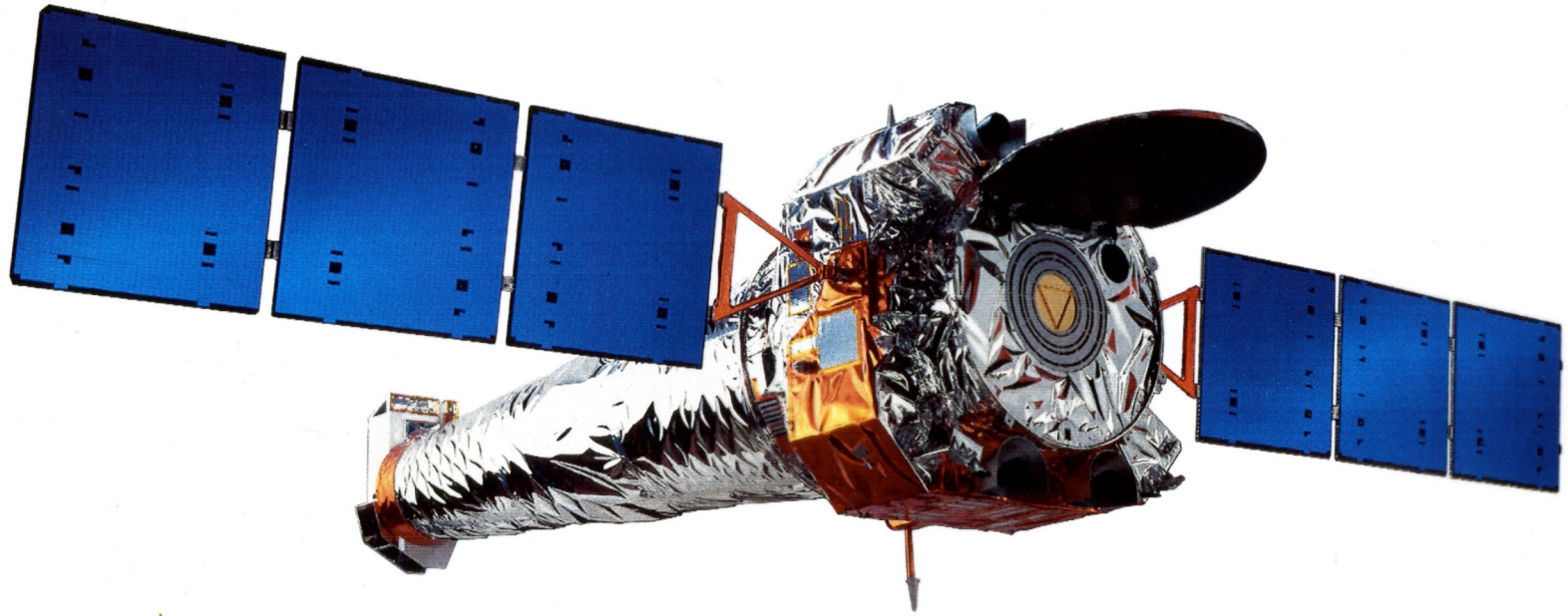
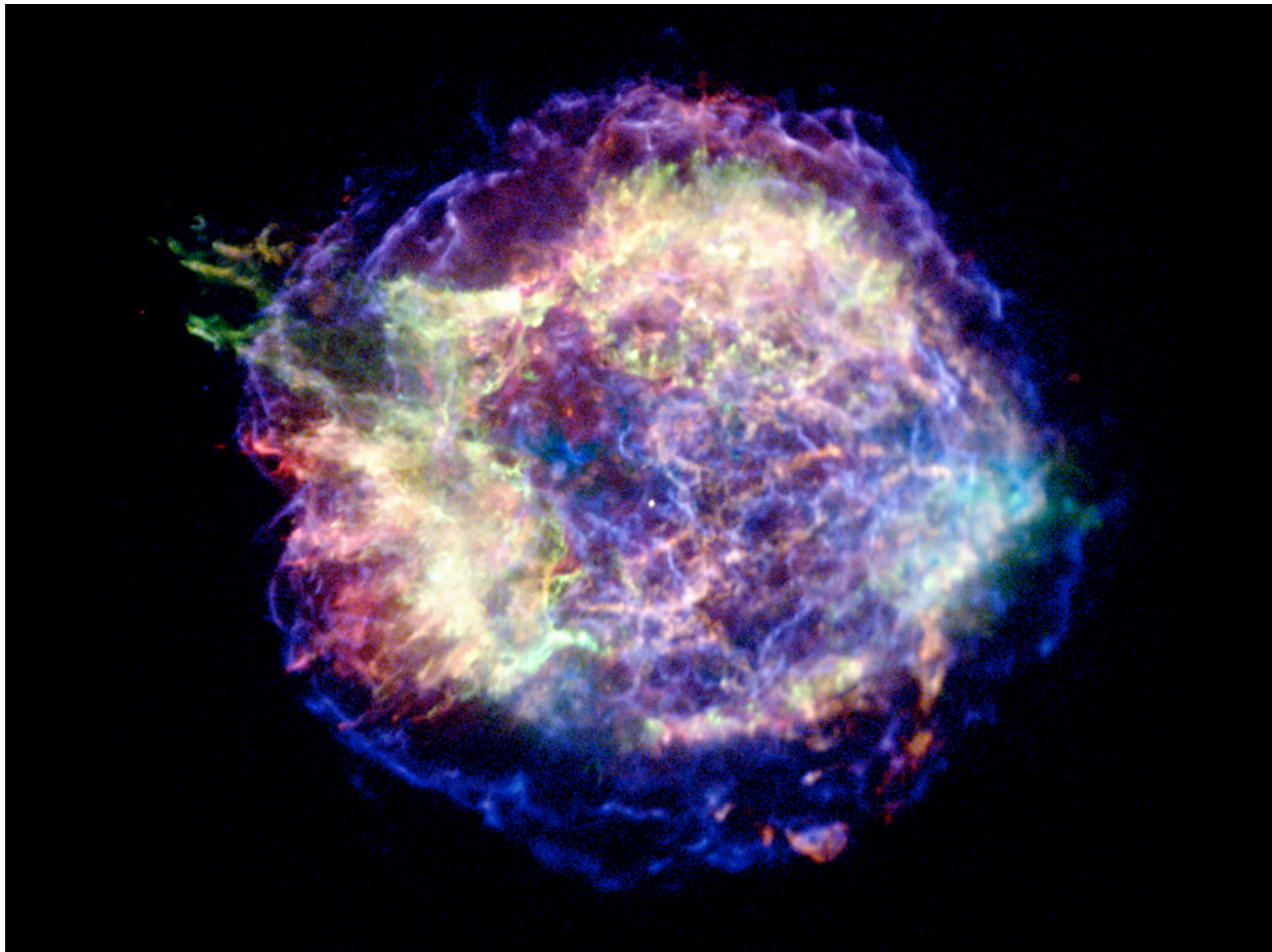


