INES DATA DESCRIPTION

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1   Introduction

INES data consist of:

- low resolution spectra extracted with an improved method from the line by line images (SILO files) of the IUE Final Archive (IUEFA).

- high resolution spectra resampled to the low resolution wavelength step.

INES also provides access to concatenated high resolution spectra (produced from the MXHI files). Low dispersion and rebinned high dispersion spectra will be distributed to a network of National Hosts in a way similar to the ULDA/USSP system (see Wamsteker et al., 1989). A Principal Center will keep the complete database and archive server.

The new extractions were done to correct the problems associated with the procedure SWET of NEWSIPS. In the following documents these features are described, and examples are given of the significant improvement of the reduced spectra obtained. In the last documents the INES system structure and data access are described. In this document we describe INES data.

2   New Features of INES Data

The main improvements of INES spectra with respect to the IUEFA spectra are:

- For low resolution data:

    - The use of a more adequate noise model (Schartel and Rodríguez-Pascual, 1998)
    - A better extraction procedure, improving significantly the extraction of spectra with lines, and the background estimations (Rodríguez-Pascual et al. 1998).
    - A better propagation of the quality flags (see document by Rodríguez Pascual et al.). The definition of the quality flags is still the same as described in the NEWSIPS Manual, Chapter 3 (Garhart et al., 1997).

– Homogenized wavelength scale for long-wavelength cameras.

- For high resolution data:

  – A wavelength correction for High Resolution concatenated spectra, so as to have an internally consistent vacuum scale (see Cassatella and González-Riestra, 1998):

  The wavelengths have been corrected according to the expression:

  $\lambda_{new} = \lambda_{old} \, (1. + \Delta v \, /c)$

  where c=299793 km s^{-1} and Δv (in km s^{-1}) is given in the following table for the different cases:

```
----------------------------------
 CAMERA             APERTURE
----------------------------------
                 LARGE       SMALL
----------------------------------
  LWP             0.         +13.7

  LWR             0.         +13.7

  SWP            +17.7       +17.7
----------------------------------
```

  – This corrections were applied once the orders were concatenated.

- Data in 'standard' FITS format:

  An important aspect for the users is that INES data are written in a 'standard' FITS format, and therefore can be analized with the usual astronomical data analysis packages. This was not the case for IUEFA data because of the way in which the data were written in the FITS array (see Chapter 12 of NEWSIPS Manual, Garhart et al., 1997), then the data analysis packages required special addenda to be able to read IUE data.

3   Image header contents for INES

The structure of the low and high dispersion file primary headers in FITS format contains (see an example in Table 1):

- 8 basic FITS keywords

- Core Data Items.

- IUE Vicar Header.

- Part of NEWSIPS Image Processing History and, only for low dispersion files, INES Image Extraction History.

The data arrays are stored as columns of the tabular FITS extension. The extension header (see an example in Table 2) includes:

- 25 basic FITS keywords.

- Filename keyword.

3.1 The Core Data Items

The following is a brief explanation of the FITS keywords of the Core Data Items (CDIs). A more detailed definition can be found in Chapter 14 of the NEWSIPS Manual (Garhart et al., 1997).

- DISPERSN. Dispersion processing type. Valid values are LOW, HIGH or HIGH@LOW (i.e. high dispersion rebinned to low dispersion)

- ABNNOSTD. This flag is set to YES for images taken in a non-standard manner.

- ABNBADSC. This flag is set to YES to indicate that a bad camera static pointing was found at the beginning of a camera read.

- ABNHTRWU. This flag is set to YES when a heater warm-up (usually 4 minutes) was performed during the prep sequence for the LWR camera.

- ABNREAD. This flag is set to YES when the image was read at a rate other than the standard 20 KB/s telemetry rate.

- ABNUVC. This flag is set to YES when a non-standard Ultraviolet to Visible Converter (UVC) voltage was used during the exposure.

- ABNHISTR. This flag is set to YES when the original image reconstruction was flawed and the image had to be recovered from the engineering history tape to obtain a good copy.

- ABNOTHER. This flag is set to YES for corrupted image reconstructions.

- POSANGLE. Large aperture position angle.

- ABNMINFR. This flag is set to YES if missing minor frames are detected in the raw image by an automatic procedure in the NEWSIPS processing.

