The IUE Status

In this report, I have attempted to assemble information on the status of the IUE that may be useful or interesting to you. References are provided where available. References given here supercede earlier references on the same topic. Where no reference is given, I am using Resident Astronomers' experience, guestimates, and rules of thumb.

Al Holm
1982 February 8

I. Scientific Instrument Hardware Status

A. Cameras (4)

i) Long Wavelength Redundant (LWR) - standard camera
no operational problems

ii) Short Wavelength Prime (SWP) - standard camera
no operational problems

iii) Long Wavelength Prime (LWP) - available with project approval
read scan control frequently fails
80 minutes extra overhead time for turn on
(Settle et al. 1981; Holm 1981a)

iv) Short wavelength Redundant (SWR) - Not available
read section grid voltages usually fail

B. Spectrographs (2)

i) Short Wavelength

Entrance Apertures

Large aperture (SWLA) - oval shape
Length for trailed spectra 21.4±.4 arcsec
Area for extended sources 200±5 sq. arcsec
(Panek 1982a)

Small aperture (SWSA) - probably non-circular effective shape
area ~ 6.8 sq. arcsec (Panek 1982b)
point source throughout 0.53±0.13

Orientation - variable (Schiffer 1980)
Echelle Mode - functional
Low dispersion mode - functional

ii) Long Wavelength

Entrance apertures

Large aperture (LWLA) - oval shape
Length for trailed spectra 20.5±1.0 arcsec
Area for extended sources 203±6 sq. arcsec
(Panek 1982a)

Small aperture (LWSA) - probably non-circular effective shape
Area ~ 6.9 sq. arcsec (Panek 1982b)
point source throughput 0.49±0.15

Orientation - variable (Schiffer 1980)
Echelle Mode - functional
Low dispersion mode - functional

C. Fine Error Sensors (2)

i) FES 1 - back-up system last used 1978 Feb 18
2 magnitudes less sensitive than FES2

ii) FES 2 - standard
positional accuracy 0.27 arcsec near center of field
3 arcsec elsewhere
8 arcsec for $m_v < -0.6$ or
$14.2 < m_v < 16$

field size 8 arcmin radius
eff. wavelength ~ 5200Å
visual calibration (Holm and Rice 1981)
Experiences electronic confusion from operation aperture closure mechanism and the sun shutter mechanism

II. Spacecraft (S/C) Hardware Status

A. Gyros (6)
No. required for three-axis stabilized attitude control - 3
No. healthy - 4
No. poorly calibrated - 1 (temperature control failed)*
No. failed - 1 (stuck since turned off for 1979 shadow season)
S/C drift rates - 3 to 20 arcsec/hour (in pitch & yaw) usually largest shortly after slewing
Maneuver accuracy since 1981 Nov 21
error/length ~ 4×10^{-4} (Panek and Baroffio 1982)

B. Reaction Wheels (4)
No. required for slewing - 3
No. in use - 3 (pitch, yaw, and roll)
Backup (skewed wheel) never used in orbit

C. Hydrazine system
Required for reaction wheel maintenance, orbit change maneuvers, and emergency sum acquisitions
50 pounds available
usage rate ~ 1 pound/year

D. Solar arrays as of 1981 November
75% of capacity at launch (Fragola & Espejo 1982)
Power positive zone - depends upon activity level
Beta angles 126 to 21° with 1 camera reading and 1 camera exposing

E. Batteries (2)
Max. depth of discharge during Sept 1981 shadow season

Battery # 1	66.6%	(Crabb 1981)
Battery # 2	69.1%	(Crabb 1981)

* This gyro finally failed at 1982 March 2, 19.50 GMT.

F. On-Board Computer (2)

i) OBC1

Temperature Limit 55.8°C
Last crash 1982 Feb 21 (1.3 hours lost)
Software systems
8K - standard
4K - new crash resistant system
capable of supporting science operations
- bug in attitude control logic

ii) OBC2 - backup system
- never used in orbit

III. Image Processing System Status
(Alderman, Turnrose, and Northover 1981)

The current system has evolved through a series of modifications. The following list is my interpretation of the most significant modifications and their implementation dates (VILSPA date in parenthesis when known).