Aspect Camera Assembly overview

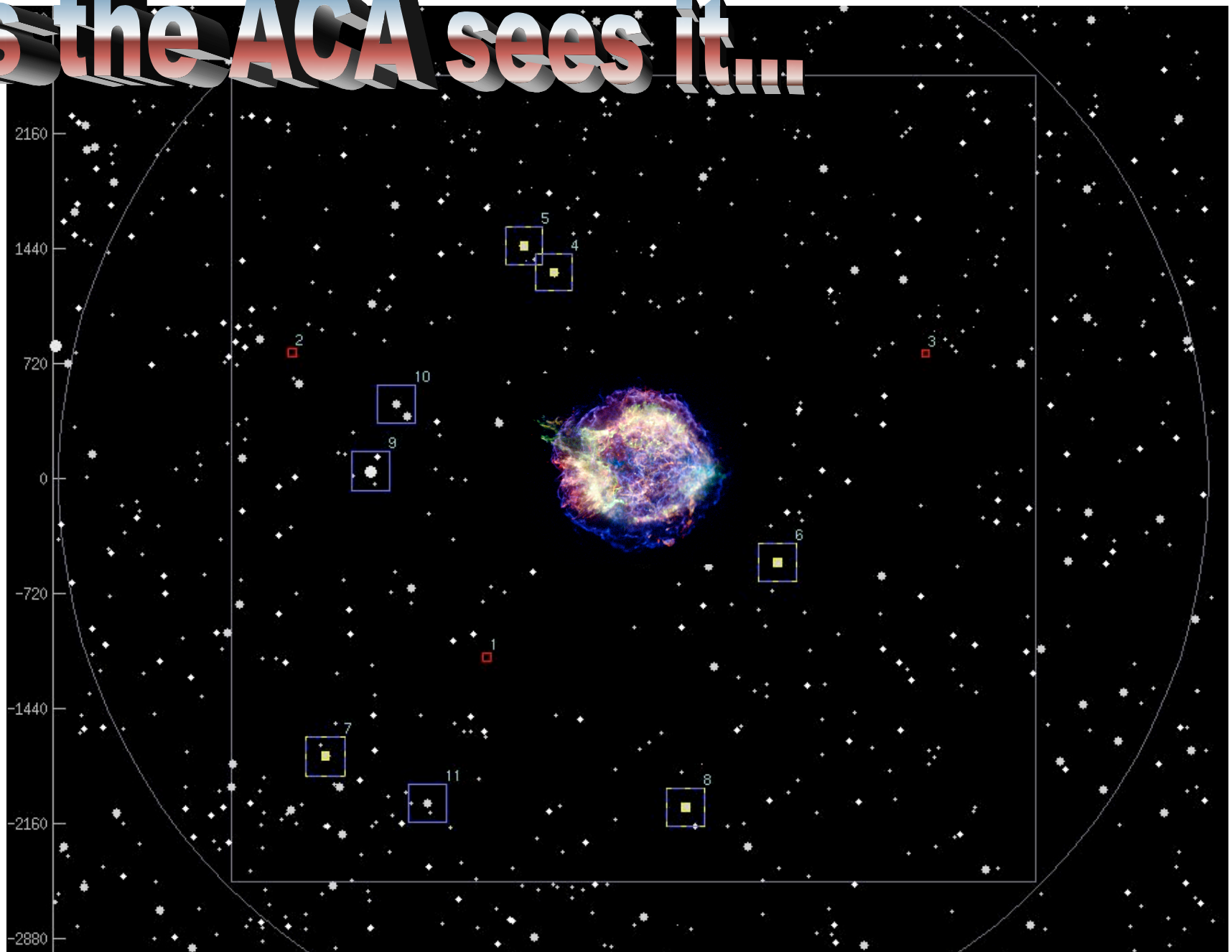
Tom Aldcroft SAO / CXC / SOT

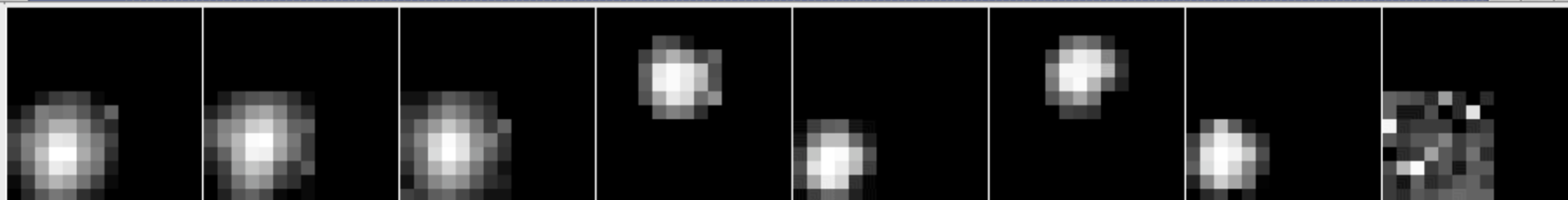


- Aspect Camera Assembly (ACA) is a 4.5" star tracker
- Price: ~ \$20M
- ACA, gyros, and reaction wheels are basis for PCAD
 - Star positions to OBC for realtime spacecraft control
 - Image data for post-facto aspect reconstruction



As the ACA sees it...





Time 176267425.35
 Date 2003:215:03:09:22.166

slot	0	1	2	3	4	5	6	7
QUALITY	0	0	0	0	0	0	0	0
MJF	47656	47656	47656	47656	47656	47656	47656	47656
MNF	32	32	32	24	24	24	24	24
INTEG	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70
GLBSTAT	0	0	0	0	0	0	0	0
COMMCNT	0	0	0	0	0	0	0	0
COMMPROG	0	0	0	0	0	0	0	0
IMGFID1	1	1	1	0	0	0	0	0
IMGNUM1	0	1	2	3	4	5	6	7
IMGFUNC1	1	1	1	1	1	1	1	2
IMGSTAT	0	0	0	0	0	0	0	0
IMGROW0	-186	367	-77	-428	33	-377	138	2
IMGCOL0	-347	33	163	455	-162	-150	-257	12
IMGSCALE	238	184	214	32	32	32	32	32
BGDAVG	19	20	22	0	0	0	0	1
IMGFID2	1	1	1	0	0	0	0	0
IMGNUM2	0	1	2	3	4	5	6	7
IMGFUNC2	1	1	1	1	1	1	1	2
BGDRMS	5	8	12	2	2	1	2	2
TEMPCCD	-15.2	-15.2	-15.2	-14.8	-14.8	-14.8	-14.8	-14.8
TEMPHOUS	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6
TEMPPRIM	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6
TEMPSEC	15.2	15.2	15.2	15.2	15.2	15.2	15.2	15.2
BGDSTAT	253	255	255	63	223	223	245	255

- Time step
- ◇ 1.025
 - ◆ 2.05
 - ◇ 4.1
 - ◇ 8.2
 - ◇ 16.4
 - ◇ 32.8
 - ◇ 131.2
 - ◇ 1049.6

Resume

Next

◆ Forward

◇ Reverse

0 0 Delay

500

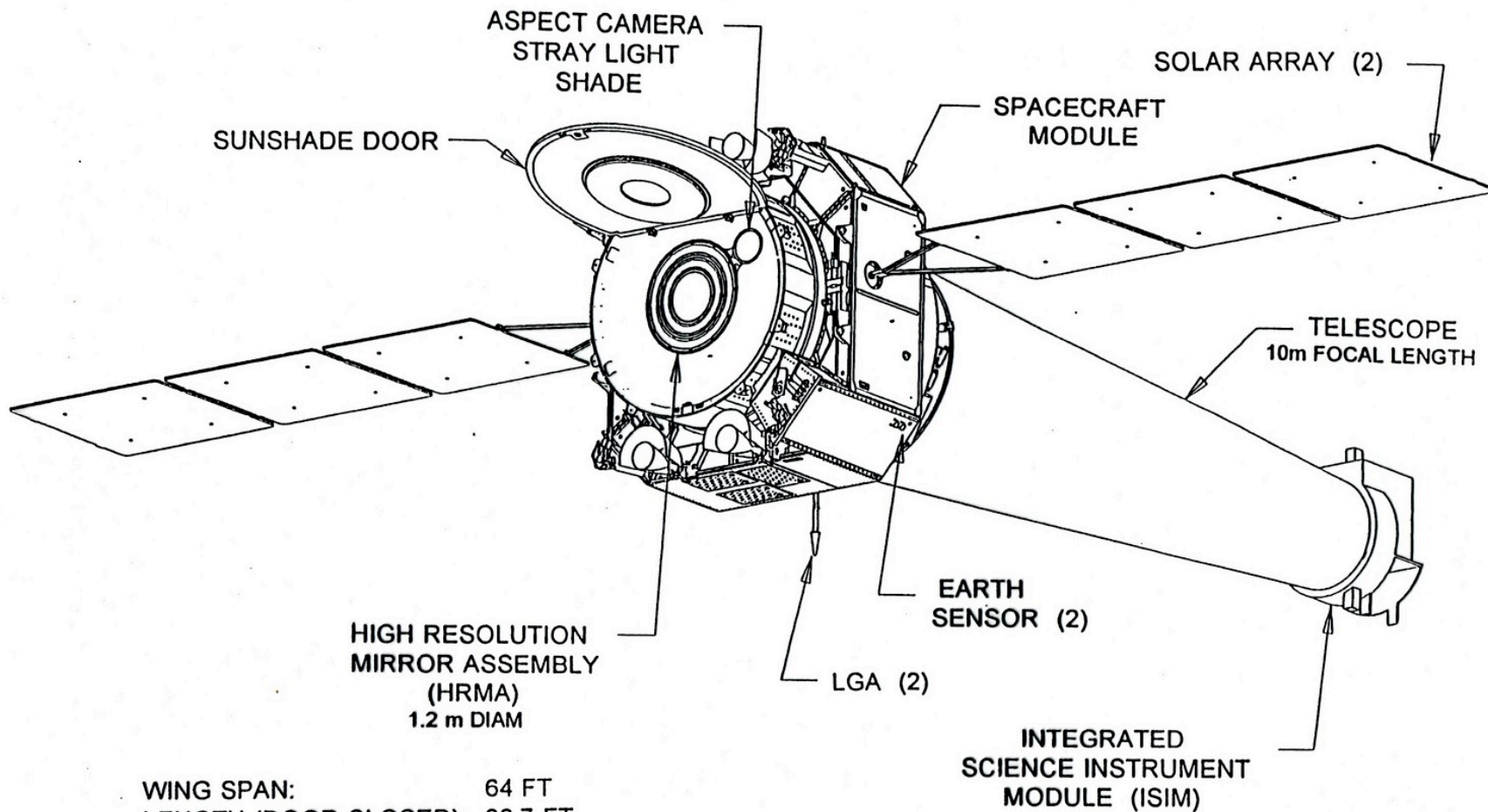
1000

1500

2000

Quit

AXAF-I DEPLOYED CONFIGURATION

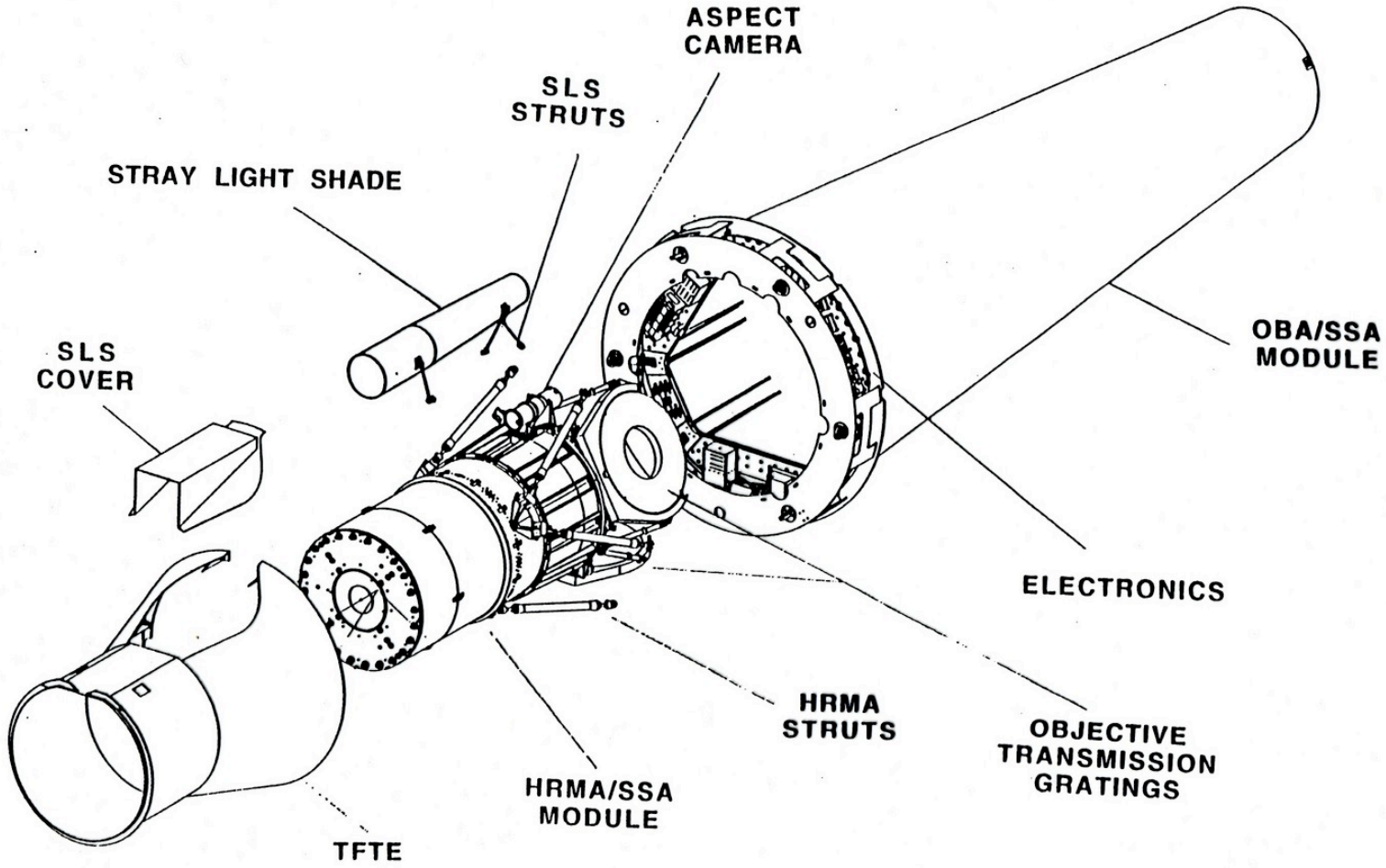


WING SPAN:	64 FT
LENGTH (DOOR CLOSED):	38.7 FT
LENGTH (DOOR OPEN):	45.3 FT
LAUNCH WEIGHT:	12,960 LB
ON-ORBIT WEIGHT:	10,560 LB
EOL POWER:	2,428 W

