Compton Gamma-Ray Observatory (CGRO) that orbited the Earth during the 1990s. CGRO studied gamma rays from many types of celestial objects, including monstrous black holes at the cores of distant galaxies ("active galaxies"), spinning collapsed stars that emit pulses of gamma-ray light ("pulsars"), and tremendous blasts of gamma radiation known as gamma-ray bursts (GRBs.) GLAST will study these known gamma-ray sources in detail but will also discover thousands of new gamma-ray sources in its five-year nominal mission.

### The main mission objectives for GLAST are to:

- Explore the most extreme environments in the Universe, where nature harnesses energies far beyond anything possible on Earth.
- Search for signs of new laws of physics and what composes the mysterious Dark Matter.
- Explain how black holes accelerate immense jets of material to nearly light speed.
- Help crack the mysteries of the stupendously powerful explosions known as gamma-ray bursts.
- Answer long-standing questions across a broad range of topics, including solar flares, pulsars and the origin of cosmic rays.

### GLAST Instrumentation and Spacecraft:

There are two science instruments on board GLAST:

1. **Large Area Telescope (LAT):** The LAT has a very wide field-of-view and is able to determine the energy of an incoming gamma ray as well as the direction in the sky from which it came, both to unprecedented accuracy.
2. **GLAST Burst Monitor (GBM):** The GBM views the entire sky not occulted by Earth to detect GRBs a few times per week and extends the energy range for GRB observations by many decades.

The LAT and the 12 detectors that make up the GBM are mounted on a spacecraft bus which provides power to the instruments through solar panels, includes momentum wheels and star trackers to point and steer the spacecraft, and provides antennae and on-board computing for data communications and data storage.

Data from the GLAST spacecraft are transmitted to Earth via NASA's Tracking and Data Relay Satellite System, where they are analyzed by scientists at Instrument Science Operations Centers at Stanford University and the National Space Science and Technology Center. The mission is managed and operated by NASA/Goddard Space Flight Center, which also staffs the GLAST Science Support Center.

GLAST will also harness the power of thousands of professional and amateur astronomers around the world by rapidly notifying them of GRBs and powerful flares from active galaxies that it detects. The astronomers can then choose to employ other telescopes using the full electromagnetic spectrum to observe the sources of the gamma rays.

GLAST will see the high-energy gamma-ray universe like never before. Centuries of astronomy have taught us that viewing the Universe with higher resolution and greater sensitivity produces amazing surprises. GLAST will provide answers to questions that have puzzled scientists for decades, but even more important, it will reveal things we had not expected, and it will raise questions we did not previously think to ask.

### Pulsar Activity

- You will need:
- 2 light emitting diodes (LEDs)
  - 1 watch battery
  - Cellophane (Scotch) tape
  - Modeling clay or aluminum foil
  - Toothpick, skewer, or string (optional)

1.) Using cellophane tape, attach the two LEDs to the battery so that they face in opposite directions. Make sure that one lead of LED is touching the positive side of the battery and the other lead is touching the negative side; Fig. 1.



Fig. 1

2.) Using either the modeling clay or aluminum foil make a round ball that encases the battery while exposing the LEDs. Note: If you are going to use aluminum foil, please make sure that the battery and the LED leads are completely encased by tape otherwise the LEDs will not light up; Fig.2.



Fig. 2

3.) Insert the toothpick or skewer into the ball, or hang the ball from a string. Spinning the ball then gives you an idea of how a pulsar creates the pulses that we see.; Fig.3.



Fig. 3

National Aeronautics and Space Administration  
Sonoma State University, NASA E/PO  
1801 E Cotati Avenue  
Rohnert Park, CA 94928  
glast.sonoma.edu

<http://www.nasa.gov>

Front: GLAST silhouetted against the simulated gamma-ray sky in the region of the galactic anti-center. The bright source above the line of gamma-emission from the Milky Way is "Geminga" - a gamma-ray pulsar. The brighter source below the Milky Way is the Crab pulsar, and the fainter source is the quasar PKS0528+134.

"Mystery creates wonder and wonder is the basis of man's desire to understand." - Neil Armstrong



# GLAST Launch Materials

- GLAST launch factsheet – still in review
- GLAST public brochure – needs revisions

### Gamma Ray Origins?

At the core of GLAST's mission is finding out what gives birth to the diverse spectrum of gamma rays. There are many intriguing possibilities including active galaxies, blazars, gamma-ray bursts, and neutron stars.

