V&V Reference Report
L2 ASCDS Version : 8.4.5

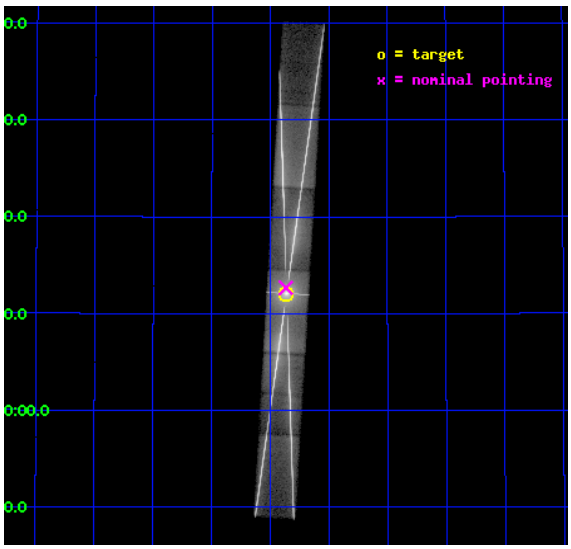
Observation 2743 - L2 Version 4
Chandra X-Ray Center

L2 Processing Date : Oct 5 2012

Contents

1 Front

seq_num	400223	Sequence number
obs_id	2743	Observation id
title	PHASE RESOLVED HIGH ENERGY RESOLUTION SPECTROSCOPY OF THE BLACK HOLE X-RAY BAINARY CYGNUS X-1	Proposal title
observer	Dr. Shu Zhang	Principal investigator
object	CYG X-1	Source name
dtycycle	0	
cycle	P	events from which exps? Prim/Second/Both
ra_targ	299.590417	Observer's specified target RA [deg]
dec_targ	35.201611	Observer's specified target Dec [deg]
ra_nom	299.59176268742	Nominal RA [deg]
dec_nom	35.211250366095	Nominal Dec [deg]
roll_nom	93.367001896581	Nominal Roll [deg]
revision	4	Processing version of data
ontime	2481.1609337926	Sum of GTIs [s]
livetime	2422.6747159442	Livetime [s]
ontime4	4643.6722413301	Sum of GTIs [s]
ontime5	4490.4653247297	Sum of GTIs [s]
ontime6	1601.8624467254	Sum of GTIs [s]
ontime7	2481.1609337926	Sum of GTIs [s]
ontime8	1949.9638735652	Sum of GTIs [s]
ontime9	4236.2780794799	Sum of GTIs [s]
l2events	1589081	Number of level 2 events

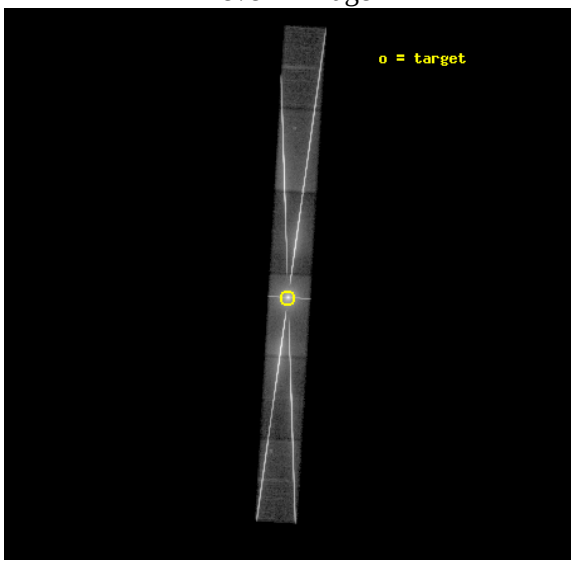


2 OBI

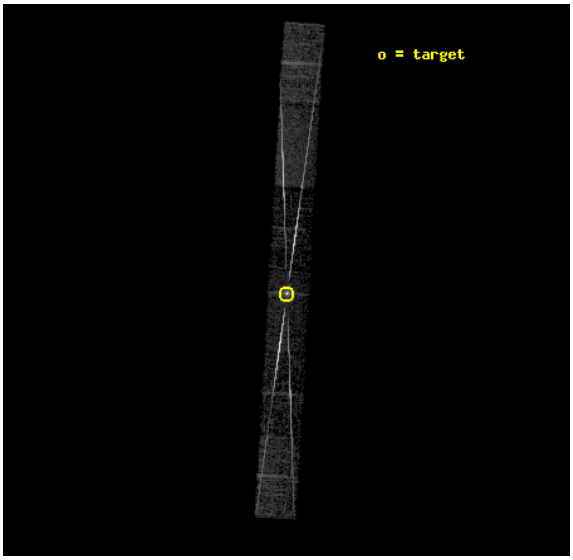
2.1 OBI

2.1.1 Images

Level 1 Image



Level 1 Bad Events



2.1.2 Parameters

obi_num	2	Obi number
ascdsver	8.4.5	Processing system revision
caldbver	4.5.2	
date	2012-10-05T14:50:35	Date and time of file creation
revision	3	Processing version of data

sched_exp_time	5000.000000	[s] Scheduled observation exposure time
ontime	2481.1609337926	Sum of GTIs [s]
ontime4	4643.6722413301	Sum of GTIs [s]
ontime5	4490.4653247297	Sum of GTIs [s]
ontime6	1601.8624467254	Sum of GTIs [s]
ontime7	2481.1609337926	Sum of GTIs [s]
ontime8	1949.9638735652	Sum of GTIs [s]
ontime9	4236.2780794799	Sum of GTIs [s]
l1events	2128821	Number of level 1 events

2.1.3 Events

	ccd 4	ccd 5	ccd 6	ccd 7	ccd 8	ccd 9
level 1 events	100596	481920	419132	510212	403535	213426
rejected events	21954	68977	111659	149314	87087	27459
rejected %	21%	14%	26%	29%	21%	12%

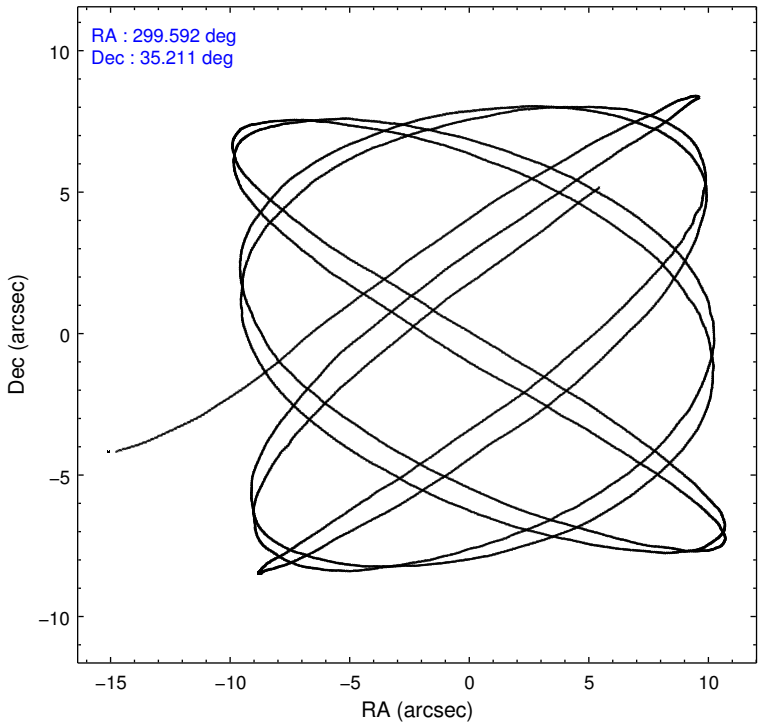
	ccd 4	ccd 5	ccd 6	ccd 7	ccd 8	ccd 9
grade 0 events	65355	125888	226902	74055	253127	156630
	64%	26%	54%	14%	62%	73%
grade 1 events	554	5117	29795	4453	24519	2322
	0%	1%	7%	0%	6%	1%
grade 2 events	8868	145397	47143	100435	43745	20961
	8%	30%	11%	19%	10%	9%
grade 3 events	2590	36146	20043	40827	17648	6500
	2%	7%	4%	8%	4%	3%
grade 4 events	2590	35863	19136	40053	17419	6317
	2%	7%	4%	7%	4%	2%
grade 5 events	857	18533	24409	21261	15471	1721
	0%	3%	5%	4%	3%	0%
grade 6 events	1728	82368	19203	131376	12217	3867
	1%	17%	4%	25%	3%	1%
grade 7 events	18054	32608	32501	97752	19389	15108
	17%	6%	7%	19%	4%	7%

