Exposure Time Algorithm For the Final Archives

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During the IUE final archiving effort the plans are for the IUE image processing system to produce a true flux calibration (i.e. time divided out: ergs/cm*cm/A/sec). The current image processing system only produces a time-integrated flux (i.e. ergs/cm*cm/A) calibration for low and high dispersion extracted spectra. To-date a true flux calibration has never been provided by the IUE image processing system because the determination of an accurate exposure time can be quite tricky. The determination of the best exposure time has been left to the IUE researcher to figure out. The purpose of this report is to assess, what sort of exposure time accuracy would be required for the final archiving effort, to identify the best location for this information, and to specify the appropriate algorithm. Until IUE data processed with the final archve processing system are generally available, IUE researchers may find this report to be useful in deriving exposure times for images processed with the current system.

The "best" exposure time will also be included as one of the Core Data Items in the IUE final archive FITS headers and in the expanded version of the IUE Merged Log of Observations (see Levay, 1990). The exposure times listed in the current version of the IUE merged log are checked against each script by the IUE Data Management Center personnel. Within the limits of the current IBM data base (i.e. 3 digits for the minutes and 2 digits for the seconds) the database and the scripts should be identical. However, the commanded exposure time typed in by the telescope operator, as listed on the script, can differ from the "true" or effective exposure time and can also differ from the exposure time stored in the image header. Thus, the exposure time in the current version of the IUE Merged Log may also be inaccurate. These inaccuracies tend to occur mainly for short exposure times, as described below. An exposure time is recorded in line 2 and in the round robin part of the IUE image header. The exposure time is not recorded in the binary portion of the header.

Note that some aspects of this report only pertain to Goddard images. VILSPA's database and log books are derived slightly differently from at Goddard, but the algorithm's proposed and the way the command computer behaves will, of course, be the same at the two stations.

I. Point-source and multiple exposures

The length of the exposure is controlled by the OBC. The total exposure time is commanded in discrete units of OBC "tics" of 0.4096 seconds. The ground command computer determines the total number of tics needed for each commanded exposure by:

[A] # OBC tics = INT [(commanded time) / 0.4096 sec]

[i.e. truncates down to nearest integer]

The effective exposure time is also reduced by the rise and fall time of the camera UVC and SEC voltages:

[B] Effective exposure time = [(# OBC tics) * 0.4096 sec] - R/F time

The rise/fall time may vary slightly as a function of camera and voltage level. The various published rise/fall times have differed slightly in the literature (Schiffer 1980, Imhoff 1984, Crenshaw 1986 and 1987). In the past we have just adopted an average value for all cameras of 0.120 sec because this was within the error bars of the various experiments. However, for the final archive we will adopt the SWP and LWP camera rise time values given by Gonzalez-Riestra (1990), which seem to be the most accurate available. The observational techniques used by Gonzalez-Riestra (1990) were similar to previous studies. However, the exposure time of the target star was longer than previous studies, which minimized uncertainties resulting from the command decoder cycle time (Oliversen, 1988). The final value of the LWR camera rise time has not yet been determined: additional observations are scheduled shortly to finalize this.

Table 1

Camera	Rise/fall (R/F) time	
LWP	0.127 sec +/- 0.003	Gonzalez-Riestra, 1990
SWP	0.129 sec +/- 0.005	Gonzalez-Riestra, 1990
LWR	TBD	

For point-source spectra the exposure time recorded on the script is the time the telescope operator enters into the ground command computer (= commanded exposure time). The time listed on the script is NOT corrected for OBC tic time and camera voltage rise/fall time.

The OBC tic and the camera voltage rise and fall time corrections are most important for "short" point-source exposures. The error from not correcting for these effects can be quite significant. For example, for a 1 second commanded SWP exposure, the effective exposure time would be 0.6902 sec, which would result in a 45% flux error if the 1 second time were not corrected for. The flux error from this effect is less than 1% for exposure times longer than about 1 minute. Thus, the IUE project has adopted a 1-minute exposure time threshold for correcting the effective exposure times.

Note that the corrections for OBC tic time and camera voltage rise and fall time apply each time the camera is turned on. For example, if a GO took a 1 second SWP exposure at each of 2 positions in the large aperture, the total effective exposure time would be 1.3804 sec. This also applies to multiple exposure segments obtained at a single position in the aperture. Thus, the 1-minute threshold for correcting the effective exposure time applies to each exposure segment and aperture.

