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ESA IUE Newsletter

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Observatory Controller's Message

W. Wamsteker

ESA IUE Observatory

Since the last Newsletter many activities have taken place which have profound impact on the IUE Project. One important event has been the "Senior Review" of NASA's astrophysics program with respect to Mission Operations and Data Analysis. This review had to take place before NASA would establish its priorities in these areas, which of course strongly affect the operational project IUE. The Review recommended to change the emphasis of the IUE Project to assure the proper conclusion of the IUE Final Archive, which was considered to be the highest priority. Since the view within the European community is not so strongly oriented towards the IUEFA and the continuation of the operational project remains high priority, studies have been made to analyze the possibilities and implications of European-only operations of IUE. On the other hand, it was also realized that a continued participation of NASA and the US Astrophysics community in the IUE Project makes a lot of sense both in terms of Project Management as well as in terms of scientific return and utilization of IUE. As a consequence of all this, general agreements have been reached between the NASA and ESA IUE Project Teams for the implementation of a revised "hybrid" scheme of IUE operations which will allow to continue IUE operations in a 3-Agency mode.

At the time of this writing we expect to be able to issue the Call for Proposals for the 19th episode of IUE observing very shortly, although some operational details are still under analysis for a final agreement. Also the three Agencies have not yet been able to agree on the duration for the 19th episode of IUE Observing: NASA is currently committed to a one year episode for budgetary reasons, while ESA and PPARC prefer a two year episode for scientific reasons. Whatever the outcome of the final negotiations the forthcoming announcement of opportunity must be understood to be the *Last Call for Proposals for IUE Observing.* Therefore, in the case that a two year duration for the 19th episode will become reality, its full science program will be defined by the proposals received in response to the next Call for Proposals. After this 19th Episode of IUE observing, where it is expected that all observations needed for a scientifically correct termination of the IUE science observing program will have been identified and accomplished, the **IUE spacecraft operations are not expected to continue beyond 31 December 1997** (keeping in mind that they might be terminated even earlier for a variety of reasons, either technical, scientific or administrative).

For your information we supply below the major changes agreed upon at this point, which will affect the way in which users will interact with the IUE Project, in the understanding that some detailed issues have not yet been settled at this moment. The hybrid operations plan for IUE is based upon the following:

1. Normally, science operations will only be performed during the 16 hour low radiation part of the IUE orbit. (A limited amount of 24hr science operations is considered for observations with an extremely important scientific justification).

2. All science Operations will be run from the ESA IUE Observatory in Spain.
3. NASA-GSFC will support 8 hours of Spacecraft management and house keeping.
4. All observations will be done in an integrated scheduling mode (G.O. presence is only foreseen for those cases in which the presence of a Guest Observer is judged to be critical for the successful execution of the observations in the opinion of the IUE Project).
5. The Last Call for Proposals is world-wide and the evaluation will be done on scientific merit by a joint NASA/ESA/PPARC Allocation Committee.

Under these conditions, ESA's Science Programme Committee (SPC) approved the issue of a Call for Proposals for the 19th Episode (the 18th Episode does not exists in ESA, since this is related to a short NASA-only AO, issued last year). Although the SPC has approved the preparations to implement the above outlined hybrid operations plan for IUE, the required additional funding will not be discussed until the May meeting of the SPC.

Since the 19th Episode of IUE observing under the arrangements outlined in points 1. to 5. will start on October, 1, 1995, it is clear that we are facing a quite tight schedule in the implementation of all that's required, and hence it can be foreseen that only a relatively short time can be allowed between the issue of the Call for Proposals and the Proposal Deadline. We will try to assure that at least two months will be available and expect also to make your life easier by allowing proposal submission via electronic communication channels in a simple way.

It is important for all of us to realize at this stage that no missions are foreseen in the near future by any of the major space agencies to supply the capabilities available with IUE. Therefore the importance of the science Programme defined by the **Last Call for Proposals for IUE Observing** will have a long term impact on the spectroscopic UV data available to the astrophysical community. It is fortunate that we will most likely be able to secure this at a time, when HST has established its full importance for astronomy, ASCA and EUVE are still operational, while important missions such as ISO, XTE, ASTRO-X, and SAX have launch windows which still allow these missions to benefit strongly from the last two years of IUE observing.

Dr. Willem Wamsteker

Personnel Changes

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ESA IUE Observatory

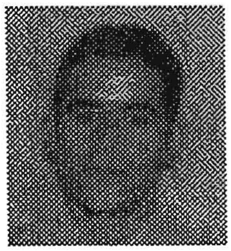
On 1st. of October 1994, **Norbert Schartel** took up the post of *Resident Astronomer* at VILSPA. He obtained his diploma in Physics at the "Technische Hochschule" of Darmstadt in 1990. After that, and before being able to enjoy the Spanish culture, he studied the soft X-ray properties of quasars and active galactic nuclei in the ROSAT All Sky Survey project at the Max-Planck Institute of extraterrestial Physics in Munich.

He hopes to be able to fulfill his duties as Resi lent Astronomer and to continue his research work. His main hobbies are the Antic and middle age history and archaeology.

Ana Pérez Calpena took up duty as *IUE spacecraft (S/C) controller* in May 1994. She finished her studies at the "Escuela Tecnica Superior de Ingeneros" of Telecommunication (Madrid) as Telecommunication Engineer in September 1992.

Her hobbies are reading, films, music and photographs. She enjoys sports as horse riding, running, swimming and trekking.

Twenty six year old **David Garcia Asensio** studied Aeronautics Engineering (aircraft option) at the "Universidad Politecnica" of Madrid. His duties as *IUE S/C controller* will be balanced by his hobbies such as reading, movies, music and painting. He plays also tennis and likes swimming, etc. He is, in general, very intersted in all things related with technology e.g. ships, astronautics, airplanes, ...

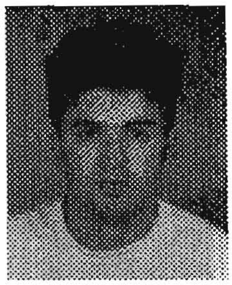


Jose Ramon Martin Zaforas joined VILSPA in May, 1994 as, yet another, *IUE S/C controller*. He holds a degree in Astrophysics of the "Universidad Complutense" of Madrid and has been working in enterprises related with software engineering, hence his experiences in both Astrophysics and Computer Science.

He like theater, cinema, history and archeology (specially Egyptology), classical music (specially Mozart), opera and also some modern music like blues and jazz. He likes sports as skiing, trekking, sailing, scuba diving, etc.

Lucky **Pedro Vargas Salgado** got his first job as *IUE S/C controller* here at VILSPA. Having finished his career as Technical Telecommunication Engineer, he took up duty starting May, 1994.

Music, cinema, sports are his hobbies if he doesn't hang out with his friends chatting.



Departures:

- *Richard Monier* (RA) left for CDS, Strasbourg, France.
- *Diego Romero Sabio* (S/C controller) transferred to ISO project.
- *Juan Piñeiro Garcia* (S/C controller) transferred to ISO project.
- *Alejandro Pena Cobian* (S/C controller) transferred to ISO project.
- *Alberto Martos Rubio* (S/C controller) transferred to ISO project.
- *Antonio Talavera* (RA) left for LAEFF, Spain.

We wish them all the best in the new jobs!

Detailed IUE Spacecraft Status Report

R. González, D. de Martino, D. Hermoso,
M. Barylak, P. Rodriguez, W. Wamsteker

ESA IUE Observatory

I. Scientific Instrument Hardware Status

A. Cameras (4)

1. **Long Wavelength Prime (LWP)**: Standard camera since 16 October 1983. Suffered in the past from READ scan control logic malfunctions, but reset by bad scan detection logic software (last BAD SCAN detected: 2 February 1985 16:56 UT).
2. **Short Wavelength prime (SWP)**: Standard camera. No operational problem.
3. **Long Wavelength Redundant (LWR)**: Backup camera. Available at 4.5 kV since 1 November 1985. Since April 1983, this camera has suffered from discharge in the UVC, producing a bright patch (flare) on the image (Lloyd, 1987a). However the flare can be avoided by reducing the UVC voltage to 4.5 kV. This results in a sensitivity reduction of 27%. Other camera characteristics remain practically unchanged (Harris, 1985; Imhoff, 1986).

   Guest observers with sufficient scientific justification can use LWR at 4.5 kV. Added overheads of camera switch ~45 mins.
4. **Short Wavelength Redundant (SWR)**: not available, declared not operational (Lloyd, 1987b). Read section grid voltages usually fail.

B. Spectrographs (2)

1. **Short Wavelength (SW)**

   Entrance Apertures:

   - Large Aperture (SWLA): oval shape. Length for trailed spectra: 21.48 ± 0.39 arcsec. (Garhart, 1992).

     Area for extended sources: 209.74 ± 6.23 sq arcsec (Garhart, 1993b).
   - Small Aperture (SWSA)

     Probably non-circular shape with effective area 6.58 ± 0.86 sq. arcsec (Garhart, 1993b). Point source throughput 0.66 at centre, $> 50\%$ at $r < 1$ arcsec (Talavera 1987).

     Position angle is dependent on roll angle i.e. the relative positions of sun and target (Muñoz, 1985; Schiffer, 1980a; Patriarchi, 1981).

Non-optimum roll impossible with 2-gyro FSS system and not allowed since August 17, 1985.

Echelle Mode - functional

Low dispersion Mode - functional

Closing of large aperture subject to project approval.

2. **Long Wavelength (LW)**

   Entrance Apertures:

   - Large Aperture (LWLA) - oval shape. Length for trailed spectra: 21.84 ± 0.39 arcsec. Area for extended sources: 203.26 ± 9.28 sq. arcsec (Garhart, 1993a).
   - Small aperture (LWSA)

     Probably non-circular shape with effective area 6.32 ± 0.86 sq. arcsec (Garhart, 1993a). Point source throughput: 0.50 ± 0.25

   Orientation as for SW spectrograph (Muñoz, 1985)

   Echelle Mode - functional

   Low Dispersion Mode - functional

   Closing of large aperture subject to project approval.

3. **Trailed images**

   The S/N ratio of low resolution spectra can be increased by up to a factor of 2 by trailing the star along the spectrograph slit. Slowest and fastest possible rates are 0.03 and 120 arcsec/s respectively.

   Exposure times: $T_{exp}(Trail) = 3.7 \times T_{exp}(Point)$

   Trailing at high resolution along the slit is not recommended as the orders will severely overlap. Trailing along the dispersion direction is possible but at the expense of a degraded spectral resolution.

   It is also possible to obtain multiple (up to three) spectra in a single low resolution exposure ("pseudo-trailing").

C. Fine Error Sensors (FES) (2)

1. **FES 1** - back-up system. Two magnitudes less sensitive than FES 2. Successfully tested for 1-gyro system in July 1987.

2. **FES 2** - standard. Resolution 0.2680 and 0.2617 arcsec/pixel in X and Y respectively. Relative position accuracy ~3 arcsec near centre, larger near edge. Full distortion map produced by Pitts (1988).

   Field size: 8 arcmin radius

   Effective wavelength ~5200 Å

   Visual calibration: Holm and Rice 1981; Stickland 1980

Sensitivity variation: Barylak et al. 1984,1985; Fireman and Imhoff 1989; Barylak 1990.

Photometric calibration:

- old reference point (-16, -208) in use from Aug. 1, 1979 to Jan. 22, 1990 at GSFC and to July 23, 1990 at VILSPA: Pérez et al. 1994.
- new reference point (-144, -176): Pérez 1991.

FES 2 experienced electronic confusion from aperture closure mechanism and the Sun shutter mechanism.

For the "FES Anomaly" see IV. H. Miscellaneous - *Scattered light in the telescope.*

D. Telescope Sun-Shutter

Closed spontaneously twice in 1984 and once in 1985, correction performed by ground command.

E. Flux Particle Monitor

During July, 24, 1991, the readings from the Flux Particle Monitor (FPM) started to become incorrect and were no longer an indication of high radiation. On October 4, 1991 the FPM and the Spin Mode Sun Sensor (SMSS), through which the FPM received its power, were switched off.

II. Spacecraft (S/C) Hardware Status

A. Gyros (6)

Number required for three-axis stabilized attitude control - 2 + Fine Sun Sensor (FSS).
Operational gyros - 2
Failed gyros - 4
Gyro 1 failed on March 2, 1981 19:50 GMT
Gyro 2 failed on July 27, 1982 07:00 GMT
Gyro 3 failed on August 17, 1985 05:00 GMT
Gyro 6 stuck since launch, turned off for 1979 shadow season

S/C drift rates - 2 to 20 arcsec/hour (in pitch & yaw) usually largest shortly after slewing, especially if change in β-angle [1] was important.

Maneuver accuracy

In November 1981 error/length = 4 x 10^{-4} (Panek & Baroffio 1982) with the 3-gyro system. In November 1994 error/length = 1 x 10^{-4}. Accuracy has improved with the 2-gyro FSS system.

[1] i.e. the angle between target and Anti-Sun

B. Reaction Wheels (4)

- Required for slewing - 3 wheels
- Operations - 3 wheels (pitch, yaw, and roll)
- Backup wheel (skewed) - never used in orbit.

C. Hydrazine System

Required for reaction wheel momentum unloading, orbit adjustment (Delta-V) maneuvers, and emergency sun acquisitions. Around 17.54 kg available. Usage rate ~0.575 kg/year.

D. Solar Arrays

Continue to perform well. Average degradation was 3.1% over 1993 (2.0% over 1988). Minimum power budget has been established to be 148 Watts with

- one camera ON
- one camera stand-by (STBY)
- Hydrazine Auxiliary Propulsion System (HAPS-2) ON and
- heater for Primary Mirror (PM1) ON.

Power positive region through the year 1995:

- January 1995: $35^o \leq \beta \leq 103^o$ (July 1989: $34^o \leq \beta \leq 108^o$)

E. Batteries

The overall performance of the batteries during shadow season #34 was good. The maximum depth of discharges were 48.6% for battery #1 and 53% for battery #2. Both batteries experienced reconditioning which increased their capacity. The predicted maximum depth of discharges for shadow season #35 (January 1995) are ~62.0% for battery #1 and ~66.0% for battery #2. Due to the failure of the 3rd electrode in battery #2, the re-charge procedure is now manually regulated.

F. On-Board Computer (OBC)

2 processors + 3 memory bank (4K each)

- Processor PR1: Standard temperature limit 57.0^o; last crash March 28, 1988.
- Processor PR2: Backup
- Memory banks 0 & 2: 8K memory routinely used for operations hold the 2-gyro FSS control law plus the OBC workers.
- Memory bank 1: 4K memory for emergency backup.

III. Image Processing System Status

The IUE Standard Image Processing System (**IUESIPS**) has evolved through a series of S/W upgrades. For a description of the IUE processing system refer to the *IUE Image Processing Information Manual, Version 2.0.* See *IUE NASA Newsletter, no. 46* for a summary of the most important implementations performed until 1991.

A list of the important upgrades and their implementations (until 1993) is given below. Note that the IUESIPS software is frozen since 1993. Users are advised to check the processing dates of images in the IUE Merged Log.

A. Output Data

VILSPA provides users with IUE data in Guest Observer (GO) format. FITS format is available only for low resolution data.

Magnetic tapes (9 tracks) at 1600 and 6250bpi, as well as DATs and EXABYTE tapes are the supported output media.

As of March 30, 1995, no photowrites will be made and plots for high resolution will only be produced upon special request.

SOFTWARE CHANGES	GSFC	VILSPA
Averaged ITF	1978 May 22	1978 Jun 14
Improved calibration line library		
Low dispersion	1978 Sep 21	1979 Feb 01
High dispersion	1979 Nov 23	1981 Mar 10
ITF error correction	1979 Jul 07	1979 Aug 07
Mean dispersion constants		
Low dispersion	1979 Oct 30	1981 Mar 10
High dispersion	1980 Jul 18	1981 Mar 10
Improved calibration line library		
New low dispersion software		
Parameterized low dispersion constants	1980 Nov 04	1981 Mar 10
Parameterized high dispersion constants	1981 May 19	1982 Mar 11
New high dispersion software	1981 Nov 10	1982 Mar 11
New LWP ripple correction	1984 Dec 17	1985 Jun 10
Extended LBL for low dispersion	1985 Oct 01	1985 Oct 01
New LWP calibration	1987 Dec 22	1987 Dec 22
Absolutely calibrated record for high dispersion	1990 Aug 30	1987 Dec 22
Parameterized high and low dispersion constants	1993 Jun 10	1993 Jun 10

B. Final Archive Reprocessing (NEWSIPS)

The design of a completely new software system with which the data will be processed (NEWSIPS) has been started by the Project about five years ago to produce the IUE Final Archive (IUEFA).

Using the experience of the users community as well as within the project, NEWSIPS incorporates the knowledge of the behavior of detectors, spectrographs and spacecraft obtained over the years. To be able to assure a good correction for the intrinsic non-linearity in the SEC cameras, a new set of calibration data was collected. Also the availability of the large collection of data available in the IUE Archive was used with the new processing software to define a new absolute calibration for the ultraviolet wavelength range.

An innovation in this approach was the use of observations of white dwarf stars to establish the small scale irregularities in the detector sensitivity, and a redetermination of the absolute UV flux scale at $\lambda \sim$230nm. The relative spectral energy distribution over the range from λ = 115nm to λ = 320nm is established with an accuracy of ±3%. The resulting absolute flux scale has now an accuracy over the whole UV range of ca. 8% and is consistent with calibrations in other wavelength domains (see also González et al., 1995).

As part of the IUEFA production, a complete review of the information included in the image header is made to assure its correctness. The output products of IUEFA will be made available in FITS format (Ponz et al. 1995).

IV. Instrumental Performance

A. Noise

1. Readout noise ~10 DN/pixel
2. Periodic noise (microphonics)
    - **SWP**: covers entire image. Amplitude generally 1-3 DN. Amplitude may be increased to 10-40 DN by mechanical activity in S/C, incl. roll slews; frequency ~200 Hz (Northover, 1979).
    - **LWR**: affects a few lines in about 85% of images; amplitude up to 110 DN (Panek 1981). Frequency of occurrence reduced from about 85% to 15% by extending by 4 min the warm-up of the cathode heater prior to the read (Holm and Panek 1982).
    - **LWP**: occurrence associated with Roll slews; amplitude up to 7 DN. Affects only the lines when a roll slew is in progress (Faelker 1982).
3. Bright spots

    Radioactive disintegrations in phosphor ~30 spots/hr (Coleman et al., 1977).

    Permanent blemishes: most pronounced pseudo-emission feature at ~2190Å low dispersion, large aperture LWR only.

    Others (Ponz 1980).

4. Typical signal-to-noise (S/N) ratios for well exposed point source spectra:
   - **SWP**: 24–30 for low dispersion, new software (S/W) (Cassatella et al., 1984).
   - **LWR**: ~14 at 2810-2910Å for low dispersion, new S/W (Cassatella et al. 1984); 6-8 for high dispersion (Barylak, 1982). 12-21 low dispersion, old S/W (Seattle et al., 1981).
   - **LWP**: 5–22 for low dispersion, new S/W (Cassatella & Lloyd, 1987); 4–13 for high dispersion (Barylak, 1982). 9–25 for low dispersion, old S/W (Seattle et al., 1981).

5. S/N properties of averaged spectra: Clarke (1981a), West and Shuttleworth (1981);

   S/N of trailed and multiple spectra: Cassatella et al. (1984).

B. Background

1. Phosphorescence fogging

   During low-radiation shifts

   LWR & SWP > 6-10 DN/hour/pixel

   LWP > 4-7 DN/hour/pixel (Ake 1982)

   Fogging rate depends on number and type of PREPS before exposure

   Overexposures cause "ghost" spectrum fogging (Snijders, 1983). Phosphorescence decay rate from $\sim t^{-0.8}$ up to several hours (Coleman, 1978); unknown after long time intervals.

2. Radiation fogging: caused by Cerenkov radiation from electrons in the van Allen belts (Coleman et al., 1977).

   Fogging rate = Cte × 10^{FPM} DN/hour

   where FPM measures the flux particle monitor in Volts and Cte = 1.00, 1.35 and 0.73 for SWP, LWP & LWR respectively.

   May be severe near perigee, more than 50% of the US 2 shifts being affected by FPM > 2.0 (Taylor and Imhoff, 1986).

C. Photometric Properties

1. New Intensity Transfer Functions (ITFs) have been obtained for all three operational cameras: SWP (ITF3), LWP (ITF2) and LWR (ITF2). Only the LWP ITF2 has been implemented under IUESIPS for production so far. Upper limits to the (older) ITFs: Turnrose (1980).

2. SWP -10 to -20% for net DN < 20

   +20 to +15% for DN > 220 at 1300Å (Holm, 1981)

   Non-linearities of SWP are described by Walter & Courvoisier, 1991.

3. LWP up to about -3% for underexposed spectra; up to about +2% for spectra close to saturation (Cassatella and Lloyd, 1987; Harris, 1983a; Seattle et al., 1981).

