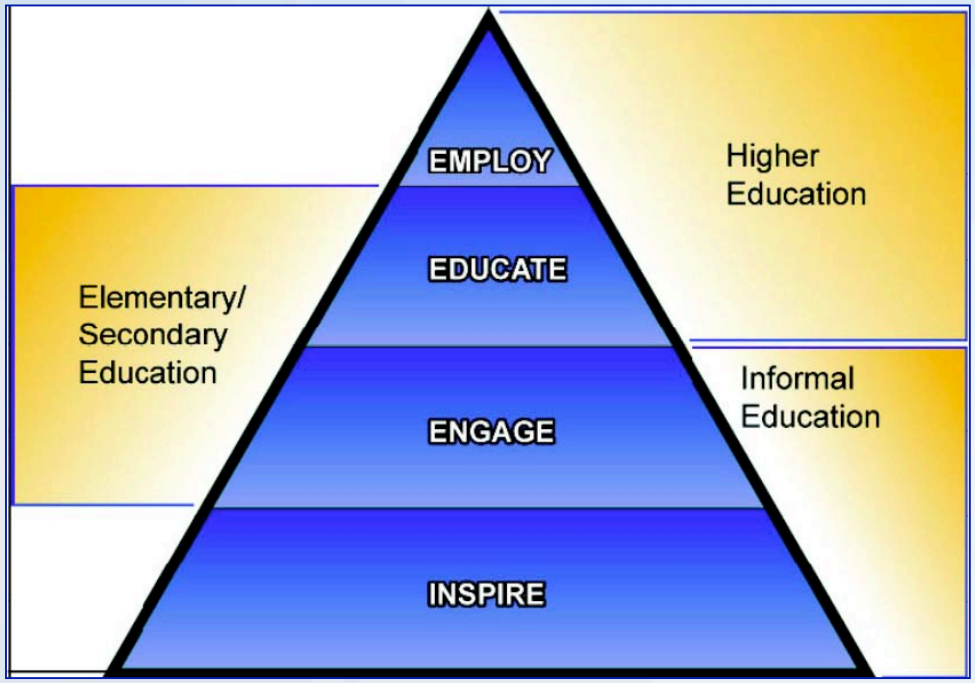
Education and Public Outreach Program Status
Fermi User's Group 02/06/09

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

Post-launch E/PO Plans – underway!

- Increased emphasis on GTN, after-school programs and the pipeline
- Continue teacher workshops
- Update all materials
- *New litho set featuring first sky map and discoveries for each type of object – not yet*
- Cosmology on-line course
  - Needs additional funding (one proposal still pending)
  - Has publisher support (Kendall-Hunt)
- International Year of Astronomy (2009)
  - NASA coordinated activities
- Fermi data into WWT (tours), Google Earth

Fermi in the Web 2.0 community

"Yippeee! I am in spaaaaaaaaccccccccccceeeeeeeeeeeee!"

Male
22 years old
ROHNERT PARK, CALIFORNIA
United States

New blog entries:

Fermi discovers a dozen new pulsars

http://www.myspace.com/glast

Fermi now has 325 friends on MySpace and 321 on Facebook

Epo's Chronicles – IYA update

- Doing special IYA "eposodes" for the first Monday each month featuring NASA's "Go Observe" objects

Alkina

Epo

http://eposchronicles.org

IYA From the Earth to the Universe

- Fermi is helping to sponsor small traveling exhibit of 14 NASA images that will go around the SF Bay Area
- Larger exhibit of 50 images will be in residence at Cal Academy and San Jose Tech Museum
- Partnership with NASA/LSI, Ames, SETI Institute, UCB/CSE, Kepler, SOFIA

IYA Exhibit

- Big images for museums and small images for traveling venues

Space Mysteries

- http://mystery.sonoma.edu
  - Galactic Doom Space Mystery needs testers – any volunteers?

