V&V Reference Report
L2 ASCDS Version : 7.6.8

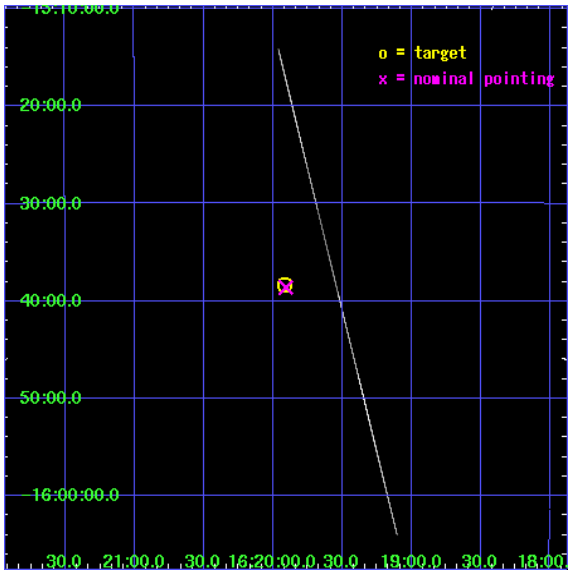
Observation 3505 - L2 Version 001
Chandra X-Ray Center

L2 Processing Date : Aug 25 2006

Contents

1 Front

seq_num	400258
obs_id	3505
title	HIGH RESOLUTION SPECTROSCOPY OF THE LMXB SCO X-1
observer	Prof. Claude Canizares
object	SCO X-1
ra_targ	244.979583
dec_targ	-15.640278
ra_nom	244.9768911365
dec_nom	-15.643776420036
roll_nom	256.02287294545
revision	3
ontime	16055.5
livetime	15992.783203125
ontime4	9728.9619322717
ontime5	8039.3385961354
ontime6	11355.158042014
ontime7	16055.5
ontime8	11417.106468916
ontime9	8714.8979323208
l2events	5565408

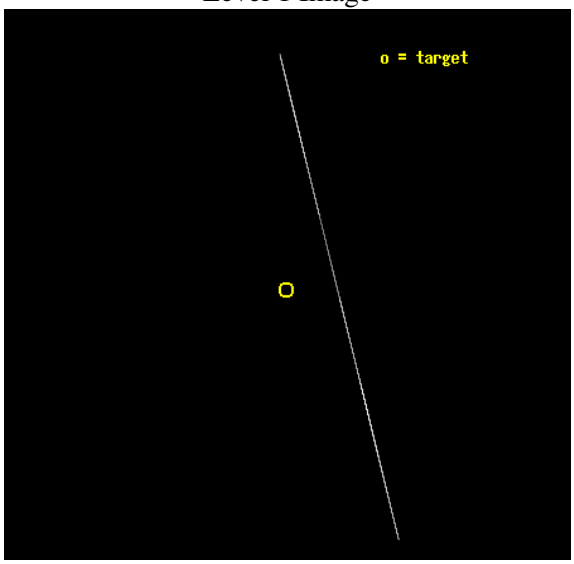


2 OBI

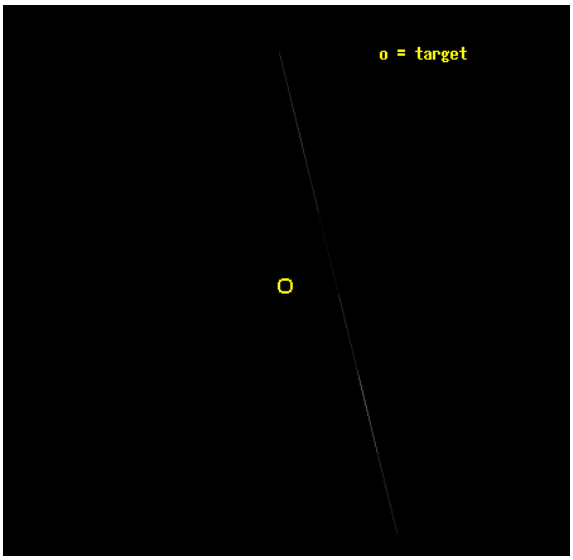
2.1 OBI

2.1.1 Images

Level 1 Image



Level 1 Bad Events



2.1.2 Parameters

obi_num	1
ascdsver	7.6.8
caldbver	3.2.2
date	2006-07-14T13:45:26
revision	2

sched_exp_time	15000.000000
ontime	16058.251679599
ontime4	9729.5751824677
ontime5	8039.9522840679
ontime6	11356.449465483
ontime7	16058.251679599
ontime8	11417.721845508
ontime9	8715.5138248503
l1events	6093582

2.1.3 Events

	ccd 4	ccd 5	ccd 6	ccd 7	ccd 8	ccd 9
level 1 events	822462	2399922	717339	195599	795870	1162390
rejected events	6369	26478	6652	2039	8366	8469
rejected %	0%	1%	0%	1%	1%	0%

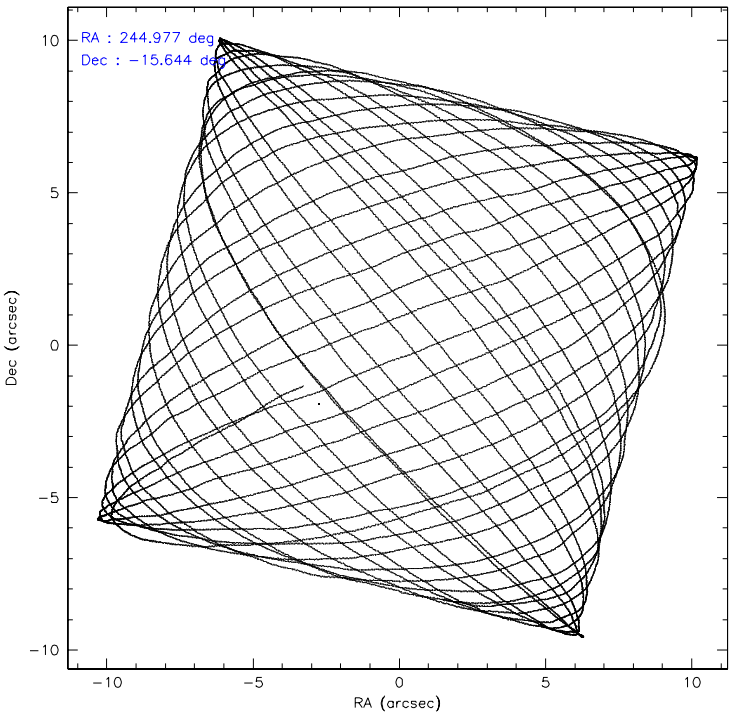
	ccd 4	ccd 5	ccd 6	ccd 7	ccd 8	ccd 9
grade 0 events	316137	726287	201351	33979	462513	840010
	38%	30%	28%	17%	58%	72%
grade 1 events	536	2720	743	95	2005	2631
	0%	0%	0%	0%	0%	0%
grade 2 events	431741	773945	417464	57534	249679	205513
	52%	32%	58%	29%	31%	17%
grade 3 events	13843	214898	12876	17602	19100	37329
	1%	8%	1%	8%	2%	3%
grade 4 events	13850	215407	12787	17647	19246	36901
	1%	8%	1%	9%	2%	3%
grade 5 events	5784	23630	5842	1911	6345	5762
	0%	0%	0%	0%	0%	0%
grade 6 events	40571	443035	66276	66831	36982	34244
	4%	18%	9%	34%	4%	2%
grade 7 events	0	0	0	0	0	0
	0%	0%	0%	0%	0%	0%

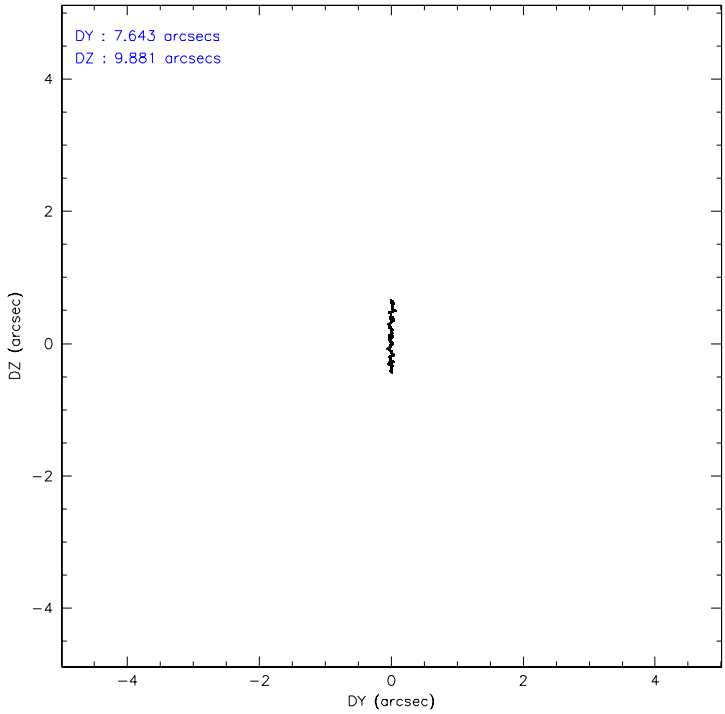
2.2 Compared Parameters

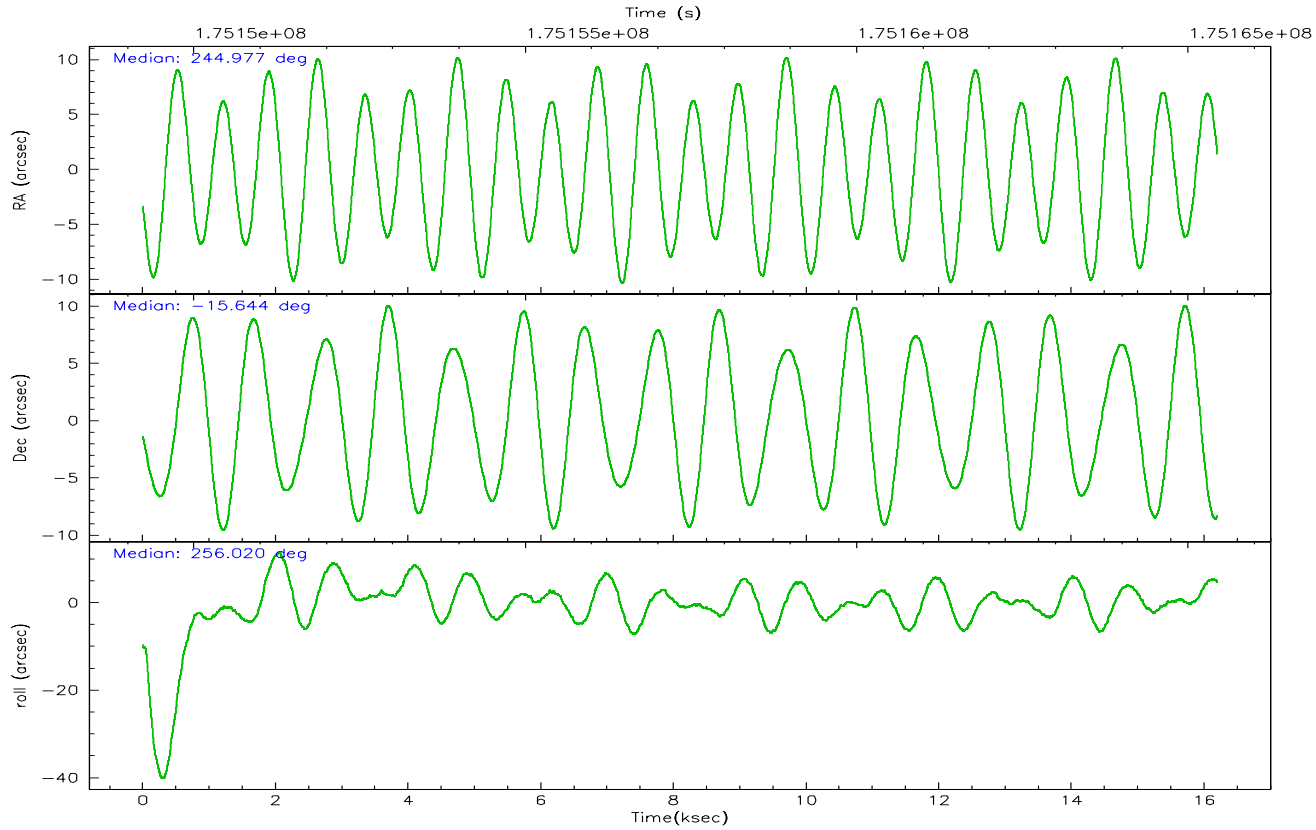
Parameter	Planned	Actual
Instrument	ACIS	ACIS
Detector	ACIS-456789	ACIS-456789
Grating	HETG	HETG
Data mode	CC33_GRADED	CC33_GRADED
Observation mode	POINTING	POINTING
Pointing RA	244.968704	244.9768911364957
Pointing Dec	-15.617700	-15.64377642003637
Pointing Roll	255.864041	256.0228729454512
SIM focus pos (mm)	-0.684267	-0.6828225247311905
SIM defocus (mm)	0	0.001444936568705701
SIM translation stage pos (mm)	-175.132523	-175.1371466454634
SIM translation stage offset (mm)	-15	-14.99537593754445
Observation start time	175150433.184000	175148965.87616
Observation start date	2003-07-21T04:52:49	2003-07-21T04:29:25
Observation end time	175165433.184000	175165645.70187
Observation end date	2003-07-21T09:02:49	2003-07-21T09:07:25
Read mode	CONTINUOUS	CONTINUOUS

