
Hayabusa Status and Proximity Operation



As of September 2nd,
2005

What is Hayabusa?

World's First Round-trip Interplanetary Flight

“HAYABUSA” Challenge to Asteroid Sample Return

Dimensions

1.0m x 1.6m x 1.1m

Weight : 380kg(Dry)

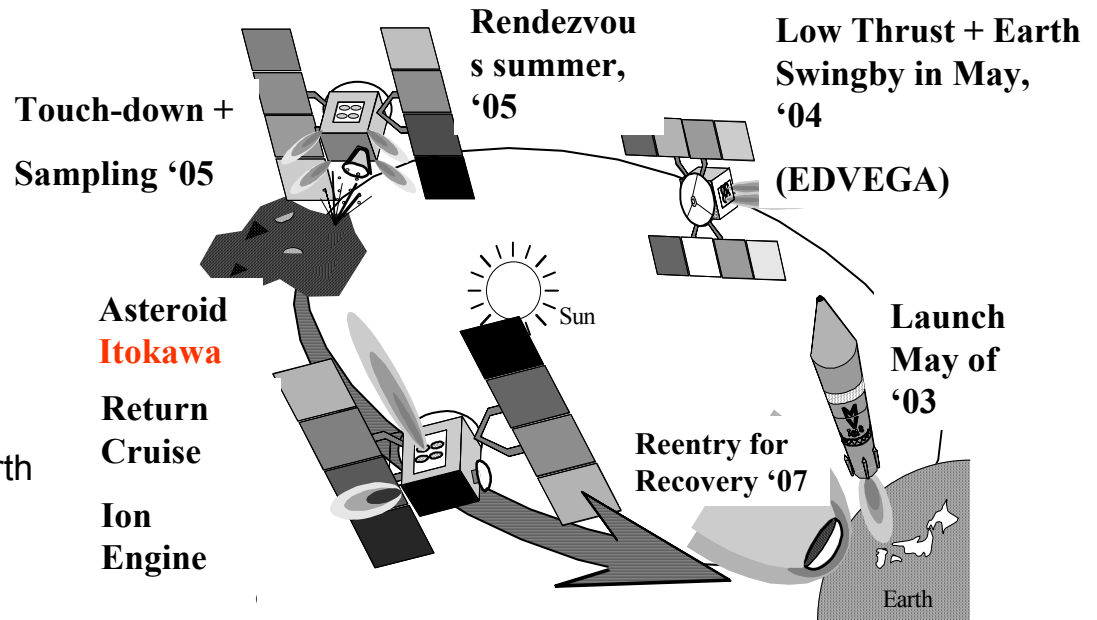
Chemical Fuel 70kg

Xe Propellant 60kg

Total 510kg

Electric Power : 2.6kW@Earth

Communication : X band



New Technology demonstrated in Hayabusa

Five Key Technology to be demonstrated :

1. Interplanetary Cruise via Ion Engines as Primary Propulsion
2. Autonomous Navigation and Guidance using Optical Measurement
3. Sample Collection from Asteroid Surface under Micro Gravity
4. Direct Reentry for Sample Recovery from Interplanetary Orbit
5. Combination of Low Thrust and Gravity Assist

