Science Fiction with IUE. III.

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This is the third in our series of articles on new "discoveries" made with IUE data (see Imhoff and Grady, 1985; Grady and Imhoff, 1985). In each case, the explanation of these "observational results" has to do with some aspect of the instrument, data processing, or calibration, rather than with the characteristics of the source. If you have noticed that many of our examples are drawn from T Tauri stars, IUE calibration stars, or Be stars, it is not a coincidence. We have drawn our examples from spectra we have been working on, or examples suggested to us. We welcome any other interesting "observational results" you have come across in your analysis of IUE spectra. Our thanks to Steve Shore, Matt Malkan, Wayne Landsman, and Dean Ahmad for their contributions.

1. Peculiar Mg II Profile seen in Mrk 279

Observational Result: Comparison of Lyman alpha, C IV, and Mg II profiles in Mrk 279 in June 1981 show that the Mg II profile is strikingly different from the other line profiles. The Mg II emission shows a peak at the wavelength corresponding to the nominal AGN redshift, as well as a sharp emission peak redward of the broad emission peak. This secondary emission feature is flanked by strong relatively narrow absorption features (Fig. 1).

Explanation: Many LWR spectra are affected by microphonics, or noise induced within the camera. The portions of the spectrum contaminated by the microphonics may appear to have complicated emission/absorption features. Sometimes these can include apparent absorption. The portion of the image affected can be identified as a horizontal strip in photowrites, from comments in the science image header, comments in the image processing label, or as a stripe oriented obliquely with respect to the dispersion direction in pseudo 3-D displays of the low dispersion line-by-line file. LWR images taken without the 4 minute heater warmup frequently have microphonics intersecting the spectrum (Holm 1982). The microphonics amplitude may be up to 110 DN, precluding retrieval of any data in the contaminated portion of the spectrum.

2. Periodic Shell Episodes in LMC Star (courtesy S.N. Shore)

Observational Result: An early-type star in the LMC suspected of undergoing periodic shell episodes was observed with IUE at intervals through one year. Sinusoidal variations in the SWP fluxes were clearly detected. Some minor changes in the resonance profiles were also seen. The IUE data are consistent either with the presence of regularly occuring shell episodes or with the star being a binary.

Explanation: In the intial observation, the star of interest was carefully centered in the large aperture. The LMC is a crowded field and a nearby star was just outside the aperture. During the course of the the year the projection of the large aperture on the plane of the sky rotated (see the discussion by Oliversen et al. 1982), putting the nearby star at first inside the aperture, then out, back in again, and finally out. With IUE observations separated by a few months, an apparently sinusoidal variation in the UV spectrum results. Archival spectra of other targets in crowded fields may have similar contamination problems.

3. Red-shifted Lyman Alpha in an RS CVn Star (courtesy W. Landsman)

Observational Result: A long SWP high dispersion small aperture spectrum of an RS CVn star shows stronger Lyman alpha emission than anticipated. The emission profile is strongly red asymmetric. The strength of the Lyman alpha emission together with the red-shift suggest that the system may be an interacting binary.

Explanation: The SWP spectrum was obtained with the small aperture, but with the large aperture open. In high dispersion the large and small aperture spectra overlap each other but are offset in wavelength with the large aperture spectrum appearing red-shifted relative to the small aperture wavelength scale. By having the large aperture open during the exposure, the small aperture spectrum was heavily contaminated by geocoronal Lyman alpha.

4. Variable Lyman Alpha Emission in Beta Dra (courtesy W. Landsman)

Observational Result: Several IUE high dispersion spectra of Beta Dra, a late-type star, have been obtained and reduced using the facilities of the GSFC IUE RDAF. Intercomparison of the reduced Lyman alpha profiles shows that the emission from this star is a strong function of time.