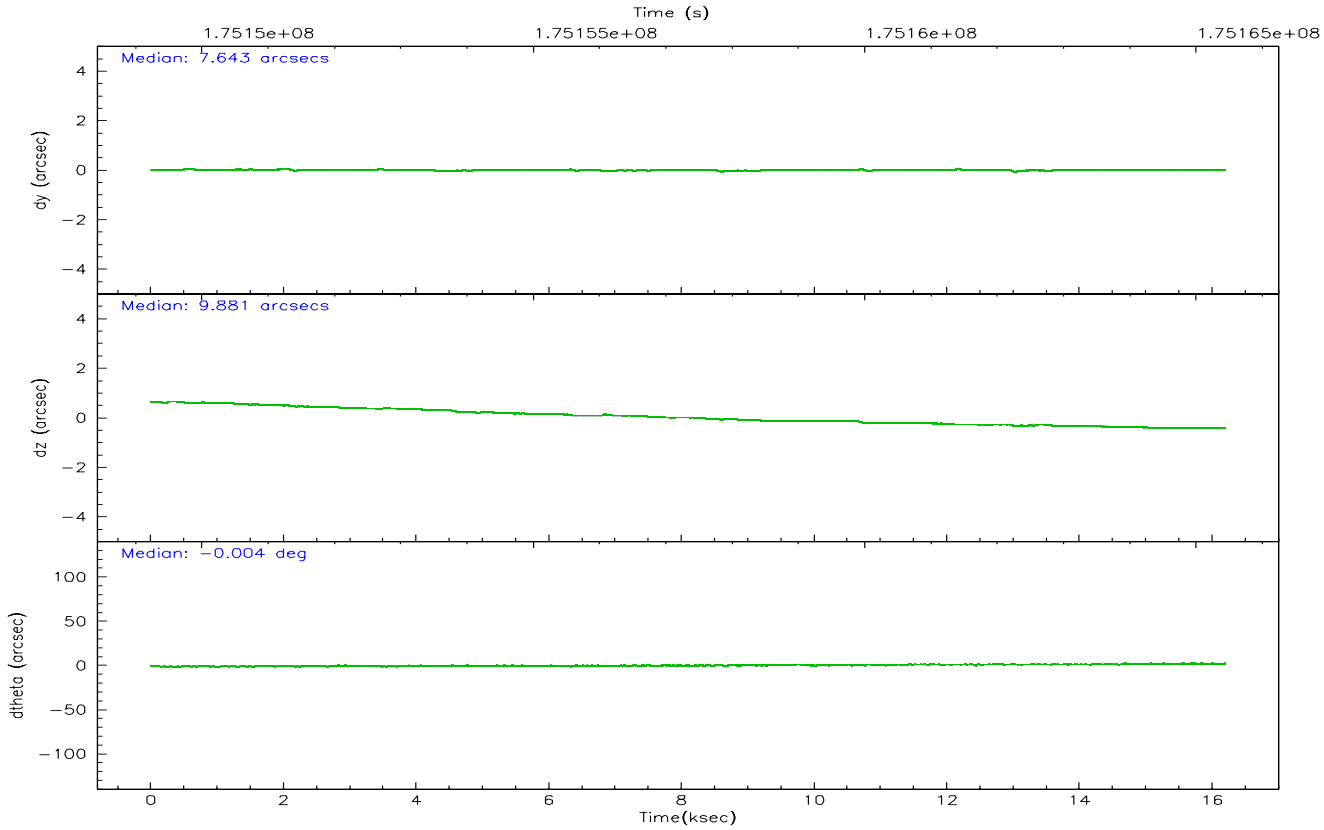
Parameter	Planned	Actual
Obspar format version number	6	6
Obspar file type	PREDICTED	ACTUAL
Obspar update status	NONE	UPDATED
On-chip summing requested	N	N
Subarray requested	NONE	NONE
Alternating exposures requested	N	N
Primary exposure time	0.000000	0

2.3 Aspect


RA : 244.977 deg
Dec : −15.644 deg
10
5
0
−5
−10
Dec (arcsec)
−10
−5
0
5
10
RA (arcsec)


DY : 7.643 arcsecs
DZ : 9.881 arcsecs
4
2
0
−2
−4
DZ (arcsec)
−4
−2
0
2
4
DY (arcsec)


Time (s)
1.7515e+08
1.75155e+08
1.7516e+08
1.75165e+08
Median: 244.977 deg
RA (arcsec)
Median: −15.644 deg
Dec (arcsec)
Median: 256.020 deg
roll (arcsec)
Time(ksec)

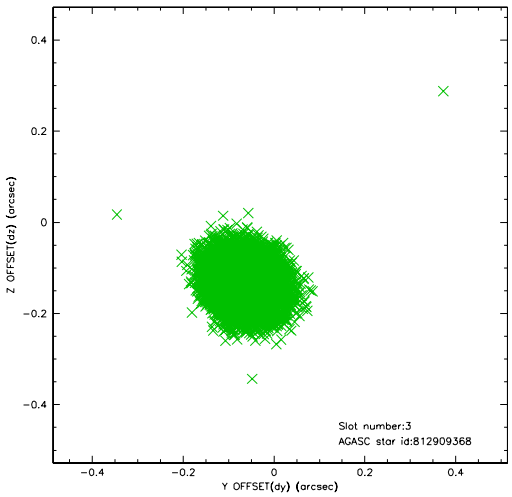

Time (s)
1.7515e+08
1.75155e+08
1.7516e+08
1.75165e+08
Median: 7.643 arcsecs
dy (arcsec)
Median: 9.881 arcsecs
dz (arcsec)
Median: −0.004 deg
dtheta (arcsec)
Time(ksec)

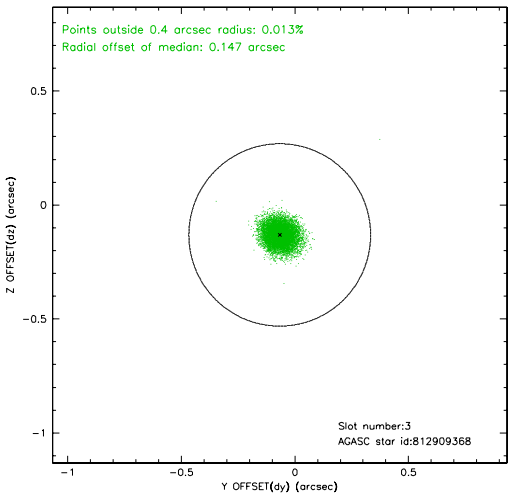
Slot Statistics

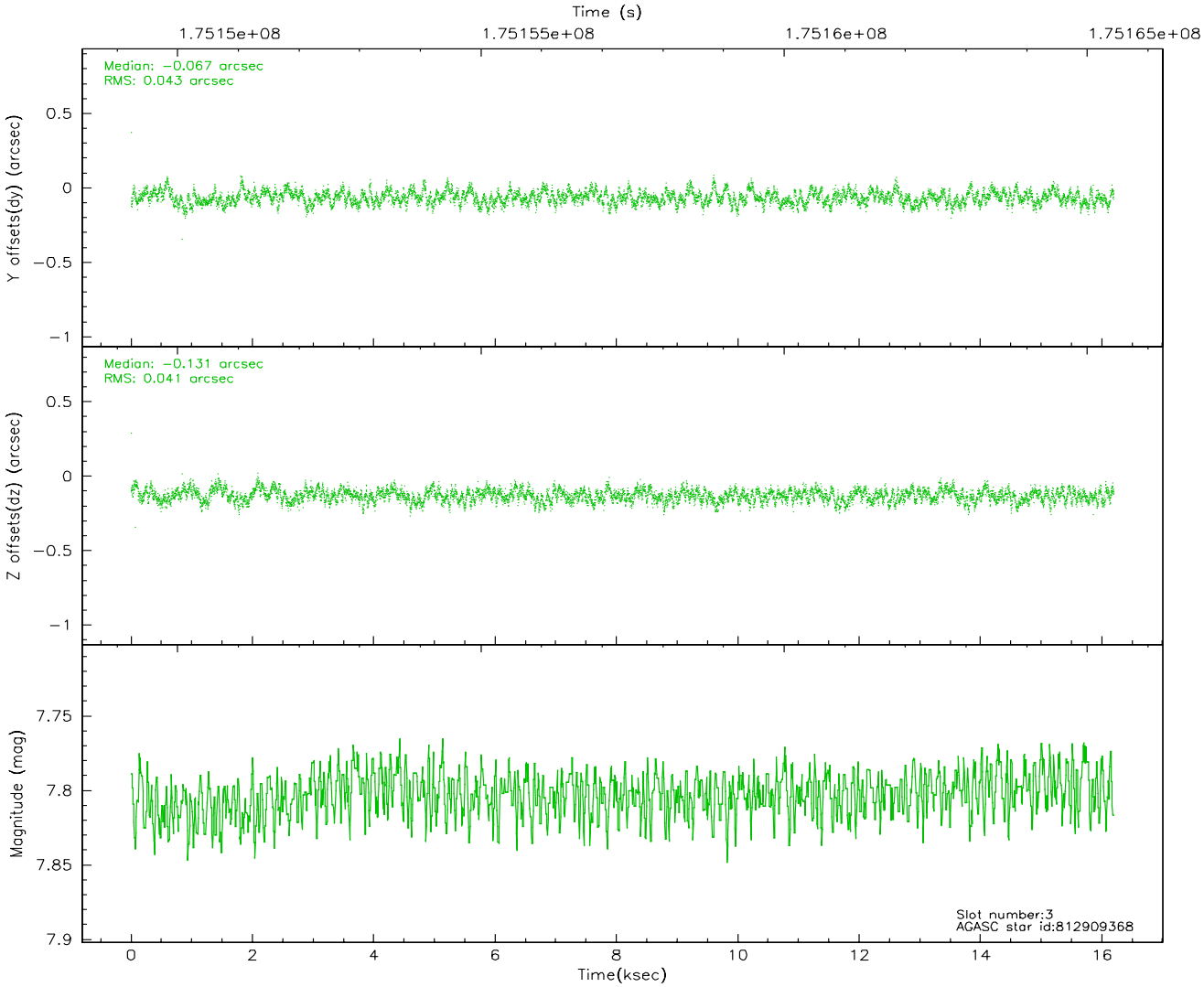
slot	status	id	mag	n_pts	med_dy	med_dz	dr1	dr2	ra	dec	mean_y	mean_z
0	FID	ACIS-S-2	7.07	3950	-0.086	-0.338	0.011	0.022	0.000000	0.000000	-759.34	-2040.01
1	FID	ACIS-S-4	7.15	3951	0.036	0.131	0.008	0.013	0.000000	0.000000	2153.93	-131.43
2	FID	ACIS-S-5	7.22	3951	0.018	0.215	0.007	0.013	0.000000	0.000000	-1811.74	-137.38
3	GUIDE	812909368	7.80	7902	-0.067	-0.131	0.063	0.100	244.337230	-15.327996	-472.24	-2379.85
4	GUIDE	812914616	9.66	7896	0.034	-0.155	0.111	0.182	244.358365	-15.447124	-74.76	-2203.22
5	GUIDE	812920176	9.77	7899	0.107	0.164	0.122	0.202	245.058523	-16.304322	2321.78	904.91
6	GUIDE	812920352	8.77	7900	0.058	0.077	0.073	0.116	244.854466	-15.546040	-152.46	-446.81
7	GUIDE	812918096	8.58	7900	-0.135	0.045	0.083	0.130	244.220820	-15.671419	825.59	-2465.26