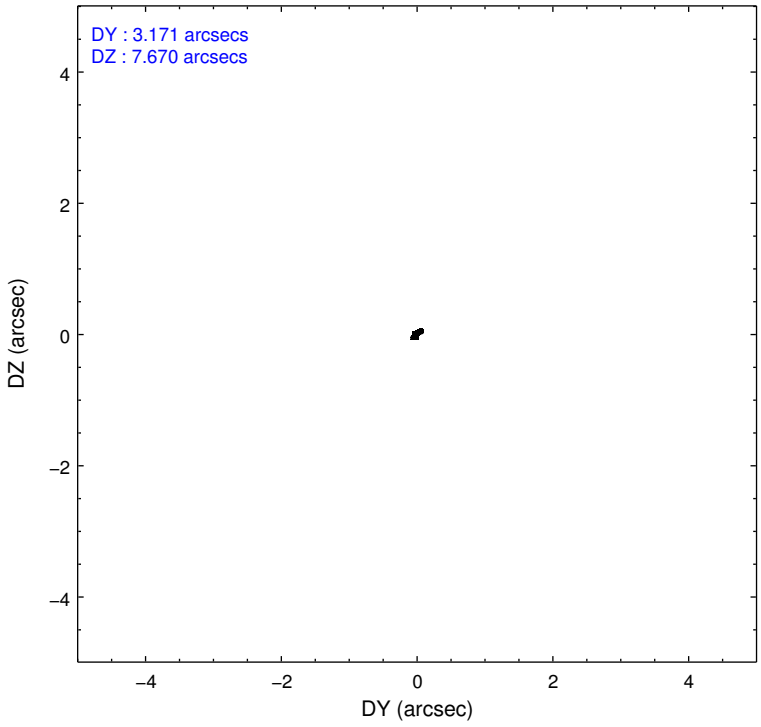
2.2 Compared Parameters

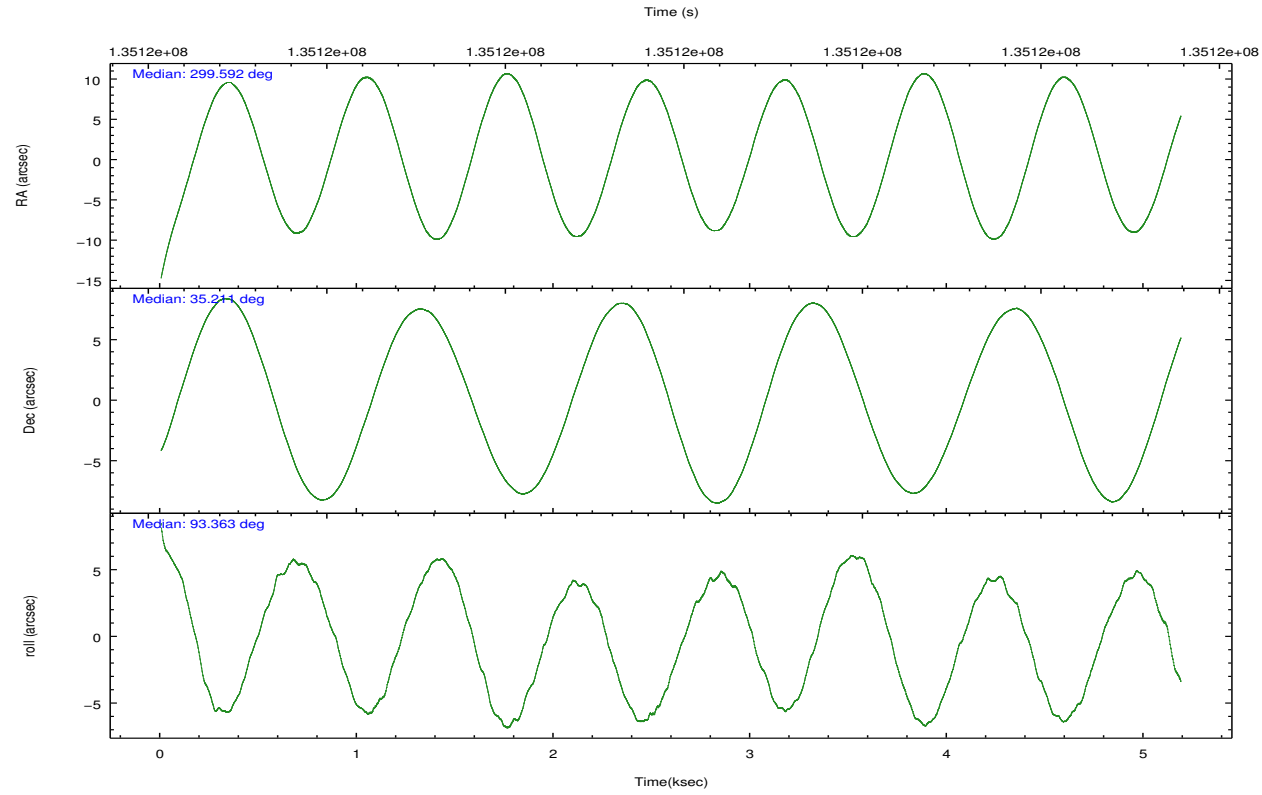
Parameter	Planned	Actual
Instrument	ACIS	ACIS
Detector	ACIS-456789	ACIS-456789
Grating	HETG	HETG
Data mode	GRADED	GRADED
Observation mode	POINTING	POINTING
[deg] Pointing RA	299.610508	299.591762687423
[deg] Pointing Dec	35.188676	35.21125036609482
[deg] Pointing Roll	93.199573	93.36700189658109
[mm] SIM focus pos	-0.684267	-0.6828225247311905
[mm] SIM defocus	0	0.001444936568705701
[mm] SIM translation stage pos	-184.612523	-184.6110867017414
[mm] SIM translation stage offset	-5.52	-5.52143588126637
Phase constraints	Y	Y
[d] Phase period	5.599847	5.599847
[d] Phase epoch (MJD)	51998.668500	51998.668500
Phase start	0.750000	0.750000
Phase end	0.760000	0.760000
Phase start error	0.050000	0.050000
Phase end error	0.050000	0.050000
[s] Observation start time (MET)	135119522.184000	135118382.0459
Observation start date	2002-04-13T21:10:58	2002-04-13T20:53:02
[s] Observation end time (MET)	135124522.184000	135125207.52118
Observation end date	2002-04-13T22:34:18	2002-04-13T22:46:47
Read mode	TIMED	TIMED

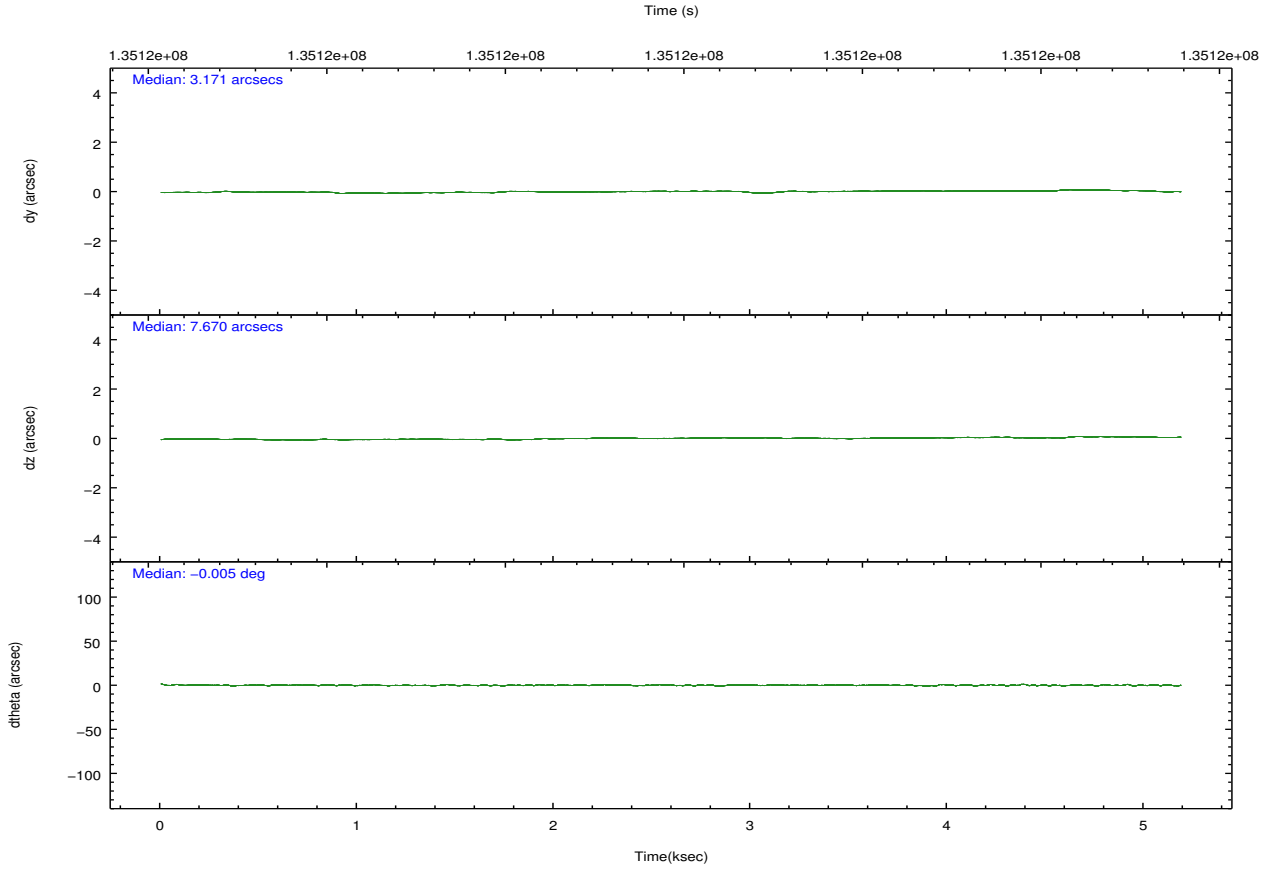
Parameter	Planned	Actual
Obspar format version number	7	7
Obspar file type	PREDICTED	ACTUAL
Obspar update status	NONE	UPDATED
Number of optional ACIS chips dropped	0	0
On-chip summing requested	N	N
Subarray requested	CUSTOM	1/2
Subarray start row	1	1
Subarray row count	512	512
Alternating exposures requested	N	N
[s] Primary exposure time	0.000000	1.7

2.3 Aspect


RA : 299.592 deg
Dec : 35.211 deg
Dec (arcsec)
RA (arcsec)
10
5
0
−5
−10
−15
−10
−5
0
5
10


DY : 3.171 arcsecs
DZ : 7.670 arcsecs
DZ (arcsec)
DY (arcsec)
4
2
0
−2
−4
−4
−2
0
2
4


Time (s)
1.3512e+08
1.3512e+08
1.3512e+08
1.3512e+08
1.3512e+08
1.3512e+08
1.3512e+08
Median: 299.592 deg
RA (arcsec)
Median: 35.211 deg
Dec (arcsec)
Median: 93.363 deg
roll (arcsec)
Time(ksec)

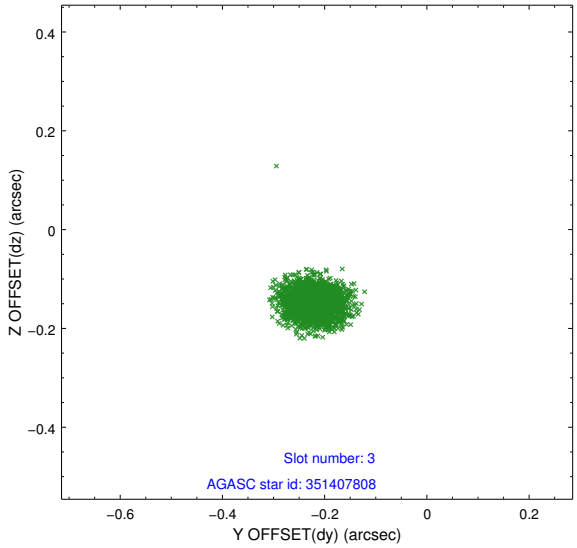

Time (s)
1.3512e+08
1.3512e+08
1.3512e+08
1.3512e+08
1.3512e+08
1.3512e+08
1.3512e+08
Median: 3.171 arcsecs
dy (arcsec)
Median: 7.670 arcsecs
dz (arcsec)
Median: −0.005 deg
dtheta (arcsec)
Time(ksec)

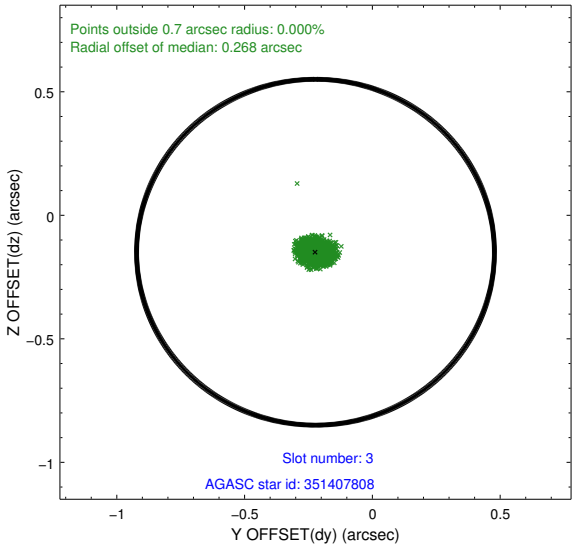
Slot Statistics

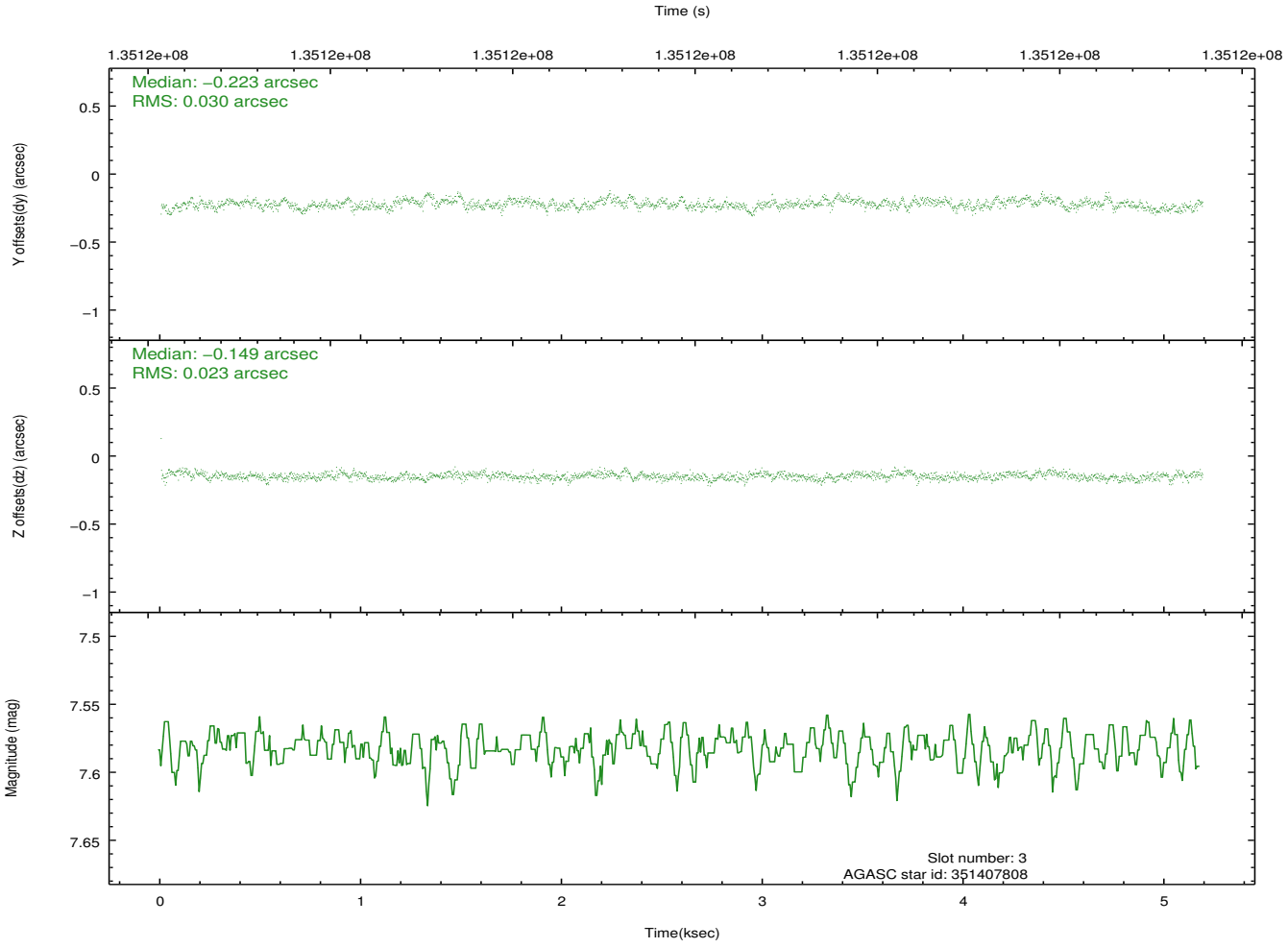
slot	status	id	mag	n_pts	med_dy	med_dz	dr1	dr2	ra	dec	mean_y	mean_z
0	FID	ACIS-S-2	7.10	1266	-0.043	-0.035	0.006	0.010	0.000000	0.000000	-755.44	-1842.73
1	FID	ACIS-S-4	7.19	1265	0.004	0.027	0.006	0.010	0.000000	0.000000	2157.33	64.56
2	FID	ACIS-S-6	7.39	1265	0.012	0.015	0.007	0.012	0.000000	0.000000	408.07	703.24
3	GUIDE	351407808	7.58	2531	-0.223	-0.149	0.039	0.066	299.102647	35.790086	2247.56	1359.61
4	GUIDE	351018080	8.33	2531	0.193	-0.103	0.051	0.085	299.327312	34.581247	-2134.74	960.24
5	GUIDE	351024856	8.54	2531	0.028	0.213	0.081	0.122	300.374482	35.139033	-296.51	-2235.61
6	GUIDE	351022664	8.91	2531	0.039	0.057	0.072	0.114	300.391114	34.583094	-2297.27	-2190.09
7	GUIDE	351414960	9.18	2530	-0.043	-0.011	0.087	0.133	298.994276	35.824617	2390.36	1667.06

