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

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&

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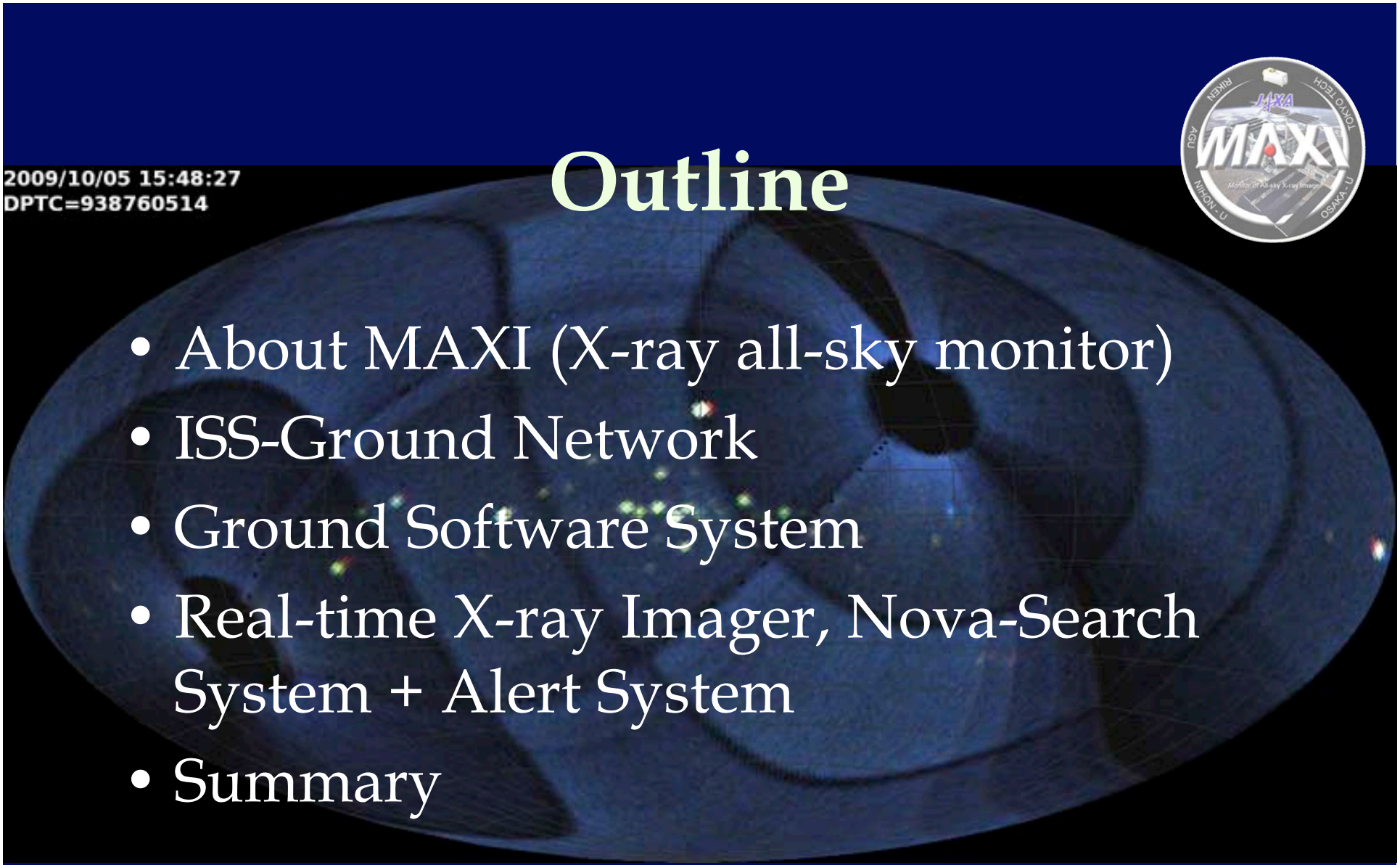
ADASS 2009 @札幌