2.4 Star Slots

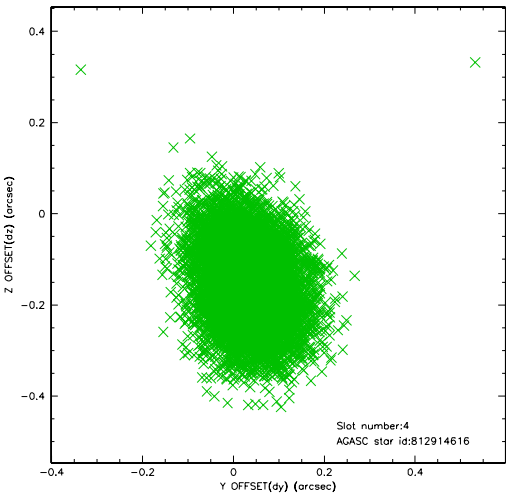
2.4.1 Slot 3

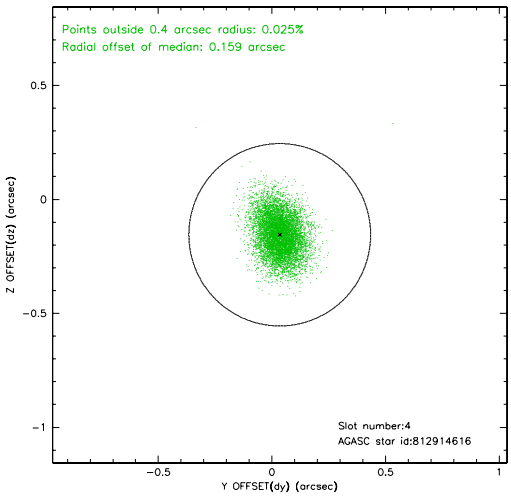


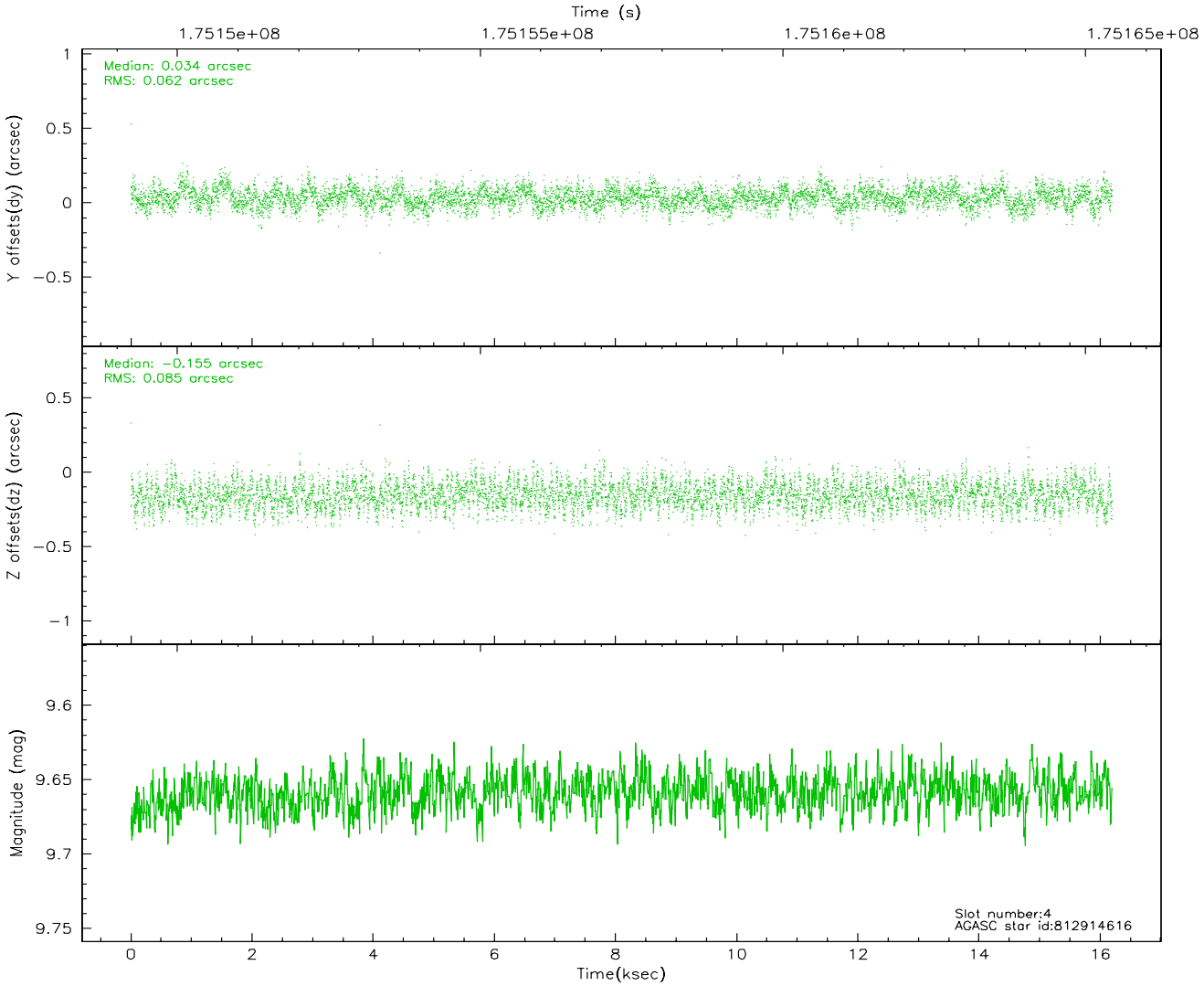




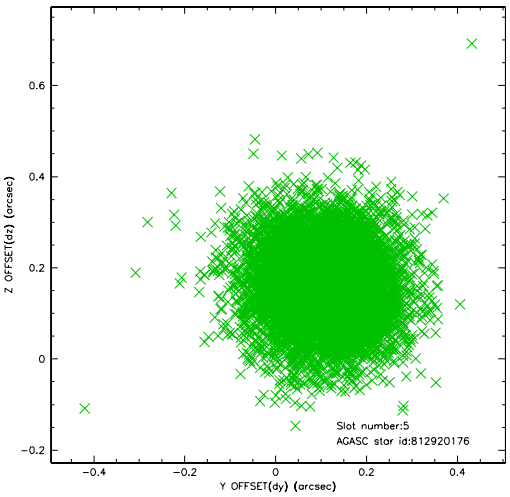
2.4.2 Slot 4

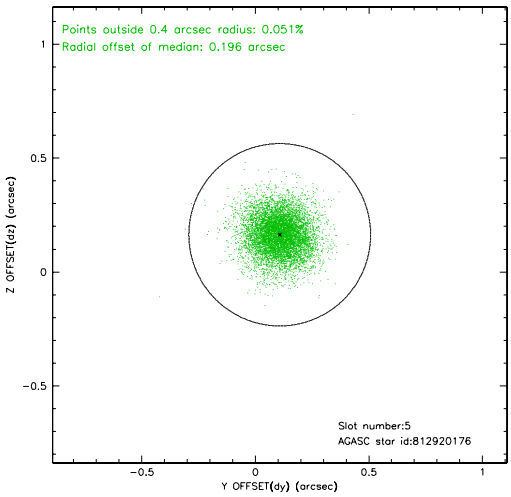

Z OFFSET(dz) (arcsec)
Y OFFSET(dy) (arcsec)
Slot number:4
AGASC star id:812914616

