# Ulysses finds surprise at sun's south pole

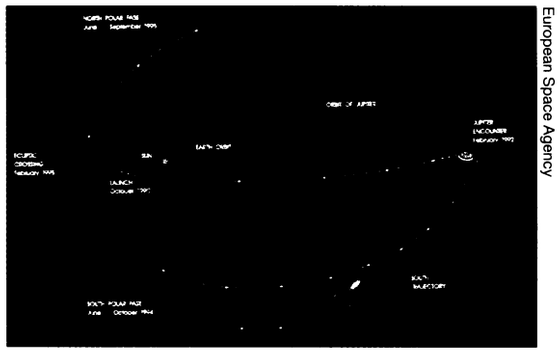
A funny thing happened to the Ulysses spacecraft during its recent sojourn below the sun's south pole. Contrary to expectations, the craft saw no signs of a magnetic south pole. Instead, it found that the magnetic field high above the solar surface has about the same intensity at the poles as at the equator.

That finding puzzles scientists, who liken the sun's magnetic field to that of a bar magnet. Iron filings sprinkled around a bar magnet reveal that the magnetic lines of force loop from one end of the bar to the other and are densest, or strongest, at each end. Researchers believe that, in a similar fashion, the looping magnetic field lines of the sun have the highest intensity at the poles.

In fact, observations from Earth indicate that at the solar surface, the outward, or radial component of the magnetic field is strongest in the polar regions. But Ulysses, the first craft to pass over the sun's poles, never ventures closer than about twice the Earth-sun distance (SN: 8/6/94, p.93). Flying through the solar wind, the stream of charged particles blowing out from the sun, the craft found that the intensity of the radial component of the magnetic field remains the same regardless of latitude.

At the craft's distance from the solar surface, "the solar wind no longer retains memory of the magnetic field rooted at the surface of the sun," says Richard G. Marsden, Ulysses project scientist for the European Space Agency in Noordwijk, the Netherlands. He suggests that the corona, or hot outer atmosphere of the sun, somehow redistributes the magnetic field. As a result, Ulysses finds a much more diffuse field at the south pole.

Researchers now expect to see a similar pattern above the sun's north pole, which Ulysses will explore for 4 months, beginning next June. — *R. Cowen*



European Space Agency

*Path of Ulysses around the sun.*

# X rays yield sharp, microscopic 3-D images

Every cell tells a unique story in three dimensions. Biologists studying subcellular structures — a maze of bulbous bits and twisted strands — struggle to visualize their true form.

It's a difficult task, given the absence of a simple technique for imaging cellular components in three dimensions without damaging the objects under view.

Approaching this problem from a new angle, Waleed S. Haddad, a physicist at the Lawrence Livermore National Laboratory in Livermore, Calif., and his colleagues describe a new type of "ultra-high-resolution X-ray tomography." Their report appears in the Nov. 18 SCIENCE.

"In the long run, we want to get to the point where we can image live cells in three dimensions or image them as close as possible to their living state," Haddad says. "We're not there yet, but that's what we're aiming for."

In that quest, Haddad and his coworkers have devised a three-dimensional visualization method that uses low-energy X rays along with a scanning transmission X-ray microscope to produce some of the highest-resolution images ever obtained.

"We were able to reconstruct some features of our test objects with a depth resolution of about 1,000 nanometers," says Haddad. "This is about 10 times greater than people have been able to achieve so far."

In addition, they achieved this resolution by combining only nine images. Other methods of X-ray tomography — such as the CT scanning commonly done in hospitals — may require 100 to 1,000 separate pictures to produce a good-quality three-dimensional image.

To test their technique, the scientists fashioned tiny plates of silicon nitride and placed patterns of gold on them. Details in the patterns ranged from 650 to 1,000 nm in length and depth. Carefully rotating the sample, they took nine two-dimensional snapshots. Using a computer, they then combined the pictures and constructed a three-dimensional image.

The researchers are now turning their attention to making three-dimensional pictures of dried sperm cells. The next step, they say, will be to image wet sperm cells.

If all goes well, they will then attempt to obtain three-dimensional images of live sperm.

"It's not easy," says Haddad. "It's hard to do without killing the cells. The key is to lower the X-ray dose. At some point, we want to try a pulsed X-ray laser so that we can collect all of the information needed in a very short time, so short that nothing moves during the exposure. But we're not at that stage yet."

To Haddad, three-dimensional images of live cells beckon "like a holy grail."

— *R. Lipkin*

## Tamoxifen trial resumes

On Nov. 9, the University of Pittsburgh resumed its enrollment of healthy women into the Breast Cancer Prevention Trial — the first of some 300 participating centers to do so. Directed by the National Surgical Adjuvant Breast and Bowel Project (NSABP), this study began in early 1992. But recruitment of new volunteers to it and all other NSABP studies came to an abrupt halt in April, pending a federal investigation of data-handling irregularities by NSABP, a research cooperative (SN: 4/30/94, p.282).

At that time, the prevention trial had enrolled only about two-thirds of the 16,000 women needed to yield statistically reliable data. Throughout the 7-month reassessment period, those already taking part in the trial continued to receive either tamoxifen — the world's top-selling cancer medication — or an inactive powder shaped into identical-looking pills.

Responding to concerns of the National Cancer Institute (NCI), which funds the NSABP studies, "a corrective plan of action was formulated to address data monitoring and quality assurance," according to a statement last week by the University of Pittsburgh, where NSABP is headquartered. It added that "new administrative procedures have been implemented, and ongoing reviews of participating sites are being conducted."

During the recruitment hiatus, several advisory boards reporting to NCI and the Food and Drug Administration reevaluated the prevention trial's design. Each concluded that the trial was important and should continue, despite a series of reports earlier this year indicating that women who take tamoxifen face a significantly elevated risk of adverse endometrial changes, including life-threatening malignancies of the uterus (SN: 6/4/94, p.356).

Because of this risk, new recruits must agree to a biopsy of endometrial tissue before receiving the drug and will be encouraged to get annual follow-up biopsies — all at the study's expense. Current participants will be offered access to the same NSABP-funded biopsies. — *J. Raloff*