Back to the Max: The salvation option

Despite the list of missions awaiting the space shuttle's return to flight, the Solar Maximum Mission satellite, repaired in orbit by shuttle astronauts in 1984, is now being considered for a second service call. Besides just fixing things, however, the proposal this time centers on prolonging the craft's life, which could otherwise end in a fiery reentry into earth's atmosphere as early as 1990.

The primary purpose of "Solar Max" was to monitor the sun throughout an entire 11-year cycle of solar activity, compiling an unbroken record of its changes. But although the satellite went into orbit in 1980, the continuous stream of data from some of its instruments goes back only to the repair mission (SN: 4/14/84, p.228), leaving seven years remaining.

The new repair project could be launched as part of some other mission, so it would not require fitting another whole shuttle flight into the program's already tight schedule. But time is of the essence. The sun's increasing activity is heating earth's outermost atmosphere, causing it to expand and increase the drag on the satellite. Predictions are uncertain, but various models suggest that between September 1990 and sometime in 1992, Solar Max will have descended to an altitude of about 230 miles, where the atmospheric drag may exceed the ability of the craft's attitude-control system to compensate for it. At this point of no return, Max will be out of control, and going down.

The remedy: Spacewalking astronauts would equip Max with a new rocket motor, to be fired after the crew has gotten safely out of the way in the shuttle. That should lift the satellite up and away from the atmosphere's grasping fringes.

However, says Frank J. Cepollina of NASA's Goddard Space Flight Center in Greenbelt, Md., who managed the previous repair flight, it could take 20 to 24 months to prepare the mission, leaving only a narrow span of time during which it can take place. It is not presently listed on NASA's shuttle schedule, and the number of possible launch opportunities has grown less certain with the May 4 explosion at one of the two U.S. plants making the chemical oxidizer for the shuttle's solid-propellant booster rockets. This could mean other such "secondary payloads" competing for a ride.

Before raising Max's orbit, the crew might also replace several malfunctioning components with others brought up from Earth. The list includes tape recorders (two of Max's present three have failed), a movable antenna (now stuck against its mounting), a power supply (before its batteries run down) and a depleted supply of propane gas used as a filter in an X-ray imaging instrument called a polychromator.

Another key goal would be modernizing the satellite's coronagraph, which photographs the sun's outer fringes and recently discovered at least two sun-grazing comets (SN: 7/16/88, p.39). It now makes its images with a television-like vidicon tube, which the instrument's chief scientist, Arthur Hundhausen of the National Center for Atmospheric Research in Boulder, Colo., describes as "pretty worn out."

The vidicon tube would be replaced with an array of charge-coupled devices, or CCDs, which Hundhausen says would offer brightness and polarization measurements of the sun's corona with greater accuracy and stability than a new vidicon. For him, a few years of CCD observations would be of greater significance than stringing together 11 unbroken years of vidicon observations. Adds Cepollina, "CCDs give you a quantum leap. They're as close a thing as you can think of to a brand new instrument."

An ever-present issue for NASA is money. The 1984 rescue mission, Cepollina says, cost about $35 million. Today's dollars don't buy as much, but much of the work, such as designing and testing tools and software, was done for the first trip and is still available, so the overall bill should be about the same.

Another concern is whether Solar Max would burn up completely or shower parts of Earth with pieces of solid metal upon reentering the atmosphere. "Most of the bigger chunks," Cepollina says, "would probably come down intact." Although most of Max's orbit is over ocean, it could pose a threat to some land areas.

Solar Max is built according to a modular system designed specifically for ease of servicing in orbit. Cepollina, who headed the design team from its beginning in the early 1970s, notes that "most of the modules are held on with high-temperature alloys, which are also well shielded, which prevents them from breaking up easily when they hit the atmospheric boundary layer." Also, the craft's scientific instruments are mounted on an 800-pound base plate, and "overall," he says, "you're talking about 5,000-plus pounds of hardware," including more than a ton of hard-to-melt titanium.

Solar Max carries no radioactive materials to worry about, but the solid spacecraft might seem to evoke more reasons than just solar science for keeping it in orbit.

— J. Eberhart

Disarming tough cancer cells

Researchers this week provided new clues to why some tumor cells are up to 100 times more resistant than others to a spectrum of anticancer drugs. Figuring out the exact biochemistry behind drug tolerance could lead to new strategies for undermining unusually hardy cancer cells.

Most previous studies have concentrated on the workings of a membrane protein that pumps cancer drugs out of resistant cells (SN: 1/3/87, p.12). Now scientists at the Joint Center for Radiation Therapy at Harvard Medical School in Boston have illustrated *in vitro* a second tactic used by these tumor cells: a metabolic pathway known as the glutathione redox cycle, which diminishes a drug's ability to kill the cell.

Reporting in the Aug. 5 SCIENCE, investigators say two drug-resistant, malignant cell lines became three to four times more sensitive to a common cancer drug, adriamycin, after being treated with an inhibitor called buthionine sulfoximine that blocks the glutathione redox cycle. Although other scientists have suggested the redox cycle is involved in drug resistance, this has not been demonstrated previously.

In similar tests, the same cell lines became five to 10 times more sensitive to adriamycin when exposed to verapamil, a compound that binds to and closes off the protein pump.

Then the researchers tested the cells' resistance when both the protein pump and the redox cycle were blocked. "When we combined the two it completely restored the sensitivity to the drugs," says Robert Kramer, who led the study. They also saw this reaction in colon-cancer cell lines that were genetically drug resistant but had never been exposed to chemotherapy.

Kramer predicts clinical trials of buthionine sulfoximine in combination with chemotherapy will begin later this year.

— L. Beil

Continued from p. 83

frequently are biological and medical types, who have to face it day in and day out. . . . Of course the world is blemished. The beauty is gravely marred, the symmetry is broken. But underneath it, what a Jew or a Christian would call the original pattern may still be discerned. One of the joys of being a physicist is that one can turn one's head from the evil to contemplate a pattern that seems at first terribly abstract, but in the end may be more real than predation or cancer or nuclear war. I am thankful for all the good medical doctors and researchers in the world, but on the whole, I prefer to be a physicist."

I am glad he was a physicist, as it enabled him to bring a lot of the joy and wonder of physics to us all.

— E.G. Sherburne Jr.