Photometric Response at the New FES Reference Point

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ABSTRACT

With the implementation of a new FES reference point (-144, -176) on January 22, 1990 at GSFC and on July 23, 1990 at VILSPA it has become necessary to calibrate this new reference point. In this report we present a preliminary FES calibration based on "first principles". Proper removal of the focus dependency on the counts allows to achieve an improved photometric accuracy.

Results and Equations

Although the FES data on this new reference point is still somewhat limited we present a preliminary photometric calibration based on "first principles." From the experience obtained in the two previous reference points, the parameters that have been known or suspected to impact the counts are: stellar color (B-V) (Wasatonic 1985), focus step (Huber et al. 1989), radiation (Imhoff et al. 1986) and, in a lesser degree, the FES temperature. By accurate FES data of 17 UBV standard stars we have determined a new zero point for overlap stars. Similarly, by measuring 27 bright stars we have determined a zero point for underlap stars.

1. Zero Point. We have started a calibration effort to convert FES counts into magnitudes at the current reference point by accurately measuring the mean FES counts of UBV standard stars in selected star fields. We have measured 17 fast and slow track/overlap stars in the Praesepe cluster (Johnson 1954) and in the Harvard E-2 region (Graham 1982). Likewise, in more sparse fields 27 bright stars were measured to determine the underlap zero point. The initial equation of interest is,

$$m_V = -2.5 * log[\frac{CTS}{1 - 1.2 \times 10^{-4} * CTS^{0.781}}] + Color + K, \qquad (1)$$

which includes the photomultiplier dead-time correction and where CTS are the observed FES counts. We have used the same *Color* correction determined for the previous reference point (Imhoff and Wasatonic 1986), namely,

$$Color = -0.271087 \times (B-V) - 0.063880 \times (B-V)^2 + 0.137764 \times (B-V)^3, \qquad (2)$$

By using equation (1) and by removing the color dependency described in equation (2) of our star sample we determined K to be 16.350 ± 0.063 valid for overlap stars and 10.995 ± 0.078 for underlap stars. An additional result from the 59 measurements of the UBV standards is that few of them were observed in both fast and slow track modes, allowing us to obtain an accurate mean of the counts in each mode.

2. Focus Dependency. A more detailed analysis of the observed FES counts taken at the new reference point of the IUE standard stars revealed a strong linear dependency of the counts against focus values. We have estimated the mean focus steps from the 59 single measurements of the 17 stars used for the zero point determination and used it as a "focus zero point." This mean focus

step was of -2.653. In addition, we have determined that the mean slope of the focus dependency against focus step to be 0.0022 (2.2%) yielding to the following correction equation.

$$CTS(corr) = CTS(obs)[1 + 0.022 \times (-2.653 - focus\ step)]. \quad (3)$$

3. Radiation Dependency and Degradation. After having corrected for the largest source of scattering in the observed FES counts, we have detected a weak correlation (r=0.04) between counts and the measured radiation levels ($0.08 \leq$ FPM ≤ 1.98). Since the slope obtained from the fitting follows the same trend described in Imhoff et al. (1986) for larger values of FPM, we confirm that it only becomes important for FPM $\geq$ 2.5 V. After careful correction of the data to account for the focus dependency we searched for degradation effects which may have occurred during this first year. At this time we have concluded that no detectable degradation effects are yet seen for neither overlap of underlap stars.

4. Conclusions. Use of the FES for photometry must be done cautiously because of the various effects on its performance. We note that the typical FES photometric accuracy can be greatly improved by removing the focus dependency on the counts. This last effect has become more noticeable with the increasing power constraints on IUE as the spacecraft ages. We recommend to firstly correct the counts for the focus dependency, equation (3), then apply the color correction equation (2), and finally convert the corrected counts into magnitudes by using equation (1) with the proper value of K. The pertinent RDAF procedure FESCALC, has been updated to include this calibration for the new reference point for observing dates after January 22, 1990 for GSFC and July 23, 1990 for VILSPA.

We report that no degradation with time of the measured counts was detected for the first 13 months of usage of the current reference point. We point out that for even more accurate FES photometric measurements it is always advisable to opt for differential photometry by using one or several nearby comparison stars of known magnitudes (Guinan 1990). A more complete calibration report for this reference point, including a revision of the *Color* correction and other parameters, will be presented in the near future in these Newsletters. The present calibration is *not* valid for FES data taken during the 'FES anomaly' experienced after January 22, 1991, where additional background scattered light was detected in the FES mainly at high beta attitudes. At the time of this writing this background has been reported to decrease substantially since its initial detection.

References

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