2.4 Star Slots

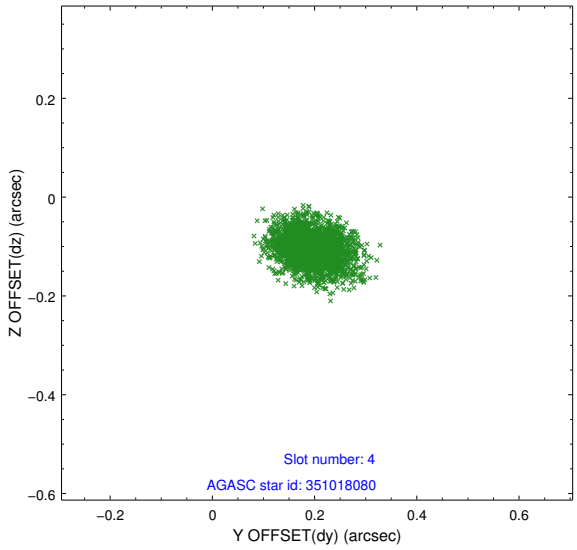
2.4.1 Slot 3

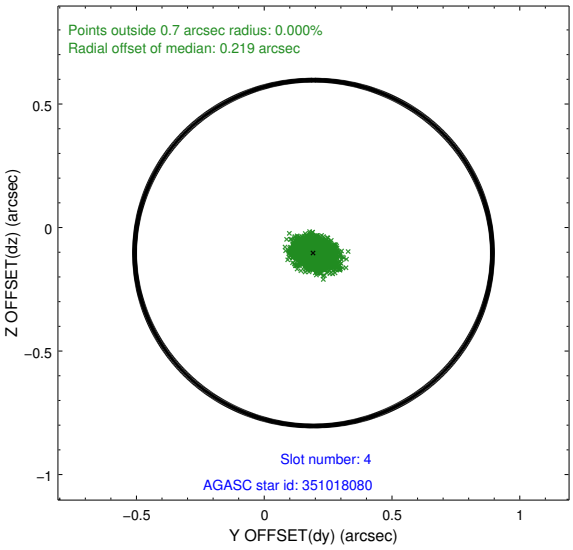


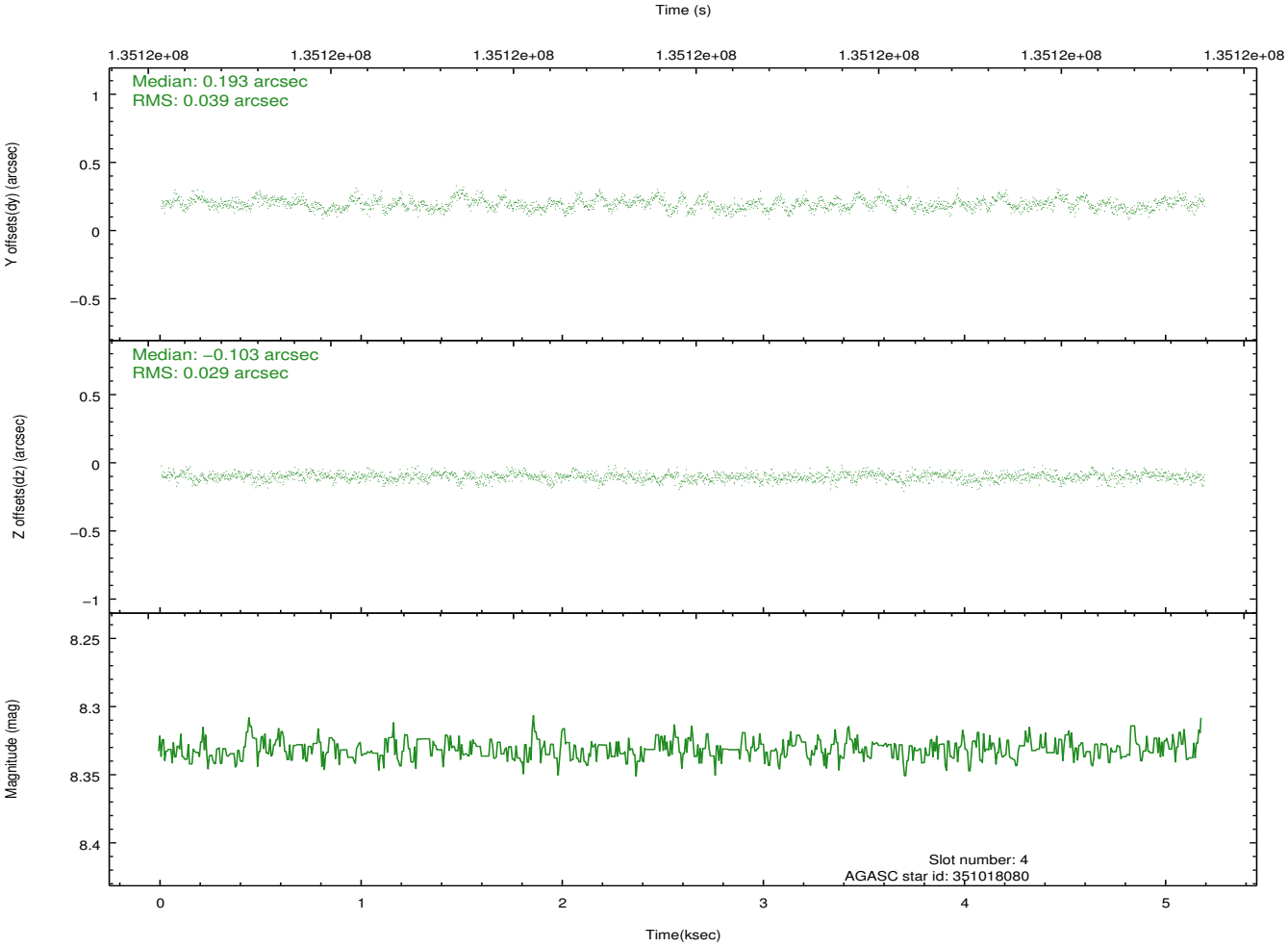




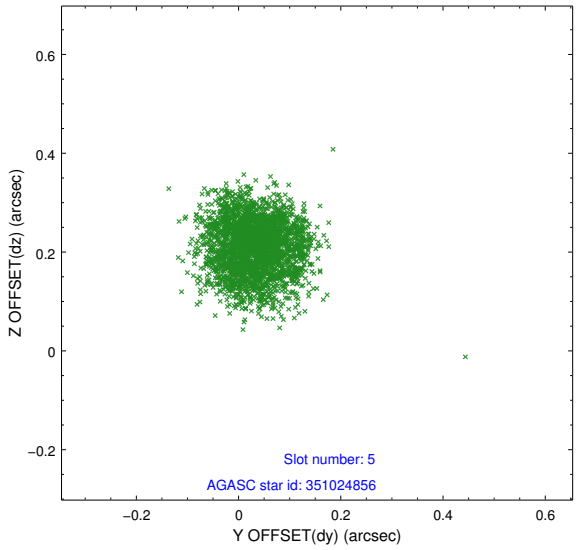
2.4.2 Slot 4

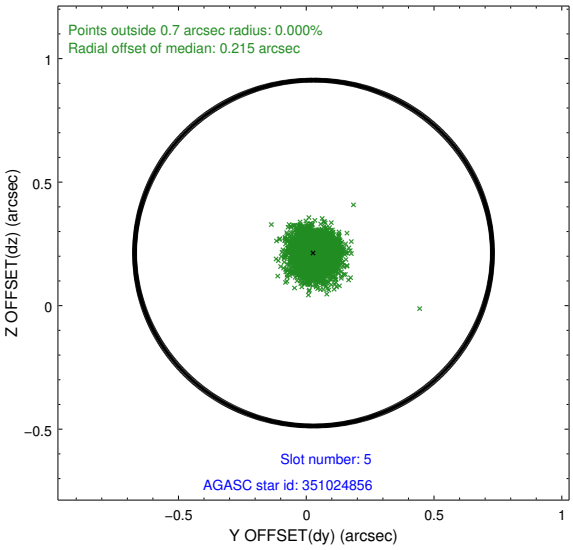

Z OFFSET(dz) (arcsec)
Y OFFSET(dy) (arcsec)
Slot number: 4
AGASC star id: 351018080