D. Absolute Calibration

1. Low dispersion SWP and LWR (Holm et al., 1982)
2. High dispersion SWP, LWP & LWR (Cassatella et al., 1994)
3. Low dispersion LWP - ITF1 (Cassatella & Harris, 1983), LWP-ITF2 (Cassatella et al., 1992).
4. Accuracy of standards ±10% 1300-3400 A (Bohlin et al., 1980)
5. Echelle ripple correction (Cassatella, 1994)

E. Sensitivity Variation

1. Temperature dependence (Garhart, 1991):

   SWP ~ -0.46%/deg of head amplifier temperature (THDA)

   LWR ~ -0.88%/deg of THDA

   LWP ~ -0.19%/deg of THDA

2. Repeatability:

   SWP: 1.5% in 25Å bins (Bohlin et al., 1980)

   LWR: 2.0% in 25Å bins (Bohlin et al., 1980)

   LWP: 2.5% in 200Å bins (Harris & Cassatella, 1983)

3. Temporal dependence (Schiffer, 1982a; Sonneborn, 1987)

   - SWP: Complex temporal and wavelength dependence (Gilmozzi et al., 1986; Bohlin & Grillmair, 1988a)
   - LWR: Wavelength dependent between -3.5% and -0.8% per year. (Clavel et al., 1988; Bohlin & Grillmair, 1988b).
   - LWP: Wavelength dependent -1.3% per year at 2850Å after 1984.5 (Garhart, 1989).

F. Resolution

1. Short wavelength Echelle mode

   Small aperture: FWHM[2] 0.085Å at 1150Å (Boggess et al., 1978)
   0.19Å at 2100Å (Boggess et al., 1978)

   Ratio Large/Small aperture: 1.01 (Penston, 1979)

2. Short wavelength low dispersion mode

[2]Full-Width-Half-Maximum

- Spectral resolution (Cassatella et al., 1985)
  Large aperture FWHM < 5Å over 1400-1600Årange
  FWHM ~7.5Å near 1900Å
  Gain in resolution using SAP: about 8% (mean over lambda)
- Spatial resolution in LAP from cross-profiles:
  FWHM 4.6 to 5.9 arcsec at optimum focus (Cassatella et al., 1985)

3. Long wavelength Echelle mode
   Small aperture: FWHM = 0.20Å (Boggess et al., 1978; Imhoff, 1983)
   Large/Small 1.09 (Penston, 1979)

4. Long wavelength low dispersion mode
   - Spectral resolution (Cassatella et al., 1985):
     LWR large aperture FWHM ~ 5.8A (2400-2900Å)
     FWHM ~ 7.7Å at 1900Å
     Gain in resolution using SAP: <3%
     LWP large aperture: ~10% better than LWR
   - Spatial resolution in LAP from cross-profiles (Cassatella et al., 1985):
     LWR 4 to 5.6 arcsec at optimum focus
     LWP 3.7 to 4.9 arcsec at optimum focus

G. Wavelength Accuracy at High Dispersion

1. Internal consistency of wavelength calibration
   SWP: 2.0 km/s; LWR: 2.7 km/s (Thompson et al., 1982)
   Errors of up to 6 km/s on individual lines

2. Internal consistency in well exposed spectra:
   Typically 2-3 km/s for SWP and 3-4 km/s for LWR for spectra free of acquisition problems (Barylak & Cassatella, 1987)

H. Miscellaneous

1. Grating scattered light: (Clarke, 1981b; Stickland, 1980; Basri et al., 1985; Crivellari et al., 1982)

2. Halation: back scattering of electrons from the phosphor decay; length ~32 ± 3 pixels (Coleman, 1978)

3. Scattered light in the telescope:
   $\frac{F_{scat}}{F} \sim d^{-2.5}$ where d is in arcsec (5" < d < 40") (Schiffer, 1982b)
   Wavelength and distance dependence: de Boer & Cassatella, 1986; Cassatella, 1986.

Since 1991, the IUE spacecraft has, in increasing measure, developed a scattered light problem, generally referred to as the "FES Anomaly". This anomaly, which is most likely caused by a loose piece of isolation tape high in the telescope tube, allows extraneous light, from directions other than where the telescope is pointing to, to enter the telescope tube. The main perturbing factor is the scattering of Sunlight into the telescope, where the baffling system is of course not designed to suppress such radiation. This increases the background of visible light seen by the IUE Fine-Error-Sensor, which is used for direct acquisition of targets down to a visible brightness of 12 mag and the fine tracking system which serves to maintain S/C stability below 1 arcsec during long exposures.

The intensity of the scattered light is a strong function of the S/C-Sun angle (β-angle). As a consequence, the limiting magnitude of the FES detectors has been drastically reduced with the obvious result that both target acquisition and S/C stabilization through offset tracking have become a more complex operation. In addition, at high β-angles also some solar UV also enters the Long Wavelength spectrograph in the range between $\lambda \sim 260$ nm and $\sim$320 nm.

Most of the problems associated with this FES Anomaly have been overcome through scheduling and modified operational procedures, which could be implemented easily due to the interactive mode of control of IUE. Long duration exposures in the long wavelength camera are currently only done at large Sun pointing angles (i.e. small β-angles) and essentially all acquisition is done in a Blind-Offset mode, which relies on accurate coordinates and which, in the past, was only used for objects too faint to be detected with the FES. The main consequence of this has been an increase of some 5% in the acquisition overhead where S/C pointing is corrected on a regular basis. This adds an additional 8% to the integration overhead, but the total observing efficiency has remained high at some 55% of the available time.

4. Plate scale: 1.525 $\pm$ 0.010 pixel/arcsec (Panek, 1982a; Bohlin et al., 1980)
5. Residual geometric errors in geometrically corrected image: $\pm$ 0.4 arcsec = $\pm$ 0.2 pixels (Panek et al., 1982a)
6. Exposure timing (Schiffer, 1980b, Heck, 1981):

   Command units (OBC ticks): 0.4096 seconds

   Effective response delay (González-Riestra, 1991):

   - SWP 0.130 secs.
   - LWP 0.123 secs.
   - LWR 0.126 secs.
7. Longest uninterrupted exposure to date: SWP 15293 with 1273 mins.

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Absolute Calibration: IUE/NEWSIPS vs. HST/FOS

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The differences between IUE/NEWSIPS and HST/FOS Absolute Calibrations

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The photometric calibration of the Faint Object Spectrograph onboard HST has been revised recently. The flux calibration of IUE for the Final Archive is also different from the one in the current processing pipeline (IUESIPS). Although the principle of both calibrations has similar aspects, there are substantial differences that lead to discrepancies in the flux level of spectra of the same object coming from both archives.

The absolute calibration of the spectrographs and cameras onboard HST has been switched to a preliminary white dwarf (WD) scale. A pure hydrogen model of the white dwarf G191 B2B with an effective temperature of 60000^o K and gravity of log g = 7.5 (Finley, private communication) is the flux reference standard. The zero point of the new WD-based scale is obtained by calculating the synthetic V magnitude of the G191 B2B model spectrum in Landolt's photometric system and adjusting the model flux to Landolt's observed magnitude, which is accurate to a level of a few milimagnitudes (see Colina & Bohlin 1994 for details). The HST fluxes in the optical agree with independent ground-based spectra to $< 1\%$. The calibration procedure for the Faint Object Spectrograph (FOS) WD-based system is explained in detail in Lindler & Bohlin (1994).

The photometric calibration for the IUE Final Archive is based on WD models and OAO-2 fluxes. The IUE/NEWSIPS inverse sensitivity function has been derived from a pure hydrogen model of the WD G191 B2B with an effective temperature of 58000^o K and a gravity of log g = 7.5 (Finley, private communication). The zero point of the new flux scale is defined by the OAO-2 fluxes of the brightest IUE standard stars in the range 2100–2300 Å (González-Riestra et al. 1994 and references therein). Differences of 2% – 4% in the temperature of the WD models produce a maximum difference of 1.3% in flux (Finley 1993, Colina 1994).

Considering the different choices in the G191 B2B models and in the zero point of the absolute scales, a *difference by a factor of 1.054* between the HST/FOS and IUE/NEWSIPS fluxes is expected, being the HST/FOS spectra brighter. This value agrees with the *average value of 1.061* for the ratio of the FOS to the IUE/NEWSIPS spectra of the primary standard G191 B2B over the IUE spectral range.

In summary, the new HST/FOS calibration on the WD scale produces fluxes that are 6% larger than IUE/NEWSIPS fluxes, independent of the wavelength over the entire IUE spectral range. Any potential user of FOS post-COSTAR and IUE/NEWSIPS data should be aware of this discrepancy. For more details and information, contact Luis Colina (colina@stsci.edu), or Rosario González-Riestra (ch@vilspa.esa.es).

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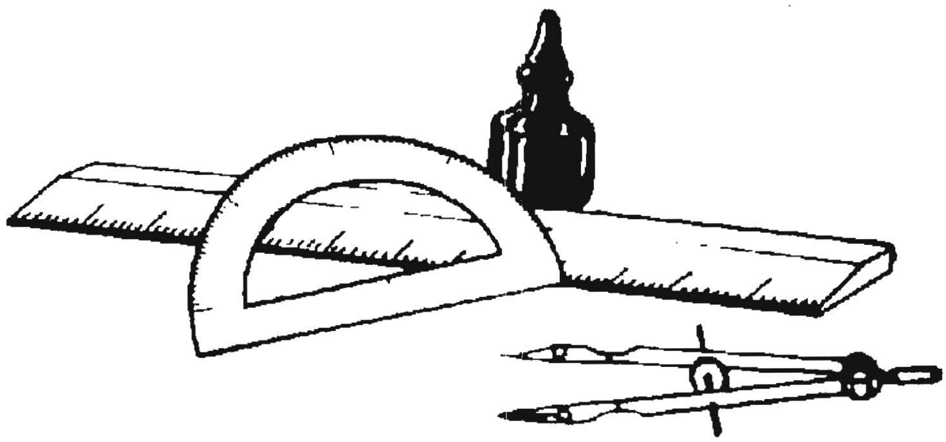

FITS Format for the IUE Final Archive

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IUE Final Archive Project

Introduction

This document describes the proposed FITS format for files to be stored in the IUE Final Archive (IUEFA). The proposed formats are suggested in order to (1) optimize storage, (2) allow easy access to data, (3) reduce the number of files, and (4) simplify the implementation. This proposal follows the recommendations laid down in the standard FITS guidelines (refs. 1 - 4, 13) except for use of the proposed Binary Table extension (refs. 11 and 13) which has not yet been officially adopted. The document describing the current IUE FITS format (ref. 5) has been used as a basic reference. Format designs used in other projects (HST and ESO archives, refs. 6 and 7, resp.) were also considered.

The proposal is based on the following concepts:

1. IUE images are stored as FITS primary arrays.
2. Pixel quality flags for an IUE image are stored as a FITS extension, in a data matrix following the primary array. The name of the extension is `IMAGE`.
3. Spectra are stored as FITS binary table extensions with each row of the table containing the wavelengths, fluxes, data quality information, etc. pertaining to one spectral order.
4. Wavelengths are uniformly sampled and are measured in vacuum.

As described in ref. 12, the new version of IUESIPS (NEWSIPS), generates the following files in the case of low resolution spectra:

1. `RI` The raw image.

2. `LI` The linearized (i.e., photometrically corrected) image and associated pixel quality flags.

3. `VD` The vector displacement file and associated cross-correlation coefficients.

4. `SILO` The resampled low dispersion image and associated pixel quality flags.

5. `MELORES` The extracted spectra.

If the raw image contains spectra collected through the two – large and small – apertures, the `SILO`, `VD`, and `MELORES` files will include data from both apertures. This is a slight change from the previous IUESIPS processing in which a separate `SILO` and `MELORES` type file was created for each aperture.
In the case of a high resolution spectrum the following files are generated:

1. RI The raw image.
2. LI The linearized image and associated pixel quality flags.
3. VD The vector displacement file and associated cross-correlation coefficients.
4. SIHI The resampled high dispersion image and associated pixel quality flags.
5. MEHIRES The extracted spectra for each order. orders spliced together and uniform sampling.

The IUE Final Archive will also include a FITS-formatted version of the Fine Error Sensor FES image files.
It is intended that the same logical format be adopted for the corresponding files of high and low dispersion images (SILO-SIHI and MELORES-MEHIRES).

Image Header

In the current version of IUESIPS each image has an associated VICAR header (refs. 8, 9). This header, from now on called the "IUE label", consists of 72-byte lines containing EBCDIC and binary information as shown in Table 1.

Table 1: IUE VICAR Header

Line number	Description	Code
1-2	Image info. written by the system	EBCDIC
3-9	General comments	EBCDIC
10-32	Real-time command buffer	EBCDIC
33-35	Blanks	EBCDIC
36-37	GO information from POT tape	EBCDIC
38-45	Blanks	EBCDIC
46	Computer switch info used at GSFC	EBCDIC
47-50	Blanks	EBCDIC
51-75	Data quality bits	Binary
76-82	S/C snapshot	Binary
83-85	Orbital elements and S/C info	EBCDIC
86-100	Camera snapshots	Binary
101-103	Databank parameters	EBCDIC
104 to end	Process History.	EBCDIC

The proposed structure of each new file header in FITS format will contain:

- Basic FITS keywords.
- Core Data Items.
- IUE label.

- Image Processing History.

This header will be attached to each of the files stored in the archive. Core Data Items, the IUE label and the cumulative Image Processing History will be contained only in the primary FITS header, the extension headers will not duplicate this information.
It should be noted that the structure of the proposed FITS header is such that some information may appear in more than one form. For example, label information may appear in more than one line of the IUE label as well as a Core Data Item. In cases where these entries disagree, the Core Data Items will always be considered the most reliable source for the specific information.

Basic FITS keywords

The basic FITS keywords define the structure and content of the FITS files, and include both the mandatory FITS keywords and, when appropriate, certain optional reserved FITS keywords. Each line of the FITS header has the syntax

```
keyname =   value / comments,
```

where `keyname` is the name of a FITS keyword conforming to the FITS keyword rules. The basic FITS keywords for each file type are shown for in the next sections below. Although not shown below, each FITS header will end with the required `END` keyword.

Core Data Items

The Core Data Items (CDIs) are defined to be the minimum set of parameters needed for both image reprocessing and scientific analysis. They include both Input CDIs, which are verified before processing, and Output CDIs, which are generated by NEWSIPS and verified during quality control after the IUEFA pipeline processing. The CDIs will appear in the FITS header of each IUE file, and in the Final Catalogue. Each CDI value will be defined by a unique FITS keyword. Because some CDIs may have multiple values, a unique correspondence may not be possible between FITS keywords and the fields of the IUE merged log. In those cases in which the CDI is either unknown or undefined for a particular IUE image, the related FITS keyword will not be included in the header. This follows the standard convention for optional FITS keywords. The complete list of CDIs and the associated FITS keywords is included in Tables 11-14 in Appendix A.
The section of the header including the CDIs will be divided into three sets:

- Common set, include aperture-independent parameters.
- Large aperture set.
- Small aperture set.

Each set will be preceded by three `COMMENT` lines as indicated in the example in Appendix B. Files corresponding to a single aperture exposure will have the corresponding (large or small) CDI set. Serendipitous data will have the (aperture independent) flag set. The corresponding CDIs are duplicated for the serendipitous aperture.
Note that FES image files have a unique set of CDIs as shown in Table 14.

IUE label

The raw image VICAR header label, as well as any appendages which had been added for database information or label corrections, will be stored in the primary FITS header. Each line will contain the original label information coded in ASCII, in bytes 9 to 80, with blanks in bytes 1 to 8. Lines originally coded in EBCDIC will be converted to ASCII, and lines containing binary data will be converted into two lines containing hexadecimal ASCII characters. (e.g., the unsigned integer byte value 63 will become '3F'). The first line of hexadecimal ASCII characters will contain bytes 1 through 33 of the original line of binary data and will be stored in columns 9 through 74. The second line will contain bytes 34 through 66 in columns 9 through 74. The traditional VICAR line number and continuation character will be stored at the end of each line in bytes 75 through 80. In this format, the IUE raw image label will generally consist of approximately 150 lines in the FITS header.
Four `COMMENT` lines will precede the IUE label and one `COMMENT` line will flag the end of the label, as indicated in Appendix B.

Processing history

The image processing history includes the cumulative processing information generated by NEWSIPS. This history documents the processing system (software identification, version if required and hardware platform), the employed scheme name and parameter values, and the individual application modules with the corresponding time stamps. Relevant variables used or computed by the various processing routines (e.g., dispersion constants, shifts used during the extraction, number of iterations in certain procedures, etc) are reported in the history lines.
Each line of the processing history will contain the keyword `HISTORY` in bytes 1 to 8, with processing information stored in bytes 9 to 71. Bytes 73 to 80 are reserved for time stamps, which will designate the GMT times at which the individual application modules are executed. Separate lines containing the processing date will indicate the start and end of the log. An example is provided in Appendix B.

File Naming Conventions

The file names are defined so as to allow the unique identification of the information stored in the file (ref. 14). It is expected that the FITS reader will assign the file names according to the keyword `FILENAME`. Files with extensions include the keyword both for the main data set and for the extensions so that the FITS reader could either store the information in a single file or store the main data set and the extension in different files.
The file name is formed by the concatenation of the following codes:

- Camera: 3 letter code (`LWP, LWR, SWP, SWR`).
- Image number: 5 digits.
- File type: 2 letter code as:

  `RI` raw image

- VD vector displacement
- XC cross correlation coefficients (extension of the VD file)
- LI linearized image
- LF flags associated with the linearized image
- SI resampled image
- SF flags associated with the resampled image
- SW wavelengths associated with the high dispersion resampled image
- MX merged extracted spectrum (large, small or both apertures)

- Dispersion: 2 letter code (HI, LO).

For example the files generated for LWP 12345, low dispersion image, would be the following:

main data set	extension
LWP12345.RILO	-
LWP12345.VDLO	LWP12345.XCLO
LWP12345.LILO	LWP12345.LFLO
LWP12345.SILO	LWP12345.SFLO
-	LWP12345.MXLO

The files generated for SWP 9876, high dispersion image, would be:

main data set	extension
SWP09876.RIHI	-
SWP09876.VDHI	SWP09876.XCHI
SWP09876.LIHI	SWP09876.LFHI
SWP09876.SIHI	SWP09876.SFHI, SWP09876.SWHI
-	SWP09876.MXHI

Images which are processed as both high dispersion and low dispersion would therefore have both sets of files in the archive. Note that this applies to the raw image file as well as the processed files, due to the dispersion dependent CDIs involved.

RI File

The IUE raw image RI is the fundamental input file for the IUE image processing system. Except for the conversion from VICAR format to FITS format (including the addition of the CDIs as FITS keywords), the data will remain unaltered.
The RI FITS file will contain a two-dimensional primary array consisting of 768 $\times$ 768 pixels, with no group structure or extensions. Each pixel is a data number (DN), coded as 8 bits unsigned integers ranging from 0 to 255. The Basic Keywords are shown in Table 2.

Table 2: RI File - Basic FITS Keywords

Keyword and value		Description
SIMPLE =	T	Standard FITS Format
BITPIX =	8	8-bit integer pixels
NAXIS =	2	Two-dimensional image
NAXIS1 =	768	Dimension along x-axis
NAXIS2 =	768	Dimension along y-axis
CTYPE1 = 'SAMPLE '		x-axis
CTYPE2 = 'LINE '		y-axis
BUNIT = 'DN '		Data Numbers
TELESCOP= 'IUE '		International Ultraviolet Explorer
FILENAME= 'AAAnnnnn.RIdd'		Filename (camera)(number).RI(disp)
DATE = 'dd/mm/yy'		Date file is written
ORIGIN = 'VILSPA '		Institution generating the file
DATAMIN =	nnn.0	Minimum pixel value
DATAMAX =	nnn.0	Maximum pixel value

LI File

The linearized image LI file contains the photometrically-corrected data sampled in raw pixel space. Each corrected pixel represents a flux number (FN) scaled by a factor of 32 for storage purposes. (Note that only pixels within the target ring in high dispersion, and in a swath along the spectrum in low dispersion have been photometrically corrected).
The LI file will contain the linearized image as a two-dimensional primary array consisting of 768 × 768 pixels, with each pixel value coded as 16 bits, two's complement integers with bits stored in decreasing order of significance. The associated pixel quality flags are stored as an image extension using 16-bit, two's complement integers. Basic Keywords in the main header and the image extension header are shown in Table 3.

VD File

The vector displacements define, for each pixel, the transformation from the raw science image space to the appropriate pixel in the SILO or SIHI space. The final displacements are the combination of the vectors computed for: (1) photometric registration, (2) geometric correction to align the reseaux, (3) rotation so that the spectral format is horizontal, (4) wavelength linearization, (5) detilting of the large aperture for extended objects, (6) alignment of the apertures such that wavelength is constant in the line direction and (7) desplaying of spectral orders for high dispersion data.
The vector displacement (VD) file will contain the x and y components (i.e., the raw image sample and line, respectively) of the normalized displacements, stored as a three-dimensional primary array consisting of 768 × 768 × 2 elements. The displacements are coded as 32 bits, floating point numbers.
The cross-correlation coefficients for each of the ~500 (~140 for low dispersion) points used to obtain the displacement between the science image and the corresponding level of the ITF, are to be stored as a binary 3D table extension. This table will contain:

1. science image x-position,

Table 3: LI File - Basic FITS Keywords

Keyword and value		Description
SIMPLE =	T	Standard FITS Format
BITPIX =	16	16-bit, 2's complement pixels
NAXIS =	2	Two-dimensional image
NAXIS1 =	768	Dimension along x-axis
NAXIS2 =	768	Dimension along y-axis
EXTEND =	T	Extensions are present
CTYPE1 = 'SAMPLE '		x-axis
CTYPE2 = 'LINE '		y-axis
BUNIT = 'FN '		Flux Numbers
BSCALE =	3.1250E-02	real=tape*bscale+bzero
BZERO =	0.	offset
TELESCOP= 'IUE '		International Ultraviolet Explorer
FILENAME= 'AAAnnnnn.LIdd'		Filename (camera)(number).LI(disp)
DATE = 'dd/mm/yy'		Date file is written
ORIGIN = 'VILSPA '		Institution generating the file
DATAMIN =	nnnnn.n	Minimum pixel value
DATAMAX =	nnnnn.n	Maximum pixel value
XTENSION= 'IMAGE '		Image extension
BITPIX =	16	16-bit, 2's complement pixels
NAXIS =	2	Two-dimensional image
NAXIS1 =	768	Dimension along x-axis
NAXIS2 =	768	Dimension along y-axis
PCOUNT =	0	number of bytes following data matrix
GCOUNT =	1	number of groups
CTYPE1 = 'SAMPLE '		x-axis
CTYPE2 = 'LINE '		y-axis
BUNIT = ' '		unitless
FILENAME= 'AAAnnnnn.LFdd'		Filename (camera)(number).LF(disp)
EXTNAME = 'LIF '		pixel quality flags

2. science image y-position,
3. ITF x-position of best match,
4. ITF y-position of best match,
5. cross-correlation coefficient,
6. number of points used to calculate the coefficient and
7. the ITF level used by the algorithm.

