CORRECTING IUE FLUXES FOR TEMPERATURE EFFECTS

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ABSTRACT: The IUE cameras are, to a small degree, sensitive to temperature. A small correction may be made to the IUE fluxes to compensate for this effect. This correction is required only for analysis requiring the highest accuracy.

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The sensitivity of IUE's cameras is, to a small degree, a function of temperature. This has been known for some time from analysis of a large number of calibration star spectra acquired for sensitivity monitoring. The most recent determination is given by Sonneborn and Garhart in this newsletter.

The sense of the effect is that as the camera becomes warmer, it becomes less sensitive. The resulting detected signal (in DNs) is smaller, so the derived fluxes must then be corrected upward. In general,

$$F_{corr}(\lambda) = \frac{F(\lambda)}{1 + c * (THDA - T_{ref})},$$

where $F(\lambda)$ is the original flux at wavelength λ, THDA is the temperature of the camera (measured at the head amplifier), T_{ref} is the reference temperature, and c is the coefficient of temperature sensitivity. The THDA for the camera is available for nearly all observations from the original script entry. It is also used in the current IUESIPS image processing for the geometric/wavelength calibration and is listed in the processing portion of the label.

In principle, T_{ref} could be chosen arbitrarily, but to facilitate comparisons among various analyses it would be preferable to adopt a standard set of reference temperatures. A logical choice would be the average temperature of the camera for the original calibration observations. These are listed in Table 1. The coefficients have been determined as part of the quick-look sensitivity monitoring analyses. The most recent values, from Sonneborn and Garhart, are listed in Table 1.

Table 1
Reference Temperatures and Temperature Coefficients

Camera	T_{ref}	c
SWP	8 °C	- .0048 ± .0004
LWR	12 °C	- .0070 ± .0006
LWP	8 °C	- .0025 ± .0004

One can quickly see that this is not a large effect. A worst case example would be the LWR, which has the largest temperature sensitivity. The range of THDA recorded for the quick-look sensitivity monitoring spectra is from about 9 °C to 18 °C. For the observation at 18 °C,

$$\frac{F_{corr}}{F} = \frac{1}{1 - .0070\ (18 - 12)},$$

which is equal to 1.042, thus at worst a 4% effect. Most observations are obtained when the THDA is within a few degrees of the reference temperature, so the effects are usually smaller. However, for analyses of several spectra in which the highest accuracy is required, the temperature correction should be included. Note that the repeatability of the fluxes for a single spectrum is typically about 3% (see Sonneborn and Garhart, this newsletter).

The temperature sensitivity has been measured using low dispersion spectra and is assumed to be independent of wavelength and location on the camera faceplate. If this is correct, then the temperature correction can be applied to high dispersion spectra as well. Because of the small size of the effect, it would be difficult to confirm this with any certainty using high dispersion spectra.

The temperature corrections described above have been included in an experimental version of the GSFC RDAF routine IUELO and may be used by visitors. The routine also permits one to correct LWR fluxes for sensitivity degradation using the method and revised values given by Clavel, Gilmozzi, and Prieto (this newsletter).