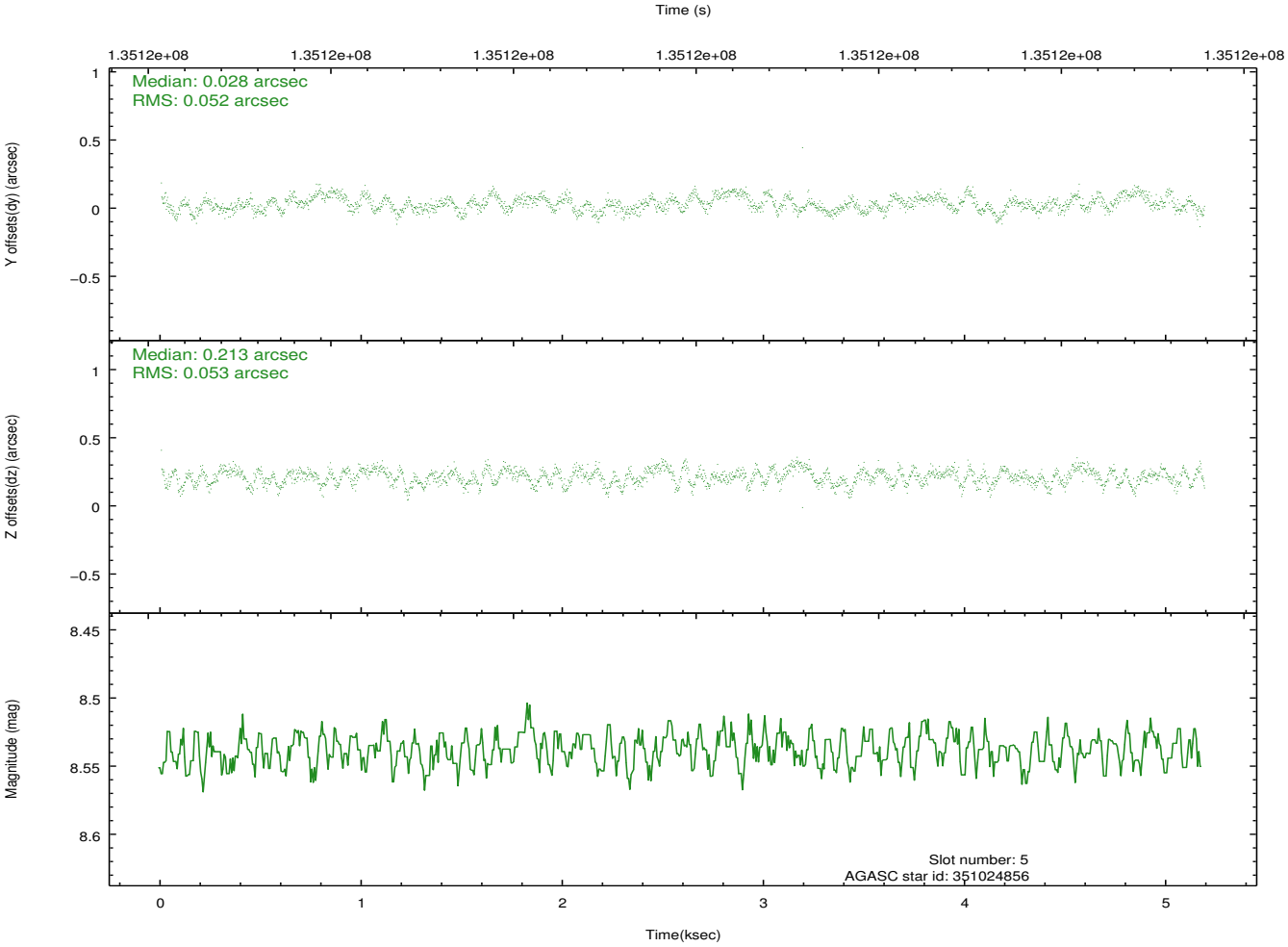

Points outside 0.7 arcsec radius: 0.000%
Radial offset of median: 0.219 arcsec
Z OFFSET(dz) (arcsec)
Y OFFSET(dy) (arcsec)
Slot number: 4
AGASC star id: 351018080


Time (s)
Median: 0.193 arcsec
RMS: 0.039 arcsec
Y offsets(dy) (arcsec)
Median: −0.103 arcsec
RMS: 0.029 arcsec
Z offsets(dz) (arcsec)
Magnitude (mag)
Slot number: 4
AGASC star id: 351018080
Time(ksec)

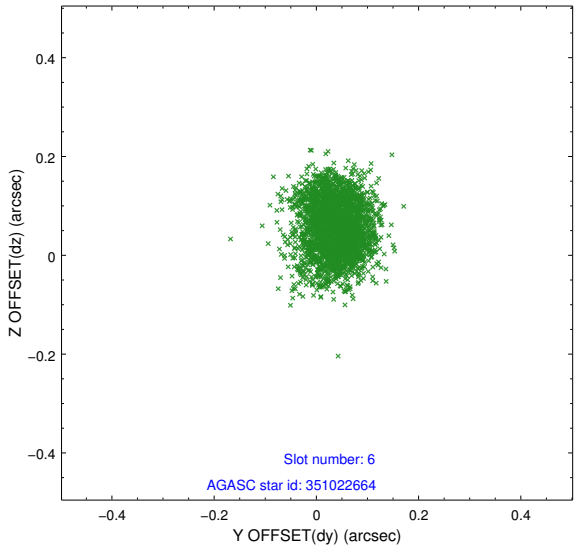
2.4.3 Slot 5

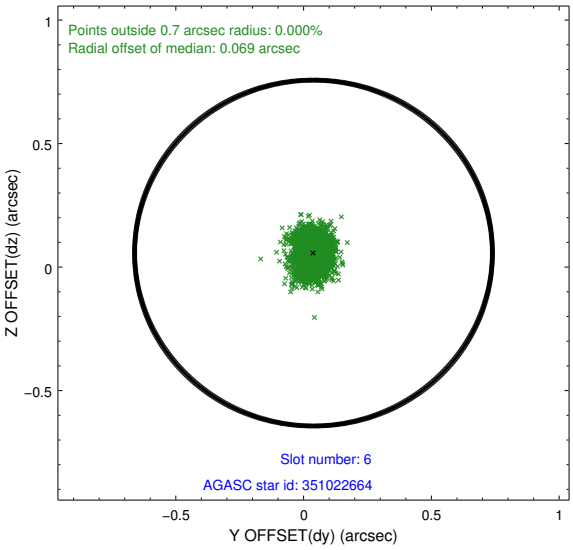

Z OFFSET(dz) (arcsec)
Y OFFSET(dy) (arcsec)
Slot number: 5
AGASC star id: 351024856

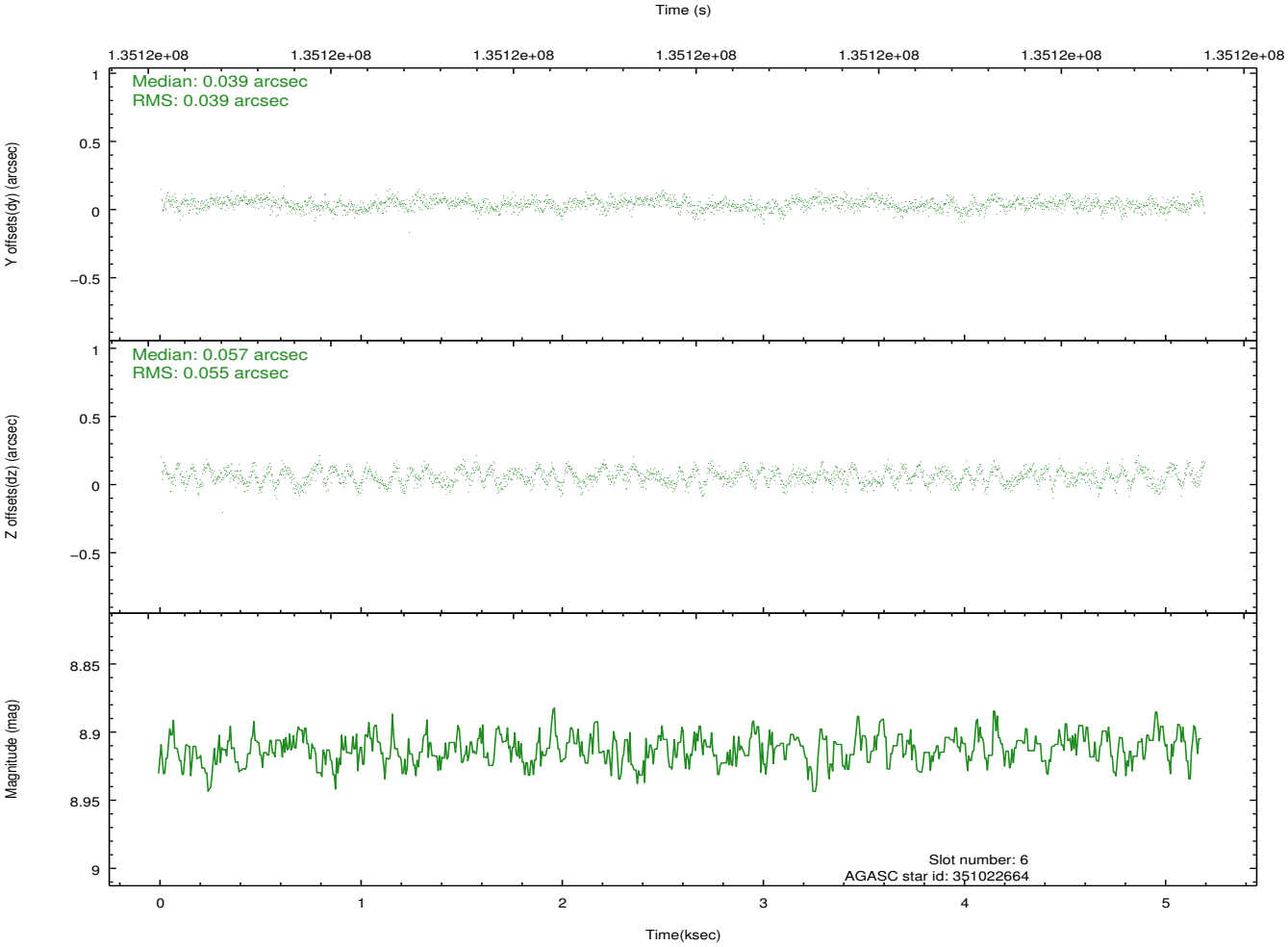

Points outside 0.7 arcsec radius: 0.000%
Radial offset of median: 0.215 arcsec
Z OFFSET(dz) (arcsec)
Y OFFSET(dy) (arcsec)
Slot number: 5
AGASC star id: 351024856


Time (s)
Median: 0.028 arcsec
RMS: 0.052 arcsec
Y offsets(dy) (arcsec)
Median: 0.213 arcsec
RMS: 0.053 arcsec
Z offsets(dz) (arcsec)
Magnitude (mag)
Slot number: 5
AGASC star id: 351024856
Time(ksec)

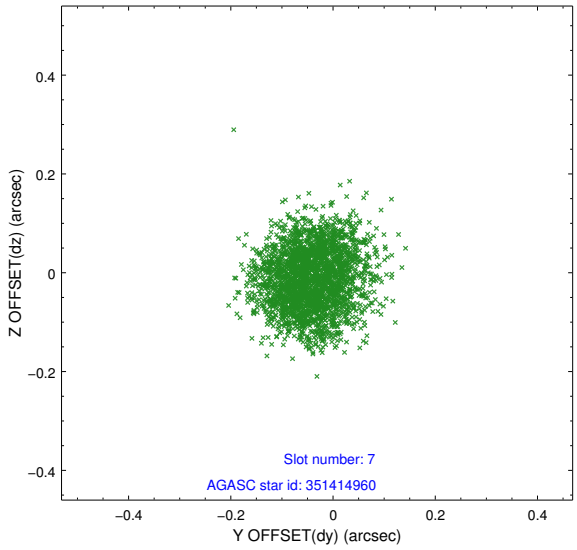
2.4.4 Slot 6

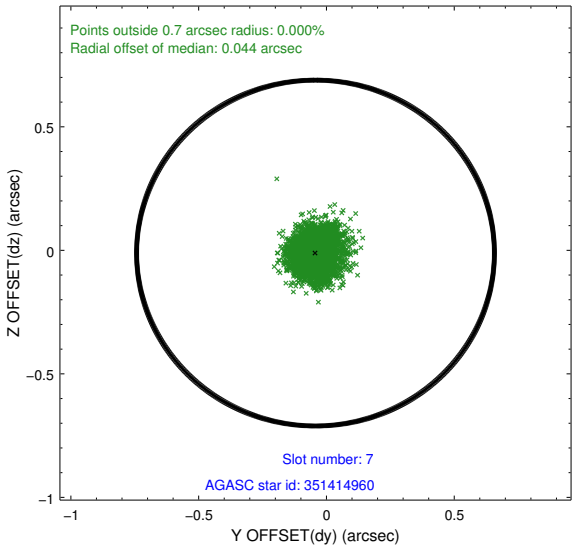

Z OFFSET(dz) (arcsec)
Y OFFSET(dy) (arcsec)
Slot number: 6
AGASC star id: 351022664