Basic Keywords in the `VD` file header and in the table extension are shown in Table 4.
Note: The keyword `NAXIS1` of the table extension has a value of 20 corresponding to the number of bytes in a row of the table.

`SILO` File

The low dispersion resampled image (`SILO`) is produced by resampling the entire LI image using the Shepard algorithm to correct for geometric distortion, rotate the image so that the spectral orders are aligned with the scan direction, and resampled so data points are evenly spaced in wavelength (ref. 12). The resulting two-dimensional array will contain data from

Table 4: VD File - Basic FITS Keywords

Keyword and value		Description
SIMPLE =	T	Standard FITS Format
BITPIX =	-32	IEEE single precision floating point
NAXIS =	3	Three-dimensional image
NAXIS1 =	768	Dimension along x-axis
NAXIS2 =	768	Dimension along y-axis
NAXIS3 =	2	Dimension along z-axis
EXTEND =	T	Extensions are present
CTYPE1 = ' '		Units along x-axis
CTYPE2 = 'PIXEL '		Units along y-axis
CTYPE3 = 'PIXEL '		Units along z-axis
BUNIT = 'PIXEL '		Pixel units
BZERO =	nnnn.	Pixel offset
BSCALE =	nn.n	Scale factor
TELESCOP= 'IUE '		International Ultraviolet Explorer
FILENAME= 'AAAnnnnn.VDdd'		Filename (camera)(number).VD(disp)
DATE = 'dd/mm/yy'		Date file is written
ORIGIN = 'VILSPA '		Institution generating the file
DATAMIN =	nnnnn.n	Minimum pixel value
DATAMAX =	nnnnn.n	Maximum pixel value
XTENSION= 'BINTABLE'		Table extension
BITPIX =	8	binary data
NAXIS =	2	Two-dimensional image
NAXIS1 =	20	width of table in bytes
NAXIS2 =	nnn	number of entries in table
PCOUNT =	0	number of bytes following data matrix
GCOUNT =	1	number of groups
TFIELDS =	7	number of fields in each row
TFORM1 = '1I '		16-bit integer
TTYPE1 = 'XRAW '		science image x-position
TUNIT1 = 'PIXEL '		unit is pixel
TFORM2 = '1I '		16-bit integer
TTYPE2 = 'YRAW '		science image y-position
TUNIT2 = 'PIXEL '		unit is pixel
TFORM3 = '1E '		single precision float
TTYPE3 = 'XITF '		ITF x-position of best match
TUNIT3 = 'PIXEL '		unit is pixel
TFORM4 = '1E '		single precision float
TTYPE4 = 'YITF '		ITF y-position of best match
TUNIT4 = 'PIXEL '		unit is pixel
TFORM5 = '1E '		single precision float
TTYPE5 = 'XCOEFF '		cross correlation coefficient
TUNIT5 = ' '		unitless
TFORM6 = '1I '		16-bit integer
TTYPE6 = 'NPOINTS '		number of points used
TUNIT6 = ' '		unitless
TFORM7 = '1I '		16-bit integer
TTYPE7 = 'ITFLEVEL'		ITF level
TUNIT7 = ' '		unitless
FILENAME= 'AAAnnnnn.XCdd'		Filename (camera)(number).XC(disp)
EXTNAME = 'XCOEF '		cross correlation coefficients

both the large and small apertures. An associated pixel quality image will describe error conditions specific to individuals pixels.
The SILO image will be stored as a two-dimensional primary array consisting of 640 × 80 pixels. Each pixel represents a flux number (FN) scaled by a factor of 32 for storage purposes. The pixels are coded as 16 bits, two's complement integers, with the bits stored in decreasing order of significance. The associated pixel quality flags are stored as an image extension and will have the same dimensions as the primary array. Table 5 shows the basic FITS Keywords for the main header and the image extension header.

Table 5: SILO File - Basic FITS Keywords

Keyword and value		Description
SIMPLE =	T	Standard FITS Format
BITPIX =	16	16-bit, 2's complement pixels
NAXIS =	2	Two-dimensional image
NAXIS1 =	640	Dimension along x-axis
NAXIS2 =	80	Dimension along y-axis
EXTEND =	T	Extensions are present
CRPIX1 =	1.	x reference pixel
CRPIX2 =	1.	y reference pixel
CRVAL1 =	nnnn.nn	Wavelength at reference pixel
CRVAL2 =	1.	Coordinate of CRPIX2
CDELT1 =	n.nnnnn	Increment in wavelengths
CDELT2 =	1.	Increment unit along y-axis
CTYPE1 = 'WAVELENGTH'		x-axis
CTYPE2 = 'SCAN '		y-axis
BUNIT = 'FN '		Flux Numbers
BSCALE =	3.1250E-02	real=tape*bscale+bzero
BZERO =	0.	Pixel offset
TELESCOP= 'IUE '		International Ultraviolet Explorer
FILENAME= 'AAAnnnnn.SILO'		Filename (camera)(number).SILO
DATE = 'dd/mm/yy'		Date file is written
ORIGIN = 'VILSPA '		Institution generating the file
DATAMIN =	nnnnn.n	Minimum pixel value
DATAMAX =	nnnnn.n	Maximum pixel value
XTENSION= 'IMAGE '		Image extension
BITPIX =	16	16-bit, 2's complement pixels
NAXIS =	2	Two-dimensional image
NAXIS1 =	640	Dimension along x-axis
NAXIS2 =	80	Dimension along y-axis
PCOUNT =	0	number of bytes following data matrix
GCOUNT =	1	number of groups
CRPIX1 =	1.	x reference pixel
CRPIX2 =	1.	y reference pixel
CRVAL1 =	nnnn.nn	Coordinate of CRPIX1
CRVAL2 =	1.	Coordinate of CRPIX2
CDELT1 =	n.nnnnn	Increment unit along x-axis
CDELT2 =	1.	Increment unit along y-axis
CTYPE1 = 'WAVELENGTH'		x-axis
CTYPE2 = 'SCAN '		y-axis
BUNIT = ' '		unitless
FILENAME= 'AAAnnnnn.SFLO'		Filename (camera)(number).SFLO
EXTNAME = 'SILOF '		SILO pixel quality flags

SIHI File

The high dispersion resampled image (SIHI) is similiar to the SILO image except that the wavelength linearization varies with spectral order and that the entire image is stored in the resulting output file. The file will consist of a 768 × 768 pixel primary array, where each pixel represents a scaled FN value coded as 16 bits, two's complement integers, with the bits stored in decreasing order of significance. Since wavelength scaling varies with spectral order, a binary 3D table extension will be used to store the following information in each row of the table:

1. Order number, one 16-bit integer.
2. Starting wavelength, one double precision floating point value.
3. Wavelength increment, one double precision floating point value.
4. Predicted line number of spectrum centroid, one single precision floating point value.

The associated pixel quality flags are stored as an image extension. Table 6 shows the basic FITS Keywords for the `SIHI` file.

`MELORES` File

The flux vectors extracted from the low dispersion resampled image are stored in the `MELORES` file. The flux vectors correspond to the net, smoothed background, and absolutely-calibrated extracted spectra. Wavelengths are uniformly sampled and are measured in vacuum.
The proposed `MELORES` file will use the binary 3D table extension (ref. 11) with fixed-length floating point vectors to contain the extracted fluxes and associated data quality flags. Since no primary data is included, the extension header will immediately follow the primary FITS header. Each row of the binary table will include the following columns:

1. Aperture designation as 'LARGE' or 'SMALL', stored in 5 ASCII characters.
2. Number of extracted points, one 16-bit integer. The number of extracted points is 640.
3. Starting wavelength, one single precision floating point value.
4. Wavelength increment, one single precision floating point value.
5. Net flux spectrum, array with 640 single precision floating point values.
6. Background flux spectrum, array with 640 single precision floating point values.
7. Sigma vector, array with 640 single precision floating point values.
8. Data quality flags as an array of 640 16-bit integers.
9. Absolutely calibrated net flux spectrum, array with 640 single precision floating point values.

Double aperture low dispersion spectra will contain two rows in the above format, with one row for each aperture (LARGE first, then SMALL). Table 7 shows the basic FITS keywords for the `MELORES` file.
Note: The keyword `NAXIS1` in the table extension defines the number of bytes per row in the table, computed as $15 + 18 \times 640$.

Table 6: SIHI File - Basic FITS Keywords

Keyword and value	Description
SIMPLE = T	Standard FITS Format
BITPIX = 16	16-bit, 2's complement pixels
NAXIS = 2	Data in Image extension
NAXIS1 = 768	x-axis dimension
NAXIS2 = 768	y-axis dimension
EXTEND = T	Extensions are present
CTYPE1 = 'SAMPLE'	x-axis
CTYPE2 = 'LINE '	y-axis
BUNIT = 'FN '	Flux Numbers
BSCALE = 3.1250E-02	real=tape*bscale+bzero
BZERO = 0.	offset
TELESCOP= 'IUE '	International Ultraviolet Explorer
FILENAME= 'AAAnnnnn.SIHI'	Filename (camera)(number).SIHI
DATE = 'dd/mm/yy'	Date file is written
ORIGIN = 'VILSPA '	Institution generating the file
DATAMIN = nnnnn.n	Minimum pixel value
DATAMAX = nnnnn.n	Maximum pixel value
XTENSION= 'BINTABLE'	Table extension
BITPIX = 8	Binary data
NAXIS = 2	Two-dimensional table array
NAXIS1 = 18	Width of table row in bytes
NAXIS2 = nn	Number of orders
PCOUNT = 0	number of bytes following data matrix
GCOUNT = 1	Only one group
TFIELDS = 4	Number of columns in the table
TFORM1 = '1I '	16-bit integer
TTYPE1 = 'ORDER '	order number
TUNIT1 = ' '	unitless
TFORM2 = '1D '	double precision floating point
TTYPE2 = 'WAVELENGTH'	starting wavelength
TUNIT2 = 'ANGSTROM'	unit is angstroms
TFORM3 = '1D '	double precision floating point
TTYPE3 = 'DELTAW '	3rd field is wavelength increment
TUNIT3 = 'ANGSTROM'	unit is angstrom
TFORM4 = '1E '	single precision floating point
TTYPE4 = 'LINE'	line number nearest order centroid
TUNIT4 = 'PIXEL'	unit is pixel
FILENAME= 'AAAnnnnn.SWHI'	Filename (camera)(number).SWHI
EXTNAME = 'SIHIW '	name of table
XTENSION= 'IMAGE '	Image extension
BITPIX = 16	16-bit, 2's complement pixels
NAXIS = 2	Two-dimensional image
NAXIS1 = 768	Dimension along x-axis
NAXIS2 = 768	Dimension along y-axis
PCOUNT = 0	number of bytes following data matrix
GCOUNT = 1	number of groups
CTYPE1 = 'SAMPLE'	x-axis
CTYPE2 = 'LINE '	y-axis
BUNIT = ' '	unitless
FILENAME= 'AAAnnnnn.SFHI'	Filename (camera)(number).SFHI
EXTNAME = 'SIHIF '	SIHI pixel quality Flags

Table 7: MELORES File - Basic FITS Keywords

Keyword and value		Description
SIMPLE =	T	Standard FITS Format
BITPIX =	8	8 bits ASCII
NAXIS =	0	No image data
EXTEND =	T	Extensions are present
TELESCOP= 'IUE '		International Ultraviolet Explorer
DATE = 'dd/mm/yy'		Date file is written
ORIGIN = 'VILSPA '		Institution generating the file
XTENSION= 'BINTABLE'		Table extension
BITPIX =	8	Binary data
NAXIS =	2	Two-dimensional table array
NAXIS1 =	11535	With of the table row in bytes
NAXIS2 =	n	Number of apertures (1-single, 2-both)
PCOUNT =	0	Number of bytes following data matrix
GCOUNT =	1	Only one group
TFIELDS =	9	Number of column in the table
TFORM1 = '5A '		character string
TTYPE1 = 'APERTURE'		aperture type (large or small)
TUNIT1 = ' '		unitless
TFORM2 = '1I '		16-bit integer
TTYPE2 = 'NPOINTS '		number of points
TUNIT2 = ' '		unitless
TFORM3 = '1E '		single precision
TTYPE3 = 'WAVELENGTH'		starting wavelength
TUNIT3 = 'ANGSTROM'		unit is angstrom
TFORM4 = '1E '		single precision
TTYPE4 = 'DELTAW '		wavelength increment
TUNIT4 = 'ANGSTROM'		unit is angstrom
TFORM5 = '640E '		single precision array
TTYPE5 = 'NET '		net flux array
TUNIT5 = 'FN '		unit is IUE FN
TFORM6 = '640E '		single precision array
TTYPE6 = 'BACKGROUND'		background flux array
TUNIT6 = 'FN '		unit is IUE FN
TFORM7 = '640E '		single precision array
TTYPE7 = 'SIGMA '		sigma
TUNIT7 = 'ERG/CM2/S/A'		unit is erg/cm2/sec/angstrom
TFORM8 = '640I '		16-bit integer array
TTYPE8 = 'QUALITY '		data quality flag
TUNIT8 = ' '		unitless
TFORM9 = '640E '		single precision array
TTYPE9 = 'FLUX '		calibrated flux
TUNIT9 = 'ERG/CM2/S/A'		unit is erg/cm2/sec/angstrom
FILENAME= 'AAAnnnnn.MXLO'		Filename (camera)(number).MXLO
EXTNAME = 'MELO '		name of table

MEHIRES File

This file contains the fluxes extracted from each order of the resampled high dispersion file along with the associated wavelengths and data quality flags. The flux vectors correspond to the net, smoothed background, and absolutely-calibrated extracted spectra. Wavelengths are uniformly sampled for each order and are measured in vacuum.
The MEHIRES file is a *single FITS file, stored as a binary 3D table extension using fixed-length floating point vectors.* No primary data or additional extensions are included. Each row of the binary table will contain information pertaining to one spectral order and will include the following fields:

1. Order number, one 16-bit integer.
2. Number of extracted points, one 16-bit integer.
3. Starting wavelength, one double precision floating point value.
4. Starting pixel at starting wavelength, one 16-bit integer.
5. Wavelength increment, one double precision floating point value.
6. Net flux spectrum, n single precision floating point numbers.
7. Background flux spectrum, n single precision floating point numbers.
8. Differential order overlap correction, n single precision floating point numbers.
9. Sigma vector, n single precision floating point numbers.
10. Data quality flags as n 16-bit integers.
11. Ripple-corrected flux spectrum, n single precision floating point numbers.
12. Start pixel for background fit, one integer number.
13. End pixel for background fit, one integer number.
14. Scale factor, one single precision floating point number.
15. Chebychev polynomial coefficients for global background correction, 7 single precision floating point numbers.
16. Slit height in pixels, one single precision floating point number.
17. Line number for centroid of spectrum, one single precision floating point number.

Table 8 shows the basic FITS Keywords for the `MEHIRES` file.
Note: The keyword `NAXIS1` in the table extension defines the number of bytes per row in the table. This value is computed as $64 + 22 \times n$, where n is the number of extracted points.

Table 8: MEHIRES File - Basic FITS Keywords

Keyword and value		Description
SIMPLE =	T	Standard FITS Format
BITPIX =	8	Binary data
NAXIS =	0	No image data
EXTEND =	T	Extensions are present
TELESCOP= 'IUE '		International Ultraviolet Explorer
DATE = 'dd/mm/yy'		Date file is written
ORIGIN = 'VILSPA '		Institution generating the file
XTENSION= 'BINTABLE'		Table extension
BITPIX =	8	Binary data
NAXIS =	2	Two-dimensional table array
NAXIS1 =	nnnnn	Width of table row in bytes
NAXIS2 =	nn	Number of orders
PCOUNT =	0	number of bytes following data matrix
GCOUNT =	1	Only one group
TFIELDS =	17	Number of column in the table
TFORM1 = '1I '		16-bit integer
TTYPE1 = 'ORDER '		order number
TUNIT1 = ' '		unitless
TFORM2 = '1I '		16-bit integer
TTYPE2 = 'NPOINTS '		number of non-zero points
TUNIT2 = ' '		unitless
TFORM3 = '1D '		double precision
TTYPE3 = 'WAVELENGTH'		starting wavelength
TUNIT3 = 'ANGSTROM'		unit is angstrom
TFORM4 = '1I '		16-bit integer
TTYPE4 = 'STARTPIX'		starting pixel at starting wavelength
TFORM4 = 'PIXEL '		unit is pixel
TFORM5 = '1D '		double precision
TTYPE5 = 'DELTAW '		wavelength increment
TUNIT5 = 'ANGSTROM'		unit is angstrom
TFORM6 = '768E '		single precision array
TTYPE6 = 'NET '		net flux array
TUNIT6 = 'FN '		unit is IUE FN
TFORM7 = '768E '		single precision array
TTYPE7 = 'BACKGROUND'		background flux array
TUNIT7 = 'FN '		unit is IUE FN
TFORM8 = '768E '		single precision array
TTYPE8 = 'DOC '		differential order overlap correction
TUNIT8 = 'FN '		unit is IUE FN
TFORM9 = '768E '		single precision array
TTYPE9 = 'SIGMA '		sigma
TUNIT9 = 'FN '		unit is IUE FN
TFORM10 = '768I '		16-bit integer array
TTYPE10 = 'QUALITY '		data quality flag
TUNIT10 = ' '		unitless
TFORM11 = '768E '		single precision array
TTYPE11 = 'RIPPLE '		ripple-corrected flux
TUNIT11 = 'FN '		unit is IUE FN
TFORM12 = '1I '		16-bit integer
TTYPE12 = 'START-BKG'		beginning pixel of background fit
TUNIT12 = 'SAMPLE '		x-axis in SIHI image
TFORM13 = '1I '		16-bit integer
TTYPE13 = 'END-BKG '		end pixel of background fit
TUNIT13 = 'SAMPLE '		x-axis in SIHI image

Table 8: continued

Keyword and value	Description
TFORM14 = '1E '	single precision
TTYPE14 = 'SCALE_BKG'	Chebychev scale factor
TUNIT14 = ' '	unitless
TFORM15 = '7E '	single precision array
TTYPE15 = 'COEFF '	Chebychev coefficients of bkg fit
TUNIT15 = ' '	unitless
TFORM16 = '1E '	single precision
TTYPE16 = 'SLITSIZE'	Slit height
TUNIT16 = 'PIXEL '	unit is pixel
TFORM17 = '1E '	single precision
TTYPE17 = 'LINE_CEN'	line number where spectral centroid is found
TUNIT17 = 'PIXEL '	unit is pixel
FILENAME= 'AAAnnnnn.MXHI'	Filename (camera)(number).MXHI
EXTNAME = 'MEHI '	name of table

Note: Table 9 intentionally omitted.

FES Image File

The Fine Error Sensor (FES) is an image dissector with an S-20 photocathode sensitive in the wavelength range from 4000-7000 angstroms. Although not routinely archived, FES images are frequently read down from the satellite and stored in a format similiar to the raw image file. FES images can have sizes of up to 127 × 127 pixels, but they are generally archived in sizes of 7 × 7, 81 × 81, 113 × 113 or 127 × 127 pixels. Although this file will be converted from VICAR to FITS format, with the VICAR label and appropriate CDIs stored as keywords in the FITS header, the FES data will remain unaltered.
The FES file will be stored as a two-dimensional primary array, with no group structure or extensions. Each pixel is coded as 16 bits, two's complement integers. Basic Keywords are shown in Table 10. The CDIs pertaining to FES images are listed in Table 14.