HIGH RESOLUTION
MIRROR ASSEMBLY
(HRMA)
1.2 m DIAM

INTEGRATED
SCIENCE INSTRUMENT
MODULE (ISIM)

**AXAF-I TELESCOPE ASSEMBLY
EXPLODED VIEW**



**SLS
COVER**

STRAY LIGHT SHADE

**SLS
STRUTS**

**ASPECT
CAMERA**

**OBA/SSA
MODULE**

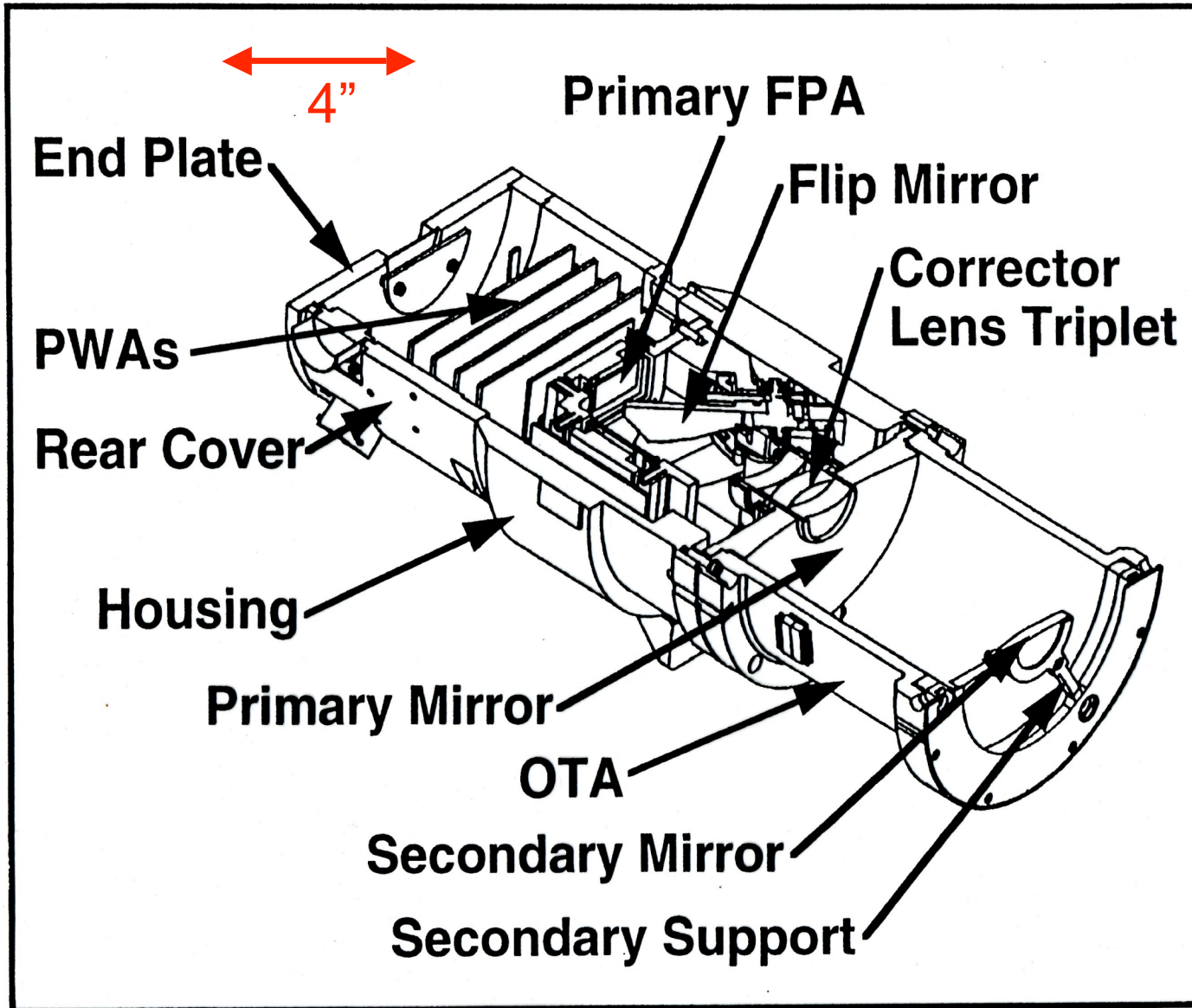
ELECTRONICS

**HRMA
STRUTS**

**OBJECTIVE
TRANSMISSION
GRATINGS**

**HRMA/SSA
MODULE**

TFTE





Aspect Camera Assembly

CXC

System Parameters

- ACA Components
 - Stray Light Shade (SLS)
 - Aspect Camera (AC)
 - Processor Electronics Assembly (PEA) x2
- Dimensions and Mass
 - SLS: 0.41m diameter, 2.34m length, 9kg
 - AC: 0.18m diameter, 0.42m length, 11.3kg
 - PEA: 9kg each
- Power
 - 20W average
- Processor
 - 1750A compatible
 - FORTH source code (in DM06)
 - 32KB PROM, 64KB RAM
 - 2 x 1280B EEPROM in AC
- Optics
 - Cassegrain telescope, with refractor triplet
 - Focal length: 991mm
 - 0.11m aperture, f/9
 - No redundancy in optics
 - 2 focal plane detectors, single-strung to PEAs
 - Flip mirror mechanism for using redundant focal plane
- Focal Plane
 - TK1024 CCD
 - 1024x1024 pixels
 - pixel size: 24 μ m x 24 μ m
 - nominal plate scale: 5"/pixel
 - active FP cooled to -10C, using Peltier thermo-electric cooler
 - 4 electrical quadrants, with individual pre-amp readouts



Aspect Camera Assembly

CXC

System Parameters

- ACA Components
 - Stray Light Shade (SLS)
 - Aspect Camera (AC)
 - Processor Electronics Assembly (PEA) x2
- Dimensions and Mass
 - SLS: 0.41m diameter, 2.34m length, 9kg
 - AC: 0.18m diameter, 0.42m length, 11.3kg
 - PEA: 9kg each
- Power
 - 20W average
- Processor
 - 1750A compatible
 - FORTH source code (in DM06)
 - 32KB PROM, 64KB RAM
 - 2 x 1280B EEPROM in AC

- Optics
 - Cassegrain telescope, with refractor triplet
 - Focal length: 991mm
 - 0.11m aperture, f/9
 - No redundancy in optics
 - 2 focal plane detectors, single-strung to PEAs
 - Flip mirror mechanism for using redundant focal plane
- Focal Plane
 - TK1024 CCD
 - 1024x1024 pixels
 - pixel size: 24 μ m x 24 μ m
 - nominal plate scale: 5"/pixel
 - active FP cooled to -10C, using Peltier thermo-electric cooler
 - 4 electrical quadrants, with individual pre-amp readouts

-19C Now



Aspect Camera Assembly

CXC

System Performance

- field of view: $1.4^\circ \times 1.4^\circ$
- tracks and centroids up to 8 images
- median dark current: 12 e/second.
- Read noise: ~ 10 e.
- Sensitivity: ~ 7200 e/s for $m_{ACA} = 10$.
- Gain: 5 e/ADU (nominal).

- Normal integration time: 1.7 seconds
- Magnitude limit: ~ 10.6 mag
- Image data: 6x6 pixels (stars) or 8x8 pixels (fids)

EOL centroid accuracy:

(FM centroiding errors, single axis, 1σ , 6x6 pixel images, 2.05s cycle time)

star, $m_{ACA} = 10.2$:

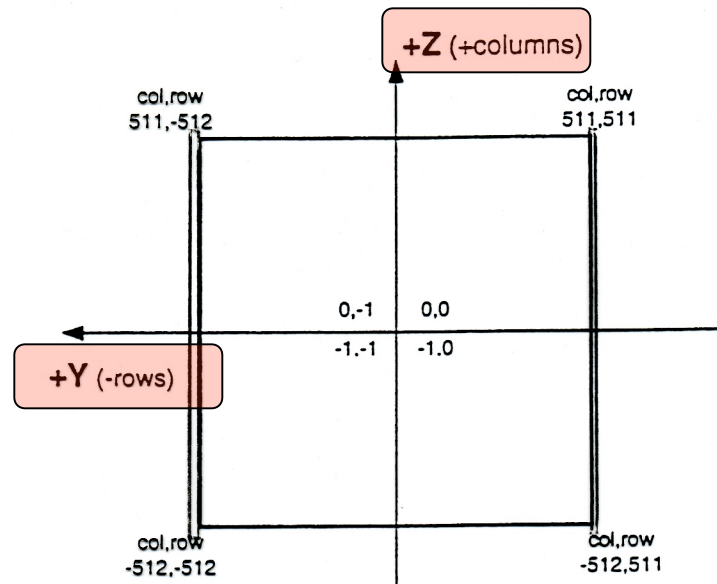
- on-orbit, spatial error = $0.80''$
- on-orbit, temporal error = $0.36''$
- post-facto, spatial error = $0.20''$
- post-facto, temporal error = $0.36''$

fiducial light, $m_{ACA} = 7.0$:

- on-orbit, spatial error = $0.80''$
- on-orbit, temporal error = $0.06''$
- post-facto, spatial error = $0.14''$
- post-facto, temporal error = $0.06''$

2. COORDINATE SYSTEMS

The Aspect Camera uses an X-Y-Z coordinate system that is nominally aligned with the AXAF-I spacecraft coordinate system. When mapped through the optics onto the AC field of view, the CCD pixels are in a plane parallel to the Y-Z plane. Figure 2-1 shows the orientation of the primary and redundant CCDs, relative to the Y and Z axes, when projected onto the AC field of view. That figure also defines the column and row numbering system for the two CCDs. CCD rows are parallel to the Z axis, and columns are parallel to the Y axis. Note that in Figure 2-1(a), row numbers increase from left to right for the primary CCD. However, for the redundant CCD, in Figure 2-1(b), row numbers increase in the opposite direction due to the effect of the flip mirror in the optical path.