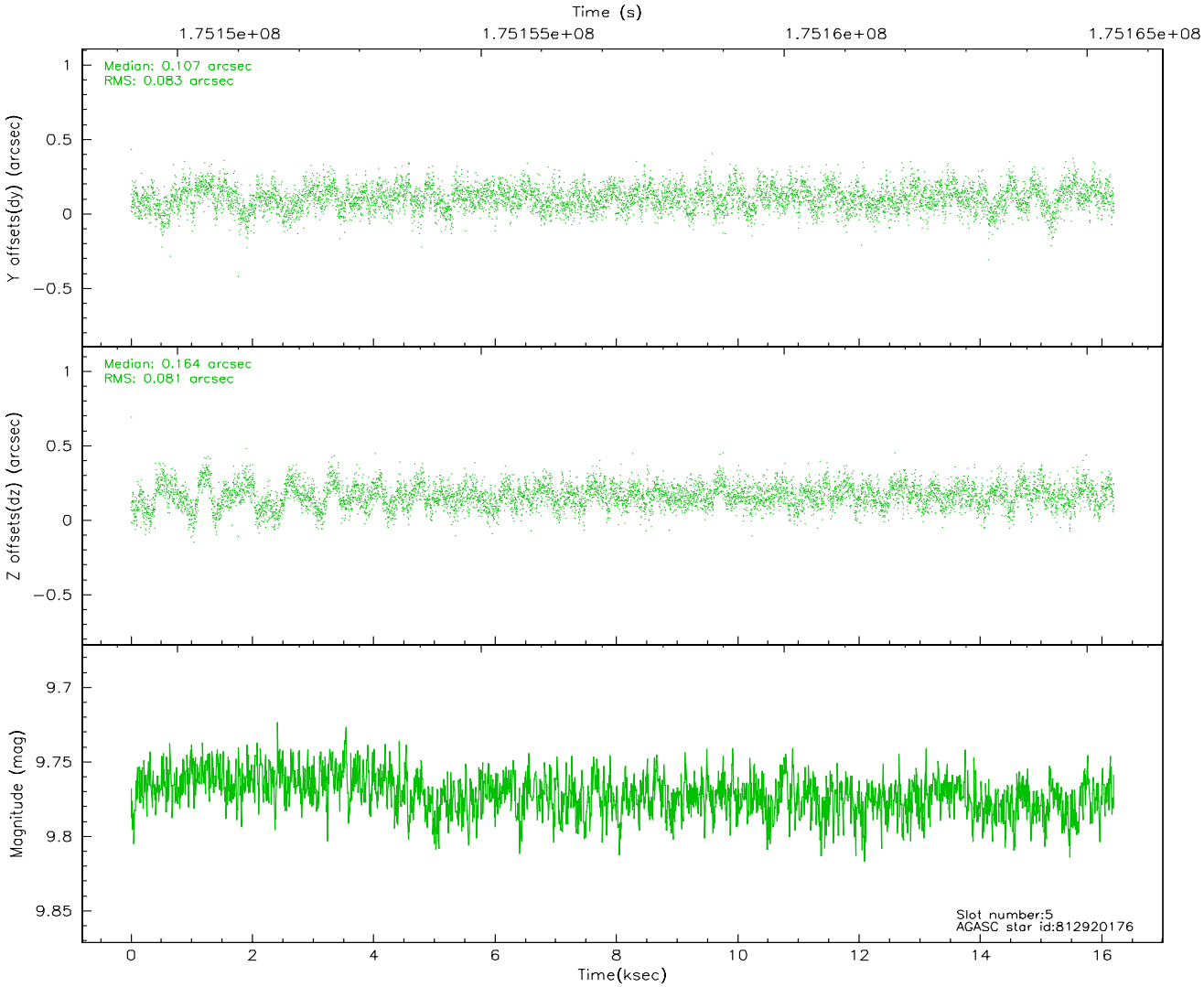

Points outside 0.4 arcsec radius: 0.025%
Radial offset of median: 0.159 arcsec
Z OFFSET(dz) (arcsec)
Y OFFSET(dy) (arcsec)
Slot number:4
AGASC star id:812914616


Time (s)
1.7515e+08
1.75155e+08
1.7516e+08
1.75165e+08
Median: 0.034 arcsec
RMS: 0.062 arcsec
Y offsets(dy) (arcsec)
Median: −0.155 arcsec
RMS: 0.085 arcsec
Z offsets(dz) (arcsec)
Magnitude (mag)
Slot number:4
AGASC star id:812914616
Time(ksec)

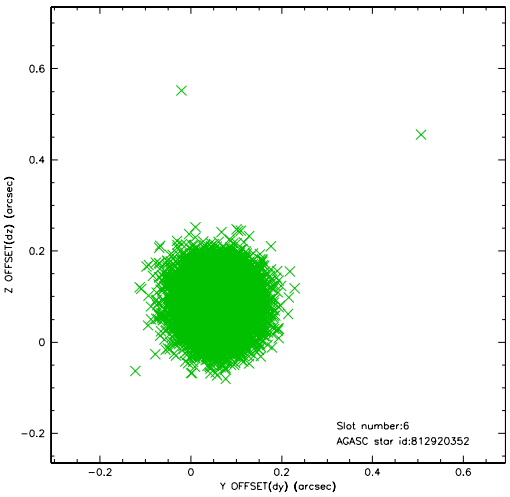
2.4.3 Slot 5

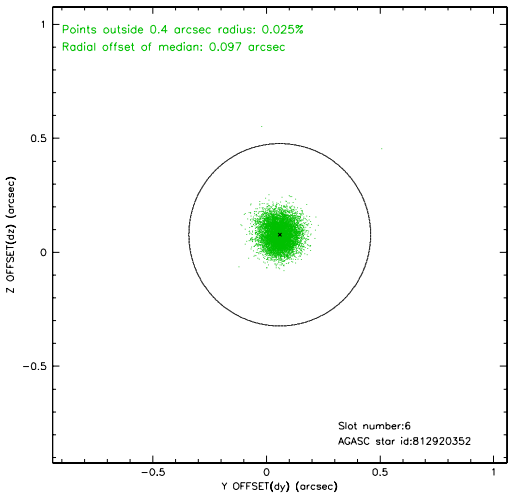

Z OFFSET(dz) (arcsec)
Y OFFSET(dy) (arcsec)
Slot number:5
AGASC star id:812920176

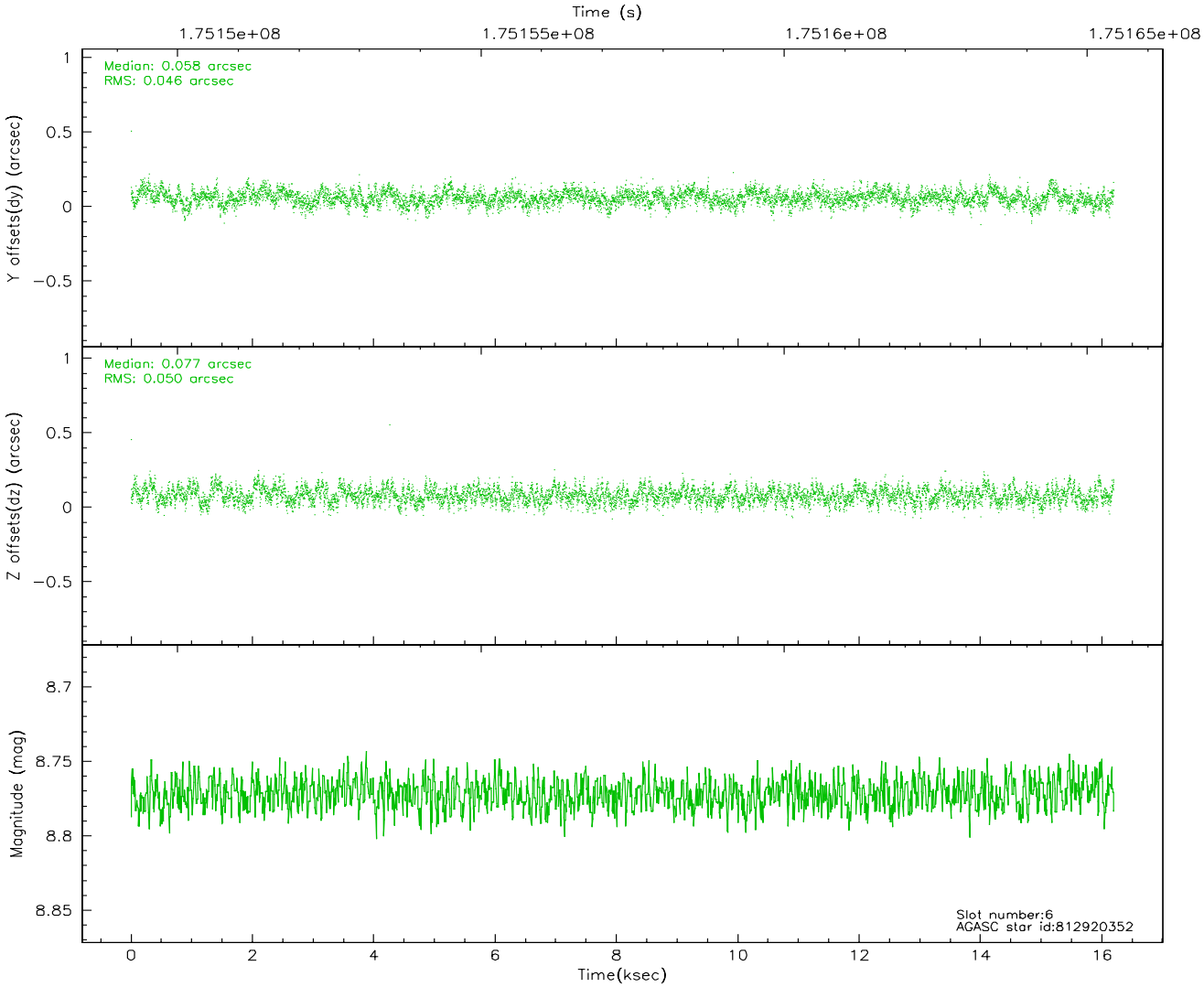

Points outside 0.4 arcsec radius: 0.051%
Radial offset of median: 0.196 arcsec
Z OFFSET(dz) (arcsec)
Y OFFSET(dy) (arcsec)
Slot number:5
AGASC star id:812920176


Time (s)
1.7515e+08
1.75155e+08
1.7516e+08
1.75165e+08
Median: 0.107 arcsec
RMS: 0.083 arcsec
Y offsets(dy) (arcsec)
Median: 0.164 arcsec
RMS: 0.081 arcsec
Z offsets(dz) (arcsec)
Magnitude (mag)
Slot number:5
AGASC star id:812920176
Time(ksec)

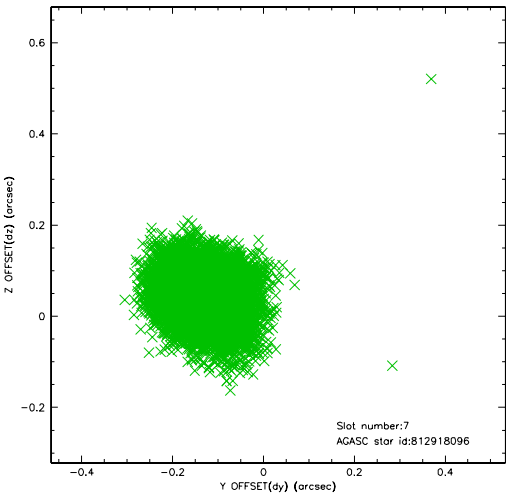
2.4.4 Slot 6

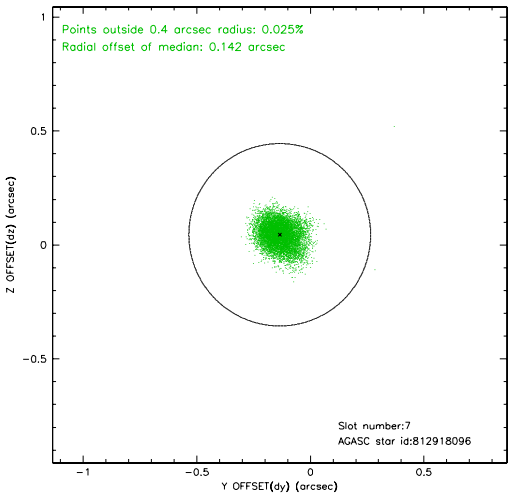

Z OFFSET(dz) (arcsec)
Y OFFSET(dy) (arcsec)
Slot number:6
AGASC star id:812920352