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Table 10: FES File - Basic FITS Keywords

Keyword and value		Description
SIMPLE =	T	Standard FITS Format
BITPIX =	16	16-bit, 2's complement pixels
NAXIS =	2	Two-dimensional image
NAXIS1 =	nnn	Dimension along x-axis
NAXIS2 =	nnn	Dimension along y-axis
CTYPE1 = 'SAMPLE '		x-axis
CTYPE2 = 'LINE '		y-axis
CUNIT1 = 'PIXEL '		Units along x-axis (8 arcsec/pixel)
CUNIT2 = 'PIXEL '		Units along y-axis (8 arcsec/pixel)
BUNIT = 'COUNTS '		Pixel units
TELESCOP= 'IUE '		International Ultraviolet Explorer
FILENAME= 'AAAnnnnn.FES'		Filename (camera)(number).FES
DATE = 'dd/mm/yy'		Date file is written
ORIGIN = 'VILSPA '		Institution generating the file
DATAMIN =	nnn.n	Minimum pixel value
DATAMAX =	nnn.n	Maximum pixel value

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Appendix A

List of Core Data Items

CDIs can be aperture independent, like the camera and image number, or may have a value that is aperture dependent, like the exposure time.
Table 11 shows aperture independent input CDIs, stored in the common set (see example in Appendix B). Table 12 includes the input CDIs with aperture dependent values, stored in the large and/or small aperture sets. The keyword name corresponding to these parameters has a prefix 'x' that can be either L for large aperture or S for small aperture.
Output CDIs are included in Table 13. (Note: This list will be expanded with parameters defined by the NEWSIPS development group).
Table 14 includes the complete list of CDIs to be archived with FES image files.
Note: Old `ABNCODE(i)` *and* `xEXPMODi` *keyword names have been defined explicitly as follows*

```
Old name      New name    CDI type     Comments
--------      --------    --------     --------
ABNCODE(1)    ABNMINFR    Output    Missing minor frames. Output CDI list
ABNCODE(2)    ABNMICRO    Output    Microphonics. Output CDI list
ABNCODE(3)    ABNNONST    Input     Non standard image
ABNCODE(4)    ABNBADSC    Input     LWP bad scans
ABNCODE(5)    ABNHTRWU    Input     LWR heater warmups
ABNCODE(6)    ABNREAD     Input     Reads at other than 20 KB
ABNCODE(7)    ABNUVC      Input     Non standard UVC voltage
ABNCODE(8)    ABNHISTR    Input     History replay
ABNCODE(9)    ABNOTHER    Input     Other Abnormality

xEXPMOD1      xXTRMODE    Output    Extraction mode. Output CDI list.
xEXPMOD2      xEXPTRMD    Input     Trail mode
xEXPMOD3      xEXPMULT    Input     Multiple exposure code
xEXPMOD4      xEXPSEGM    Input     Segmented exposure code
```

Table 11: Aperture-independent Input CDIs

Keyword and value	Description
CAMERA = 'camera '	LWP, LWR, SWP, SWR
IMAGE = nnnnn	Sequential image number
DISPERSN= 'dispersion'	Dispersion HIGH, LOW, BOTH, NA
APERTURE= 'aperture'	Aperture LARGE, SMALL, BOTH, NA
DISPTYPE= 'proc_disp'	Process dispersion HIGH, LOW
READMODE= 'read_mode'	Read mode FULL, PARTIAL
READGAIN= 'read_gain'	Read gain HIGH, LOW
EXPOGAIN= 'exposure_gain'	Exp. gain MAXIMUM, MEDIUM, MINIMUM
UVC-VOLT= nn.n	UVC Voltage in Kilovolts
ABNNOSTD= 'YES/NO '	Non standard image
ABNBADSC= 'YES/NO '	LWP Bad scans
ABNHTRWU= 'YES/NO '	LWP heater warm-ups
ABNREAD = 'YES/NO '	Reads at other than 20 KB
ABNUVC = 'YES/NO '	Non standard UVC Voltage
ABNHISTR= 'YES/NO '	History replay
ABNOTHER= 'YES/NO '	Other abnormality code
THDAREAD= nn.nn	THDA at read of exposure
EQUINOX = 1950.0	Epoch of coordinates
STATION = 'station '	Observing station VILSPA, GSFC
ORBEPOCH= 'dd/mm/yy'	Orbital element: epoch
ORBSAXIS= nnnnn.n	Semi-Major Axis in kilometers
ORBECCEN= n.nnnnnnn	Eccentricity
ORBINCLI= nnn.nnn	Inclination in degrees
ORBASCEN= nnn.nnn	R.A. of Ascending Node in degrees
ORBPERIG= nnn.nnn	Arg. of Perigee in degrees
ORBANOMA= nnn.nnn	Mean Anomaly in degrees
POSANGLE= nnn.nn	Position angle of Large aperture
LAMP = 'lamp '	TFLOOD, CALUV, NONE
PGM-ID = 'Prog_id '	Program identification (Char*5)
COMMENT BY GO ...	G.O. comments (n*Char*60)
COMMENT BY RA ...	R.A. comments (n*Char*60)

Table 12: Aperture-dependent Input CDIs

Keyword and value		Description
xDATEOBS=	'dd/mm/yy'	(User friendly) Observing date
xTIMEOBS=	'hh:mm:ss'	(User friendly) Observing time
xMJD-OBS=	nnnnn.nnnnn	Start of obs. ($JD - 2400000.5$)
xEXPTRMD=	'trail_mode'	Trail mode NO-, X-, Y-TRAIL
xEXPMULT=	'multiple_exp'	Multiple exp. mode
xEXPSEGM=	'segmented_exp'	Segmented exp. code YES/NO
xEXPTIME=	nnnnn.nnn	Integration time in secs.
xTHDASTR=	nn.nn	THDA at start of exposure
xTHDAEND=	nn.nn	THDA at end of exposure
xRA =	nnn.nnnn	Slit R.A. in degrees (homogenoeus)
xDEC =	nnn.nnnn	Slit Dec. in degrees (homogeneous)
xLAPSTAT=	'status'	Large aperture status (OPEN/CLOSED)
xFESnMD =	'mode '	FES(1,2) mode (FO, FU, SO, BO)
xFESnCN =	nnnnn	FES(1,2) Counts
xFESnBK =	nnnnn	FES(1,2) background counts
xTARGET =	'target '	Object as given by Guest Observer
xTARGRA =	nnn.nnnn	R.A. in degrees (given by GO)
xTARGDEC=	nnn.nnnn	Dec. in degrees (given by GO)
xOBJECT =	'homo. id'	Homogeneous object id (C*28) defined as
xIUECLAS=	nn	Object class
xTRAILRT=	nnnn.nnnnn	Trail rate
xTRAILNR=	nnn	Number of trail passes
xFOCUS =	nnnn.nn	Focus
xFPM =	nnnn.nn	Flux particle monitor
xGSTARnX=	nnnnn	X coordinate of guide star in FES1, 2
xGSTARnY=	nnnnn	Y coordinate of guide star in FES1, 2
xGSTARnC=	nnnnn	Guide star counts in FES1, 2
xGSTARnM=	'mode'	FO, FU, SO, F, S, O, U

Note that the keyword xOBJECT contains the following fields:

Catalog (4 characters), Identification (12 characters), and Complementary object id. (12 characters).

Table 13: Output CDIs

Keyword and value		Description
ABNMINFR= 'YES/NO '		Bad/missing minor frames
ABNMICRO= 'YES/NO '		Microphonics
CC-PERCN=	nnn.n	Cross-correlation perc. successful
CC-WINDW=	nnn	Cross-correlation window size
CC-TEMPL=	nn	Cross-correlation template size
CC-MEDN =	n.nnn	Median cross-correlation coefficient
CC-STDEV=	n.nnn	Std. dev. of cross-corr. coefficients
SHFTMEAN=	n.nnn	Mean shift between image and ITF
SHFTMAX =	n.nnn	Maximum shift between image and ITF
ITF = 'cccyyRyyA'		ITF used (Camera and year)
TILTCORR= 'YES/NO '		Tilt correction applied to low disp LAP data
MEANRAT =	nnn.nnn	SI vs LI mean
STDEVRAT=	nnn.nnn	SI vs LI standard deviation
SERENDAP= 'LARGE/SMALL'		Serendipitous second aperture
xMJD-MID=	nnnnn.nnnnn	Mid point of observation ($JD - 2400000.5$)
xHELCORR=	nn.nnnnn	Heliocentric corr. to midpoint
xDATABKG=	nnn	Estimated background level (spectra)
xDATACNT=	nnn	Estimated continuum level (spectra)
xCNTRAPR=	nnn.n	Predicted center line of spectrum
xXTRMODE= 'mode '		Extr. mode POINT, EXTENDED
xXTRPROF= 'profile '		Default profile used (low disp)
xXTRASYM= 'YES/NO '		Assymetrical profile in extraction
xXTRCNTR=	nnn.n	Center line opt. extr. spectrum
xFLUXAVE=	nnnnnn.n	Average net flux FN (low disp)
xOFFSET =	nn.nn	Global spectral format offset
xRADVELO=	nnn.n	Radial velocity for high dispersion

Table 14: FES CDIs

Keyword and value		Description
CAMERA = 'FESn '		FES1 or FES2
IMAGE =	nnnnn	Sequential FES image number
BITRATE =	nn.nn	Telemetry bitrate (Kbits/sec)
SAMPLES =	n	Samples per minor frame (1 or 8)
EXPTIME =	nnnnn.nnnnn	Integration time in secs.
DATEOBS = 'dd/mm/yy'		Observing date
TIMEOBS = 'hh:mm:ss'		Observing time
MJD-OBS =	nnnnn.nnnnn	Start of obs. (JD - 2400000.5)
TARGET = 'target '		Object as given by Guest Observer
TARGRA =	nnn.nnnn	R.A. in degrees (given by GO)
TARGDEC =	nnn.nnnn	Dec. in degrees (given by GO)
EQUINOX =	1950.0	Equinox of coordinate system
OBJECT = 'obj_name'		Homogeneous Object ID.
RA =	nnn.nnnn	Slit R.A. in degrees (homogeneous)
DEC =	nnn.nnnn	Slit Dec. in degrees (homogeneous)
TCDF =	nn.nnn	FES camera temperature
IUECLAS =	nn	Object class
FOCUS =	nnnn.nn	Focus
FPM =	nnnn.nn	Field Particle Monitor
RELIMAGE= 'cccnnnnn'		Related scientific image
PGM-ID = 'prog_id '		Program identification
COMMENT		Comments

Appendix B

Header Example

The following example shows the FITS header corresponding to a low dispersion, double aperture MXLO image. In the case of a single aperture spectral image, the header includes only the corresponding large (or small) aperture set.

```
         1         2         3         4         5         6         7
1234567890123456789012345678901234567890123456789012345678901234567890

SIMPLE  =                    T / Standard FITS Format
BITPIX  =                    8 / 8 bits ASCII
NAXIS   =                    0 / No image data
EXTEND  =                    T / Extensions are present
TELESCOP= 'IUE     '           / International Ultraviolet Explorer
DATE    = '06/08/94'           / Date file was written
ORIGIN  = 'GSFC    '           / Institution generating the file
COMMENT *
COMMENT * CORE DATA ITEMS - COMMON SET
COMMENT *
CAMERA  = 'SWP     '           / Camera
IMAGE   =                17215 / Sequential image number
DISPERSN= 'LOW     '           / Spectrograph dispersion mode
APERTURE= 'BOTH    '           / Aperture
DISPTYPE= 'LOW     '           / Dispersion processing type
READMODE= 'FULL    '           / Read mode
READGAIN= 'LOW     '           / Read gain
EXPOGAIN= 'MAXIMUM '           / Exposure gain
UVC-VOLT=                 -5.0 / UVC voltage
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
THDAREAD=                 9.34 / THDA at read of image
EQUINOX =              1950.00 / Epoch of coordinates
STATION = 'GSFC    '           / Observing station
ORBEPOCH= '09/06/82'           / Orbital elements epoch
ORBSAXIS=              42170.2 / Semi-major axis in kilometers
ORBECCEN=            0.2243381 / Eccentricity
ORBINCLI=               28.455 / Inclination in degrees
ORBASCEN=              174.048 / Ascending node in degrees
ORBPERIG=              290.449 / Argument of perigee in degrees
ORBANOMA=               90.794 / Mean anomaly in degrees
POSANGLE=               138.43 / Pos angle of the large aperture (deg)
LAMP    = 'NONE    '           / Lamp
PGM-ID  = 'EHEEJ   '           / Program identification
ABNMINFR= 'NO      '           / Bad/missing minor frames
CC-PERCN=                 94.9 / Cross-correlation % successful
CC-WINDW=                   29 / Cross-correlation window size
CC-TEMPL=                   23 / Cross-correlation template size
CC-MEDN =                0.861 / Median cross-correlation coefficient
CC-STDEV=                0.173 / St dev of cross-corr coefficients
SHFTMEAN=                0.050 / Mean shift between image and ITF
SHFTMAX =                0.279 / Maximum shift between image and ITF
ITF     = 'SWP85R92A'          / ITF identification
TILTCORR= 'NO      '           / Tilt correction flag
MEANRAT =                1.005 / SI vs LI mean
STDEVRAT=                0.991 / SI vs LI standard deviation
SERENDAP= 'SMALL   '           / Serendipitous spectrum in aperture
COMMENT BY RA:  EXP 1 APER L C=85,B=20
COMMENT BY RA:      0 MISSING MINOR FRAMES NOTED ON SCRIPT
```

```
COMMENT BY RA:  EXP 1 TRACKED ON GYROS
COMMENT BY RA:  S   PREP USED
COMMENT *
COMMENT * CORE DATA ITEMS - LARGE APERTURE SET
COMMENT *
LDATEOBS= '14/06/82'           / Observing date
LTIMEOBS= '16:03:18'           / Observing time
LMJD-OBS=          45134.66896 / Mod. JD start of obs. (JD - 2400000.5)
LEXPTRMD= 'X-TRAIL '           / Trail mode
LEXPMULT= 'NO      '           / Multiple exposure mode
LEXPSEGM= 'NO      '           / Segmented exposure code
LEXPTIME=                5.908 / Integration time in seconds
LTHDASTR=                 9.80 / THDA at start of exposure
LTHDAEND=                 9.84 / THDA at end of exposure
LRA     =               0.2948 / Homogeneous R.A. in degrees
LDEC    =             -17.6143 / Homogeneous Dec. in degrees
LLAPSTAT= 'OPEN    '           / Large aperture status
LFES2MD = 'FU      '           / FES(2) mode
LFES2CN =                  415 / FES(2) counts on target
LTARGET = 'HD 225132'          / Object as given by Guest Observer
LTARGRA =               0.2950 / R.A. in degrees (given by GO)
LTARGDEC=             -17.6142 / Dec. in degrees (given by GO)
LOBJECT = 'HD  225132'                   / Homogeneous Object ID
LIUECLAS=                   22 / Object class
LTRAILRT=             3.636041 / Trail rate
LTRAILNR=                    1 / Number of trail passes
LFOCUS  =                -0.47 / Focus
LFPM    =                 2.30 / Flux particle monitor
LGSTAR2M= 'NO      '           / Guide star mode FES2
LMJD-MID=          45134.66899 / Mod. JD middle of obs. (JD - 2400000.5)
LHELCORR=              0.00002 / Heliocentric corr to midpoint (days)
LDATABKG=                   20 / Estimated mean background level (DNs)
LDATACNT=                   76 / Estimated maximum continuum level (DNs)
LCNTRAPR=                 51.0 / Predicted center line of spectrum
LXTRMODE= 'EXTENDED'           / Extraction mode
LXTRPROF= 'EMPIRICAL'          / Profile used
LXTRASYM= 'NO      '           / Asymmetrical profile in extraction
LXTRCNTR=                 49.9 / Center line of extracted spectrum
LFLUXAVE=                 39.7 / Average flux (FNs)
COMMENT *
COMMENT * CORE DATA ITEMS - SMALL APERTURE SET
COMMENT *
SDATEOBS= '14/06/82'           / Observing date
STIMEOBS= '16:03:18'           / Observing time
SMJD-OBS=          45134.66896 / Mod. JD start of obs. (JD - 2400000.5)
SEXPTRMD= 'X-TRAIL '           / Trail mode
SEXPMULT= 'NO      '           / Multiple exposure mode
SEXPSEGM= 'NO      '           / Segmented exposure code
SEXPTIME=                0.776 / Integration time in seconds
STHDASTR=                 9.80 / THDA at start of exposure
STHDAEND=                 9.84 / THDA at end of exposure
SRA     =               0.2948 / Homogeneous R.A. in degrees
SDEC    =             -17.6143 / Homogeneous Dec. in degrees
SLAPSTAT= 'OPEN    '           / Large aperture status
SFES2MD = 'FU      '           / FES(2) mode
SFES2CN =                  415 / FES(2) counts on target
STARGET = 'HD 225132'          / Object as given by Guest Observer
STARGRA =               0.2950 / R.A. in degrees (given by GO)
STARGDEC=             -17.6142 / Dec. in degrees (given by GO)
SOBJECT = 'HD  225132'                   / Homogeneous Object ID
SIUECLAS=                   22 / Object class
STRAILRT=             3.636041 / Trail rate
STRAILNR=                    1 / Number of trail passes
SFOCUS  =                -0.47 / Focus
SFPM    =                 2.30 / Flux particle monitor
SGSTAR2M= 'NO      '           / Guide star mode FES2
SMJD-MID=          45134.66896 / Mod. JD middle of obs. (JD - 2400000.5)
SHELCORR=              0.00002 / Heliocentric corr to midpoint (days)
SDATABKG=                   20 / Estimated mean background level (DNs)
```

```
SDATACNT=                   44 / Estimated maximum continuum level (DNs)
SCNTRAPR=                 24.9 / Predicted center line of spectrum
SXTRMODE= 'POINT   '           / Extraction mode
SXTRPROF= 'EMPIRICAL'          / Profile used
SXTRASYM= 'NO      '           / Asymmetrical profile in extraction
SXTRCNTR=                 23.8 / Center line of extracted spectrum
SFLUXAVE=                 14.2 / Average flux (FNs)
COMMENT *
COMMENT * THE IUE VICAR HEADER
COMMENT *
COMMENT IUE-VICAR HEADER START
                                 1   1 768 768   1 1 013117215             1  C
          3876*   4*IUESOC  *   *   *   128*      *   *  * * * * * *     * 2  C
        SWP 17215, HD 225132, 5.5 SEC TRAIL, LOW DISP, LARGE APER          3  C
                                                                           4  C
                                                                           5  C
        OBSERVER: JENKINS   PROGRAM: EHEEJ   DAY 165  14 JUN 82            6  C
                                                                           7  C
                                                                           8  C
                                                                           9  C
        82165161012* 9   * 218 *OPSPRC29*155919 TRAIL 3  .363640E 01     * 10  C
        144656 EXPOBC 3 25 0   MAXG NOL *160046 TARGET IN SWLA           * 11  C
        145038 MODTIME 3 0 0            *160321 EXPOBC 3 25 0   MAXG NOL * 12  C
        145106 FIN 3 T 217 S 97 U 109   *160537 MODTIME 3 0 0            * 13  C
        145217 TARGET FROM SWLA         *160636 FIN 3 T 128 S 97 U 109   * 14  C
        145313 ITER 1 TIME  .800000E 01 *160748 TARGET FROM SWLA         * 15  C
        150046 TLM,SWPROM               *160837 ITER 1 TIME  .549994E 01 * 16  C
        150222 READPREP 3 IMAGE 17213   *160919 TLM,SWPROM               * 17  C
        150254 SCAN READLO SS 1 G3 44   *161012 READPREP 3 IMAGE 17215   * 18  C
        150309 X 60 Y 76 G1 82 HT 105   *161047 SCAN READLO SS 1 G3 44   * 19  C
        152311 TLM,FES2ROM              *161104 X 60 Y 76 G1 82 HT 105   * 20  C
        152701 TRAIL 3  .125000E 01     *161040                          * 21  C
        152806 TARGET IN SWLA           *161103                          * 22  C
        153015 EXPOBC 3 25 0   MAXG NOL *140858 TARGET FROM SWLA         * 23  C
        153232 MODTIME 3 0 0            *140931 S/C READY FOR MANEUVER   * 24  C
        153258 FIN 3 T 133 S 97 U 109   *140951 MODE SWH                 * 25  C
        153359 TARGET FROM SWLA         *141020 READPREP 3 IMAGE 17212   * 26  C
        153442 ITER 1 TIME  .160000E 02 *141055 SCAN READLO SS 1 G3 44   * 27  C
        153507 TLM,SWPROM               *141109 X 60 Y 76 G1 82 HT 105   * 28  C
        153539 READPREP 3 IMAGE 17214   *143117 TLM,FES2ROM              * 29  C
        153610 SCAN READLO SS 1 G3 44   *144246 MODE SWL                 * 30  C
        153625 X 60 Y 76 G1 82 HT 105   *144305 TRAIL 3  .250000E 01     * 31  C
        155622 TLM,FES2ROM              *144429 TARGET IN SWLA           * 32  C
                                                                          33  C
                                                                          34  C
                                                                          35  C
        EHEEJ* *  *JENKINS         *   *   *H*00225132*0*0* * 22          36  C
        0001107-173650*  0*B9*4*4.56*+0.03*         *    *      *   *     37  C
                                                                          38  C
                                                                          39  C
                                                                          40  C

                                 . . . . . . . .
                                 . . . . . . . .
                                 . . . . . . . .

        2020202020203820202020202005C20202025202020202020512020202020032424D 97  C
        20202020202061202020202020202020202020202020202020202020202020203920 97  C
        20202020202038207220202020205C2020202020202020202020206320324120 98  C
        202061222020202020206020202F20202020202020202020202020202020202020203920 98  C
        2020202020203820702020202020202025202020202020202020206320324120 99  C
        2020612720202020202020202F20202020202020202020202020202020202020203920 99  C
        20202020202038202020202020205C2020202C20202020202020512020206420314446 100 C
        20202020206B602020202009B202020202020202020202020202020202020203031 100 C
        *VBBLK* 08:41 JUN 15,'82                                               L
COMMENT IUE-VICAR HEADER END
HISTORY IUE-LOG STARTED                          06-AUG-1994 22:46:41
HISTORY PROCESSING SYSTEM: NEWSIPS VERSION 2.3.1
HISTORY ULTRIX VERSION
HISTORY SWP17215
```

```
HISTORY PROCESSED AT GODDARD SPACE FLIGHT CENTER
HISTORY ****************************************************************
HISTORY ****************************************************************
HISTORY START RAW_SCREEN                          6-AUG-1994 22:48:24
HISTORY   13 BRIGHT SPOTS DETECTED
HISTORY    0 MISSING MINOR FRAMES DETECTED
HISTORY LARGE APERTURE SPECTRUM WILL BE EXTRACTED AS
HISTORY           EXTENDED SOURCE
HISTORY SERENDIPITOUS SMALL APERTURE FLUX DETECTED
HISTORY LARGE APERTURE CONTINUUM DN LEVEL =  76
HISTORY SMALL APERTURE CONTINUUM DN LEVEL =  44
HISTORY BACKGROUND DN LEVEL =  20
HISTORY END   RAW_SCREEN                          6-AUG-1994 22:48:53
HISTORY ****************************************************************
HISTORY START TTDC                                6-AUG-1994 22:48:57
HISTORY TEMPERATURE USED FOR CORRECTING DISPERSION CONSTANTS =  9.84
HISTORY DATE OF OBSERVATION USED FOR CORRECTING
HISTORY           DISPERSION CONSTANTS = 14/ 6/82  16:03:18
HISTORY THIRD-ORDER FIT OVER TIME USED
HISTORY FIRST-ORDER FIT OVER TEMPERATURE USED
HISTORY ZERO-POINT CORRECTION =  -0.68 ANGSTROMS
HISTORY SPATIAL CORRECTION =  -0.14 PIXELS
HISTORY END   TTDC                                6-AUG-1994 22:48:59
HISTORY ****************************************************************
HISTORY START CROSS-CORR                          6-AUG-1994 22:49:10
HISTORY WINDOW SIZE USED:    29 X  29 PIXELS
HISTORY TEMPLATE SIZE USED:  23 X  23 PIXELS
HISTORY ITF USED:  SWP85R92A
HISTORY  95.0  PERCENT SUCCESSFUL CORRELATIONS (132 OUT OF 139)
HISTORY MEDIAN CORRELATION COEFFICIENT: 0.861
HISTORY STANDARD DEVIATION OF CORRELATION COEFFICIENT: 0.173
HISTORY MEAN SHIFT IN PIXELS: 0.050
HISTORY MAXIMUM SHIFT IN PIXELS: 0.279
HISTORY NUMBER OF SUCCESSFUL SHIFTS FILTERED AS UNRELIABLE IN
HISTORY     POST-FILTER ROUTINE:   1
HISTORY END   CROSS-CORR                          6-AUG-1994 22:50:53
HISTORY ****************************************************************
HISTORY START PHOTOM                              6-AUG-1994 22:52:24
HISTORY ITF USED: SWP85R92A
HISTORY MEAN TEMPERATURE OF ITF:  9.3 C
HISTORY ITF UVC=-5.0 KV; UVFLOOD WAVELENGTH = 2536 A; ITF SEC =-6.1 KV
HISTORY ITF CONSTRUCTION: RAW SPACE, FOURIER FILTERED; JAN92
HISTORY END   PHOTOM                              6-AUG-1994 22:54:02
HISTORY ****************************************************************
HISTORY START GEOM                                6-AUG-1994 22:55:39
HISTORY WAVELENGTH LINEARIZATION APPLIED USING CHEBYSHEV COEFFICIENTS:
HISTORY      C(0) = 319.620
HISTORY      C(1) = 318.820
HISTORY      C(2) = 0.87967
HISTORY      C(3) = 0.67988
HISTORY WAVELENGTH ZEROPOINT AND SPATIAL SHIFT APPLIED:
HISTORY      ZERO-POINT SHIFT = -18.24 ANGSTROMS
HISTORY      SPATIAL SHIFT =   3.07 PIXELS
HISTORY FINAL TIME/TEMP CORRECTED DISPERSION CONSTANTS USED:
HISTORY      1050.00 ANGSTROMS, 1.6763 ANGSTROMS/PIXEL
HISTORY PREDICTED CENTER LINE OF LARGE APERTURE = LINE 51.0
HISTORY PREDICTED CENTER LINE OF SMALL APERTURE = LINE 24.9
HISTORY END   GEOM                                6-AUG-1994 23:01:10
HISTORY ****************************************************************
HISTORY START SWET                                6-AUG-1994 23:01:52
HISTORY  NOISE MODEL USED: SWP  VERSION 1.0
HISTORY
HISTORY  *********************LARGE APERTURE DATA***********************
HISTORY
HISTORY  PREDICTED SPECTRUM CENTER AT LINE 51, CENTROID FOUND AT
HISTORY       LINE 50, PEAK AT LINE 48, AVERAGE PEAK FN =    39.7
HISTORY  CROSS-DISPERSION PROFILES BINNED WITH A BLOCKSIZE OF   1 PIXELS,
HISTORY       FOR A TOTAL OF 526 BLOCKS, OF WHICH  95 ARE REJECTED
HISTORY  FIT PROFILE WITH 15 NODES AND  3.50 SIGMA REJECTION
```

```
HISTORY  PROFILE CENTROID AT LINE  49.9
HISTORY  EXTRACT FLUX FROM LINES 39 THROUGH  61
HISTORY  REJECT PIXELS DEVIATING BY  4.0 SIGMA
HISTORY  OUT OF    14720 PIXELS       0 REJECTED AS COSMIC RAY HITS,
HISTORY         257 FLAGGED AS BAD
HISTORY  ABSOLUTE FLUX CALIBRATION SWP VERSION 1.2 APPLIED USING:
HISTORY       MODE = LARGE APERTURE TRAILED SOURCE
HISTORY       CALIBRATION EPOCH = 1985.00
HISTORY       CAMERA RISE TIME = 0.130 SECONDS
HISTORY       EFFECTIVE EXPOSURE TIME =     5.908 SECONDS
HISTORY  TEMPERATURE-DEPENDENT SENSITIVITY CORRECTION APPLIED USING:
HISTORY       THDA OF IMAGE =  9.84
HISTORY       REFERENCE THDA =  9.40
HISTORY       TEMPERATURE COEFFICIENT = -0.0046
HISTORY       TEMPERATURE CORRECTION FACTOR =   1.002
HISTORY  SENSITIVITY DEGRADATION CORRECTION SWP VERSION 1.0 APPLIED USING:
HISTORY       MODE = LARGE APERTURE TRAILED SOURCE
HISTORY       CALIBRATION EPOCH = 1985.00
HISTORY       OBSERVATION DATE = 1982.452
HISTORY
HISTORY  *********************SMALL APERTURE DATA***********************
HISTORY
HISTORY  PREDICTED SPECTRUM CENTER AT LINE 25, CENTROID FOUND AT
HISTORY       LINE 24, PEAK AT LINE 24, AVERAGE PEAK FN =    14.2
HISTORY  CROSS-DISPERSION PROFILES BINNED WITH A BLOCKSIZE OF   1 PIXELS,
HISTORY       FOR A TOTAL OF 526 BLOCKS, OF WHICH 193 ARE REJECTED
HISTORY  FIT PROFILE WITH 15 NODES AND  3.50 SIGMA REJECTION
HISTORY  PROFILE CENTROID AT LINE  23.8
HISTORY  EXTRACT FLUX FROM LINES 18 THROUGH  30
HISTORY  REJECT PIXELS DEVIATING BY  4.0 SIGMA
HISTORY  OUT OF     8320 PIXELS       4 REJECTED AS COSMIC RAY HITS,
HISTORY          98 FLAGGED AS BAD
HISTORY  ABSOLUTE FLUX CALIBRATION SWP VERSION 1.2 APPLIED USING:
HISTORY       MODE = SMALL APERTURE POINT SOURCE
HISTORY       CALIBRATION EPOCH = 1985.00
HISTORY       CAMERA RISE TIME = 0.130 SECONDS
HISTORY       EFFECTIVE EXPOSURE TIME =     0.776 SECONDS
HISTORY  TEMPERATURE-DEPENDENT SENSITIVITY CORRECTION APPLIED USING:
HISTORY       THDA OF IMAGE =  9.84
HISTORY       REFERENCE THDA =  9.40
HISTORY       TEMPERATURE COEFFICIENT = -0.0046
HISTORY       TEMPERATURE CORRECTION FACTOR =   1.002
HISTORY  SENSITIVITY DEGRADATION CORRECTION SWP VERSION 1.0 APPLIED USING:
HISTORY       MODE = LARGE APERTURE POINT SOURCE
HISTORY              APPLIED TO SMALL APERTURE DATA
HISTORY       CALIBRATION EPOCH = 1985.00
HISTORY       OBSERVATION DATE = 1982.452
HISTORY END   SWET                                  6-AUG-1994 23:02:46
HISTORY ****************************************************************
HISTORY START FITSCOPY                              6-AUG-1994 23:02:53
END
```

