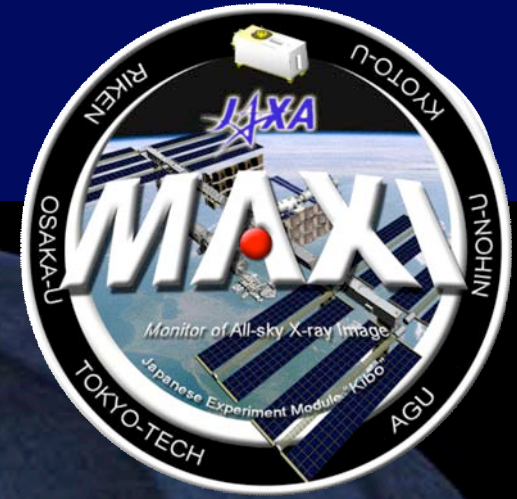


2009/11/15 12:21:17
DPTC=938760514

Real-time X-ray Transient Monitor and Alert System of MAXI on the ISS



Hitoshi Negoro (Nihon U.)

&

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M. Kohama, T. Mihara, M. Sugizaki (RIKEN),
N. Kawai (Tokyo Tech), A. Yoshida (AGU),
S. Eguchi (Kyoto U.) and MAXI Team

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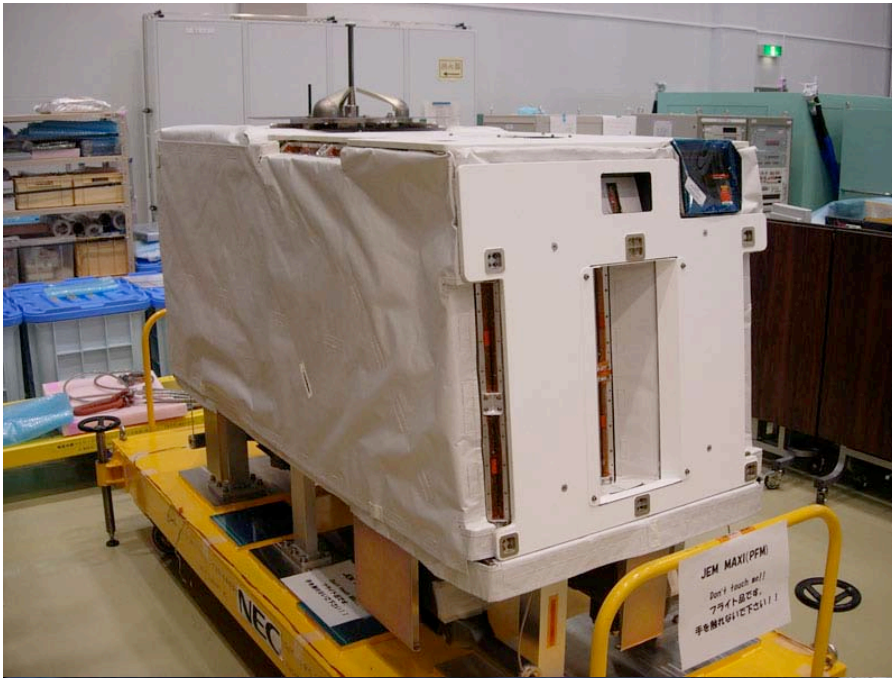
2009/10/05 15:48:27
DPTC=938760514



