SSU Mission Updates

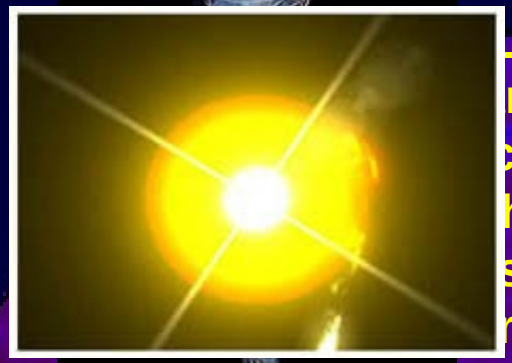
July 28, 2008

Professor Lynn Cominsky

Current SSU Missions

- GLAST - launched June 11, 2008
- Swift – launched November 20, 2004
- XMM-Newton – launched December, 1999
- NuSTAR – now in Phase B, planned for 2011 launch
- SNAP – will be proposed as soon as the AO comes out (expected this year)
- EXIST – doesn't really exist!
- All these missions are in low-Earth orbit, and study the sky in either x-rays or gamma rays (or both)

The Gamma-ray Sky in False Color – from EGRET/Compton Gamma Ray Observatory



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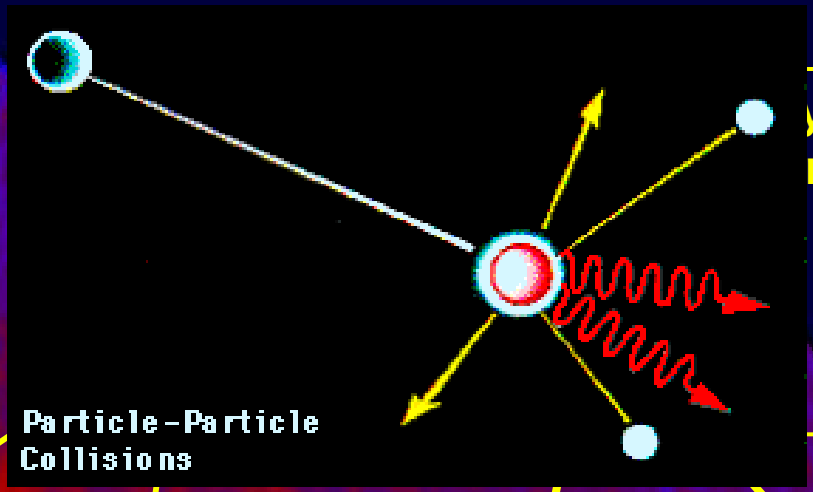

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The Unknown – over half the sources seen by EGRET remain mysterious

Blazars – supermassive black holes with huge jets of particles and radiation pointed right at Earth.

Gamma-r
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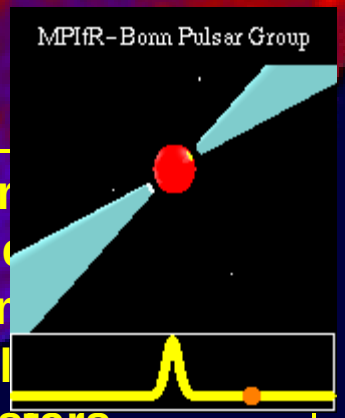
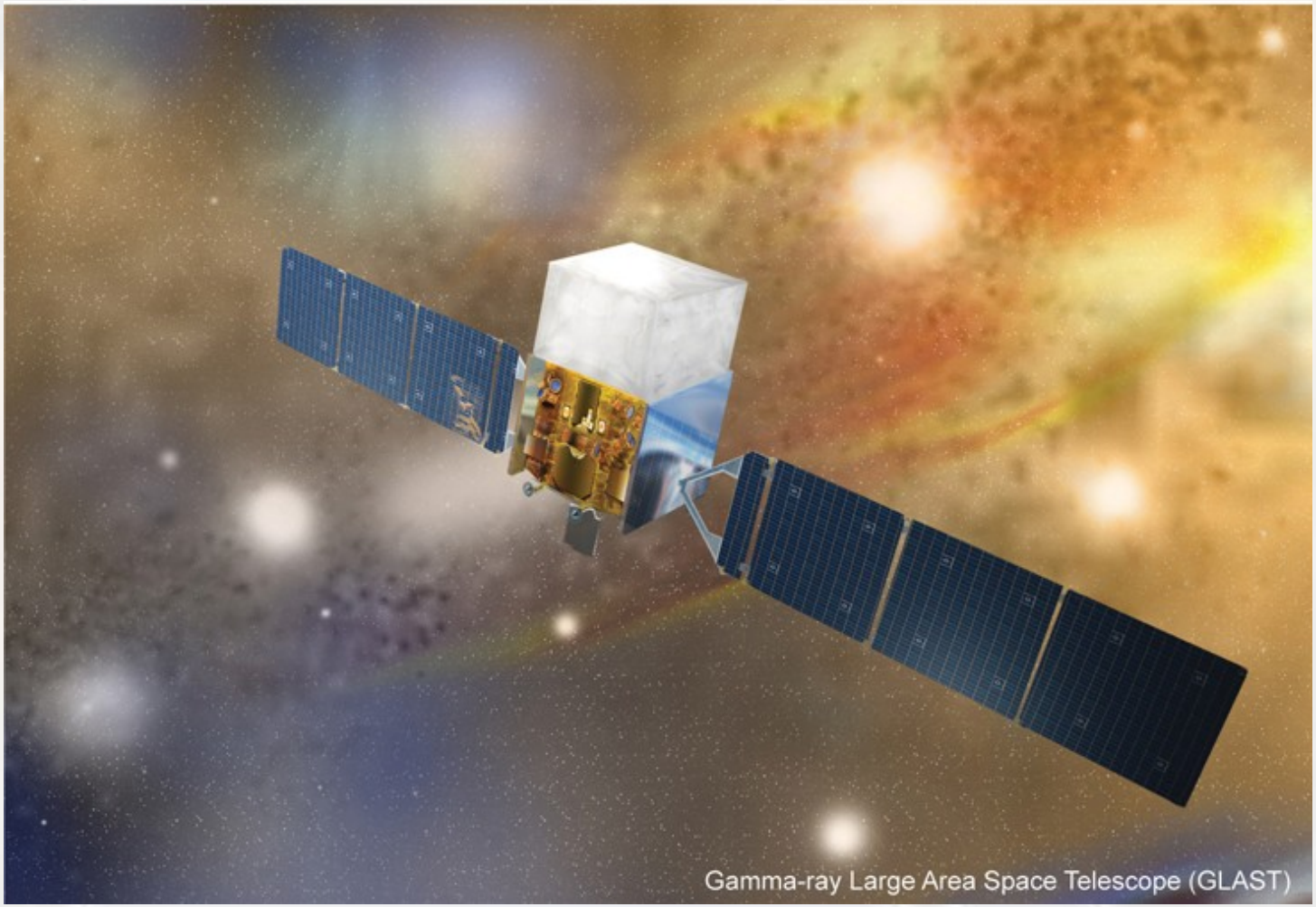
neutron stars.



