



# RAIDS Update

The Remote Atmospheric and Ionospheric Detection System aboard the ISS

September 9, 2009



Figure 1: The fairing is being installed around the H-II Transfer Vehicle in the at Tanegashima Space Center on August 23, 2009. The vehicle was placed aboard the second stage on August 30. (Photo credit: JAXA)

## Ready for Launch!

The RAIDS experiment was transferred to the Japanese Aerospace Exploration Agency (JAXA) on May 12, 2009 for flight to the International Space Station on the maiden launch of the H-II Transfer Vehicle (HTV). The stated purpose of this HTV-1 mission is "to deliver supplies to the ISS and to verify the rendezvous flight techniques and operability of the HTV on-board systems." This also happens to be the first launch of JAXA's new HII-B rocket. The vehicle for this flight is designated as a "Technical Demonstration Vehicle". If all these new systems operate as designed, RAIDS will be installed onto the space station around September 23, and begin science operations in mid- to late-October.



Figure 2: The Experiment Pallet carrying HREP and the Japanese SMILES payload is shown June 23 after being loaded into the HTV unpressurized cargo module. (Photo credit: JAXA)

## Experiment Status

During the summer HREP and its companion Japanese payload SMILES were integrated onto the Experiment Pallet (nicknamed "the queen-size bed"). The pressurized, unpressurized, avionics, and propulsion modules of the HTV were integrated, stacked, and placed in a clamshell fairing. On August 30 the encapsulated HTV was transferred to the vehicle assembly building at the Tanegashima Space Center for stacking on the launch vehicle. Currently, everything is on-track for launch from Tanegashima Space Center when the window opens. The HTV-1 launch window extends from September 11 02:04 Japan Time (September 10 13:04 EDT) through September 30. Once the launch window closes for fishing season, the next window of opportunity would be sometime around February.



*Figure 3: The Payload Operations Control Center at NRL has ground stations for commanding, telemetry display, and quick look data analysis.*

The RAIDS Team has spent much of this summer after hardware delivery preparing for mission operations. A Payload Operations Control Center (POCC) has been assembled at NRL (Fig. 3). From the POCC in the Space Science Division, we can send commands to HREP/RAIDS and access the NASA voice loops. Data is streamed live through the TDRSS satellites over the internet to NRL, and recorded data

can be retrieved to cover Loss-of-Signal periods. Mission operation simulations have been performed, as well as command and data handling tests. NASA has certified the POCC as flight-ready.

The RAIDS team has several last-minute open items in the area of mission support software and automated data processing. The tasks primarily involve software upgrades that will make accessing and working with data easier for the team. We are working to close these items before HREP is installed onto JEM-EF and data flows.

## RAIDS Checkout Plan

Another major activity during the summer for the Instrument Team has been developing the RAIDS on-orbit checkout plan and initial science operations plan. Finalizing the check-out plan has been challenging, due to a lack of information about the HTV mission schedule and our need to coordinate some time-critical RAIDS checks (such as sun apparitions in our field-of-view). At the HREP Mission Readiness Review on September 8, we received an updated HTV mission timeline (Table 1) which led to significant revisions to the RAIDS Check-out Plan (Table 2).

**Table 1: HTV Mission Timeline (JAXA, Aug. 27, 2009)**

Flight Day	Tasks
1	Launch/Insertion, post-insertion auto sequence (the HTV subsystem activations, attitude control, self-check, TDRS communications establishment, initiation of communication with the HTV Mission Control Room (MCR), TKSC, far field rendezvous flight maneuver
2	Far field rendezvous flight maneuver
3	Far field rendezvous flight demonstrations: Collision Avoidance Maneuver (CAM), passive abort and attitude control, correction from large attitude deviation, Free Drift
4–6	Far field rendezvous flight maneuver
7	IMMT review on the HTV demonstration operations data ; Arrival at the HTV PROX range
8	ISS proximity operations, final approach, capture by station's robotic arm, berthing to the ISS critical vestibule outfitting, activation of the HTV subsystems
9	Vestibule outfitting, crew ingress, cargo transfer (from HTV to ISS)
10–11	Cargo transfer from HTV to ISS
12	Temporary installation of the Exposed Pallet (EP) to Kibo Exposed Facility (EF)
13–14	Transfer and installation of HREP and SMILES to the Exposed Facility (EF)
15	Removal of the EP from the EF and reinstallation of the EP onto the HTV (robotic operation), transfer of waste and used materials from the ISS to the HTV (Inter-vehicular activity)

Table 2: RAIDS Check-Out Timeline (rev. 09/08/2009)