(a) Primary CCD

ACA tracks stars to establish Spacecraft attitude

Aspect system flight hardware

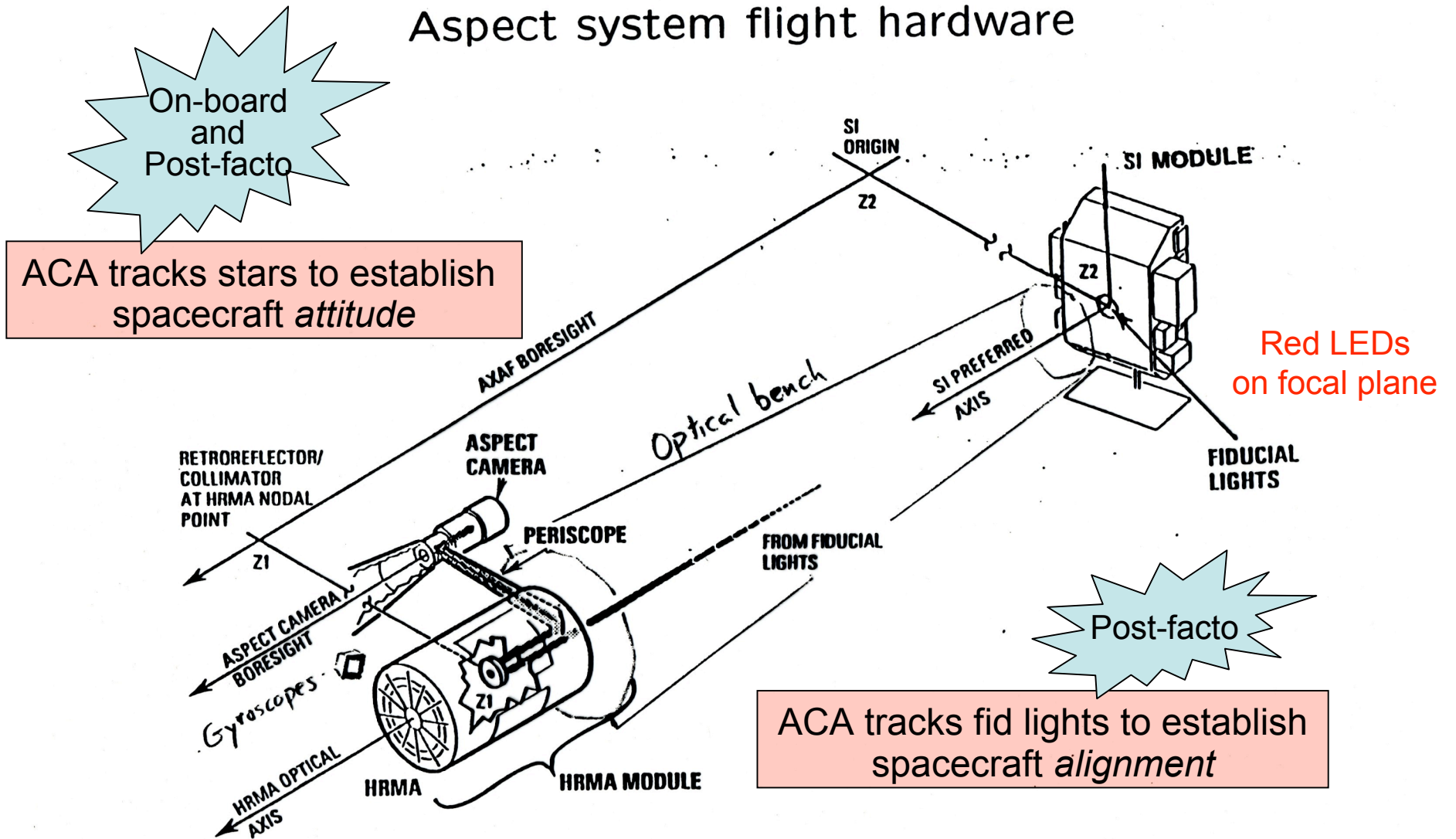
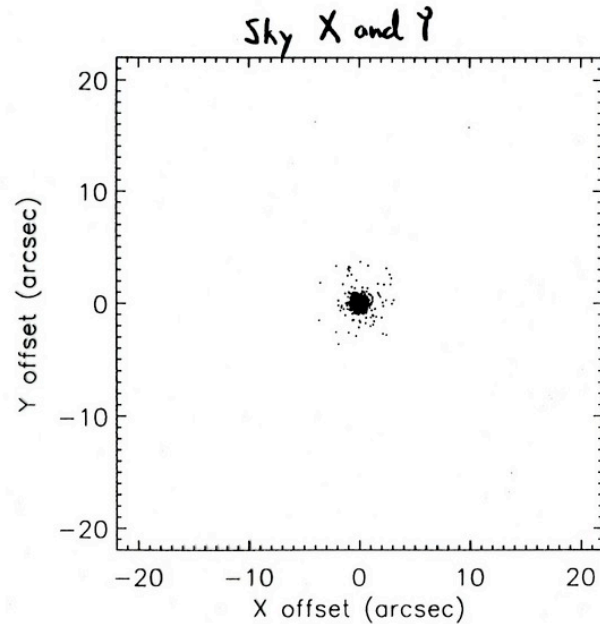
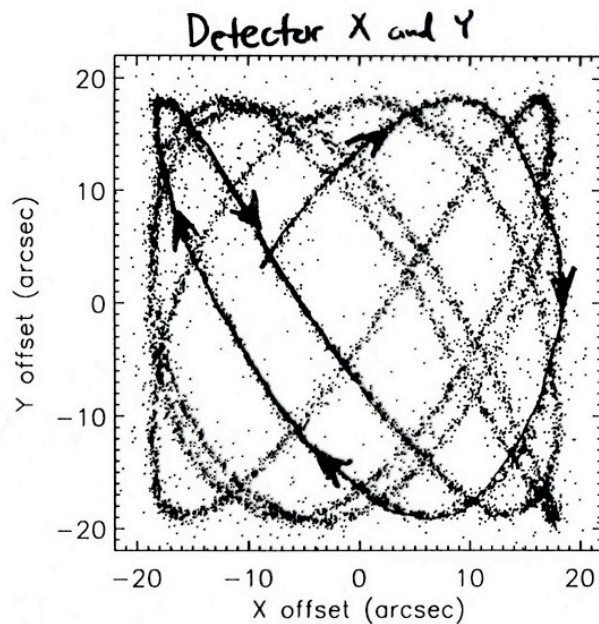


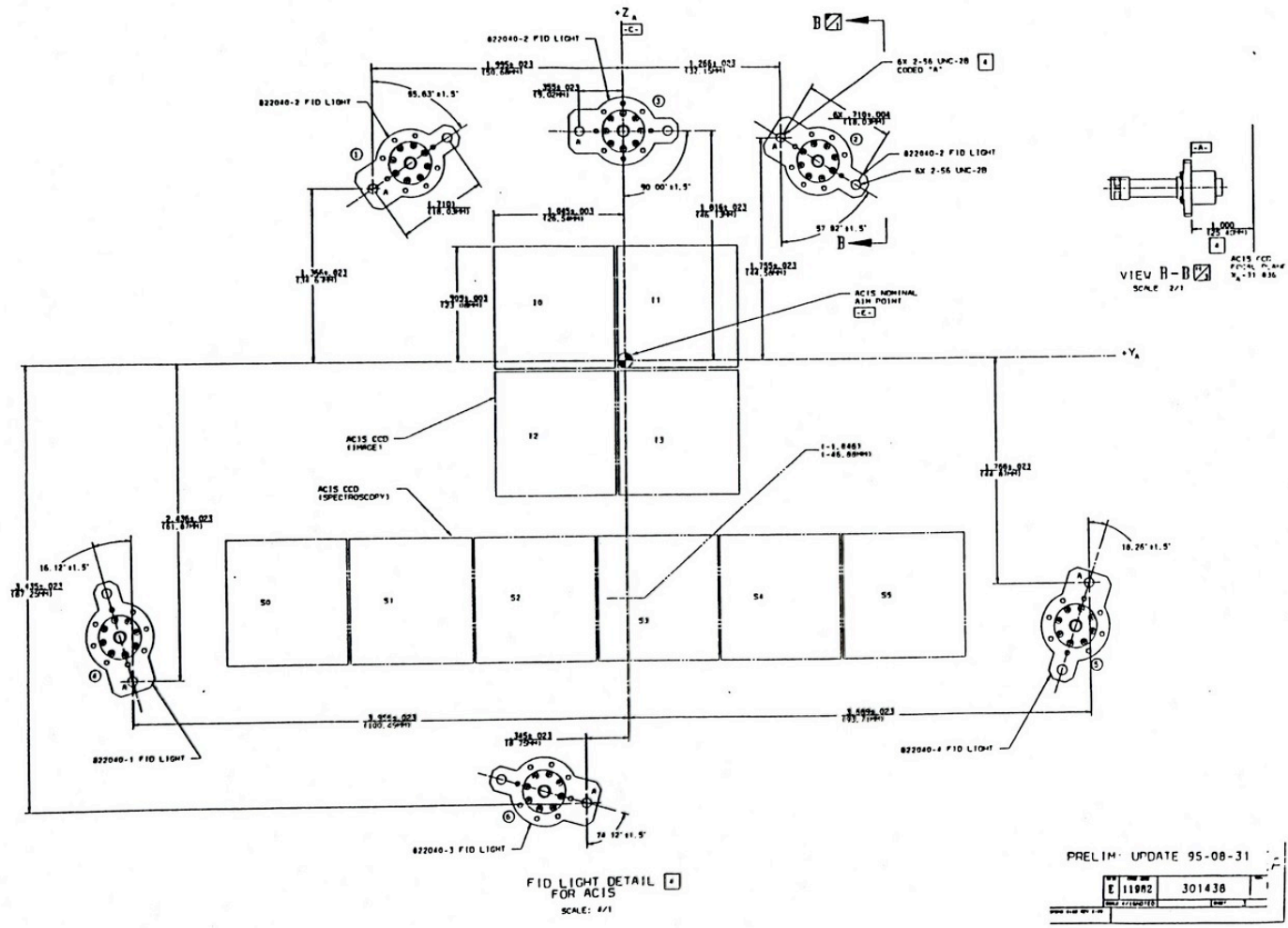
Figure 4.2-1. Aspect Determination Hardware and Alignment Axes