GLAST

- Eight EAs went to Florida to see the launch – only Linda Smith was able to stay long enough!
- This is a Delta II heavy – note the 9 boosters (Swift only had 3)

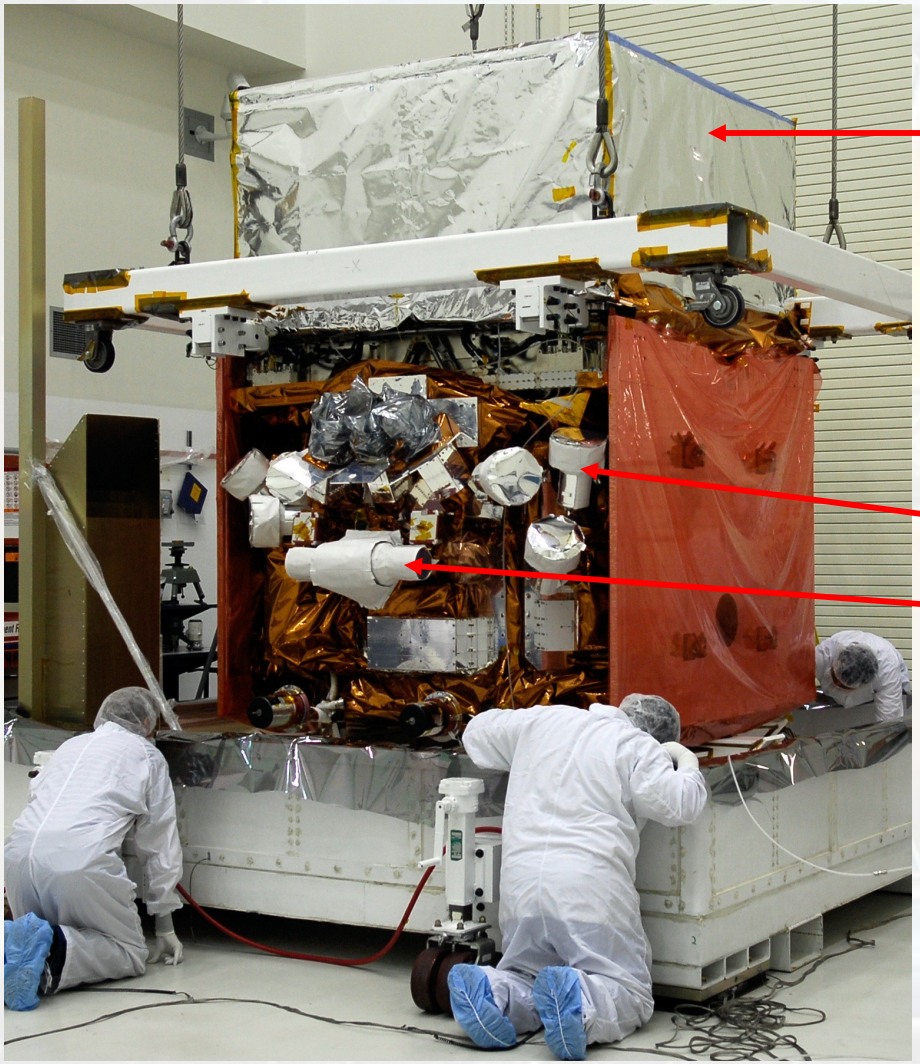
GLAST Litho image



GLAST Mission

- First space-based collaboration between astrophysics and particle physics communities
- Expected duration 5-10 years (there are no expendables on board)
- Over 3000 gamma-ray sources will be seen