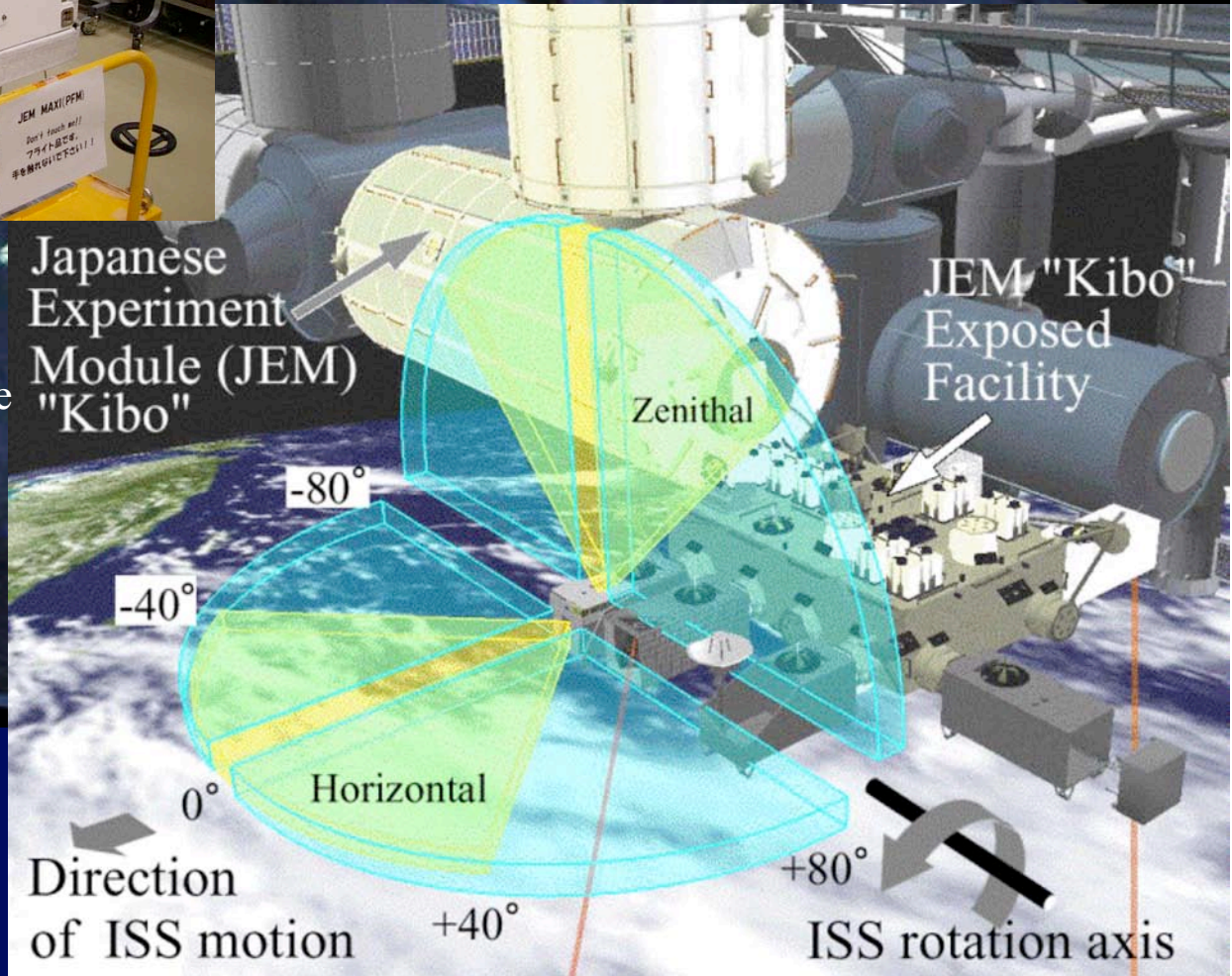
Outline

- About MAXI (X-ray all-sky monitor)
- ISS-Ground Network
- Ground Software System
- Real-time X-ray Imager, Nova-Search System + Alert System
- Summary


MAXI Monitor of All-sky X-ray Image



- July 16: Launched by space shuttle Endeavour.
- Aug 3: MAXI Power On
- Aug 8: One GSC camera was on.
- Aug 13: All the 12 GSC cameras were on.
