# XMM-Newton Education and Public Outreach Program

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# E/PO Work Breakdown Structure

1) Management
2) Formal Education
   - Educator Ambassador Program
   - Supernova Educator Unit
   - *CLEA* X-ray Spectroscopy *Lab*
   - Portable Planetarium Show
3) Informal Education
   - Space Place Partnership
   - After School Programs
   - Global Telescope Network
4) Public Outreach
   - Additional publications
   - E/PO Web Site
   - *Amateur Astronomers & Night Sky Network*
5) Assessment and Evaluation (WestEd)

# Educator Ambassadors

- XMM-Newton supports 2 Educator Ambassadors
  - Master teachers selected in national competition
  - Training July 10-14, 2006 at SSU – focused on standardizing presentation packages to different audiences to ensure coherent content delivery
- XMM-Newton workshops and talks have directly reached over 3600 students, teachers, and members of the general public through 44 talks and workshops in 2003-2006
- Tom Estill has left the program, as he accepted a position in GSFC Education Department. He continues to do XMM-related workshops, but we are no longer paying him.
- A new call for EAs will be issued in Fall 2007.

# Teacher Training 2006

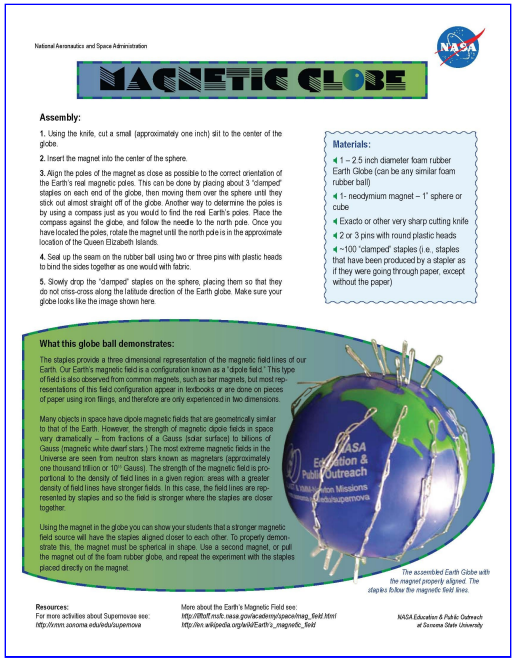
# Supernova Educator Unit – with GLAST

*Reviewers STILL needed – Beta-version now available!*

- 3 activities
  - Biography of a Supernova
  - The Crawl of the Crab
  - At the Heart of a Supernova

- **Poster of Supernovae**
  - Images of real Supernovae
  - Shows what a Supernova looks like during different stages of the explosion – timeline used for biography

# Other printed materials



National Aeronautics and Space Administration

NASA

MAGNETIC GLOBE

**Assembly:**

1. Using the knife, cut a small (approximately one inch) slit to the center of the globe.
2. Insert the magnet into the center of the sphere.
3. Align the poles of the magnet as close as possible to the correct orientation of the Earth's real magnetic poles. This can be done by placing about 3 "clamped" staples on each end of the globe, then moving them over the sphere until they stick out almost straight off of the globe. Another way to determine the poles is by using a compass just as you would to find the real Earth's poles. Place the compass against the globe, and follow the needle to the north pole. Once you have located the poles, rotate the magnet until the north pole is in the approximate location of the Queen Elizabeth Islands.
4. Seal up the seam on the rubber ball using two or three pins with plastic heads to bind the sides together as one would with fabric.
5. Slowly drop the "clamped" staples on the sphere, placing them so that they do not criss-cross along the latitude direction of the Earth globe. Make sure your globe looks like the image shown here.

