IUE NEWS

November 12, 1985 Special Edition Greenbelt, Maryland

GYRO 3 FAILS - BACKUP CONTROL MODE PERFORMS WELL

IUE lost Gyro 3, one of the three functioning gyros out of the original six, on August 17. The failure occurred in only a few minutes, but the alert operations staff detected the problem and put the spacecraft into a "safe" spin mode. Subsequently the backup control mode, which had been developed over two years ago for such a contingency, was loaded into the spacecraft's computer. The backup mode uses the two remaining gyros and a sun sensor to provide positional information for attitude control (see Sonneborn, this newsletter). Extensive verification and testing of the new mode was performed by the IUE staff. Some high priority observations, such as those during the ICE encounter with Comet Giacobini-Zinner, were carried out during the test period. The backup mode performed well, and normal operations were resumed at GSFC on September 30 and at VILSPA on October 15.

The gyro failure occured during a US1 shift at about 1 am. Despite the late hour, the Telescope Operator on shift noticed that some of the spacecraft telemetry values concerning the guide star tracking had started to change faster than usual. He alerted the Operations Director overseeing the spacecraft engineering functions, who quickly realized that a gyro was failing. The OD commanded the spacecraft into a safe mode known as "sunbath" mode, in which the satellite is maintained in a slow spin with a constant beta of 67°.

An emergency meeting was convened later that day, a Saturday. Attending were the NASA officials who oversee the IUE Project, the NASA attitude control specialists who designed the two-gyro backup system, representatives from the groups who wrote the on-board computer software and the ground system software, engineering and spacecraft operations staff members, and several Resident Astronomers. The group reevaluated their options - either try the backup mode on the satellite for the first time, or try to turn Gyro 6 back on. Gyro 6 had been turned off to conserve power during a shadow season in 1978 but had not come back on again. Some attempts had been made to restart the gyro, all unsuccessful. An extensive effort to restart the gyro, requiring repeated turn-on commands over many days, had not been tried because it involved some risk to the remaining two gyros. On the other hand, ground computer simulations of the backup two-gyro mode had been promising. The final decision was postponed until the gyro design engineers could be consulted two days later. However there was a strong feeling that the risks of the gyro turn-on should be avoided since the two-gyro mode appeared to work reasonably well on the simulator. A brief attempt was made to restart Gyro 6 that evening, but as had occurred in previous instances, the gyro did not respond.

On Sunday, August 18, the two-gyro control software was loaded into the spacecraft's computer for the first time. The software was carefully checked to insure that it had loaded correctly, since the entire program had to be transmitted from the ground as bits. One error in the code was detected and corrected.

On Monday morning, August 19, a meeting was held with gyro design engineers to evaluate the advisability of trying to turn on Gyro 6. After some discussion, it was decided that the risks involved in restarting Gyro 6 were too great and the chances of getting it started too small to permit an extensive turn-on attempt. Thus the emphasis was placed on trying to get the backup control mode tested and implemented.

Later that day, the command was sent for the on-board computer to start running the attitude control programs without sending any commands to control the spacecraft pointing. In this way, it could be verified that the programs were handling the data correctly and were executing without errors. At 2:50 pm the on-board computer was commanded to start controlling the spacecraft pointing. It successfully stopped the spacecraft motion, which had been a spin at a rate of about 1 rotation per hour. After some initial oscillations, the spacecraft stabilized well in all three axes.

Over the next several days, all the various capabilities of the attitude control mode were tested and evaluated. First, the several new control modes imploying the various combinations of sensors (gyros, sun sensors, and FES) were tried out. The basic tracking modes, in which the on-board computer uses FES information to maintain pointing on a star, were tried. A few short fixed-rate slews of a few arcmin were tried. Larger maneuvers were tried. An important test was the ability to maneuver across the beta 75 line, at which the on-board computer must switch from using data from one sun sensor head to a second head. This procedure could not be tested in advance with the simulator; fortunately it was successful. During this testing process, several errors in the code were found and corrected. Different values for the filters used in the FES tracking modes were tried in order to improve the tracking accuracy.

The first few days of testing proceeded without any knowledge of where the satellite was pointed. This was neccesary since the attitude could not be determined without moving the spacecraft, but such maneuvers had not yet been tried and tested. As luck would have it, earthlight was seen in the FES so that it was known that the Earth had passed near the field of view. The RAs were able to use the information on the current beta and the time of Earth passage to estimate a rough attitude. After the maneuvering capability had been tested, they searched over a few degrees of sky for about 2 hours, finally finding the star Sigma Herculis. Attitude was thus regained on August 22 at about 9:50 am.

During the several weeks involved in checking out the two-gyro mode, the engineering staff, Resident Astronomers, and Telescope Operators at both GSFC and VILSPA worked to understand how to use the new control mode. Experiences with the simulator provided some help, but in many ways the spacecraft behaved differently from what had been seen with the simulator. Different techniques were tried to see how best to acquire targets and track on them. A number of observations of standard stars were obtained to try out the various techniques.

The gyro failure occurred less than two weeks before Earth shadow season. The normal tracking mode used with the three-gyro control system during shadow could not be used on the two-gyro system. A special control mode that does not use the sun sensor, known as "wheel hold", was tested prior to shadow season. The wheel hold mode had never before been used with IUE. This mode maintains constant angular momentum on the reaction wheels which are normally used to slew the spacecraft; however the spacecraft pointing drifts by a few degrees per hour. This mode was used to hold the spacecraft during Earth shadow periods each day. Because of the drifts, the RA had to perform an attitude recovery every day after the shadow for three weeks! This mode will not be needed in future shadow seasons, since other tracking modes have been tested and found reliable since the August shadow period.