Gamma rays permeate the cosmos. They are emitted from objects as nearby as our own Sun and Milky Way Galaxy to those as far away as tremendous explosions in the early universe. GLAST, NASA's new gamma-ray observatory will open a wide window on the extreme universe. With a huge leap in all key capabilities, GLAST will enable scientists to answer complicated and perplexing questions related to supermassive black-hole systems, gamma-ray bursts, pulsars and the origins of cosmic rays. GLAST will also uncover new sources of gamma rays and will enable searches for signals of new physics.

NASA's GLAST mission is an astrophysics and particle physics partnership developed in collaboration with the U.S. Department of Energy, along with important contributions from academic institutions, laboratories and partners in France, Germany, Italy, Japan, Sweden and the United States.

### Anatomy of a Space Telescope

**GLAST**  
Gamma Ray Large Area Space Telescope  
<http://www.nasa.gov/glast>

### Dark Matter

**Dark Matter** – The origins of dark matter, speculated to make up as much as 22 percent of the universe, remain a mystery. If dark matter is made up of hypothetical particles called WIMPs (Weakly Interacting Massive Particles), as many scientists theorize, then interactions of these WIMPs may produce gamma rays detectable by GLAST's Large Area Telescope. If so, GLAST could provide scientists with data that shed critical new light on the mystery of dark matter.

**Unidentified Sources** – It is likely there are many more types of gamma-ray sources among those presently unidentified and those to be discovered by GLAST. The superior angular resolution of GLAST's Large Area Telescope should help unveil the nature of these mystery sources, providing new understanding of the origin of their gamma rays and possible new laws of physics.

**Active Galaxies and Blazars** – An active galaxy is a galaxy with a super-massive central black hole. These black holes produce high-energy radiation from the swirling disks of matter falling into them. Some of these black holes also eject streams of matter thousands of lightyears at very nearly the speed of light. Blazars are thought to be Active Galaxies whose jets happen to be pointing straight towards us. When this happens, we see gamma rays associated with the jets.

**Gamma-Ray Bursts** – Gamma-ray bursts are the most energetic explosions in the universe. Recent observations have linked the origins of GRBs to the death throes of very massive stars, or to collisions between two black holes and/or neutron stars – both events which will lead to the birth of a new black hole. GLAST will provide new insights into these mysterious and exotic events by studying their gamma rays over a huge range of energies.

**Neutron Stars** – When the core of a massive star undergoes gravitational collapse, it forms a very dense object known as a neutron star. These objects have densities on the order of 1023 kg/m<sup>3</sup>. (Imagine condensing Mt. Everest down to the size of a sugar cube.) With magnetic fields trillions of times that of Earth, these objects work like high-energy particle accelerators, expelling jets of gamma rays which rotate through our line of sight, producing pulsations that we can observe. Other neutron stars – the so-called magnetars – may possess even stronger magnetic fields. Magnetar starquakes can unleash tremendous flares of gamma rays.

**Cosmic Rays and Supernova Remnants** – Cosmic rays are subatomic particles that are accelerated to very near the speed of light by mechanisms that are still a mystery. One theory suggests that these particles are accelerated by the shockwaves of supernovas. The LAT will be searching for the gamma-ray signature of this acceleration.

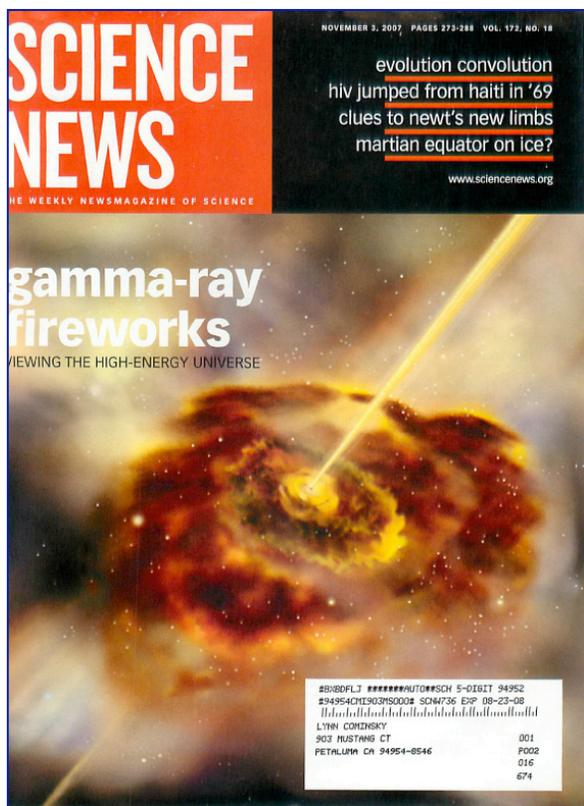
GLAST

NASAfacts



# PR Update

- GLAST Media Day 9/19/07 at GSFC
  - 16 reporters attended, many stories resulted – AP too