**Materials:**

- 1 – 2.5 inch diameter foam rubber Earth Globe (can be any similar foam rubber ball)
- 1- neodymium magnet – 1" sphere or cube
- Exacto or other very sharp cutting knife
- 2 or 3 pins with round plastic heads
- ~100 "clamped" staples (i.e., staples that have been produced by a stapler as if they were going through paper, except without the paper)

**What this globe ball demonstrates:**

The staples provide a three dimensional representation of the magnetic field lines of our Earth. Our Earth's magnetic field is a configuration known as a "dipole field." This type of field is also observed from common magnets, such as bar magnets, but most representations of this field configuration appear in textbooks or are done on pieces of paper using iron filings, and therefore are only experienced in two dimensions.

Many objects in space have dipole magnetic fields that are geometrically similar to that of the Earth. However, the strength of magnetic dipole fields in space vary dramatically – from fractions of a Gauss (solar surface) to billions of Gauss (magnetic white dwarf stars.) The most extreme magnetic fields in the Universe are seen from neutron stars known as magnetars (approximately one thousand trillion or $10^{15}$ Gauss). The strength of the magnetic field is proportional to the density of field lines in a given region: areas with a greater density of field lines have stronger fields. In this case, the field lines are represented by staples and so the field is stronger where the staples are closer together.

Using the magnet in the globe you can show your students that a stronger magnetic field source will have the staples aligned closer to each other. To properly demonstrate this, the magnet must be spherical in shape. Use a second magnet, or pull the magnet out of the foam rubber globe, and repeat the experiment with the staples placed directly on the magnet.



*The assembled Earth Globe with the magnet properly aligned. The staples follow the magnetic field lines.*

**Resources:**
For more activities about Supernovae see:
http://vmm.sonoma.edu/edu/supernova

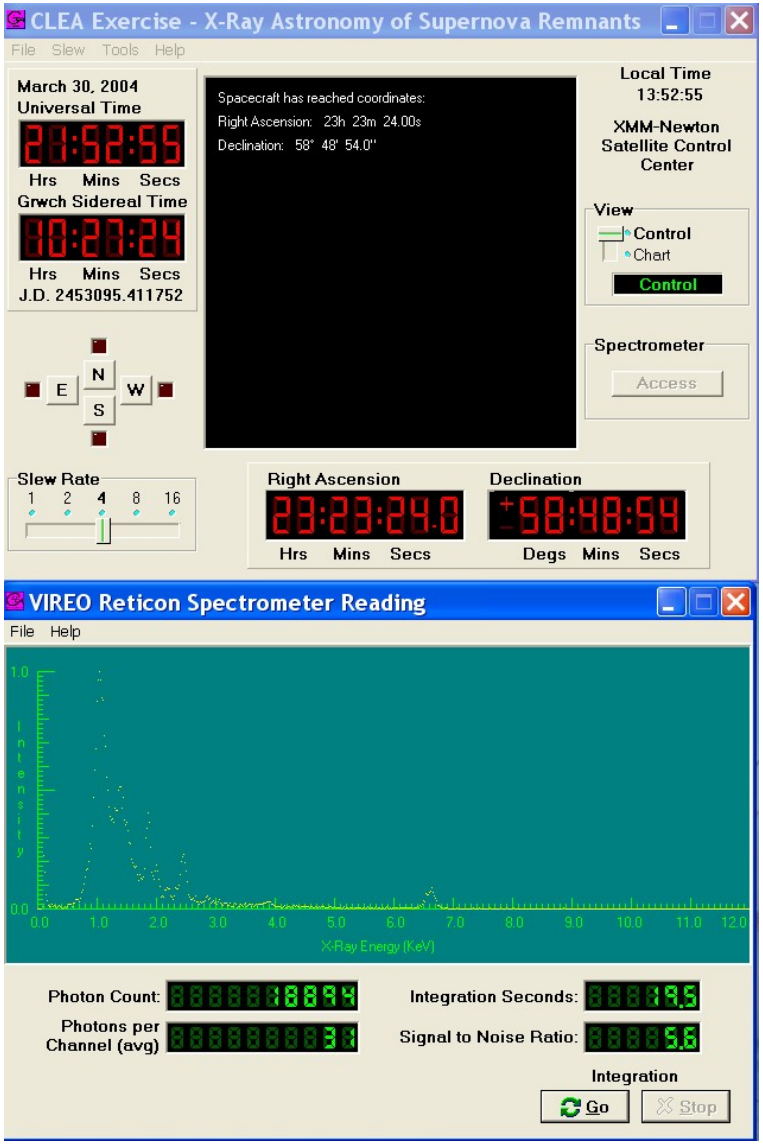
More about the Earth's Magnetic Field see:
http://liftoff.msfc.nasa.gov/academy/space/mag_field.html
http://en.wikipedia.org/wiki/Earth's_magnetic_field