After all these attitude recoveries, it may not be surprising that the RAs invented a new way of recovering attitude. The method uses both the beta and the rate at which beta changes at the unknown attitude; these quantities can be measured directly from the sun sensors. Ironically this method could have been used with the three-gyro system instead of the beta zero recovery method. It takes about the same length of time but does not require discharging the batteries, which was a problem with the beta zero recovery technique. Beta zero recoveries can not be performed with the two-gyro system; the sun sensor does not detect the sun reliably at betas less than 15°.

Some science observations were carried out during the two-gyro testing period. The first GO observations were of Comet Giacobini-Zinner, prior to the ICE encounter, on August 30; subsequent observations were obtained during the encounter. Various observations were performed under a "recommissioning" phase of operations. Programs which required straight-forward observational techniques or which were time-critical were carried out. Particular concern centered on the capability of performing blind offsets. This required the development of a new method of performing accurate offset slews, which has proven to be fairly accurate (see Sonneborn, this newsletter).

Normal operations were resumed at GSFC on September 30 and at VILSPA on October 15.

Due to the interruption of the scheduled GO programs, the Eighth Episode was extended through the end of May to accomodate the rescheduling of those programs. The Ninth Episode proposal deadline at GSFC was postponed to December 14. VILSPA retained the original deadline of November 22.

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LONDON IUE SYMPOSIUM

A joint ESA-NASA-SERC IUE Symposium will be hosted by SERC in London on July 14-16, 1986. The organizers would like a response from interested astronomers by January 11, 1986, in order to judge how many people will be attending and to make the appropriate arrangements. The NASA IUE Project has approved the use of IUE research funds for this meeting, as announced in the Ninth Episode proposal package. Please see the announcement in this newsletter for details.

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LWR NOW AVAILABLE TO GUEST OBSERVERS IN NEW MODE

The LWR is once again generally available to Guest Observers, but now may be used only in its new configuration. A lowering of the Ultraviolet Converter voltage was performed to reduce the effects of the discharge, or "flare", in the UVC portion of the camera. Consequently the effective sensitivity of the camera is reduced by a factor of 1.37. Details of the reconfiguration, use, and calibration of the camera are given later in this newsletter (see articles by Imhoff and Harris).

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FAST TRAILS REVISITED

In the last newsletter, a new technique for performing very fast trails successfully was presented. With the failure of Gyro 3, the fate of this new technique was uncertain. Recently the new technique was tested in the two-gyro mode. It works! Trails at rates of 95 and 120 arcsec/sec were successfully performed. This result means that low dispersion spectra with effective exposure times of only 0.167 sec can be obtained. The new technique was tried successfully on Vega, a star which previously could not be optimally exposed in low dispersion. Checks are now being made of the absolute flux levels obtained with the fast trails.

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PROGRESS ON IUE'S RECALIBRATION

Work on the recalibration of IUE was delayed temporarily by the gyro failure but has resumed. A new LWP ITF has been created and is currently being tested. The new SWP ITF will probably be created in the next few months. Work is starting on the new absolute calibrations for the LWR and LWP, although a few additional observations are needed. In particular, trailed spectra of Eta UMa, the fundamental calibration standard, will be obtained using the new fast trail technique described above.

Implementation of the new calibrations depends in part on the results of the current discussions within the IUE Project about the IUE archives. Various plans are being studied on how best to create a final IUE archive, balancing the use of new calibrations and processing techniques against the large effort required to reprocess 50,000 or more images.

It may be noted that, in the last six months, efforts to use the long wavelength UV-flood lamps have failed. This may indicate that the lamps have failed permanently. The lamps are used to produce the UV-flood images required to create an ITF. Thus there is a good chance that no future ITF observations can be obtained on either the LWR or LWP cameras.

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LWR SENSITIVITY CHANGE CORRECTIONS

Two techniques have been presented in the recent newsletters that permit one to correct LWR absolute fluxes from low dispersion spectra for the time-dependent sensitivity changes. These techniques are presented by Holm (1985, NASA IUE Newsletter No. 26, pg. 11) and Clavel et al. (1985, IUE Newsletter No. 27, pg. 50). Some preliminary results are available from a comparison between the two techniques.

Both methods appear to do a reasonable job of correcting for sensitivity changes in the LWR low dispersion spectra. Holm's algorithm appears to undercorrect somewhat, while Clavel et al.'s values appear to overcorrect slightly. Both techniques appear to overcorrect slightly at short wavelengths compared to long wavelengths; such a systematic effect may be important for attempts to determine extinction or color temperatures. Additional work is in progress using additional spectra to test these preliminary results.

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TWO NEW HOTELS

Two new hotels have sprung up near Goddard in the last several months. Guest Observers may wish to try them out (no endorsements implied!). The Red Roof Inn may be reached from the Beltway, exiting east on Route 564 (Lanham Severn Road). One can reach Goddard without using the Beltway by taking Lanham Severn and Cipriano Roads. Cipriano terminates at Greenbelt Road one block from Goddard's main gate. The Hilton can be reached by going north on Kenilworth from the Beltway. The hotel is just off Kenilworth.

Red Roof Inn
9050 Lanham Severn Rd.
Lanham, MD 20706
(301) 731-8830
Reg. rates $29.95 sgl/ $36.96 dbl

The Hilton
6400 Ivy Lane
Greenbelt, MD 20770
(301) 441-3700
Reg. rates $70 sgl/ $80 dbl
Govt. rates $60 / $70

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IUE PERSONNEL CHANGES

Kent Thurston has recently joined the staff as a Telescope Operator. Kent hails from Cleveland, Ohio, and got his degree at Wooster College in Wooster, Ohio.

Catherine L. Imhoff