GLAST instruments



Large Area Telescope

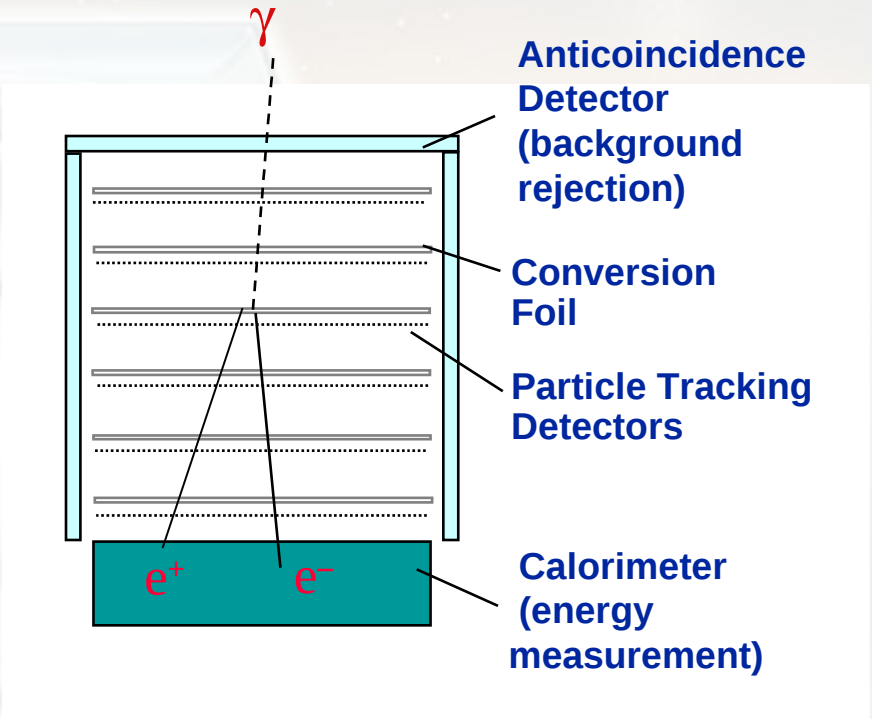
(20 MeV to 300 GeV)

GLAST Burst Monitor

(10 keV to 30 MeV)

How does a gamma-ray telescope work?

- The key is "high-energy"
- A gamma ray is a packet of energy – lots of energy.