- CC-PERCN. Percentage of the total number of sub-image arrays for which cross correlations were successful.

- ITF. The Intensity Transfer Function used in image processing.

- COMMENT BY RA. Resident Astronomers comments about the image.

- COMMENT BY GO. Guest Observer comments about the image.

- DATEOBS. Date at the start of observation (UT).

- TIMEOBS. Time (hour, minute and second) at exposure start (UT).

- EXPTRMD. The trail mode indicates if the target was trailed along either the FES X-axi s, the FES y-axis, or not trailed.

- EXPMULT. This flag indicated the acquisition of multiple spectra in the large aperture.

- EXPSEGM. This flag indicated spectra obtained by more that one commanded exposure.

- EXPTIME. Effective exposure time.

- RA. Right Ascension of the observed target (1950).

- DEC. Declination of the observed target (1950).

- TARGET. Guest Observer designated target name.

- TARGRA. Guest Observer designated target Right Ascension.

- TARGDEC. Guest Observer designated target Declination.

- OBJECT. Homogeneous target identifier.

- HJD-MID. Middle date and time of observation with heliocentric time correction stored as a Julian Date.

- RADVELO. Net radial velocity correction for high-dispersion data taking into account the motions of IUE and the Earth.

3.2 The IUE Vicar Header

Between the lines IUE VICAR HEADER START and IUE VICAR HEADER END there are seven lines which are comments entered by the Telescope Operator (TO) in real time, and comments added during the processing (see an example in Table 2).

3.3 History

In all INES files, low, high and rebinned files, the RAW SCREEN comments, which are generated by NEWSIPS processing history, are included.

The comments generated by INES extraction are also included in the low dispersion files.

3.4 Filename

The file names are defined in such a way to allow a unique identification of the information stored in the file. All extensions are **FITS**.

The filenames are formed as:

<camera><image><dispersion><aperture>

where:

- <camera> : is a 3 letter code (LWP, LWR, SWP)

- <image>: is a 5 digits number.

- <dispersion>: is a 1 letter code as

    - L low dispersion data
    - H high dispersion data
    - R high dispersion rebinned data

- <aperture>: is a 1 letter code as

    - L large aperture
    - S small aperture

References

[1] Cassatella A., González-Riestra R. 1998, *'Evaluation of IUE High Resolution Spectra processed with NEWSIPS'*, INES Document 3.7.

[2] Garhart M.P., Smith M.A., Levay K.L., Thompson R.W. 1997, *'International Ultraviolet Explorer New Spectral Image Processing System Information Manual - Version 2.0'* (see INES Document 3.2.3).

[3] Rodríguez-Pascual P.M., Schartel N., Wamsteker W., Pérez-Calpena A. 1998, *'Extraction of Low Dispersion Spectra for INES'*, INES Document 4.3.

[4] Schartel N., Rodríguez-Pascual P.M. 1998, *'INES Noise Model'*, INES Document 4.2.

[5] Wamsteker W., Driessen C., Muñoz J.R., et al. 1989, A&ASS **79**, 1.

Table 1: *Example of an INES header*

```
SIMPLE  =                    T / file does conform to FITS standard
BITPIX  =                    8 / number of bits per data pixel
NAXIS   =                    0 / number of data axes
EXTEND  =                    T / FITS dataset may contain extensions
TELESCOP= 'IUE     '           / International Ultraviolet Explorer
DATE    = '25/10/97'           / Date file was written
ORIGIN  = 'VILSPA  '           / Institution generating the file
CAMERA  = 'SWP     '           / Camera
IMAGE   =                58387 / Sequential image number
DISPERSN= 'HIGH@LOW'           / Dispersion processing type
APERTURE= 'LARGE   '           / Aperture
ABNNOSTD= 'NO      '           / Non-standard image acquisition
ABNBADSC= 'NO      '           / LWP bad scans
ABNHTRWU= 'NO      '           / LWR heater warmup
ABNREAD = 'NO      '           / Read at other than 20 KB
ABNUVC  = 'NO      '           / Non-standard UVC voltage
ABNHISTR= 'NO      '           / History replay
ABNOTHER= 'NO      '           / Other abnormality
POSANGLE=               350.09 / Pos angle of the large aperture (deg)
ABNMINFR= 'NO      '           / Bad/missing minor frames
CC-PERCN=                 94.3 / Cross-correlation % successful
ITF     = 'SWP85R92A'          / ITF identification
COMMENT BY RA:
COMMENT BY GO: FESBCK:735,FO; LAST IUE IMAGE
DATEOBS = '26/09/96'           / Observing date
TIMEOBS = '09:09:03'           / Observing time
EXPTRMD = 'NO-TRAIL'           / Trail mode
EXPMULT = 'NO      '           / Multiple exposure mode
EXPSEGM = 'NO      '           / Segmented exposure code
EXPTIME =             7199.819 / Integration time in seconds
RA      =             290.4792 / Homogeneous R.A. in degrees
DEC     =              29.5753 / Homogeneous Dec. in degrees
TARGET  = 'BF CYG  '           / Object as given by Guest Observer
TARGRA  =             290.4808 / R.A. in degrees (given by GO)
TARGDEC =              29.5761 / Dec. in degrees (given by GO)
OBJECT  = 'V*  BF CYG'         / Homogeneous Object ID
HJD-MID =         2450352.92451 / JD middle of obs. with Heliocentric corr.
RADVELO =               -17.41 / Heliocentric velocity correction in km/s
```

