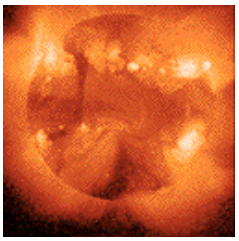
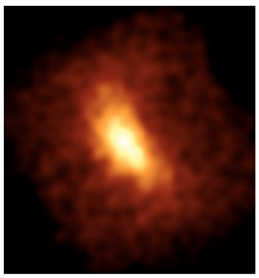
X-Ray Astronomy Field Guide

Solar System



The Sun's hot outer atmosphere produces X-rays, but because it is so close - a mere 93 million miles - it is too bright for Chandra's sensitive eyes. Pictured right is an X-ray image of our Sun, courtesy of The Soft X-ray Telescope on board the Yohkoh satellite. This telescope was designed to study the hottest part of the Sun's atmosphere (the corona). The corona is so hot (about 2 million degrees Celsius) that it is best seen by detecting the X-rays it emits.

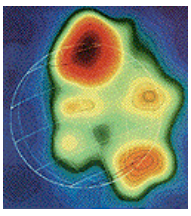


Chandra can observe other objects in our solar system, however, such as comets. Pictured left is an X-ray image of Comet C/1999 S4 (LINEAR), as observed by the Chandra X-Ray Observatory on July 14, 2000. Comets resemble "dirty snow balls" a few miles in diameter with a surrounding cloud of dust and gas. Until the mid 1990's they were thought to be much too cold to produce X-rays, which are usually associated with million-degree Celsius gas or high energy particles. The X-ray emission from comets is produced by high energy particles, but the high energy particles come not from the comet but from the Sun.

The upper part of the Sun's atmosphere, or corona, are so hot that they evaporate in a flow of matter called the solar wind. The solar wind is composed of ions of hydrogen, helium and small percentages of heavier elements such as carbon, nitrogen and oxygen moving at speeds in excess of a million kilometers per hour.

When these ions, which have a large positive charge, collide with a comet, they can pull electrons away from the neutral atoms (predominantly hydrogen) of the comet in what is called a charge-exchange collision. The electrons are usually captured into high-energy states of the solar wind ions, and emit X-rays as they shift into lower-energy states. These X-rays have an energy that is equal to the difference in energy states, and if detected with an X-ray spectrometer, provide a telling signal that the charge-exchange collision is occurring.

By observing a number of comets, it should be possible to study the chemistry of the solar wind, and to learn more about the cloud of dust and gas surrounding comets. The charge-exchange process is also expected to produce X-rays when the solar wind hits the atmospheres of planets such as Venus.



Elsewhere in the solar system, high energy particles produced in the magnetic fields surrounding Jupiter can give off detectable amounts of X-rays. On the right is a ROSAT soft X-ray HRI image of Jupiter. This image was taken during the impact of comet Shoemaker-Levy 9 in July, 1994. Image courtesy of: Hunter Waite, Randy Gladstone, and Southwest Research Institute.