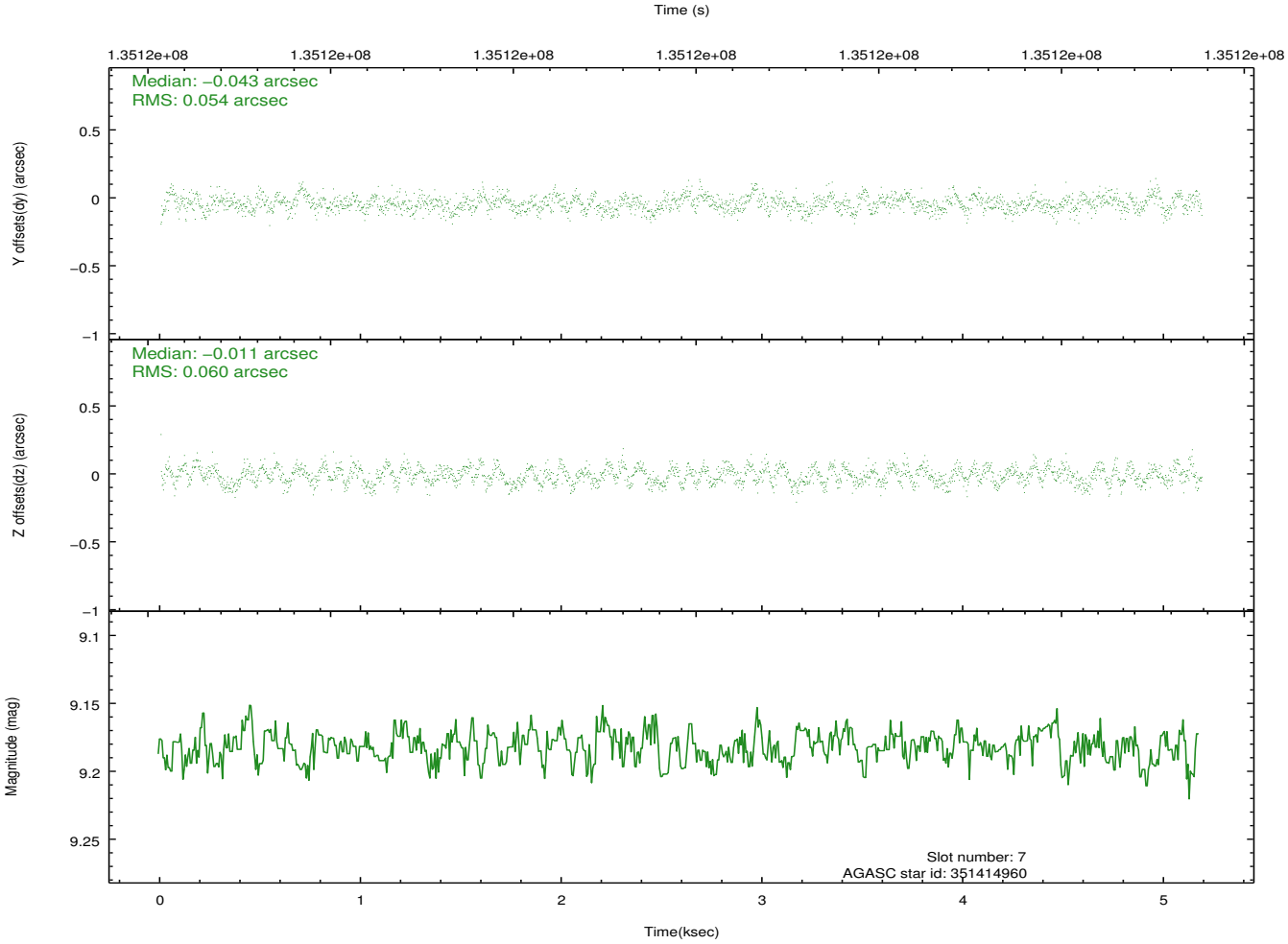

Points outside 0.7 arcsec radius: 0.000%
Radial offset of median: 0.069 arcsec
Z OFFSET(dz) (arcsec)
Y OFFSET(dy) (arcsec)
Slot number: 6
AGASC star id: 351022664


Time (s)
Median: 0.039 arcsec
RMS: 0.039 arcsec
Y offsets(dy) (arcsec)
Median: 0.057 arcsec
RMS: 0.055 arcsec
Z offsets(dz) (arcsec)
Magnitude (mag)
Slot number: 6
AGASC star id: 351022664
Time(ksec)

2.4.5 Slot 7

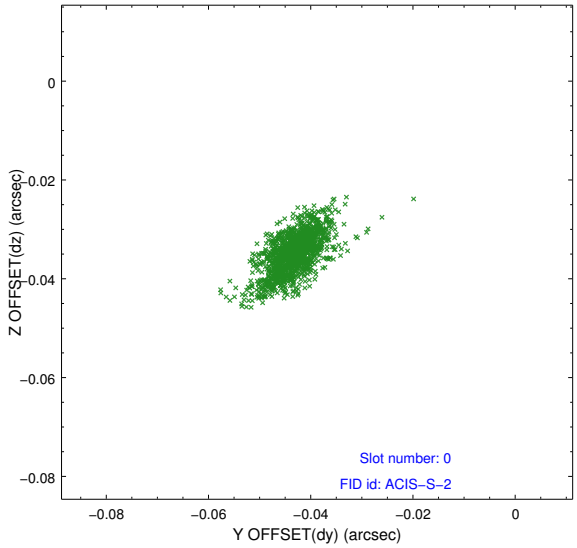

Z OFFSET(dz) (arcsec)
Y OFFSET(dy) (arcsec)
Slot number: 7
AGASC star id: 351414960

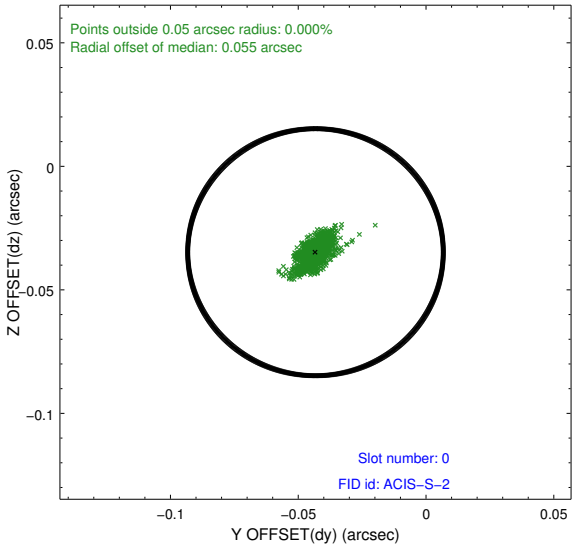

Points outside 0.7 arcsec radius: 0.000%
Radial offset of median: 0.044 arcsec
Z OFFSET(dz) (arcsec)
Y OFFSET(dy) (arcsec)
Slot number: 7
AGASC star id: 351414960

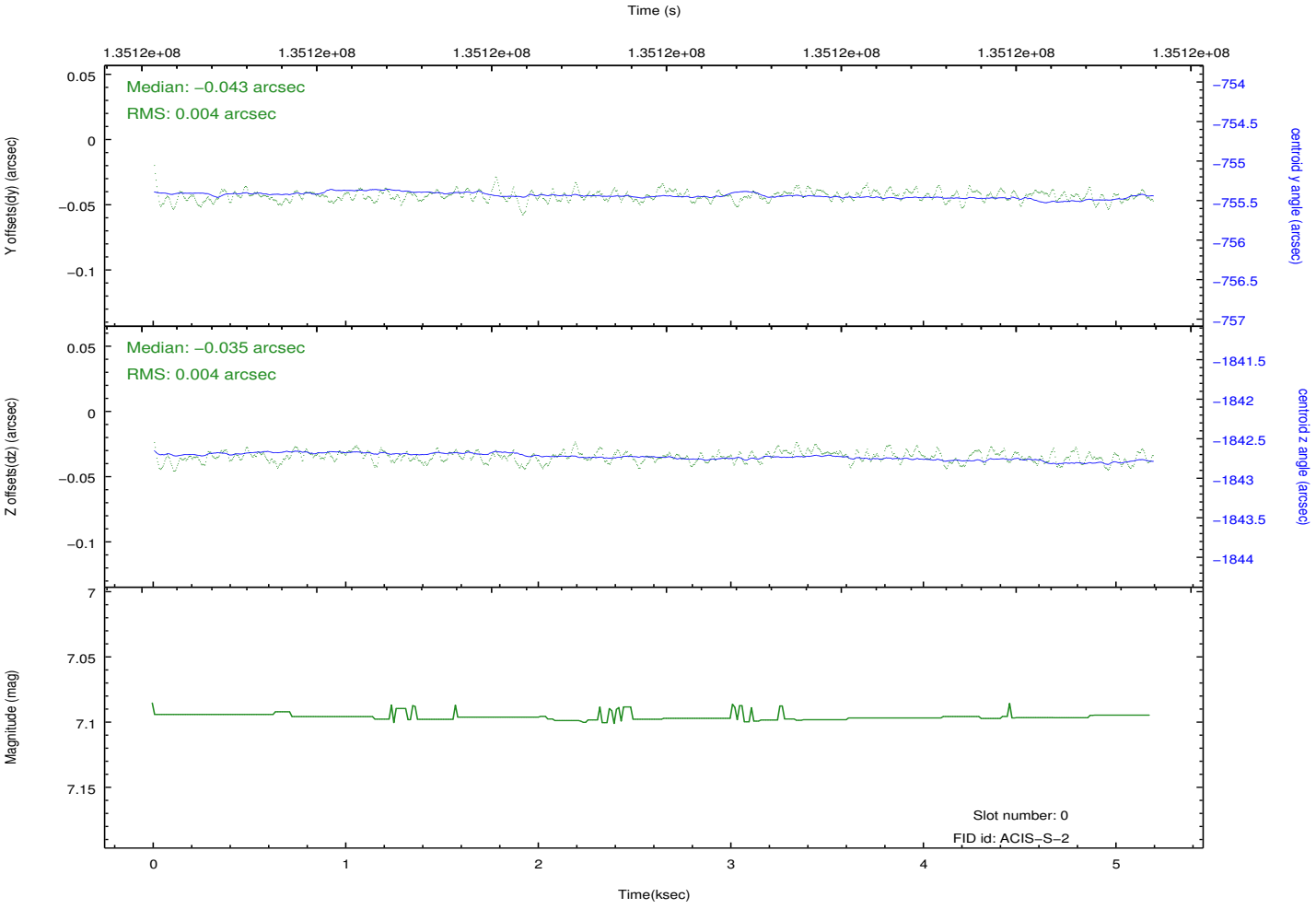

Time (s)
Median: −0.043 arcsec
RMS: 0.054 arcsec
Y offsets(dy) (arcsec)
Median: −0.011 arcsec
RMS: 0.060 arcsec
Z offsets(dz) (arcsec)
Magnitude (mag)
Slot number: 7
AGASC star id: 351414960
Time(ksec)