Day	Event	Event Name	Description	Notes:	Duration
1	1	HREP Install	HREP installed at EFU#6		
1	2	HREP Surv Pwr	HREP EFU#6 survival power ON	MSFC/PRO and JAXA coordination	
1	3	HREP ON	Turn on HREP Operational Power (IIU)	Monitor IIU boot (Verify proper boot); Monitor thermal configuration (verify thermal configuration); Send IIU no-op command(verify command link)	0.5h
1	4	HREP ICU ON	Turn on HREP ICU	Monitor ICU boot (verify proper boot); Monitor ICU thermal states (verify temps); Send ICU no-op command (verify command link)	0.5h
1	5	RAIDS ON	HREP/RAIDS activation and heater configure	Turn on RAIDS FMP, Monitor RAIDS Boot, Turn on RAIDS Heater Bus (monitor thermal states)	0.5h
2	16	RAIDS EUV Door	RAIDS EUV detector outgassing	Open the EUV detector door to vent detector into the cavity (with dust door shut). ENSURE: EUV detector temperature is above 0C(+margin) to allow H2O liberation and grating is warm.	14d
3	6.1	MSFC Low Power Test a	MSFC/ POD low power command test	MSFC/PRO sends to the "HREP Low Power Mode" Commands and HREP verifies status	0.5h
3	6.2	MSFC Low Power Test b	HREP return to operations test	HREP commands ICU and RAIDS power on (event 3&4)	0.5h
3	15	RAIDS Noise Levels	RAIDS Sealed detector noise trending	Power all sealed-tube sensors to trend temperature, noise performance, and search for potential light leaks. Spectrometer motors run. If no light leaks observed when HREP is in sunlight, 3 days is sufficient for noise trending. Sensor data must be collected and analysed. - <b>MUST OCCUR AFTER LOW-POWER SHUTDOWN, EVENT 6.1-6.2</b>	3d
6	20.1	RAIDS 1st Motion	RAIDS deployment and FUV first light	Deployment + First Light for FUV. Protect NIR/Vis, NUV, MUV sensors from accidental Rayleigh scattering damage, start the scan mechanism, deploy RAIDS. FUV does not need to be turned off. Successful deploy, door indicators show open and returned to stowed position. <b>DAYSIDE - NEEDS ISS VIDEO SUPPORT DURING COMMAND WINDOW</b>	4h
7		RAIDS Safing-test	Test of RAIDS sun-avoidance safe-mode and recovery	Scan RAIDS down to disk to test sun-avoidance mode, set instruments to Mode 0 (all instruments off). Recover to stand-by state.	1h
7		RAIDS Platform test 1	Test of platform turn-around point (max-alpha)	Set max-alpha point and test with scan of platform	0.5h
8	22	RAIDS Scan Mode	Scan mode testing	Specialized Scan Mode Test, Upload specialized scan mode parameters to FMP and Script to IIU, and verify operation with most sensors off. Do this with sensitive sensors off.	24h
10	24	RAIDS Low Limits	Low altitude limit search	Identify the lowest altitude the NIR/Vis sensors can safely measure w/o damage. Start high, and work low. Angle for maximum safe count rate determined for the most sensitive sensors (NIR/Vis). <b>ESTIMATED 7 COMMAND WINDOWS REQUIRED DAILY (ALTERNATING ORBITS)</b>	3d
12	25	RAIDS Alt Limit Set	Set low altitude scan limit	Implement low altitude angle limit with reverse bit using nominal scan. (Minimum altitude scan angle determined.)	0.5h
12	21	RAIDS Low Scan	RAIDS Low scan testing	Verify on-orbit low altitude angle limit scan performance with reverse bit. Do this with sensitive sensors off.	24h
15	26	RAIDS Sequencer Test	Sequencer functional test	RAIDS Test Sequencer functionality according to 1992 test plan.	24h
16	20.3	RAIDS EUV On	RAIDS Power ON EUV sensor	Execute 14+ days after Event 16 (EUV Detector outgassing)	0.5h
16	20.4	RAIDS EUV Limb scans	Collect limb-scan data with EUV	RAIDS EUV On, Status of all other sensors determined by results of low-altitude limit search (Event 24)	24h
17		RAIDS Normal Ops	RAIDS enter normal operating mode	Precautions taken until sun sensors can be fully evaluated at next apparition within scan field of view	
30+	19	RAIDS Sun Sensor	Sun sensor testing	Sun Sensor Threshold setting, Set safing overrides.	1d



*Figure 3: HREP/RAIDS at Tanegashima in May with all experiment red-tag items removed, ready for flight. (Photo credit: NRL)*

It is apparent that the complex scheduling associated with ISS maneuvers, crew activities, and spacecraft dockings will require a great deal of flexibility for experiment commissioning and science operations.

After launch, the HTV will perform several days of test maneuvers near the ISS prior to docking. Astronauts will first unload the pressurized cargo section. Then, astronauts will use the SSRMS and JEM-RMS robotic arms to transfer the Experiment Pallet and install the payloads through a complex sequence of activities. RAIDS installation is planned for mission day 13, approximately September 23, and its companion payload SMILES the following day.