EXTENSION HEADER

```
XTENSION= 'BINTABLE'           / Table Extension
BITPIX  =                    8 / Binary data
NAXIS   =                    2 / Two_dimensional table array
NAXIS1  =                11535 / Bytes per row (15+18*NPOINTS)
NAXIS2  =                    2 / Number of apertures (1-single, 2-both)
PCOUNT  =                    0 / Number of bytes following data matrix
GCOUNT  =                    1 / Only one group
TFIELDS =                    9 / Number of columns in the table
TFORM1  = '5A      '           / Count and data type of field 1
TTYPE1  = 'APERTURE'           / Aperture type (large or small)
TUNIT1  = '        '           / Unitless
TFORM2  = '1I      '           / Field 2 has one 2-byte integer
TTYPE2  = 'NPOINTS '           / Number of points
TUNIT2  = '        '           / Unitless
TFORM3  = '1E      '           / Count and data type of field 3
```

```
TTYPE3  = 'WAVELENGTH'          / 3rd field is starting wavelength
TUNIT3  = 'ANGSTROM'            / Unit is angstrom
TFORM4  = '1E      '            / Count and data type of field 4
TTYPE4  = 'DELTAW  '            / 4th field is wavelength increment
TUNIT4  = 'ANGSTROM'            / Unit is angstrom
TFORM5  = '640E    '            / Count and data type of field 5
TTYPE5  = 'NET     '            / 5th field is net flux array
TUNIT5  = 'FN      '            / Unit is IUE FN
TFORM6  = '640E    '            / Count and data type of field 6
TTYPE6  = 'BACKGROUND'          / 6th field is background flux array
TUNIT6  = 'FN      '            / Units IUE FN
TFORM7  = '640E    '            / Count and data type of field 7
TTYPE7  = 'SIGMA   '            / 7th field is the sigma
TUNIT7  = 'ERG/CM2/S/A'         / Unit is erg/cm2/sec/angstrom
TFORM8  = '640I    '            / Count and data type of field 8
TTYPE8  = 'QUALITY '            / 8th field is the data quality flag
TUNIT8  = '        '            / Unitless
TFORM9  = '640E    '            / Count and data type of field 9
TTYPE9  = 'FLUX    '            / 9th field is the calibrated flux
TUNIT9  = 'ERG/CM2/S/A'         / Unit is erg/cm2/sec/angstrom
FILENAME= 'SWP17215.MXLO'       / Filename (camera)(number).MXLO
EXTNAME = 'MELO    '            / Name of table
END
```

IUE Computing Facilities at VILSPA

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Introduction

This paper describes the computing facilities of the **IUE** project currently available at Vilspa.

These facilities are currently based on two different kind of systems: VMS and Ultrix, and are grouped into two Clusters: the *Vilspa Vax Cluster* and the *Vilspa Ultrix Cluster*. These clusters provide an open and flexible environment and are part of a powerful communication system composed of LANs[4], hubs, routers, communication processors and WANs[5], i.e. the **ESA** communication network.

This enable IUE users to access the Clusters and the services provided by the Internet and the SPAN[6]/DECnet WANs.

Since three years, a smooth transition from VMS to Unix/Ultrix is being done at Vilspa, mainly driven by the computing requirements of the IUE Final Archive project (IUEFA) which was developed under Ultrix, for reasons of speed and economy. The ESA IUE observatory is making the transition from VMS to Unix and it is foreseeable that many of the IUE computing facilities and activities will be on Unix systems in the future.

During 1995, a new Alpha 2100 Server, running OSF/1[7], will be installed to further consolidate the computing power under Unix and to satisfy the necessities of the IUE Data Base, the future IUEFA data distribution and other user services.

The aim of this paper is to give a general vision of all IUE Computing Facilities. The document outlines the current hardware, system software, science applications and utilities available.

[3] INSA (Ingenieria y Servicios Aeroespaciales) Systems Analyst, ESA/ESOC Contract 4219/80/D/HGE

[4] Local Area Network

[5] Wide Area Network

[6] Space Physics and Analysis Network

[7] Open Software Foundation, Unix Operating System

Systems configuration

Figure 1 shows a detailed diagram for the hardware configuration. Within this Figure, a MicroVax II called **MAX** is shown. This is an stand-alone machine used until the end of 1994 for the IUE Data Bank service. This service has recently been moved to the Vax Cluster.

The Vax Cluster

The Vax Cluster is formed by the following Vax machines:

- Node **V3600** : MicroVax 4000/100A. Cluster Boot Node.
- Node **V3500** : MicroVax 3500. Cluster satellite.
- Node **WS3201**: WorkStation 3200. Cluster satellite.
- Node **WS3202**: WorkStation 3200. Cluster satellite.
- Node **WS3203**: WorkStation 3200. Cluster satellite.

The Vaxes have a CISC[8] CPU. The MicroVax 4000/100A CPU is rated as 24 VUPS (Vax Unit of Performance = The speed of the Vax 11/780 CPU, about 1 MIPS[9]). All the other Vax Cluster CPUs are equivalent in type[10] and speed, to about 3 VUPS. The currently running version of VMS is 5.5-2H4, for all Cluster CPUs.

The Vax Cluster Boot node (**V3600**) provides the VMS Operating System to its satellites by sharing a Common System Disk. The **V3500** node shares 6 disks with the **V3600** node, via a common bus (DSSI[11] Bus), and it is able to provide "boots" to the Cluster WorkStation satellites in case of a **V3600** failure. This is a minimum fail-over capacity to assure support for key applications running under the Vax Cluster, e.g. the daily IUESIPS processing and the IUE Data Bank.

All the Vax Cluster disks are cluster wide accessible, which minimizes the duplication and maintenance of Operating System Software and applications while providing a high degree of availability. The Vax Cluster System Disk, the disks holding both the users' accounts and the applications reside all on the 6 shared cluster disks. The WorkStations' disks contain only scratch areas[12] and local page and swap files.

User disks are backed up weekly in an unattended way on Exabyte tapes. The System Disk is saved monthly. The Vax Cluster is shutdown routinely once a month to perform a System Disk Backup and Restore. Except for this down time no other down times are routinely scheduled.

The Vax Cluster Disk distribution is shown in Table 1. The available tape devices, which are also cluster wide accessible, are shown in Table 2. The Vax Cluster and the Ultrix Cluster

[8] Complex Instruction Set Computer

[9] Million of Instructions per second

[10] MicroVax 3600 CPU class

[11] Digital Storage System Interconnect

[12] *Midas Scratch Areas*

Table 1: Vax Cluster Disks

Node	Logical Disk	Physical Disk	Capacity	Usage
V3600+V3500	$DISK00:	1DIA0:	2 GB	Clust.Sys.Disk + V3600&V3500 Page&Swap
V3600+V3500	$DISK01:	1DIA1:	2 GB	User's Accounts Disk
V3600+V3500	$DISK02:	1DIA2:	2 GB	Projects Disk + V3600 2nd. Page&Swap
V3600+V3500	$DISK03:	1DIA3:	2 GB	IUE Data Bank Disk
V3600+V3500	$DISK04:	1DIA4:	3.5 GB	IUEFA Processing Operations Disk
V3600+V3500	$DISK05:	1DIA5:	3.5 GB	Applications and Utilities Disk
V3600	$DISK06:	1DUA3:	622 MB	Scratch No. 1
V3600	GSCNORTH	1DUB1:	622 MB	Guide Star Catalogue North CD-ROM
V3600	GSCSOUTH	1DUB2:	622 MB	Guide Star Catalogue South CD-ROM
V3600		1DUB0:	622 MB	Public CD-ROM
V3500	$DISK90:	1DUA0:	290 MB	Scratch No. 2
V3500	$DISK91:	1DUA1:	1.5 GB	IUEFA System Disk + IUECAL
V3500	$DISK92:	1DUA2:	1.5 GB	IUEFA Optical Disk Service Disk
V3500		1DUB4:	6.5 GB	IUEFA SONY Optical Disk Drive
V3500		1DUB5:	6.5 GB	IUEFA SONY Optical Disk Drive
V3500		1DUC4:	6.5 GB	IUEFA SONY Optical Disk Drive
WS3201	$DISK10:	WS3201$DUA0:	159 MB	Midas Scratch No.5 + Local Page&Swap
WS3201	$DISK11:	WS3201$DUA1:	159 MB	Midas Scratch No.1
WS3202	$DISK20:	WS3202$DUA0:	159 MB	Midas Scratch No.2 + Local Page&Swap
WS3203	$DISK30:	WS3203$DUA0:	159 MB	Midas Scratch No.3 + Local Page&Swap
WS3203	$DISK31:	WS3203$DUA1:	159 MB	Midas Scratch No.4

are physically located in the VSCC[13] Rooms No. 1, 2 and 3. We refer to these locations as VSCC 1, VSCC 2 and VSCC 3, respectively. All these rooms are located within the Vilspa Operations Building No.1 (OPS 1), i.e.:

- VSCC 1 : Vilspa OPS Building 1, Room 20.
- VSCC 2 : Vilspa OPS Building 1, Room 17A.
- VSCC 3 : Vilspa OPS Building 1, Telefile-85 Computer Room.

There are currently about 142 registered user accounts on the Vax Cluster, 80% are individual user accounts, and the rest are project and service accounts. Standard user accounts are allocated on the $DISK01: (USER1$DISK:). The project accounts, which normally require large amounts of disk space, are on the $DISK02: disk (USER2$DISK:). The IUE Final Archive project has dedicated disks with a total of 6.5 GB, excluding the Optical Disks platters, which are used for reading and writing IUEFA products.

The Vax Cluster has currently a total disk space of 17.7 GB, excluding Optical Disks platters and CD-ROMs. The average daily work load is about 25 users on the **V3600** (licensed for 40 users), 1 user per workstation (licensed for 2 users), an 2 users on the **V3500** (licensed for 20 users).

[13]Vilspa Scientific Computer Center

Table 2: Vax Cluster Tape Devices

Node	Tape Device	Type	Max. Capacity	Location
V3600	V3600$MUA0:	TK 70	290 MB	VSCC 2
V3600	V3600$MUB0:	TU 81 Plus 9 track	40 MB approx. (1600 bpi)/ 100 MB ca. (6250 bpi)	VSCC 2
V3600	V3600$MUC0:	TU 81 Plus 9 track	40 MB approx. (1600 bpi)/ 100 MB ca. (6250 bpi)	VSCC 2
V3600	V3600$MUD5:	EXABYTE 8500C	2.3 GB (8200 mode)/5.0 GB (8500 mode) + Data Compr.	VSCC 2
V3600	V3600$MUD6:	EXABYTE 8500	2.3 GB (8200 mode)/5.0 GB (8500 mode)	VSCC 2
V3500	V3500$MUA0:	TK 70	290 MB	VSCC 2
V3500	V3500$MUB0:	TLZ04 DAT	1.2 GB (60m DAT/DDS tape)	VSCC 2
V3500	V3500$MUB1:	TLZ04 DAT	1.2 GB (60m DAT/DDS tape)	VSCC 2
V3500	V3500$MUB2:	WangDAT 3400 (TLZ06)	2 GB (90m DAT/DDS tape) + Compression	VSCC 2
V3500	V3500$MUB3:	WangDAT 3400 (TLZ06)	2 GB (90m DAT/DDS tape) + Compression	VSCC 2
V3500	V3500$MUB4:	WangDAT 3400 (TLZ06)	2 GB (90m DAT/DDS tape) + Compression	VSCC 2
V3500	V3500$MUB5:	WangDAT 3400 (TLZ06)	2 GB (90m DAT/DDS tape) + Compression	VSCC 2

The Vax Cluster total scratch disk space is 1.712 GB Out of this, 800 MB are allocated for what are called *Midas Scratch Areas*. There users can work without disk quota limitation under their own subdirectories. Two additional scratch disks, `scratch1` and `scratch2`, are also available. The Midas scratch areas are routinely cleaned every two weeks, while the `scratch1` and `scratch2` disks are erased weekly.

The Vax Cluster is currently being dedicated to the following main activities:

- MIDAS astronomical data processing.
- IDL and IUEDAC (IUERDAF) astronomical data analysis.
- Numerical algorithms and simulations.
- General scientific data analysis applications (Mongo, SuperMongo, PGPLOT, Cloudy, Nebular, Dipso, etc).
- TeX and LaTeX document preparation.
- IUESIPS daily processing.
- IUE Data Bank. ULDA/USSP.
- IUEFA processing control and OD generation.
- IUE RTOPS and Guide Star Catalogue support.
- User support (program development, mail, networking, etc).

The Vax Cluster provides X Windows services through the DEC Windows/Motif version 1.1, based on X 11 Release 5. The Cluster WorkStations run the DECWindows/Motif X Server on their X Displays. In addition, users can display X Clients running on the **V3600** and **V3500** nodes under these WorkStation Displays. The X Display can be transported either via DECnet or TCP/IP[14]. This allows X Clients running on remote Unix/Ultrix machines to be displayed on Cluster WorkStations and vice versa.

[14]Multinet TCP/IP services for OpenVMS

Vax Cluster Communication Services

The Vax Cluster communication services are based upon the DECnet protocol on top of Ethernet. In addition, all the Cluster nodes are Internet nodes throughout the same Ethernet controllers. Internet communication services are provided via Multinet 3.3C. Cluster disks are served to the Ultrix Cluster via Multinet NFS services (NFS server). The Internet domain defined for the Vax and Ultrix Clusters is *vilspa.esa.es* (network 131.176.121.0).