2.5 FID Slots

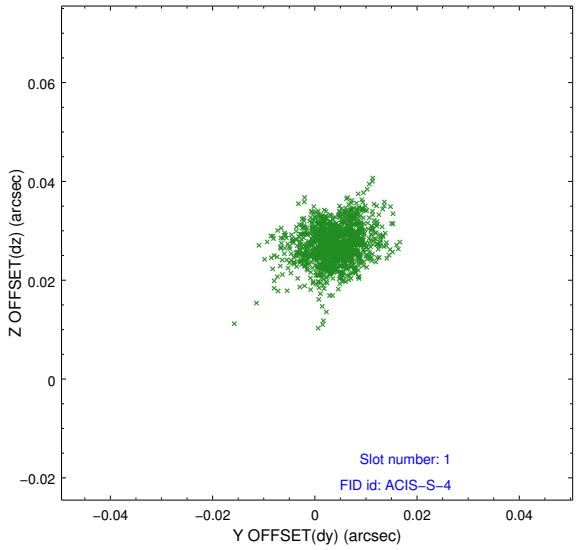
2.5.1 Slot 0

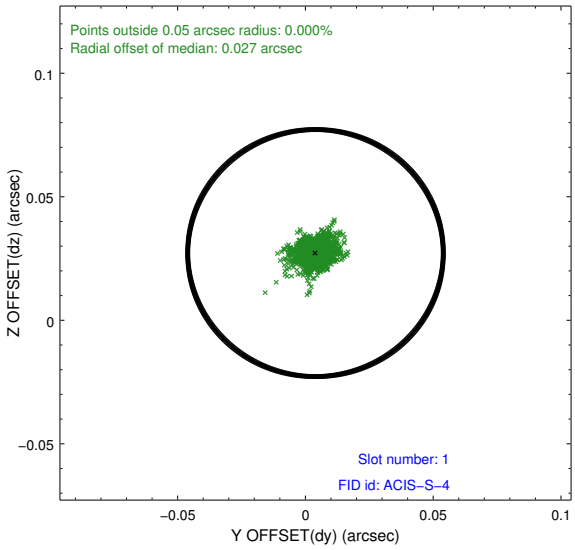


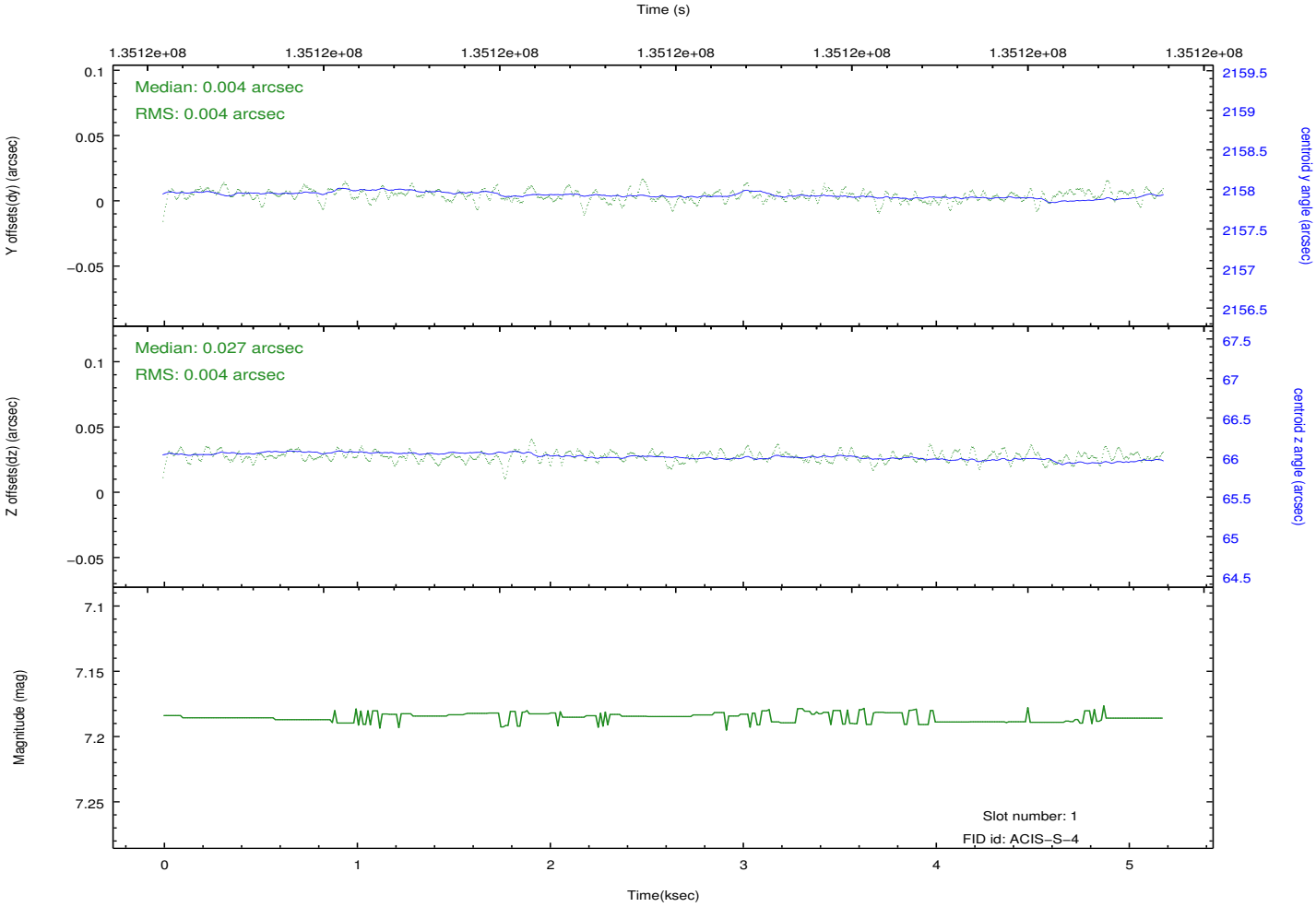




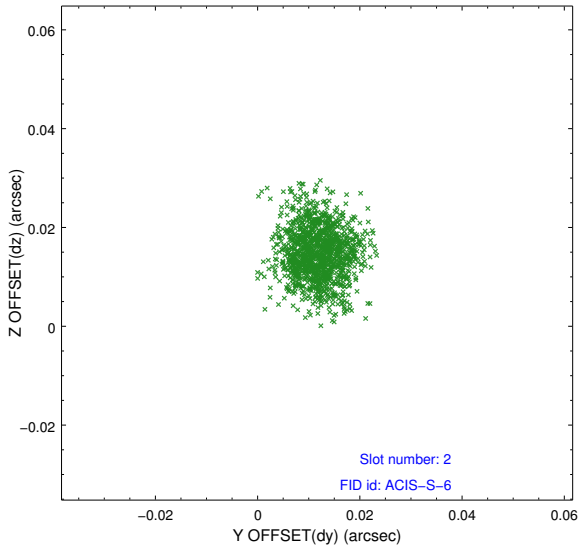
2.5.2 Slot 1

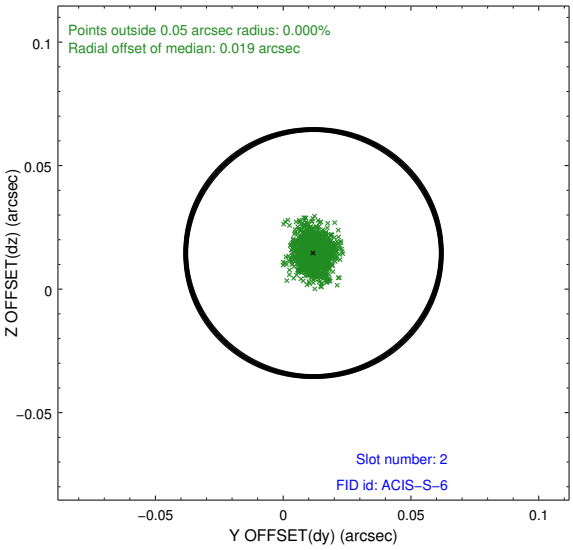

Z OFFSET(dz) (arcsec)
Y OFFSET(dy) (arcsec)
Slot number: 1
FID id: ACIS−S−4

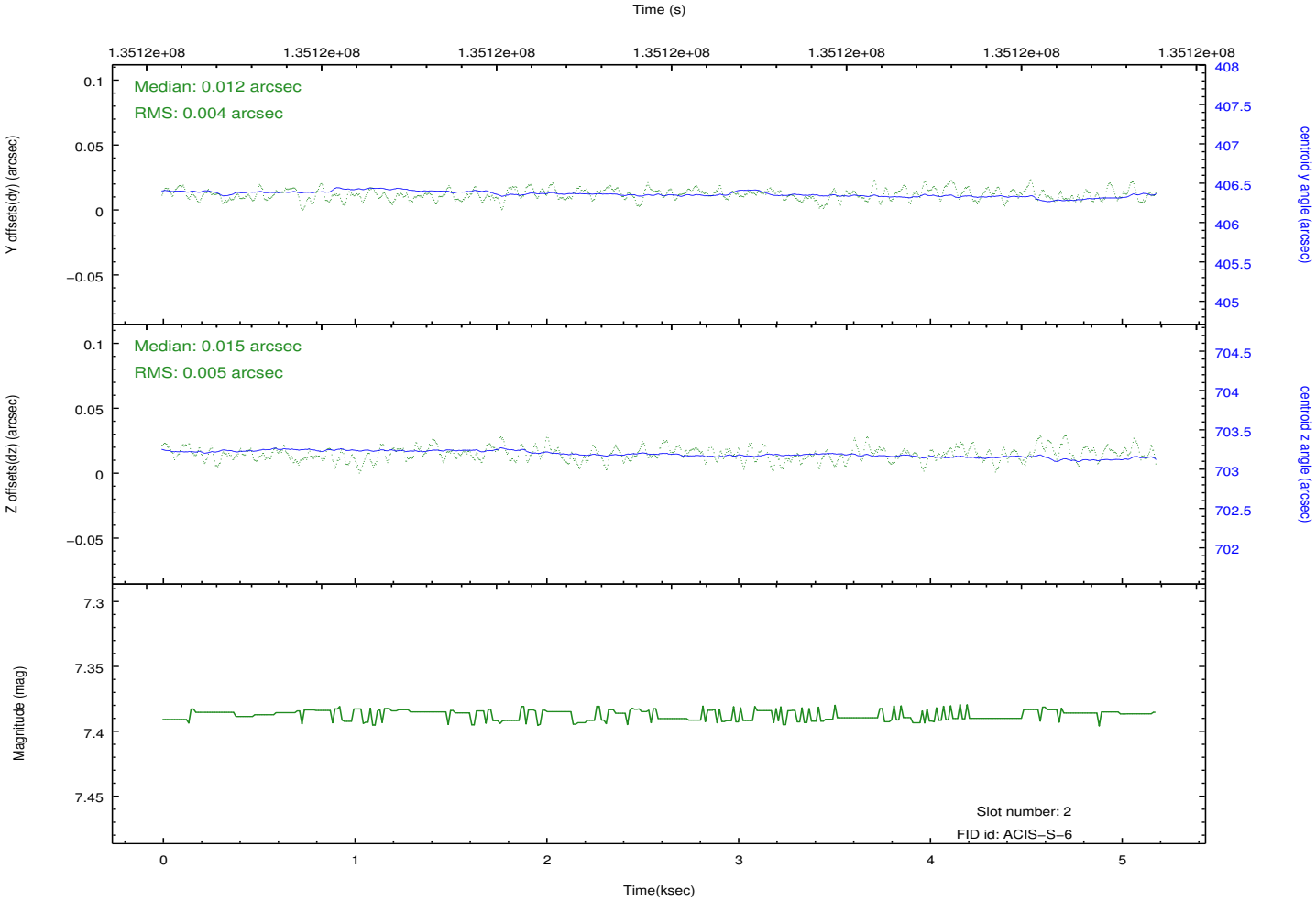

Points outside 0.05 arcsec radius: 0.000%
Radial offset of median: 0.027 arcsec
Z OFFSET(dz) (arcsec)
Y OFFSET(dy) (arcsec)
Slot number: 1
FID id: ACIS−S−4


Time (s)
Median: 0.004 arcsec
RMS: 0.004 arcsec
Y offsets(dy) (arcsec)
centroid y angle (arcsec)
Median: 0.027 arcsec
RMS: 0.004 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

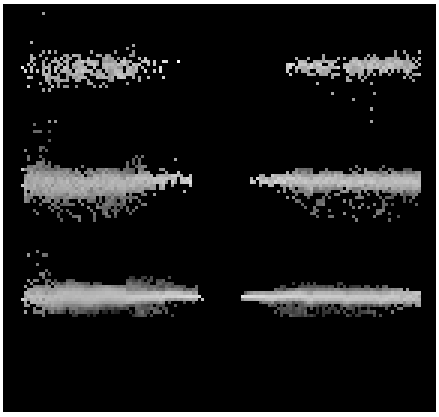

Z OFFSET(dz) (arcsec)
Y OFFSET(dy) (arcsec)
Slot number: 2
FID id: ACIS−S−6


Points outside 0.05 arcsec radius: 0.000%
Radial offset of median: 0.019 arcsec
Z OFFSET(dz) (arcsec)
Y OFFSET(dy) (arcsec)
Slot number: 2
FID id: ACIS−S−6

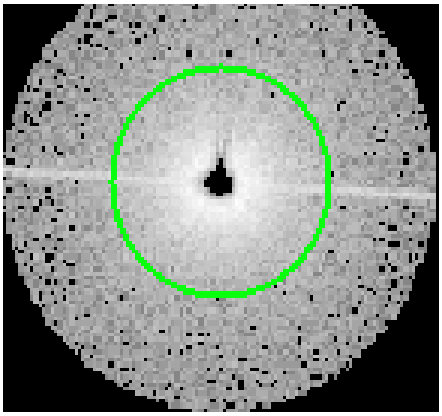

Time (s)
Median: 0.012 arcsec
RMS: 0.004 arcsec
Y offsets(dy) (arcsec)
centroid y angle (arcsec)
Median: 0.015 arcsec
RMS: 0.005 arcsec
Z offsets(dz) (arcsec)
centroid z angle (arcsec)
Magnitude (mag)
Slot number: 2
FID id: ACIS−S−6
Time(ksec)