Explanation: Further inspection of the scripts and science image headers for these spectra show that the spectra were processed using manual registration. One of the spectra (the minimum flux spectrum) was incorrectly manually shifted in the wrong direction during the registration process sp that the spectral order was only partially in the extraction window. As noted in Imhoff and Grady (1985) the orders at the short wavelength end of the SWP high dispersion spectrum are severely crowded, and small errors in extraction will result in depressed fluxes or even negative net or absolutely calibrated fluxes. Images processed using the manual registration are subject to larger errors than for automatically registered images. Recent improvements in the manual registration procedure should reduce the errors.

5. Dramatic Variation in QSO Continuum Level (courtesy M. Malkan)

Observational Result: Comparison of archival LWR and LWP spectra of QSO 1317+28 shows that the continuum flux level has changed by a factor of 17 without apparent changes in the line profiles. The fluxes in LWP 1374 are the lowest observed for this QSO. This effect is apparently real, because examination of the changes in the IUESIPS processing of LWP images

via the RDAF procedure ASSESS show no entries which can account for the flux depression. Similarly inspection of the science image headers do not reveal any obvious extraction errors, and the QSO spectrum is correctly centered in line 28 of the spatially resolved LBL file.

Explanation: When the LWP spectrum was retrieved from the IUE Condensed Data Archives, a reprocessed version of the image was also listed as present. The gross and background spectra for the original and the reprocessed spectra are identical except for a factor of 17 in FN level. Inspection of the science image header image processing section of the 1981 processing (lines 100-125, see Figure 2c) shows that the scale factors were omitted when LWP ITF1 was initially installed at VILSPA. The correct scale factors are present in the 1985 reprocessing (Figure 2d). The total number of images affected by this error is currently under investigation.

6. A Transient Wind Detected in Cr III in 32 Cyg (courtesy I. Ahmad)

Observational Result: An IUE high dispersion spectrum of 32 Cyg obtained on May 28 1983 showed a P Cyg profile in Cr III 1399 A (Fig 3). The data was carefully reduced using the facilities of the GSFC RDAF and was apparently unaffected by any image processing errors (Ahmad 1986).

Explanation: Inspection of the photowrite for this image shows a large telemetry dropout intersecting the high dispersion spectrum. Since the spectrum is at an angle with respect to the camera scan direction, the background and spectrum are intersected at different wavelengths. This produces apparent "emission" longward of the "absorption", or a classic P Cygni profile. Telemetry dropouts are quite obvious in photowrites, but may be hard to spot in an extracted spectral file, especially for high dispsersion where there are no line-by-line (spatially resolved) files. One signature of a telemetry dropout intersecting the gross spectrum but not the background is a net flux which is below zero (the dropout has no signal, but the background has some positive signal).

Two of the examples above are due to rather obscure processing errors, which required lengthy investigations by the observatory staff to uncover. If you suspect processing errors in your data, please feel free to contact us for assistance.

REFERENCES

Ahmad, I.A. 1986, Ap.J. 301, (in press).

Grady, C.A., and Imhoff C.L 1985, NASA IUE Newsletter 28, 140.

Holm, A.V. 1982, NASA IUE Newsletter 18, 10.

Imhoff, C.L., and Grady, C.A. 1985, NASA IUE Newsletter 26, 66.

Landsman, W. 1986, private communication.

Malkan, M. 1986, private communication.

Oliversen, N.A., Imhoff, C.L., Ake, T.B., Holm, A.V., and Sonneborn, G. 1982, IUE Observer's Guide (Preliminary Version).

Shore, S.N. 1986, private communication.