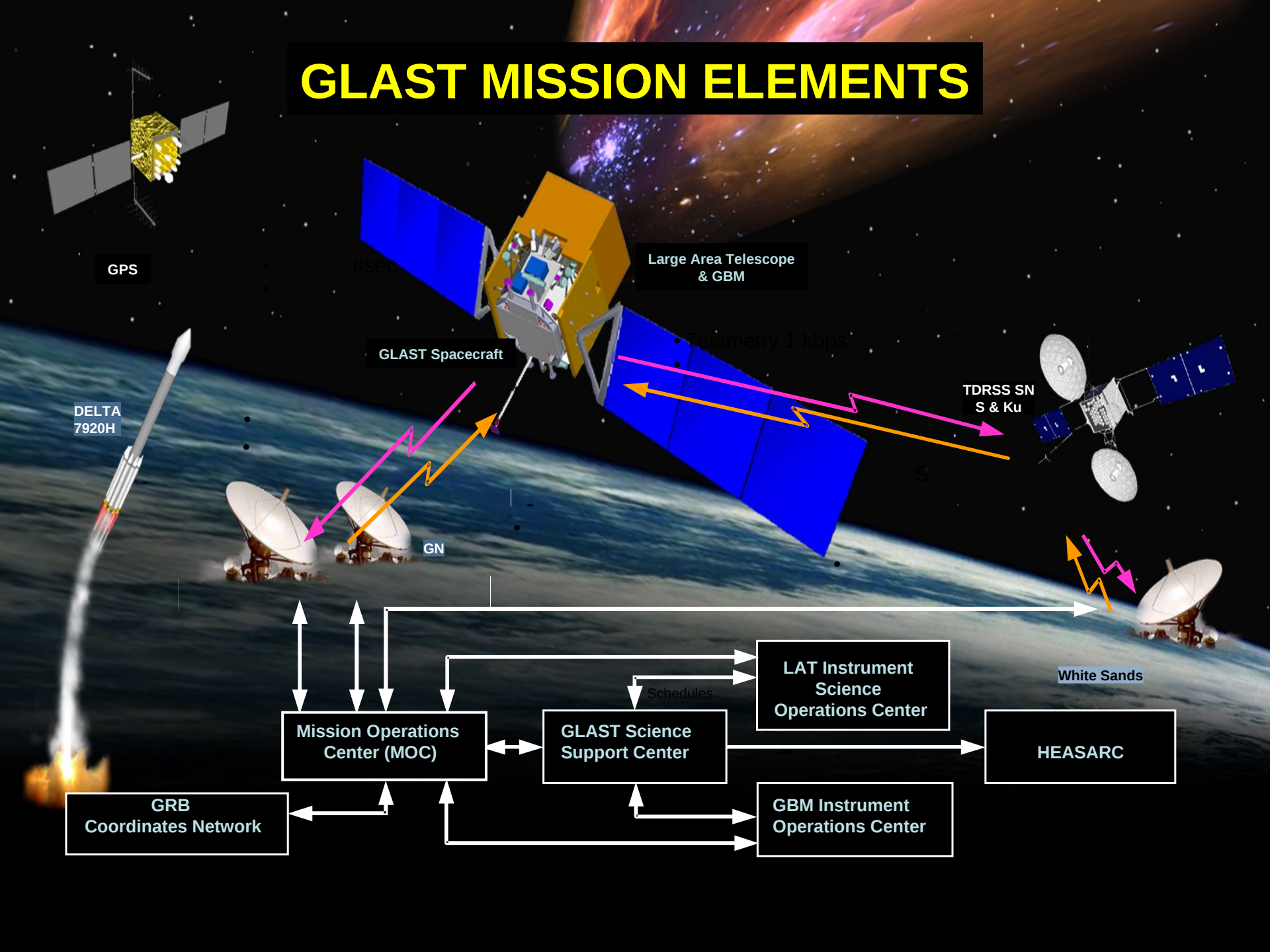


Energy? That's E, and $E = mc^2$

Convert the energy to mass.

Thanks Al!