Point-source and multiple exposure times from the label:

The following describes what should be present in a "normal", current label. Computer crashes, history replays, ground-system glitches, etc. can of course, cause pieces of the label to be missing. Many of the early IUE labels may be missing information too.

For a "normal" point-source exposure the exposure-start tag in the round-robin looks like:

EXPOBC cam# #minutes #seconds MAXG NOL

The number of seconds is rounded to the nearest integer by the ground command computer and is thus, not accurate enough for "short" exposures.

The exposure end tag is also recorded by the "FIN" round-robin entry:

FIN cam# T t S sec voltage U uvc voltage

where, t= total accumulated exposure time truncated by the ground command computer to the nearest second. Due to truncation this value may not agree with the value in the EXPOBC tag. For a given image, the exposure time in the FIN tag is incremented every time another exposure segment is taken. Thus, a given image can have more than one FIN tag. The last FIN tag should record the total exposure time accumulated for a given image (e.g. LGAP + SMAP + each segment). Note that the FIN tag is placed in the image header by the EXPFIN procedure. The EXPFIN procedure is run automatically for all trailed exposures and for each point-source exposures (segments) less that 3 minutes in length. However, for exposure times longer than 3 minutes the telescope operator must remember to run the EXPFIN procedure separately. Thus the exposure time in the FIN tag can be subject to errors and is not accurate enough for recording short exposure times.

The total time the camera was turned on (seconds) is also taken from the final FIN tag and is recorded in line 2 of the image header. It should be the total sum of all exposure segments (LGAP + SMAP) for a given image.

II. Low Dispersion Trailed spectra:

The effective exposure time (in seconds) for a trailed spectrum is given by:

[C] Effective expotime = [(eff. aperture length)/(trail rate)] * (# passes)

where,

Table 2

CAM	Eff. aperture length	
SWP	21.4 arcseconds	Panek, 1982; Crenshaw and Park, 1989
LWR	21.3 arcseconds	Oliversen, 1987
LWP	21.3 arcseconds	[LWR value assumed]

Note that the camera rise/fall time and OBC tic time corrections are NOT applicable to trailed spectra.

For ALL trailed spectra the exposure time on the script is NOT accurate. The trailed exposure time on the script may be rounded off and assumes an aperture length of 20 arcseconds. For trailed exposures the EXPOBC tag, the FIN tag exposure times, and the exposure time listed in line 2 of the header are also NOT accurate.

The trail rate (arcseconds/second) given on the script (usually under the "Remarks" section) is the value entered by the Telescope Operator into the ground computer. The trail rate is also recorded in the round-robin of the image header:

TRAIL cam# rate

The round-robin trail rate is rounded to 6 significant digits which should of be sufficient accuracy for most trails.

The number of trail passes is given on the script (if the number of passes is not listed on the script then it can be assumed that a single pass trail was performed) and in the round robin:

ITER #passes TIME expotime

Note that the expotime given in the ITER statement assumes an effective aperture length of 20 arcseconds and thus differs slightly from the "best" effective exposure time.

The effective trailed exposure times are also affected by a truncation in the trail rates actually performed versus the requested trail rates. The source of this truncation is due to the OBC using integer arithmetic for the pitch and yaw components of the trail slew angles. Only the slowest trails are affected significantly. For very long trailed exposures (greater than about 10 minutes) the actual exposure time may be up to 4% longer than requested. This effect may also vary as the TRAIL procedure was changed with time. This effect was initially discussed by Al Holm in an internal IUE memo dated Jan 31, 1984. It has not yet been determined if this effect will be corrected for in the IUE Final Archive. The number of IUE images affected by this are actually quite small and may therefore be ignored.

The fastest possible trail rate is 120 arcsec/sec and the corresponding shortest possible trailed exposure time is 0.1775 sec.

Thus, for fast trails a minimum of 3 significant digits after the decimal point are needed to record an exposure time with an accuracy of better than 2%.

III. Other Items Which Can Affect the Derived Fluxes

There are many things that can affect the final derived fluxes. It is not the intention of this report to try to discuss all the potential observing problems. However, a couple of the most common are mentioned below.

