# New technique provides the first full view of the far side of the sun

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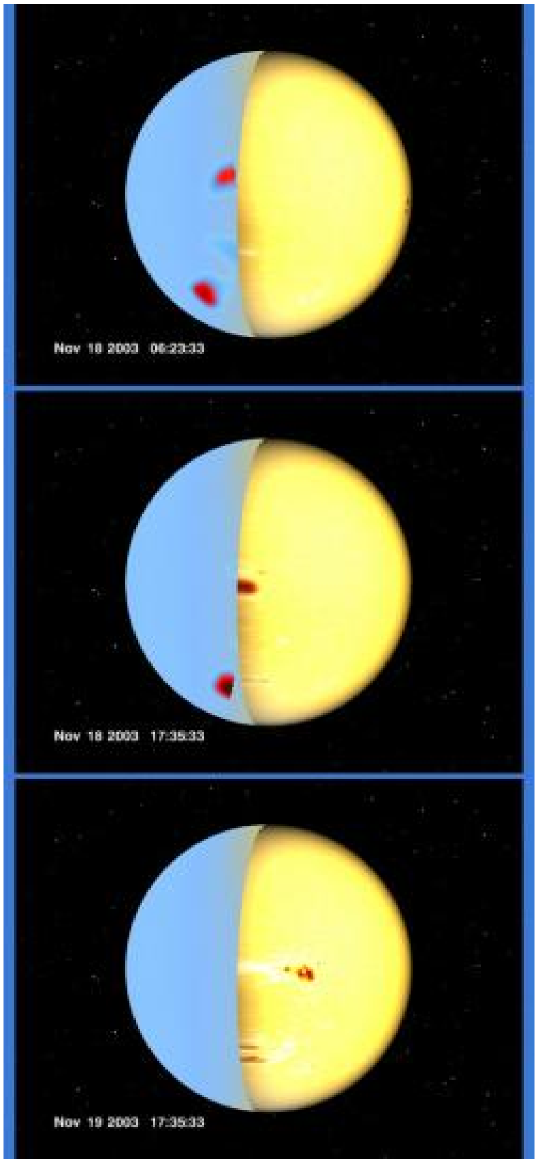
The hidden face of the sun is fully visible for the first time, thanks to a new technique developed at Stanford University.

Only half of the sun--the near side--is directly observable. The far side always faces away from Earth and is therefore out of view. But the new technology allows anyone with a computer to download images of the entire solar surface--an important advance with practical applications, say researchers, because potentially damaging solar storms that form on the far side now can be detected days, or even weeks, before they wreak havoc on Earth.




This image shows two active regions crossing the solar east limb in November 2003. The right side, in yellow, are white light images showing sunspots. The left side (blue) shows the prediction of sunpots on the farside. Since the white light observations are images made "straight on", they are stretched into blurry lines when they are projected to show the view over the limb. This is simply because we do not have a camera above the east limb (yet).

"Sunspots, solar flares and other active regions on the surface of the sun emit radiation that can interfere with orbiting satellites, telecommunications and power transmission," says Philip Scherrer, research professor in the Stanford Department of Physics. "This new method allows more reliable warning of magnetic storms brewing on the far side that could rotate with the sun and threaten the Earth."

It takes about 27 days for the sun to rotate on its axis, so an active region that forms on the far side can remain hidden for up to 13 days, surprising Earth-bound observers when it finally rotates into view. That's what happened in October 2003, when active regions from the back side suddenly appeared on the eastern edge of the sun, spewing X-rays, ultraviolet radiation and high-energy particles into space. "We were not able to make a public prediction about the intensity of that activity, because at the time we could only image about a quarter to a third of the far side," Scherrer says. "The new method allows us to see the entire far side, including the poles."

## SOHO mission

Scherrer and his Stanford colleagues study the sun using data from the Solar and Heliospheric Observatory (SOHO), a research satellite launched in 1995 by NASA and the European Space Agency. On board SOHO is the Michelson Doppler Imager (MDI), an electronic instrument that creates images of the sun's interior by measuring the velocity of sound waves produced by hot, bubbling gases that well up to the surface--a technique called acoustic helioseismology.

"Heliosesimology works on the same principle as medical ultrasound, which can create an image of a fetus inside a pregnant woman," Scherrer explains. "In this case, we're looking through a star with sound waves."

Positioned about 1 million miles above Earth, the SOHO satellite always faces the visible front side of the sun. In 2000 and 2001, scientists Charles Lindsey and Doug Braun--now at NorthWest Research

Associates Inc.--developed two techniques that resulted in the first pictures of the sun's back side. However, both techniques had limitations. One method only produced images near the center of the far side, while the other was restricted to views at the edges. To get complete image, researchers would have to combine both methods, but that proved to be a major technical challenge.

The problem was finally overcome last summer when a new computer algorithm was developed by the Stanford SOHO/MDI team in collaboration with Kenneth Oslund, an undergraduate at the California Institute of Technology. Their work resulted in the MDI Farside Graphics Viewer, which displays the first full images of the far side of the sun. The viewer is available online at soi.stanford.edu/press/farside_Feb2006/web.

## Solar max

"This new method is a vast improvement," Scherrer says. "It should be especially important during the next solar maximum, which should begin in 2011, when solar activity will be at its peak."

He points out that during the last "solar max," which lasted from 2000 to 2003, solar storms temporarily knocked out power in the northern parts of Sweden and Canada and destroyed a satellite that was used to verify credit card payments at numerous gas stations in the United States. Air transportation also can be disrupted when solar radiation interferes with the operation of Global Positioning System satellites, or when aircraft that take short cuts over the North Pole have to take longer routes to prevent passengers and crew from being exposed to intense X-ray radiation.

"Our goal is to give pilots and air traffic controllers a day or two notice of a possible solar event," Scherrer says, adding that missions to Mars and other planets also can be affected when solar storms interfere with satellite communications to Earth. Last week, researchers at the National Center for Atmospheric Research in Colorado released new computer models predicting that the next solar cycle will be 30 to 50 percent stronger than last time.

In 2008, SOHO is scheduled to be replaced by NASA's Solar Dynamics Observatory (SDO), a more advanced satellite designed to provide new data about the magnetic forces inside the sun that drive the 11-year solar cycle. Stanford, the University of Colorado and the Lockheed Martin Corp. will lead the SDO research effort.

"With cell phones and other devices, we've gotten more and more dependent on the space environment, so there are real economic reasons for missions like SOHO and SDO," Scherrer says.

Source: Stanford University

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