- Aug 14: SSC cameras were on.



from NASA's Astronomy Picture of the Day on Oct. 5

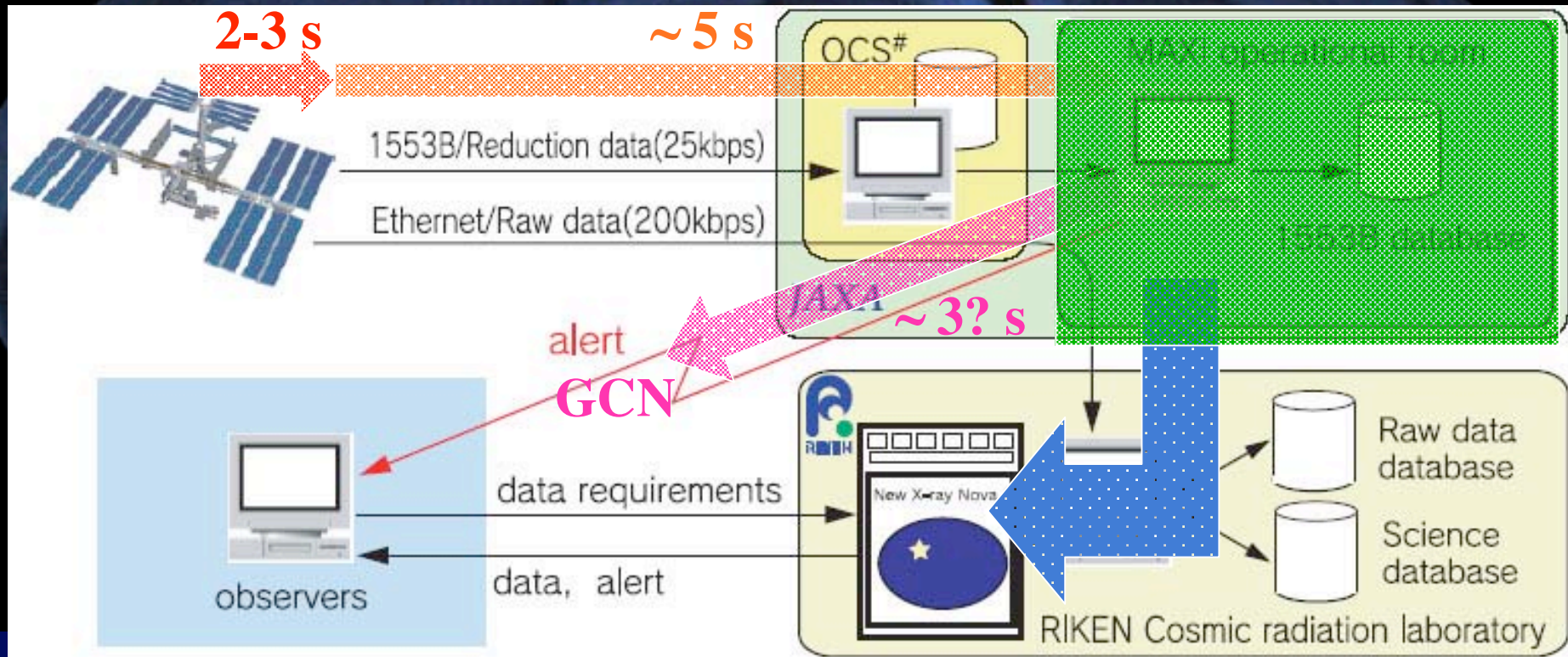
- 
- Main Goals
 - to discover transient objects, such as X-ray Novae, Gamma-ray Bursts, and provide prompt alert information.
 - to monitor long and short-term time variabilities of X-ray sources including AGNs.
 - to make all-sky X-ray maps and catalogs.