GLAST MISSION ELEMENTS



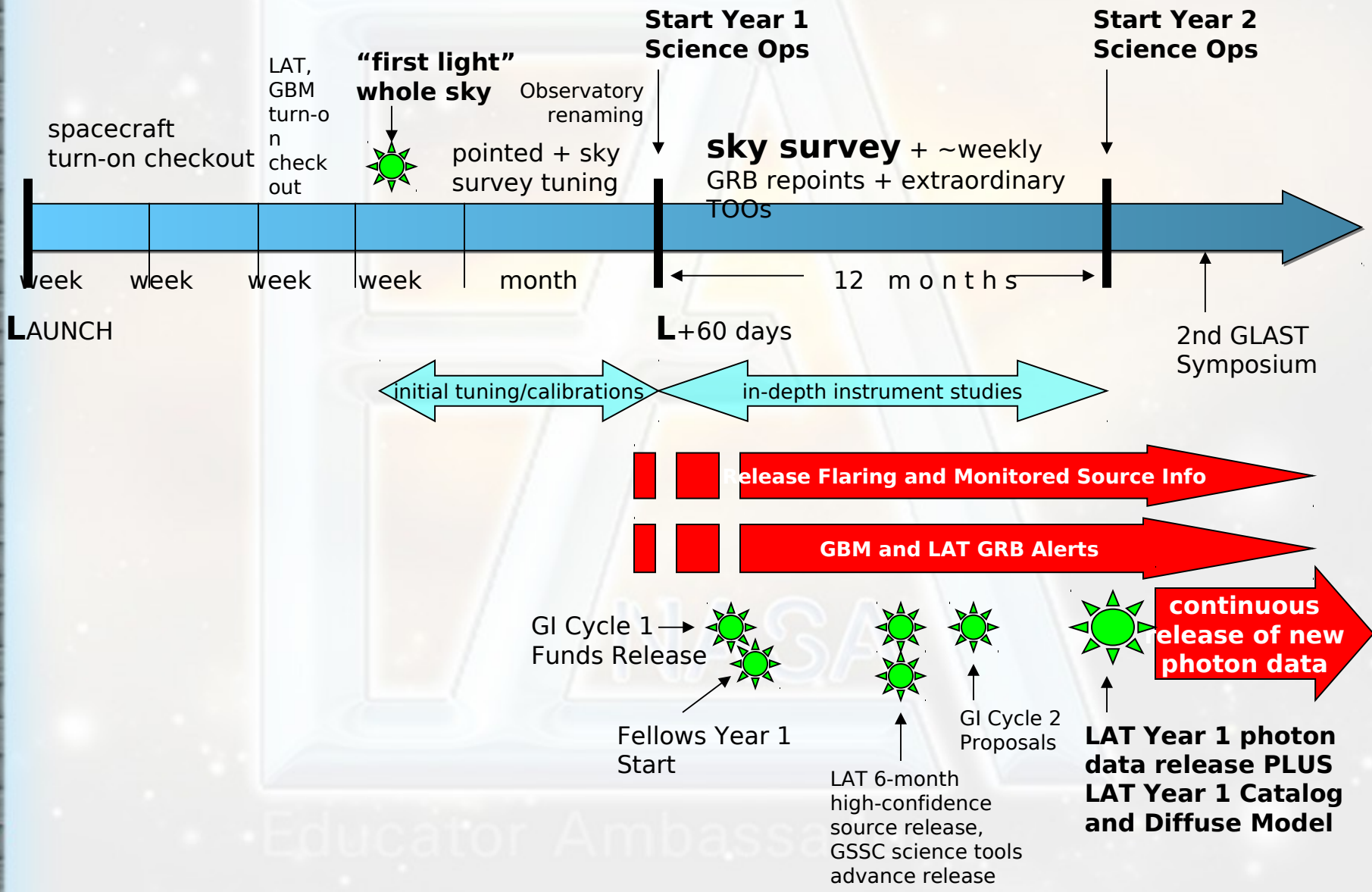
IOC Highlights

- 12 - 14 June
  - routine communications established
  - Guidance, Navigation, and Control (GN&C) components powered on and functional. First transition from inertial pointed mode to sky survey mode.
- 15-23 June
  - observing modes and patterns tested
  - science data return link established and tested
- 24-25 June
  - INSTRUMENTS TURNED ON!
    - » process completed much faster than expected, no significant problems encountered.
    - » triggering and recording events. Rates close to expectation. Everything is functioning very well.
    - » LAT data shipped to Instrument Science Operation Center at SLAC and routinely processed. GBM data shipped to the GBM Instrument Operations Center in Huntsville and routinely processed.
- 26-28 June
  - Continued detailed instrument studies.
  - Burst alert path tested.

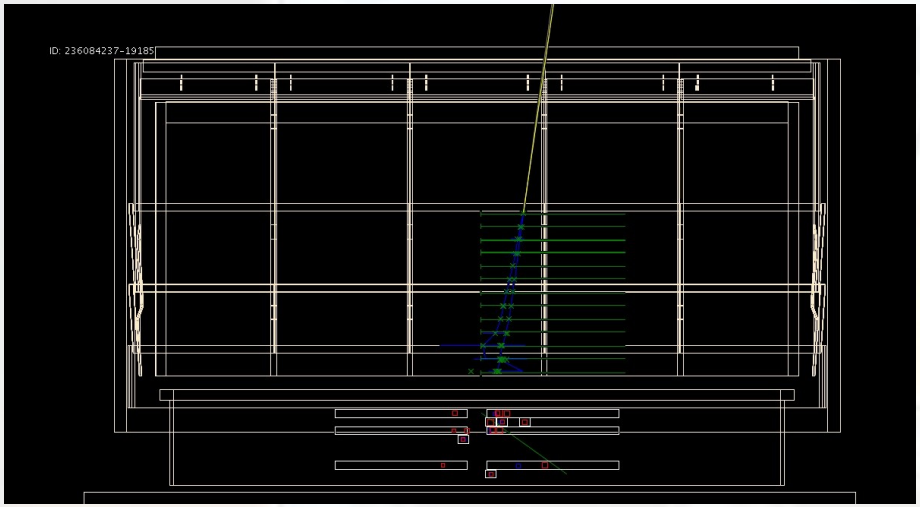
Observatory Status

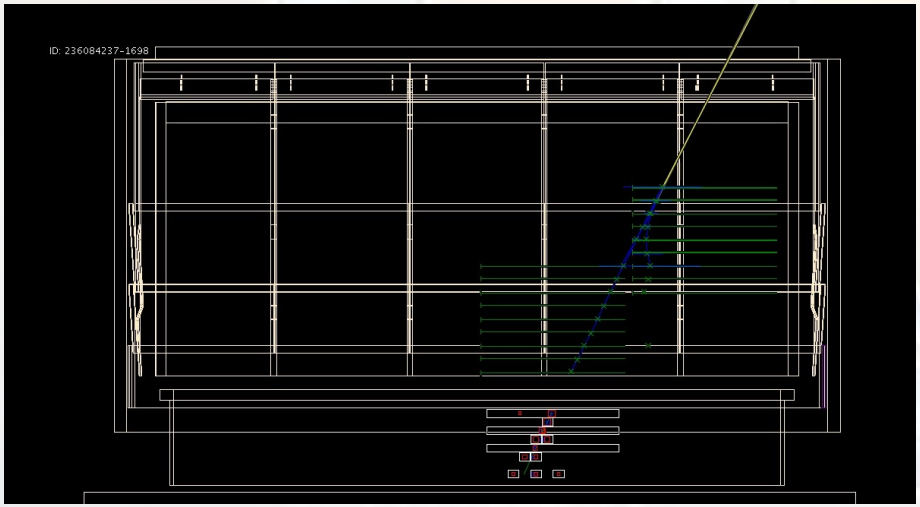
- All systems checked out and functioning very well!
- Routine data dumps. Data handling and processing going smoothly end-to-end, thanks to preparation and simulations across the whole team prior to launch.
- GPS information (position, time) spot-on, better than requirements by large factors.
- Both instruments turned on and operational.
  - well into period of detailed instrument engineering studies, tuning and on-orbit calibrations. Essential steps prior to science observations.
  - instrument team members worldwide happily examining the engineering data.
  - backgrounds appear to be close to expectation and very manageable.
- GREAT cooperation across all the instrument elements, functioning as an integrated team.
- See http://www.nasa.gov/GLAST

