

Planetary Wonderings

November Focus: Chandra --- The Telescope With "X-Ray Eyes"

By Mary-Frances Bartels, NASA Solar System Ambassador

Recently I attended a telecom training session on the Chandra X-ray Observatory. While the discussion was primarily to announce some new findings from the telescope, the presenter expanded on x-rays, why we study astronomical x-ray sources, and how an x-ray telescope is different from visual, radio, and infrared telescopes. Of all the items he mentioned, I was particularly fascinated in how Chandra's mirrors are so different from the standard telescope mirror. Let's take a closer look at the x-ray universe and how we study it:

- What are x-rays?

X-rays are a highly energetic form of light, not visible to human eyes. Light can take on many forms -- including radio waves, microwaves, infrared, visible, ultraviolet, X-ray and gamma radiation. Very low temperatures (hundreds of degrees below zero Celsius) produce mostly low energy radio and microwave photons, whereas human bodies (about 30 degrees Celsius or so) produce largely infrared radiation. Objects at very high temperatures (millions of degrees Celsius) emit most of their energy as x-rays.

- Why do we need X-ray telescopes?

Much of the matter in the universe cannot be seen by any other telescope. X-ray telescopes are the only way we can observe extremely hot matter. It takes gigantic explosions, or intense magnetic or gravitational fields, to energize particles to these high temperatures. Where do such conditions exist? In an astonishing variety of places, ranging from the vast spaces between galaxies to neutron stars and black holes.

- How do X-ray telescopes differ from optical telescopes?

X-rays do not reflect off mirrors the same way that visible light does. Because of their high-energy, X-ray photons penetrate into the mirror in much the same way that bullets slam into a wall. Likewise, just as bullets ricochet when they hit a wall at a grazing angle, so too will x-rays ricochet off mirrors. These properties mean that X-ray telescopes must be very different from optical telescopes. The mirrors have to be precisely shaped and aligned nearly parallel to incoming x-rays. Thus they look more like barrels than the familiar dish shape of optical telescopes.

- Why can't we have earthbound X-ray observatories?

X-ray observatories must be placed high above the Earth's surface because the Earth's atmosphere absorbs x-rays.

- What makes Chandra unique?

Since its launch on July 23, 1999, the Chandra X-ray Observatory has been NASA's flagship mission for X-ray astronomy, taking its place in the fleet of "Great Observatories." Chandra detects and images X-ray sources that are billions of light years away. The mirrors on Chandra are the largest, most precisely shaped and aligned, and smoothest mirrors ever constructed. If the surface of Earth was as smooth as the Chandra mirrors, the highest mountain would be less than six feet tall! The images Chandra makes are twenty-five times sharper than the best previous X-ray telescope. This focusing power is equivalent to the ability to read a newspaper at a

distance of half a mile. Chandra's improved sensitivity is making possible more detailed studies of black holes, supernovas, and dark matter. Chandra will increase our understanding of the origin, evolution, and destiny of the universe.

- What has Chandra discovered in its eight years in orbit? Chandra has made several astounding discoveries:
 - Brightest supernova ever
 - Heaviest stellar black hole
 - Eclipse of black hole
 - Evidence for a significant new class of supernova
 - That Saturn reflects X-Rays from the sun
 - Evidence that most cosmic rays may originate from supernovas

Chandra still has two years left to its first extended mission. Who knows what it will find next?

→ **New Mailing List Available:** I have created *Astronomy for Educators* (AstronomyEd) on Freelists.Org. Presently, it is an “announcement only” service where I will post these columns as well as other space- and education-related opportunities for (home) educators and students. I receive this information from multiple sources, and plan to forward those of interest to the list. Traffic on the list should be about several messages per month. While it is “announcement only” with only myself making posts, anyone with information they think would be of interest is encouraged to send it along to astronomyed@freelists.org for approval. Subscription information may be found at the end of this article.

Resource of the Month: The North American Skies email alert service --- Larry Sessions, a fellow NASA-SSA from Colorado, has an e-mail service that alerts subscribers to worthwhile astronomical and space events that can be easily observed without expensive equipment. This can include meteor showers, eclipses, displays of the aurora, bright planets and sightings of the International Space Station and Space Shuttle. The frequency of alerts varies, but Larry estimates that he sends alerts about once every couple of weeks. <http://www.mscd.edu/%7EPhysics/astro/NASsubscribe.htm>

Activity of the Month: Learn more about supernovas, one kind of object studied by Chandra. You may already be familiar with the most famous supernova remnant, the Crab Nebula. Check out supernova-related demonstrations at <http://chandra.harvard.edu/edu/formal/demos/snr.html> . One of the three activities is even fairly tasty, if you like angel food cake that is.

Suggestions, questions, and comments about “Planetary Wonderings” are welcomed and may be directed to stargazer @ keeplookingup.net (remove spaces). Past columns may be found at www.keeplookingup.net (click on “Planetary Wonderings” on the right side of opening screen).

Remember to *keep looking up!*

Sources (not already mentioned): <http://chandra.harvard.edu/edu/chandra101.html>
http://www.nasa.gov/mission_pages/chandra/news/index.html

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