The Vax Cluster nodes are world-wide accessible via DECnet/SPAN. The use of node numbers is recommended (e.g. **V3600::** is 28847::), instead of node names, to identify Vax Cluster DECnet nodes from outside Vilspa, since these may not be defined on external DECnet/SPAN node databases. The same recommendation applies for mail exchange via DECnet/SPAN (e.g.: Use 28847::user_name as the mail address instead of **V3600::**user_name).

Due to security regulations, direct incoming Internet communications (e.g. `telnet` and `ftp`) are not allowed to any Vax Cluster node, except e-mail. But outgoing Internet communications have no restrictions. `Telnet` and `ftp` connections to Vilspa are only allowed to the MicroVax 3300 communications node (**v3300.vilspa.esa.es**). This node is also part of the SPAN/DECnet Network where it is known with the **VILSPA** node name and has the DECnet number 28.171 (28843).

E-mail from the Vax Cluster to the Internet is sent via the SMTP[15] Mail agent, that can be invoked from the standard VMS MAIL facility. For example, to send an e-mail to a typical Internet user address, i.e. user@domain, write the user address into the **To:** field of the VMS MAIL prompt as smtp%"user@domain".

There is no anonymous `ftp` service under the Vax Cluster. Anonymous `ftp` access to Vilspa is restricted to the **v3300.vilspa.esa.es** node.

The Ultrix Cluster

The Ultrix Cluster is formed by the following RISC[16] CPU machines:

- **encina**: DECSystem 5900 Server (R3000A CPU, 40 MHz). Boot server.
- **roble**: DECSystem 5900 Server (R3000A CPU, 40 MHz).
- **cipres**: DECStation 5133 (R3000A CPU, 33 MHz). Boots from **encina**.
- **enebro**: DECStation 5133 (R3000A CPU, 33 MHz). Boots from **encina**.
- **abedul**: DECStation 5133 (R3000A CPU, 33 MHz). Boots from **encina**.
- **tilo**: DECStation 5133 (R3000A CPU, 33 MHz).

There is an additional standalone DECStation 5000/200 (R3000 CPU, 25 MHz) called **dino** dedicated to the IUEFA Processing Pipeline, which shares resources of the Ultrix Cluster.

[15]Simple Mail Transport Protocol

[16]Reduced Instruction Set Computer

The Ultrix Cluster CPUs using the MIPS[17] RISC R3000A and R3000 chips, have the following performances[18]:

- DECSystems 5900, R3000A chip : 10.70/6.0 Linpack Single/Double MFLOPS[19].
- DECStations 5133, R3000A chip : 8.79/5.93 Linpack Single/Double MFLOPS.
- DECStation 5200, R3000 chip: 6.81/3.73 Linpack Single/Double MFLOPS.

We have chosen the same CPU Benchmark, i.e. the well known Linpack Single/Double precision suite that measures speed in MFLOPS. By using the same benchmark, a Sun SPARCstation IPX (SPARC LSI CPU, 40 MHz) gives 4.34/2.65 MFLOPS. The DECSystem is similar in speed to the MicroVax 4100A.

All these machines run currently the Ultrix Operating System version 4.4.

The Ultrix Cluster is based upon the TCP/IP communication services, in particular the NFS services. Different to the Vax Cluster, there is no common Operating System Disk shared by all the Ultrix Cluster nodes, which would act as boot disk. Only the DECStations **enebro**, **cipres** and **abedul**, make a remote boot from **encina** (from a specific System Disk which is different to the local System Disk of **encina**). All other Ultrix machines have their own local Operating System Disk. However, these independent machines serve or mount other local disks via NFS, therefore sharing Cluster disk and software resources.

The Ultrix Cluster disks distribution is shown in Table 3. Within Ultrix (Unix) the disk units are replaced by "File Systems" assigned to physical disk partitions. These partitions can be a part of or the whole physical disk.

All the Ultrix Cluster devices, i.e. disks and tapes, are SCSI[20] devices.

Table 4 shows all the Ultrix Cluster tape devices.

Tables 5 and 6 show the disks and tapes on the IUEFA Processing node **dino**.

The Ultrix Cluster uses the NIS[21] service to distribute important information from a Master NIS server (**encina**) to its clients. The NIS service provides information on users (*passwd* file), user groups (*group* file), network hosts (*hosts* file), networks (*networks* file), TCP/IP services (*services* file), mail aliases (*aliases* file), etc, via distributed database files called maps. The two most important are the *passwd* and the *group* NIS maps. By maintaining a distributed *passwd* file through NIS, users can make logins into any Ultrix Cluster node using the same username and password, and it is assured that they all have the same account root directory for all the nodes. The Ultrix Cluster users file systems are defined as `/user1`, for standard

[17] manufacturer of RISC R3000 chip series

[18] Source: Digital Equipment Corporation, June 1993

[19] Million of Floating Point Operations per second

[20] Small Computer System Interface

[21] Network Information Service, also known as Yellow Pages

Table 3: Ultrix Cluster Disks

Node	Partition	File System	Capacity	Usage
encina	/dev/rz0a	/ (root)	20 MB	Root File System (Boot)
encina	/dev/rz0b		192 MB	1st. Swap sapce for encina
encina	/dev/rz0d	/usr	1.1 GB	encina Operating System Software
encina	/dev/rz1c	/user1	1.312 GB	User's accounts
encina	/dev/rz2a	/root2	20 MB	Backup of the Root File System.
encina	/dev/rz2b		192 MB	2nd. Swap space for encina
encina	/dev/rz2d	/apps1	1.1 GB	Applications Software
encina	/dev/rz16d	/dlclient0	292 MB	Root File System for enebro, cipres & abedul (Boot)
encina	/dev/rz16e	/dlenv0	1. GB	Common usr file system for enebro, cipres & abedul
encina	/dev/rz17c	/user2	1.312 GB	User & project Accounts.
encina	/dev/rz18c	/apps2	1.312 GB	Applications Software
encina	/dev/rz5c	/encina_cd1	622 MB	CD-ROM with Ultrix On-line Doc.
encina	/dev/rz21c	/encina_cd2	622 MB	CD-ROM with Ultrix On-line Doc.
roble	/dev/rz0a	/ (root)	16 MB	Root File System for roble (Boot)
roble	/dev/rz0b		192 MB	1st. Swap space for roble
roble	/dev/rz0h	/usr	834 MB	Operating System Software
roble	/dev/rz0g	/var	398 MB	Admin. File System for roble
roble	/dev/rz1d	/oracle	1.233 GB	Oracle DBMS Software and DB files
roble	/dev/rz1b		65 MB	2nd. Swap space for roble
roble	/dev/rz2c		1.312 GB	Adabas DBMS Software & DB Files
roble	/dev/rz5c	/roble_cd1	622 MB	CD-ROM for Ultrix On-line Doc
cipres	/dev/rz0b		192 MB	1st. Swap space for cipres
cipres	/dev/rz0d	/cipres/disk1	782 MB	Cluster Scratch Disk 1
cipres	/dev/rz1c	/cipres/disk2	981 MB	Cluster Scratch Disk 2
cipres	/dev/rz2b		192 MB	2nd. Swap space for cipres
cipres	/dev/rz2d	/cipres/disk3	195 MB	Cluster Scratch Disk 3
cipres	/dev/rz3c	/cipres/iuefa	390 MB	IUEFA Distributed Processing Disk
cipres	/dev/rz4c	/cipres_cd1	622 MB	User Service CD-ROM
cipres	/dev/rz5c	/cipres_cd2	622 MB	User Service CD-ROM
enebro	/dev/rz0b		192 MB	1st. Swap space for enebro
enebro	/dev/rz0d	/enebro/disk1	782 MB	Cluster Scratch Disk 4
enebro	/dev/rz1c	/enebro/disk2	981 MB	Cluster Scratch Disk 5
enebro	/dev/rz2b		192 MB	2nd. Swap space for enebro
enebro	/dev/rz2d	/enebro/disk3	195 MB	Cluster Scratch Disk 6
enebro	/dev/rz3c	/enebro/iuefa	390 MB	IUEFA Distributed Processing Disk
enebro	/dev/rz8c	/enebro_cd1	622 MB	User Service CD-ROM
enebro	/dev/rz9c	/enebro_cd2	622 MB	User Service CD-ROM
enebro	/dev/rz10c	/enebro_cd3	622 MB	User Service CD-ROM
enebro	/dev/rz11c	/enebro_cd4	622 MB	User Service CD-ROM
abedul	/dev/rz0b		192 MB	1st. Swap space for abedul
abedul	/dev/rz0d	/abedul/disk1	782 MB	Cluster Scratch Disk 7
abedul	/dev/rz1c	/abedul/iuefa	981 MB	IUEFA Distributed Processing Disk
abedul	/dev/rz2b		192 MB	2nd. swap space for abedul
abedul	/dev/rz2d	/abedul/disk2	295 MB	Cluster Scratch Disk 8
tilo	/dev/rz0a	/ (root)	15.5 MB	Root File System (Boot)
tilo	/dev/rz0b		192 MB	1st. Swap space for tilo
tilo	/dev/rz0d	/usr	782 MB	Operating System Software
tilo	/dev/rz1b		192 MB	2nd. Swap space for tilo
tilo	/dev/rz1d	/usr/users	782 MB	User's accounts
tilo	/dev/rz2c	/tilo/disk1	390 MB	Scratch Area.
tilo	/dev/rz3c	/tilo/disk2	390 MB	Scratch Area

Table 4: Ultrix Cluster tape devices

Node	Tape Device	Type	Max. Capacity	Location
encina	/dev/rmt0h	DAT-TLZ06	2 GB (90m DAT/DDS tape)	VSCC 3
encina	/dev/rmt1h	TZ30	90 MB (CompactTape/TK50)	VSCC 3
encina	/dev/rmt2l	EXABYTE 8200	2.3 GB	VSCC 3
encina	/dev/rmt2h	EXABYTE 8500	5.0 GB	VSCC 3
encina	/dev/rmt3l	EXABYTE 8200	2.3 GB	VSCC 3
encina	/dev/rmt3h	EXABYTE 8500	5.0 GB	VSCC 3
roble	/dev/rmt0h	DAT-TLZ06	2 GB (90m DAT/DDS tape)	VSCC 3
enebro	/dev/rmt0l	EXABYTE 8200	2.3 GB	VSCC 1
enebro	/dev/rmt0h	EXABYTE 8500	5.0 GB	VSCC 1
abedul	/dev/rmt0l	WangDAT 3400	1.2 GB (60m DAT/DDS tape)	VSCC 1
abedul	/dev/rmt0h	WangDAT 3400	2 GB (90m DAT/DDS tape)	VSCC 1

Table 5: IUEFA Processing node (dino) disks

Node	Partition	File System	Capacity	Usage
dino	/dev/rz0a	/ (root)	19.3 MB	Root File System (Boot)
dino	/dev/rz0b		96 MB	1st. Swap space for dino
dino	/dev/rz0g	/usr	818 MB	Operating System Software
dino	/dev/rz1b		96 MB	2nd. Swap space for dino
dino	/dev/rz1g	/fadevel	836 MB	IUEFA Processing Software
dino	/dev/rz2c	/usr/users/iuefa	1.312 GB	IUEFA Processing Area
dino	/dev/rz5c		622 MB	CD-ROM

Table 6: IUEFA Processing node (dino) tape devices

Node	Tape Device	Type	Max. Capacity	Location
dino	/dev/rmt0h	TZ30	90 MB (CompacTape)	VSCC 1
dino	/dev/rmt1h	TLZ04	1.2 GB (60 m DAT/DDS)	VSCC 1

Table 7: Ultrix Cluster File System Mounting Table

File System	encina	roble	cipres	enebro	abedul	tilo	dino
/dlclient0	local	n/a	nfs	nfs	nfs	n/a	n/a
/dlenv0	local	n/a	nfs	nfs	nfs	n/a	n/a
/usr/local	local	nfs	nfs	nfs	nfs	n/a	n/a
/user1	local	nfs	nfs	nfs	nfs	n/a	n/a
/user2	local	nfs	nfs	nfs	nfs	n/a	n/a
/apps1	local	nfs	nfs	nfs	nfs	n/a	n/a
/apps2	local	nfs	nfs	nfs	nfs	n/a	n/a
/cipres/disk1	auto	n/a	local	auto	auto	n/a	n/a
/cipres/disk2	auto	n/a	local	auto	auto	n/a	n/a
/cipres/disk3	auto	n/a	local	auto	auto	n/a	n/a
/cipres/iuefa	auto	n/a	local	auto	auto	n/a	n/a
/enebro/disk1	auto	n/a	auto	local	auto	n/a	n/a
/enebro/disk2	auto	n/a	auto	local	auto	n/a	n/a
/enebro/disk3	auto	n/a	auto	local	auto	n/a	n/a
/enebro/iuefa	auto	n/a	auto	local	auto	n/a	n/a
/abedul/disk1	auto	n/a	auto	auto	local	n/a	n/a
/abedul/disk2	auto	n/a	auto	auto	local	n/a	n/a
/abedul/iuefa	auto	n/a	auto	auto	local	n/a	n/a
tilo:/usr/users	nfs	nfs	nfs	nfs	nfs	local	n/a
dino:/fadevel	auto	n/a	auto	auto	auto	n/a	local

users, and `/user2` for project accounts and other "large quota" accounts. The `/apps1` and `/apps2` file systems, contain applications and utilities.

Table 7 shows how the different Ultrix Cluster file systems are mounted over the whole Cluster and Cluster related Ultrix machines. Within Table 7, the keyword *local* specifies that the file system is locally mounted by the respective node, the keyword *nfs* specifies those file systems mounted continuously via NFS, and the keyword *auto* specifies file systems mounted via the NIS Auto-mounter service. The *n/a* keyword designates file systems not mounted at all on the respective node.

The *Ultrix Cluster Scratch* file systems are provided to allow users to handle large amounts of data. There is a total of 5.0 GB scratch disk space distributed on 8 scratch file systems, where users can work without disk quota limitation under their own subdirectories. In addition there are two scratch areas, each having 390 MB, under the **tilo** DECStation. The 8 scratch files systems are routinely cleaned every two weeks.

The Ultrix Cluster users file systems are saved weekly. The Ultrix Cluster is routinely shutdown monthly to perform Operating System backups.

The Ultrix Cluster DECStations allow users to work under DECWindows/Motif (current version is 1.2 based on X 11 Release 5). The Ultrix DECSystems **encina** and **roble** can also provide remote X Display via TCP/IP, either on the Ultrix DECStations or on any other Ultrix or Vax WorkStation.

The current total disk space available under the Ultrix Cluster, excluding the DECStation 5200 **dino**, is 22.5 GB approximately. There is a total user scratch space of 5.3 GB. The IUE Final Archive has allocated a total disk space of 5.1 GB, where 3.3 GB are on **dino** and 1.8 GB are in a dedicated file systems on the Ultrix Cluster DECStations.

There are about 125 registered user accounts, where about 90% are individual users or project accounts. The average daily work load on **encina** (licensed for 32 users) is about 20 users, 2 users on the Ultrix DECStations (licensed for 2 users), 4 users on **roble** (licensed for 8 users), and about 2 users on **dino** (licensed for 8 users).

The Ultrix Cluster is currently being dedicated to the following main activities:

- MIDAS Astronomical data processing.
- IDL astronomical data analysis.
- Numerical algorithms and simulations.
- General scientific data analysis applications.
- TeX and LaTeX document preparation.
- IUEFA NEWSIPS processing pipeline.
- IUE Integrated Scheduling.
- World Wide Web and Internet facilities.
- IUE Data Base facilities (Oracle and Adabas).
- User support (program development, mail, networking, etc).

The DECStation 5133 **tilo** is currently being dedicated to the IUE Integrated Scheduling.

Ultrix Cluster Communication Services

All the Ultrix Cluster and Ultrix related WorkStations run TCP/IP and are part of the Internet, as nodes of the *vilspa.esa.es* domain (network 131.176.121.0). The routing from the local network to the Internet is made via a Cisco router (**vilspar1**, 131.176.121.250). Concerning Domain Name Services, all Ultrix Cluster nodes are cache-only servers (i.e. do not provide any kind of Domain Name Server table). The Primary Domain Name Server for the *vilspa.esa.es* domain is the **v3300.vilspa.esa.es** node (MicroVax 3300, **VILSPA** SPAN node).

The Ultrix Cluster provides the TCP/IP communication services, NFS and NIS. The **enebro**, **cipres** and **abedul** DECStations share the same NIS Yellow Pages domain for information exchange. The master server for this domain is **encina** and there is also a slave server, i.e. **roble**.

All the Ultrix Cluster nodes and related Ultrix machines are also DECnet end nodes (DECnet Phase IV). They also run the DECnet/Internet Gateway software allowing them to exchange files and e-mail between DECnet and Internet.

External access from the Internet to the Ultrix Cluster machines is restricted to the e-mail and the Web (*World Wide Web* **http** server on **encina**, port 80). Outgoing communications to the Internet are not restricted.

Under the Ultrix Cluster there are several Mail User Agents (MUA) available:

- **mail**: The Ultrix standard mail agent.
- **dxmail**: The DECWindows/Motif mail agent.
- **mh**: RAND Mail Handler.
- **xmh**: X Windows interface to MH.
- **elm**: The USENET Community Trust elm mail user agent.
- **xmailtool**: An X interface to the mh mail agen, by Cray Systems.

All these mail agents interface to a unique Mail Transport Agent (MTA), the **sendmail**, to deliver either local or remote mail messages. The **sendmail** is able to deliver and accept messages directed to all the Ultrix Cluster nodes via DECnet by using the standard DECnet Mail syntax, `NODE::USER`, where `NODE` can be any of the DECnet node names or numbers for the Ultrix machines, and `USER` any of the registered users within them.

The current **sendmail** configuration for the Ultrix Cluster nodes does not manage mail on a centralized mail hub. Users are being advised to centralize mail either on the **encina** or **roble** servers until **sendmail** is configured to operate with a Cluster server mail hub.

There are no anonymous `ftp` services implemented under any Ultrix node.

X Terminals

There are currently four X Terminals, model DEC VXT2000+, named **pino, nogal, laurel,** and **fresno**, which boot their X Server software from **encina**. These terminals allow connections or X sessions with all Ultrix and Vax Cluster nodes via the TCP/IP and LAT protocols. DECnet X sessions are not available.

User X sessions on the X Terminals use the DECWindows/Motif Window Manager, `mwm`[22] when connected to Vax Cluster nodes and the X11R5 Window Manager, `twm`[23], when connected to Ultrix Cluster nodes.

Software Configuration

Vax Cluster Software

Operating System Software and Layered Products

Table 8 outlines the current Operating System Software main components and all the layered products, either from DEC or from other companies.

[22]Motif Window manager
[23]Tab Window Manager

Table 8: VMS Operating System Software components and Layered products

Product	Version	Description	Node availability
VAX/VMS	5.5-2H4	VAX/VMS Operating System	All nodes
VAX DECnet	5.5	DECnet Communication Services	All nodes
DECWindows/Motif	1.1	DECWindows/Motif (X11R5)	All nodes
Vaxcluster	5.5	Vaxcluster Software	All nodes
VAX Fortran	5.6	Fortran Compiler	All nodes
VAX C	3.1	C Compiler	All nodes
LSE	3.1	Language Sensitive Editor (CASE Tool)	All except V3500
CMS	3.4	Code Management System (CASE Tool)	All except V3500
DEC Print Serv.	4.1	Printing Services	All nodes
PrintServer	5.0	PrintServer Supporting Host Software	V3600
Pathworks	4.1	Pathworks Server Services	V3600
Multinet	3.3C	Multinet TCP/IP Services	All nodes
Multinet NFS	3.3C	Muntinet NFS Services	All Nodes
PowerTools	3.0	Syst. manager Administration Tools	All except V3500
DLB	4.0	Dynamic Load Balancer (VMS Perform. Managt.)	All except V3500
VAXSim (SDD)	1.6	Sympton Directed Diagnostic Monitor	All nodes
MDM	4.4	MicroVax Diag. Monitor	All nodes
ADABAS	3.2	Adabas DBMS System	V3600
Natural	2.16	Natural Language for Adabas DBMS	V3600
WordPerfect	5.1	WordPerfect for VMS	V3600
MX	1.2-3	Mail Message Exchange Soft.	All nodes
DECsplit	1.3	DEC Software Product Licensing & Installation	V3600

Applications and Utilities

Table 9 outlines all Applications and Utilities currently available under the Vax Cluster. Most of these applications are not licensed (i.e. public domain), and are free software granted by Scientific Institutions or individuals, others are comercial software packages.

Within Table 9, the keyword *A* used in column 3 means *Available* and the keyword *T* means *Testing*. *T* is used for software being installed and tested and hence is not yet fully available. In column 6 the *A* means that the documentation or manual for the specific utility or application is *Available* either in the VSCC 1 room or upon request.

The software listed in Table 9 has been described in internal Technical Notes (TN) or Software Documents (SD), which have been distributed to all users.

All Applications and Utilities listed in Table 9 are available on all the Vax Cluster nodes.

Ultrix Cluster Software

The currently available Ultrix Cluster Software includes the Ultrix Operating System and related software (Ultrix layered products) and all the Applications and Utilities needed to support the different IUE activities.