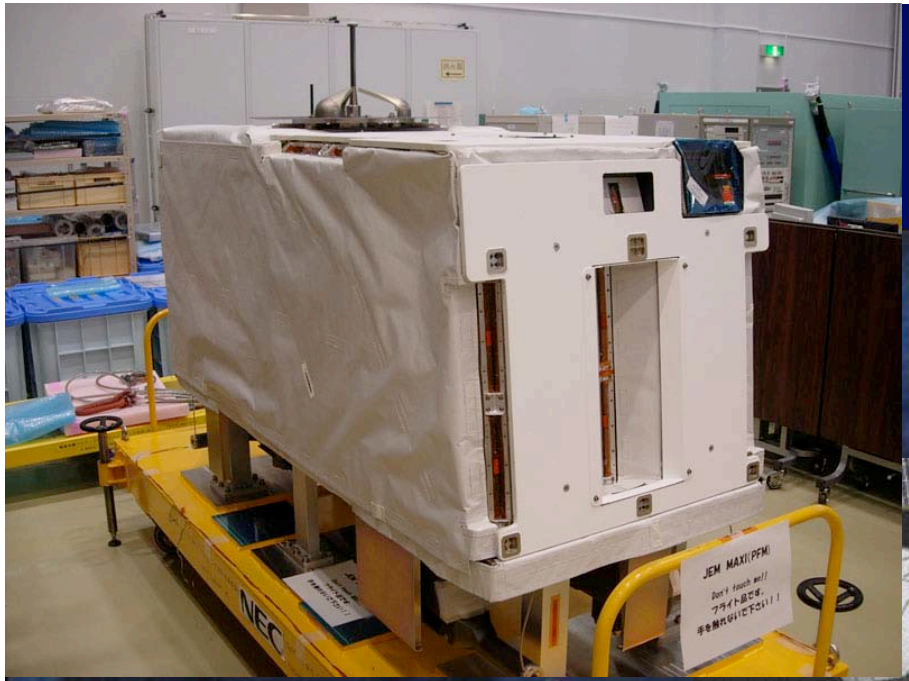


Outline

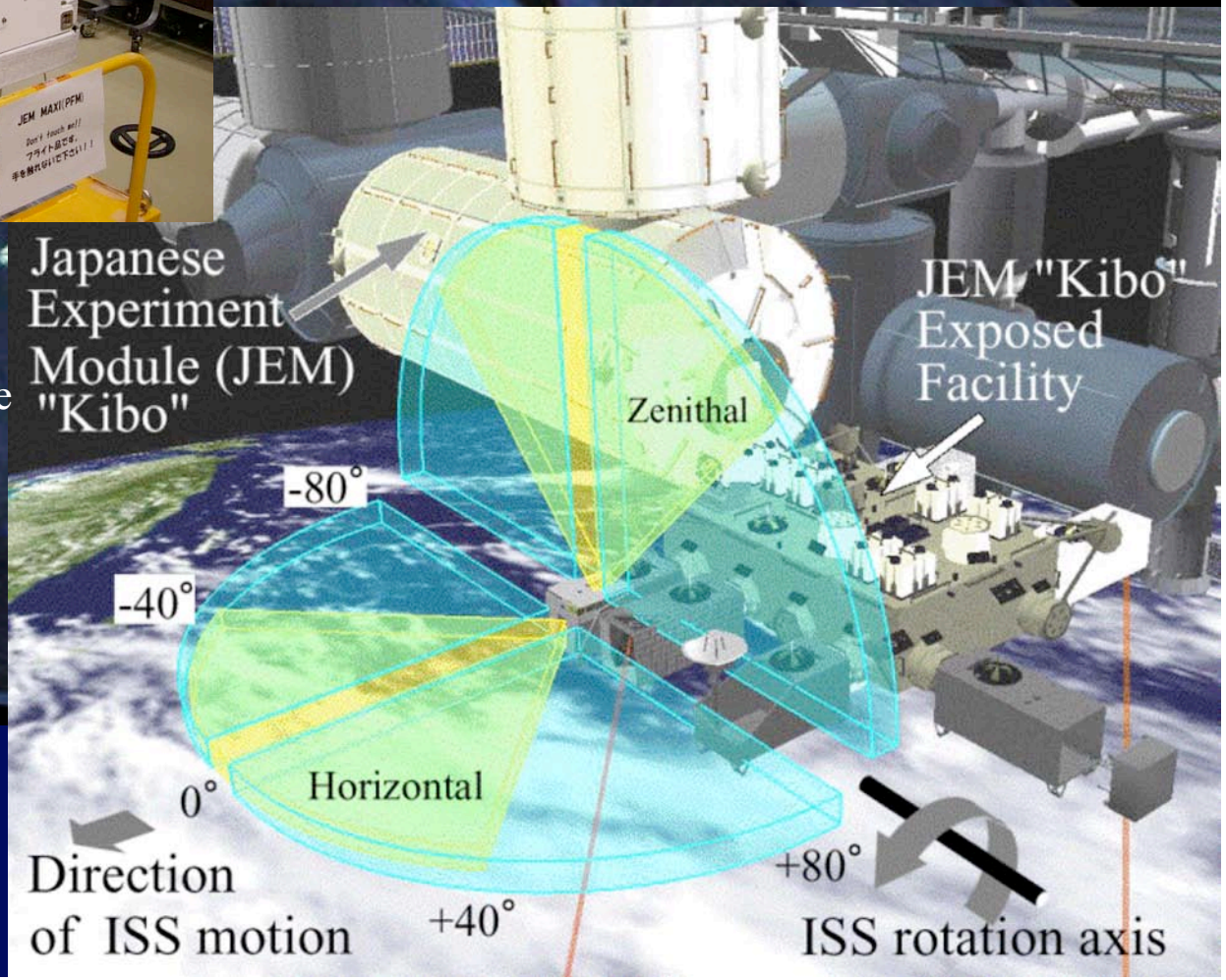
- About MAXI (X-ray all-sky monitor)
- ISS-Ground Network
- Ground Software System
- Real-time X-ray Imager, Nova-Search System + Alert System
- Summary