Averaged Intensity Transfer Function (ITF)	1978 May 22 (78 June 14)
Improved λ calibration Line Library: Low dis.	1978 Sept 21 (79 Feb 01)
Correct SWP ITF error	1979 July 7 (79 Aug 07)
Mean dispersion constants: Low disp.	1979 Oct 30 ( )
Improved λ calibration Line Library: High dis.	1979 Nov 23 (81 Mar 10)
Mean dispersion constants: High disp	1980 July 18 (81 Mar 10)
"New" Low disp software	1980 Nov 4 (81 Mar 10)
Parameterized low dispersion constants	1981 Mar 3 ( )
Parameterized high dispersion constants	1981 May 19 ( )
"New" High disp software	1981 Nov 10 ( )

IV. Instrumental Performance

A. Noise

i) Readout noise ~10 DN/pixel

ii) 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 ~85% of images
amplitude up to 110DN
amplitude decays ~25%/image line (Panek 1981)
frequency ~300 HZ (Panek 1981)
occurrence associated with heating of
read section of camera
occurrence modified by delaying
read (Holm and Panek 1982)

iii) Bright Spots

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

permanent blemishes

most pronounced pseudo-emission feature ~2190Å low disp., large aperture

others (Ponz 1980)

iv) Typical Signal/Noise Ratio for well exposed point source spectra

SWP	10-30	old software	(Cassatella et al. 1980)
	7-27	new software	
LWR	12-21	old software	(Settle et al. 1981)
	8-15	new software	
LWP	9-25	old software	(Settle et al. 1981)
	6-18	new software	

v) S/N properties of averaged spectra

(Clarke 1981a)

(West and Shuttleworth 1981)

B. Backgrounds

i) Phosphorescence fogging

During low-radiation shifts

LWR & SWP	6-10	DN/hour/pixel
LWP	4-07	DN/hour/pixel (Ake 1982)

Fogging rate depends on no. and type of PREPs before exposure

Overexposures cause "ghost" spectrum fogging

phosphorescence decay rate

$\sim t^{-0.8}$ up to several hours (Coleman 1978)

unknown after long time intervals

ii) Radiation fogging

caused by Cerenkov radiation from electrons in the van Allen belts (Coleman et al. 1977)

may be severe near perigee (US shift 2)

recent experience 22% low fogging shifts

15% high fogging shifts

C. Photometric properties

i) Upper limits to ITFs (Turnrose 1980)

ii) Linearity errors in processed spectra

SWP -10 to -20 percent for Net DN $\lesssim$20

+10 to +15 percent for ave. DN >220 @ 1300Å (Holm 1981b)

LWR +10 to +20 percent for Net DN $\lesssim$40

LWP -5 to -10 percent for Net DN $\lesssim$50 (Settle et al 1981)

possibly better with ITF 1

D. Absolute Calibration

i) Low dispersion SWP and LWR (Bohlin and Holm 1980)

ii) High dispersion SWP and LWR (Cassatella et al. 1981)

- Not accurate for spectra processed with "New" high dispersion software

iii) LWP - Not yet available

iv) Accuracy of standards

±10% 1300Å - 3400Å

v) Echelle ripple correction (Ake 1981)

E. Sensitivity Variation

i) Temperature dependence (Schiffer 1982a)

SWP −0.5%/°C of head amplifier temperature (THDA)
LWR −1.1%/°C of THDA
LWP unknown

ii) Repeatability (1σ after temperature correction) (Schiffer 1982a)

SWP 2% in 150Å bins
LWR 2.5% in 300Å bins
LWP unknown

iii) Temporal dependence (Schiffer 1982a)

SWP −6.3%/year @ 1850Å before 1979.3
<0.3%/year since 1979.3
LWR ≤1.%/year until mid 1980
≅4.5%/year @2400Å and 2600Å since mid 1980

LWP unknown

F. Wavelength Resolution

i) Short wavelength echelle mode

small aperture FWHM 0.085Å @ 1150Å (Boggess et al. 1978)
0.19Å @ 2100Å (Boggess et al. 1978)
large/small 1.01 (Penston 1979)

ii) Short wavelength low dispersion mode

large aperture FWHM 6.1Å (Cassatella and Penston 1978)
large/small 0.99±0.7 (Ponz and Cassatella 1981)

iii) Long wavelength echelle mode

small aperture FWHM 0.20Å (Boggess et al. 1978)
large/small 1.09 (Penston 1979)

iv) Long wavelength low dispersion mode

large aperture FWHM 9.2Å (Cassatella and Penston 1978)
large/small 1.17±0.15 (Ponz and Cassatella 1981)