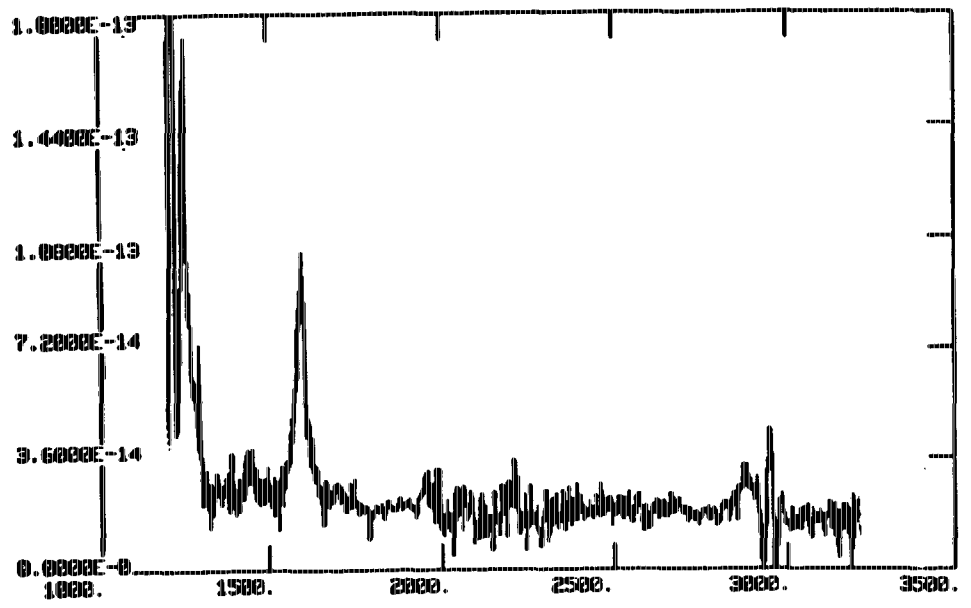


Figure 1: Mrk 279 in 1981 June. Note the complex structure in the Mg II profile compared to the Lyman alpha and C IV profiles from the same date.

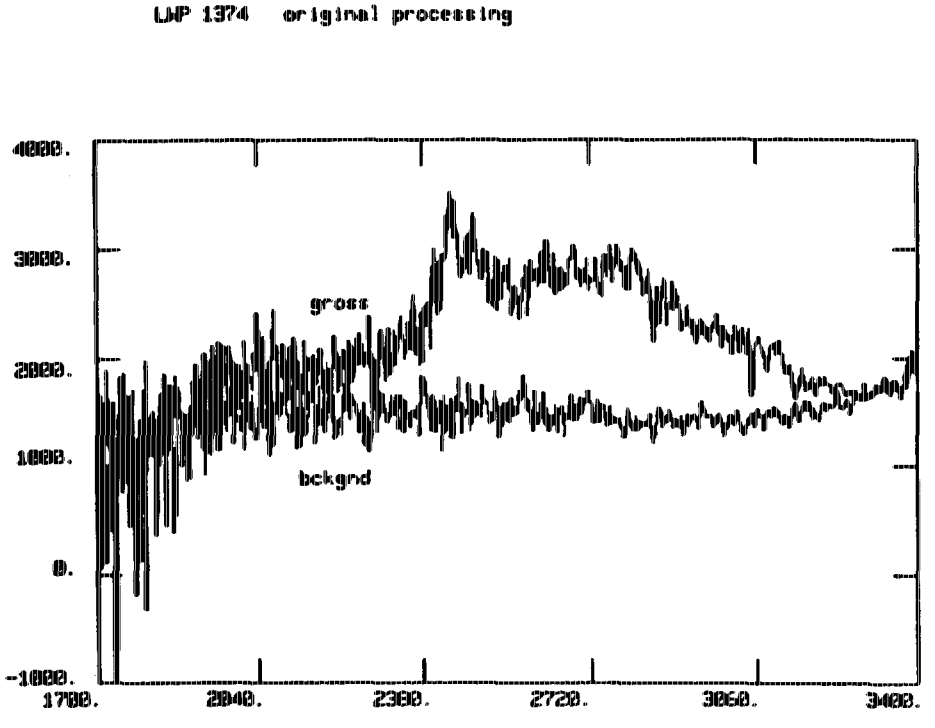
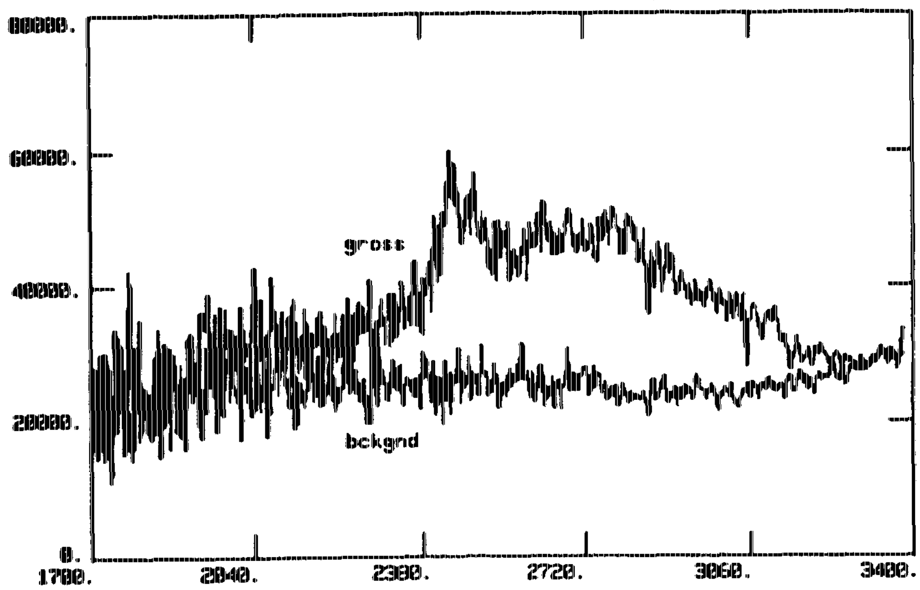