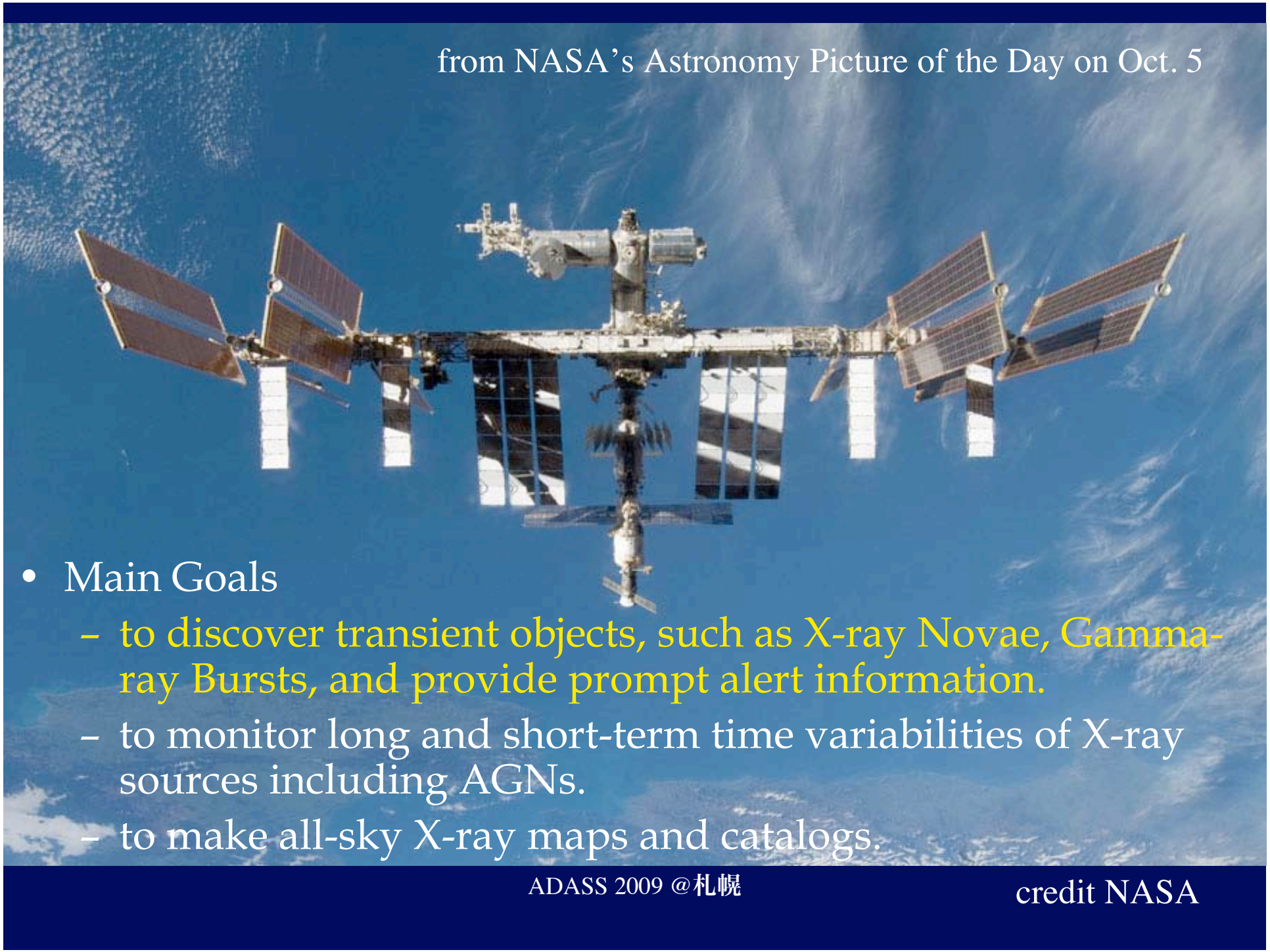
MAXI

Monitor of All-sky X-ray Image



- July 16: Launched by space shuttle Endevour.
- 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.





- 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.

credit NASA

ISS-Ground Network

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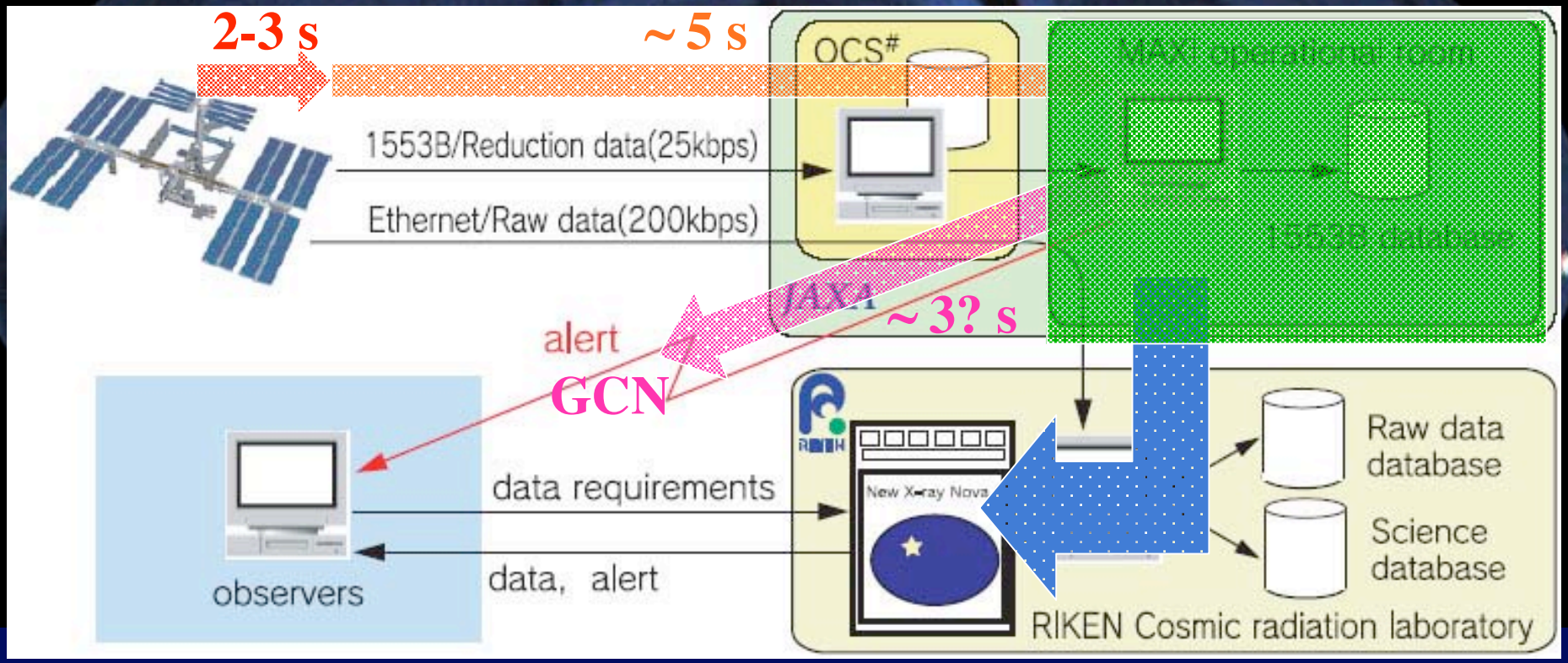
How fast can we let you know...?



