Helios, Science and the Sun: Data Delay

Helios, the instrument-crammed satellite that passed closer to the sun than any other manmade object (SN: 3/22/75, p. 188) has turned out to be a triumph for its German designers, surviving and observing in temperatures that would melt lead. Back on earth, unfortunately, the affairs of Helios have been far less successful. More than a year after the spacecraft's Dec. 10, 1974, launching, and with Helios B set to take off Jan. 15 from Kennedy Space Center, the program's team of solar researchers have only a tiny fraction of their data. The rest is struggling to emerge from a morass of antiquated computers, incompatible equipment and inadequate programming.

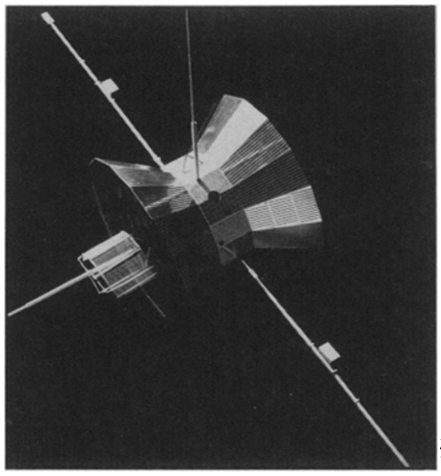
Ten months after Helios passed less than 46.3 million kilometers from the sun, its scientists have received, according to a source close to the program, "perhaps a couple of weeks of data," and that is a 100-percent increase over the amount that were available as recently as September. In the summer, Helios officials in Germany predicted that they would be through their already fat backlog of data by early December. Instead, the source reports, "they're only about a third of the way to their goal."

The computer originally made available for processing Helios scientific data was an old, germanium-transistor CDC 3600, hardly a state-of-the-art speed demon. New tape drives bought for it turned out to be incompatible, and when the system was uprated last summer it was discovered that there was timing problems in the data that the existing programming could not handle. Helios researchers reporting at an August conference were obliged to make do with sketchy, "quick-look" data of as few as two hours per day from the probe's 11 experiments. To help with the backlog, Helios officials have reportedly been using an additional computer rented from the National Oceanic and Atmospheric Administration in Boulder, Colo.

Fortunately, it's only a matter of time. None of the data, which are preserved on master tapes, have been lost, and by the time Helios B gets down to work in the spring, the processing should be flowing right along. It should be worth the wait.

Even the quick-look results are intriguing. Helios A has, for example, verified the spiral component of the sun's magnetic field structure as far as 0.3 astronomical units from the sun. A surprise—requiring more complete data for verification—seems to be that the field strength increases more slowly than expected as one approaches the sun, roughly proportional only to the decrease in distance, rather than distance squared.

Also unexpected were the high number



NASA

Helios A, booms out, stalks the sun.

and flux, or flow rate, of micrometeoroids—space dust—near the sun. (They seem to offer surprises at every turn: Detectors aboard the Pioneer 10 and 11 spacecraft showed virtually no increase in dust-sized particles as the probes passed through the asteroid belt between Mars and Jupiter.) Between earth and perihelion, Helios showed a 4-fold increase in number and a 15-fold increase in flux of dust particles heavier than 10^{-12} grams. Strangely, the particles seemed to have differing compositions, suggesting that perhaps they came from many different sources. In addition, the particle flux measurements were different for the ascending and descending sides of the probe's orbit. Perhaps, suggests H. Fechtig of the Max Planck Institute in Heidelberg, there is a symmetry effect about the solar equator rather than the plane of the ecliptic. Helios B, he points out, should be able to amplify on the subject, since it will be flown "upside down," thus letting the particles strike its detectors from reversed directions.

Much of the most interesting Helios A data, however, is still being processed. Spectral line-broadening, for example, is expected to yield valid information on turbulence as close as half a solar radius above the sun's surface. At least three major solar eruptions are on the tapes, according to James Trainor of the NASA Goddard Space Flight Center, notably including one in which bursts of particles, neatly collimated into angles as small as 20 degrees, are displaced by up to 60 degrees from presumably related X-ray emissions. As a bonus, the event occurred only three or four days after perihelion, putting Helios in a box seat.

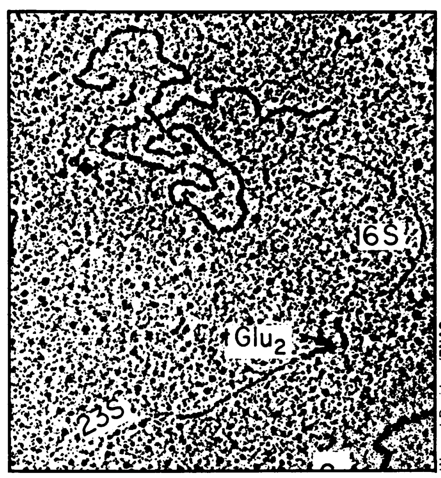
Helios B may go even closer. It will be aimed at a perihelion only .287 AU from the sun, compared to .309 AU for its predecessor. It will also carry an added experiment: a gamma-ray burst detector which, working in tandem with earth-orbiting probes such as the military Vela satellites, should enable long-baseline measurements for accurate locating of gamma-ray sources in the distant reaches of the sky. The only engineering change will be to the insulation on one instrument boom, a tribute to the designers' foresight in an untried environment. □

Mapping genes on DNA molecules

In a DNA virus, a bacterial cell or a mammalian cell, one or many DNA molecules are present. Parts of each DNA molecule make molecules of RNA. The RNA is then used to make proteins or to serve as transfer or ribosomal RNA. Thus, those regions of each DNA molecule that make RNA are genes.

Several years ago, Norman Davidson of the California Institute of Technology and several other scientists devised a technique to visualize, under the electron microscope, those areas of a DNA molecule that serve as genes. But the technique was insensitive, so that gene mapping was difficult. Now Davidson, along with Caltech colleague Madeline Wu, has greatly improved the technique so that gene mapping is much easier and can be done with greater confidence. Wu and Davidson report their findings in the November PROCEEDINGS of the NATIONAL ACADEMY of SCIENCES.

The original technique worked like this:



Wu and Davidson/PNAS

DNA strand under microscope. Thin stretches are genes; thick areas are not.

A DNA molecule consists of two strands, so heat was used to make the two strands fall apart. The mixture containing the two