Educator Ambassador Workshops

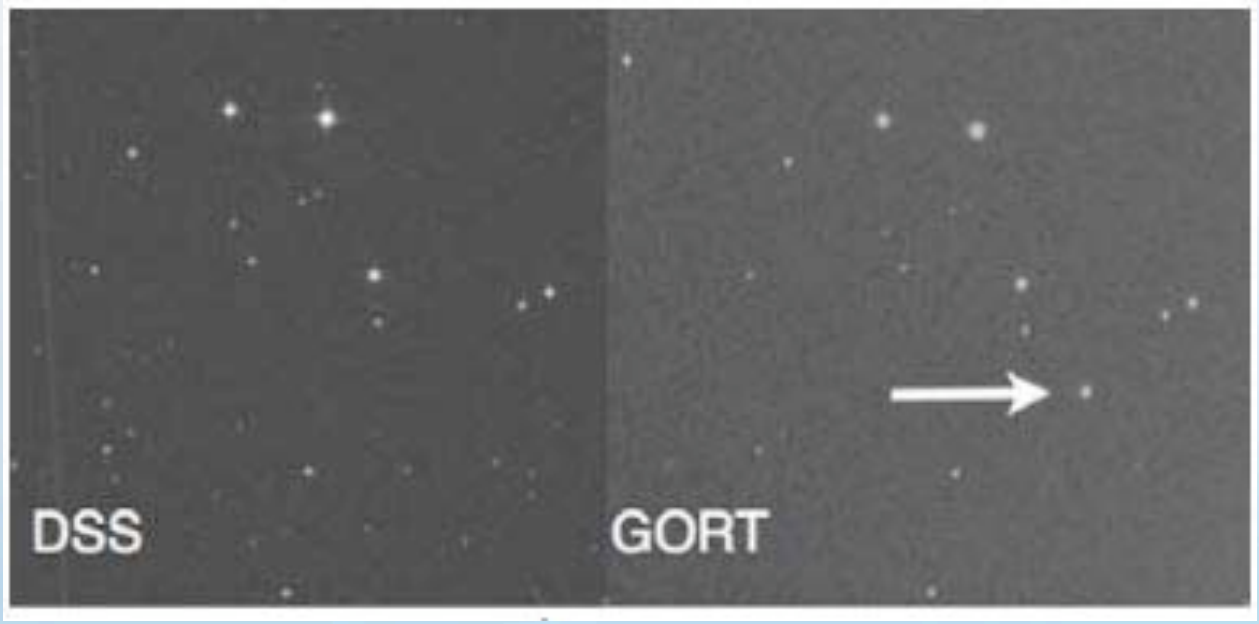
- 39 since last FUG meeting (9/27/08) at venues such as: National Science Teacher's Association Regional meetings (Cincinatti, Portland, Charlotte), National meeting (Boston), Illinois Science Teacher's Meeting, Detroit Area Mathematics Teachers, Kentucky Science Teachers, New Jersey Science Educators Association,

After-school programs

- Roseland University Prep Pre-MESA day competition:
  - 1st and 3rd place in Mousetrap cars
  - Tie for 1st place in Algebra 2, First place in Pre-calculus and in Calculus
- Field trip to San Jose Tech Museum with MESA club

Global Telescope Network 2/09

- Two poster papers on this work at AAS in Long Beach – "Undergraduate Research using GTN" and "Transforming Introductory Astronomy in the Urban University"
- We got our first GRB afterglow robotically! GRB081203A
- Campaigns: Mkn 401 and 1ES1959+650



Fermi Litho – now updated

Exploring the Extreme Universe

Launch: June 11, 2008

Fermi 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 Fermi'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 Space Telescope, 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.) Fermi 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 Fermi 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.

Fermi Instrumentation and Spacecraft:

There are two science instruments on board Fermi:

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

Fermi is harnessing 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.

Fermi is seeing 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. Fermi 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.