Chandra Aspect

- Aspect solution is a time history of the exact pointing attitude and spacecraft alignment
- Allows conversion from detector pixel coordinate to sky position (RA,Dec), as well as construction of exposure maps

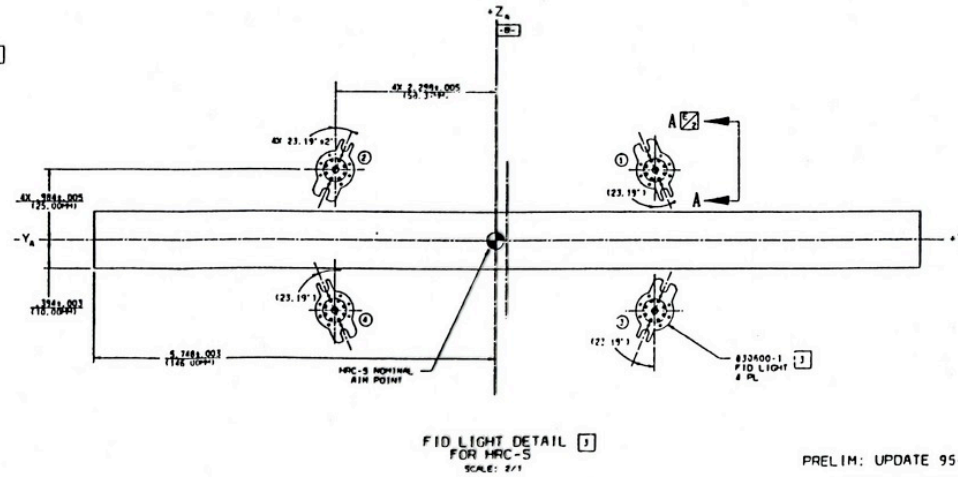
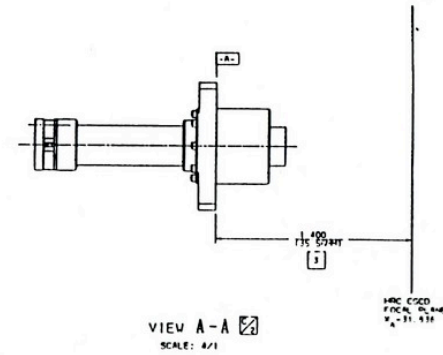
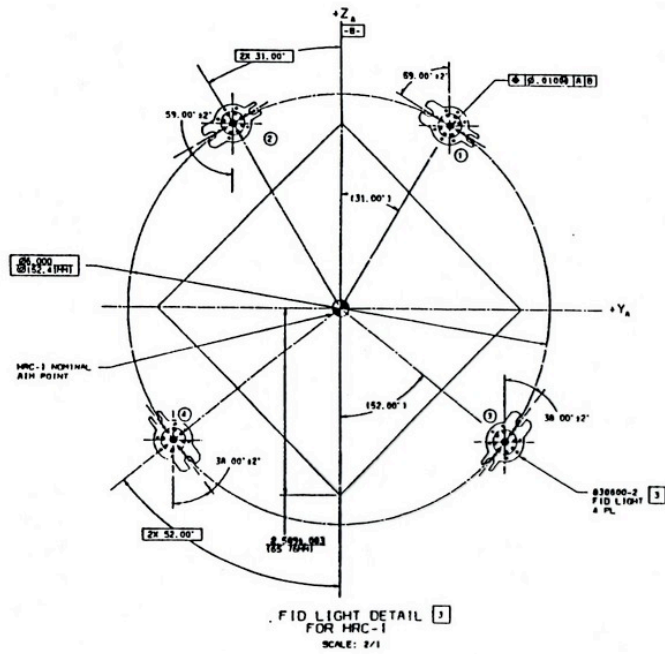
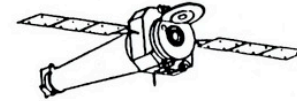


ACIS FIDUCIAL LIGHT CONFIGURATION



HRC FID LIGHT CONFIGURATION

AXAF-I



PRELIM: UPDATE 95-08-31

E 11982	301425	1
REV 2/10/92	100	2

ACA normal operations

- For ACA normal operations consists of the sequence:
 - Maneuver to new attitude in Normal Maneuver Mode
 - Acquire acquisition stars to establish fine attitude
 - Perform one-shot attitude update
 - Acquire guide stars and fid lights
 - Maintain attitude and dither (8-20 arcsec) in Normal Point Mode while tracking guide stars
- To support this:
 - Ground sends maneuver commands and *star catalogs* to the OBC via command loads
 - OBC sends commands to ACA at the right time

OBSID: 8615 DEEP2 Field 3 ACIS-I SIM Z offset:0 (0.00mm) Grating: NONE
 RA, Dec, Roll (deg): 351.498937 0.252615 117.299923
 Dither: ON Y_amp= 8.0 Z_amp= 8.0 Y_period=1000.0 Z_period= 707.1
[BACKSTOP](#) [GUIDE](#) [SUMM](#) [OR](#) [MANVR](#) [DOT](#) [MAKE](#) [STARS](#) [TLR](#) [PREV](#) [NEXT](#)

MP_TARGQUAT at 2008:219:16:44:57.113 (VCDU count = 2556380)
 Q1,Q2,Q3,Q4: 0.85156877 -0.06444051 -0.03668332 0.51897243
 MANVR: Angle= 1.34 deg Duration= 275 sec Slew err= 20.8 arcsec

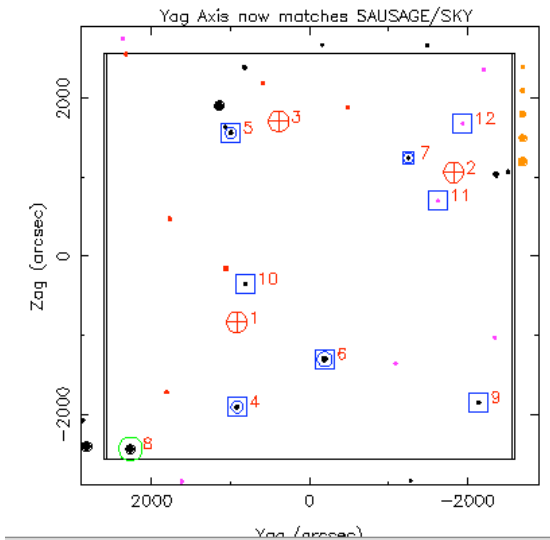
MP_STARCAT at 2008:219:16:44:58.756 (VCDU count = 2556386)

IDX	SLOT	ID	TYPE	SZ	MINMAG	MAG	MAXMAG	YANG	ZANG	DIM	RES	HALFW	PASS	NOTES
[1]	0	1	FID	8x8	5.797	7.000	8.000	919	-844	1	1	25		
[2]	1	5	FID	8x8	5.797	7.000	8.000	-1828	1053	1	1	25		
[3]	2	6	FID	8x8	5.797	7.000	8.000	385	1697	1	1	25		
[4]	3	75764496	BOT	6x6	5.797	9.159	10.656	918	-1907	20	1	120		
[5]	4	75768872	BOT	6x6	5.797	9.247	10.750	992	1561	20	1	120		
[6]	5	75769104	BOT	6x6	5.797	8.373	9.875	-193	-1302	20	1	120		
[7]	6	687346912	BOT	6x6	5.797	9.604	11.109	-1252	1245	10	1	70	a2g2	
[8]	7	75770840	GUI	6x6	5.797	6.121	7.625	2266	-2436	1	1	25	g2	
[9]	7	687347656	ACQ	6x6	5.797	9.472	10.969	-2144	-1849	20	1	120	a2	
[10]	0	75766872	ACQ	6x6	5.797	9.791	11.953	809	-350	20	1	120	a3	
[11]	1	687350968	ACQ	6x6	5.797	10.705	12.203	-1626	701	20	1	120	a4	
[12]	2	687351272	ACQ	6x6	5.797	10.736	12.328	-1941	1677	20	1	120	a4	c

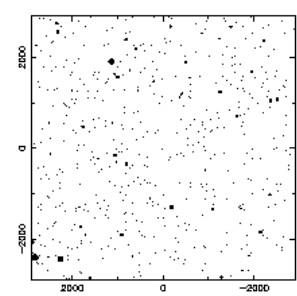
>> WARNING: [11] Magnitude. 10.705
 >> WARNING: [12] Magnitude. 10.736
 >> WARNING: [12] Marginal star. B-V = 0.700, Mag_Err = 0.46, Pos_Err = 0.28

Probability of acquiring 2,3, and 4 or fewer stars (10^x): -7.662 -5.608 -3.855
 Acquisition Stars Expected : 6.72

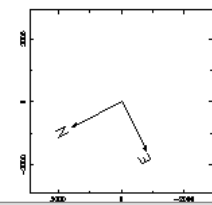
Stars at RA=351.498937 Dec=0.252615 Roll=117.299923



Star Field



Compass



OBSID: 8615 DEEP2 Field 3 ACIS-I SIM Z offset:0 (0.00mm) Grating: NONE
 RA, Dec, Roll (deg): 351.498937 0.252615 117.299923
 Dither: ON Y_amp= 8.0 Z_amp= 8.0 Y_period=1000.0 Z_period= 707.1
[BACKSTOP](#) [GUIDE](#) [SUMM](#) [OR](#) [MANVR](#) [DOT](#) [MAKE](#) [STARS](#) [TLR](#)

▲ [PREV](#) ▼ [NEXT](#)

MP_TARGQUAT at 2008:219:16:44:57.113 (VCDU count = 2556380)
 Q1,Q2,Q3,Q4: 0.85156877 -0.06444051 -0.03668332 0.51897243
 MANVR: Angle= 1.34 deg Duration= 275 sec Slew err= 20.8 arcsec