Figure 2: a) Gross and background flux numbers (uncorrected for instrument sensitivity from the 1981 processing of LWP 1374.

LWP 1374 REPROCESSED



b) Gross and background flux numbers when reprocessed in 1985, a factor of 17 greater than with the original processing.

```
                          000100010007204 0   1 2 0211 1374          1  C
    99*   4*10NOV-1 *   *    *     0*      *    * * * * * * * *   *  2  C
01317+28,LWP1374,LORES,LAP,350M05,13:15:32                          3  C
10-NOV-81,SPREP,MAG,LOREAD,UK474,WILSON                             4  C
UK3075,210D49M0.1S,623,1031,203 S0                                  5  C
                                                                     6  C
                                                                     7  C
                                                                     8  C
                                                                     9  C
0132219265 2* 9   * 210 *OPSDEV25*150936 MODTIME 1 330 0        * 10  C
        fu   -          '  RES     D  >I%I I '/                  100  C
*INSERT    21:132 NOV 10,'81                                         HC
****** PHOTOMETRICALLY CORRECTED IMAGE ******                         C
****** SCHEME NAME:  FILLAC, VILSPA RELEASE: R13 *****                C
PCF C/** DATA REC. 12 1    1    1 768 768 5  1  6.1  5.0 2536  0.00000 1PC
        0         2300        3969        6062        7790       10256   1PC
     12982       14050       17900       20562       23379       32973   1PC
     1.000       1.000       1.000       1.000       1.000       1.000   1PC
     1.000       1.000       1.000       1.000       1.000       1.000   1PC
TUBE   1 SEC EHT  6.1 ITT EHT  5.0 WAVELENGTH 2536 DIFFUSER 0         1PC
    C     MODE : FACTOR    .283E 00                                  1PC
*PHOTOM    21:132 NOV 10,'81                                         HC
**********  DATA FROM LARGE APERTURE ***********                     C
*SPECLO    21:132 NOV 10,'81                                         HC
OBSERVATION DATE(GMT): YR=81  DAY=322  HR=19  MIN=15                 C
TARGET COORD, (1950):  RT. ASC.=13 17 34.2  DECL.= 27 43 51          C
0SPECLO: OMEGA=  03.0, HBACK=  5, DISTANCE= 11.0                     C
        :HT= 9, DO0=    1; ISN:       0 PSN       1 SIGS=  .000 SIGL=  .000C
D 1= -.25361468465 0D 03   2   .24671759090 1D 00   3   .0000000000000D 00C
A 1=  .10655473529 4D 04   2  -.28690632451 90 00   3   .0000000000000D 00C
LINE SHIFT =  1.682      SAMPLE SHIFT =  1.378   AUTO                C
*POSTLO    21:132 NOV 10,'81                                         HC
****MERGED SPECTRA- GROSS, BACKGROUND, NET, & ABS. CALIB. NET        C
*ARCHIVE   21:132 NOV 10,'81                                         HL
   .>
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← wrong scale factor

c) Portion of the science image header (.LAB file) showing where the ITF scale factors are printed. The original version shown here is off by a factor of 17.

