Craft eyes solar storms, hints at cooler core

An orbiting observatory has spied a dozen tornadoes in the sun's atmosphere, each nearly as wide as Earth and swirling faster than 50,000 kilometers per hour. Other data from the spacecraft, known as SOHO (Solar and Heliospheric Observatory), hint that the sun's fiery core is either misshapen or slightly cooler than expected.

The tornadoes lie at the sun's poles—the same regions where darker, cooler parts of the atmosphere, known as coronal holes, are concentrated. From these holes emanates the fastest component of the stream of charged particles called the solar wind.

"We now need to see if the characteristics of the tornado events make them likely to be significant contributors to the origin of the wind," says C. David Pike of the Rutherford Appleton Laboratory in Chilton, England. He and Helen E. Mason of the University of Cambridge in England presented the findings this week at a press briefing at Rutherford. They also describe their work in an upcoming Solar Physics.

Pike and Mason deduced the presence of tornadoes from measurements taken by SOHO's coronal diagnostic spectrometer. The researchers found that the ultraviolet radiation emitted by ionized oxygen atoms was shifted to both longer and shorter wavelengths, as if some of the material were moving toward Earth and some away from it. That pattern is characteristic of a tornadolike swirl of gas.

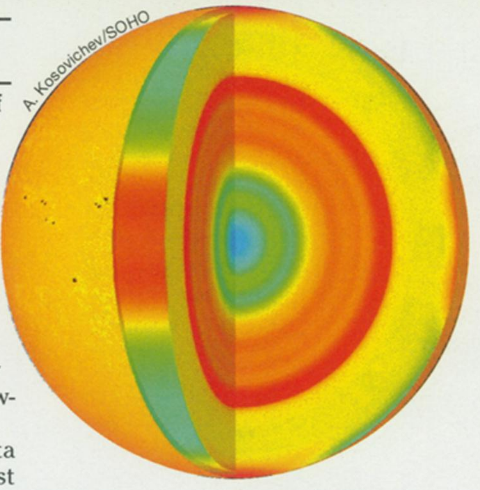
It's not surprising that the turbulent sun, whose motions twist magnetic fields and unleash enormous amounts of energy, would possess stormlike features, says Douglas Gough of Cambridge. Astronomers have previously discovered such motion at the sun's lower depths, notes Pike.

Less definitive, more puzzling data from other SOHO instruments suggest that the sun's hydrogen-burning core is something of a wimp. From measurements of the rise and fall of the solar surface, Gough and his colleagues deduce that sound waves at the core are traveling slightly less rapidly—about 0.1 percent less—than the standard model indicates. This suggests a lower temperature at the core, because sound waves slow down as a medium becomes cooler.

Alternatively, the core may be misshapen. If it resembles a football or a lemon instead of a perfect sphere, sound waves would travel more slowly.

Even if the core is generating less heat than predicted, its performance could be temporary, Gough notes. Complicating matters, theorists may not have an accurate fix on the rate at which the core consumes hydrogen to generate heat. "My hope is that when we've accumulated more data from SOHO, we will be able to determine" the true nature of the core, Gough says.

NASA and the European Space Agency recently announced that they will fund SOHO through 2003. That will enable the craft to view the sun at its most temperamental, during the peak of its sunspot cycle, expected in 2000. —*R. Cowen*



Cutaway view of the sun indicates deviations in sound speed from the standard model. Regions where the speed is higher than predicted are shown in red, lower than predicted in blue.

Synchrotron beam makes cells tell all

Nothing makes a cell more willing to confess its secrets than the bright light of a synchrotron. An international team of scientists reports that it has used that intense glare to grill a few suspects and has obtained some of the first images of the chemical components of intact, living cells.

The researchers, working with the National Synchrotron Light Source at Brookhaven National Laboratory in Upton, N.Y., shone bright infrared light onto cells and used a combination of spectroscopy and microscopy to create images. The technique revealed more than the shape and structural features of cells, which microscopy can uncover.

"We were able to monitor the location of lipids, proteins, and nucleic acids inside," says Paul Dumas of the Applied Electromagnetic Radiation Laboratory (LURE) in Orsay, France.

The method, known as infrared spectromicroscopy, could open up "a new investigation domain," allowing researchers to trace the chemical changes in living cells as they undergo processes such as cell division or programmed death, says Dumas. "We were able to image, for the first time, the role played by lipids" during cell division.

Lipids, molecules that form cell membranes, appear to concentrate in the region where a dividing cell pinches into two. Dumas and his colleagues noticed the appearance in dying cells of a chemical feature not present in living cells.

The researchers report their findings in the April 28 Proceedings of the National Academy of Sciences.

Infrared light is commonly used to identify organic compounds. By determining what wavelengths of light a sample absorbs, scientists can deduce some of the compounds it contains. The bonds between elements such as carbon, hydrogen, oxygen, and nitrogen absorb infrared radiation of characteristic energies.

Combining an infrared spectrometer with a microscope gives researchers a way to both identify and map the location of a cell's organic compounds. Ordinary infrared light sources don't deliver enough photons to reveal the chemical details of cells, says Dumas. Synchrotron radiation, created as electrons whirl around in a particle accelerator, is 1,000 times brighter.

Infrared spectromicroscopy takes about an hour to scan a cell completely. Dumas predicts that improved detectors could cut the time down to less than a minute, making movies of cell processes possible.

Although the synchrotron infrared images reveal considerable detail, images taken with synchrotron X rays show even more, says physicist Gelsomina De Stasio of the Italian National Research Council in Rome and the Swiss Institute of Technology in Lausanne.

X-ray spectromicroscopic images she has obtained at the University of Wisconsin's Synchrotron Radiation Center in Stoughton display cellular details just 23 nanometers across, one-thousandth the size of the smallest structures in the infrared images. Moreover, instead of probing mainly carbon bonds, X rays can detect individual nuclei of most elements, she explains.

However, the "great advantage" of infrared light is that it works at normal atmospheric pressure, De Stasio notes. So far, X-ray spectromicroscopy can't image living cells because the samples must be dehydrated and placed in a vacuum chamber.

"The vacuum doesn't kill the cell, but the cell kills the vacuum," releasing substances that must be pumped out, she explains. De Stasio is working on ways to isolate the cells in a pocket of water inside the chamber. —*C. Wu*