Year 1 Science Operations Timeline Overview



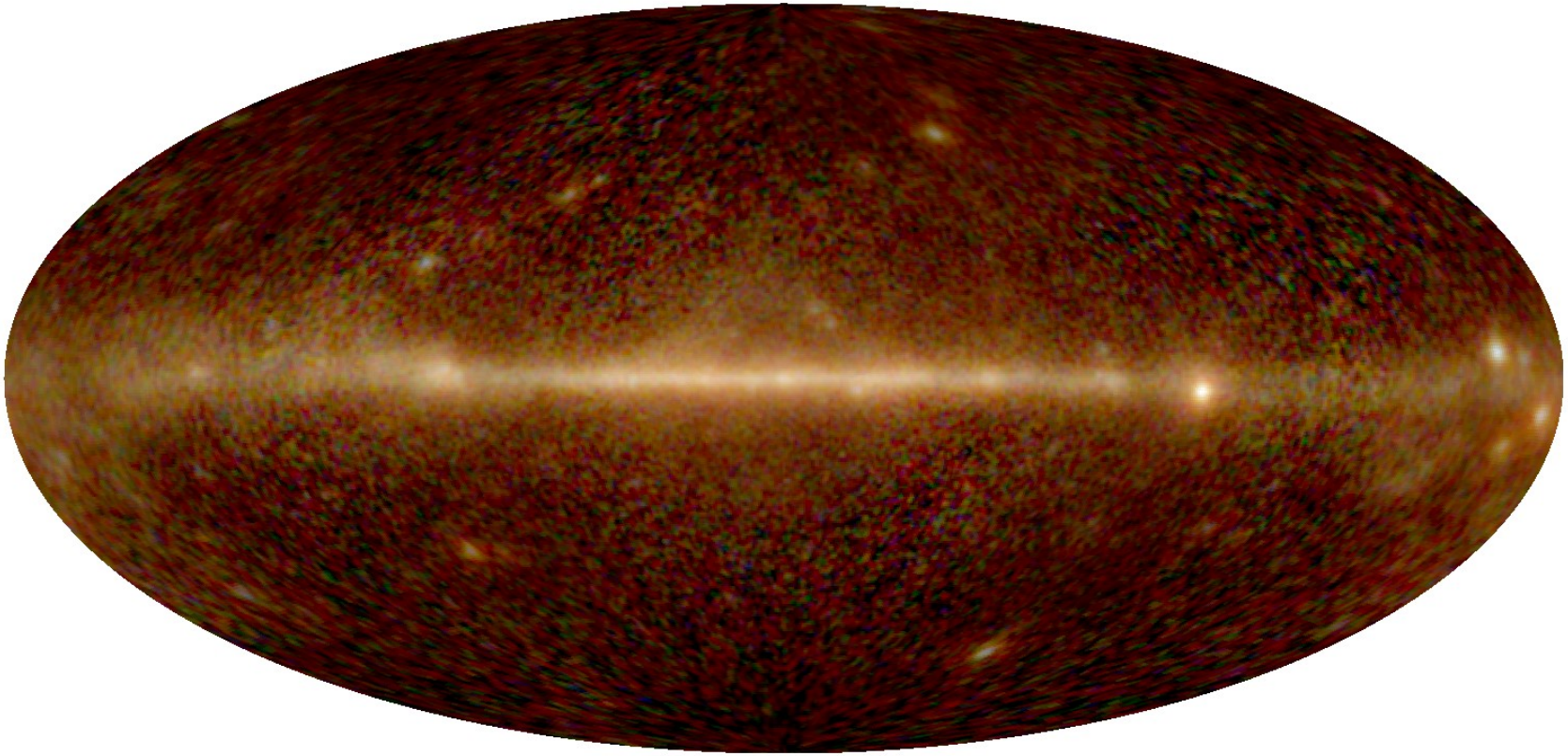
Real data: LAT Single GR Event Displays



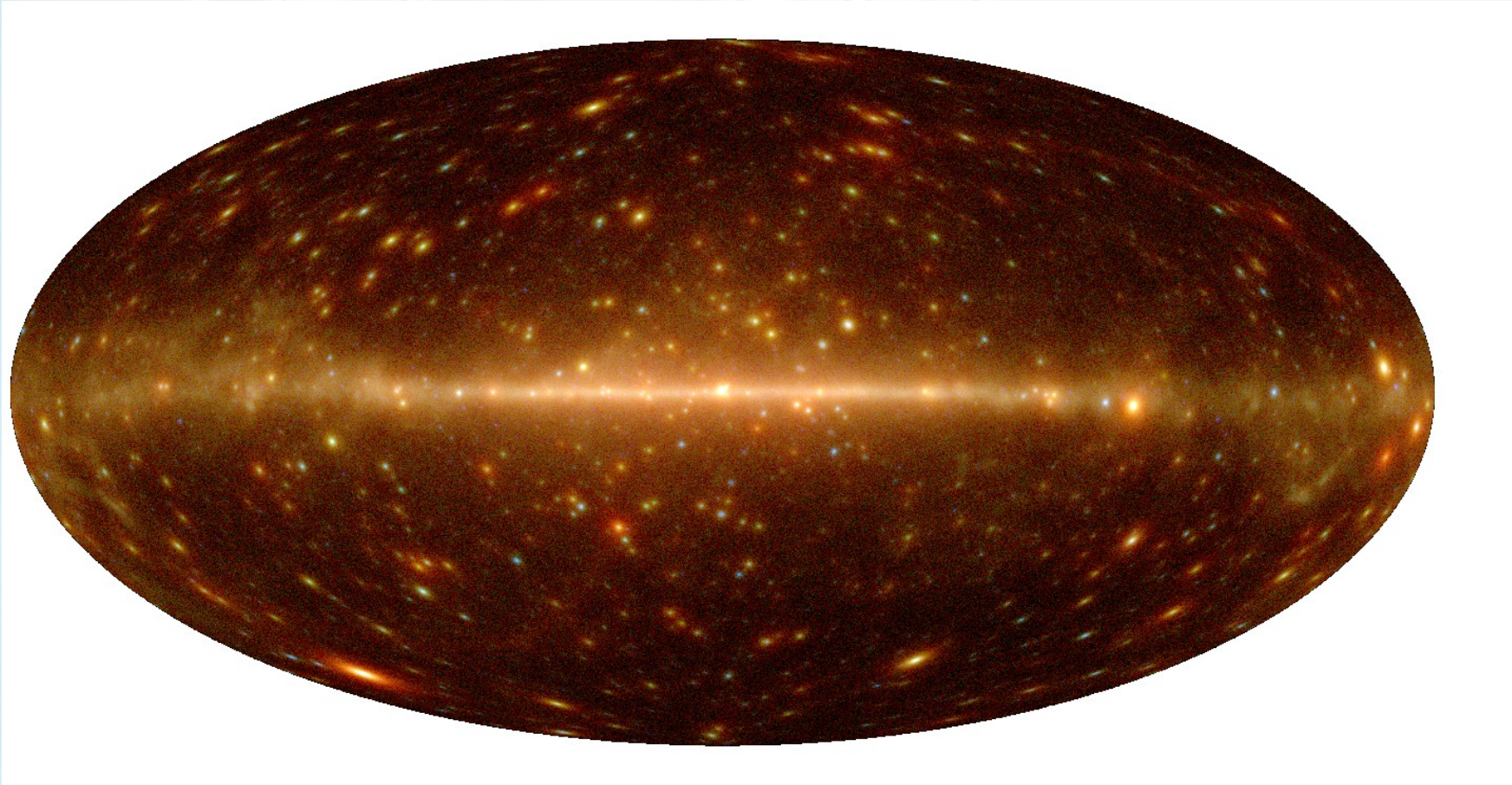


The green crosses show the detected positions of the charged particles, the blue lines show the reconstructed track trajectories, and the yellow line shows the candidate gamma-ray estimated direction. The red crosses show the detected energy depositions in the calorimeter. The anticoincidence detector shows no incoming charged particles in these events.

CGRO/EGRET View of the Universe



GLAST view of the Universe



Expected Gamma-ray Sky after 1 year

GLAST products

- New for launch:
  - GLAST launch litho
  - GLAST factsheet
  - Public brochure was updated
- Featured products for educators:
  - Active Galaxy Educator's Guide and poster
  - Active Galaxy Pop-up Book and Ed guide
  - 3 TOPS modules
  - GLAST paper model
- Also have to give away:
  - Lanyards
  - Stickers
  - Mission posters
  - Mini-plots
  - Magic Cubes

Swift

- Swift continues to enjoy good health, despite a scare with one of the gyros in Aug – October 2007. Swift is using the backup gyro for the one that went bad, but it took 2 months to reconfigure the software, as the backup gyro was aligned somewhat differently. New software has actually improved Swift's pointing accuracy since then.
