### SSM- imaging aspects Ravishankar BT SAG, URSC

STREEP CONTRACT.



### Introduction

- Coded Mask: Non-focussing, indirect imaging. \*
- Detector Plane: histogram of detected photon strike positions. Position sensing wires: from charge ratio; regular updates
- Iteratively model the super-position of shadows of the coded \* pattern due to all sources.
- SSM's very wide field of view: Edge SSMs (SSM1 and SSM2):  $100^{\circ} \times 27^{\circ}$ Central SSM (SSM3):  $100^{\circ} \times 22^{\circ}$
- Prerequisite: Precomputed Shadow Response Library for given detector parameters, geometry, efficiency, etc







#### Introduction

- Imaging is only the last and important stage of a detailed pipeline.
- The pipeline is fully automated 24/7, periodically polls ISSDC for data.
- Turn around time ~ 25 min.





#### **Rotation Mechanism**



- Shown here are sky projections of FsOV.
- Stare-and-step mode: 10 deg step, 10 min stare;
   Limits: 5 deg and 355 deg
- Since mid 2021, Stare-and-step stopped.
- Coded MaskDetector\* Now: Platform angle chosen based on<br/>current X-ray sky activity for every<br/>pointing and commanded for each SAM
  - No Coning in the rotation platform so far.







**Observed Photon Strike positions** on all anodes (shown for SSM1 camera only)

**Detector Plane Histogram (DPH): After** applying calibration constants on event-list (shown for SSM1 camera only)

## Imaging



# Imaging

 X: Shorter Coding axis and Y across

X

Scanning Sky Monitor

- Sky: nominal:
  125 elements (X) &
  55 elements (Y) 6875
  skybins unwrapped.
- Eight anode wires: same number of bins as mask pattern – 504 detbins unwrapped.

\*





\* -Inner rectangular FOV first followed by outer annular FOV -Two runs: joint fit for all known sources and then individual fit -Local Field: subpixel imaging employed -SVDFIT-based algorithm used for the fit

# Imaging





\* -Richardson-Lucy based algorithm to identify candidates -SVDFIT on those candidates to further check and flux estimation

# Imaging







Crab







Detected Flux, ph/sqcm-sec

#### **GRS 1915+105**



### Imaging results



#### H 0614+091







#### A 0535+262



# Tricky points

- \* Changes in Gain
- Dynamic background:
  - charged particle induced
  - earth limb scattering
- Anodes:
  - response: ground assessment and keeping track of variations on-board.
     Coupled with background effects
  - local deformities: not merely nonlinear effects on shadow
  - Position resolution coupled with anode calibration factors



### Variation in Crab counts (SSM3)



Num Photons







# Charged Particle Background

٠	Effects of SAA		450		
	Tentacles away from 'SAA region'		400		
			350		
	- Almost every orbit!	nts/sec	300		
	- Diagnostic · VCR CCR	, cou	250	-	
	Diagnostic. Ven, cen	ooral HBT	200		
		Tem	150		
	VCR (Veto count-rate):		100		
	anode-layer & Veto layer (counts high energy Xrays	too)	50		
			0 211	8.76	21
	CCR (Coincident count-rate above + between anodes	):			L1 F L1 F



# Charged Particle Background

		2500	
*	Effects of SAA	2300	000
	Tentacles away from		299700
	'SAA region'	2000	
	-low energy electrons		
	-Almost every orbit!	1500	*
	- Diagnostic: VCR, CCR		-
	poral	1000	
	Ten		-
		500	
	VCR (Veto count-rate): anode-layer & Veto layer		
	(counts high energy Xrays too)	0	
		222	29.2

CCR (Coincident count-rate): above + between anodes AS1A11\_080T01\_9000004756\_32997 SSM3







#### Sun will never appear in the FOV.

- Whenever Earth in FOV, it will be Sun-lit!
- Effects depend on Solar activity. \*

#### Earth in FOV

#### AS1A11\_065T01\_9000004794\_33440 SSM3 180 334400 160 140 120 counts/ 100 emporal HB<sup>1</sup> 80 60 40 20 2259.34 2259.26 2259.27 2259.28 2259.3 2259.31 2259.32 2259.33 2259.35 2259.29 MJD-57293.0 L1 HBT-ILR,c/s L1 HBT-Veto,c/s L1 HBT-CCR,c/s HVREF:SAA MKF:SAA EARTHFLAG ECLIPSE

Shown here is a flare detected on 2021 Dec 4 6:50 UT



### Charged Particle Background and Anode response changes

- Anodes: \*
  - -Shifts in the shadows; sometimes locally
  - -Local deformities which seem to degrade

Animation

Scattering at the walls: anode-ends and edge anodes register more counts.



# Charged Particle Background



### Charged Particle Background and Anode response changes



scale cross this match); edge-bins 5 counts (scaled

2016:May vs 2022:Feb





#### Thank You