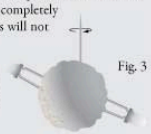


Fig. 3

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

http://www.nasa.gov

LG-2008-3-119-GSFC

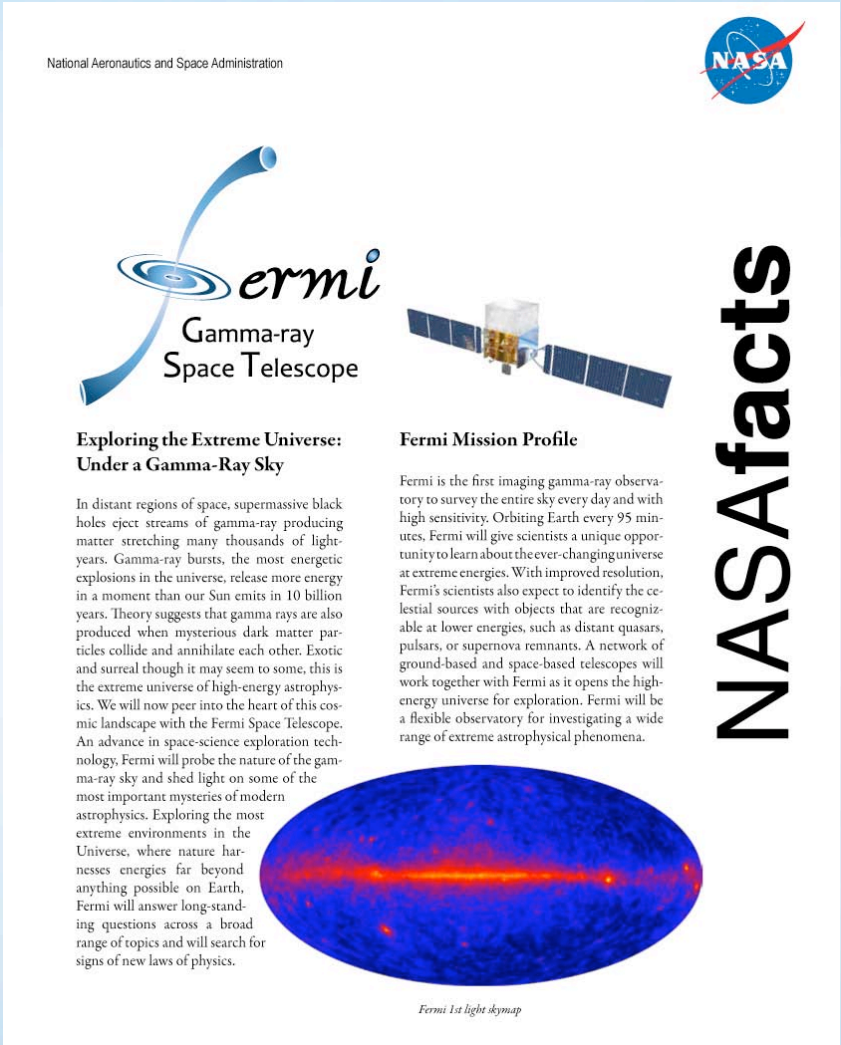
Front: Fermi silhouetted against the simulated gamma-ray sky in the region of the galactic anti-center. The bright source above the line of gamma-emission from the Milky Way is "Geminga" - a gamma-ray pulsar. The brighter source below the Milky Way is the Crab pulsar, and the fainter source is the quasar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

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

Should be back in print by Summer AAS meeting

Fermi Fact Sheet

- Now updated – need additional content for the back page
- Used to have lists of countries and heads of instruments
- What should we put instead?



National Aeronautics and Space Administration

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 will now peer into the heart of this cosmic landscape with the Fermi Space Telescope. An advance in space-science exploration technology, Fermi will probe the nature of the gamma-ray sky and shed 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 will answer long-standing questions across a broad range of topics and will search 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 will give scientists a unique opportunity to learn about the ever-changing universe at extreme energies. With improved resolution, Fermi's scientists also expect to identify 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 will work together with Fermi as it opens the high-energy universe for exploration. Fermi will be a flexible observatory for investigating a wide range of extreme astrophysical phenomena.