THE WEEKLY NEWSMAGAZINE OF SCIENCE

## SCIENCE NEWS

NOVEMBER 3, 2007 VOL. 172, NO. 18

**Features**

- 280 Fossil Sparks** New finds ignite controversy over ape and human evolution. *by Bruce Bower*
- 283 Gammas from Heaven** Physicists and astronomers join forces to study the high-energy universe. *by Ron Cowen*

**This Week**

- 275 HIV came from Haiti to United States** *by Brian Vastag*
- 275 Gliding mammals may be primates' nearest kin** *by Susan Miller*
- 276 Protein aids limb regrowth in newts** *by Patrick Barry*
- 276 Ground yields antibacterial agents** *by Sarah Williams*
- 277 Ice could lurk beneath Martian equator** *by Sid Perkins*
- 277 ADHD drug's mental lift proves surprisingly weak** *by Trevor Bower*
- 278 Rock, paper, toxins** *by David Catlett*
- 278 Manipulating receptors may impede sepsis** *by Nathan Seppa*

**Of Note**

- 285 DNA to Neanderthals** Lighten up. Printing scheme could yield 3-D photonic crystals.

**Meetings**

- 286 The first *matrosella* *Dicynophus* class were hoodlums, not rippers**
- Dinosaurs mated sexually while still growing.
- Meet the old wolves, some as the new wolves.

**Departments**

- 287 Books**
- 287 Letters**

**COVER** NASA's Gamma-Ray Large Area Space Telescope, set for launch next spring, will view violent cosmic events such as jets of gamma-ray-emitting material shot out of monster black holes at the centers of galaxies, as illustrated here. (A. Simonne/Sonoma State, NASA)

**THIS WEEK ONLINE**  
<http://blog.sciencenews.org/>  
 MainText: A supercomputer model fed by real-time data is beginning to make sense of the seemingly unpredictable movement of wildfowl.

**274** NOVEMBER 3, 2007 VOL. 172

## GAMMAS FROM HEAVEN

Physicists and astronomers join forces to study the high-energy universe

*BY RON COWEN*

Not long ago, physicists seeking to understand the cataclysmic events at the birth of the universe had to rely on massive, earthbound experiments in which beams of charged particles, steered by powerful magnetic fields, traveled in circles for miles before smashing into each other. Now, an increasing number of these particle physicists have turned to the skies, teaming with astronomers to launch spacecraft that can capture gamma rays from astrophysical processes with energies far greater than anything that can be generated in the most powerful atom smashers on Earth.

Carrying thousands to billions of times as much energy as visible-light photons, gamma rays "are telling us about the most energetic processes in the universe," says David Thompson of NASA's Goddard Space Flight Center in Greenbelt, Md. But detecting gamma radiation is no easy feat. Scientists have built a variety of ground-based detectors that capture the secondary radiation created when gamma rays crash into gas molecules in Earth's atmosphere, but only a detector above the atmosphere can capture gamma rays directly.

Gamma-ray astronomy got a big boost in 1991 with the launch of the NASA's now-defunct Compton Gamma-Ray Observatory (CGRO). That push continued with missions such as the European Space Agency's INTEGRAL satellite and NASA's Swift spacecraft. But the agency's GLAST (Gamma-ray Large Area Space Telescope) mission, set for launch next spring, will give scientists a view of the gamma-ray sky at higher energies and with sharper resolution and greater sensitivity than any previous craft has provided.

GLAST may shed light on dark matter, primordial black holes, and other cosmic oddities near and dear to the hearts of physicists and cosmologists. The Earth-orbiting craft will detect gamma rays with energies up to 300 gigaelectronvolts (GeV), far beyond the 20 GeV energies that previous instruments in space have reached. "That's a huge discovery window," says GLAST team member Thompson.

**RECORDING RAYS** Every 4 hours, GLAST's Large Area Telescope (LAT) will scan the entire sky, hunting for sources of gamma rays with energies from 20 million eV (MeV) to 300 GeV. Another set of 14 separate detectors, the GLAST Burst Monitor (GBM), will cover a vast range of lower energies, from 8,000 eV up to 50 MeV.

**GAMMAS IN THE GALAXY** ... At gamma-ray energies, the Milky Way forms a brilliant swath across the sky. Much of this high-energy emission has its origin in supernova remnants, expanding shells of gas created when a blast wave from an exploded star plows into surrounding space, sweeping up material along the way. Intense magnetic fields entrained in these shells of gas can, (Visible-light photons have energies of about 1 eV.) GLAST's goal is to reveal the origins of the mysterious and sporadic cosmic flashes known as gamma-ray bursts.