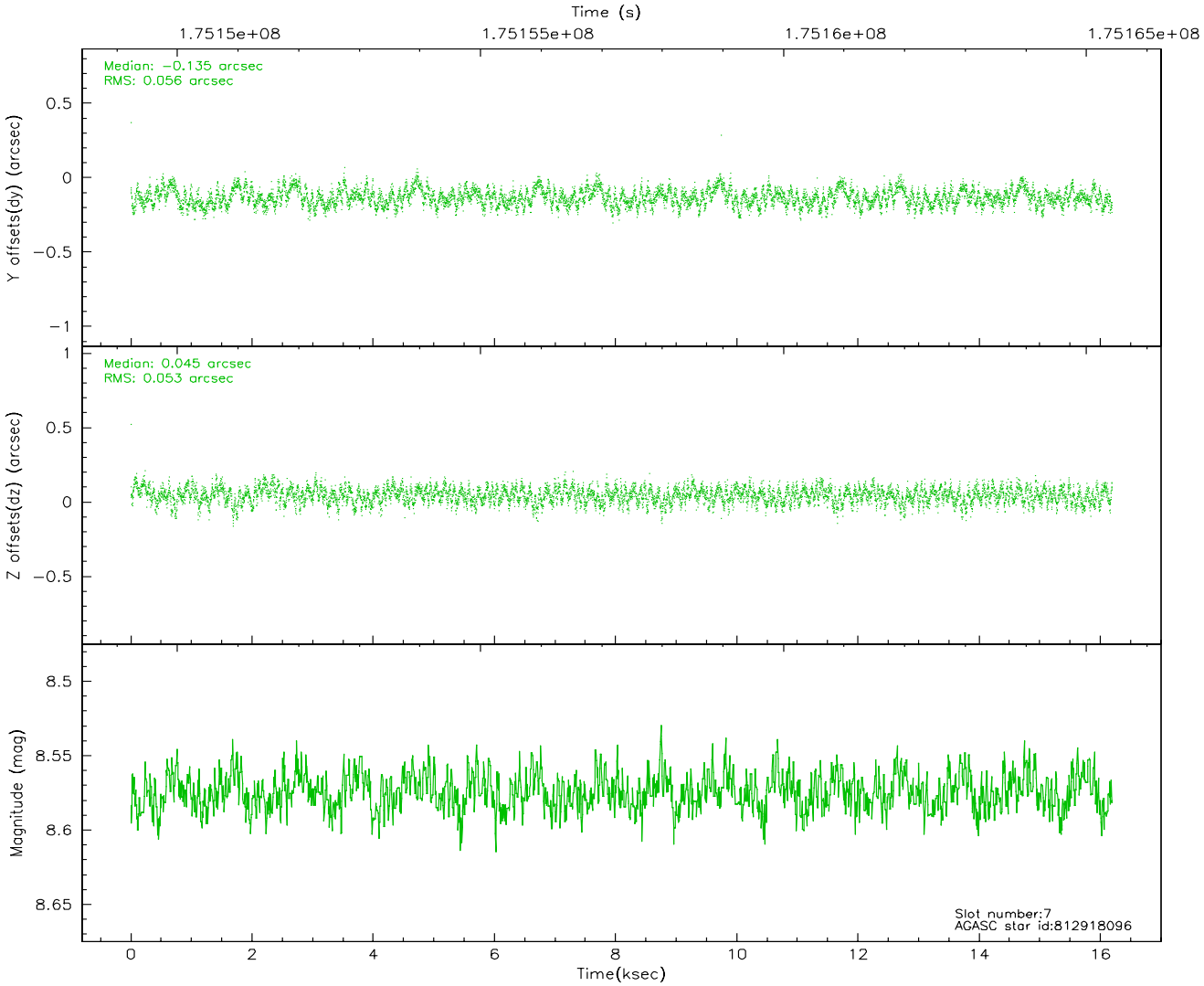

Points outside 0.4 arcsec radius: 0.025%
Radial offset of median: 0.097 arcsec
Z OFFSET(dz) (arcsec)
Y OFFSET(dy) (arcsec)
Slot number:6
AGASC star id:812920352


Time (s)
1.7515e+08
1.75155e+08
1.7516e+08
1.75165e+08
Median: 0.058 arcsec
RMS: 0.046 arcsec
Y offsets(dy) (arcsec)
Median: 0.077 arcsec
RMS: 0.050 arcsec
Z offsets(dz) (arcsec)
Magnitude (mag)
Slot number:6
AGASC star id:812920352
Time(ksec)

2.4.5 Slot 7

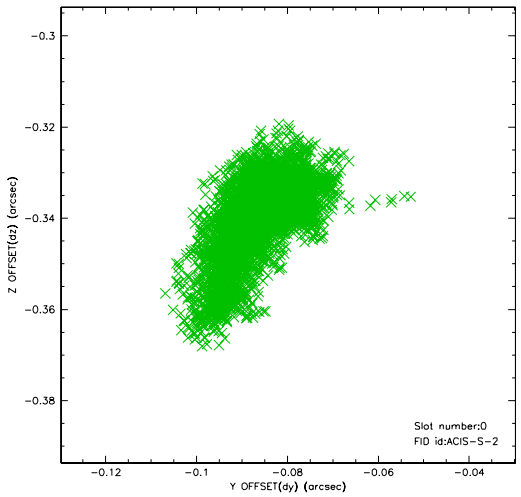

Z OFFSET(dz) (arcsec)
Y OFFSET(dy) (arcsec)
Slot number:7
AGASC star id:812918096

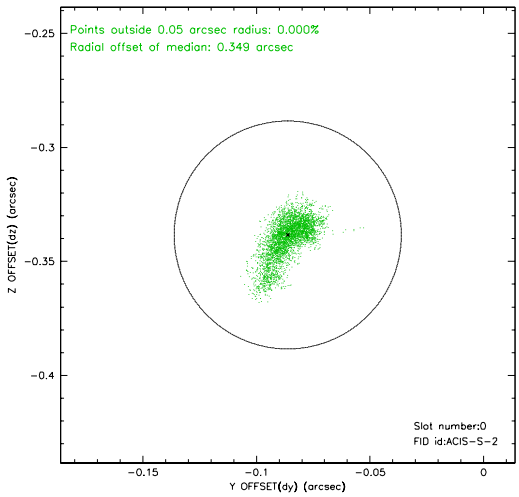

Points outside 0.4 arcsec radius: 0.025%
Radial offset of median: 0.142 arcsec
Z OFFSET(dz) (arcsec)
Y OFFSET(dy) (arcsec)
Slot number:7
AGASC star id:812918096

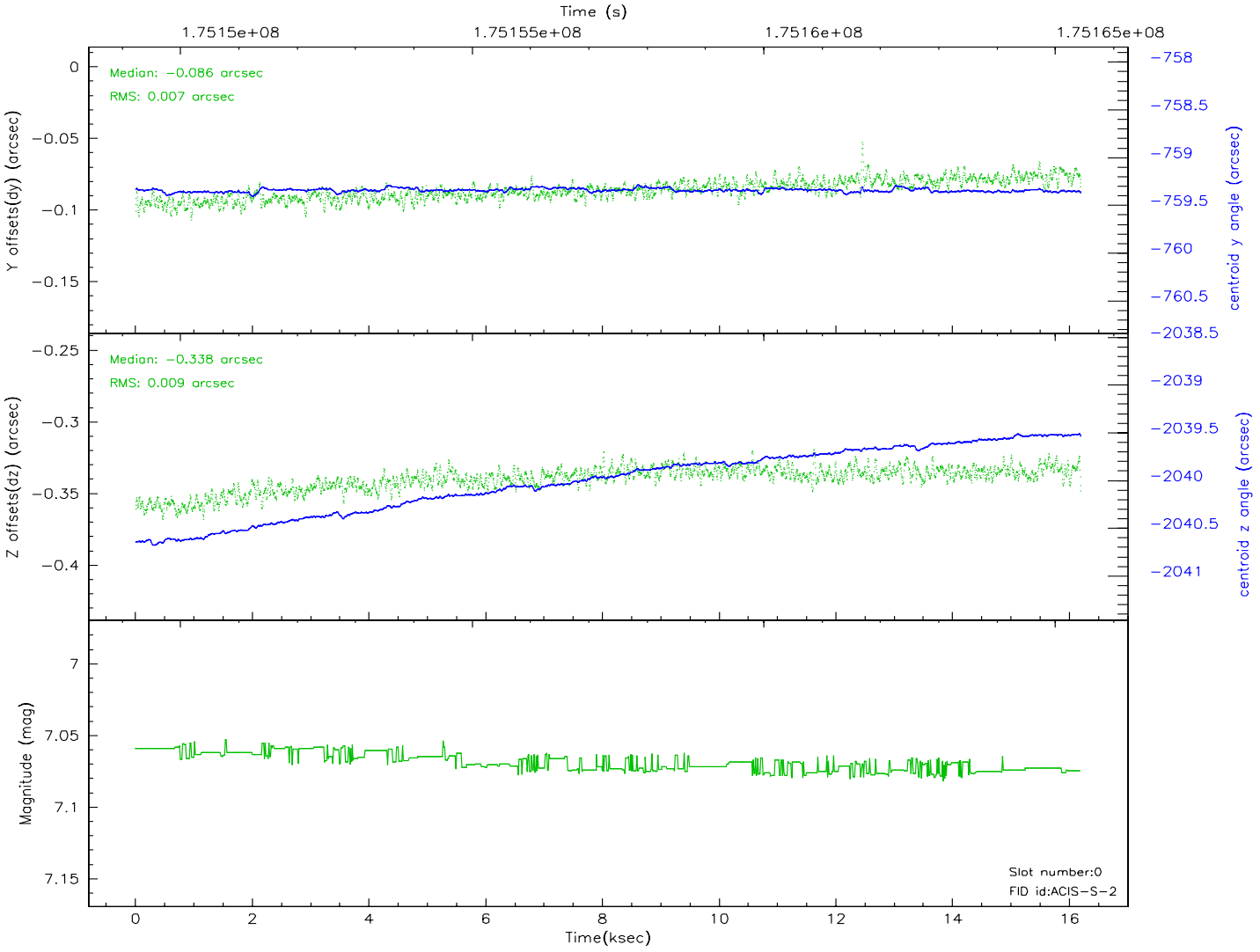

Time (s)
1.7515e+08
1.75155e+08
1.7516e+08
1.75165e+08
Median: −0.135 arcsec
RMS: 0.056 arcsec
Y offsets(dy) (arcsec)
Median: 0.045 arcsec
RMS: 0.053 arcsec
Z offsets(dz) (arcsec)
Magnitude (mag)
Slot number:7
AGASC star id:812918096
Time(ksec)