ISS-Ground Network



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How fast can we let you know..?

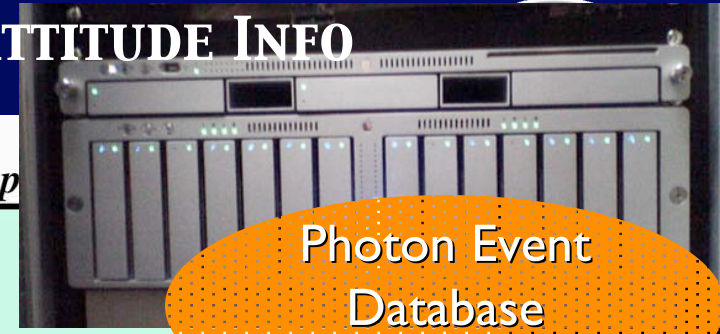


It must be possible to send alert information in ~10 s.

MAXI Ground Software System

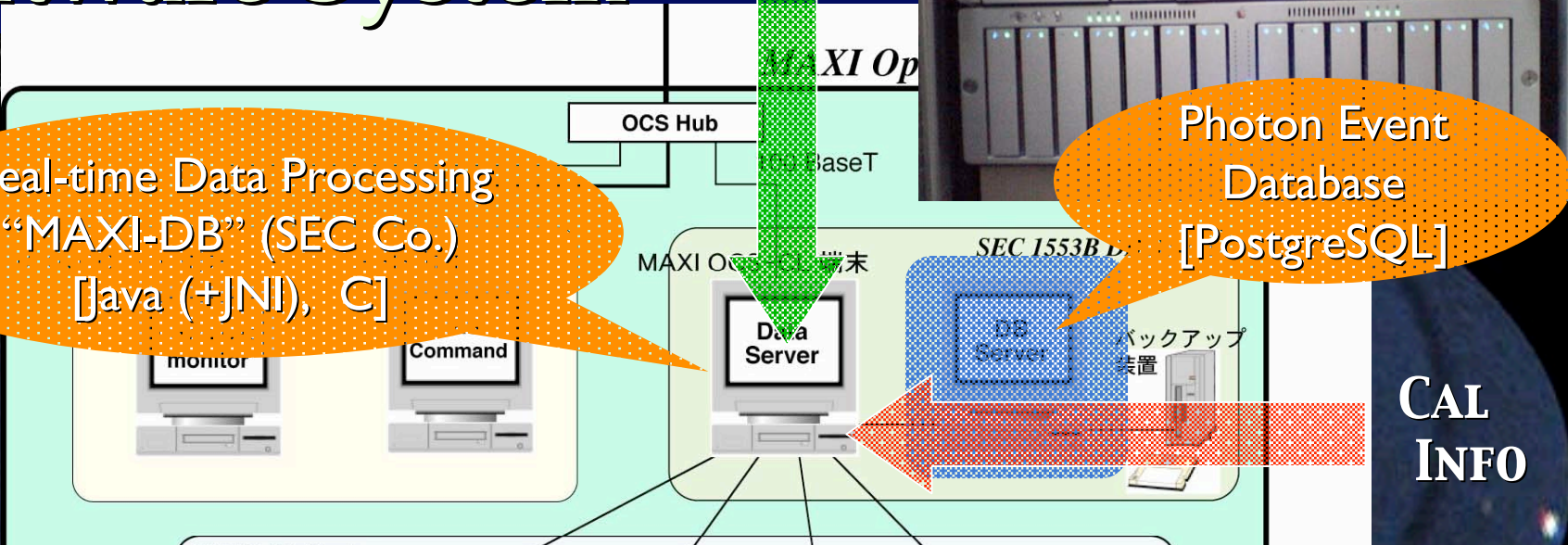
X-RAY EVENT DATA
+ TIME & ATTITUDE INFO

2009/10/05 15
DPTC=938760

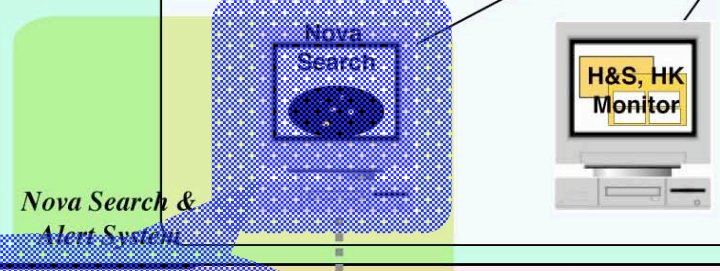


Real-time Data Processing
"MAXI-DB" (SEC Co.)
[Java (+JNI), C]

Photon Event Database
[PostgreSQL]



MAXI QL System



NovaSearch & Alert System



Public Data Archival System
(P. #37, Kohama+)

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Nova Search System



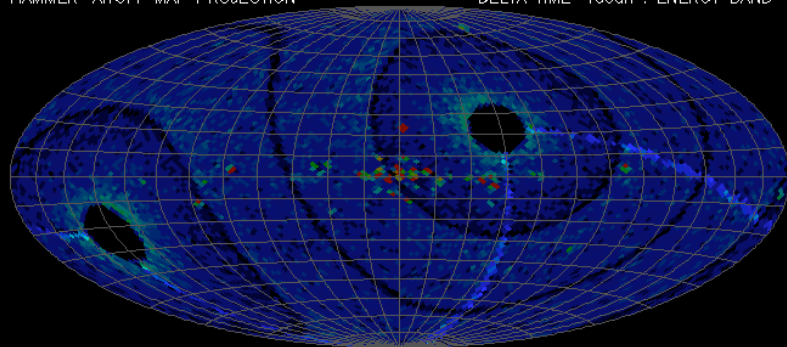
- Real-time X-ray Imager, and Transient Monitor
- Written in C
 - Libraries: HEALPix, GTK+ (PGPLOT), atFunctions (in HEADAS), and pthreads
- Developed under Linux and MacOSX
 - “Thread Viewer” and “Shark” for OSX are powerful tools to check CPU time for multiple (4 or 8) CPU cores.
- There are many functions..

PGPLOT and GTK+ Versions

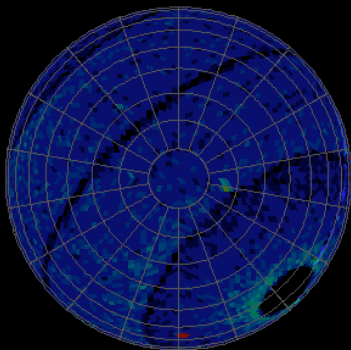


2009/10/05 15:48:27

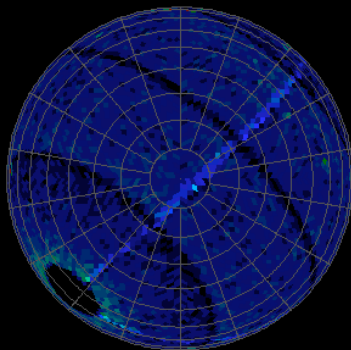
HAMMER-AITOFF MAP PROJECTION DELTA TIME=1scan : ENERGY BAND=all



