Solar Eruption Seen in Unprecedented Detail

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On April 9, the Sun erupted and blasted a bubble of hot, ionized gas into the solar system. The eruption was observed in unprecedented detail by a fleet of spacecraft, revealing new features that are predicted by computer models but difficult to see in practice.

The observations are being discussed today in a press briefing at the American Geophysical Union Joint Assembly in Fort Lauderdale, Fla.

Such eruptions, called coronal mass ejections or CMEs, happen periodically and pose a potential threat to astronauts or satellites if aimed at Earth. Astronomers study these explosions in hope of being able to predict them and provide “space weather” forecasts. The April 9 CME occurred on the edge or limb of the Sun as viewed from Earth. As a result, the X-ray brightening (solar flare) usually associated with a CME was hidden from view, allowing sun-watching spacecraft to take longer exposures and uncover fainter structures than usual.

“Observations like this are very rare,” said Smithsonian astronomer Ed DeLuca, (Harvard-Smithsonian Center for Astrophysics) who is presenting the findings at today’s press briefing.

Using the Smithsonian-developed X-ray Telescope (XRT) aboard the Hinode sun-watching satellite, astronomers saw a spiral (helical) magnetic structure unwind as it left the Sun during the CME. Such unwinding can release energy as the magnetic field goes from a more twisted to a less twisted configuration, thereby helping to power the eruption.

Hours later, XRT revealed an inflow of material toward a feature that appears as a bright line—actually an object known as a current sheet seen edge-on. A current sheet is a thin, electrified sheet of gas where oppositely directed magnetic field lines annihilate one another in a process known as magnetic reconnection. The extended observations from XRT show that magnetic fields flow in toward the current sheet for many hours after the eruption, progressing first toward the sheet and then down to the sun's surface.

Computer models of CMEs predict such movements of magnetic field lines, but observing them has proven difficult. The unique positioning of this CME on the sun's limb allowed astronomers to measure those motions.

They also determined that the temperature of the current sheet is between 5 and 18 million degrees Fahrenheit, which matches previous measurements higher up in the corona by the Ultraviolet Coronagraph Spectrometer on the SOHO spacecraft.

A workshop is planned to study in detail the results from Hinode XRT, and other observations of this event by TRACE, STEREO, RHESSI, SOHO, and Hinode's other instruments. Together, those observations will provide a more complete picture of the source and evolution of CMEs.

Hinode is a Japanese mission developed and launched by ISAS/JAXA, with NAOJ as domestic partner and NASA and STFC (UK) as international partners. It is operated by these agencies in cooperation with ESA and the NSC (Norway).

Source: Harvard-Smithsonian Center for Astrophysics