Outta sight! A crafty peek at the sun's back

When it comes to studying the far side of the sun, astronomers are no longer in the dark. Researchers reported last week that employing a detector on an orbiting spacecraft, they have had their first glimpse of the sun's hidden half.

Scientists may be able to use this new capability to provide earlier warnings of solar storms that will strike Earth, damaging satellites and disrupting power grids. Solar storms are expected to be on the rise as the sun reaches the maximum of its 11-year activity cycle next year.

The new discovery relies on detection of ultraviolet radiation emitted by the hydrogen gas that bathes our solar system. Radiation from the sun clears a bubble in this gas about the size of Earth's orbit, and the inside of the bubble can act like a giant theater screen. When energy emitted by a solar outburst strikes the screen, it produces ultraviolet hot spots.

An instrument aboard the SOHO (Solar and Heliospheric Observatory) spacecraft can detect these hot spots even from outbursts on the sun's hidden face. "We can monitor the back side of the sun without looking at it directly," says Jean-Loup Bertaux of the CNRS Service d'Aéronomie in Verrieres le Buisson, France. He presented the findings at a SOHO workshop in Paris.

"Bertaux's work represents an entirely new way, and to my knowledge the only successful way, to identify the patterns of activity on the far side of the sun," says Craig DeForest of Stanford University.

Viewing hydrogen gas over the entire sky, a SOHO detector known as Solar Wind Anisotropies (SWAN) records a wavelength of ultraviolet radiation called Lyman alpha. Such light cannot be seen through Earth's atmosphere, but from SOHO's vantage point 1.5 million kilometers from our planet, it readily detects the radiation. When a solar storm erupts, the bubble of hydrogen gas radiates 5 to 15 percent more ultraviolet light than it normally does, says Bertaux.

Every solar disturbance gets carried along with the sun's 28-day rotation. As a result, each outburst is like a lighthouse beam, sweeping across the screen of hydrogen gas. Bertaux reports, "We have verified that the large areas of enhanced emission that we see are indeed moving on the sky with the 28-day period."

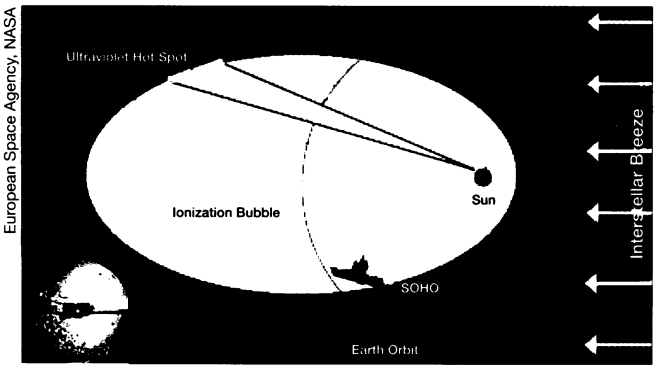
Bertaux told SCIENCE NEWS that his team has shown that storm activity on the sun's near side, imaged directly by another SOHO detector, also produces the expected ultraviolet glow recorded by SWAN. Moreover, when an active region on the near side rotates out of view, SWAN continues to detect an enhanced ultraviolet glow from the hydrogen gas.

The technique has also uncovered disturbances that originate on the farside and then rotate into Earth's view. Monitoring the sky at the Lyman-alpha wavelength "therefore offers a unique opportunity to detect in advance some new solar activity," Bertaux notes.

Although the technique is for now only a research tool, it "has the potential to give us a much longer lead time," as much as 14 days, for predicting solar storms, agrees Ron D. Zwickl of the National Oceanic and Atmospheric Administration's Space Environment Center in Boulder, Colo.

Richard C. Canfield of Montana State University in Bozeman points out that the method cannot distinguish outbursts likely to pose a threat to Earth from those that may turn out to be weaklings. Estimating the power of outbursts requires other diagnostic tools now available only for the sun's near side. These include direct images of twisted magnetic fields in the sun's atmosphere, Canfield says (SN: 3/13/99, p. 164). —*R. Cowen*

European Space Agency, NASA



Lightest region indicates storm activity on the farside, recorded July 20, 1996. The sun's radiation carves a bubble in the hydrogen gas in which the solar system is embedded. Ultraviolet light from a solar eruption strikes the inside of the bubble's surface, generating a hot spot. Inset: Celestial hemisphere illuminated by ultraviolet radiation from the sun's farside.

Amino acid puts the muscle in mussel glue

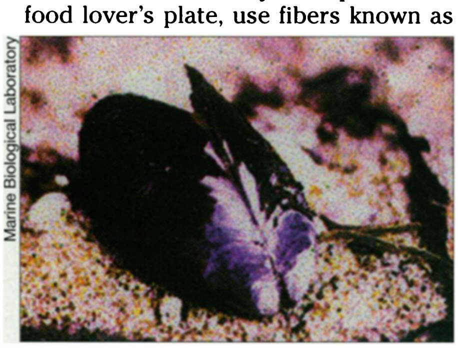
The proteins that mussels use to anchor themselves underwater derive their strength and stickiness from a single amino acid, according to a new study. The finding could help researchers develop moisture-resistant glues for biomedical and industrial purposes.

The modified amino acid, called dihydroxyphenylalanine (DOPA), has two functions. It allows the proteins containing it to stick to a variety of surfaces and also to set into a tough, rubbery cement, report Miaoer Yu, Jungyeon Hwang, and Timothy J. Deming of the University of California, Santa Barbara (UCSB).

"The fact that they have identified one [compound] doing those two completely different things is quite intriguing to me," says Herbert Waite, a marine biochemist at UCSB not connected with the current study. "In industry, people generally use different reagents for those two functions."

Mussels, before they end up on a seafood lover's plate, use fibers known as byssal threads to tether themselves (SN: 1/5/91, p. 8). Flat adhesive plaques at the ends of the threads bind to surfaces, allowing the bivalves to hang on even while buffeted by strong waves.

Marine Biological Laboratory



A blue mussel (Mytilus edulis) *can anchor itself underwater with strong, sticky proteins.*

To make the glue, mussels first connect standard amino acids into chains and then modify them chemically, says Waite. DOPA results when an enzyme adds a second hydroxyl group to the amino acid tyrosine. Though not the most abundant amino acid in the adhesive, DOPA makes up 5 to 20 percent of its content.

To investigate DOPA's role, Deming's group synthesized model proteins containing 5 percent DOPA and the rest glutamic acid. These molecules bound much more strongly to aluminum than did proteins containing only glutamic acid.

The researchers also discovered that DOPA, in an oxidized form, is responsible for cross-linking protein strands. "That cross-linking has to kick in in order for that adhesive to perform," says Waite. "Otherwise, it's only bound to the surface, not to itself." Deming and his colleagues report their findings in the June 23 JOURNAL OF THE AMERICAN CHEMICAL SOCIETY.

Unlike industrial adhesives used today, such protein-based glues would be made using water instead of harsh organic solvents. Also, the ability of the mussel adhesive to stick and set in water makes it attractive for medical and dental applications. In animals and laboratory cultures of human cells, the mussel adhesive does not appear to be toxic, Waite notes. Only further studies will reveal how DOPA makes the protein waterproof. —*C. Wu*