Star catalog

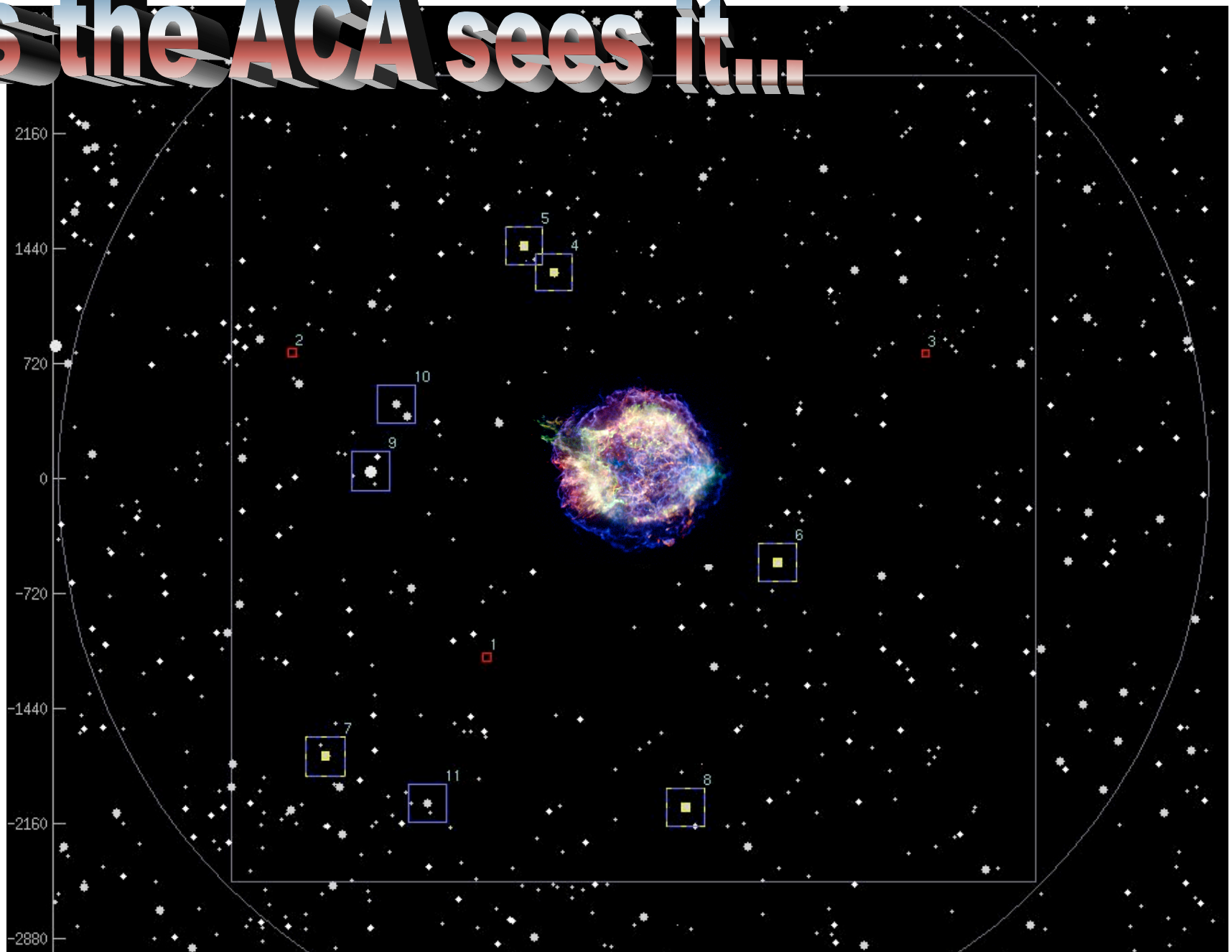
MP_STARCAT at 2008:219:16:44:58.756 (VCDU count = 2556386)

IDX	SLOT	ID	TYPE	SZ	MINMAG	MAG	MAXMAG	YANG	ZANG	DIM	RES	HALFW	PASS	NOTES
[1]	0	1	FID	8x8	5.797	7.000	8.000	919	-844	1	1	25		
[2]	1	5	FID	8x8	5.797	7.000	8.000	-1828	1053	1	1	25		
[3]	2	6	FID	8x8	5.797	7.000	8.000	385	1697	1	1	25		
[4]	3	75764496	BOT	6x6	5.797	9.159	10.656	918	-1907	20	1	120		
[5]	4	75768872	BOT	6x6	5.797	9.247	10.750	992	1561	20	1	120		
[6]	5	75769104	BOT	6x6	5.797	8.373	9.875	-193	-1302	20	1	120		
[7]	6	687346912	BOT	6x6	5.797	9.604	11.109	-1252	1245	10	1	70		a2g2
[8]	7	75770840	GUI	6x6	5.797	6.121	7.625	2266	-2436	1	1	25		g2
[9]	7	687347656	ACQ	6x6	5.797	9.472	10.969	-2144	-1849	20	1	120		a2
[10]	0	75766872	ACQ	6x6	5.797	9.791	11.953	809	-350	20	1	120		a3
[11]	1	687350968	ACQ	6x6	5.797	10.705	12.203	-1626	701	20	1	120		a4
[12]	2	687351272	ACQ	6x6	5.797	10.736	12.328	-1941	1677	20	1	120		a4 c

>> WARNING: [11] Magnitude. 10.705
 >> WARNING: [12] Magnitude. 10.736
 >> WARNING: [12] Marginal star. B-V = 0.700, Mag_Err = 0.46, Pos_Err = 0.28

Probability of acquiring 2,3, and 4 or fewer stars (10^x): -7.662 -5.608 -3.855
 Acquisition Stars Expected : 6.72

As the ACA sees it...



On-console!

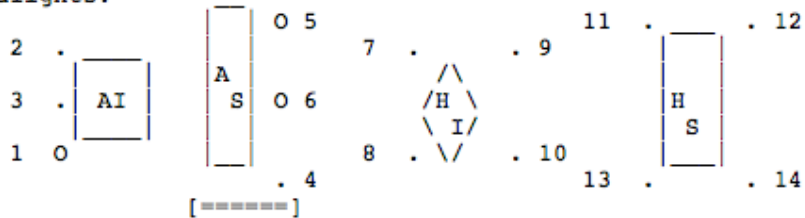
ON: TAB @ 2008189.013413907
 Zone: NOTIN (based on RADMON)
 Dither: ENDITH
 SCS-84: DISA

```

Fidlights:
2 1 5 -0 7 -0 9 -0 11 -0 12 -0
3 -0 6 -0 8 -0 10 -0 13 -0 14 -0
1 1 4 1

Star Cat:
IMAGE Status Image Centroid Angle Star
# Flags Function Y Z Mag
0 FID TRAK 919.925 -844.775 7.000
1 FID TRAK -773.775 -851.500 7.000
2 FID TRAK 2139.150 1055.100 7.000
3 STAR TRAK -1042.950 -1420.275 8.250
4 STAR TRAK 1208.200 -2297.075 9.875
5 STAR TRAK -1837.175 1989.425 8.688
6 STAR TRAK 1332.850 289.550 8.250
7 STAR TRAK 1963.225 884.775 9.250
  
```

Fidlights:



Star Cat:

IDX	IMNUM	TYPE	IMGSZ	MINMAG	MAXMAG	YANG	ZANG	DIMDTS	RESTRK	HALFW
[1]	0	FID	8x8	5.797	8.000	922	-1737	1	1	25
[2]	1	FID	8x8	5.797	8.000	-1826	160	1	1	25
[3]	2	FID	8x8	5.797	8.000	388	803	1	1	25
[4]	3	BOT	6x6	5.797	8.125	1515	1461	20	1	120
[5]	4	BOT	6x6	5.797	9.906	160	-1921	20	1	120
[6]	5	BOT	6x6	5.797	10.188	-781	21	9	1	65
[7]	6	BOT	6x6	5.797	9.719	1268	-2036	20	1	120
[8]	7	GUI	6x6	5.797	10.562	-1599	-2469	1	1	25
[9]	7	ACQ	6x6	5.797	10.000	2320	-1	15	1	95
[10]	0	ACQ	6x6	5.797	10.594	247	-264	20	1	120
[11]	1	ACQ	6x6	5.797	11.094	751	1263	20	1	120
[12]	2	ACQ	6x6	5.797	11.375	-952	1935	20	1	120

 * Transmitter Off *
 * 2008189.144502056 *

COMMAND>

ASPECT CAMERA TELEMETRY	PCAD MODE	NPNT	TLM FORMAT	FMT2	CTU VCDU	637306	ADDITHEN	ENAB
	ADCONLAW	NPNT	TLM SUBFMT	NORM	OBC VCDU	637296	ADDITHR1	0.0000e+00
	AOABERRN	DISA	AOFATTUP	NONE	AOETIMEX	270864523	ADDITHR2	-1.1217e-05
OBSID 9892	AOACINTT	1697.656	ADACPRGS	0	AOCINTNP	ENAB	ADDITHR3	-3.2701e-05

ACA MEAS	IMAGE #	Status Flags	Image Functn	Fid Lt Flag	Centroid Angle		Star Mag	Acquisition Success		GLOBAL STATUS			
IMAGE 0	0	FID	TRAK	FID	919.93	-844.78	7.0	AOFWAIT	NOWT	AORFSTR1	1	ADACPMRF	OK
IMAGE 1	1	FID	TRAK	FID	-773.75	-851.53	7.0	ADACASEQ	KALM	AORFSTR2	6	ADACRAMF	OK
IMAGE 2	2	FID	TRAK	FID	2139.10	1055.10	7.0	ADOFSTAR	GUID			ADACROMF	OK
IMAGE 3	3	STAR	TRAK	STAR	-1039.15	-1428.88	8.2	ADONSTARS	5	ENTRY 0	ID	ADACSUMF	OK
IMAGE 4	4	STAR	TRAK	STAR	1211.90	-2305.43	9.9	ADOKALSTR	5	ENTRY 1	ID	ADACHIBK	OK
IMAGE 5	5	STAR	TRAK	STAR	-1833.75	1980.60	8.6			ENTRY 2	ID		
IMAGE 6	6	STAR	TRAK	STAR	1336.50	280.85	8.2	SUCCESS FLAGS		ENTRY 3	ID	ADACCALF	OK
IMAGE 7	7	STAR	TRAK	STAR	1966.75	875.73	9.2	ADACQSUC	SUC	ENTRY 4	NOID	ADACRSET	OK
								ADOCDESUC	SUC	ENTRY 5	ID	ADACSNTRY	OK
								ADOBRTSUC	SUC	ENTRY 6	ID		
								ADOFIDSUC	SUC	ENTRY 7	ID		
								ADACRPT	0				
								AORSTART	ENAB				