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

MAXI Ground Software System

X-ray Event Data + Time & Attitude Info

Photon Event Database [PostgreSQL]

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

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OCS Hub

Monitor

Command

Data Server

DB Server

バックアップ装置

SEC 1553B

Cal Info

MAXI QL System

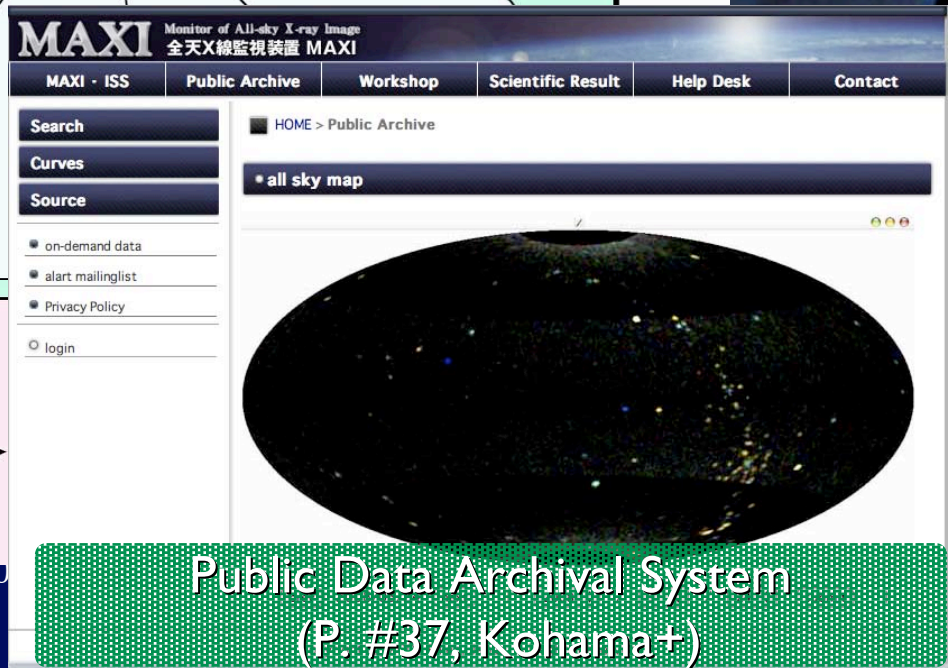
Nova Search

H&S, HK Monitor

Nova Search & Alert System

WAN

NovaSearch & Alert System



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

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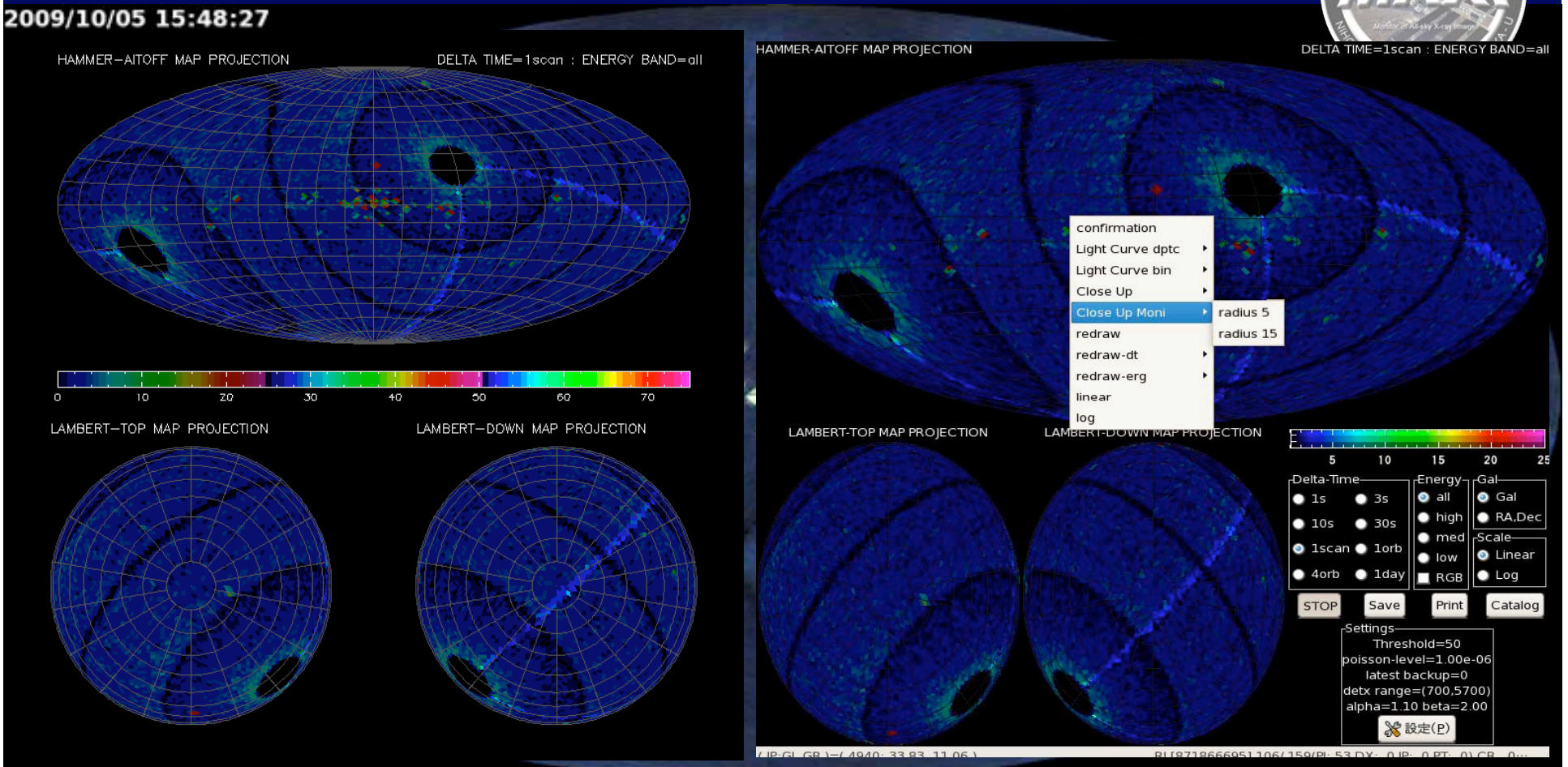
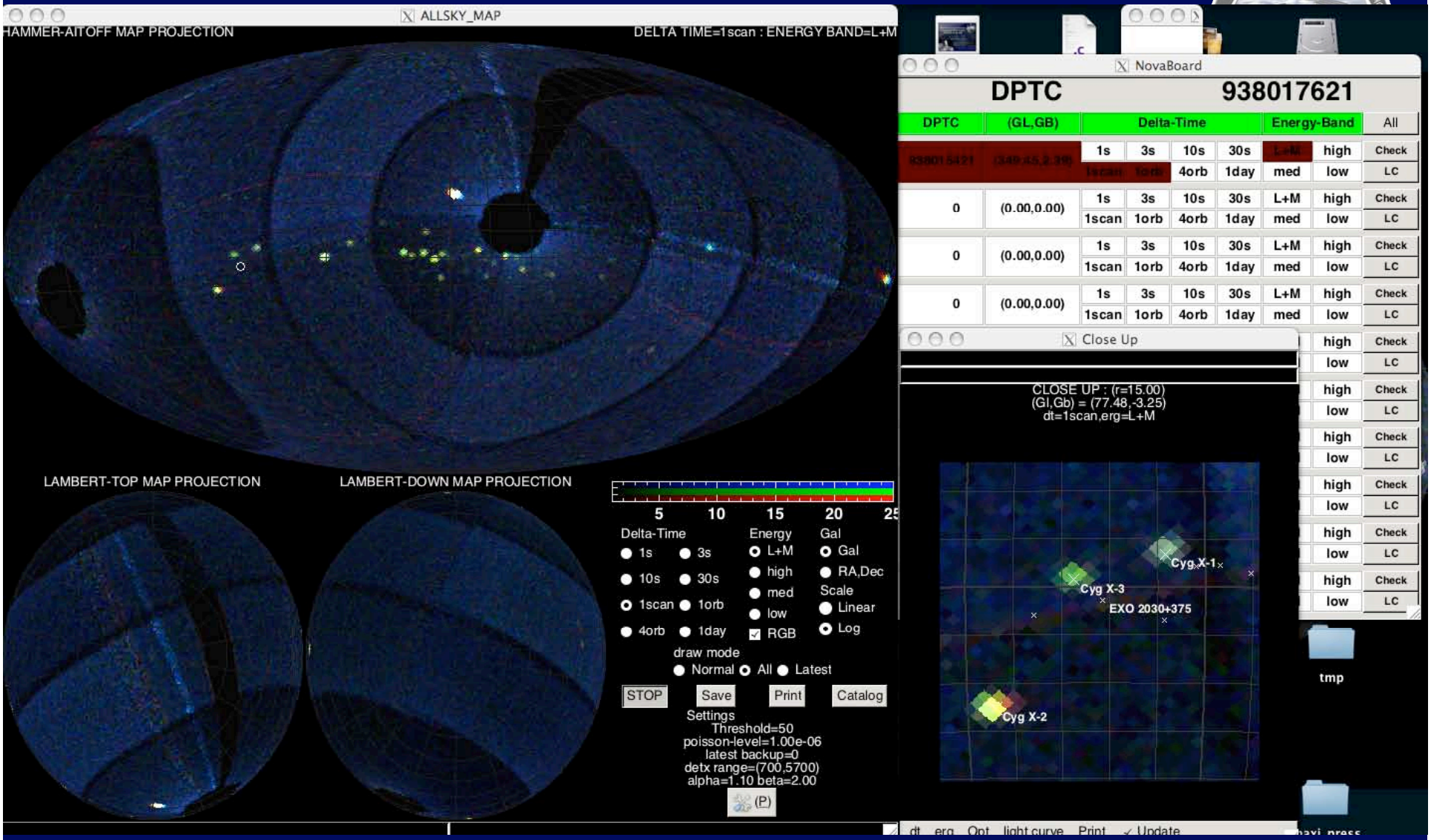
Nova Search System

- 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..