LAMBERT-TOP MAP PROJECTION

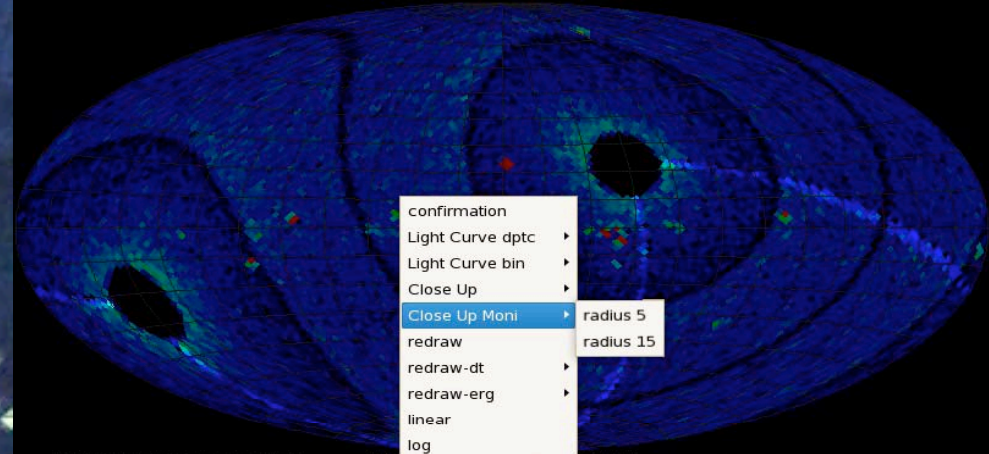


LAMBERT-DOWN MAP PROJECTION



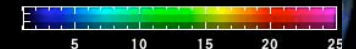
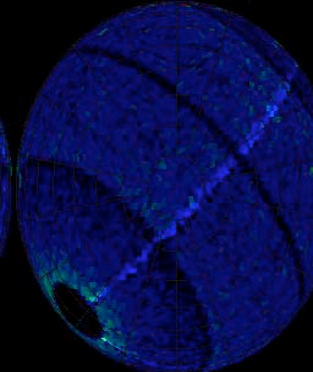
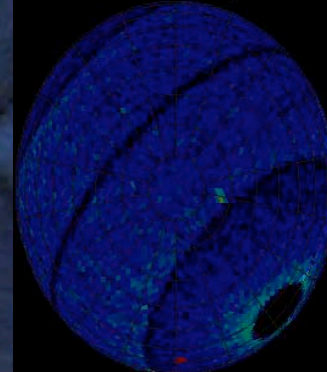
HAMMER-AITOFF MAP PROJECTION

DELTA TIME=1scan : ENERGY BAND=all



LAMBERT-TOP MAP PROJECTION

LAMBERT-DOWN MAP PROJECTION



Delta-Time: 1s 3s 10s 30s 1scan 1orb 4orb 1day

Energy: all high med low

Gal: Gal RA,Dec

Scale: Linear Log

STOP Save Print Catalog

Settings

Threshold=50
poisson-level=1.00e-06
latest backup=0
detc range=(700,5700)
alpha=1.10 beta=2.00

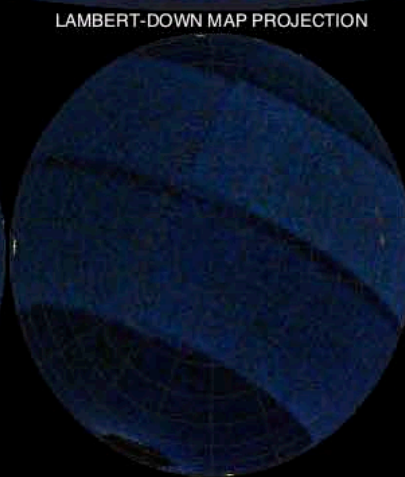
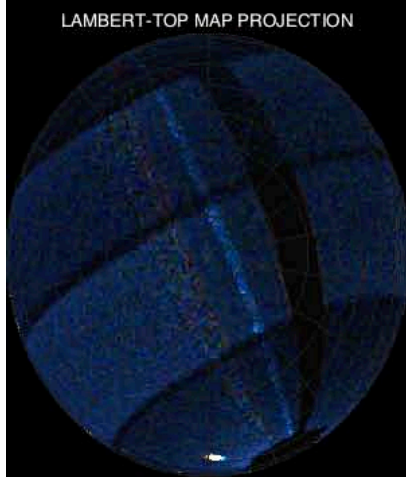
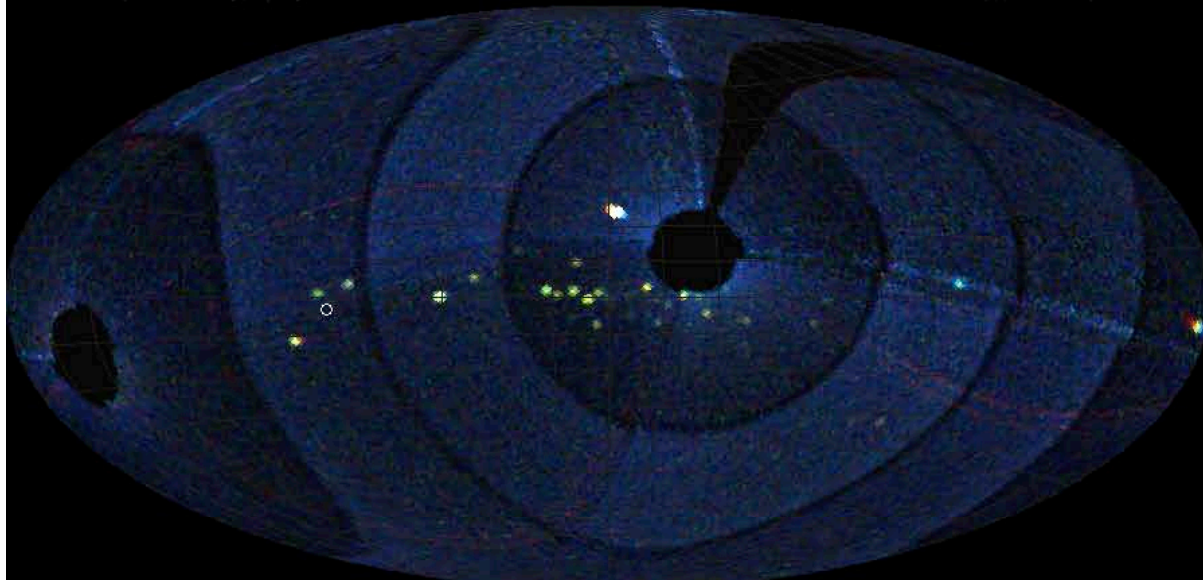
設定(P)

