will be expected to support rapid sharing of data. And Brooks says that even NHGRI cannot demand that grantees avoid filing for patents. The intellectual property issues, Brooks says, are "not clear yet," although NHGRI may end up "strongly encouraging" those who win grants not to lay commercial claim to the SNPs they discover.

Some technical issues also remain to be resolved. The task of designing the computer database will be more complex than it seemed at first, according to James Ostell of NCBI, the home of GenBank, which is hoping to begin receiving data this fall. For example, the SNPs must be defined according to the context in which they are found and the methods used to find them. Because investigators are using many different methods, Ostell explains that NCBI is trying to devise a flexible format that will accommodate all. It won't be easy.

And geneticists are debating whether it is necessary to pretest each SNP for heritability before adding it to the database. Some argue that this should be done; others say it isn't necessary. As these "emotional" discussions go on, the format for describing each SNP in the database has gone through several revisions, Ostell says. The final version will be approved this summer. Right now, "nobody knows for sure" that the SNP database will function as everyone hopes, Ostell says. But he adds, "it wouldn't be science ... if we could guarantee in advance that it would work."

–Eliot Marshall

SOLAR PHYSICS

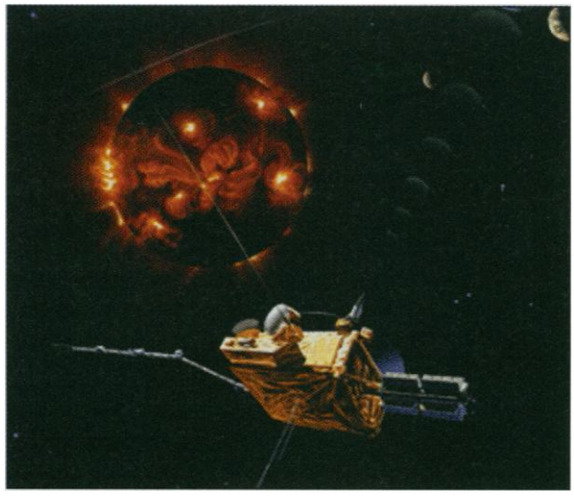
Ulysses Laps Sun, Inspires New Missions

As one major mission to the sun passes a milestone, solar physicists are laying plans for a new assault on the sun's secrets. Last month the European-built Ulysses spacecraft finished its first complete orbit of the sun, a 7-year reconnaissance of particles and magnetic fields high over the sun's north and south poles. Now researchers are hoping to extend Ulysses's operations into a second orbit, and they are proposing a flotilla of other missions, including one probe that would venture to within two solar diameters of the sun's surface.

All these proposals are aimed at observing peaks in the 11-year cycle of solar activity, the next of which is due early next century. Ulysses's exploration of the sun's wind of particles and its magnetic fields took place when solar activity was at low ebb. Now researchers hope Ulysses will make comparable observations as the sun's magnetic activity crescendos. They would also like to complement its long-range view of the sun with images and measurements "closer to the region where the solar wind is actually heated and gains its maximum energy," says Richard Marsden, the European Space Agency's (ESA's) project scientist for Ulysses. At a March meeting in Tenerife, solar astronomers discussed possible missions.

Launched in October 1990 and operated jointly by ESA and NASA, Ulysses "went into totally new, unexplored territory," says Peter Wenzel, head of ESA's Solar System Division. It swung past Jupiter in February 1992 and headed down toward the sun's south pole, passing close to it in September 1994 (*Science*, 16 September 1994, p. 1659) and over the north pole a year later. Throughout its circuit, Ulysses's nine instruments sampled the magnetic field and the stream of electrons, protons, and other particles in the solar wind. "Ulysses has provided us with a map of the solar wind at all latitudes," says Marsden.

Each kind of observation turned up surprises. Researchers already knew that the solar wind has both a slow, gusty component and a weaker, fast component. The fast wind was thought to blow only from the poles, but Ulysses found that it dominates most of the space around the sun, Wenzel says. Similarly, researchers thought the sun's magnetic field would be much stronger over its poles, because the field is largely a dipole, like a giant bar magnet. "We find that this is not the case," says André Balogh of Imperial College in London. And although the splayed field lines above the poles were expected to act as a funnel for cosmic rays, says Balogh, "Ulysses discovered that there was not a large [cosmic-ray] increase" over the poles. Solar scientists now believe that this is because ripples in the magnetic field, called Alfvén waves, scatter the incoming cosmic rays, says Wenzel.



ESA/NASA

Solar explorer. In a composite image, Ulysses samples the particles and magnetic fields that stream from the sun.

Now researchers would like to see how this picture changes during the next solar maximum. The key event in the solar cycle is the reversal of the solar magnetic field shortly after the maximum, in 2001 or 2002, which is still a mystery to astronomers. "This is going to be a very exciting period," says Marsden. At the moment, however, ESA only has guaranteed funding for the Ulysses mission until 2001. Balogh says it is crucial that the spacecraft be able to witness this event. "Without Ulysses," he says, understanding the reversal "doesn't stand a hope." Marsden says that constraints on ESA's science budget may make operation beyond 2001 difficult, but his team will try to save money up to 2001 in an effort to extend the mission for 1 or 2 years.

Solar physicists are already drawing up other plans to observe the next solar cycle. At the meeting in Tenerife, about 100 mainly European astronomers hammered out plans for a closer look at the sun. "Before the meeting there was a great deal of disagreement," says Eric Priest from St. Andrews University in the United Kingdom, who initiated the meeting. Three projects were under discussion: a Solar Orbiter imaging mission, which would be launched by ESA around 2007 and orbit the sun closer than Mercury; the Stereo mission, consisting of multiple spacecraft that would combine their images to form a three-dimensional picture of gas movements and magnetic fields close to the sun; and the Probe mission, which would approach the sun to a distance of two solar diameters to measure its magnetic field and sample the solar wind.

Although NASA is supporting preliminary studies into both Stereo and Probe, with a view to launching them in 2004, European astronomers at the Tenerife meeting came down firmly on the side of the Solar Orbiter. "The European solar physicists would like to have Orbiter as their main mission, but would also like to be part of a wider program," Priest says, perhaps by contributing instruments to Stereo and Probe.

–Alexander Hellemans

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