(1) The very shortest 1 and 2-tic point-source exposures are also affected by the 0.03 sec command decoder cycle time (Oliversen, 1988). This introduces an uncertainty of about 10% in 1-tic exposure times. However, the uncertainty acts randomly. The OBC exposure tic length of 0.4096 sec is actually an average value, and 65% of the time a 1 tic exposure will be 0.0104 sec too long while 35% of the time it will be 0.0196 sec too short. Unfortunately, one can't predict, for a given image, which way it will be affected without looking at the spectral data and comparing it to other identical 1-tic exposures. Thus, the final IUESIPS/database system will not include a correction for the command decoder cycle time.

(2) Trails with high trail rates (>~ 50 arcsec/second) can graze or in some instances miss the large aperture all together. This was particularily true for trails obtained before the implementation of the "fast" trail technique in 1985 (Oliversen, 1986). This, also can mimic a change in the effective exposure time. Careful examination of the trailed images can usually help to identify obviously "bad" trails.

(3) The through-put of the small aperture is roughly 67% times the through-put of the large aperture for point source spectra (Talavera 1987). However, the exact response of the small aperture is variable depending on how well centered the target is in the small aperture. For this reason the small aperture is not recommended for use to obtain accurate absolute fluxes.

IV. Potential Pitfall

There is a small chance that the above values used for the effective trail path length and the camera rise/fall time may have to be revised slightly later. The effective trail path length is determined during the derivation of the absolute calibrations by comparison of the response of trailed spectra with point-source large aperture spectra. The "final" values probably won't be available until shortly before the final archive reprocessing begins. The values given above are our current best estimates, which are not likely to change much but, we can't absolutely guarantee that no changes will occur at the last minute.

V. Summary

The following is recommended:

For all point-source and multiple exposures with individual segments shorter than 60 seconds in length, the commanded time(s) should be taken from the GSFC script and effective time calculated from equation [A] and [B] using a camera voltage rise/fall time of 0.129 sec for the SWP and 0.127 sec for the LWR. For times longer than 60 seconds the existing database value can be used without any further corrections (unless it disagrees with the script).

For all trails, take the trail rate and the number of trail passes from the script (or possibly the round-robin) and calculate the effective exposure time using equation [C] and the effective trailed path length given in Table 2.

Some sample scripts and label prints are attached for reference.

REFERENCES:

Crenshaw, D. M., 1986. NASA IUE Newsletter, No. 31, p. 37.

Crenshaw, D. M., and Park, E. A. May 1989, IUE Three-Agency Report.

Gonzalez-Riestra, R. 1990, May 1990, IUE Three-Agency Report.

Imhoff, C. 1984, NASA IUE Newsletter, No. 24, p. 24.

Levay, K. 1990, NASA IUE Newsletter, No. 42, p. 40.

Oliversen, N. 1986, NASA IUE Newsletter, No. 31, p. 40.

Oliversen, N. June 1987, IUE Three-Agency report.

Oliversen, N. 1988, NASA IUE Newsletter, No. 35, p. 73.

Panek, R. 1982, NASA IUE Newsletter, No. 18, p. 68.

Schiffer, F. 1980, NASA IUE Newsletter, No. 11, p. 33.

Talavera, A. 1987, ESA IUE Newsletter, No. 28, p. 53.

GSFC Script for point-source large + small Aperture Spectra

OBSERVER R. Pitts | PROGRAM ID PHCAL
OBJECT Zeta Cas | Date July 21, 1984
RA (1950) 00h 34m 10s | Target Serial No: 1
DEC (1950) +53° 37' 19"

V 3.68 | Sp. T. B2IV
E(B-V) ____ | Class No. 20 | (B-V) -0.19

Camera LWP / LWR | SWP
PREP Standard | Overexposed | Other
Dispersion Mode High | Low
Large Aperture Close | Open
Object Aperture Small | Large
EXP Time ____ min | LGAP 0.41 sec | SMAP 0.82 sec | Trailed | Multiple
EXP Gain Max | Other ____
Read Normal | Ping Avoidance | Other
Remarks: Absolute Calibration
Over-exposure: ___X expected

Commanded Exposure Time →

PROCESSING SPECIFICATIONS
*** NO DEFAULTS ***

Processing Type:
- Point Source X
- Extended (lo disp) ____
- Trailed (lo disp) ____
- Full Aperture (hi disp) ____

Process Both Apertures X

Registration:
- Automatic Shift X
- Manual Shift ____
- Do Not Shift ____

Plot Options: (Circle)
- Plots Desired: Yes No
- Scale SWP Without Lyman alpha: Yes No

Hold for Special Processing ____
Remarks: Copy to ...