2.5 FID Slots

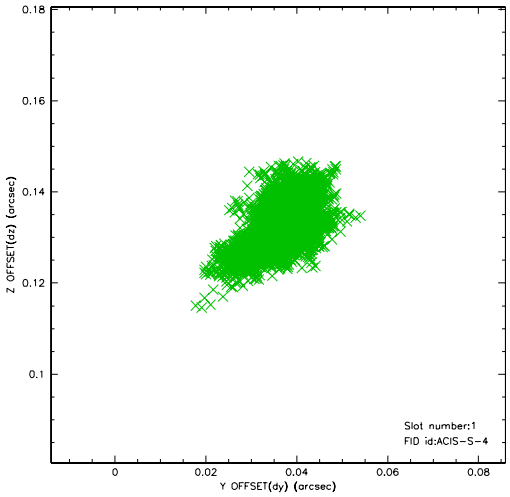
2.5.1 Slot 0

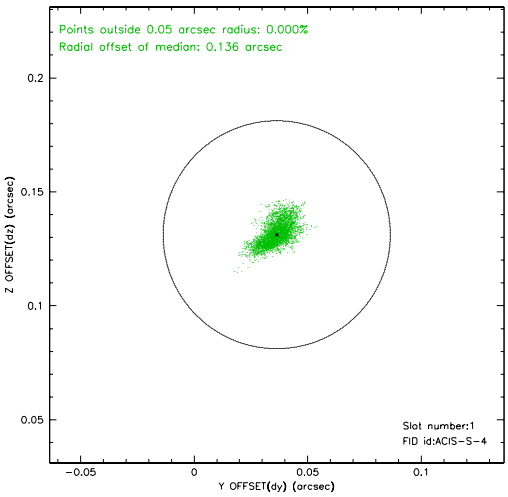


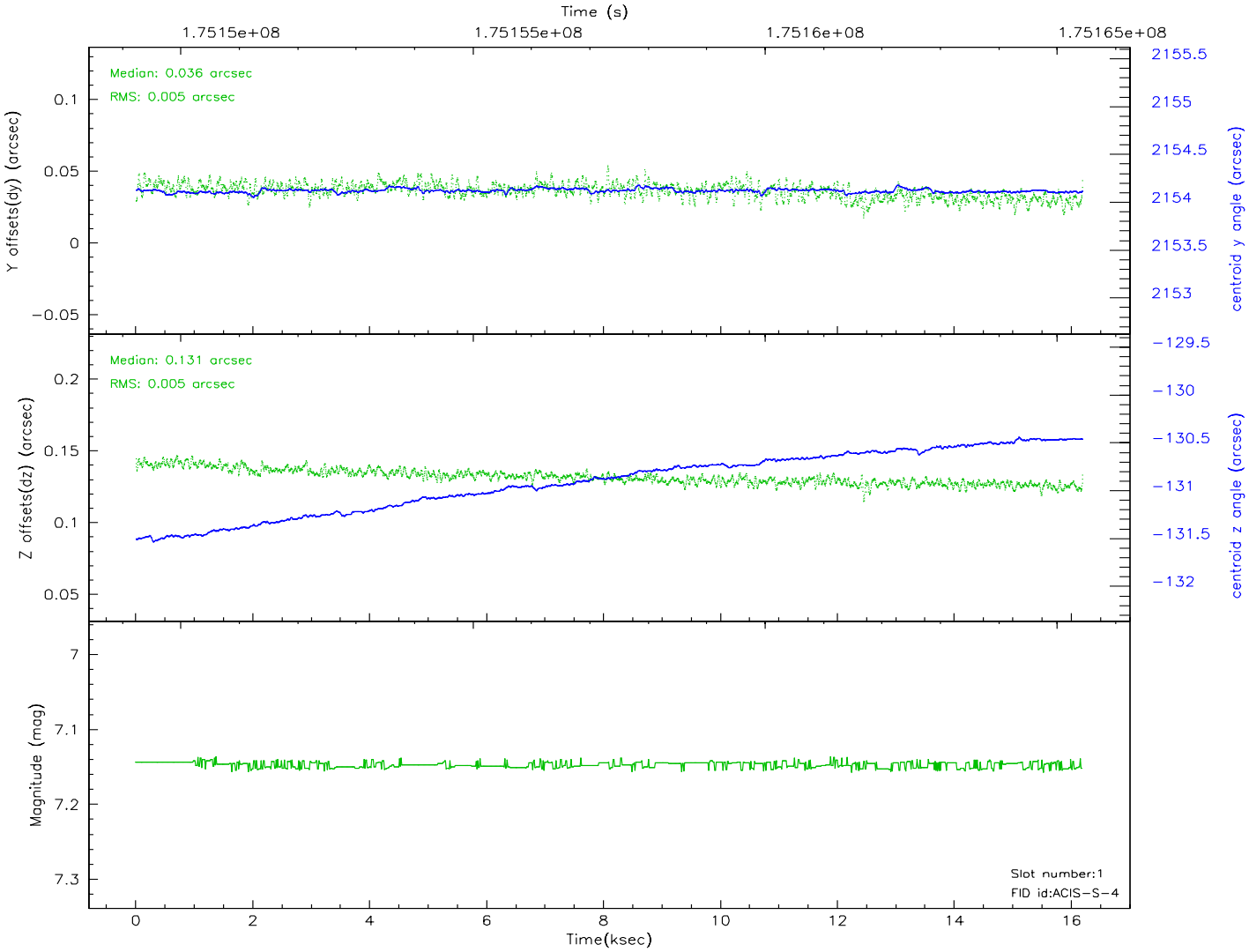




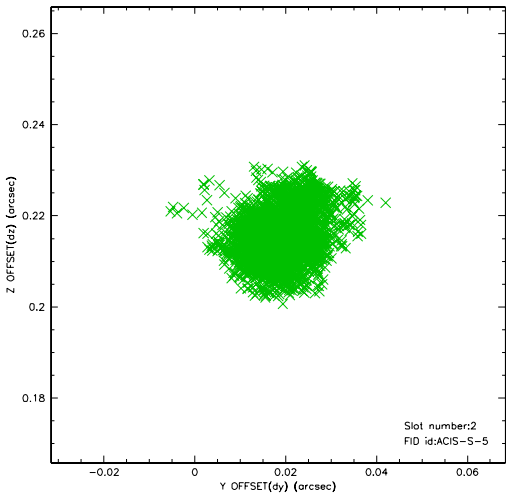
2.5.2 Slot 1

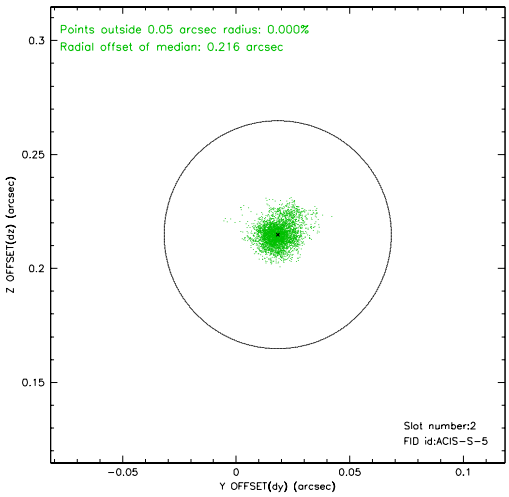

Z OFFSET(dz) (arcsec)
Y OFFSET(dy) (arcsec)
Slot number:1
FID id:ACIS-S-4

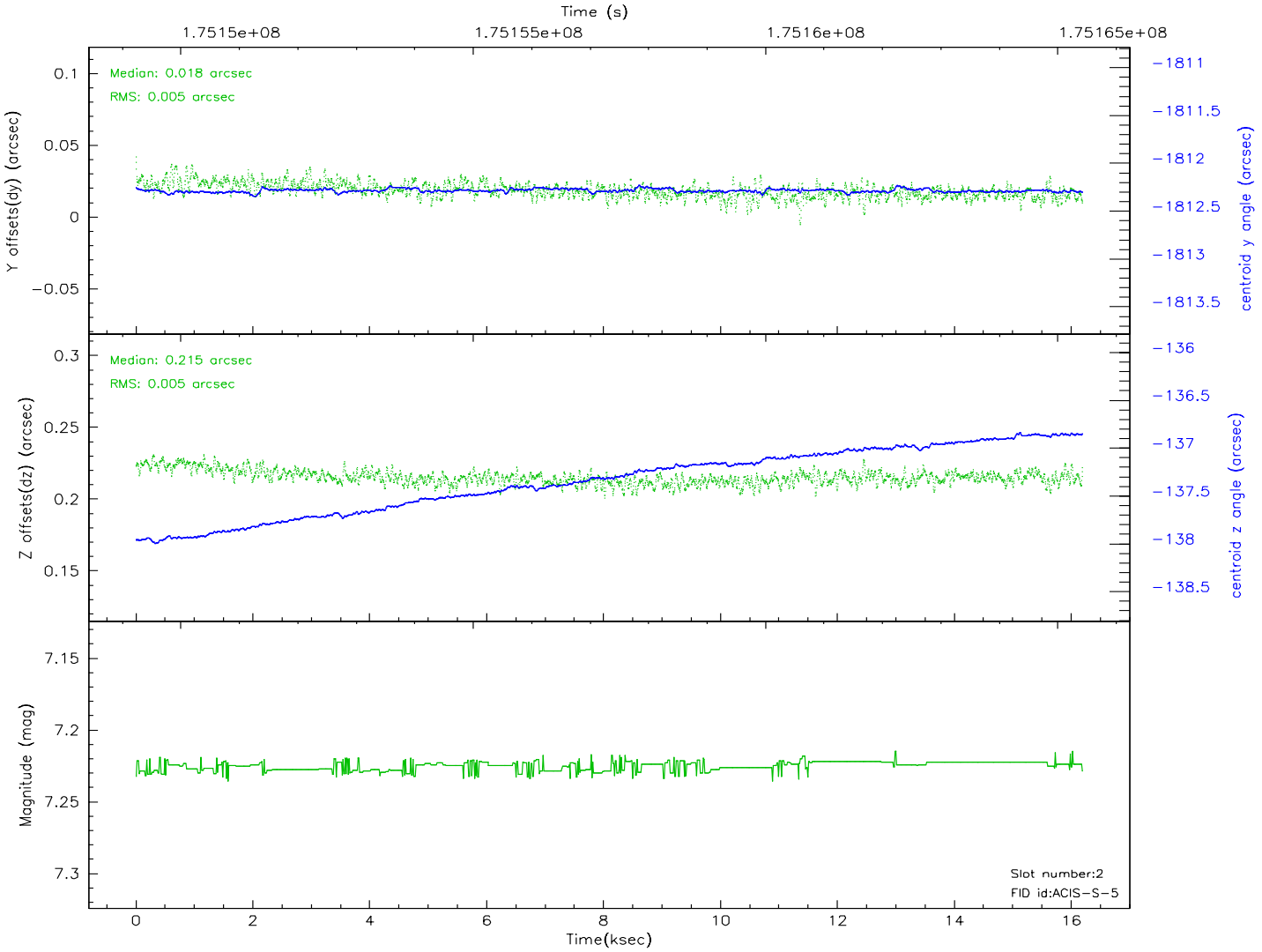

Points outside 0.05 arcsec radius: 0.000%
Radial offset of median: 0.136 arcsec
Z OFFSET(dz) (arcsec)
Y OFFSET(dy) (arcsec)
Slot number:1
FID id:ACIS-S-4


Time (s)
1.7515e+08
1.75155e+08
1.7516e+08
1.75165e+08
Median: 0.036 arcsec
RMS: 0.005 arcsec
Y offsets(dy) (arcsec)
centroid y angle (arcsec)
Median: 0.131 arcsec
RMS: 0.005 arcsec
Z offsets(dz) (arcsec)
centroid z angle (arcsec)
Magnitude (mag)
Slot number:1
FID id:ACIS-S-4
Time(ksec)

2.5.3 Slot 2

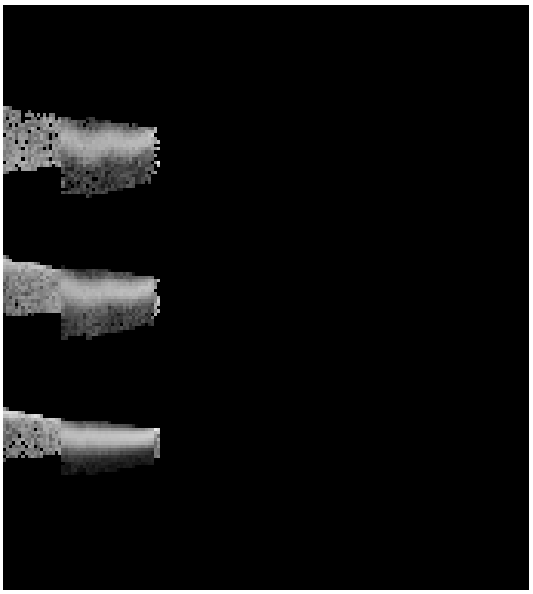

Z OFFSET(dz) (arcsec)
Y OFFSET(dy) (arcsec)
Slot number:2
FID id:ACIS-S-5


Points outside 0.05 arcsec radius: 0.000%
Radial offset of median: 0.216 arcsec
Z OFFSET(dz) (arcsec)
Y OFFSET(dy) (arcsec)
Slot number:2
FID id:ACIS-S-5

