IUE Calibration Progress Report

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This report summarizes the progress being made on several calibration projects being worked on by the IUE staff and updates the last calibration progress report by Imhoff (1986).

I. FES Geometrical Calibration

The FES suffers from geometrical distortion across its field-of-view. The overall pattern for FES No.2 is that of a distorted S-shape pattern (Pitts 1987). If a star is moved between two points within the FES by a slew of known distance, the final FES position will be displaced by an amount equal to the relative FES geometrical distortion between the star's original and final positions. Under the three-gyro and two-gyro/FSS control systems, these distortions have not been a major difficulty. The one-gyro/FSS control system will rely upon accurate positioning of a guide star in the FES field to place the target in the aperture. Therfore, such distortions could lead to large centering errors. Mapping of the geometrical distortions of FES No.2 has proceeded on a time available basis over the last 2 1/2 years and is now complete.

FES No.1 has not been used for routine operations since shortly after launch because it is less sensitive than FES No.2. FES No.1 is needed as a backup in case of failure of FES No.2. In addition, it may be desirable to use both FESs simultaneously under the one-gyro/FSS control mode. Thus, the IUE project decided that the geometrical distortions of FES No.1 should be measured. Accordingly, FES No.1 was turned on, verified to be operational, and the geometric mapping completed during the months of June and July 1987.

II. New ITFs

The new ITFs for the LWR and LWP cameras have been created and tested. They will be implemented and available at the same time as the new absolute calibrations.

The new SWP ITF has been created and is undergoing tests. Initial results indicate that the new ITF produces images which are significantly less noisy than with the current ITF (Nichols-Bohlin 1987).

III. Low Dispersion Absolute Calibrations

Progress continues on defining the new absolute calibrations. These new calibrations are necessary primarily because of the new ITFs. The ITFs define the correspondence between DNs and FNs, so the resulting Flux Numbers for the old and new ITFs are not the same. In addition, the cameras have changed in sensitivity since the original calibration observations were obtained.

The task of deriving the new absolute calibrations has been split between the NASA/GSFC and VILSPA Resident Astronomers. Goddard astronomers are working on the LWR (Oliversen 1987) and SWP absolute calibrations, and VILSPA astronomers are working on the LWP calibration. Observations for all three cameras have been completed. A total of about 135 LWR and 150 SWP spectra will be used for the new calibrations. Reprocessing of the LWR and LWP data with the new ITFs has been completed, and reprocessing of the SWP data is in progress.

The first step in deriving a new calibration is to study and compensate for several possible systematic effects. Twice overexposed data (near the sensitivity maximum) were acquired for the new calibrations in order to improve the signal-to-noise at the extreme wavelength regions. The overexposed data were checked for possible linearity errors and none were found. Consequently, the non-overexposed parts of the twice overexposed data and the optimally exposed data were averaged together assuming that no corrections for linearity errors were needed.

Systematic differences in response between the large-aperture point-source, trailed, and small-aperture spectra have been analyzed. The average large aperture to trailed ratio varies strongly as a function of wavelength. The point to trail ratio is systematically less than one at all wavelengths. The ratio varies from about 0.96 between about 2600A to 3000A and decreases to 0.85 to 0.90 at the extreme wavelength limits. In addition, the relative response of the small aperture to the large aperture is quite flat from about 2000A to about 3100A.

Next, all the spectra for each standard of a given type were averaged together to form an accurate spectrum in units of FN/sec. This was done separately for both the large-aperture point-source data and for the trailed data, using the point-source to trailed ratio where appropriate. Preliminary inverse sensitivity curves were then derived for the point-source large-aperture data and for the trailed data. Finally, the small aperture to large aperture ratio was used to derive the small aperture inverse senstivity curve from the large-aperture point-source inverse sensitivity curve.

We are currently checking the accuracy of the new LWR calibration. Once verified, the new curve will be implemented in production processing. The new calibration will also become available for reprocessing of LWR data upon request to the IUE Project Scientist.

Systematic differences between the trailed and large-aperture point-source spectra were also investigated for the LWP absolute calibration and were found to be similar to the LWR results (Cassatella 1987). The fact that both the LWR and LWP large-aperture point-source fluxes are generally lower than the trailed fluxes probably indicates that the assumed trail path length of 20.5 arcsec (Panek 1982) is in error by a small amount.

IV. Wavelength Calibration

An error has been discovered in the wavelength calibration of low-dispersion images. The SWP wavelength assignments near Lyman alpha are currently too small by about 3 Angstroms. The error occurs only along the SWP low dispersion direction and thus does not affect wavelength assignments in high dispersion. In addition, the other cameras are unaffected. The project is continuing to study the problem in order to revise the wavelength dispersion constants and to better determine which images have been affected.

V. Camera Response Time

The response time is equal to the time required for the SEC and UVC voltages to rise to the standard value of -5.0 kV and drop back down after the exposure is over. The response time is particularily significant for short exposures. Since the response times were last determined for the three IUE cameras a number of years ago, it was decided to redetermine these values with new data. The rederived response times were found to be 114 msec for the LWP and LWR cameras, and 125 msec for the SWP cameras. These values are consistent with previous determinations and the mean value of 120 msec is still appropriate (Crenshaw, 1987).

VI. Fast Trail Technique

The fast trail technique, which is discussed in Oliversen (1986), was used to obtain optimally exposed trailed spectra of Eta UMa for the new absolute calibrations. Since then, it has been used to obtain trails of some additional ground-based standard stars that previously were thought to be too bright for IUE. In particular, optimum trailed SWP and LWP spectra of Vega and Alpha Leo were obtained and overexposed spectra of Sirius were also obtained.

References

Nichols-Bohlin, J. 1987, Report presented at the June IUE Three-Agency Committee Meeting.

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CALIBRATION PROGRESS CHART
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	LWR	LWP	SWP
ITFs:			
Plan observations	|	|	|
Obtain data	|	|	|
Process data	|	|	|
Derive effective exposure times	|	|	|
Coadd images for each ITF level	|	|	|
Create ITF	|	|	|
Verify construction of ITF	|	|	↓
Analysis of performance	|	↓	
Analysis of performance versus time	↓		
Absolute Calibrations:			
Plan observations	|	|	|
Obtain data	|	|	↓
Process data with new ITF	|	|	
Derive systematic effects	|	↓	
Derive instrumental fluxes for each star	|		
Derive absolute calibration	↓		
Verify accuracy of calibration			