RA/TO pitts/ABRAHAM | Observatory Record Number 29643
FES Counts Out 945, 948 | In 219, LGAP, SMAP 311 | Overlap | Fast | Underlap | Slow
Tracking Mode FES | X | Y | CT
GYRO

Focus -2.20, -2.54 | Radiation 3.10 | Beta 94, 7, 21.8 | S/C ROLL 299, 27, 55, 6 | FSS Roll -0, 1, 48, 2
EXP Start UT Day 203 | Hr 14 | Min 09 | Sec 57 | HDA in Expo 11, 2
LGAP / SMAP 14 | 14 | 34
READ Start UT Day 203 | Hr 14 | Min 18 | LWR extended heater warmup/ LWP bad scan starts 4m
Archive Tape 5635 | IMAGE SEQUENCE No. LWR 17485

Levels
- Emission Line ____ DN, or ____ X OVER
- Continuum SMAP TEO LGAP 177 DN, or ____ X OVER
- Background 27 DN, or ____ X OVER
- Noise 11 DN, Y 877, 870 PING1

Comments: E_x, E_y LGAP = 0,1; $E_x E_y$ SMAP = 0,1

Remarks to Data Management/IPC
Header wrong ____

SAMPLE Point-Source Exposure

"Total Time"

```
                                  1   1   72048    1 1 012117485
  5635*    5*IUESOC   *    *    *       1*        *    *  *  *  *  *  *         *
LWR 17485, ZETA CAS, 0.41 SEC LGAP, 0.82 SEC SMAP, LOW DISP
4 MIN HEATER WARMUP   -  PING AVOIDANCE TECHNIQUE
SMAP/LGAP EXPOSURE RATIO = 2

OBSERVER:  PITTS,  ID:  PHCAL,   203/1984     JULY 21


84203141818* 9    * 218 *OPSPRC40*121105 TARGET IN LWSA                 *
130829 READ 2 IMAGE 17484         *121120 FESCT 259 IN 22 0 0           *
131255 SCAN READLO SS 1 G3 58     *121241 GDE TRACK X 1158  Y 70        *
131312 X 56 Y 72 G1 99 HT 106     *121344 EXPOBC 2 1 59    MAXG NOL     *
132057 TLM,FES2ROM                *121548 FIN 2 T 186 S 98 U 109        *
133935 S/C READY FOR MANEUVER     *121710 TARGET FROM LWSA              *
134109 TLM,LWRROM                 *121849 TLM,LWRROM                    *
134410 SPREP 2                    *121952 READPREP 2 IMAGE 17483        *
135738 TLM,FES2ROM                *122417 SCAN READLO SS 1 G3 58        *
140824 TARGET IN LWLA             *122434 X 56 Y 72 G1 99 HT 106        *
141003 EXPOBC 2 0 0    MAXG NOL   *124441 TLM,FES2ROM                   *
141048 FIN 2 T 0 S 98 U 109       *125123 TARGET IN LWLA                *
141140 TARGET FROM LWLA           *125242 GDE TRACK X 1003  Y 56        *
141331 TARGET IN LWSA             *125339 EXPOBC 2 1 59    MAXG NOL     *
141442 EXPOBC 2 0 1    MAXG NOL   *125547 FIN 2 T 118 S 98 U 109        *
141522 FIN 2 T 1 S 98 U 109       *125655 TARGET FROM LWLA              *
141615 TARGET FROM LWSA           *125902 TARGET IN LWSA                *
141738 TLM,LWRROM                 *125918 FESCT 248 IN 19 0 0           *
141819 READPREP 2 IMAGE 17485     *130050 GDE TRACK X 1157  Y 68        *
142251 SCAN READLO SS 1 G3 58     *130146 EXPOBC 2 3 28    MAXG NOL     *
142308 X 56 Y 72 G1 99 HT 106     *130524 FIN 2 T 326 S 98 U 109        *
141851                            *130607 TARGET FROM LWSA              *
142307                            *130730 TLM,LWRROM                    *



PHCAL*1*02*PITTS            *  1*    *H*00003360*0*0*1* 21
 034103+533719*999*B2*4* 3.7* 0.04*          *      * 999.99*     *
```

Large Aperture time ⟹ (141003 EXPOBC 2 0 0 / 141048 FIN 2 T 0 S 98 U 109)

Small aperture time ⟹ (141442 EXPOBC 2 0 1 / 141522 FIN 2 T 1 S 98 U 109)

Comments typed in by Telescope Operator

Eff time (LGAP) = 0.2896 sec

Eff time (SMAP) = 0.6992 sec

(assuming a camera rise/fall time of 0.120 sec).