We made some pseudo functions to port to GTK+:
e.g, cpgswin() -> pgtkswin()

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ALLSKY_MAP DELTA TIME=1scan : ENERGY BAND=L+M



5 10 15 20 25

Delta-Time
 1s 3s 10s 30s
 1scan 1orb 4orb 1day

Energy
 L+M high med low RGB

Gal
 Gal RA,Dec Linear Log

draw mode
 Normal All Latest

STOP Save Print Catalog

Settings
 Threshold=50
 poisson-level=1.00e-06
 latest backup=0
 detx range=(700,5700)
 alpha=1.10 beta=2.00

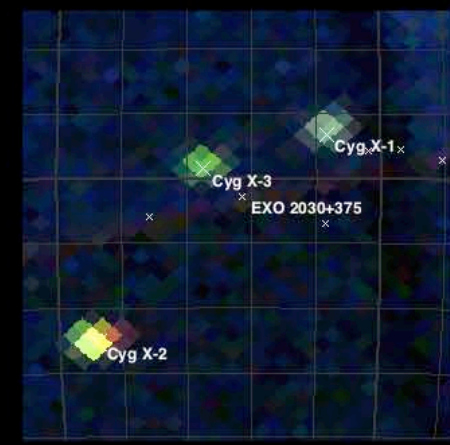
(P)

NovaBoard DPTC 938017621

DPTC	(GL,GB)	Delta-Time				Energy-Band		All
938017621	(349,45,2.38)	1s	3s	10s	30s	L+M	high	Check
		1scan	1orb	4orb	1day	med	low	LC
0	(0.00,0.00)	1s	3s	10s	30s	L+M	high	Check
		1scan	1orb	4orb	1day	med	low	LC
0	(0.00,0.00)	1s	3s	10s	30s	L+M	high	Check
		1scan	1orb	4orb	1day	med	low	LC
0	(0.00,0.00)	1s	3s	10s	30s	L+M	high	Check
		1scan	1orb	4orb	1day	med	low	LC

Close Up

CLOSE UP : (r=15.00)
(Gl,Gb) = (77.48,-3.25)
dt=1scan,erg=L+M



high	Check
low	LC
high	Check
low	LC
high	Check
low	LC
high	Check
low	LC
high	Check
low	LC
high	Check
low	LC

tmp

Alert System

2009/10/05 15:48:27
DPTC=93816514

(see Ishiwata+,
P. #33)

GUI: CERN (ROOT) libs



MAXI Alert System

id	DPTC	RA	Dec	timescale	band
000000004	851834466	(270.53, -25.29)		*****1s/3s/10s/30s	low/med/high
000000003	851834393	(264.38, -25.28)		*****10s/30s	low/med/high
000000002	851834365	(265.08, -27.28)		*****3s/10s/30s	low/med/high
000000001	851834381	(244.92, -15.30)		*****3s/10s/30s	low/med/high
000000004	851834451	(270.42, -25.68)		*****1s/10s/30s	low/med/high
000000004	851834450	(270.40, -25.66)		*****10s/30s	low/med/high
000000003	851834391	(264.38, -25.28)		*****10s/30s	low/med/high
000000002	851834359	(265.08, -27.28)		*****3s/10s/30s	low/med/high
000000001	851834358	(244.69, -16.33)		*****10s/30s	low/med/high

id	DPTC	RA	Dec	timescale	band
000000004	851834466	(270.70, -24.62)		*****1scan	*****
000000004	851834466	(270.70, -24.62)		*****1scan	*****
000000004	851834466	(270.70, -24.62)		*****30s	*****
000000004	851834466	(270.70, -24.62)		*****30s	*****
000000004	851834465	(270.70, -24.62)		*****1scan	*****
000000004	851834465	(270.70, -24.62)		*****30s	*****
000000004	851834465	(270.70, -24.62)		*****30s	*****
000000004	851834464	(270.70, -24.62)		*****1scan	*****
000000004	851834464	(270.70, -24.62)		*****30s	*****
000000004	851834464	(270.70, -24.62)		*****30s	*****
000000004	851834463	(270.70, -24.62)		*****30s	*****
000000004	851834463	(270.70, -24.62)		*****30s	*****
000000004	851834463	(270.70, -24.62)		*****10s	*****
000000004	851834463	(270.70, -24.62)		*****10s	*****
000000004	851834462	(270.70, -24.62)		*****30s	*****
000000004	851834462	(270.70, -24.62)		*****30s	*****
000000004	851834462	(270.70, -24.62)		*****10s	*****
000000004	851834462	(270.70, -24.62)		*****10s	*****
000000004	851834461	(270.70, -24.62)		*****30s	*****
000000004	851834461	(270.70, -24.62)		*****30s	*****
000000004	851834461	(270.70, -24.62)		*****10s	*****
000000004	851834460	(270.70, -24.62)		*****30s	*****
000000004	851834460	(270.70, -24.62)		*****30s	*****
000000004	851834460	(270.70, -24.62)		*****10s	*****
000000004	851834460	(270.70, -24.62)		*****10s	*****
000000004	851834459	(270.70, -24.62)		*****30s	*****