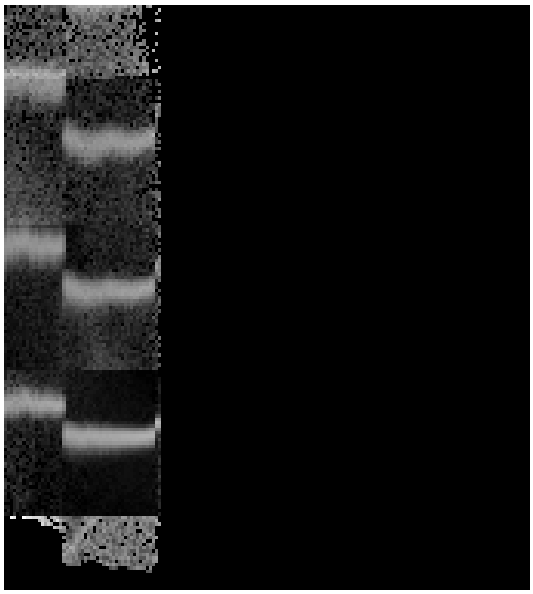

Time (s)
1.7515e+08
1.75155e+08
1.7516e+08
1.75165e+08
Median: 0.018 arcsec
RMS: 0.005 arcsec
Y offsets(dy) (arcsec)
centroid y angle (arcsec)
Median: 0.215 arcsec
RMS: 0.005 arcsec
Z offsets(dz) (arcsec)
centroid z angle (arcsec)
Magnitude (mag)
Slot number:2
FID id:ACIS-S-5
Time(ksec)

3 Gratings

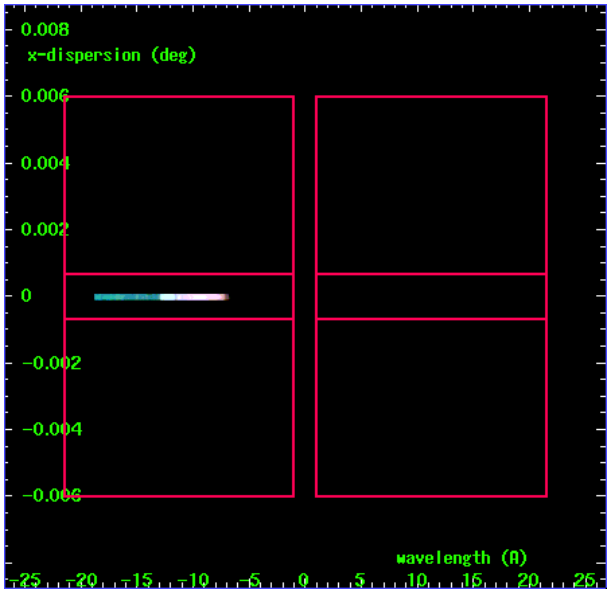
3.1 HEG Arm



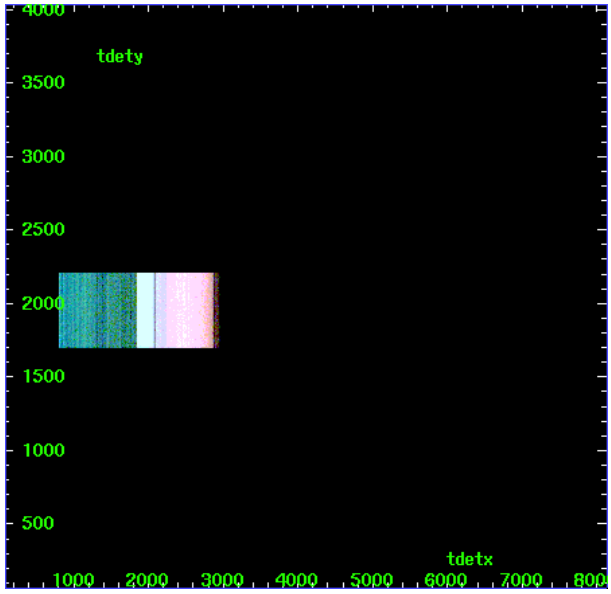
HEG Order Sort 123



HEG Order Sort ALL

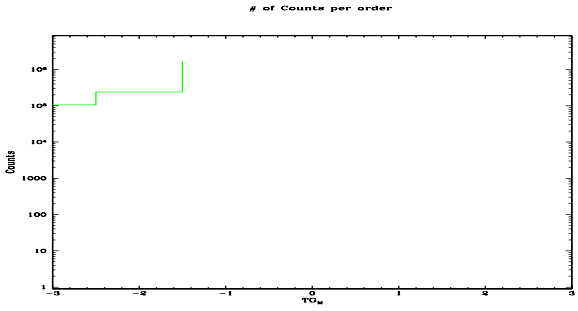


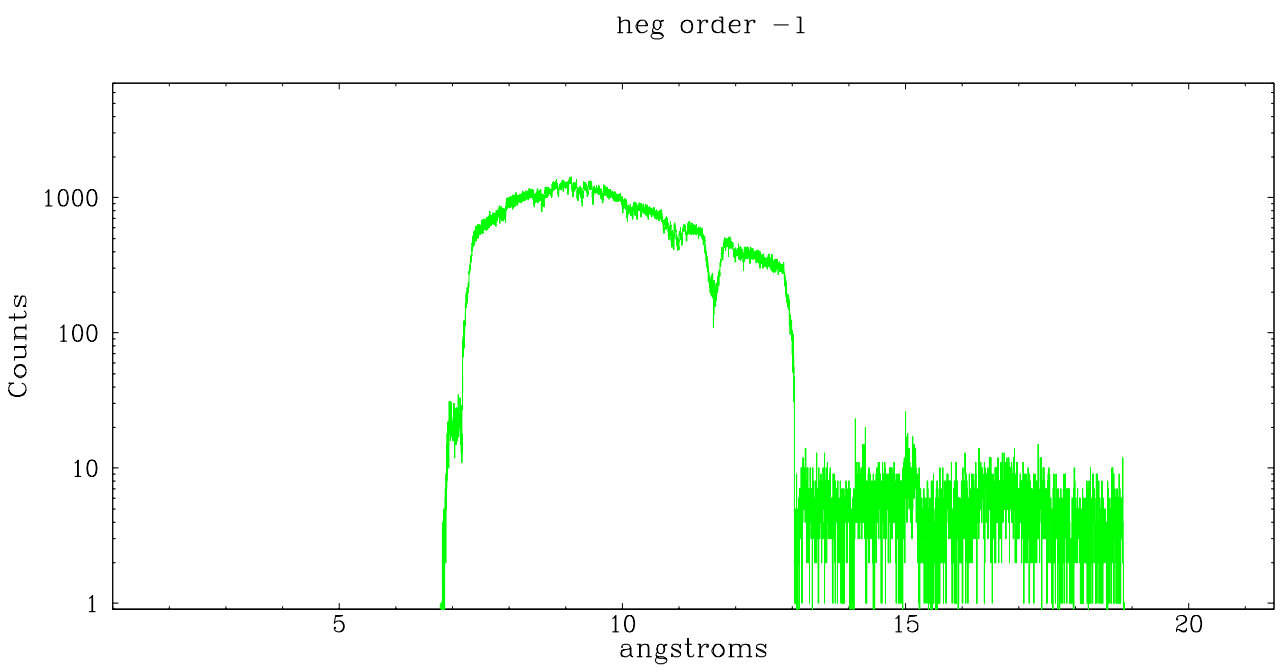
Spot Image HEG

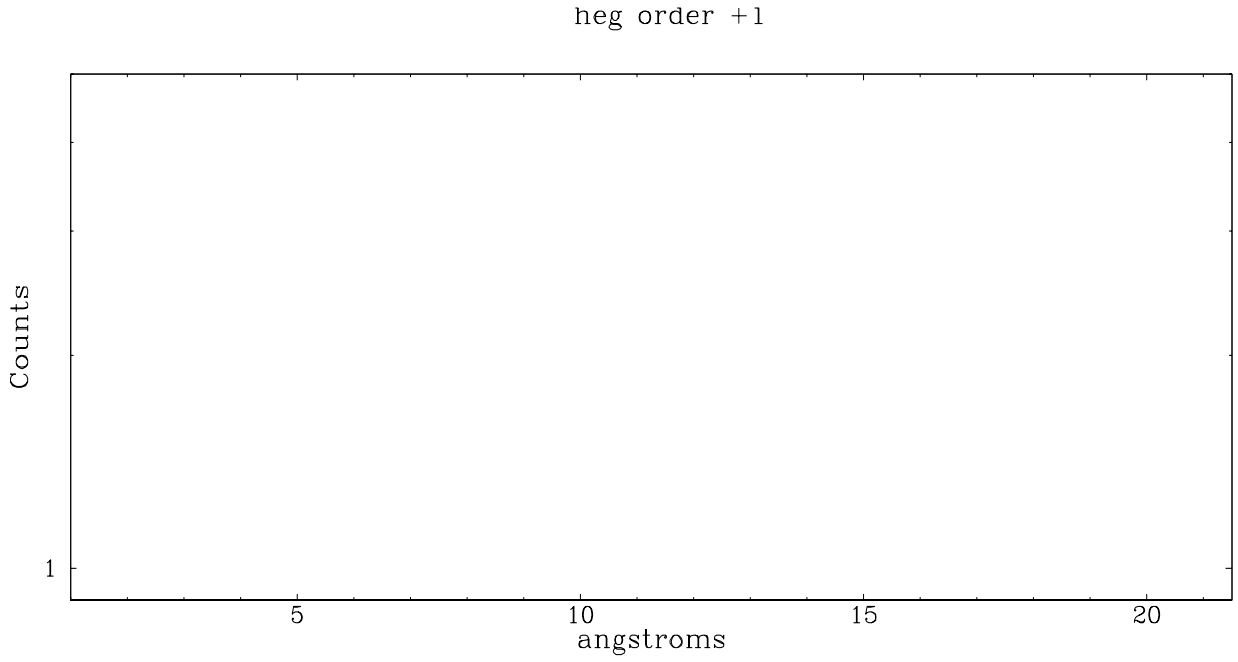


Full Detector HEG

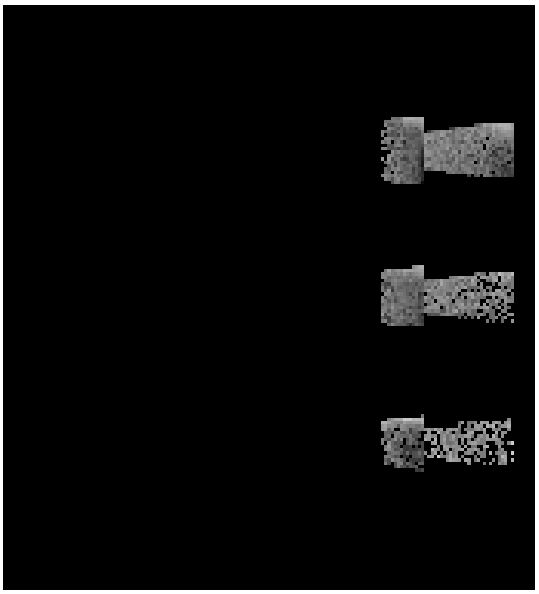
	order -3	order -2	order -1	order 0	order 1	order 2	order 3
Events	105221	240079	1682728	0	0	0	0