Immediately after installation, HREP and RAIDS will be powered for health and status monitoring. RAIDS will perform dark count noise characterization, deployment, scan mechanism tests, first light, and initial airglow surveys during a 17 day checkout. However, due to planned spacecraft dockings during this period, we anticipate additional delays for instrument safing during ISS maneuvers. Check-out could stretch out up to 30 days after initial power-up.

We prefer to maintain a more aggressive schedule, because in mid-November the Russian Mini Research Module is expected to deploy just outside the RAIDS field-of-view. This module could pose a glint or scattered light risk for the RAIDS NIR/visible sensors.

## Initial Science Operations

Following checkout, initial science operations will consist of full spectral scans by the spectrometers at five altitudes: 115, 125, 135, 150, and 180 km with a roughly 180-sec cadence. These measurements will take place over 30 days to allow orbital precession through 12 hours of local time (excluding shutdown periods for sun-safing or ISS docking activities).

Using the full spectral scans of the spectrometers will allow cross-calibration of the 765 nm photometer response with the NIR spectrum. These data may serendipitously address our chemistry goals. The goal is to achieve the minimum mission success criteria quickly, before routine science operations focus upon monochromatic NIR limb scans.

## Viewing HTV-1 Launch

Due to very limited invitations for this inaugural launch of the HTV system, none of the US experiment teams will attend the the launch in Japan. NASA television will provide live coverage of the event. Coverage begins Thursday, Sep. 10 at 12:45 EDT on the NASA Public and Media television channels.

NASA TV will cover the manipulator arm activities of HTV capture and EP transfer. STP is arranging for e ISS video coverage of the RAIDS deployment.



*Figure 4: Launch of an H-IIA from the Yoshinobu launch complex at Tanegashima Space Center. (Photo credit: JAXA)*



Figure 5: The RAIDS team polo shirt stylishly proclaims "I'm a space nerd."

## RAIDS Collectibles

We have ordered navy blue cotton polo shirts with embroidered RAIDS experiment logos. They came out well, and we are preparing a second order (by popular demand!). The shirts cost \$25; if you are interested contact Scott Budzien.

We are investigating ordering coffee mugs with the RAIDS experiment logo in the near future.

## Information Resources

JAXA ISS HTV Information Site (English) includes some basic information on-line and a nice press-kit: <http://iss.jaxa.jp/en/htv/index.html>

JAXA HTV website (English) [http://www.jaxa.jp/projects/rockets/htv/index\\_e.html](http://www.jaxa.jp/projects/rockets/htv/index_e.html)

JAXA HTV/H-IIB website for countdown [http://www.jaxa.jp/countdown/h2bf1/index\\_e.html](http://www.jaxa.jp/countdown/h2bf1/index_e.html)

JAXA HTV/H-IIB Photo Gallery [http://jda.jaxa.jp/jda/p2\\_e.php?genre=1](http://jda.jaxa.jp/jda/p2_e.php?genre=1)

JAXA H-IIB/HTV mission video (in Japanese) <http://www.youtube.com/watch?v=QuMQXjwHg6c>

RAIDS public website (NRL approval pending) <https://raids.nrl.navy.mil/>

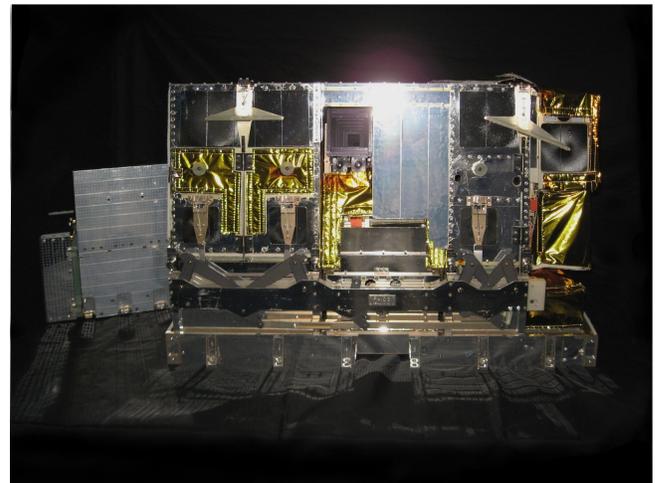
RAIDS Instrument and Science Team website and wiki. Contact Scott Budzien for access. <https://raids.nrl.navy.mil/team/>

NASA TV information and web video <http://www.nasa.gov/multimedia/nasatv/index.html>

## Science Team Meeting

After we have assessed the performance of the RAIDS hardware during checkout—possibly after the first several days of initial science operations—we should have a RAIDS Science Team virtual meeting. This meeting, likely occur in late October, would provide an opportunity to distribute and discuss the initial science observations, to introduce existing data software tools, and to identifying additional data analysis and support needs. The meeting could also provide an opportunity to fine-tune the initial science operations mode, if necessary.

Meeting and telecon planning will be coordinated via email once the start date of initial science operations firms up.



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