Command

Show Detail

Ignore Noise

Alert Nova

Catalog Update

Parameter

Threshold (order) : 8

Reson (deg) : 1.5

Accuracy (deg) : 1.5

Scan Time (sec) : 20

Keep Time (sec) : 604800

Spread Limit (pix) : 50

Status connection host

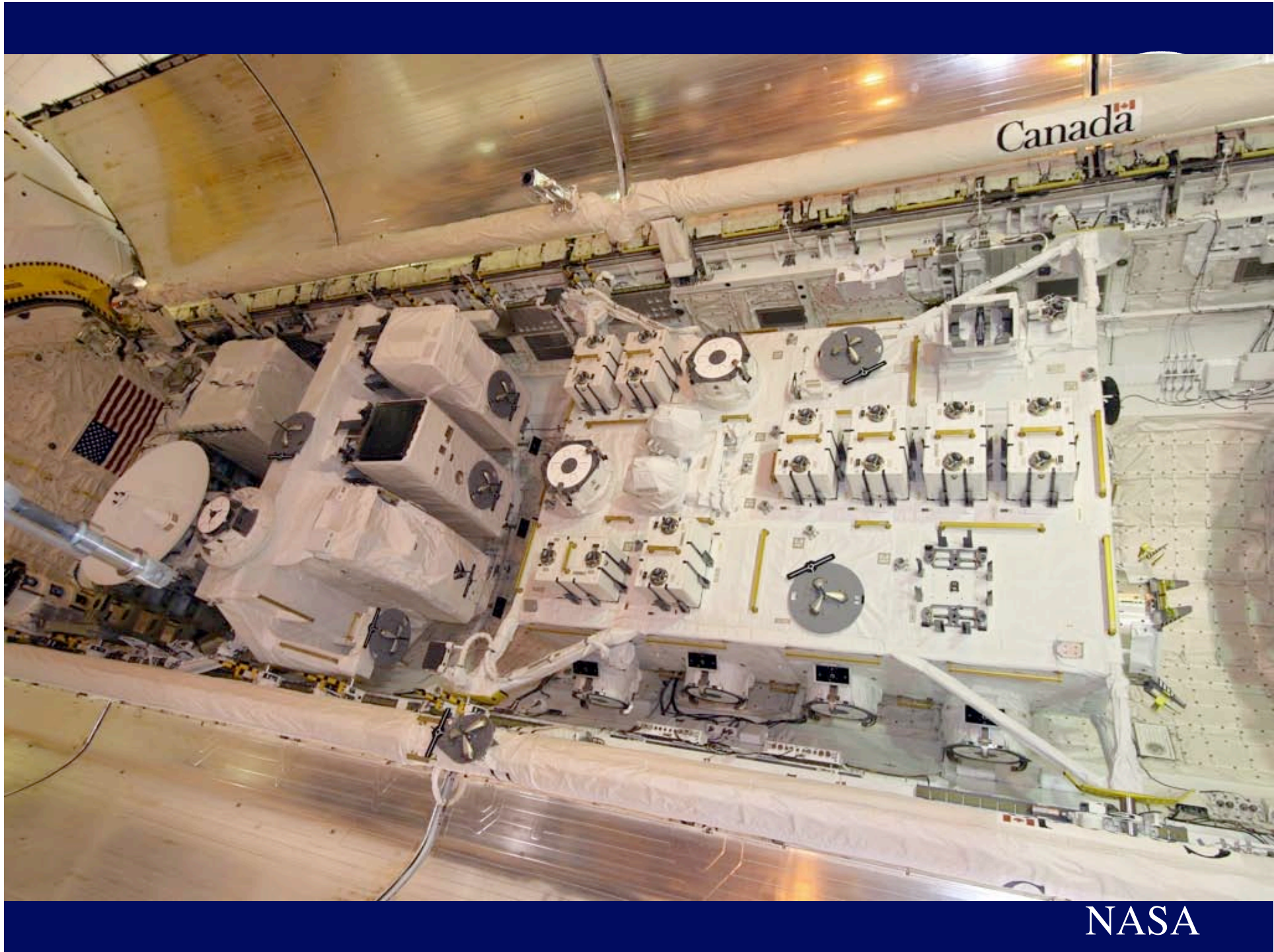
Distance	Flux	RA	Dec	Name
0.31	929.91	(270.28, -25.08)		1RXS J180108.7-250444, GX 5-1
0.49	21.22	(270.30, -25.74)		1RXS J180112.6-254435, GRS 1758-258
1.18	4.18	(269.24, -25.11)		SWIFT J1756.9-2508
1.29	7.77	(271.71, -24.50)		2S 1803-245, SAXWFC J1806.9-2434.7
2.13	4.28	(272.69, -26.15)		SAX J1810.8-2609, V4722 Sgr
2.44	4.16	(268.38, -23.82)		SAX J1753.5-2349

Summary



2009/10/05 15:48:27
DPTC=938760514

- The Nova-Search system works well as a real-time transient monitor.
 - 2 GRBs have been already detected in less than 2 months.
 - Detector calibration and parameter tuning for real data, not simulation data (see Eguchi+, P.#18), are still necessary to detect more.
- The automatic send-alert system is still under development.
- If the latter system works, the alert information can be sent to the world in ~ 10 s after the on-board detection.
- Then, real-time collaborations with other observatories in various wavelengths, including VO, must be important.