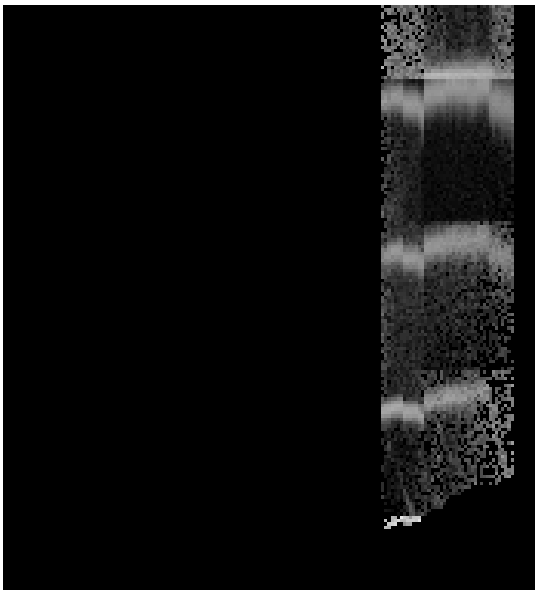

heg order −1
Counts
1000
100
10
1
5
10
15
20
angstroms


heg order +1
Counts
1
5
10
15
20
angstroms

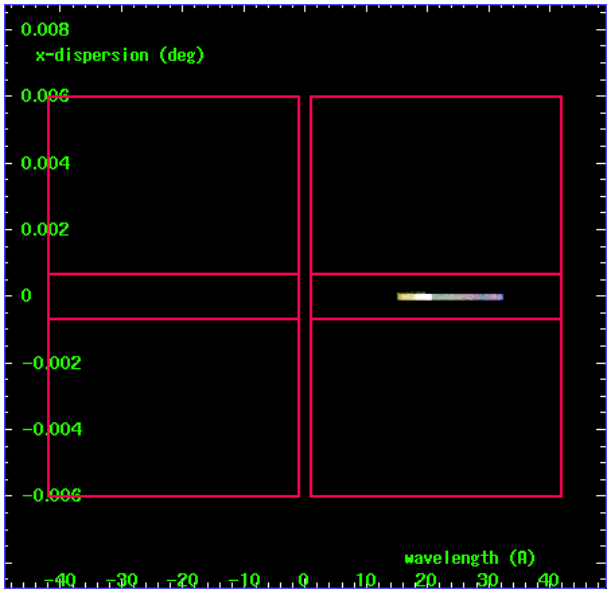
3.2 MEG Arm



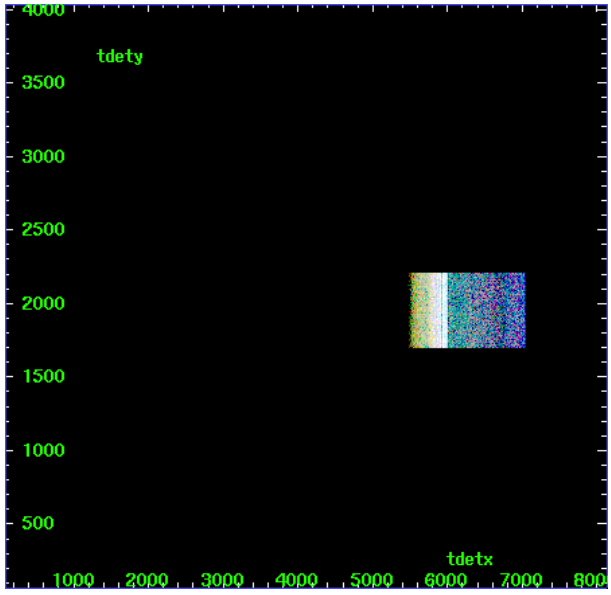
MEG Order Sort 123



MEG Order Sort ALL

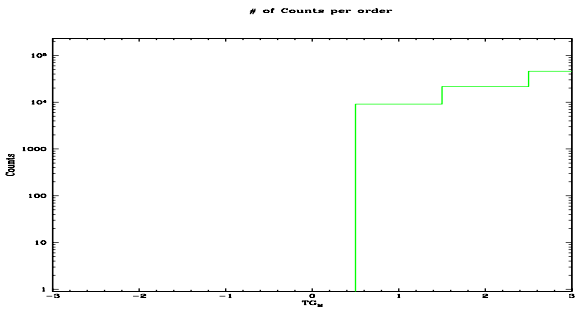


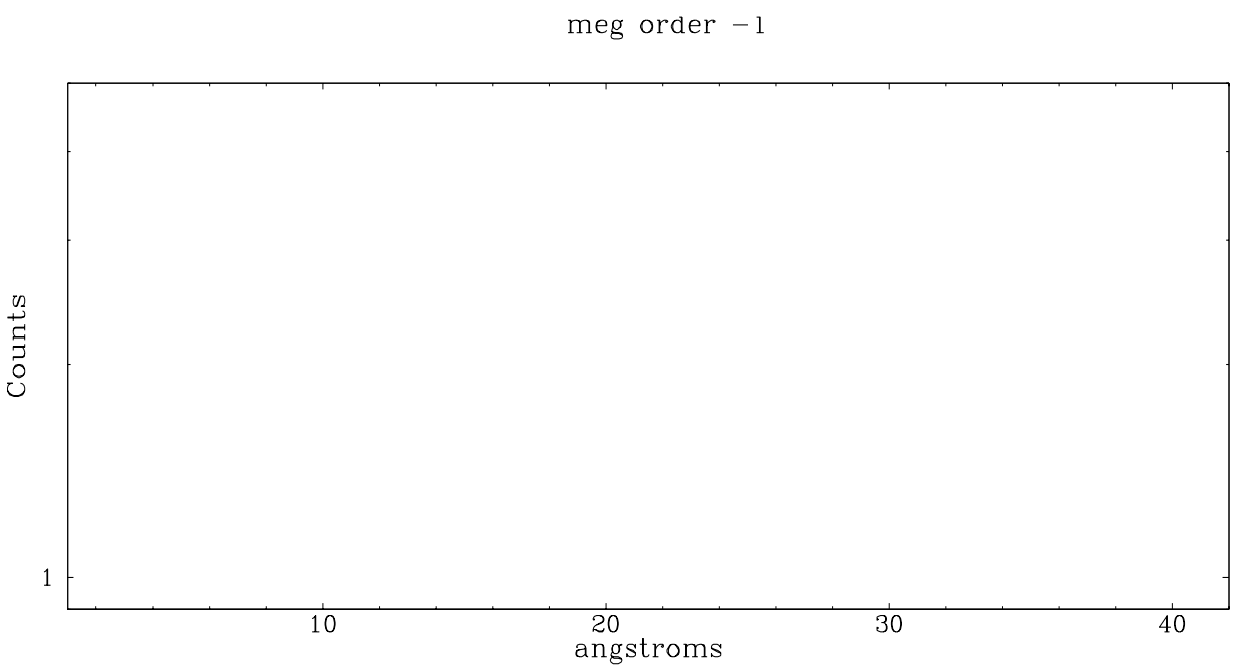
Spot Image MEG

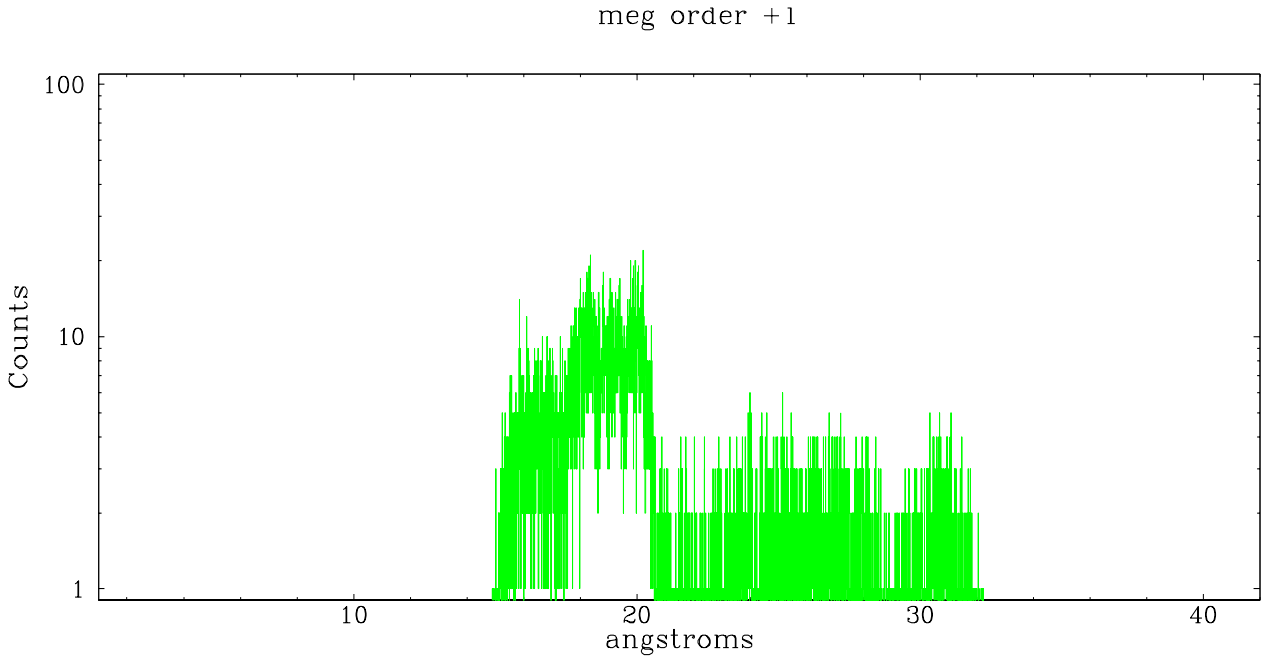


Full Detector MEG

	order -3	order -2	order -1	order 0	order 1	order 2	order 3
Events	0	0	0	0	9137	21571	46068




meg order −1
Counts
1
10
20
30
40
angstroms


meg order +1
Counts
100
10
1
10
20
30
40
angstroms

A Summary

A.1 Status

V&V Scientist	Joy Nichols
V&V Date (YYYY-MM-DD)	2007.06.15
V&V Edition	1
V&V Disposition and Status	OK
V&V Charge Time	16.058

A.2 Comments

```
Sco X-1 intentionally off-chip; a nominal mapping of source celestial
position to virtual chip position was used for zero-order centroid, and
is somewhat in error. The sky coordinates used in this processing are
x=4077.53, y=4122.10, derived from the position of Sco X-1. Although
some minus-order HEG counts are detected in the extraction window, no
MEG counts fall in the extraction window. This observation will require
some user-iteration to obtain an improved zero order centroid. It is
also possible that inaccurate graded-mode gain calibration and/or
order-sorting tables, or pileup in the MEG arms, are responsible for the
misalignment of the extraction regions with the spectral
data.

================================================================================

The following analysis techniques are recommended:

1. Reprocess with acis_process_events to eliminate the CTI correction:
params
apply_cti=no; apply_tgain=yes;gainfile=CALDB. This will yield sharper,
more well-defined orders.

2. Determine position of zeroth order (iteration may be necessary
here).

3. To get mask size, determine perpendicular separation of source from
counts trace. We calculate 640 pixels.

4. Run tg_create_mask with params use_user_pars=yes;
last_source_toread=A;
sA_zero_x=4077.53 (iterate); sA_zero_y=4122.10 (iterate);
sA_zero_rad=20;
sA_width_meg=1400 (2*640=1200+200(safety margin)=1400).

5. Run tg_resolve_events on results above, using the flat order sorting
to compensate for the bad gain: params osipfile=NONE; osort_lo=0.2;
osort_hi=0.5. The first and second orders of the spectrum should work
fine with this setup. For third order and above, the bad gain
```

correction
will scale the CCD energy into the next order.

==========
The charge time is based on CCD_ID=7 (S3), which had no dropped frames
and does reflect the requested exposure. Other chips have dropped
frames
due to telemetry saturation by the dispersed spectra, and their
effective exposures range from 8-11.4 ksec. Spectral arms are piled
up.