

Operation status of MAXI and ISS

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ABSTRACT

In July 2009, MAXI and Japanese Experiment Module “Kibo” Exposed Facility (JEM-EF) were delivered to the International Space Station (ISS) by Space Shuttle Endeavor and were completed by the robot-arm operation of Koichi Wakata and ISS Crew. MAXI was powered on in August/03/2009, and MAXI observation has been started from August/17/2009. We report the recent one year operation status of the MAXI and ISS. The operation of MAXI did not so go well easily. It suffered from some troubles of communications. “Kibo” Operation team and MAXI Operation team have improved some on-board telecommunication system and the ground equipments to store MAXI data more completely. Now, MAXI observation data are almost completely delivered to our analysis system.

KEY WORDS: MAXI, ISS, Operation

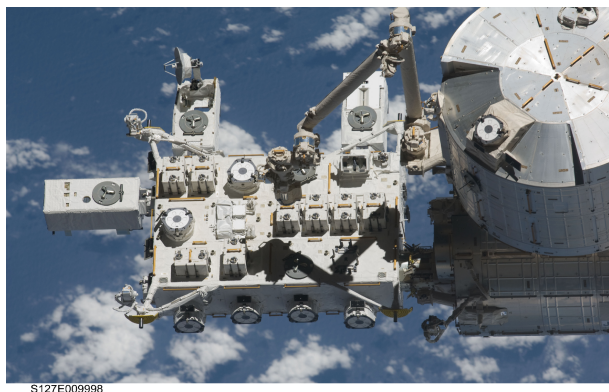
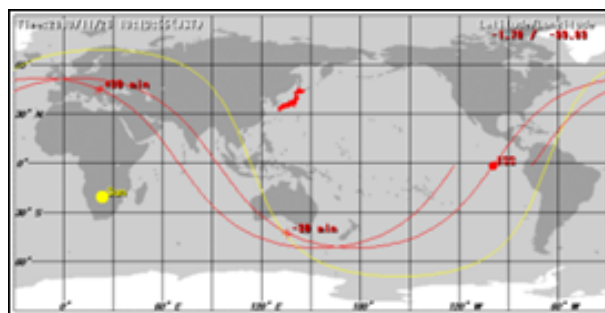


Fig. 1. Japanese Experiment Module “Kibo” Exposed Facility (c)NASA

1. General

The Japanese Experiment Module “Kibo” Exposed Facility(JEM-EF) can be used as a site of space observations. Since the ISS always faces the bottom side to the Earth, the sky view from the ISS is rotating all the time.



Inclination	51.65 deg
Perigee Height	346 km
Apogee Height	357 km
Revolution per Day	15.73

Fig. 2. ISS orbit (Nov/25/2010)

Table 1. GSC and SSC

	GSC	SSC
Detector	12 proportional counters	32 X-ray CCD tips
Effective area	5530 cm ²	200 cm ²
Energy range	2-30 keV	0.5-12 keV
Energy resolution	18 % at 5.9 keV	150eV at 5.9 keV
FOV	160 deg(L) × 1.5 deg	90 deg(L) × 1.5 deg
Timing accuracy	0.1 msec	5.8 sec

Moreover, there are a small vibration in attitude. Thus the mission is good for an all-sky monitor. Monitor of All-sky X-ray Image(MAXI) is high ability all-sky monitor that can observe the all-sky with about 1.5 degree position resolution and high sensitivity, which is attached to the JEM-EF ram side port (EFU No.1).

MAXI employs two types of X-ray cameras, Gas Slit Camera (GSC) and Solid-state Slit Camera (SSC). Each consists of two perpendicular fan-beamed field of view that scans the sky with the revolution of the International Space Station. Details are shown in table 1. The observed data will be provided to world wide astronomers as soon as possible though the ground analytical system.

2. Operation and Data Communication

ISS Operation is strictly managed to keep the astronaut's safety. So all of ISS activity have been planned before two weeks. In MAXI, the file transfer for the observation plan and the commanding for updating this file every day, are put in the ISS Operation plan. And it is executed every day.

The International Space Station which MAXI will be attached has two types of continuous telemetry down links (low-speed Mil-1553b interface and medium-speed Ethernet interface) that cover about 30 to 70 percents in real-time connection, detail is shown in figure 3. The data processing of MAXI is done to two stages on the ground (Tsukuba Space Center and RIKEN). The health check of the detectors, the attitude determination and the lack of data are confirmed in Tsukuba Space Center, and all of down linked data are transferred to the RIKEN data distribution system. At RIKEN, new public archive data will be updated after the analytical process.

2.1. Topics

We are keeping the MAXI observation, though there were various events after operation began, too.

- 2009/07/16 Launch
- 2009/08/03 MAXI powered on

- 2009/08/18 Observation start and Press release "GSC first image"
- 2009/08/25 First Ethernet link trouble was occurred.
- 2009/09/07 2nd times Ethernet link trouble was occurred.
- 2009/11/09 The checkout of ICS link down-link path succeeded.
- 2009/11/26 Press release "GSC 2 month all sky image"
- 2009/12/15 Daily data distribution was started.
- 2009/12/23 17th Ethernet link trouble was occurred. (last)
- 2010/03/05 New Ethernet adaptor for MAXI was attached.
- 2010/04/22 The checkout of ICS link up-link path succeeded.
- 2010/06/06 MAXI emergency shutdown was occurred by Active Thermal Control System trouble.
- 2010/08/01 Ethernet link was down by ISS External Thermal Control System line trouble.