NASA

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DPTC=938760514

X-ray Cameras



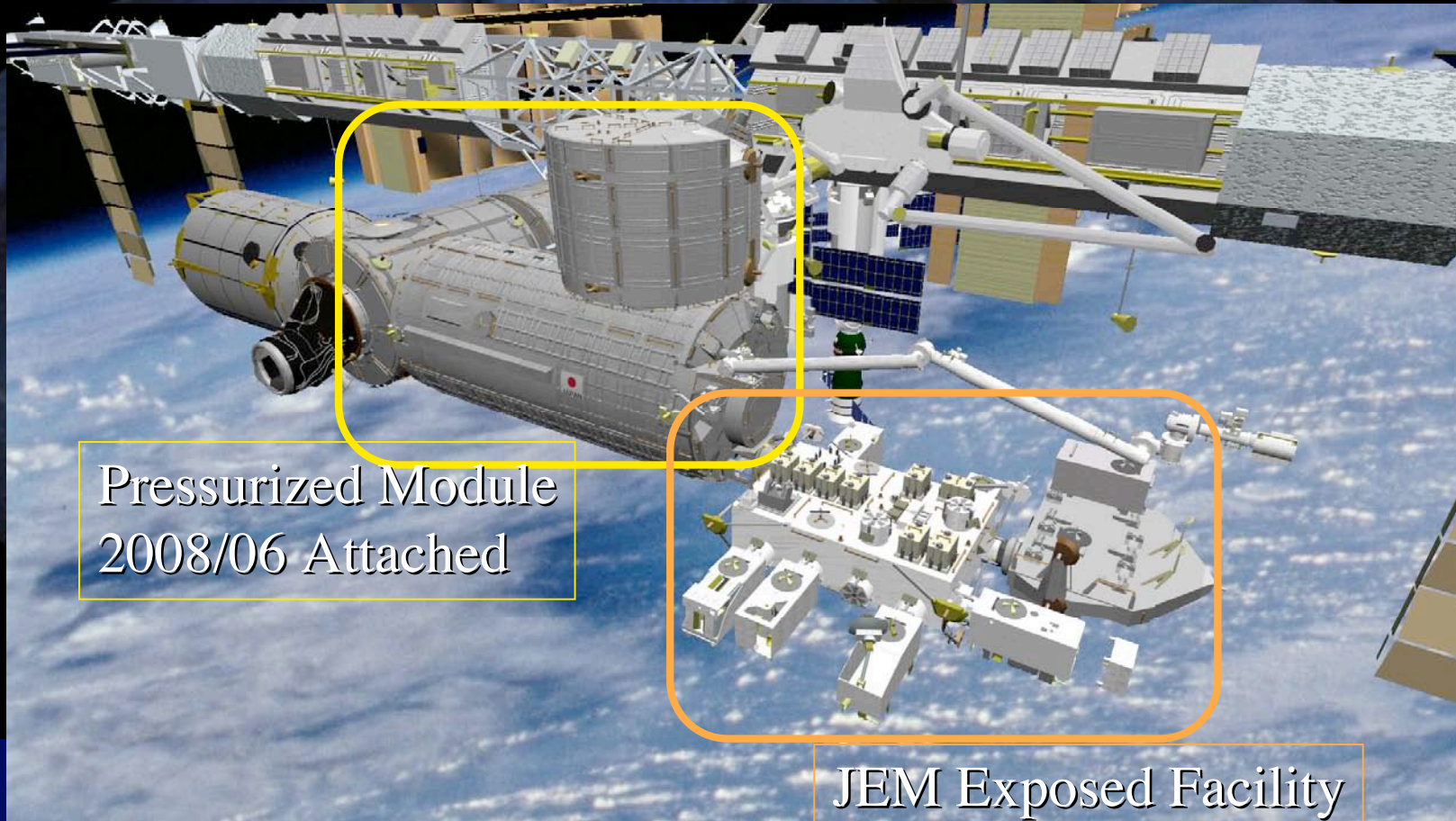
	Gas Slit Camera, GSC	Solid State Camera, SSC
Detectors	12 Position Sensitive PCs.	32 CCDs
Energy Band	2-30 keV	0.5-12 keV
Effective Area	5350 cm ²	200 cm ²
FOV	(160° x 1.5°) x 2	(90° x 1.5°) x 2
Spatial Res.	~ 0.1°	~ 0.1°

Where is MAXI ?



2009/10/05 15:48:27
DPTC=938760514

On Kibo (Hope) / ISS



Pressurized Module
2008/06 Attached

JEM Exposed Facility
2009/07/16 Launched
2009/07/19 Attached

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