```
                    000100010008720048   1 2 0211 1974   0104      1  C
   99*   **10NOV-1 *   *   *    0*      *   * * * * * * *     * 2  C
01317+28,LWP1374,LORES,LAP,350M85,13:15:32                        3  C
10-NOV-01,9PREP,MAKG,LOREAD,UK474,WILSON                          4  C
UK3075,2100490408.15,623,1031,883 SO                              5  C
                                                                  6  C
                                                                  7  C
                                                                  8  C
                                                                  9  C
0132219265Z* 9   * 218 *OPSDEV25*150936 MODTIME 1 330 0       * 10  C
      fu   -        ' RES     D  >I<I I '/                      100  C
*INSERT   21:132 NOV 18,'81                                        HC
****** RAW IMAGE ******                                             C
*ARCHIVE   21:132 NOV 18,'81                                       HC
0111101310137AL LO 00510170000000000000000131532035000   V       1APC
UK474V01317+28             001317342274351  103100000  1   9999  2APC
      WILSON      000000000020                                   3APC
*INSERT   08:112 OCT 18,'85                                        HC
****** PHOTOMETRICALLY CORRECTED IMAGE ******                       C
****** SCHEME NAME:  F1LLAC, VILSPA RELEASE: R14 ******             C
POF C/** DATA REC. 12 1   1   1 768 768 5  1  6.1  5.0 2536  0.00000 1PC
         0       2300      3969      6062      7790     10256    1PC
     12982      14850     17900     22562     23379     32973    1PC
    17.000     17.000    17.000    17.000    17.000    17.000    1PC
    17.000     17.000    17.000    17.000    17.000    17.000    1PC
TUBE   1 SEC EHT  6.1 ITT EHT  5.0 WAVELENGTH 2536 DIFFUSER 0    1PC
     C     MODE : FACTOR   .283E 00                              1PC
*PHOTOM   08:112 OCT 18,'85                                        HC
********* DATA FROM LARGE APERTURE *********                        C
*ESPECL   08:112 OCT 18,'85                                         C
OBSERVATION DATE(GMT): YR=81 DAY=322 HR=19 MIN=15, (JD): 2444927.3821  C
TARGET COORD (1950) :  RT. ASC.=13 17 34.2  DECL.= 27 43 51         C
OPTIONS :HT= 9,  HBACK= 5,  DISTANCE= 11.0,  OMEGA=  83.0           C
MEAN RESEAU  (GMT= 00.122-00.138 NO. FF=  3 SIGS= .088 SIGL= .107 PX)  C
MEAN DC  (GMT= 00.160-04.071  NO. HLC=  51  SIGS= .225 SIGL= .459 PX)  C
B 1= -.254443108226590 03 B 2=  .2465361695600 00 B 3=  .0000000000000D 00C
A 1=  .10653428706530 04 A 2= -.2867015866250 00 A 3=  .0000000000000D 00C
THDA FOR RESEAU MOTION = 11.04                  MEAN RESEAU USED    C
THDA FOR SPECTRUM MOTION = 11.04                                    C
THERMAL SHIFTS:   LINE =  1.007   SAMPLE =   .256                   C
REGISTRATION SHIFTS:   LINE = -1.275  SAMPLE = -1.096   AUTO        C
*POSTLO   08:112 OCT 18,'85                                        HC
****MERGED SPECTRA- GROSS, BACKGROUND, NET, & ABS. CALIB. NET       C
*ARCHIVE   08:112 OCT 18,'85                                       HL
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← correct scale factor for LWP ITF

d) Image processing section of reprocessed LWP image showing correct ITF scale factors.