GSFC Script for a Trailed Spectrum

Information on this form will be available to all IUE Guest Observers

OBSERVER R. Pitts PROGRAM ID PHCAL

OBJECT Eta UMa Date March 13, 1985

RA (1950) 5h 3m 0.2s Target Serial No. 6

δ (1950) + 41° 10' 8.2"

m_v 3.18 Sp. T. B3 V

E(B-V) +0.02 Class No. 21 (B-V) ______

Requested trail Rate

Camera	LWP / (LWR)	SWP	
PREP	(Standard) ✓	Overexposed	Other
Dispersion Mode	High	(Low) ✓	
Large Aperture	Close	(Open) ✓	
Object Aperture	Small	(Large) ✓	
EXP Time	______ min	1.92 sec	(Trailed) Multiple
EXP Gain	(Max)	Other ______	
Read	Normal	(Ping Avoidance)	Other

Remarks:
LWR Absolute Calibration
TRAIL RATE: 10.41667 "/sec
Over-exposure: 2 X expected

PROCESSING SPECIFICATIONS
***** NO DEFAULTS *****

Processing Type:
- Point Source ______
- Extended (lo disp) ______
- Trailed (lo disp) X
- Full Aperture (hi disp) ______

Process Both Apertures ______

Registration:
- Automatic Shift X
- Manual Shift ______
- Do Not Shift ______

Plot Options: (Circle)
- Plots Desired: Yes (No)
- Scale SWP Without Lyman alpha: Yes No

Hold for Special Processing ______

Remarks:
Copy for VILSPA

RA/TO Pitts / Garhart Observatory Record Number 32415

FES Counts Out 1333 In 256 Overlap (Underlap) (Fast) Slow

Tracking Mode FES (GYRO) X Y CT

S/C ROLL 97, 3, 28.9

Focus -1.47 Radiation 0.78 Beta 93, 43, 36.3 FSS Roll -0, 4, 21.3

EXP Start UT Day 072 Hr 19 Min 44 Sec 40 THDA in Expo 13.8

READ Start UT Day 072 Hr 19 Min 51 LWR extended heater warmup/ LWP bad scan starts 4 min.

Archive Tape #6094 IMAGE SEQUENCE No. LWR 17653

Levels				Comments:
Emission Line	____ DN, or	____ X OVER		
Continuum	____ DN, or	2 X OVER		trail proc. expo. time = 1.92000 sec
Background	30 DN, or	____ X OVER		
Noise	____ DN, Y	______		Ex=0 Ey=-1 at R.P. after trail