All in all, researchers will have a spacecraft capable of recording gamma-ray radiation over an energy range spanning seven orders of magnitude.

LAT is the modern-day version of the Energetic Gamma-Ray Experiment Telescope (EGRET) instrument, which flew more than a decade ago on CGRO. Because gamma rays are so energetic, they can't be focused or contained using lenses and mirrors as visible light can. EGRET's detectors, relying on a technique originally developed for particle accelerators, were sensitive to energies up to about 20 GeV. EGRET recorded a total of 271 gamma-ray-emitting objects. LAT uses a more sophisticated version of the same technology designed for the abandoned Superconducting Supercollider project. It is expected to record thousands of sources. It has 16 tower-shaped gamma-ray detectors, each consisting of thin tungsten foils interleaved with silicon strips, giving a total collecting area of about 125 square meters. An incoming gamma ray that collides with a tungsten atom converts into an electron and its antiparticle, the positron. The silicon strips record the paths of the electron and the positron, from which the arrival direction of the gamma ray can be deduced. The total area of the silicon strips is more than 70 sq m, similar to the area that had CERNS' spallation new Large Hadron Collider (LHC), expected to begin operation in Geneva early next year.

The electron and positron then pass into blocks of cesium iodide, which scintillates as they absorb the energy of each particle. The intensity of the flashes reveals the energy of the electron and positron, and therefore that of their parent gamma ray.

Although gamma-ray images from LAT will be fuzzy compared with the arrestingly sharp visible-light photos that the Hubble Space Telescope produces, they will nevertheless locate the brightest sources to within an area about one five-hundredth the diameter of the full moon. Astronomers expect the images to be the first to reveal structure in what previously appeared as featureless point sources on the gamma-ray sky.

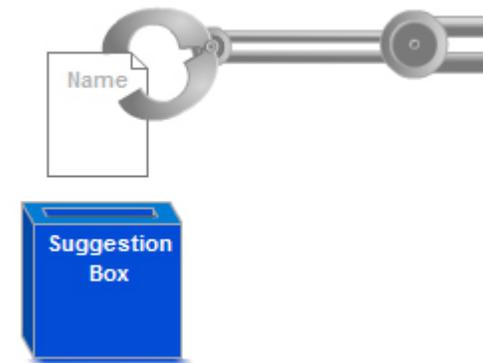




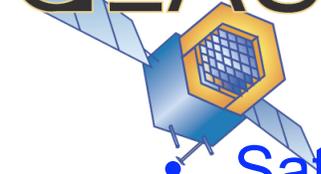
## GLAST Naming Suggestion Box

---

- NASA HQ press release on 2/7/08  
– site went live
- About 8200 responses world-wide to date, including famous dead scientists and also famous living people (against the rules), acronyms, and funny ideas
- Featured in 2/22 Science magazine but they seem to think that GRBs is all GLAST will see
- Opt-in for certificate and press release
- <http://glast.sonoma.edu/glastname>



# GLAST



## Top names as of 2/29/08

---

- Satellite of Love 267 (This is from a Lou Reed song)
- Hulk/Banner 238
- Sagan 153
- Villard 120 (French discoverer of gamma-rays in 1900, worked with the Curies who gave him radium)
- GLAST 109
- Einstein 82 (probably already used)
- Stargazer 77
- Looking Glass 62
- GREAT 48 (Gamma-Ray Energy Astronomical Telescope or Extensive Area Telescope)
- Hawking 40 (not eligible)
- Fermi is in 16<sup>th</sup> place with about 27 entries, tied with Rutherford and Enterprise (like the starship)

---

**GLAST**



# GLAST Naming Certificate



**GLAST**



## Press Releases from HQ or GSFC

---

- Next: GLAST Observatory arrives at Cape Canaveral for rocket integration – in progress!!
- February 13, 2008: GLAST's Delta II Rocket's First Stage Arrives in Cape Canaveral
- February 7, 2008: NASA Calls for Suggestions to Re-Name Future Telescope Mission
- December 19, 2007: NASA's GLAST Satellite Gets Unwrapped for the Holidays
- November 30, 2007: NASA's GLAST Satellite Arrives at Naval Research Lab for Testing



## PR and E/PO Summary

---

- We are working on a few more things for launch – possible educator event at KSC
- GLAST Media Guide – updated, will be reprinted
- NASA portal site –  
<http://www.nasa.gov/glast> - being updated for each press release
- Still in progress for launch:
  - **Fact sheet – being reviewed**
  - **Brochure – still needs updates**