IS CHANDRA REALLY UP THERE?

In case you wondered if Chandra is really up there, take a look at these pictures shot by Gary Emerson with a 25 cm telescope at the E.E. Barnard Observatory. Gary used an astronomical program called "The Sky" to find the spacecraft position. First he shot with a wide-angle camera and found Chandra, and then he homed in with the 25 cm telescope.

It was, according to Emerson, "The kind of night that astronomers dream of, with the Milky Way lighting the evening sky and stars visible down to the horizon. After working on the project for a couple of years, seeing Chandra that night was like seeing an old friend."

In a few minutes Chandra will move across the background of the stars even though it is 6000 miles above the Earth at its closest approach. On an exposure lasting just a few minutes, it will appear as a streak.

Emerson worked as a test engineer on Chandra's Charge Coupled Device (CCD) aspect camera at Ball Aerospace. The aspect camera is used to find optical guide stars to aid in pointing the observatory. Gary grew up in Chicago, and did not plan on graduating from high school, let alone going to college, until a seventh grade teacher sparked his interest in astronomy with visits to the planetarium and nearby observatories.

"It's so critical to have good teachers at that age," Emerson said. Emerson's mother bought him a small telescope that he used to explore the universe from the third floor deck of their apartment. While a freshman in high school, Emerson joined the Smithsonian Astrophysical Observatory's Operation Moonwatch program. Like Homer Hickam, the hero of the movie "October Skies," Emerson was hooked by the sight of Sputnik orbiting overhead.

"Three days after Sputnik launched, we were able to observe the rocket body going over Chicago," Emerson says. "I was hooked. I knew I wanted to work in aerospace, although the term had not been coined yet. I just wanted to build satellites and work on all sorts of spacecraft. So here I am."
The Space Shuttle Columbia delivered Chandra to a low Earth orbit. Then, the Inertial Upper Stage rocket boosted Chandra up to a higher altitude where a built-in propulsion system took Chandra to its final orbit. This elliptical orbit takes the spacecraft to an altitude of 140,161 km (86,900 mi) - more than a third of the distance to the moon - before returning to its closest approach to the earth of 10,000 kilometers (6,200 mi). It takes approximately 64 hours and 18 minutes to complete an orbit.

Van Allen Belts

The Chandra spacecraft spends approximately 85% of its orbit above the Van Allen belts, charged particles that surround the Earth. This makes uninterrupted observations of as long as 55 hours possible, making the overall percentage of useful observing time much greater than the low earth orbit of a few hundred kilometers used by most satellites.

Satellite Tracking Tutorial

Follow along with this tutorial to see for yourself just what the Chandra orbit looks like. Please note, your browser must be java-enabled.

In a browser window, bring up:
http://liftoff.msfc.nasa.gov/realtime/JTrack/3d/JTrack3d.html

This loads the java-based J-Track 3D tool. You may get a screen telling you that this is not a secure transfer (it's a safe tool, don't worry about loading it) in which case click on Grant.

Allow some time for the tool and its database to load (it will warn that it is loading satellite data). After it loads, you should be viewing the Earth with numerous little dots around it. Above the earth on the same screen is a set of menu bars that read View, Satellite, and Options. Follow these steps:

1. Click on Satellite and choose Select. You will get a menu with a number of satellite names. Scroll down the list and choose Chandra. You should see the orbit track light up.

2. Notice that the orbit is much bigger than the viewing screen. Click on View and select Zoom Out. Do this a few times until you can see the whole orbit.

Note: This is a 3-d representation; the red part of the orbit is the part that is "out of the screen" and the grey part is "into the screen." The current position of the satellite is indicated by the position at which the name appears.

3. Observe that there appears to be a line of dots across the Earth, along with more dots scattered in various places. Try the following:

   a. Place your cursor right at the center of the Earth and, holding down the left mouse button, slowly move the mouse straight down. The Earth (and everything else) tips down so that you are looking down on the northern hemisphere.

   b. The line of dots across the Earth is really a ring! What could that be? This is the ring of geostationary satellites - those satellites which just sit right at a fixed point above the equator. There is a particular altitude (about 40,000 km) at which the orbital period exactly matches the rotation period of the Earth. If a satellite orbits right along the equator at this altitude, it will just sit above the particular spot on the Earth. Some of these are weather satellites. Most are communications satellites.

   Yes, there is a lot of stuff up there!

   c. Click on any satellite to see its name and orbit. (You can always get back to Chandra by repeating step "1"). If you look back at the Satellite options, under Select, you will see a button marked Sat. Info. Click on this and it will bring up information on the satellite you are looking at and display it in your browser window.

4. Next, zoom back until the Earth takes up most of the window. You will witness the haze of low-altitude satellites which include Hubble, Mir, the Space Station, and many others. If you watch closely, you will see them move. (If you don't, go to Options and set the Update Rate to 1s or 5s.) You can find Hubble (HST), Mir, or the Space Station (Station) under Satellite/Select if you want to see where they are.

5. Still having fun? If you have a good connection speed go to Options and choose Timing. Select X1000 and then go to Options under Update Rate and choose 1/4 second. Wait a while for this all to load. You should observe objects moving at 1000 times their actual rates. With a slower modem this may not work as well.