Remarks to Data Management/IPC

Header wrong ______

181 DN @ 2300 Å

Exposure time based on 20 arcsec size trail path length

SAMPLE TRAILED SPECTRA

"Total" time (including time out-side aperture)

```
                                   1    1    72048      1  1 012117653
  6094*     5*IUESOC    *     *     *     117*       *     *  *  *  *  *  *      *
LWR 17653, ETA AUR, 1.92 SEC TRAIL, LO DISP, LARGE APER
DID 4 MIN HEATER WARMUP FOR PING AVOIDANCE PRIOR TO READ
EX= 0, EY= -1 AT R.P. AFTER TRAIL

OBSERVER: PITTS         ID: PHCAL        13 MAR 85        DAY 072-073


85 72195123* 9      * 218  *OPSPRC40*195154                                  *
190159 TARGET IN LWLA             *195606                                    *
190538 EXPOBC 2 25 0    MAXG NOL  *153032 SCAN READLO SS 1 G3 47             *
190741 MODTIME 2 0 0              *153049 X 53 Y 71 G1 97 HT 106             *
190814 FIN 2 T 115 S 98 U 109     *155524 TLM,FES2ROM                        *
190938 TARGET FROM LWLA           *175145 MODTIME 3 170 0                    *
191029 ITER 1 TIME   .960002E 00  *175717 FIN 3 T 22199 S 97 U 109           *
191208 TLM,LWRROM                 *175824CAMON,LWR                           *
191241 READPREP 2 IMAGE 17652     *180014 EXPOBC 3 25 0    MAXG NOL          *
191706 SCAN READLO SS 1 G3 58     *180109 TLM,LWRROM                         *
191718 X 56 Y 72 G1 99 HT 106     *180143 CSELECT LWR                        *
193845 TLM,FES2ROM                *180507 SPREP 2                            *
194055 TRAIL 2    .104167E 02     *181801 TLM,FES2ROM                        *
194216 TARGET IN LWLA             *182520 FIN 3 T 23699 S 97 U 109           *
194446 EXPOBC 2 25 0   MAXG NOL   *182604 TARGET FROM SWLA                   *
194647 MODTIME 2 0 0              *182645 CAMOFF 1                           *
194717 FIN 2 T 116 S 98 U 109     *182923 S/C READY FOR MANEUVER             *
194824 TARGET FROM LWLA           *182946 TLM,SWPROM                         *
194921 ITER 1 TIME   .192000E 01  *183104 READ 3 IMAGE 25445                 *
195055 TLM,LWRROM                 *183144 SCAN READLO SS 1 G3 44             *
195124 READPREP 2 IMAGE 17653     *183159 X 60 Y 76 G1 82 HT 105             *
195550 SCAN READLO SS 1 G3 58     *184052 TLM,FES2ROM                        *
195609 X 56 Y 72 G1 99 HT 106     *190031 TRAIL 2    .208333E 02             *


PHCAL*1*02*PITTS              *    6*     *H*00032630*0*0*1* 21
 5 3 02+4110 8*999*B3*5* 3.2* 0.02*             *       * 999.99*      *
```

Comments typed in by Telescope Operator

Trail rate = 10.41667 "/sec , one trail pass

$$\text{Eff time} = \frac{21.3}{10.41667} * 1 = 2.045 \text{ sec}$$

GSFC Script for a Trailed Spectrum

Information on this form will be available to all IUE Guest Observers

Requested Trail rate & # passes

OBSERVER Pitts
OBJECT BD+28 4211
RA (1950) 21h 48m 57.4s
(1950) +28° 37 34
m_v 10.53
E(B-V) -0.02

PROGRAM ID PHCAL
Date Jan. 15, 1985
Target Serial No. 42

Sp. T. Op
Class No. 16
(B-V) ____

PROCESSING SPECIFICATIONS
*** NO DEFAULTS ***

Processing Type:
- Point Source ____
- Extended (lo disp) ____
- Trailed (lo disp) X
- Full Aperture (hi disp) ____

Process Both Apertures ____

Registration:
- Automatic Shift X
- Manual Shift ____
- Do Not Shift ____

Plot Options: (Circle)
- Plots Desired: Yes (No)
- Scale SWP Without Lyman alpha: Yes No

Hold for Special Processing ____
Remarks: Copy for VILSPA

Camera	LWP / (LWR) ✓	SWP		
PREP	(Standard) ✓	Overexposed	Other	
Dispersion Mode	High	(Low) ✓		
Large Aperture	Close	(Open) ✓		
Object Aperture	Small	(Large)		
EXP Time	____ min	230 sec	(Trailed)	Multiple
EXP Gain	(Max)	Other ____		
Read	Normal	(Ping Avoidance)	Other	

Remarks:
→ 3 passes — TK Rate/pass = 0.26087 ″/sec
NR Absolute Calibration
Over-exposure: ___ X expected

- -

RA/TO Pitts/wasatmic
Observatory Record Number 31734
FES Counts Out 240 In 2 (Overlap Fast) Underlap Slow

Tracking Mode FES (GYRO) X Y CT

S/C ROLL 145 33 23.1
Focus -1.73 **Radiation** 19 **Beta** 121 48 12.7 **FSS Roll** -00 02 26.0

EXP Start UT Day 015 Hr 00 Min 23 Sec 16 **THDA in Expo** 13.8

READ Start UT Day 015 Hr 00 Min 52
LWR extended heater warmup/ 4MIN
LWP bad scan starts ____

Archive Tape 5987
IMAGE SEQUENCE No. LWR 17588

Levels

Emission Line	—	DN, or	____	X OVER
Continuum	190	DN, or	____	X OVER
Background	33	DN, or	____	X OVER
Noise Ping	8	DN, Y = 895 Y = 899		

Comments: AFTER 3 PASSES:
Ex = 2
Ey = -1

2300 Å - 135 DN

Remarks to Data Management/IPC

Header wrong ____

CS 8/0:5