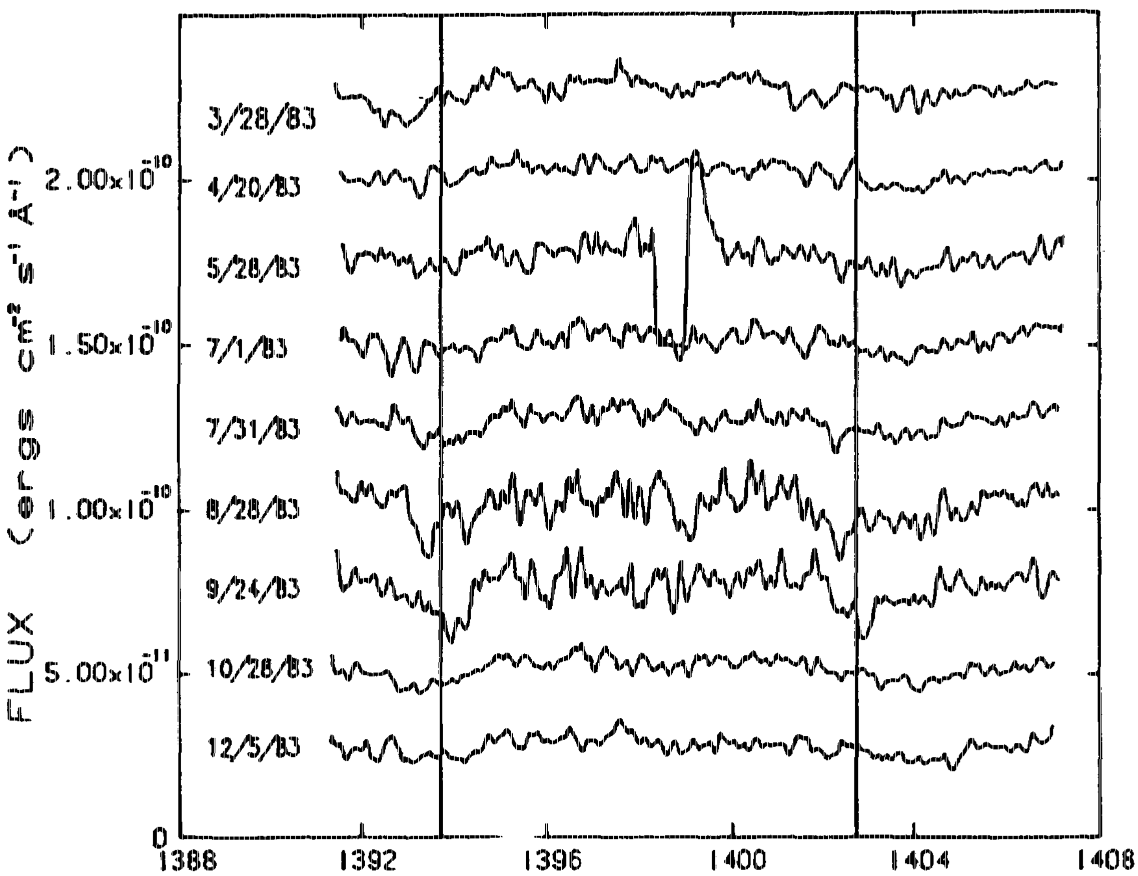

Figure 3: Transient Cr III P Cygni profile detected in 32 Cygni.