- Neil Gehrels and the team won the Rossi prize from the AAS/HEAD for GRB discoveries!
- Swift is now a mature mission, and although its primary science is still GRBs, there are many other exciting things that Swift is studying…

Swift Press-worthy Science

http://swift.gsfc.nasa.gov/docs/swift/news/

10/4/06 - Mug Shots of Supernovas Reveal Two Key Findings

10/5/06 - Headcount of Local Black Holes

11/6/06 - Monster Stellar Flare Dwarfs All Others

11/21/06 -Twin Star Explosions Fascinate Astronomers

12/21/06 - Swift Finds New Kind of Black Hole Explosion

Swift Press-worthy Science

3/8/07 - Gamma-Ray Birth Cries Suggest Massive Magnetic Engines

5/22/07 - Gamma-ray Bursts Active Longer Than Thought

6/26/07 - Double Supernova in Galaxy Seen

7/30/07 - New Type of Active Galaxy

9/12/07 - Bizarre Planet-Mass Object Orbiting Neutron Star

12/18/07 - “Shot in the Dark” Explosion Stuns Astronomers

Swift Press-worthy Science

2/26/08 - Swift Satellite Catches a Galaxy Ablaze with Starbirth

3/20/08 - Satellite Detects Naked-Eye Explosion Halfway Across Universe

5/19/08 – The Mouse That Roared: Pipsqueak Star Unleashes Monster

5/21/08 – NASA's Swift Satellite Catches First Supernova in the Act of Exploding (more about this later from Kevin M.)