3 Gratings

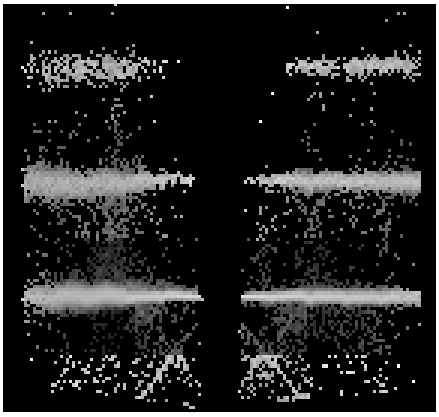
3.1 HEG Arm



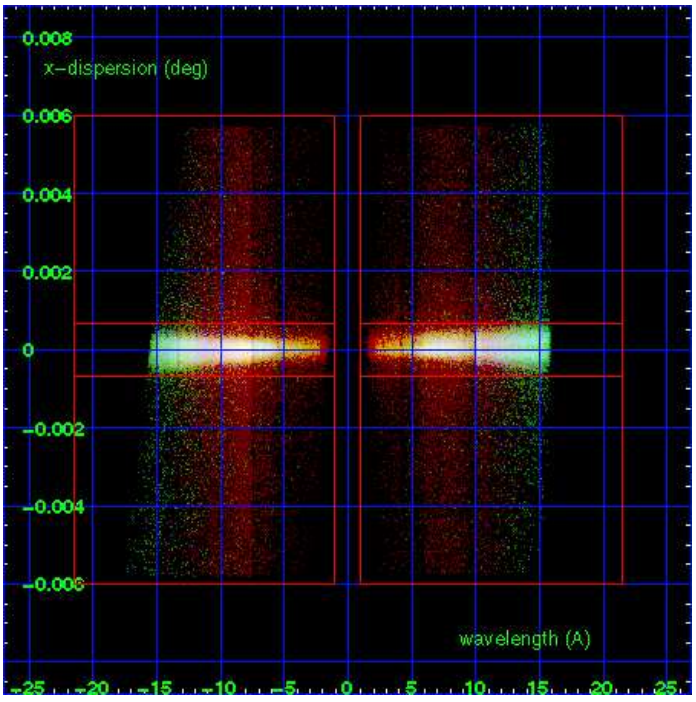
HEG Order Sort 123



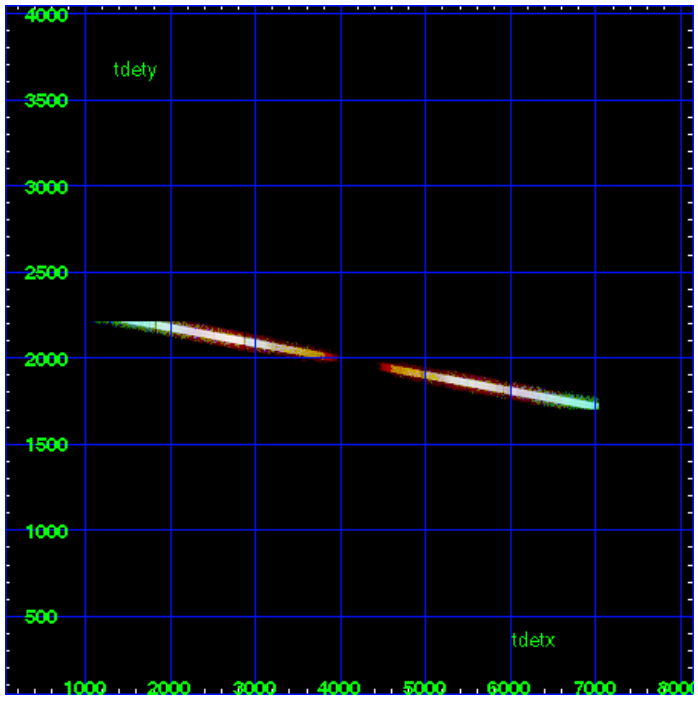
HEG Zero Order



HEG Order Sort ALL

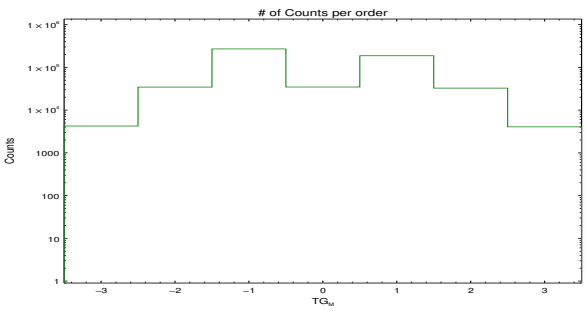


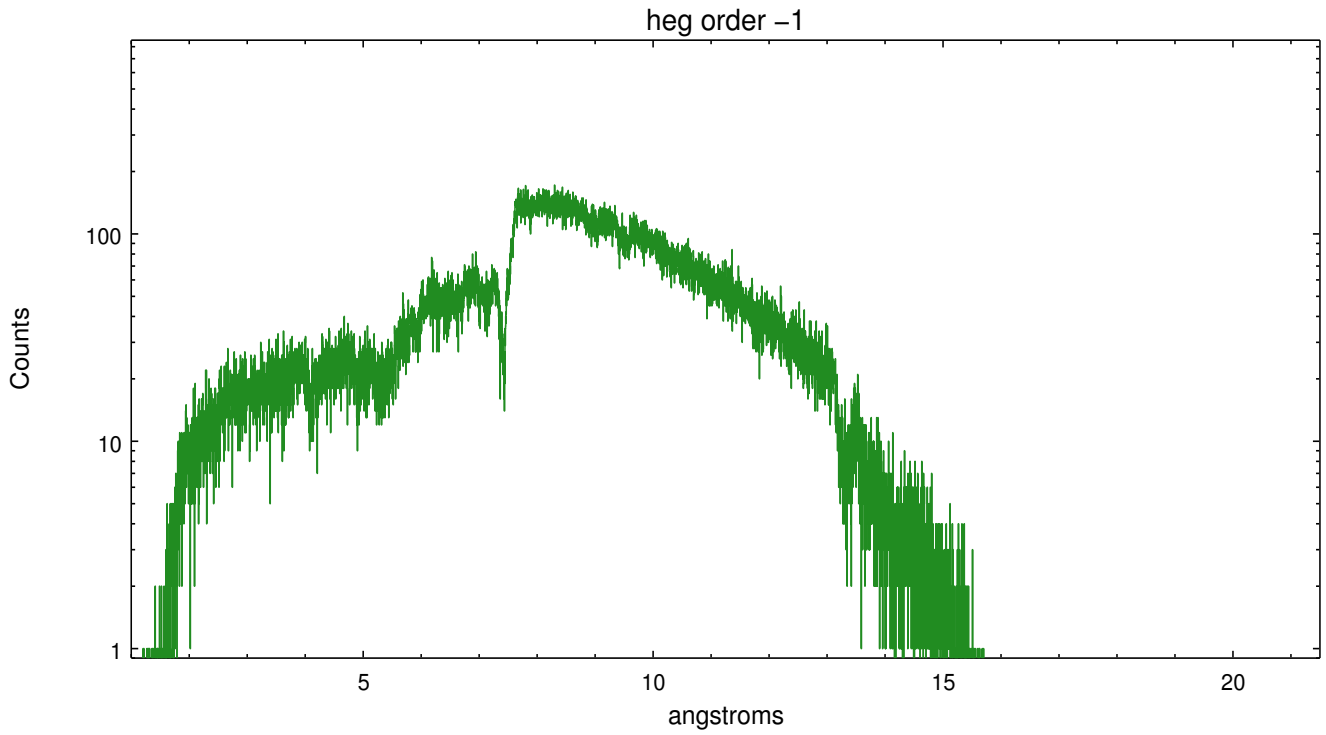
Spot Image HEG

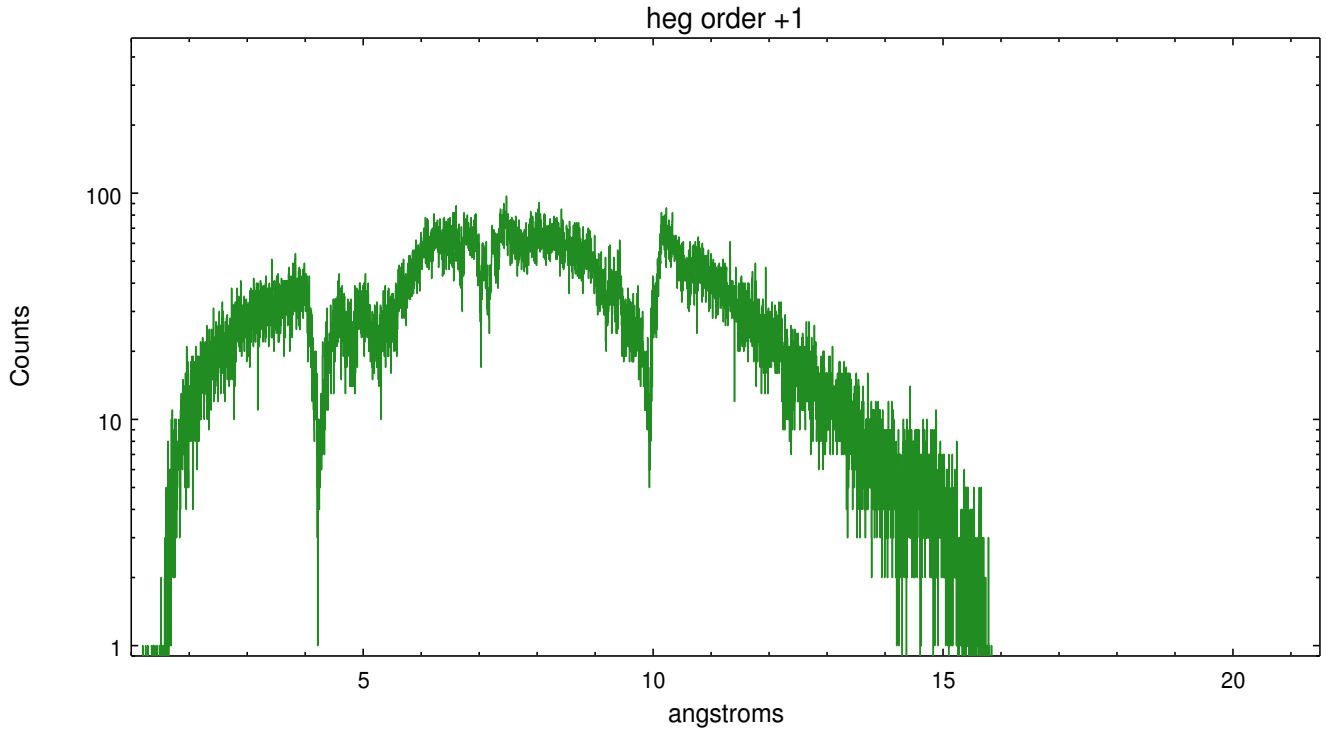


Full Detector HEG

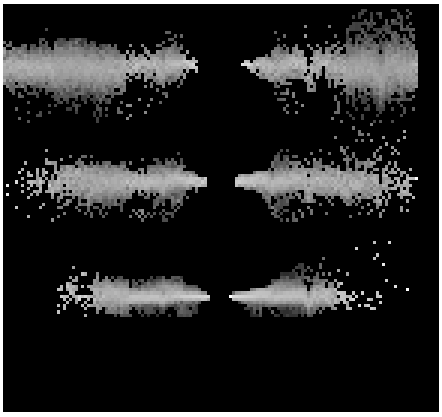
	order -3	order -2	order -1	order 0	order 1	order 2	order 3
Events	4243	34560	270283	34715	187387	32706	4060