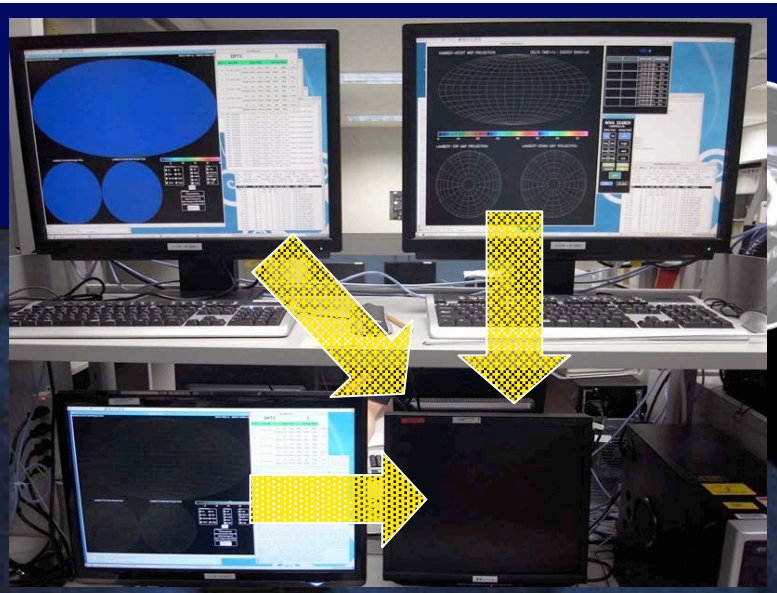
PGPLOT and GTK+ Versions



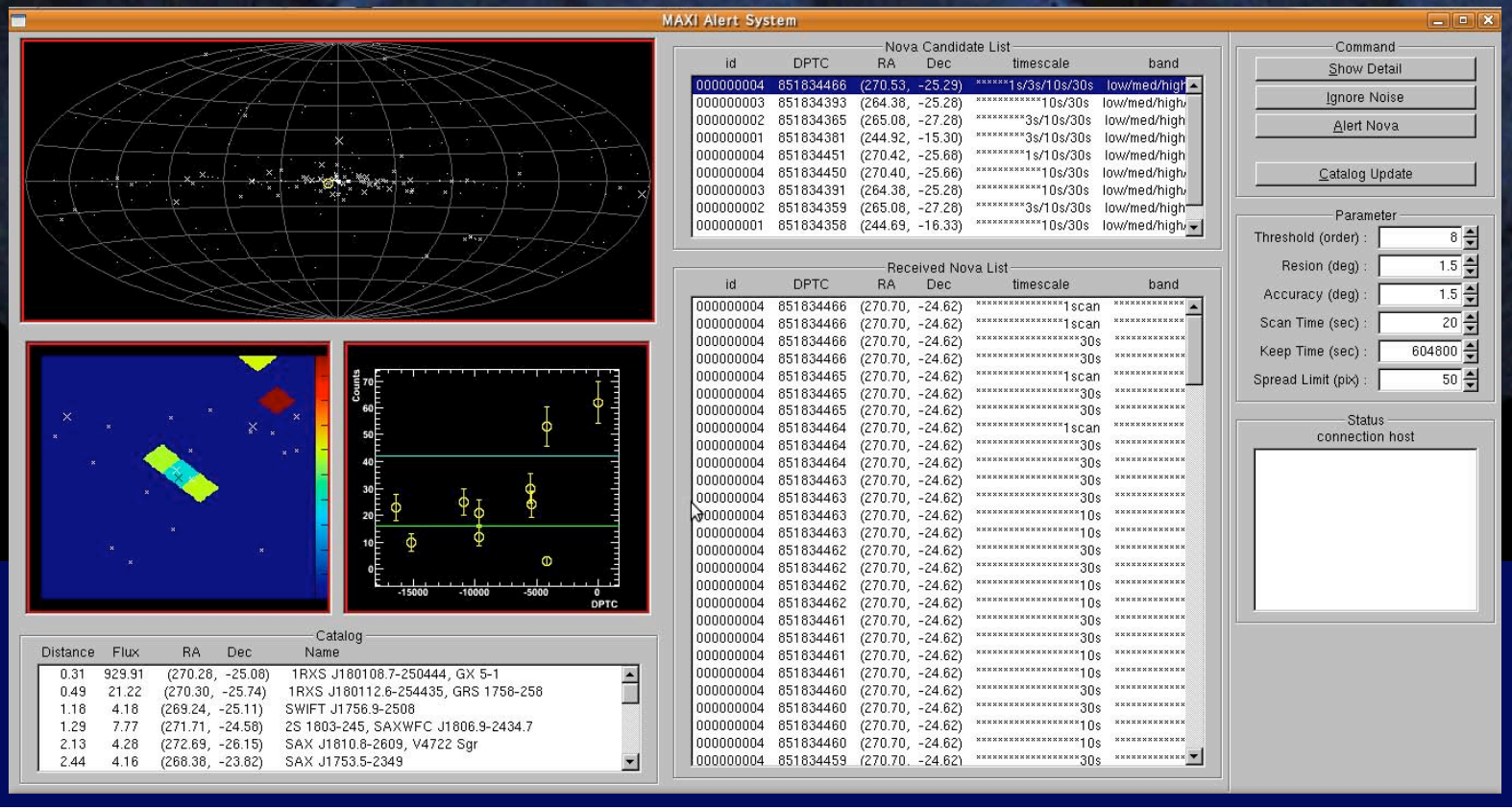
We made some pseudo functions to port to GTK+:
e.g, cpgswin() -> pgtkswin()


ALLSKY_MAP
HAMMER-AITOFF MAP PROJECTION
DELTA TIME=1scan : ENERGY BAND=L+M
LAMBERT-TOP MAP PROJECTION
LAMBERT-DOWN MAP PROJECTION
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
Scale
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
1s 3s 10s 30s L+M high Check
1scan 1orb 4orb 1day med low LC
0 (0.00,0.00)
Close Up
CLOSE UP : (r=15.00)
(Gl,Gb) = (77.48,-3.25)
dt=1scan,erg=L+M
Cyg X-1
Cyg X-3
EXO 2030+375
Cyg X-2
tmp
dt erg Opt light curve Print Update