IMAGE PROC	IMAGE #	Pixel Flags		Additional Flags				PWR	SEL	FID LIGHT CURR (mA)				
IMAGE 0	0	OK	OK	Sat	Dfct	Can Col	Quad Bndy Mtpl	Strs	Ioniz Rad	PEA-1	A	#	FLCA-A	FLCA-B
IMAGE 1	1	OK	OK	OK	OK	OK	OK	OK	OK	AOPEASEL	DISA	1	1.0	-0.1
IMAGE 2	2	OK	OK	OK	OK	OK	OK	OK	OK	PEA1 Flip Mirror	OFF	2	1.0	-0.1
IMAGE 3	3	OK	OK	OK	OK	OK	OK	OK	OK	PEA1 Calibration Mode	ON	3	-0.1	-0.1
IMAGE 4	4	OK	OK	OK	OK	OK	OK	OK	OK	PEA1 Power Conv	YES	4	1.0	-0.1
IMAGE 5	5	OK	OK	OK	OK	OK	OK	OK	OK	Pri Mirror Pos PEA1	NO	5	-0.1	-0.1
IMAGE 6	6	OK	OK	OK	OK	OK	OK	OK	OK	Rdt Mirror Pos PEA1	NO	6	-0.1	-0.1
IMAGE 7	7	OK	OK	OK	OK	OK	OK	OK	OK			7	-0.1	-0.1

ACA PROC	VALID 0 SUBFMT	MEASUREMENT RESIDUALS		VALID 0 LOS VECTOR TO STAR IN ACA FRAME			
IMAGE 0	8.4792e-07	-1.3667e-07	-5.0385e-03	-6.9273e-03			
IMAGE 1	-8.1808e-07	1.3015e-06	5.8785e-03	-1.1171e-02			
IMAGE 2	1.5029e-06	2.5076e-08	-8.8872e-03	9.6096e-03			
IMAGE 3	-3.1657e-07	8.1012e-07	6.4799e-03	1.3609e-03			
IMAGE 4	3.3531e-07	-2.3979e-07	9.5350e-03	4.2457e-03			
IMAGE 5	-3.1286e-07	-1.4189e-06	5.3531e-03	-3.1737e-03			
IMAGE 6	-4.6538e-08	4.9274e-07	8.0745e-03	5.8894e-03			
IMAGE 7	-6.0734e-07	4.3989e-06	1.1159e-02	-2.0079e-03			

Temperatures (Deg F)		CCD Primary	
Lens Temp	66.1	ACH1 Housing	66.8
Primary Mirror	64.9	ACH2 Housing	66.8
Secondary Mirror	65.5	AC Housing	
HRMA 2 Mirror	66.1		

ACA dark current calibration

- High-energy particles in space damage the CCD, creating *warm* and *hot* pixels.
- About 3 times per year the ACA dark current is measured using a special full-frame mode of the ACA and IU.
- ACA cal data are received in the 512 kb/s VC2 stream which replaces normal realtime telemetry.
- The dark cal consists of 5 full-frame readouts (5 sec and 10 sec) at slightly different positions.
- This procedure takes about 3 hours and must be done in realtime contact during perigee.

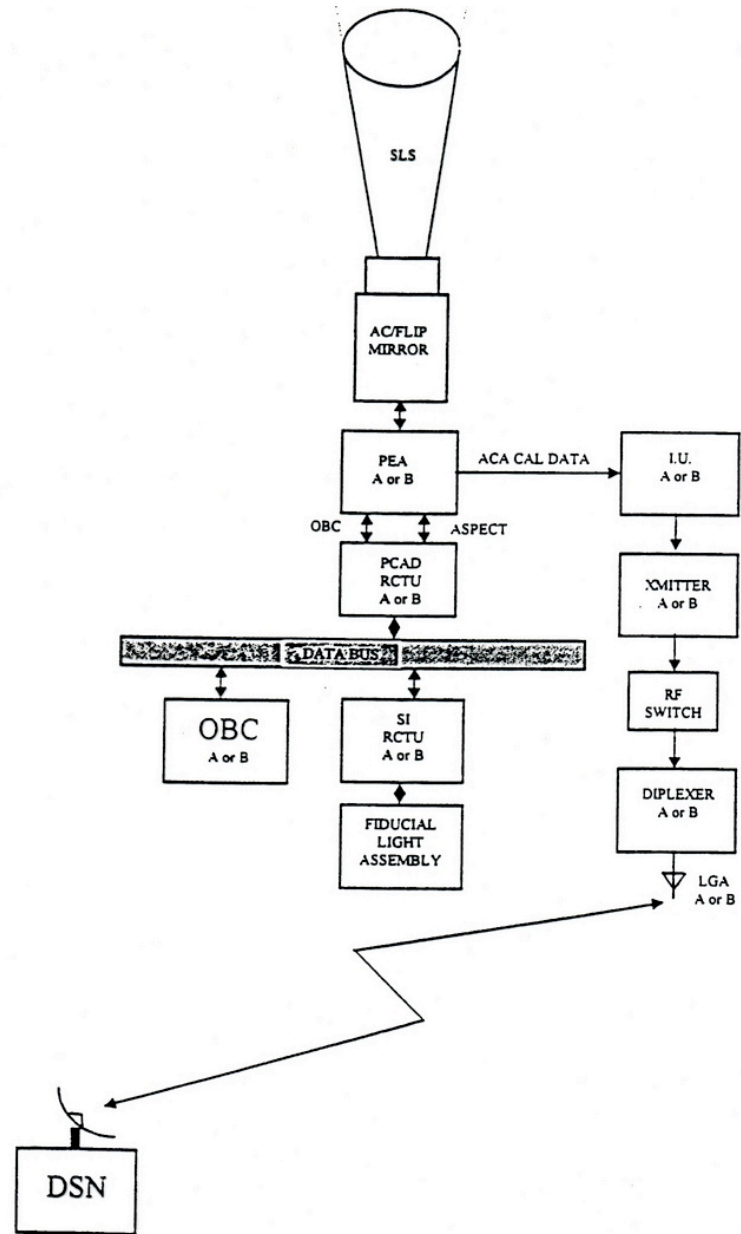


Figure 1-1. Camera to DSN signal path.

**CHANDRA FLIGHT OPERATIONS TEAM ENGINEERING
DIRECTIVE**



CHANDRA FLIGHT OPERATIONS TEAM ENGINEERING DIRECTIVE # 3K

Date: 07/03/08
To: FOT OCs/CCs **Phone:** 617.496.7226

From: E. Martin **Phone:** 617.496.7342 **Location:** CAMA/33
Email: emartin@ipa.cfa.harvard.edu

Subject: Autonomous Aspect Camera Dark Current Operations (06 July 2008)

Some information & reminders regarding the Aspect Camera dark current calibration:

- Please inform DSN and Cambridge Ops that Virtual Channel 2 (VC2) data will be coming in, and verify that DSN is ready to record VC2 data.
- Please record data quality:
 - One minute prior to the first VC2 data interval.
 - Immediately following the start of VC2 data flow and 30 sec before the end of the VC2 interval.
 - One minute after the last VC2 data interval.
- Virtual Channel 2 Data Intervals:

Obs ID	Start	End
57710	2008:188:20:52:00.000	2008:188:21:01:50.000
57708	2008:188:21:35:00.000	2008:188:21:44:50.000
57706	2008:188:22:18:00.000	2008:188:22:27:50.000
57704	2008:188:23:01:00.000	2008:188:23:10:50.000
57702	2008:188:23:44:00.000	2008:188:23:53:50.000

- If normal telemetry fails to be available at the end of any calibration sequence, it is likely that SCS 107 has been activated. CAP 787 may be used to restore normal telemetry.

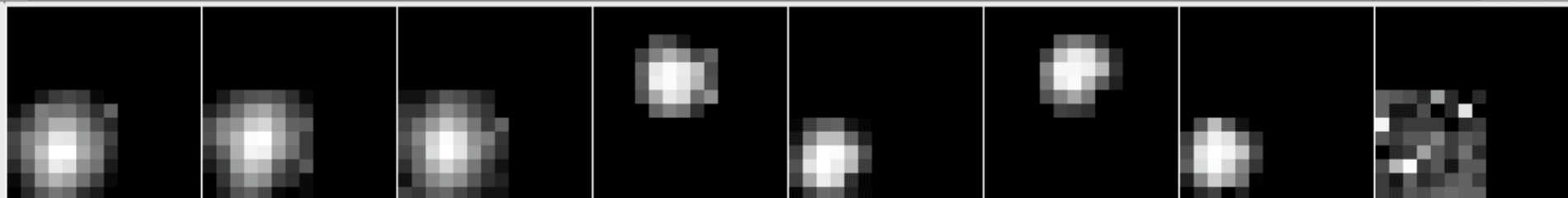


Aspect Camera Assembly

CXC

ACA EGSE

- Sun workstation “coot” in SOT area of TST room
- real-time telemetry capture and archive
- ACA display
 - splat.pl
 - shows status, pixel data and images (log intensity scale), and command receipt and processing
- general purpose engineering telemetry displays
 - all engineering telemetry available
 - simple display page definition
 - disp <page_name>
 - rtplot <page_name>
- similar functions available on CXC and HEAD workstations



Time 176267425.35
 Date 2003:215:03:09:22.166

slot	0	1	2	3	4	5	6	7
QUALITY	0	0	0	0	0	0	0	0
MJF	47656	47656	47656	47656	47656	47656	47656	47656
MNF	32	32	32	24	24	24	24	24
INTEG	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70
GLBSTAT	0	0	0	0	0	0	0	0
COMMCNT	0	0	0	0	0	0	0	0
COMMPROG	0	0	0	0	0	0	0	0
IMGFID1	1	1	1	0	0	0	0	0
IMGNUM1	0	1	2	3	4	5	6	7
IMGFUNC1	1	1	1	1	1	1	1	2
IMGSTAT	0	0	0	0	0	0	0	0
IMGROW0	-186	367	-77	-428	33	-377	138	2
IMGC0L0	-347	33	163	455	-162	-150	-257	12
IMGSCALE	238	184	214	32	32	32	32	32
BGDAVG	19	20	22	0	0	0	0	1
IMGFID2	1	1	1	0	0	0	0	0
IMGNUM2	0	1	2	3	4	5	6	7
IMGFUNC2	1	1	1	1	1	1	1	2
BGDRMS	5	8	12	2	2	1	2	2
TEMPCCD	-15.2	-15.2	-15.2	-14.8	-14.8	-14.8	-14.8	-14.8
TEMPHOUS	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6
TEMPPRIM	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6
TEMPSEC	15.2	15.2	15.2	15.2	15.2	15.2	15.2	15.2
BGDSTAT	253	255	255	63	223	223	245	255