Swift images

- http://swift.gsfc.nasa.gov/docs/swift/results/releases/

Ultraviolet Image of M33 – Stefan Immler

Swift images

XRT

UVOT

“Naked Eye” Burst as seen by Swift – Stefan Immler

Swift Products

- Newton's Laws poster set
- Swift Eyes Through Time videos and educator's guide (Penn State) - download
- GRB Educator's Guide and poster
- Still available:
  - Swift glider
  - Swift model booklets
  - Swift sticker
  - Swift mini-plots
- Needing update: GEMS guide

XMM-Newton

- Still functioning well
- Extended by the Europeans for at least five more years
- NASA support is waning, however, as it did not do that well at the Senior Review
- We expect to have XMM funding for another year at the full level but then not sure what will happen
- XMM-Newton Image Gallery visible in Google Earth – see Multi-media gallery

Latest XMM News:

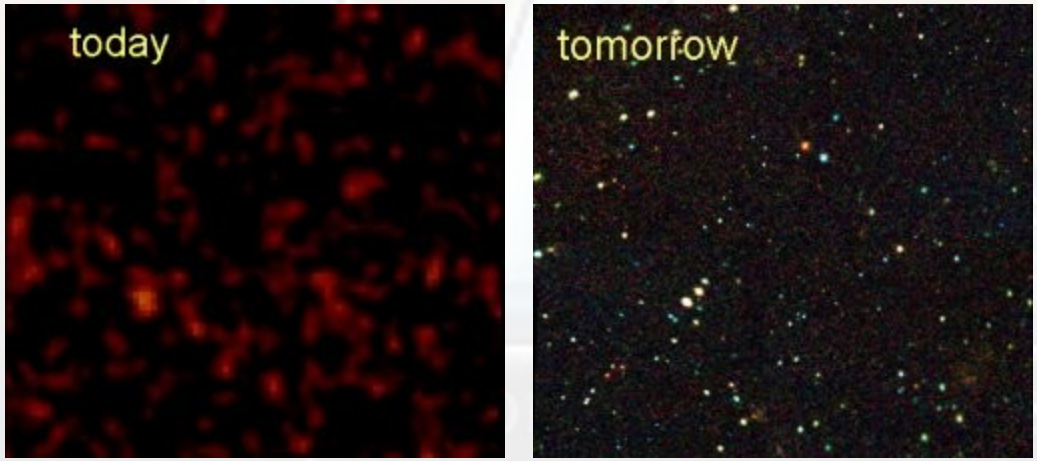
- **http://xmm.esac.esa.int/external/xmm_news/latest_news.shtml**
- 4/7/08 Cosmic engines surprise XMM-Newton
- 4/15/08 Milky Way's giant black hole awoke from slumber 300 years ago
- 5/6/08 XMM-Newton discovers part of missing matter in the universe
- 6/10/08 XMM-Newton finds hidden supernova
- 6/23/08 XMM-Newton watches lazy pulsar being jazzed up by companion
- 7/18/08 XMM-Newton discovers the star that everyone missed

XMM-Newton Products

- New! Supernova Educator's Unit – Kevin McLin will present this later (with GLAST)
- CLEA Lab "Dying Stars and the Birth of the Elements" and manual
- Space Place "Black Hole Rescue" (online)
- Still in progress: eXtreme Universe planetarium show
- Will be reprinted: XMM Rulers

NuSTAR

- NuSTAR = **Nu**clear **S**pectroscopic **T**elescope **Ar**ray
- Focusing hard (up to 80 keV) x-ray telescope with an extendable mast
- http://www.nustar.caltech.edu



NuSTAR drawing

NuSTAR science

- 3 major science goals
  - Finding black holes – especially those that are hidden by lots of interstellar dust
  - Studying supernovae – Titanium has a spectral line in the energy range covered by NuSTAR, which provides lots of information about the conditions in the remnant
  - Understanding Active Galaxies – a complement to GLAST, NuSTAR will study jets from AGs.

NuSTAR program

- Is in Phase B – needs to be confirmed for flight
- This should happen in Winter 2009
- Launch expected in August 2011
- We will be (re)-defining the E/PO program for NuSTAR during the next year
- Right now, having an EA is most of the program
- NuSTAR does have a MySpace page

SNAP

- SNAP = **S**uper**N**ova **A**cceleration **P**robe
- SSU received some money to redo their website, which is at http://snap.lbl.gov
- LRC (and Caty Pilachowski) also piloted a two-day workshop on behalf of SNAP with teachers in Indiana last summer – we are going to do this workshop with you over the next two days – you will hear more about SNAP later in the week.
- We hope to be able to propose for SNAP sometime later this year

Other resources of interest:

- GRB Lottery Site: http://swift.sonoma.edu/grb_lotto/index.php
- GRB Skymap Site: http://grb.sonoma.edu
- GTN Site: http://gtn.sonoma.edu
- Black Hole Rescue: http://spaceplace.jpl.nasa.gov/en/kids/blackhole/
- MySpace, Facebook and CafePress sites for: GLAST (glast), Swift (swiftsatellite), XMM-Newton (xmmnewton),
- MySpace and Facebook only for: SNAP (snapsatellite),
- MySpace only for: NuSTAR (nustarsatellite)