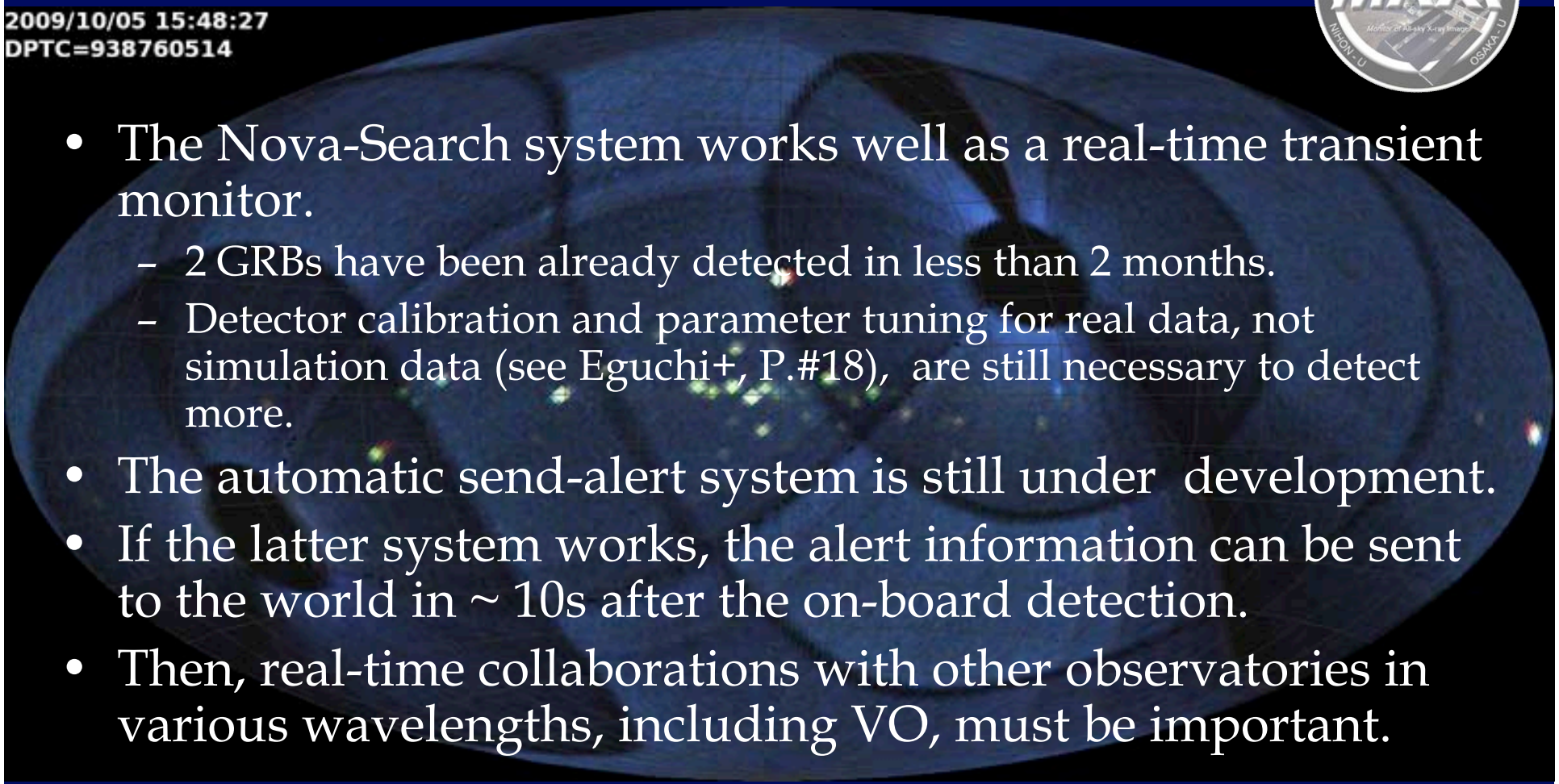
Alert System (see Ishiwata+, P. #33)



