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

Hitoshi Negoro (Nihon U.)

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S. Miyoshi, H. Ozawa, and R. Ishiwata (Nihon U.), S. Ueno, H. Tomida, M. Suzuki, M. Matsuoka (JAXA), M. Kohama, T. Mihara, M. Sugizaki (RIKEN), N. Kawai (Tokyo Tech), A. Yoshida (AGU), S. Eguchi (Kyoto U.) and MAXI Team
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.
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

How fast can we let you know..?

2-3 s

~ 5 s

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

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MAXI Ground Software System

X-ray Event Data + Time & Attitude Info

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

Photon Event Database [PostgreSQL]

NovaSearch & Alert System

Public Data Archival System

MAXI QL System

H&S, HK Monitor

WAN

Public Data Archival System
(P. 797, Kohama et al.)
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+:

\texttt{e.g, cpgswin() -> pgtkswin()}

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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.
## X-ray Cameras

<table>
<thead>
<tr>
<th></th>
<th>Gas Slit Camera, GSC</th>
<th>Solid State Camera, SSC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Detectors</strong></td>
<td>12 Position Sensitive PCs.</td>
<td>32 CCDs</td>
</tr>
<tr>
<td><strong>Energy Band</strong></td>
<td>2-30 keV</td>
<td>0.5-12 keV</td>
</tr>
<tr>
<td><strong>Effective Area</strong></td>
<td>5350 cm²</td>
<td>200 cm²</td>
</tr>
<tr>
<td><strong>FOV</strong></td>
<td>((160° \times 1.5°) \times 2)</td>
<td>((90° \times 1.5°) \times 2)</td>
</tr>
<tr>
<td><strong>Spatial Res.</strong></td>
<td>(~ 0.1°)</td>
<td>(~ 0.1°)</td>
</tr>
</tbody>
</table>

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Where is MAXI?
On Kibo (Hope) / ISS

Pressurized Module
2008/06 Attached

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