NASA Education & Public Outreach at Sonoma State University

- Heart of the Supernova Litho - approved
- Two articles by our Space Place partners ( Dr. Tony Phillips, author)
  - **– "Not a Moment Wasted" – about XMM Slew Survey – distributed to over 200 astronomy clubs for their monthly newsletters**
  - **–"Brush your teeth and avoid black holes" – children's article about x-rays distributed to 14 major newspapers nation-wide – in English and Spanish - promotes Black Hole Rescue spelling game**
- Space Exploration and Humanity: A Historical Encyclopedia – article by LRC

# CLEA Laboratory

- Dying Stars and the Birth of the Elements
- Released in early 2006, debuted at AAS in Washington DC
- Uses simulated x-ray spectra to teach about the abundances of chemical elements in supernovae
- *Approved by NASA Product Review – glowing recommendations*



# eXtreme Universe Planetarium Show

- For portable (inflatable) Planetaria
- Planetarium show student manual and teacher's guide already completed
- Poster at AAS in Seattle
- Beta test version now available, will be piloted – uses Stellarium 0.8.1 – expect version 0.9 soon.
- Will use ROSAT all-sky survey catalog, plus about a dozen embedded object images that you can zoom in on.

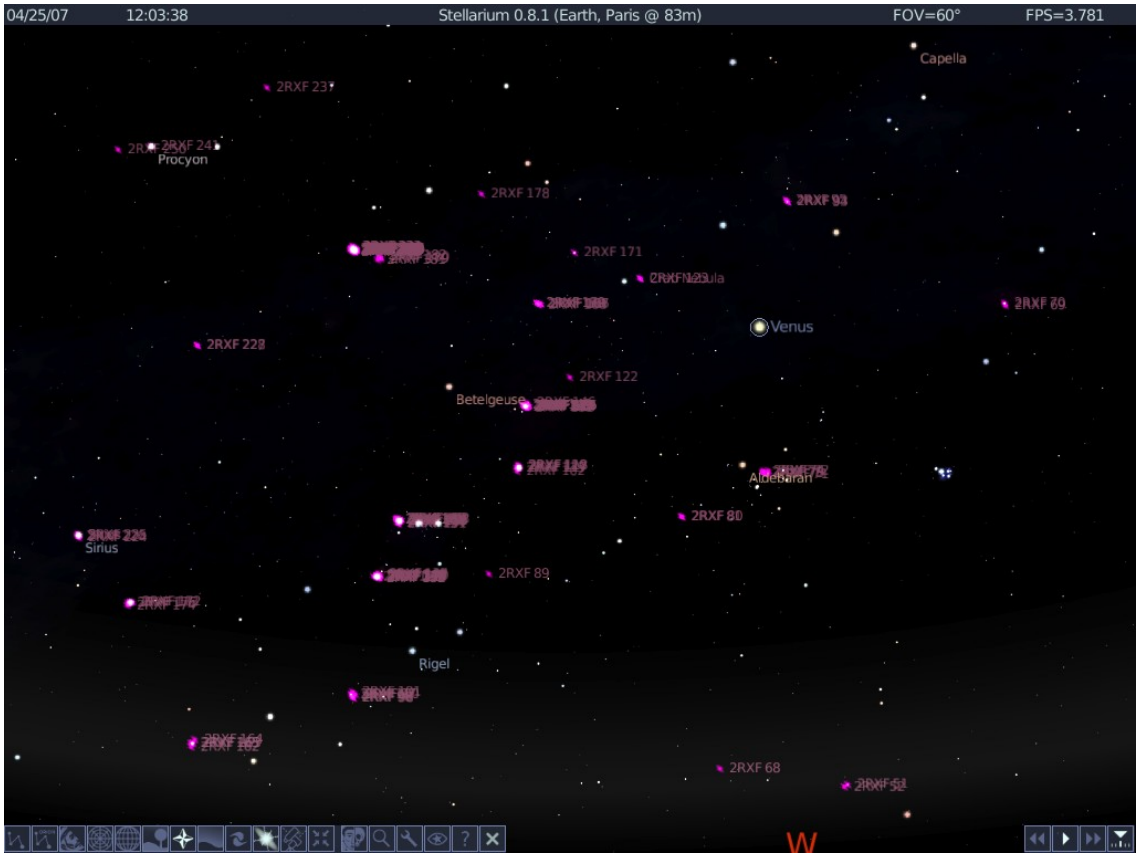
# eXtreme Universe Screenshots

# eXtreme Universe Screenshots

Visible sky near Orion

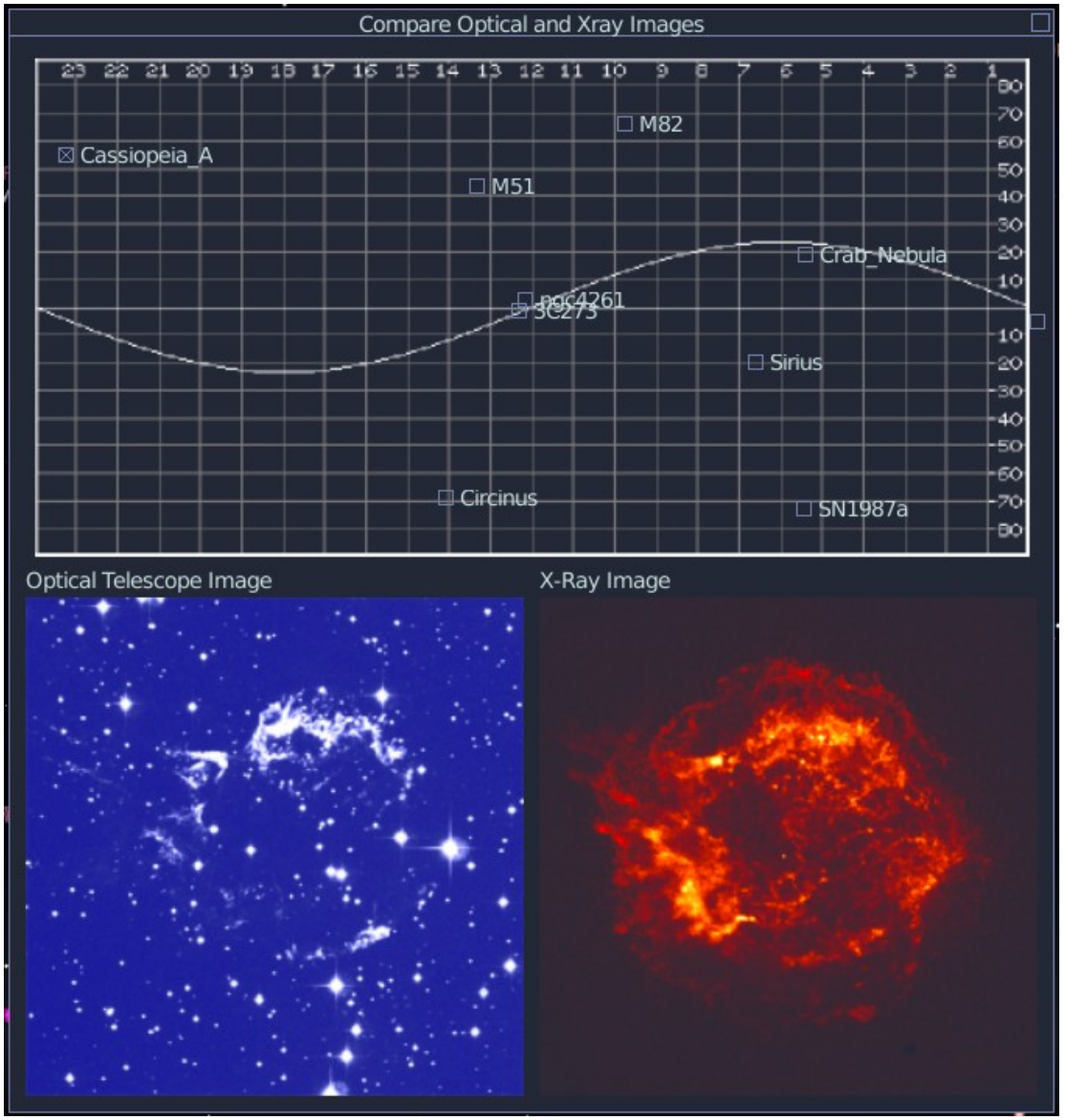
# eXtreme Universe Screenshots

- X-ray sky near Orion
- We have now deleted the ROSAT source names



# eXtreme Universe Screenshots

- CAS A
- Direct comparison of images in visible vs. X-ray



# eXtreme Universe Screenshots

- M51
- Overlaid images in visible vs. X-ray (visible is too faint to see)

# Global Telescope Network

- News since 5/06:
- PROMPT telescopes at CTIO
  - 5 optical and 1 IR 0.4 m
  - Operated by SkyNet software
- Pi of the Sky – at Las Campanas – Polish collaboration