2.2. Ethernet link trouble

In 2009/08/29, MAXI Ethernet link was suddenly stopped. When we investigated the cause, it turned out that Ethernet chip was weak to heavy traffic. Whenever the trouble of the Ethernet communication, we had to reboot the MAXI system. We developed a new Ethernet adaptor (figure 4) to cancel this trouble. This protects the invasion of an irrelevant packet from the outside by installing it in the upstream of MAXI. We experienced rebooting 17 times by the time this new unit was installed. Now, MAXI observation data are almost completely delivered.

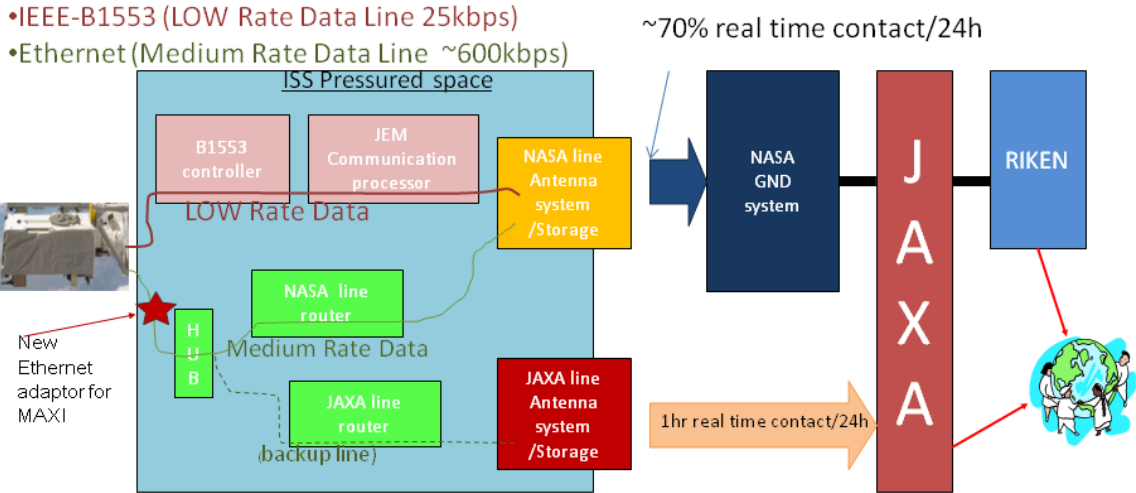


Fig. 3. MAXI data link flow

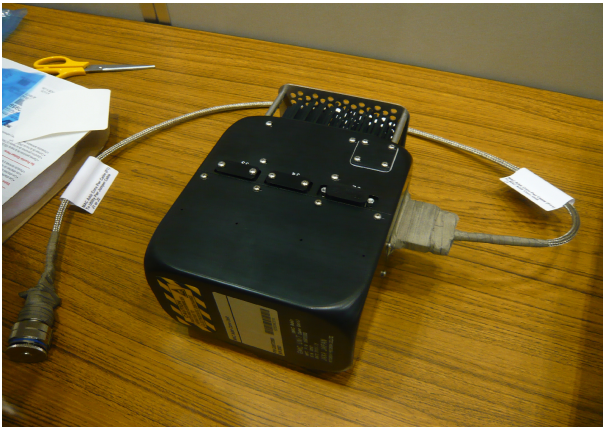


Fig. 4. New Ethernet Adaptor.

2.3. Data acquisition rate

The Low Rate Data Line has been stable very much since the beginning of mission. Resent data losses are due to the maintenance of the ground equipment. These can be collected later.

On the other hand, after the installation of new Ethernet adaptor, the Medium Rate Data Line is very stable though it was very unstable at first.

The figure 5 shows data acquisition rate after 08/03/2009.

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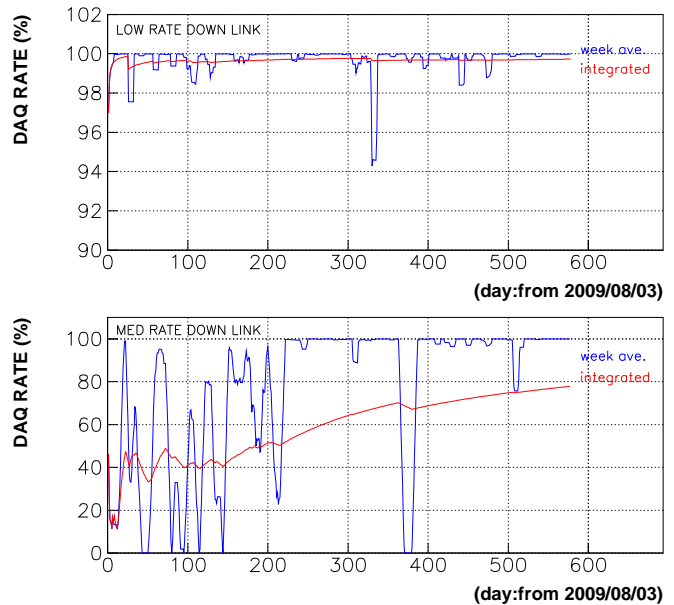


Fig. 5. MAXI Data acquisition rate. Upper figure shows LOW rate down-link acquisition rate. lower figure shows Medium rate down-link acquisition rate.

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