G. Wavelength Accuracy

i) Internal consistency of wavelength calibration determinations (Thompson et al. 1981)

SWP 2.0 km/sec
LWR 2.7 km/sec
LWP unknown

ii) Possible systematic errors

SWP unknown now
early data (Leckrone 1980)
LWR ~10 km/sec
LWP unknown

H. Miscellaneous

i) Grating scattered light
(Clarke 1981b)
(Stickland 1980)

ii) Halation : Backscattering of Electrons from the phosphor
decay length ~ 32±3 pixels (Coleman 1978)

iii) Scattered Light in the Telescope
$F_{scat} \propto d^{-2.5} F_*$ (Schiffer 1982b)
where d is in arcsec $(5<d<40)$

iv) Plate scale
1.51±0.04 pixel/arcsec (Panek 1982b)

v) Residual geometric errors in geometrically corrected image
±0.4 arcsec = ±0.2 pixels (Panek et al. 1982)

vi) Exposure timing (Schiffer 1980b)

command units	0.4096 seconds	
effective response delay	0.12 seconds	LWR & SWP
	unknown	LWP

vii) Longest Exposure to Date
SWP 15293 1273 minutes

References

Ake, T.B. 1981, NASA IUE Newsletter, No. 15, p. 60.

________. 1982, IUE Internal memo.

Alderman, D.F., Turnrose, B.E., and Northover, K.J.E. 1981, NASA IUE Newsletter, No. 15, p. 77.

Boggess, A., et al. 1978, Nature, 275, 377.

Bohlin, R.C., and Holm, A.V. 1980, NASA IUE Newsletter, No. 10, p. 37

Cassatella, A., and Penston, M. 1978, ESA IUE Internal memo MP/cr-116.

Cassatella, A., Holm, A., Ponz, D., Schiffer, F.H. 1980, NASA IUE Newsletter, No. 8, 1.

Cassatella, A., Ponz, D., and Selvelli, P.L. 1981, NASA IUE Newsletter, No. 14, p. 170.

Clarke, J.T. 1981a, NASA IUE Newsletter, No. 14, 149

__________. 1981b, NASA IUE Newsletter, No. 14, 143.

Coleman, C.I. 1978, paper presented at the Seventh Symposium on Photoelectric Image Devices at Imperial College, September 1978.

Coleman, C.I., Golton, E., Gondhalekar, P., Hall, J., Oliver, M., Sandford, M., Snijders, T., and Stewart, B. 1977, IUE Technical Note No. 31.

Crabb, W. 1981, Report to the Three-Agencies

Fragola, J., and Espejo, P. 1982, Bendix report.

Holm, A.V., 1981a, NASA IUE Newsletter, No. 15, p.95.

_________. 1981b, NASA IUE Newsletter, No. 15, p. 70.

Holm, A.V., and Rice, G. 1981, NASA IUE Newsletter, No. 15, p. 74

Holm, A.V., and Panek, R.J. 1982, NASA IUE Newsletter, No. 18

Leckrone, D.S. 1980, NASA IUE Newsletter, No. 10, p.25

Northover, K.J.E. 1979, Report to the Three-Agencies

Panek, R.J. 1981, Report to the Three-Agencies

_____. 1982a, NASA IUE Newsletter, No. 18.

Panek, R.J., and Baroffio, B. 1982, IUE Internal memo.

Panek, R.J., Holm, A.V., and Schiffer, F.H., III 1982, in "Instrumentation in Astronomy IV. SPIE Proceedings Vol. 331".

Penston, M. 1979, Report to the Three-Agencies

Ponz, D. 1980, ESA IUE Newsletter, No. 8, p. 12

Ponz, D., and Cassatella, A. 1981, Report to the Three-Agencies

Schiffer, F.H. 1980a, NASA IUE Newsletter, No. 9, p. 32.

____________. 1980b, NASA IUE Newsletter, No. 11, p.33

____________. 1982a, NASA IUE Newsletter, No. 18.

____________. 1982b, IUE Internal memo.

Settle, J., Shuttleworth, T., and Sandford, M.C.W. 1981, NASA IUE Newsletter, No. 15, p. 97.

Thompson, R.W., Turnrose, B.E., and Bohlin, R.C. 1981, NASA IUE Newsletter, No. 15, p. 8

Turnrose, B.E. 1980, NASA IUE Newsletter, No. 9, p. 13.

West, K., and Shuttleworth, T. 1981, ESA IUE Newsletter, No. 12, p. 27.