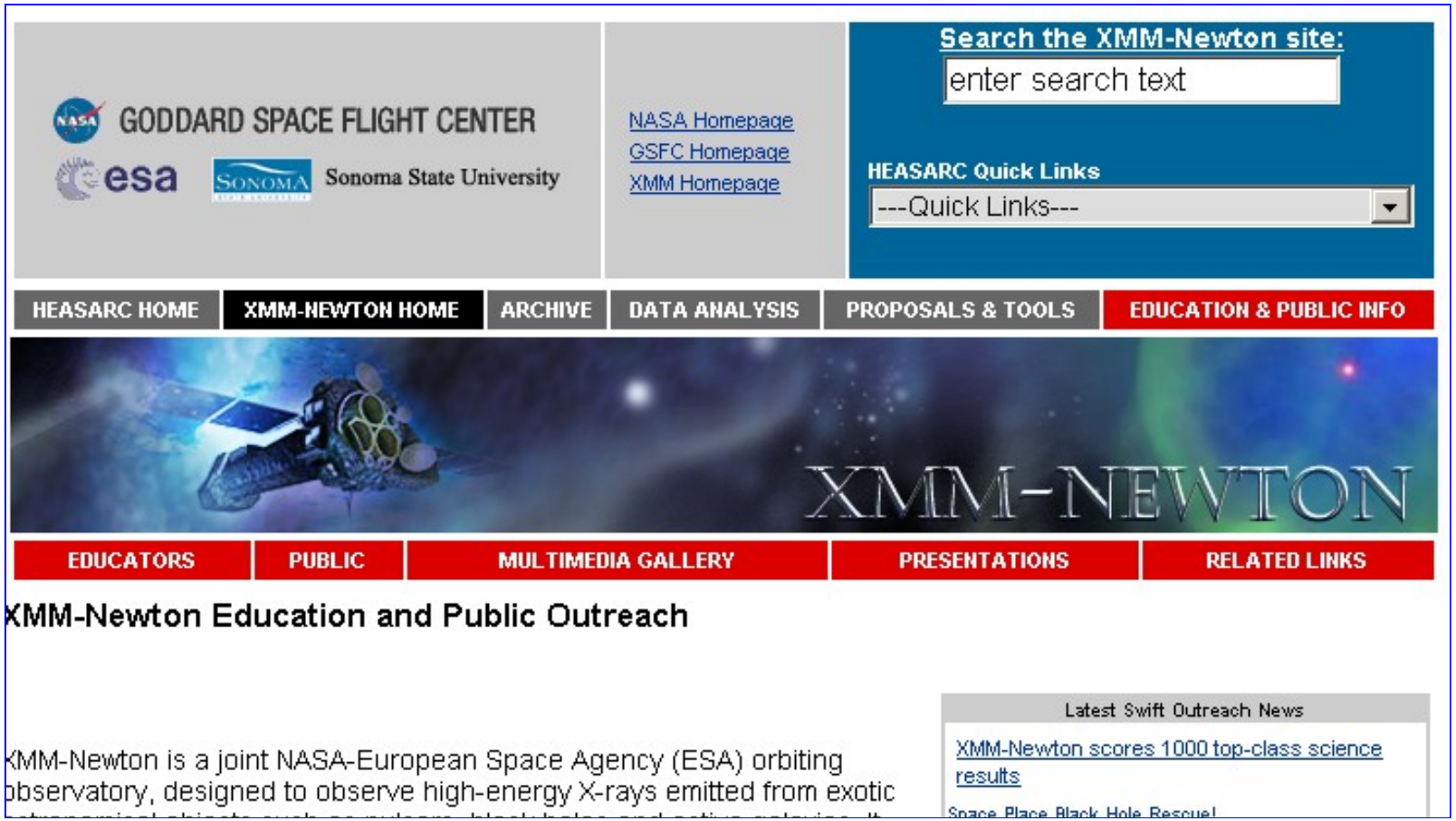
6 PROMPT telescopes at CTIO

2 Pi of the Sky 4 Mpixel CCD cameras at Las Campanas

# XMM-Newton GTN – Polar project

- Observations were begun in 2003 with GTN (but AAVSO were already monitoring many of the target objects.) Standard sequences are given for each.
- Validated data (usable for publication) are available upon request to AAVSO.
- *Polar list:* AN UMa, AR UMa, MR Ser, AM Her, QQ Vul, BL Hyi, EF Eri, VV Pup, GQ Mus, V834 Cen, V2214 Oph, V347 Pav
- http://gtn.sonoma.edu/participants/catalog/query.php
- *We STILL have no XMM scientists partnering with us to use the visible light data that have been accumulated!*

# XMM-Newton E/PO website




- One-NASA format – now in review
- http://xmm.sonoma.edu:81

# Night Sky Network

- “Extreme Universe” kit for amateur astronomers
- Being produced by Astronomical Society of the Pacific (ASP) & funded by GLAST, XMM, Swift and Suzaku
- Overall theme and messages approved, activities are next, then field testing.
- Will be done in 2008 and released to over 200 clubs.

# Extreme Universe NSN messages

- Supernovae and gamma-ray bursts are normal processes in the lives (or rather the deaths) of massive stars.
  - Massive stars are short-lived and rare
  - These explosions are very powerful.
- Supernovae shape the universe and sow the seeds for new worlds & life
  - By creating and circulating the heavier elements from which planets and life are made
  - By compressing clouds of gas and dust to initiate the process of forming new stars
- X-rays and gamma rays are released in the death of massive stars and from black holes and neutron stars that remain after the supernovae.
  - This kind of radiation can be dangerous to life.
  - This radiation is light energy, just much more energetic than visible light
  - Although the radiation from these events can be destructive to life, in a universe without these powerful explosions, there would be no life
- Earth's atmosphere protects us from most of this radiation and as a consequence, prevents us from detecting this radiation from Earth's surface.
  - We must put detectors above the atmosphere – out in space – to study this radiation.
  - NASA has missions to study X-rays and gamma rays emitted by powerful events in the universe.

# E/PO Summary

- XMM-Newton E/PO is exciting the public and students of all ages
- Both XMM Products submitted in 2006 were approved by NASA Product Review
- Over 3,600 teachers have been trained in 4 years by XMM-Newton Educator Ambassadors
- Night Sky Network kit should be exciting to amateur astronomers – due out in 2008