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Thought-Provoking Imagery Shows Sun's Place in the

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THOUGHT-PROVOKING IMAGERY SHOWS SUN'S PLACE IN THE GALAXY

An action-packed movie assembled from images taken by an instrument aboard the NASA-European Space Agency Solar Heliospheric Observatory (SOHO) has provided a remarkable galactic perspective on the Sun and its place in the Milky Way.

Taken during Dec. 22-27, 1996, the series of images show the Sun drifting in front of the stars of the constellation Sagittarius, as the constant solar wind blows outward in all directions. Soon, a comet passes into view from the south and disappears behind the Sun. Finally, in an unrelated event, a plainly visible giant puff of solar gas is emitted, representing a large mass ejection in a direction away from the Earth.

The remarkable images come from SOHO's visible-light coronagraph, LASCO, which is able to mask the intense rays from the Sun's surface in order to reveal the much fainter glow of the solar atmosphere, or corona. Operated with its widest field of view, LASCO's unprecedented sensitivity enabled it to see the thin ionized gas of the solar wind out to the edges of the picture, 13 million miles from the Sun's surface. Many stars are brighter than the gas, and they create the background scene.

The results may alter human perceptions of the Sun in the same way that the Apollo lunar mission photographs revealed the Earth to be a beautiful but isolated planet in space, according to leader of the LASCO team, Dr. Guenter Brueckner of the Naval Research Laboratory, Washington, DC.

"I spend my life examining the Sun, but this movie is a special thrill," Brueckner said. "For a moment, I forget the years of effort that went into creating LASCO and SOHO, and leave aside the many points of scientific importance in the images. I am happy to marvel at a new impression of our busy star that gives us life, and which affects our environment in many ways that we are only now beginning to understand."

For many centuries even astrologers knew that the Sun was in Sagittarius in December and drifting towards the next zodiacal constellation, Capricorn. This was a matter of calculation only, because the Sun's own brightness prevented a direct view of the starfield. The SOHO-LASCO movie makes this elementary point of astronomy a matter of direct observation for the first time.

"This is an especially dramatic sample of the data that scientists are now starting to gather routinely from SOHO," said George Withbroe, director of the Sun-Earth Connection science program at NASA Headquarters, Washington, DC. "It really helps drive home the idea that the Sun is a typical star, although we certainly have a special relationship with it."

In the movie, north is at the top of the scene, which corresponds with the orientation of the Sun as seen at midday in the northern hemisphere of Earth. SOHO's progress in orbit around the Sun remains in step with the Earth's motion. SOHO travels towards the right (west) in relation to the stars during the period of observation. As a result, the Sun's position appears to shift to the left (eastwards) in front of the stars. In this mode, LASCO observes an area of the sky 32 times wider than the visible Sun itself.

At the time of the observations, SOHO is looking towards the heart of the Milky Way Galaxy, which lies in the constellation of Sagittarius. The Milky Way, made by the light of billions of distant stars, forms a luminous band slanting down and to the right. Dark lanes seen in the Milky Way are real features familiar to astronomers. They are created by dust clouds in the disk of the galaxy that obscure the distant stars.

A doomed comet, previously unknown, enters on the left of the image on Dec. 22. Its path curves towards the Sun and on Dec. 23 it disappears behind the occulting mask of the coronagraph. It fails to reappear on the far side of the Sun. Whether or not its trajectory took it directly towards the visible surface, the comet must have evaporated in Sun's atmosphere. It was one of a family of comets known as sungrazers, believed to be remnants of a large comet that broke up perhaps 900 years ago. Other fragments were responsible for spectacular comet apparitions in 1843, 1882 and 1965.

Called Comet SOHO 6, it is one of seven sungrazers discovered so far by LASCO. Analyses of these cometary orbits, now in progress, are a prerequisite for their inclusion in the official record of comet discoveries. LASCO also provided unique pictures of Comet Hyakutake passing behind the Sun in early May 1996.

Debris strewn from the tails of many comets makes a disk of dust around the Sun, in the ecliptic plane where the planets orbit. It scatters sunlight and is sometimes visible at twilight on the Earth, known as the Zodiacal Light. In the raw images obtained by LASCO, the Zodiacal Light is brighter than the solar corona. Image processing subtracted these effects precisely, to bring the solar wind and the Milky Way into plain view.

Random flickers of light in the images are due to cosmic rays striking the detector. Cosmic rays are energetic particles coming from exploded stars in the Milky Way, and variations in the solar wind influence their intensity in the vicinity of SOHO and the Earth. Operating beyond the Earth's protective magnetic field, which repels many particles, SOHO is more exposed to the cosmic rays.

In the largest outburst from the Sun seen in the December movie, a mass ejection causes billions of tons of gas to race out into space on the right-hand (western) side of the Sun. The origin of this event much lower in the Sun's atmosphere was evident in an expanding bubble seen in processed images from the SOHO extreme ultraviolet imager.

Coronal mass ejections are the hurricanes of space weather. SOHO is ideally placed to report and even anticipate their origins in the Sun's atmosphere. Although the Sun is

supposedly very quiet at present, being close to the minimum count of sunspots, LASCO has observed so many outbursts large and small -- roughly one a day -- that scientists are having to think again about how to define a coronal mass ejection. Later LASCO images, from Jan. 6, 1997, revealed a large mass ejection directed towards the Earth.

The movie and still photographs related to it are available on the Internet at the Naval Research Laboratory's SOHO/LASCO home page:

<http://lasco-www.nrl.navy.mil/lasco.html>

A mission of international scientific cooperation between NASA and the European Space Agency (ESA), SOHO was launched on Dec. 2, 1995. It is situated near the L-1 Lagrangian point, where the Earth's and Sun's gravitational forces balance, some one million miles sunward from the Earth. This vantage point enables solar astronomers to use SOHO's 12 science instruments to observe the Sun continuously, with no intervening "night." Major areas of research include studies of the solar interior via helioseismology, the solar atmosphere in ultraviolet and visible light, and the solar wind and energetic particles.

SOHO and its instruments are operated from the Goddard Space Flight Center, Greenbelt, MD, for the NASA's Office of Space Science, Washington, DC.

Brueckner will discuss the video and its contents in detail in a briefing at 6 p.m. EST on Saturday, Feb. 15, during the annual meeting of the American Association for the Advancement of Science at the Seattle Convention Center. For more information, contact the AAAS press room at 206/624-9087.

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