Table 9: Vax Cluster Applications and Utilities

Name	Version	Status	Help	Run command	Docs./Manuals
Scientific Applications					
Apig	1.0	A	help apig	start_apig/run_apig (toolsup)	A
Cloudy	84.06	A	help cloudy	cloudy (toolsup)	A
Dipso	2.06	A	help dipso	dipso (toolsup)	A
Nebular	1.30	A	help nebular	nebular/equib/ratio (toolsup)	A
Saoimage	1.04	A	help saoimage	saoi (toolsup)	A
Mongo	1982	A	Internal	mongo	A
PGPLOT	4.9	A	help pgplot	pgpup	A
SuperMongo	2.2	A	internal	smup + sm	A
SuperMongo	2.8	T	internal	smup + sm	A
NAG Fortran Lib	Mark15	A	help nag		A
NAGHELP	Mark15	A	naghelp	naghelp	A
NAG G-Floating	Mark15	A			A
NAG Fortran Lib	Mark16	T			A
NAGHELP	Mark16	T			A
IDL	3.5.1	A	Internal	idlup + idl	A
IDL	3.6.1	T	Internal		A
Astrolib		A	none		Source
IUEDAC		A	Internal	IUER*DAF	A
ESO-MIDAS	91may	A	Internal	pm	A
ESO-MIDAS	92nov	A	Internal	pm 92nov	A
ESO-MIDAS	93nov	A	Internal	pm 93nov	A
ESO-MIDAS	94nov	T	Internal		A
Atlas9		A	none		Source
Equi. Width (EWID)		A	none		Source
FITSIO	3.2	A	none		Source & Doc.
FITSIO	3.3	A	none		Source & Doc.
Numrecipes		A	none		Source
Gaussfit	3.03	A	none	gaussfit	A
BETAS		A	none	betas	A
DIAMANTE (GSC)		A	none	diamante (X device)	A
GUIDESTAR (GSC)		A	none	guidestar (VT device)	A
RTOPS/RTAID		A	none	rtops	A
Utilities					
TEX	2.09	A	none	texup + tex	TEXBook
LATEX	2.9	A	none	texup + latex	LATEXBook
xdvi	1990	A	help xv	texup + xv	A
AA_TEX	1994	A	none	Style files	A
Spell	2.2	A	help spell	spell	A
TAPES		A	help tapes	tapes	A
MTU	5.0	A	Internal	mtu	A
Swing	3.1	A	help swing	swing	A
cd	1989	A	cd ?	cd	A
more	1.50	A	help more	more	A
psf	1.5	A	none	psf	A
psfl	1.5	A	none	psfl	A
ps	1.5	A	none	ps	A
xterm	1.02	A	help xterm	xterm	A
vms2tar	1.11	A	none	vms2tar	A
tar2vms	2.3	A	none	vms2tar	A
tar		A	none	tar	A
compress		A	none	compress	A
WordPerfect	5.1	A	help WP51	wp	A
cdrom		A	none	cdup/cdrom	A
Lynx	2.3.8	A	internal	lynx	A
Mosaic	2.0	A	internal	mosaic/xmosaic	A
NEWS Reader	1993	T	internal	news	A

Table 10: Ultrix Operating System Software components and Layered products

Product	Version	Description	Node availability
Ultrix	4.4	Complete Ultrix Operating System Distribution	All nodes
DECWindows/Motif	1.2	DECWindows/Motif on X11R5	All nodes
TCP/IP	4.4	TCP/IP Communication Services	All nodes
BIND	4.4	Domain Name Services (BIND)	All nodes
NFS	4.4	Network File System Services	All nodes
NIS	4.4	Network Information Services (Yellow pages)	All nodes
DMS	4.4	Diskless Management Services	encina
DECnet/Ultrix	4.2	DECnet Services (Phase IV End Node)	All nodes
DECnet/IP Gtwy.	4.2	DECnet/Internet Gateway Services	All nodes
Pathworks	1.2	Pathworks Server Services	encina
PrestoServe	2.1	PrestoServe Services for Disk Caching	encina & roble
C	4.4	Standard Ultrix C Compiler	All nodes
DEC Fortran	3.2	DEC Fortran Compiler for Ultrix RISC	encina & dino
DECFuse	1.2A	DECwindows CASE Tool	encina & abedul
DEC VUIT	2.0b	DECWindows/Motif GUI Builder	abedul
DECdesign	2.0	DEC Design CASE Tool	encina
DEC Test Mgr.	1.0	DEC Test Manager CASE Tool	encina
Ultrix/SQL	2.0	Ultrix/SQL DBMS (DEC Test Manager)	encina
PrintServer	5.0	PrintServer Supporting Host	encina
VXT	1.3	X Terminals Supporting Software	encina
SoftPC	4.0	MS-DOS emulation under Ultrix RISC	encina
Adabas	1261	Adabas DBMS	roble
Natural	2125	Natural for Adabas DBMS	roble
Oracle	7.0	Oracle DBMS	roble

Operating System Software and Layered products

Table 10 outlines all of the currently available Operating System Software main components and layered products, either from DEC or from other companies.

Applications and Utilities

Table 11 lists all the currently available Applications and Utilities under the Ultrix Cluster. Most of this software is not licensed (public domain), or free software granted by Scientific Institutions or individuals, and others are commercial software packages (e.g. IDL, etc.).

Within Table 11, the keyword *A* used in column 3 means *Available* and the keyword *T* means *Testing* as described above (see section *Applications and Utilities*).

The software listed in Table 11 has been described in internal Vilspa Technical Notes (TN) or Software Documents (SD), which have been distributed to all users.

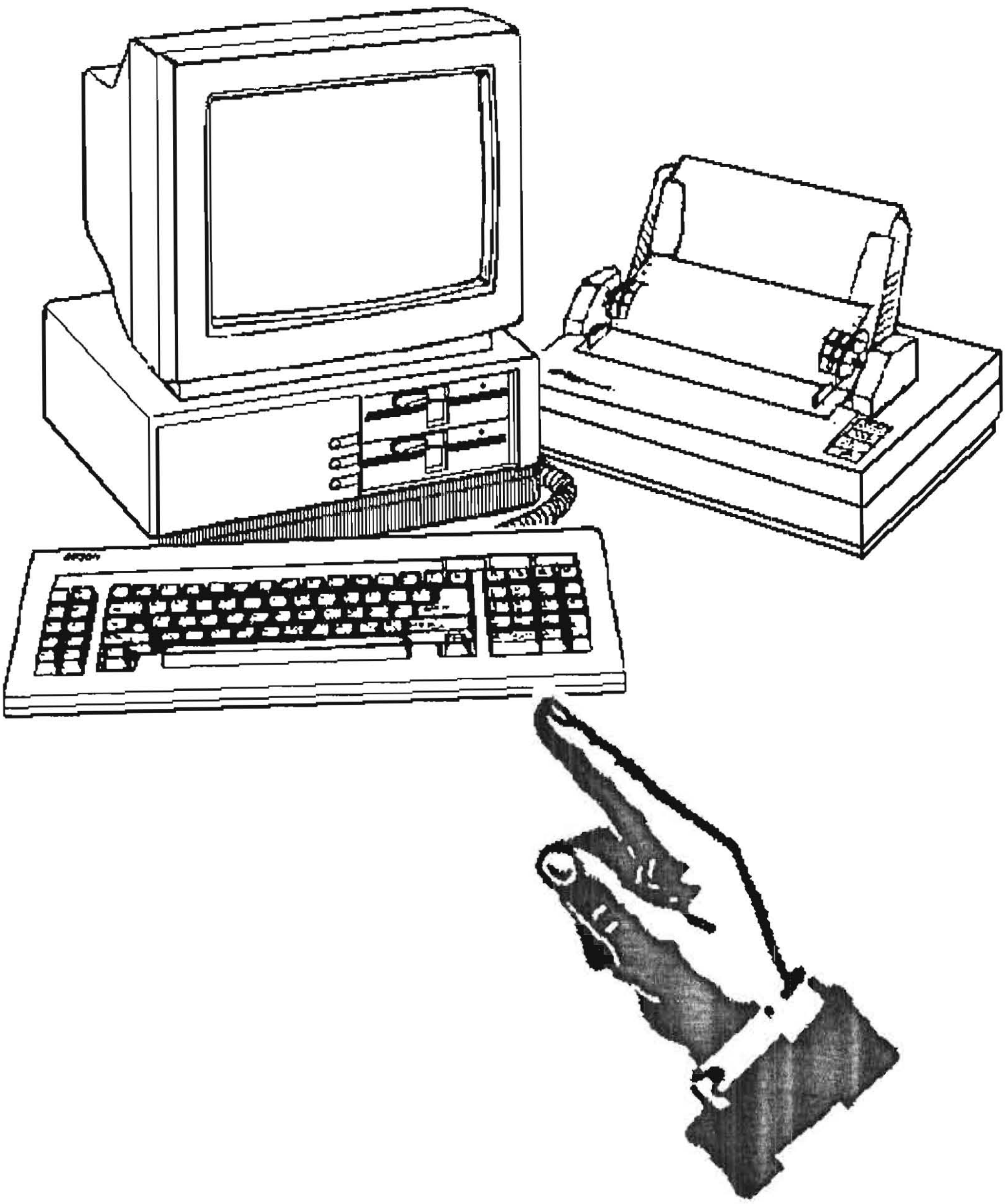
All software listed in Table 11 except the NAG Fortran Library and its associated On-line help (`naghelp`) is available on all the Ultrix Cluster nodes. NAG is only available on **encina**. The applications and utilities which involve excutable programs or shell scripts are accessed throught the user path, which by default includes the `/usr/bin`, the `/usr/local/bin`, and

Table 11: Ultrix Cluster Applications and Utilities

Name	Version	Status	Help	Run command	Manuals
Scientific Applications					
ESO-MIDAS	93NOV	A	Internal	inmidas	A
ESO-MIDAS	94MAY	A	Internal	setmidas/inmidas	A
EXSAS	94JUL	A	Internal	MIDAS 94MAY Context	A
ESO-MIDAS	94NOV	T	Internal	setmidas/inmidas	A
IDL	3.5.1	A	Internal	idl	A
IDL	3.6.1	T	Internal		A
NAG	Mark 15	A		Library	A
NAG help	Mark 15	A	naghelp	naghelp	A
Astrolib		A	From IDL		A
Cloudy	84.06	A	none	/appsl/cloudy/cloudy	A
gfit		T	none		A
DSS	1994	A	none	getimage	A
IUEDAC		T			A
SM	2.3.8	A	Internal	sm	A
PGPLOT	5.0	T			A
ADS	4.0	T	none		A
HRTS	1994	T	none		A
Utilites					
gcc C, C++	2.5.6	A	man -P /usr/local/man gcc	gcc	A
TeX	3.1415	A	man -P /usr/local/man tex	tex	TeXBook
LaTeX	3.1415	A	man -P /usr/local/man latex	latex	LaTeXBook
dvips	5.55a	A	man -P /usr/local/man dvips	dvips	A
xdvi	1.8	A	man -P /usr/local/man xdvi	xdvi	A
bibview	2.1	A	internal	bibview (X Display)	A
LaTeXtohtml	0.6.4	A	(Mosaic utility)	/user2/html/utils/latex2html	A
xv (+FITS)	3.0a	A	man xv	xv	A
ghostscript	2.6.0	A	gs -h	gs	A
ghostview	1.4.1	A	man ghostview	ghostview (X Display)	A
perl	4.036	A	man perl	/usr/bin/perl	A
GNU Emacs	19.22	A	man -P /usr/local/man emacs	emacs	A
EDT +	6.09	A	man edt	edt	A
x3270	R5	A	man x3270	x3270	A
tn3270	4.1.1	A	man tn3270	tn3270	A
Mosaic	2.4	A	internal	Mosaic/xmosaic	A
httpd	1.3	A	none	Daemon	A
Lynx	2.3	A	man lynx	lynx	A
freeWAIS	0.2/0.3	A	none	waisserver (Daemon)	A
xwais	0.3	A	internal	xwais	A
xarchie	2.0.6	A	man xarchie	xarchie	A
xgopher	1.3	A	man xgopher	xgopher	A
xrn	4.4.3	A	man xrn	xrn	A
ftptool	4.5	A	man -P /usr/local/man ftptool	ftptool	A
traceroute		A	man traceroute	traceroute	A
xnetload	1988-pl5	A	man xnetload	xnetload	A
kermit	5A (188)	A	man kermit	kermit	A
GNU gzip,gunzip		A	man -P /usr/local/man gzip,gunzip	gzip,gunzip	A
GNU gz utils.		A	man -P /usr/local/man gz_utility	gz_utility	A
identd	2.1.1	A	man identd	Daemon	A
elm	2.4	A	man -P /usr/local/man elm	elm	A
xmailtool	1.8	A	man xmailtool	xmailtool	A
xmailbox		A	man xmailbox	xmailbox	A
xbiff++		A	man xbiff++	xbiff++	A
xfsm	1.79	A	man xfsm	xfsm	A
xkeycaps	2.07	A	man xkeycaps	xkeycaps	A
GNU make	3.69	A		/usr/local/bin/make	A
GNU gdb	2.5.6	A	man -P /usr/local/man gdb	gdb	A
GNU xxgdb	1.08	A	man -P /usr/local/man xxgdb	xxgdb	A
xvgr, xfig		T	none		
Tripwire	1.1	T			A
TCP/IP wrapper	6.3	T			A

the /usr/bin/X11 directories.

IDL and the VAX-like editor EDT+ are accessed as commercial products, via a License Manager running on **encina**, which distributes the available licenses to all the Cluster nodes upon user request. Current licenses are 3 for IDL (floating network licenses) and 32 for EDT+ (network licenses), respectively.



ESA IUE caught in the Web

M. Barylak, J.D. Ponz, A. de la Fuente, O. Holm

VILSPA

Introduction

The ESA IUE project has been caught by the World-Wide-Web (WWW or W3), a system which helps people to navigate the Internet via hypertext links connecting computers with prolific information sources.

You may have heard of the Internet, either as the land of knowledge, and current civilization's most impressive creation (?) or as the Infobog, a pervasive, invasive information cacophony which will inundate us with junk at the speed of light. No matter how you see it, Internet and with it the information overload is a reality and is here to stay. It becomes easier to handle once you accept it as part of your life.

The way to get started is simple: get a computer and a modem. Sign up with one of the many network providers (for a list of your national access providers see e.g. Ref. 1). Install some software e.g. Mosaic[24] NetScape[25] or Lynx[26] and see for yourself, from daily newspapers, commercial marketings and electronic shopping malls to software repositories and doctoral theses.

You may want to skip this article and get into the real stuff by connecting to one of the following addresses (or Uniform Resource Locators (URLs)):

- `http://www.vilspa.esa.es/iue/iue.html`, IUE project at Villafranca
- `http://www.vilspa.esa.es/`, Welcome page.

WWW at VILSPA

The first implementation of a WWW browser at Villafranca took place during summer 1993, within the context of exploratory studies to define a distribution mechanism for the IUE Final Archive. After comparing the services provided by different architectures (Ref. 2), it was evident that hypermedia information systems – even at the implementation level two years ago – were an adequate solution.

[24] the most popular WWW browser which provides a graphical user interface (GUI) and hence needs windows i.e. X11, MS-Windows, Mac, ...

[25] a commercial package similar to Mosaic also called *"Mozilla"*

[26] a terminal based WWW browser, faster because there are no image loads

A pilot project was started and tested during the unique opportunity of the Jupiter/Shoemaker-Levy 9 event in July 1994. At that time, we had an HTTP[27] server running at VILSPA, together with well defined mechanisms to provide up-to-date information on recent comet impact observations together with pointers to the latest IUE observations.

Although the sever was only announced to a limited number of places, it was rather popular given the number of visitors we had (i.e. over 1,000). This "old SL-9 server" is still in operation but the information is no longer updated.

Based on this experience, we collected the requirements for a general information service (Ref. 3) in coordination with LAEFF (Laboratorio de Astrofísica Espacial y Física Fundamental, located at Villafranca), also taking into account the needs of the IUE project (Ref. 4). In addition, IUE Final Archive data were placed under the Web for internal access and quality control purposes only (Ref. 5).

Services

For a list of currently offered services see Fig. 1 or connect to the above indicated URLs.

The general WWW server of VILSPA (see Fig.2) floods you with information about the station in general (including non-trivial descriptions on how to reach Villafranca by car), other projects currently running at the station and the LAEFF. In addition, it maintains useful links to (1) astronomical resources in the Internet (also called the **AstroWeb**), (2) other space related information resources, including ESA, NASA and other agencies, (3) WWW virtual libraries at CERN, and (4) Spanish research Institutes and Universities on the Internet.

Design Goals

The main design goals considered in the definition of the WWW information service were:

- proper selection of the information to be provided,
- adequate balance between text and images,
- uniform presentation of the information,
- coordination with other information services, and
- optimized maintenance.

Selection of the information

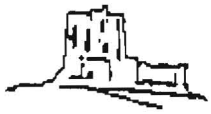
As mentioned in the introduction, the main problem associated with the usage of WWW is the overwhelming amount of gigabytes available. One will never be able to read all the information that's out there. Information providers should try to avoid to get everybody drown in the infobog.

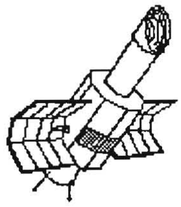
[27]Hyper-Text Transport Protocol

At VILSPA, we adopted a two-layered approach, ie. the overall services are divided into external ie. public accessible, and internal ie. restricted to local staff only, information items. Only tested, assessed and relevant information for the general user is moved to the external server.

esa

european space agency
agency spatiale européenne





International Ultraviolet Explorer (IUE) satellite

The International Ultraviolet Explorer (IUE) satellite was launched on the 26th of January 1978 by a Thor–Delta rocket from Cape Kennedy and transferred into a geosynchronous orbit over the Atlantic Ocean.

IUE is a joint project between NASA, PPARC and ESA. The IUE project serves the international astronomical communites from two observatories, one located at the NASA Goddard Space Flight Center and the second here at the ESA Villafranca Satellite Tracking Station (VILSPA).

- IUE Personnel
- Spacecraft Status (Jul. 1994)
- IUE Publications
- The IUE Merged Observing Log
- The Uniform Low Dispersion Archive (ULDA)
- IUE Data Request Form
- Schedule
- The IUE Final Archive (IUEFA)
- Some IUE related pictures

Home page | Feedback | Search | Help

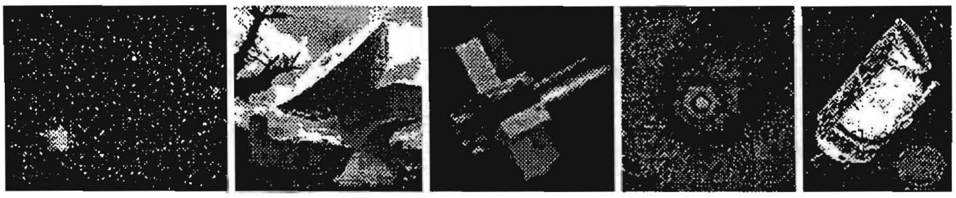
MB, Last update: Feb. 10, 1995.

Fig. 1: ESA IUE WWW home page

Text and Images

One important aspects of WWW as hypermedia system is to allow images, videos and sounds to be embedded into documents. This contributes to clarify the information, according to the sayings *"one image is worth more than thousand words ...* " and *"illoustrious graphics are as a display of coloured light to gladden my commonplace vision ...* " but is expensive in terms of network load and time invested into the transfer of these normally larger files.

Villafranca Satellite Tracking Station



Villafranca Information Service

Welcome to the homepage of the Villafranca Satellite Tracking Station. The Station is located 30 km West of Madrid, Spain. Villafranca belongs to the European Space Agency (ESA) ground stations network.

General Information
- Villafranca
- Local information service
- LAEFF
- What's new

Satellite Projects
- IUE: International Ultraviolet Explorer
- ISO: Infrared Space Observatory
- MARECS: Maritime Communication Satellites

ESA Establishments
- ESA Home Page
- ESA Headquarters (local)
- ESTEC
- ESOC
- EAC (local)
- ESRIN

Other Information Sources
- On Astronomy: AstroWeb
- On Space Agencies and Organizations
- On Space Industry
- On the World Wide Web
- On the World Wide Web in Spain

Other Local Services
- HTML Validation Service
- SL9/Jupiter Observing Campaign: images locally available
- SL9/Jupiter Observing Campaign: experimental server

About this server | Feedback | Search | Help

OJH & JDP. Last update:9 Jan 1995.

Fig. 2: ESA VILSPA home page

In addition, many users access the WWW via text-based browsers (e.g. Lynx) as provided by many dial-in Internet Access Providers with the advantage of faster document retrieval (no image load) and the provision of additional facilities.

It was therefore decided to limit the usage of embedded graphics and images to the cases were it deemed really necessary. In the future, this concept might change when network with broader bandwidths and more efficient servers will become available.

Uniform Presentation

In order to improve the usability of the server, we thought it important to define a consistent look and feel. Hence our information pages are presented in an uniform way, based on the following minimal set of rules:
(1) Uniform page headers, with informative titles (at least in the upper information levels),
(2) limit the number of intermediate steps to get to the actual information, using itemized lists in the intermediate (navigation) pages,
(3) consistent page bottom, with navigation aids, direct access to information items, feedback facility and a consistent help, that refers to on-line manuals, and
(4) identification of the author (maintainer) and date of page creation or last modification.

Coordination with other servers

A key point in the WWW architecture is the distributed nature of its information repositories. In order to provide a coherent information service and to minimize both network traffic and maintenance effort, some coordination with other centers is required.

We coordinate the information of our server with

- the IUE Data Analysis Center (IUEDAC) at GSFC (Ref. 6),
- the Laboratorio de Astrofísica Espacial y Física Fundamental (LAEFF) at Villafranca (Ref. 7),
- the AstroWeb, the list of resources on Astronomy and Astrophysics in the Internet (Ref. 8),
- other Agency sites,
- local servers in Spain.