Fermi 1st light skymap

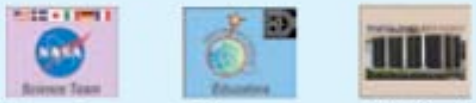
Fermi Card Game

- Being revised in response to NASA Product Review recommendations

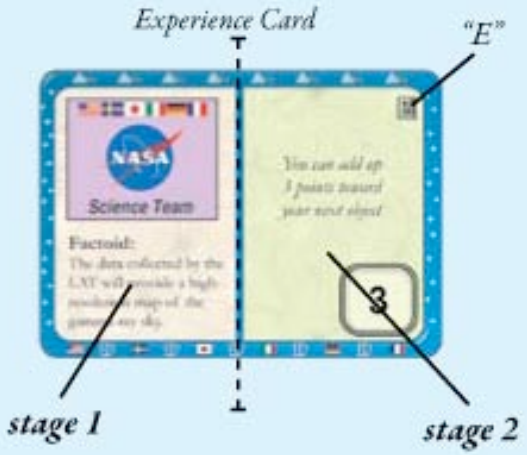
The Experience Cards:

Blue cards with an "*E* " in the upper right corner are Experience cards. Note how each "*E* " card is split in two halves for Stage 1 and Stage 2 (image to the right). In Stage 1, each card is worth 1 experience point. In Stage 2, each card has its listed value in the lower right corner.

There are three types of *Experience* cards all labeled with an "*E* " in the upper right corner: **Science Team (flags icon)**, **Educators (or ED)**, and **Wild Card** (see icons below).



Science Team *Educators* *Wild Card*



All three cards have a **factoid** about Fermi on them. Although they are not part of the game play, it is an interesting thing to know about Fermi and the objects it studies.

Fermi Card Game

- Rules are being simplified

Turn example :
Let's say you want to play the "Spacecraft Body" *Satellite* card— you need to have 1 *ED* card and 2 *Science Team* cards.

2 Science Team and 1 ED "E" cards

Spacecraft Body card

Place the "*S* "card on the mat and discard the *Experience* cards used after showing them to your opponent.

Fermi Card Game

- Cards are being updated

A new direction – Educational Research

- We are responding to NASA's new metrics that want us to show the need for our products
- Conducting a survey to find out what A101 students know about Fermi-related topics such as the structure and contents of the Universe
- Results will be published in AER

Black Hole Show Analysis

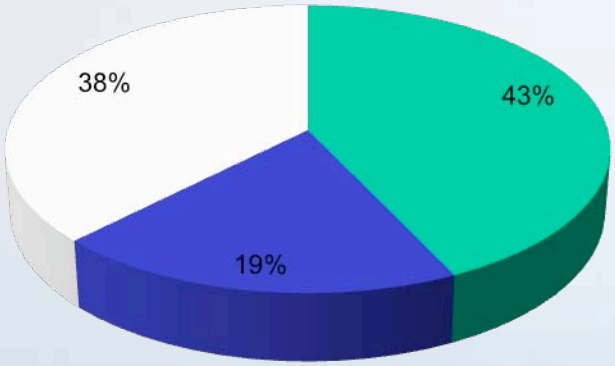
- We accumulated data about the Black Hole planetarium show (pre- and post-) to try to figure out what people might have learned – the results were interesting but disappointing
- Conclustion: engaging visuals are not sufficient to create learning, especially when complicated images are shown to non-scientists

Example of results from survey

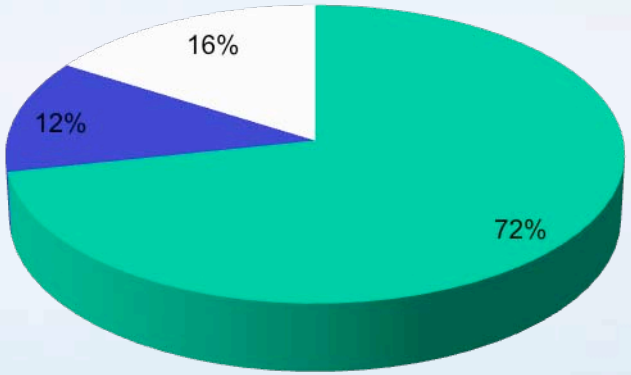
pre-show

post-show

Do black holes have mass?