GUI: CERN (ROOT) libs

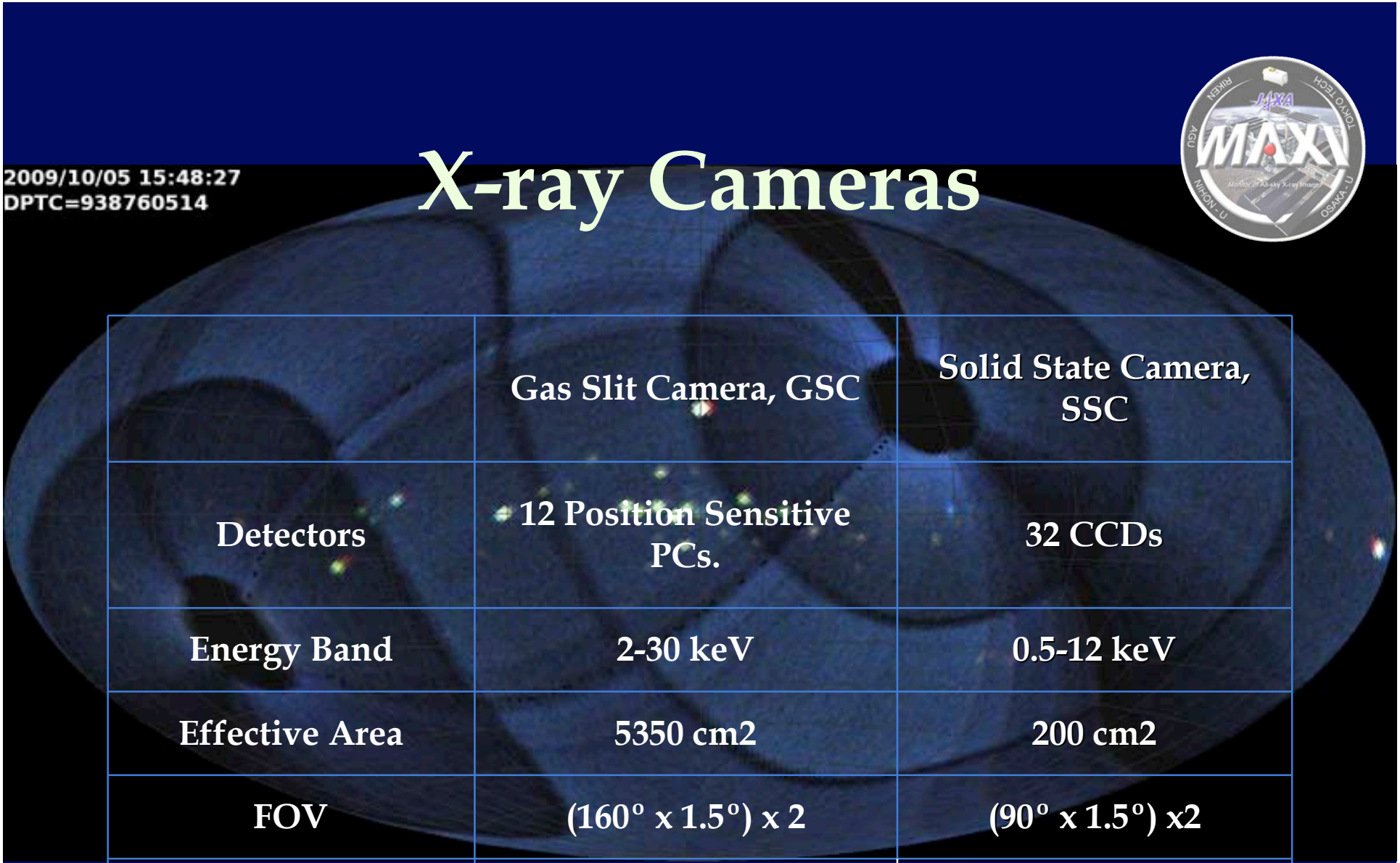


Summary



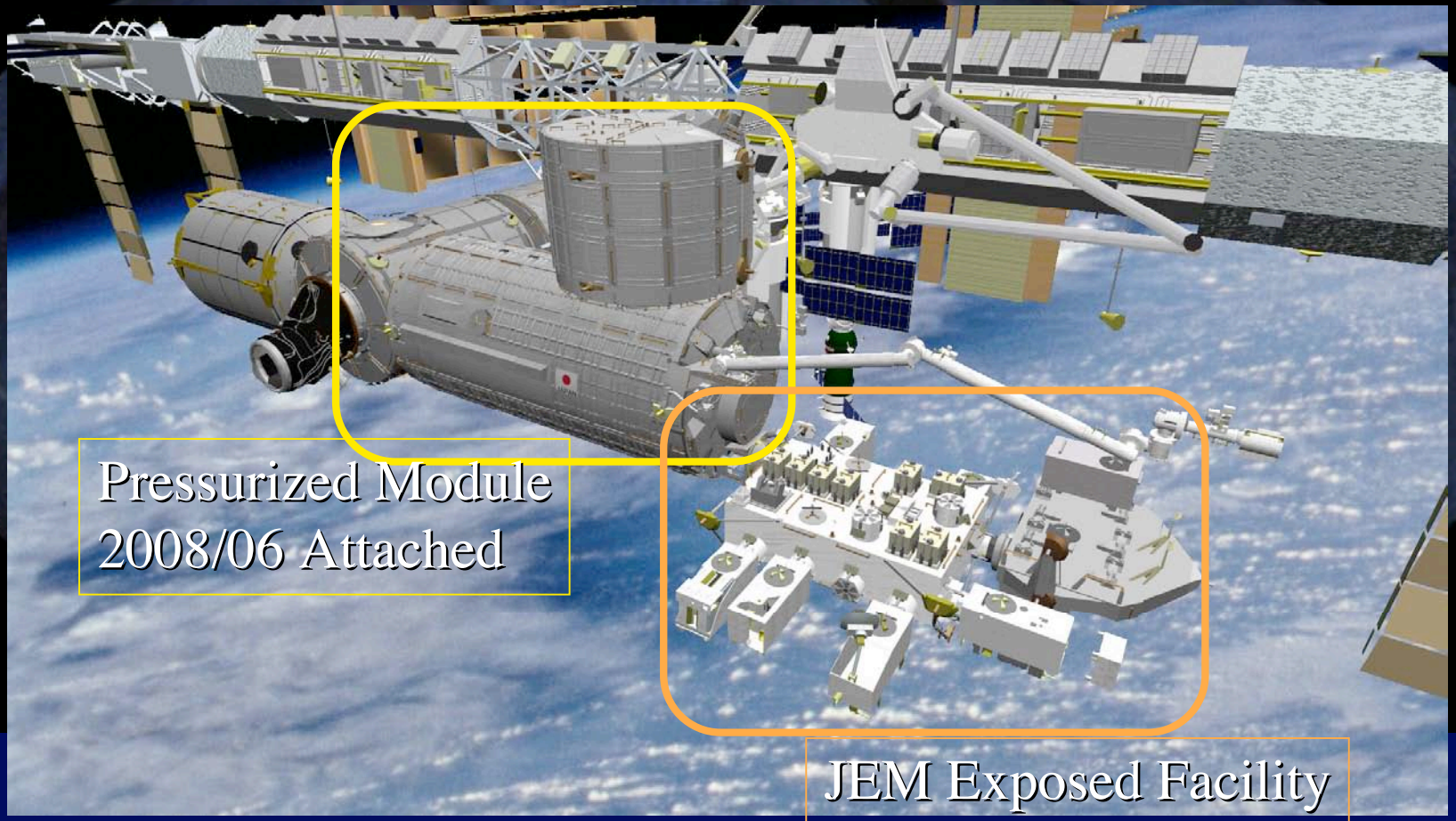
- The Nova-Search system works well as a real-time transient monitor.
  - 2 GRBs have been already detected in less than 2 months.
  - Detector calibration and parameter tuning for real data, not simulation data (see Eguchi+, P.#18), are still necessary to detect more.
- The automatic send-alert system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

NASA



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 cm2	200 cm2
FOV	(160° x 1.5°) x 2	(90° x 1.5°) x2
Spatial Res.	~ 0.1°	~ 0.1°

Where is MAXI ?
On Kibo (Hope) / ISS

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