Ulysses: A magnetic odyssey, by Jove

The Ulysses spacecraft swung close to Jupiter during the past two weeks, using that planet's gravity as a slingshot to lift the craft out of the plane in which the planets orbit the sun. The Jovian encounter — a prerequisite for an unprecedented exploration of the sun's polar regions in 1994 and 1995 — marks a turning point not only for the spacecraft but also for scientific understanding of Jupiter's magnetic field.

Comparing measurements made by Ulysses — a joint European-U.S. mission — with those from previous missions, researchers have discovered that Jupiter's magnetic field expands and contracts over a period of years. The Ulysses data reveal that the field on the sunward side stretches some 7 million kilometers from Jupiter's core, or about 100 times the planet's radius — double the distance indicated by the Voyager mission in 1979, but similar to that recorded by Pioneer 10 in 1973.

Scientists presented the new findings last week during a press briefing at NASA's Jet Propulsion Laboratory (JPL) in Pasadena, Calif.

Several researchers, including Ulysses project scientist Edward J. Smith of JPL, speculate that the density of the solar wind (charged particles streaming from the sun toward the planets) determines the extent of the Jovian field. A drop in solar wind density may allow the magnetic field to expand, Smith says.

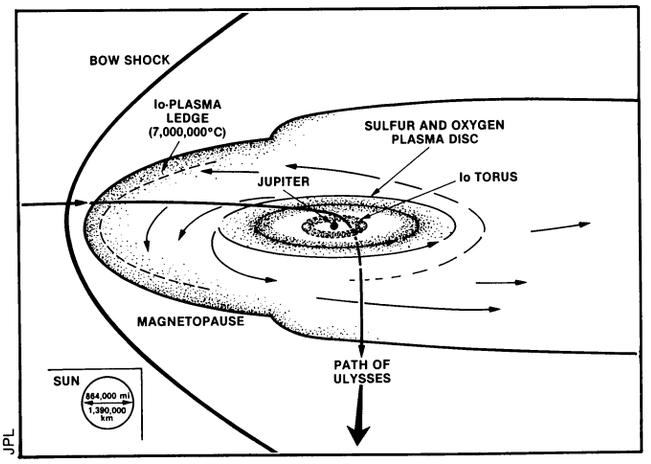
Ulysses detected such a drop on Feb. 2, just six hours before it encountered Jupiter's bow shock, the region where the solar wind meets the outer edge of the Jovian magnetic field, reports David J. McComas of Los Alamos (N.M.) National Laboratory. He suggests that Jupiter's magnetic field contracts or expands depending on the solar wind's strength.

The solar wind may exert another influence on the magnetic field. While probing the outer edge of the field, Ulysses identified layers of electrons that appear to come from the sun. Researchers had thought that solar-wind particles could not penetrate the Jovian field; the electron finding suggests that solar particles provide a previously overlooked component of the field, McComas says.

As it approached Jupiter, Ulysses pierced a doughnut-shaped region of ions that girdles the planet. These ions come from Io, one of Jupiter's moons, where volcanoes spew out sulfur, oxygen and sodium atoms. Ionized by intense radiation, the particles are hurled into orbit around Jupiter, following the looping paths of the planet's magnetic field lines.

The Ulysses data indicate that the doughnut's ion density is only half that detected by the Voyager mission. Instead of finding an unbroken ring of charged particles, as the Voyager craft had, Ulysses' radio observations reveal that the doughnut now consists of six "hot spots," where ions cluster, separated by gaps where few ions reside. This suggests that Io's volcanoes have temporarily died down, Smith says.

Ulysses' observations also show that the strength of the magnetic field varies as the field rotates in sync with Jupiter's 10-hour day. In addition, the craft has confirmed a puzzling finding from Pioneer 10: Energetic electrons far from the planet, where the magnetic field is weak, nonetheless rotate along with the field. Such motion, which can create beams of X-rays and radio waves, may help explain light emissions from rotating stars that have large magnetic fields, says K.-Peter Wenzel, Ulysses project scientist for the European Space Agency in Noordwijk, the Netherlands. He adds that researchers now look forward to analyzing the data gathered as Ulysses exited the field on the dusky side of the planet. Ulysses is the first spacecraft ever to probe that region. — *R. Cowen*



JPL

Ulysses entered Jupiter's magnetopause (the outer edge of its magnetic field) on Feb. 3. Passing within 314,000 km of the planet's core on Feb. 8, Ulysses probed the Io torus, a doughnut-shaped belt of ions fed by Jupiter's third-largest moon. Diving out of the plane in which the planets orbit the sun, the craft ended its Jovian flyby on Feb. 17.

Babies adapt to low-fat mother's milk

While adults fight the yen for rich, fatty foods, newborn babies require lots of fat to fuel their explosive growth. But what happens when mother's milk is low in fat?

A new study provides reassuring evidence that most babies will compensate for their mother's low-fat yield by nursing longer.

Some new mothers have difficulty breast-feeding, and pediatricians have speculated that such mothers can't keep up with a newborn's voracious demand, leading to a cranky baby and a frustrated mom. To find out more about nursing success, pediatrician Jon Tyson took a closer look at the fat content and volume of breast milk.

Tyson and his colleagues at the University of Texas Southwestern Medical Center at Dallas recruited new mothers who wanted to breast-feed their infants. The researchers obtained breast milk samples from the recruits and used a centrifuge to measure the fat layer. They calculated milk-fat yield by factoring in both the fat content and the amount of milk each woman produced.

The team identified 20 women with a low-fat milk yield. In most cases, these women produced milk with the usual amount of fat but in low volumes, Tyson says. Next, the researchers selected 20 women with a high-fat milk yield and sent both groups of mothers home to care for their 2-week-old infants.

Six weeks after birth, babies in the low-fat group weighed slightly less than those in the high-fat group, the researchers report in the February PEDIATRICS. But the small weight difference probably doesn't mean much, Tyson says. On two other measures of growth — body length and head size — the babies in the low-fat group progressed just as rapidly as their counterparts in the high-fat group, he notes.

Rather than crying over less milk, infants in the low-fat group seemed to make up for the loss by spending more time at their mother's breast. The Texas team found that these babies nursed longer and emptied the breast more completely than their peers in the high-fat group.

Nonetheless, women in the low-fat group may develop breast-feeding problems in the future, Tyson says. Although babies adapt to the low-fat environment by sucking more, this leaves the mother with scant milk reserves. If mom gets sick and her already-low milk production drops even lower, the baby might not get enough to eat. During such periods, Tyson recommends more frequent feedings, which spur a mother's milk production.

— *K.A. Fackelmann*