The coordination is based on a synchronized transfer of so-called "mirror" copies of selected items and a consistent definition of pointers. This coordination is evolving rapidly, as more information servers are being added to the Internet.

Optimized maintenance

Critical points in the management of an on-line information service are

1. keeping the information items up-to-date whenever necessary,

2. maintaining the service in terms of availability and integrity.

In order to achieve this with our server, the different areas of information are well identified and are managed by the most appropriate persons, who are responsible for the content. Her/his e-mail address is located at the page bottom, so that comments, general feedback and even complains may be sent. Before including new pages, its format is validated by local tools to check the conformance of the document to the current standard (i.e. HTML[28] 2.0).

On the other hand, to assure both information availability and integrity of the referrenced documents, the whole system is periodically transversed by programs which alert of broken, re-directed or recently updated links. In addition, all accesses are logged and are routinely analyzed. In this way, we see if the server is running smoothly and can estimate the usefulness of the different information items.

What did we learn?

The experience has been very positive: the service requires only a limited amount of software and maintenance, as the tasks to keep the information updated are well identified.

During the Jupiter/Shoemaker-Levy 9 observing campaign, statistics of the period July-December 1994 show that the server was accessed from 41 different countries (Internet domains, to be precise) by 1,170 different nodes (Internet subdomains) all over the world.

The server is currently supporting 15,000 external accesses per month from nearly 50 different Internet domains, and the statistics indicate a growing trend.

We believe that this technology is clearly the best way to make information available to the user community, and plans are in hands to distribute IUE Final Archive data via WWW (in terms of a "New Technology" ULDA) and to provide up-to-date information of the on-going IUE project (e.g. Last Call for Proposals, current scheduling etc.)

But here we need your feedback. We, as system analysts and starry-eyed fantasists, in looking for the "techie" solution, have maybe overlooked simpler, more powerful ideas.

References

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2. J.A. de la Fuente, F. Marcelo, 1993. "Internet information services at Villafranca", TN/7051-00/AF-FM/930929.

3. J.D. Ponz, O. Holm, M. Barylak, 1994. "Information services using WWW at Villafranca. Users requirements", SD/WIS001-03/JDP-OH-MB/941004.

4. M. Barylak, 1994. "ESA IUE under VILSPA's WWW information service", SD/WIS002-02/MB/941024.

[28] Hyper-Text Markup Language

5. I. Yurrita, O. Holm, 1994. "IUEFA output product retrieval. Users guide", TN/8034-02/IY-OH/940830.

6. IUE Data Analysis Center,
`http://iuesn1.gsfc.nasa.gov/iue/iuedac_homepage.html`.

7. LAEFF information server,
`http://www.laeff.esa.es/`.

8. H.-M. Adorf, D. Egret, A. Heck, R. Jackson, A. Koekemoer, F. Murtagh, D. Wells: 1994, "The AstroWeb Database of Internet Resources" The Messenger **78**, 44.

Frontiers of Space and Ground-Based Astronomy

The Astrophysics of the 21st Century

—

Edited by

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The Proceedings of the XXIIth ESLAB symposium, which was dedicated to the 15th anniversary of IUE, presents a comprehensive review of the status of astrophysics and cosmology today. The book presents an outstanding insight into the current and future fundamental problems which will be addressed by the scientists in the 21st century.

The accomplishments of the golden decades, in which many new observing windows have been opened to all astronomers through space exploration, the 4-meter class ground telescopes and interferometric techniques at radio wavelengths, are high-lighted concisely and understandably. The state of our theoretical understanding of the Universe, extending from the nearby interstellar medium (the Solar Bubble) out to the very early stages of the Universe, and the importance of gravitational lenses are illustrated in lucid reviews. A set of beautiful color pictures from recent experiments illustrates the future of observational astronomy. The reviews are comprehensive and are at a level suitable for professional astronomers who want to remain informed about the fields beyond their specialties, for students at graduate and undergraduate level, as well as for decision makers who need to understand the importance of the scientific challenges which will require support in the future.

This volume has been published by *Kluwer Academic Publisher* in the Astrophysics and Space Science Library vol. 187 (ISBN 0-7923-2527-3).

Contents:

LINUX - a free UNIX System

M. Barylak, E. Ojero, J.D. Ponz

ESA IUE Observatory

Introduction

Are you an average, ordinary, every-day person, happy to mess around with personal computers (PCs) and content to see `MS-DOS/Windows` popping up on your screen? Then this article might not be of interest to you.

But if you are fed up to be locked into proprietary software, to wait for vendors to fix this stupid, little bug and to be forced to pay for `Fat-Suite-Office-etc.` software where half of the stuff you may not even use, then you may be interested to hear from the UNIX clone *Linux*.

Copyright - Copyleft - Freeware

It all started presumably with the concept of *Freeware* - software that is free. Richard Stallman, author of the versatile and powerful text editor *EMACS*, created a "body of free software" called GNU which enables everybody to use computers without splashing out huge amounts of money. With like-minded colleagues he formed the Free Software Foundation (FSF) which provides this *Freeware*, (ie. mostly UNIX utilities like bash, awk, emacs, etc.) with the invaluable asset of getting them also in source code, all covered by the *GNU Public License* (GPL). This (copyright, or better copyleft) license allows you to modify and build on FSF software but insists that you distribute the derived product on the same basis ie. leaving others free to duplicate and use the whole work.

This was one important starting point of *Linux*, which was originally written by Linus Torvalds, in Helsinki, Finland.

Linux

The main reasons which speak for *Linux* are:

- It complies with standards ie. POSIX[29] , TCP/IP, ISO9660, etc.
- It was developed in Europe hence it is one of the few *European computer products*
- It is *Freeware* hence it is very cheap - a similar, commercial UNIX system may cost up to $3.000,-

[29]POSIX – Portable Operating System Interface based on UNIX

- It is UNIX (and comes with X11/R5; recent releases with X11/R6), a system which is used in research institutes since decades;
- it may enable you, like at the IUE observatory, a smoother transition to UNIX.

Linux is a completely free re-implementation of the POSIX specifications, with System V and BSD extensions and is available in both source code and binary form. It is copyrighted by **Linus B. Torvalds** (`torvalds@kruuna.helsinki.fi`) and other contributors and is freely re-distributable under the terms of the GNU Public License.

Linux provides the power of a fast and memory efficient, multi-user, protected mode, 32bit UNIX operating system to midsize (386/486/586) PC platforms. It supports a wide range of software, including X Windows, Emacs, TCP/IP networking, etc.

Ports of *Linux* to other CPU's are in progress e.g. for the DEC Alpha, Motorola 680x0 based Commodore Amiga, Apple MAC, and Atari ST/TT machines. Ports to the PowerPC and MIPS R4600 are in early development.

We started fumbling around with *Linux* version 0.97 back in 1992 when we also tried to install BSD386. *Linux* develops very rapidly (new versions come out about once every two weeks) but you do not have to upgrade that often only if you want to be at the "bleeding edge". One major stable release was version 1.1 (released in April 1994). This version of the Yggdrasil distribution (one of the many commercial outfits which sells *Linux* on CD-ROM) is currently installed in the PCs of the IUE observatory at VILSPA, sharing peacefully the resources with `MS-DOS/Windows`[30].

Linux - what for ?

Most of the common UNIX tools and programs have been ported to *Linux*, including almost all of the GNU stuff and many X clients from various sources. Actually, "ported" is often too strong a word, since many programs compile out of the box without modifications, because *Linux* tracks POSIX quite closely.

Basic UNIX commands: `ls, tr, sed, awk` and so on...

Software development tools: a large set of development tools for languages including ANSI C, C++, Modula 3, Prolog, SML, Smalltalk, Basic, Tcl/Tk, and both Pascal to C, and Fortran to C translators are available not to mention `gdb, make, bison, flex, perl, rcs, cvs, gprof`, etc...

X-window workstation: any X windows application for X11/R5 or X11/R6 (Xfree86) under one of the following windows manager: Openlook (olwm, olvwm), Motif (mwm - extra license to be paid), MIT (twm), fvwm, etc.

Editors: `GNU Emacs, Lucid Emacs, MicroEmacs, jove, epoch, elvis (GNU vi), vim, vile, joe, pico, jed.`

[30] LINUX can mount MS-DOS partitions and hence can interchange files with DOS very efficiently.

Shells: Bash (POSIX sh-compatible), zsh (include ksh compatiblity mode), pdksh, tcsh, csh, rc, ash (mostly sh-compatible), and many more.

Telecommunication: Taylor (BNU-compatible) UUCP, kermit, szrz, minicom, pcomm, xcomm, term/slip, Seyon, etc. *Linux* can run both the World Wide Web (WWW) clients such as *Mosaic* and *Lynx* and also provide a stable platform for providing data to the Internet (i.e. httpd, gopher, archie, wais, etc.).

News and mail: C-news, innd, trn, nn, tin, smail, elm, mh (supporting both UUCP and SMTP protocols)

Textprocessing: TEX, LATEX, groff, doc.

Games: several tons of...

Programs for Astronomers

Here are several packages which may be of interest to Astronomers:

- **SAOimage** - is a utility for displaying astronomical images which runs under the X11 window environment. SAOimage provides a large selection of options for zooming, panning, scaling, coloring, pixel readback, display blinking, and region specification.
- **MIDAS** - the Munich Image Display and Analysis System works fine under *Linux*.
- **AIPS, IRAF, Lick Mongo, SLALIB, Khoros** - all have ports started, some may have prototypes up and running.
- **STARLINK** - welcomes the emergence of *Linux* and is undertaking a feasibility study of porting STARLINK software.
- **XEPHEM** - is an interactive astronomical ephemeris program for X Windows systems. It computes lots of information about the planets and any solar system objects for which orbital elements are available. A sample database of some 16000+ objects is included in the release kit.
- **GNUPLOT** - is a command-driven interactive function plotting program. 'plot' and 'splot' are the primary commands of the program. They plot functions and data in many, many ways. 'plot' is used to plot 2-d functions and data, while 'splot' plots 3-d surfaces and data.
- **XMGR, XVGR, ACE/gr** - is an XY plotting tool for workstations or X-terminals using X11. A few of its features are:
  - Polynomial regression, splines, running averages, DFT/FFT, cross/auto-correlation.
  - Plots up to 10 graphs with 30 data sets per graph.
  - User defined scaling, tick marks, labels, symbols, line styles, colors.
  - Batch mode for unattended plotting.

  - o Read and write parameters used during a session.
  - o Hardcopy support for PostScript, HP-GL, and FrameMaker .mif format.

  While ACE/gr has a convenient point-and-click interface, most parameter settings and operations are available through a command line interface.

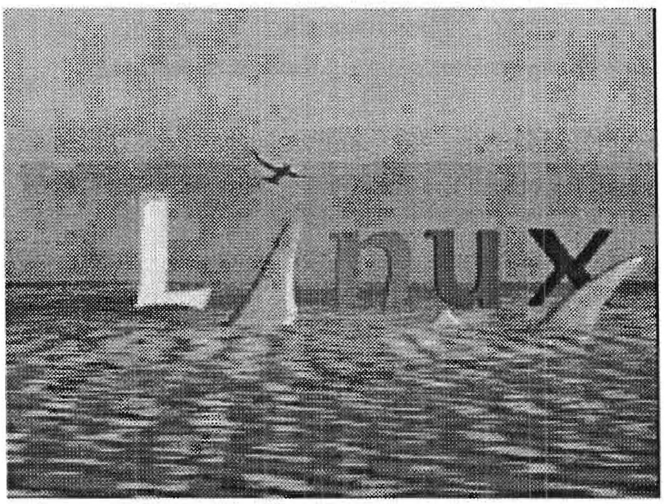
- **XPaint** - is a color image editing tool which features most standard paint program options. It allows for the editing of multiple images simultaneously and supports various formats, including PPM, XBM, TIFF, GIF, etc.
- **XFIG** - is a menu-driven tool that allows the user to draw and manipulate objects interactively in an X window. The resulting pictures can be saved, printed on postscript printers or converted to a variety of other formats (e.g. to allow inclusion in LaTeX documents).
- **XSAT** - an X Window System based satellite tracking program.
- **XARCHIE, XGOPHER, MOSAIC** - a suite of programs which allow for modern, effective, and comfortable information retrievals on the *Internet*.
- **etc...**

There is a WWW page called "LinuxAstro" which has more up-to-date information: `http://bima.astro.umd.edu/nemo/linuxastro/`

"How does a wise man act given this information ?"

"A wise man might bend his inquiring footsteps in the direction of the author's receptive ear for more information on *Linux*, or have a look at one of the many *Linux* pages on the WWW (e.g. `http://www.linux.org/`)."

"A *very wise* man does not act; but maintaining an impassive countenance, he awaits the unrolling of events until he sees what must inevitably take place. It is thus that his reputation for wisdom is built-up."



Coming to Villafranca

-mb-

-..-

The long and winding roads that lead to the Villafranca Satellite Tracking Station have disappeard, at the least the windings. Villafranca lies approximately 30km from the centre of Madrid. The new motorways **M-40** and **M-503** (called *"la carretera de los satélites"*) link now VILSPA almost directly with Madrid.

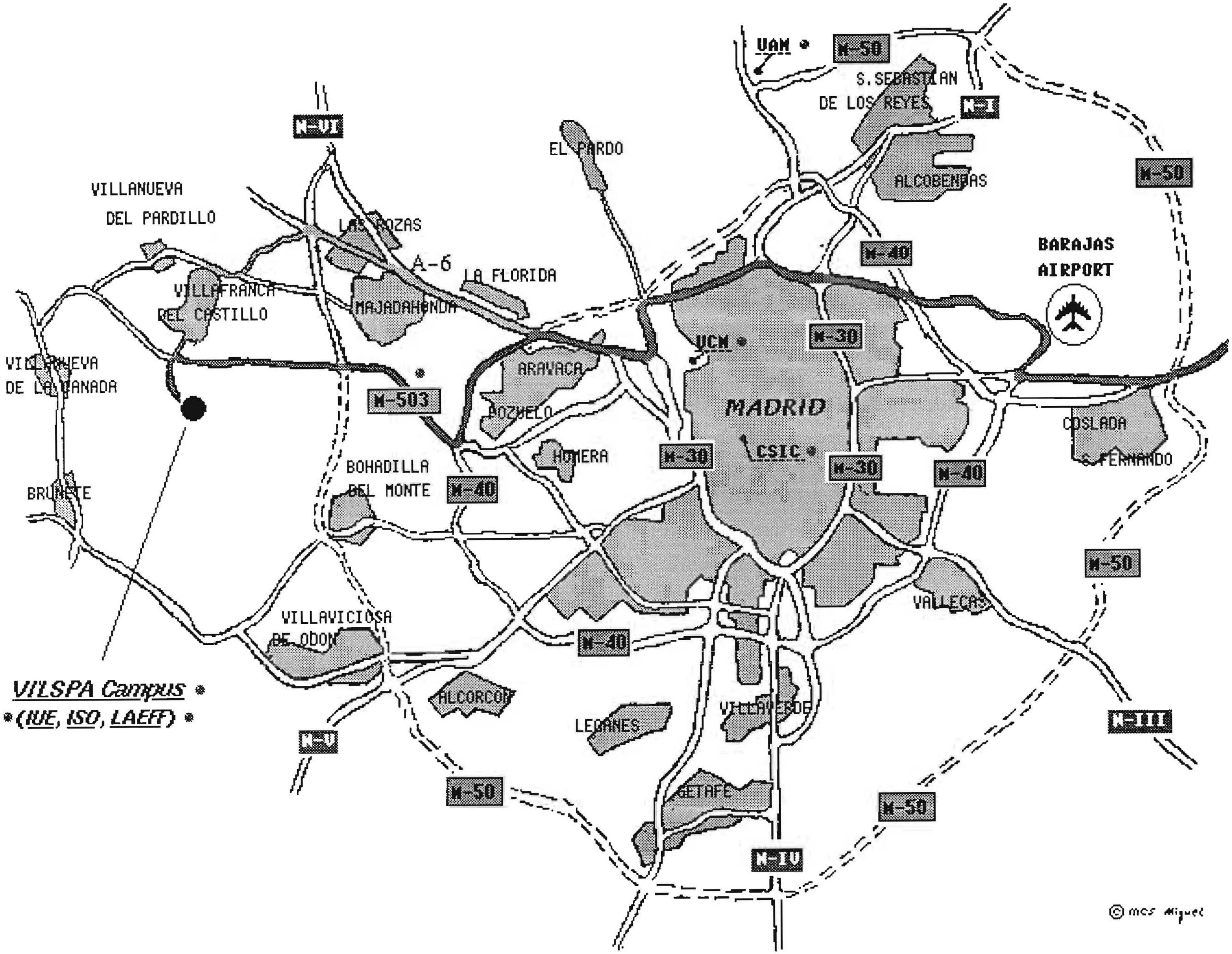
At Barajas (Madrid's airport), the easiest (but slightly longer) way is to take the beltway **M-40** in the South direction ie. direction [N-IV, N-V, Talavera]. Follow **M-40** for ca. 35 minutes and leave the motorway by the sign [M-503, Majadahonda] (at junction 40) and follow the the indications given in the last paragraph.

To reach VILSPA from the center of Madrid, follow the signs to highway **A-6 or N-VI** in direction of Villalba and continue along **N-VI** until you reach junction 11. At junction 11, exit **N-VI** for motorway **M-40** in the direction of [Toledo, Talavera N-IV, N-V]. Continue for approximately 4 kms and leave at junction 41 joining the motorway **M-503** in direction to *Majadahonda*.

[31] After ca. 5 kms on **M-503** in direction to *Majadahonda* exit at junction 8 following the signs to [M-516, Boadilla, Majadahonda]. At the very first roundabout turn left in direction of [M-516 Boadilla] crossing over the motorway. Continue in direction of *Boadilla* passing another roundabout. At the third roundabout, you will finally see an [**esa>**] sign in direction [El Escorial, Valdemorillo, Villanueva de Pardillo, etc]. Now follow **M-503** until the next roundabout at ca. 5 kms. There another [**esa>**] sign will lead you after ca. 2 kms to the station. *(Sounds a lot more complicated than it actually is!)*

Please see the schematic map next page to get a general overview ...
(map courtesy of Miguel Cerviño, Laboratorio de Astrofísica Espacial y Física Fundamental (LAEFF)).

[31] please see also <http://www.laeff.esa.es/images/dibujos/planoM40.html> to get a better picture.


UAM
M-50
S.SEBASTIAN
DE LOS REYES
N-I
N-VI
EL PARDO
M-50
ALCOBENDAS
VILLANUEVA
DEL PARDILLO
LAS ROZAS
A-6
M-40
BARAJAS
AIRPORT
LA FLORIDA
VILLAFRANCA
DEL CASTILLO
MAJADAHONDA
M-30
UCM
VILLANUEVA
DE LA CANADA
ARAVACA
M-503
MADRID
POZUELO
COSLADA
S.FERNANDO
HUMERA
M-30
CSIC
M-30
M-40
BOHADILLA
DEL MONTE
M-40
BRUNETE
M-50
VILLAVICIOSA
DE ODON
VALLECAS
M-40
VILSPA Campus
(IUE, ISO, LAEFF)
ALCORCON
LEGANES
VILLAVERDE
N-III
N-V
M-50
GETAFE
M-50
N-IV
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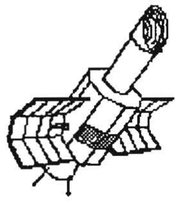
esa



european space agency
agency spatiale européenne

villafranca del castillo — satellite tracking station

IUE Data Request

Data Tape: ______________________ (filled in by VILSPA)

Tape Density: O 1600 bpi O 6250 bpi O DAT O Exabyte O FTP

Requested Data:
O Raw data only O Extracted high resolution spectra only
O Line by line + extracted low dispersion spectra
O Complete: raw image + extracted spectra

Cam#	Imagenumber	Cam#	Imagenumber	Cam#	Imagenumber	Cam#	Imagenumber

Camera numbers: 1 = LWP / 2 = LWR / 3 = SWP / 9 = FES

Request Reason (mark corresponding circle):
O Normal Release (6 months rule)
O Special Release o Data from my program . . . .
o others (give details) ______________________

Requested by: ______________________ Date of Request: ______________

Mailing Address: ______________________

____

e-Mail / Tel. / FAX: ______________________

VILSPA Database Administrator: ______________________ Date: ______________

Mail to:

Dr. Michael Barylak

ESA IUE Observatory

Apartado 50 727

28080 Madrid

SPAIN

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☐ Please note my change of address as below. (I attach the current mailing label for cancellation.)

☐ Having become acquainted with the ESA IUE Newsletter through a colleague/library, I would like to be placed on the regular mailing list. My name and address, including the post code, are given below.

☐ Please delete my name and address (printed below) from the Newsletter distribution list.

NAME:

ADDRESS:

Now tear off this last page and return it to ESA, Paris, in the convenient posting format provided. Simply fold and staple leaving the mailing address (verso) visible.

Ilse Vollgraf
European Space Agency
8-10, rue Mario Nikis
75738 PARIS Cédex 15
France

esa

european space agency
agence spatiale européenne

March 1995

S a l l y   B a b a y a n

has pleasure in introducing her successor

I L S E   V O L L G R A F

who will be taking good care of you in the future

Sally wishes also to thank all those who have expressed their very friendly sentiments and warm wishes for her retirement. She very much regrets that she cannot respond personally to each and every one of you.

8-10 rue Mario-Nikis 75738 Paris Cedex 15 - ✆ (33.1) 53 69 76 54
Télécopieur (33.1) 53 69 75 60 - Télex ESA 202746 - Télégr. Spaceurop Paris