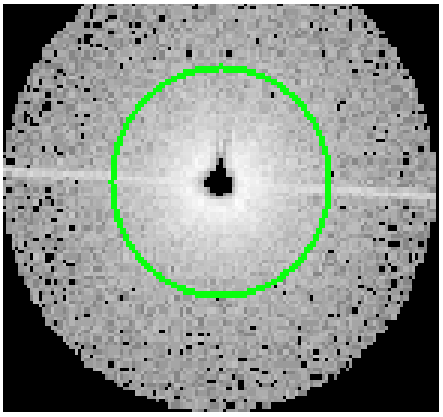

heg order −1
Counts
100
10
1
5
10
15
20
angstroms


heg order +1
Counts
100
10
1
5
10
15
20
angstroms

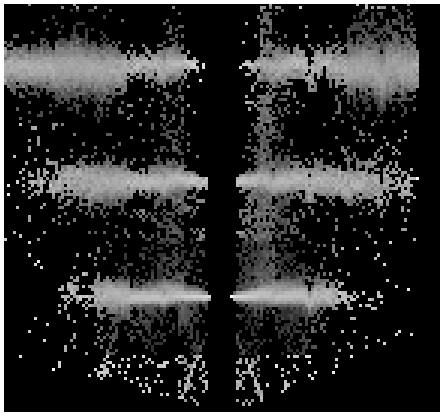
3.2 MEG Arm



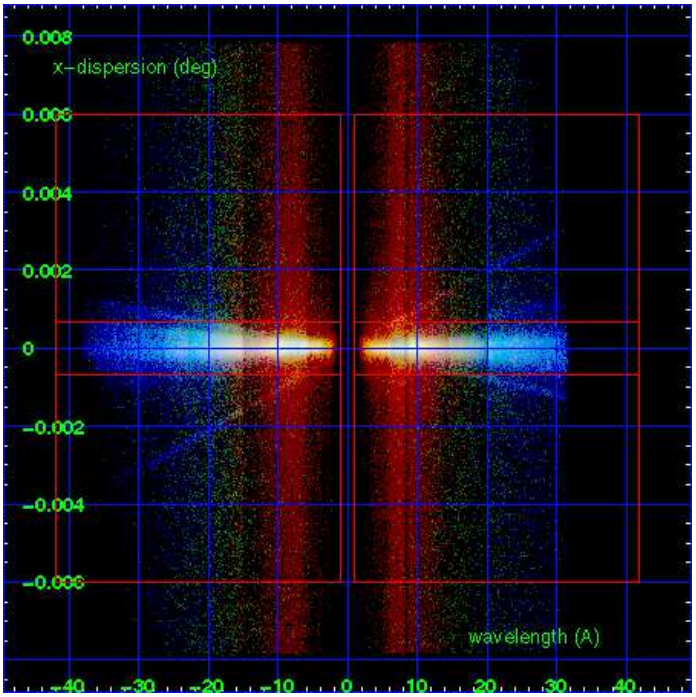
MEG Order Sort 123



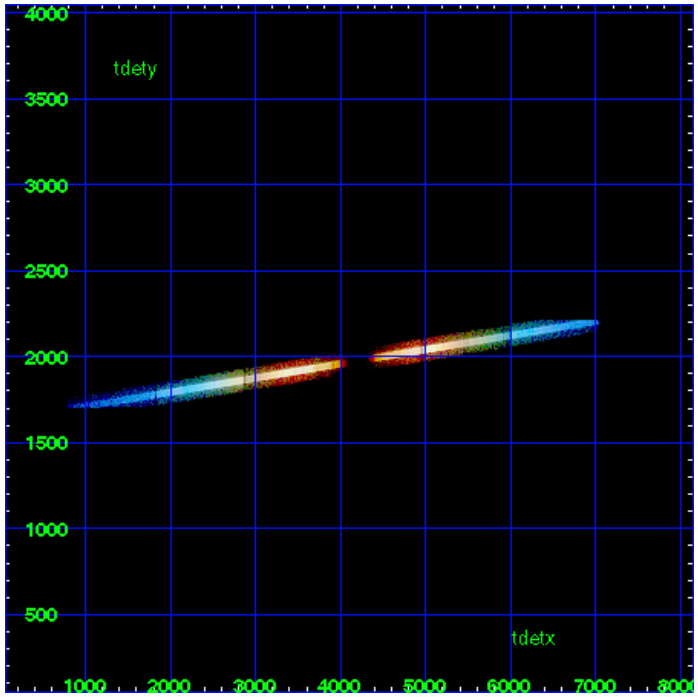
MEG Zero Order



MEG Order Sort ALL

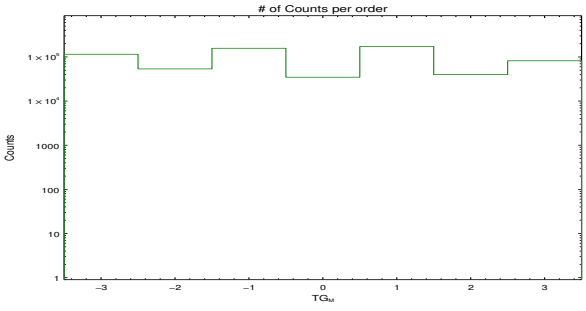


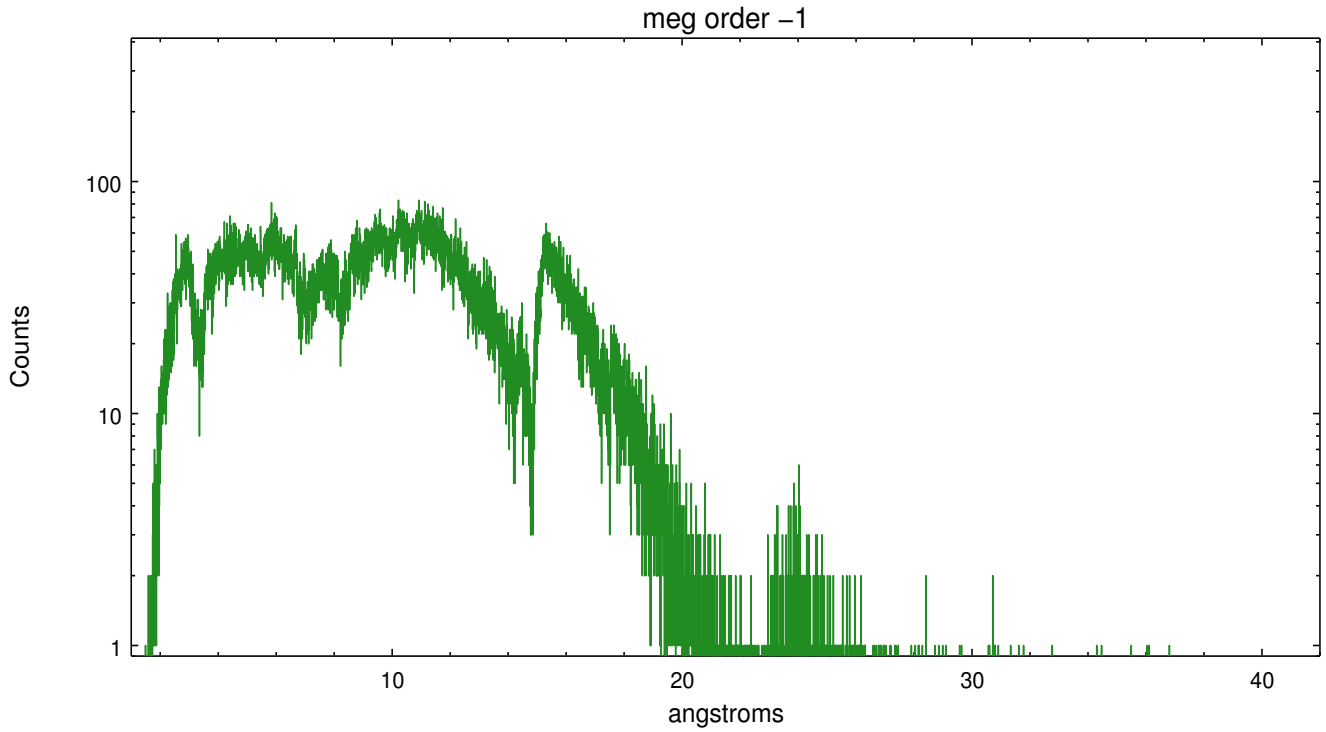
Spot Image MEG

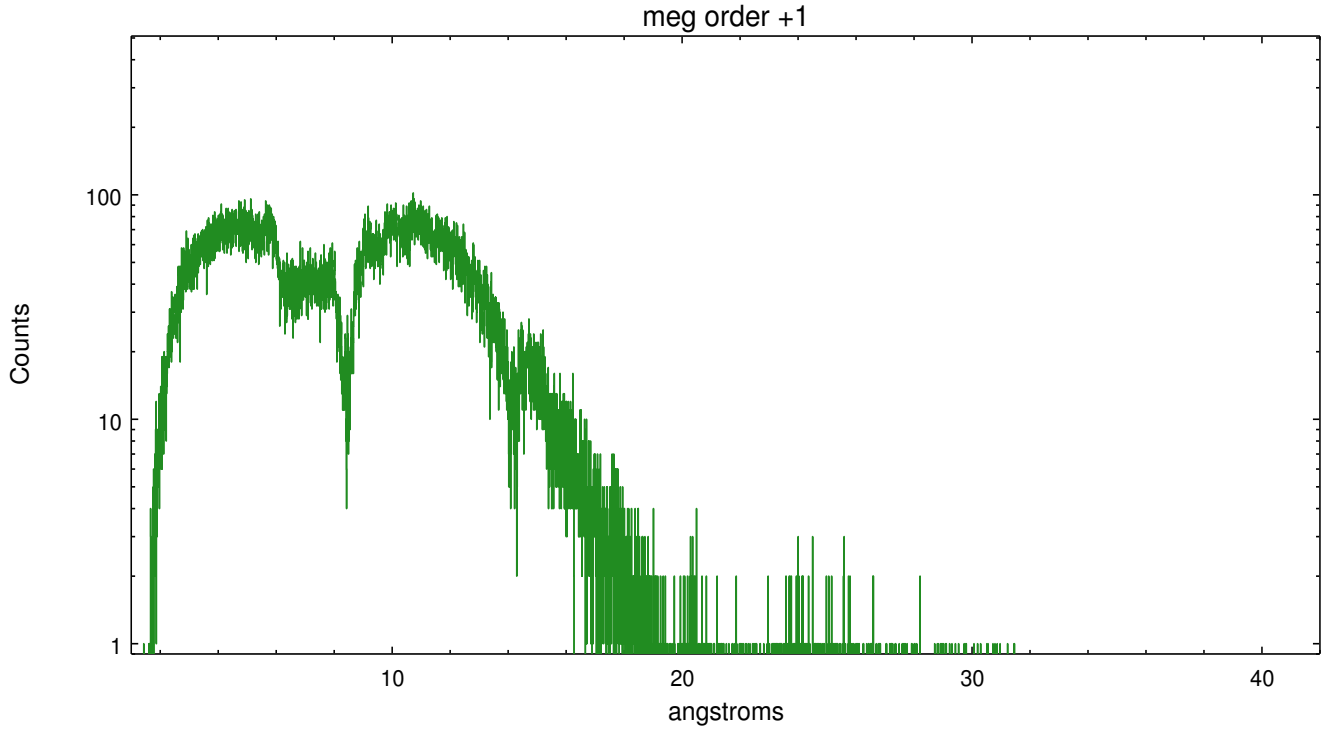


Full Detector MEG

	order -3	order -2	order -1	order 0	order 1	order 2	order 3
Events	114948	53568	157011	34715	172105	39870	82021




meg order −1
Counts
100
10
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)	2012.10.10
V&V Edition	1
V&V Disposition and Status	OK
V&V Charge Time	5.231

A.2 Comments

Zeroth order piled up and cratered. Standard data processing software did not correctly locate the zeroth order due to pileup. Manual intervention was used to input the correct sky coordinates (x=4105.07, y=4026.02) into the *src1a.fits file table. These corrected coordinates were determined using a software tool developed by CXC called findzero, which is expected to be released in CIAO as tg_findzo (currently in ISIS as findzo). The tool calculates the point of intersection of the readout streak and the meg arm. The zeroth order source position determined by the standard pipeline processing using the tool tgdetect was not used in this processing. The newly determined zeroth order coordinates have been placed in the *src1a.fits file, replacing the coordinates determined by tgdetect. Note that these corrected coordinates of the zeroth order cannot be reproduced by running tgdetect on the data.
===
The spectrum is clearly visible in an image of bad events. This is likely due to pileup which causes grade migration into bad event grades.

===
The charge time should be based on CCD_ID=4 (S0), which had the fewest dropped frame.Original charge time has been retained. Other chips have dropped frames due to telemetry saturation by the zeroth order (no mitigating zero order sample-cycle or exclusion region was requested) and dispersed spectra. Their effective exposures range from 1.602-4.643 ks.
===
For analysis of orders 3 and above, the data should be re-extracted using custom order-sorting boundaries (osort_lo, osort_hi in tg_resolve_events) to bypass the ccd response. For high orders, residual calibration uncertainties in the response are magnified, and MEG 3rd orders are clipped in PHA-space somewhat near the ends of the spectrum.