- Yes, the mass can be measured by observing the black hole's effect on nearby objects.
- No, black holes have no mass; they are voids in space.
- Scientists have no direct evidence that black holes have mass, so this question cannot be answered at the present time.

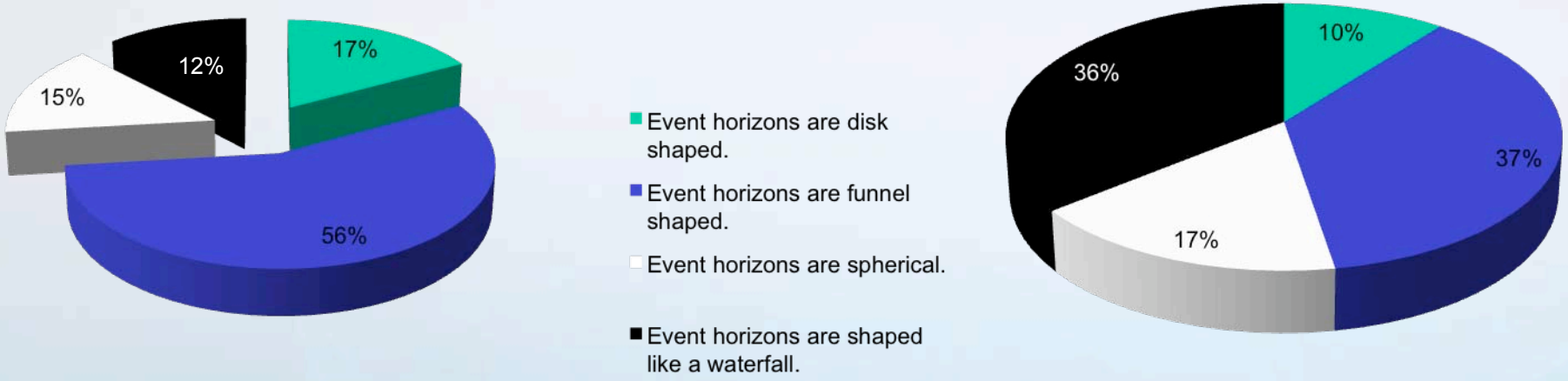


Example of results from survey

pre-show

post-show

What shape is the event horizon around a black hole?