- Time step
- ◇ 1.025
 - ◆ 2.05
 - ◇ 4.1
 - ◇ 8.2
 - ◇ 16.4
 - ◇ 32.8
 - ◇ 131.2
 - ◇ 1049.6

Resume

Next

◆ Forward

◇ Reverse

0 0 Delay

500

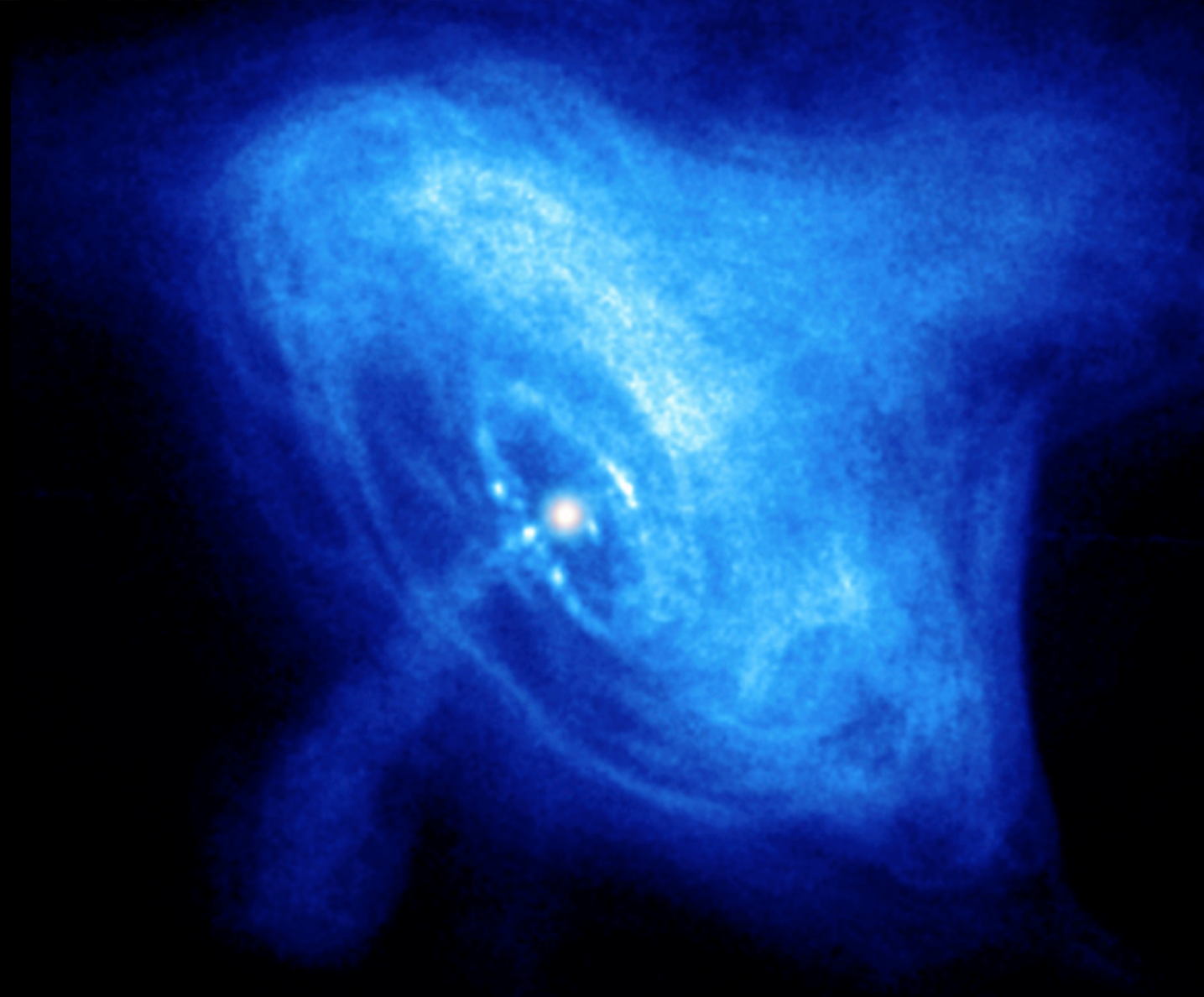
1000

1500

2000

Quit

Crab Nebula



Backup slides



Aspect Camera Assembly

CXC

Post facto Aspect Determination

- Kalman filter
 - based on TRW design
 - uses past and future data
- ACA image centroiding
 - first moment
 - gaussian fitting
 - PSF fitting
- performance
- data products



Aspect Camera Assembly

CXC

Documents and References

- ACA Equipment Specification, EQ7-278, Rev F, 19 December 1997
- ACA DM11, Aspect Camera Assembly User's Manual, Rev A, 28 July 1998
- ACA DM05, Software Requirements Specification, Volume 1, PEA Flight Software, Rev H, 13 January 1998
- ACA DM06, Software Design Specification, Volume 1, PEA Flight Software, Rev E, 25 February 1998
- ACA Critical Design Audit presentation, 18 and 19 December 1995
- Ball Aerospace SER S97.20879.SYS.422, "Demonstrated performance of the PFU AC: ATP position accuracy test results", D. Michaels, 12 Nov 1997
- <http://hea-www.harvard.edu/asclocal/doss/doss.html> - pre-launch reports
- <http://asc.harvard.edu/mta/ASPECT> - post-launch reports



Aspect Camera Assembly

CXC

Calibration

- focal plane coordinates
 - calibrated from Ball's Better Accuracy Test System (BATS)
 - 20-coefficient polynomials in Y, Z; functions of row, col, temp.
 - T, T^2, T^3 terms zeroed because of BATS systemic T dependency
- point spread function (PSF)
 - ray-trace library
 - library of super-resolved images across f.o.v. from pixel image data
- dark current
 - median ~12 electrons/second
 - fraction in high dark current tail increasing with time
- read noise: ~10 electrons, confirmed from width of dark current peak
- derived quantities
 - bad pixel list (> 2000 e/s), traps (visual inspection)
 - centroiding error array: from Monte Carlo of 10.2 mag star across f.o.v. with Poisson shot noise and Gaussian read noise.

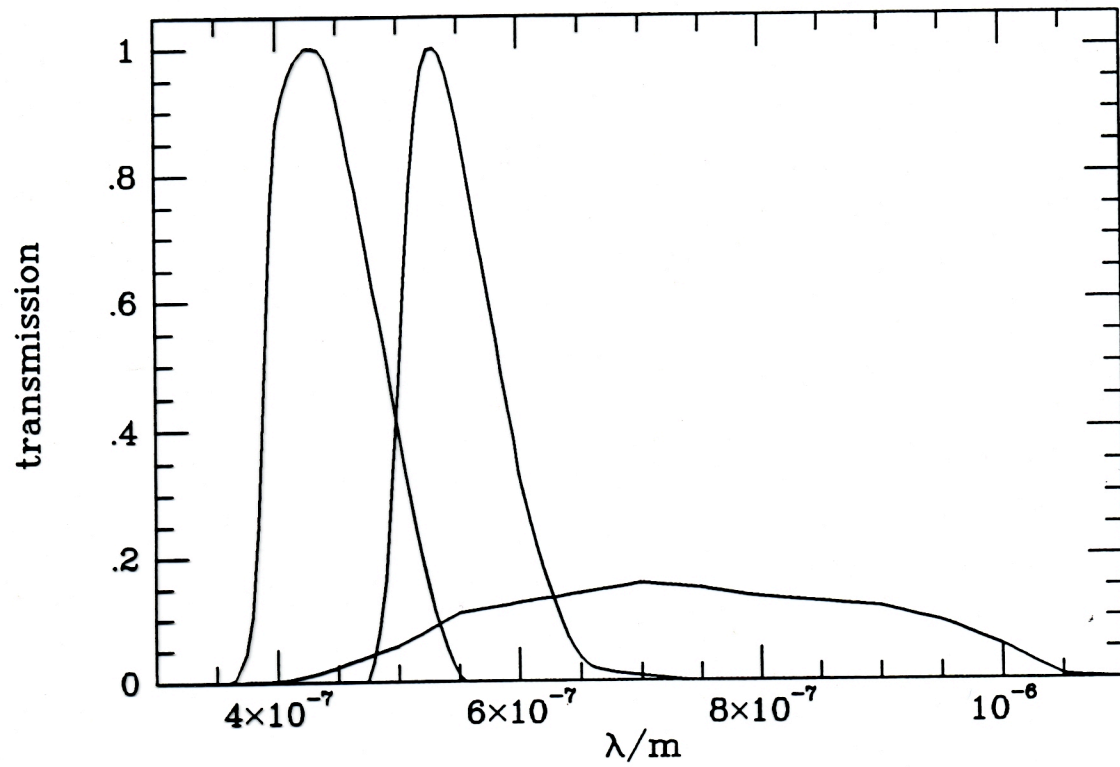


Figure 1. The aspect camera effective filter, compared with the Johnson B and V filters. Note that the aspect camera is redder than the V filter and much broader than either of the Johnson filters.



Aspect Camera Assembly

CXC

Operation

- constraints and restrictions
- commands (and syntax errors)
- telemetry - 2 separate streams:
 - OBC telemetry: status, FM centroids, magnitudes
 - aspect telemetry: status, 4x4 or 6x6m or 8x8 pixel readouts
 - “Header 3” diagnostic telemetry
- timing: nominal ACA integration = 1.696 seconds
- dark current calibration and calibration data format: @512kbps through IU
- patching: see DM-11
 - patch table: starts at address CB36
 - fidlight tracking patch: starts at address D200
 - reset patch: see DM-11
- AC EEPROM -separate EEPROMs for PEA-A and PEA-B
 - contents
 - re-programming: see DM-11