Table 2: *example of an INES Vicar Header and Extension Header*

```
COMMENT IUE-VICAR HEADER START
       BF CYG,SWP58387,HRES,LAP,120M00S,09:09:03
       960926,SPREP,MAXG,LOREAD,SI027,RODRIGUEZ (S.O.)
       57,12.5,B0,8.2,,82D54M50S,1007,294,27000,FO
       FESBCK:735,FO; LAST IUE IMAGE
       I.P.S.: CARLOS YUSTE


COMMENT IUE-VICAR HEADER END
HISTORY START RAW_SCREEN                        25-OCT-1997 00:16:15
HISTORY   23 BRIGHT SPOTS DETECTED
HISTORY    0 MISSING MINOR FRAMES DETECTED
HISTORY LARGE APERTURE SPECTRUM WILL BE EXTRACTED AS
HISTORY            POINT SOURCE
HISTORY LARGE APERTURE CONTINUUM DN LEVEL = 156
HISTORY BACKGROUND DN LEVEL = 121
HISTORY ORDER REGISTRATION
HISTORY   INSUFFICIENT FLUX FOR EMPIRICAL ORDER REGISTRATION
HISTORY      RMS OF FOUND VS ACTUAL ORDER POSITIONS > NOISE CRITERION
HISTORY   PREDICTIONS BASED ON TIME AND TEMPERATURE WILL BE USED
HISTORY END   RAW_SCREEN                       25-OCT-1997 00:16:17
END


XTENSION= 'BINTABLE'          /Written by IDL:   3-Feb-1998 15:09:38.00
BITPIX  =                   8 /
NAXIS   =                   2 /Binary table
NAXIS1  =                  14 /Number of bytes per row
NAXIS2  =                 495 /Number of rows
PCOUNT  =                   0 /Random parameter count
GCOUNT  =                   1 /Group count
TFIELDS =                   4 /Number of columns
TFORM1  = '1E      '           /Real*4 (floating point)
TTYPE1  = 'WAVELENGTH'         /Label for column 1
TUNIT1  = 'ANGSTROM'           /Units of column 1
TDISP1  = 'F10.3   '           /Display format for column 1
TFORM2  = '1E      '           /Real*4 (floating point)
TTYPE2  = 'FLUX    '           /Label for column 2
TUNIT2  = 'ERG/CM2/S/A'        /Units of column 2
TDISP2  = 'E15.7   '           /Display format for column 2
TFORM3  = '1E      '           /Real*4 (floating point)
TTYPE3  = 'SIGMA   '           /Label for column 3
TUNIT3  = 'ERG/CM2/S/A'        /Units of column 3
TDISP3  = 'E15.7   '           /Display format for column 3
TFORM4  = '1I      '           /Integer*2 (short integer)
TTYPE4  = 'QUALITY '           /Label for column 4
TUNIT4  = '        '           /Units of column 4
TDISP4  = 'I7      '           /Display format for column 4
FILENAME= 'SWP58387RL.FITS'    /Filename(camera)(number)(disp)(aper).FITS
END
```

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