PR Update

- Fermi press releases since last FUG:
  - **January 6, 2009**

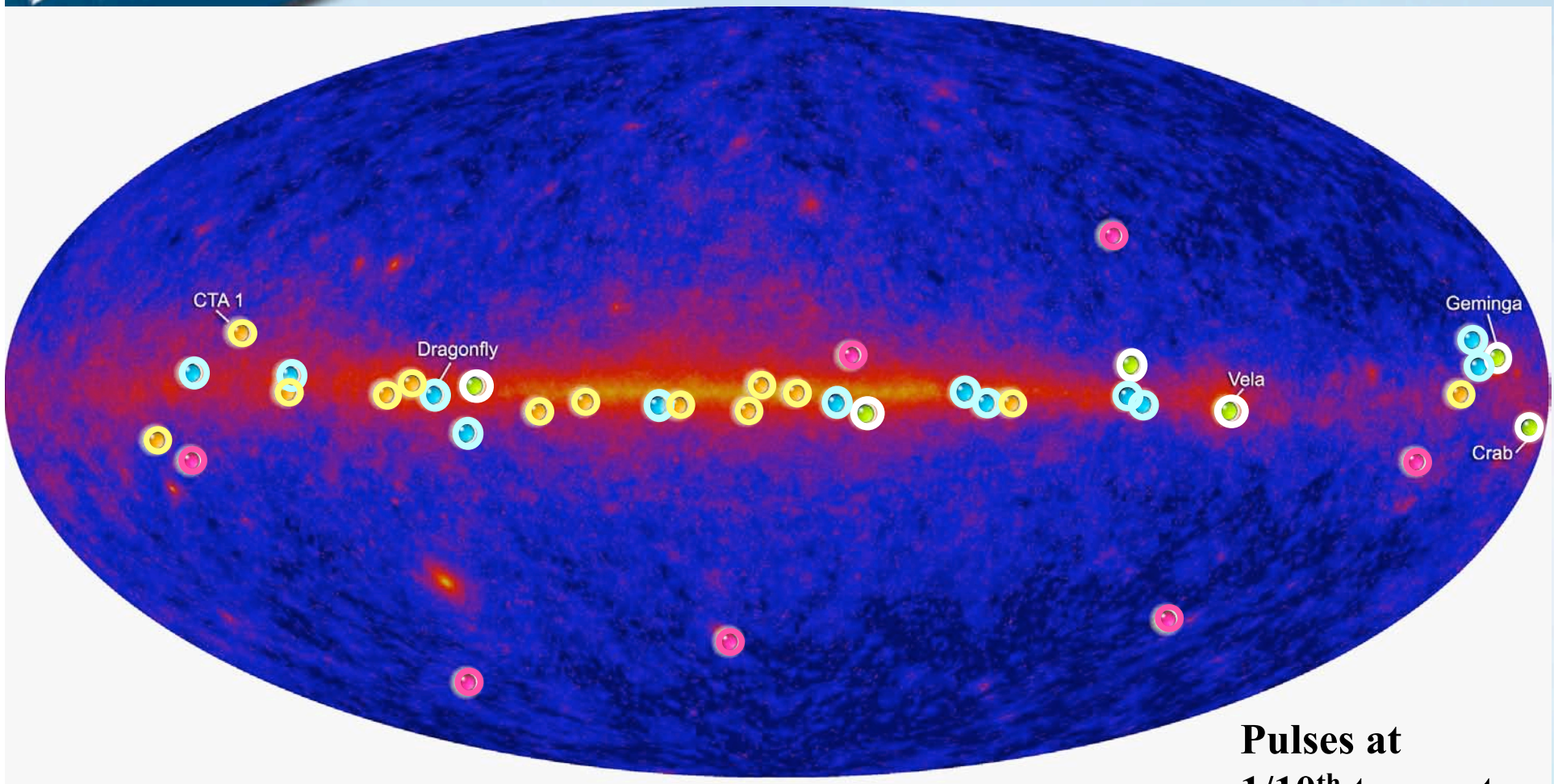
  NASA'S Fermi Telescope Unveils a Dozen New Pulsars – press conference at AAS with Roger Romani and Alice Harding
  - **October 16, 2008**

  NASA'S Fermi Telescope Discovers First Gamma-Ray-Only Pulsar – NASA HQ release
  - **New:** Sent to HQ this week: release on SGR J1550-5418 – joint with Swift

PR Update

- Animation for AAS Press conference
  - Outer magnetospheric model

The Pulsing Sky (Romani)



Fermi Pulsar Detections

- New pulsars discovered in a blind search
- Millisecond radio pulsars
- Young radio pulsars
- Confirmed pulsars seen by Compton Observatory EGRET instrument

Pulses at 1/10th true rate

PR and E/PO Summary

- We are moving forward on all planned activities (except have not started new litho set yet, awaiting a few more discoveries.)
- Look for updated litho, factsheet by the summer AAS. Card game needs product review approval before we reprint it.
- PR is starting, but results are challenging to explain, especially in today's media world