

Offered Title: X – Rays

I'm continuing my discussion about the Electromagnetic Spectrum. We have looked at radio/microwave, and visible light spectroscopy. Now let's dig into the realm of x-rays.

On the electromagnetic spectrum, x-rays are just a bit longer wavelength than gamma rays. X-rays are highly energetic photons, light we cannot see with our eyes. They are dangerous to life as they ionize atoms and break molecular bonds. Exposure to x-rays is something we need to limit. Fortunately for life X-rays are absorbed by our atmosphere. To study them we need to get above our atmosphere.

Where do x-rays come from? Our good old buddy gravity has a big role in the production of x-rays, other than in medical practice. X-ray photons are produced by accelerating electrons at very high speeds. In medical practice the electrons are accelerated in an x-ray tube via high voltage. In our universe electrons are accelerated around and within objects by gravity and generate x-ray photons. We did not really know of x-ray sources other than our Sun until 1962 when Scorpius X-1 was discovered. This discovery basically started the field of x-ray astronomy. Other sources abound, including but not limited to stars, galaxy clusters, quasars, black holes, even some comets, anywhere highly accelerating electrons exist.

Beside our atmosphere blocking them, figuring out how to detect x-rays in a meaningful way presents another challenge. The first detectors were simple counters that provided the number of x-ray "hits" encountered. They were initially sent up in sounding rockets like the V-2 or Aerobee 150. But due to the very short time (minutes) above the atmosphere and expense of rockets, balloons were tried. Unfortunately, balloons cannot get high enough to capture lower energy x-rays. Nevertheless, in 1964 a balloon flight from Palestine, TX recorded a higher energy x-ray source, the supernova remnant in the Crab Nebula. Balloons continue to be used for high energy x-ray study and satellite x-ray observatories have been developed for high and low energy x-ray study.

X-ray telescopes use what is termed glancing angle reflection where the x-ray photons are directed to a detector upon glancing off the mirror. This technique is used due to improved signal to noise ratio vs. direct reflection. The down side for this technique is a very narrow field of photon capture. The material used for mirrors is ceramic or metal foil, coated with gold or iridium. The detectors used include scintillation counters, Geiger counters, CCD, and CMOS. They share the common goal of determining quantity and energy values of the x-ray photons.

The "image" produced by x-ray telescopes shows concentrations, and energies of the x-rays. This adds to the information produced by other imaging techniques.

What's in the Sky

The early morning show continues. Get up just before dawn from the 23rd to the 25th and watch a waning crescent Moon join up with Antares, then Saturn, then Mercury.

New Moon occurs on the 27th at 6:07 p.m. CST.