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GLOBAL SOLAR NETWORK PEERS BEHIND THE SUN

Images of the far side and interior of the Sun obtained from a network of solar telescopes were presented today at the American Astronomical Society meeting in Albuquerque, New Mexico, by Douglas Braun of NorthWest Research Associates Inc. in Boulder, Colorado, and Charles Lindsey of the Solar Physics Research Corp. in Tucson, Arizona.

The achievement marks the first time that Earth-based observations have been used to image the solar far side. Scientists will use the new capability to develop better tools to predict solar storms.

Groups of sunspots, or "active regions", are sometimes the source of solar eruptions which can disrupt communications and electrical power transmission and pose hazards to astronauts. "We now have a new source of data to help forecast active regions up to two weeks before the Sun rotates them into our direction," said Braun.

The images were obtained with data from the National Science Foundation's Global Oscillation Network Group (GONG), a worldwide network of telescopes which detect small vibrations of the solar surface caused by sound waves which propagate throughout the Sun. The study of these waves and their use in probing the solar interior is called "helioseismology". GONG has been operating since 1995 but recently underwent a major enhancement with the installation of new high-resolution detectors. "We're getting our first close look at what the improved network, which we now call 'GONG+' is capable of seeing," says John Leibacher who is the GONG Project Director at the National Solar Observatory in Tucson.

For the past two years, the technique of "helioseismic holography" pioneered by Lindsey and Braun has been used to map active regions on the solar far side with data from the Michelson Doppler Imager (MDI) instrument on board the *Solar and Heliospheric Observatory* (*SOHO*). The procedure is similar to a sonar system, picking out and measuring particular sound waves emanating from the near surface of the Sun which propagate into the solar interior and bounce off the far surface before returning.

Seismic far side images, updated daily on the MDI web site (http://soi.stanford.edu/data/farside), have been helpful to a broad variety of users ranging from solar astronomers planning upcoming observing sessions at their telescopes to amateur radio enthusiasts. All share a need for accurate predictions of solar activity which the images provide.

Scientists are developing a daily farside imaging system using GONG+ data to ensure the continuity of the active-region prediction program. A new space-based helioseismology instrument is planned for the *Solar Dynamics Observer*, scheduled for launch in 2007 as part of the NASA Living With a Star program. "While we expect *SOHO* and MDI to continue providing data until *SDO* is launched, the spacecraft or instrument could fail at any time," says Professor Philip Scherrer of Stanford University who is Principal Investigator of the *SOHO*/MDI project. "We would like to make a transition from using MDI data to using GONG+ data and these results show it is possible," Scherrer adds.

Free of the blurring effects of the Earth's atmosphere, spacecraft observations are preferable to those made with ground-based telescopes in revealing small-scale features. But Braun and Lindsey demonstrated that seismic images made of the solar far side from simultaneous MDI and GONG+ data were essentially identical. "The sound waves we observe on the near side of the Sun which are used to image the far side have very long wavelengths, " explains Lindsey. "Those waves are readily visible in GONG+ data." The GONG+ network has another property crucial for routine solar forecasting – with six telescopes located on five continents it can observe the Sun nearly 24 hours a day.

Braun and Lindsey are also using helioseismic holography, a highly efficient and flexible tool, to look inside the solar interior to understand how active regions develop and emerge onto the surface. Today they presented the first subsurface seismic images derived from simultaneous MDI and GONG+ data. Confirming a number of earlier studies, including those made by the MDI group at Stanford, these images show that the solar interior beneath active region speeds up sound waves. They also reveal rapid subsurface outflows of gas away from sunspots. "Comparisons between GONG+ and MDI data provide a direct test of how atmospheric or instrumental noise may effect seismic images of both the farside and interior of the Sun," says Braun, adding that "the prospects of using GONG+ to directly image the deep layers of the Sun look quite favorable."

This work is supported by the Stellar Astronomy and Astrophysics Program at the National Science Foundation (NSF), and the Sun Earth Connection/Living with a Star program at the National Aeronautics and Space Administration (NASA). The GONG project is managed by the National Solar Observatory, which is operated by the Associated Universities for Research In Astronomy, Inc. under a cooperative agreement with the NSF. SOHO is a cooperative project between the European Space Agency and NASA.

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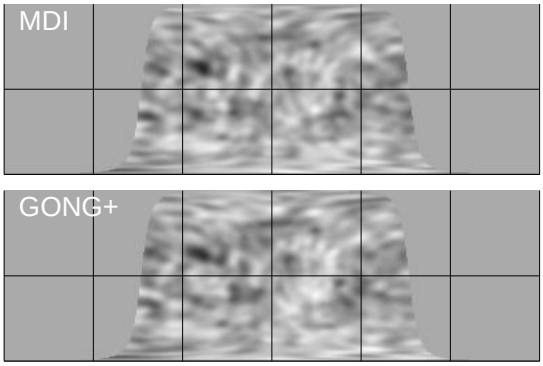
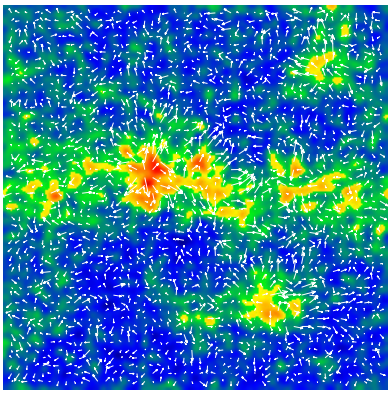
THE FOLLOWING IMAGES AND FURTHER INFORMATION ARE AVAILABLE ON THE WEB AT http://www.colorado-research.com/~dbraun/farside-gong



A comparison of seismic images of the solar far side made from MDI data and GONG+ data. The dark patches indicate solar active regions. This image can be obtained over the internet at http://www.colorado-research.com/~dbraun/farside-gong/ as soon as the embargo expires.



The first seismic image made of the subsurface of an active region with GONG+ data. The redder regions indicate where sound waves propagate faster and the arrows show the direction of gas flows. This image can be obtained over the internet at http://www.colorado-research.com/~dbraun/farside-gong/ as soon as the embargo expires.