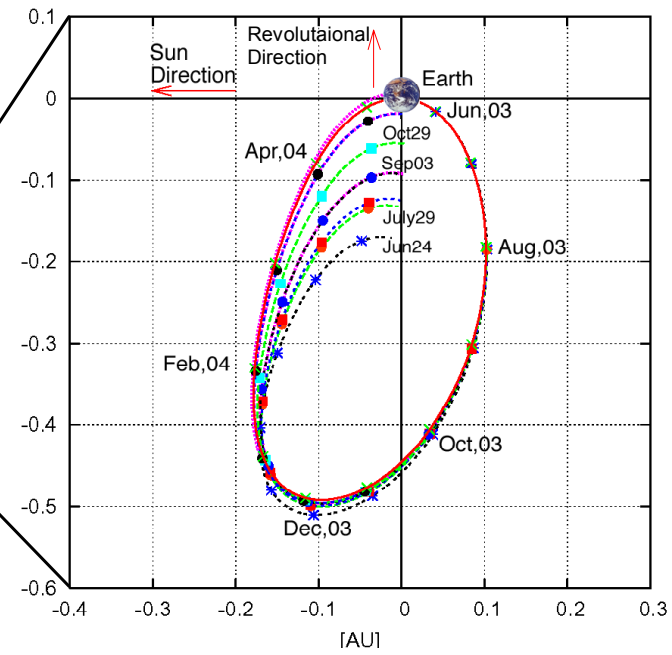
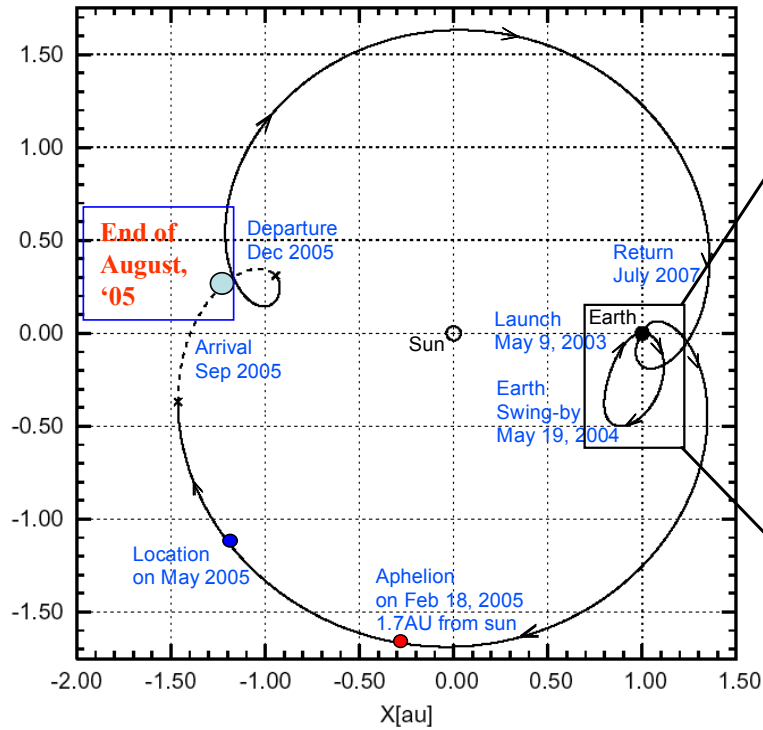
Other New Technology introduced :

Bi-Propellant Small Thrust Reaction Control System, X-band Up/Down Communication, Complete CCSDS Packet Telemetry, Duty Guaranteed Heater Control Electronics assuring Heater Power Constraint, Wheel Unloading via Ion Engines, PN-Code Ranging, Lithium Ion Re-chargeable Battery, Multi-Junction Solar Cell, etc.

Current Status of Hayabusa

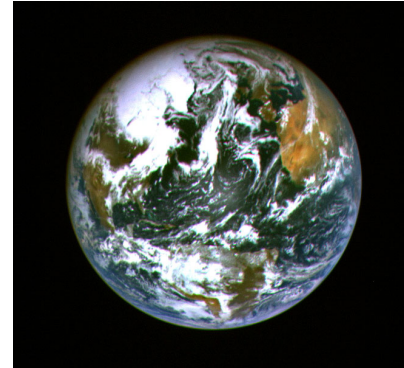
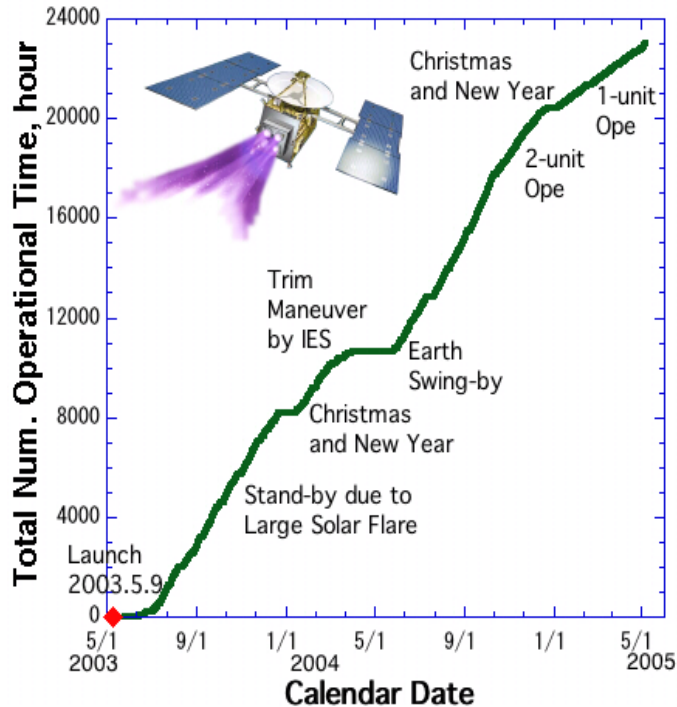
- Since the launch on May 9th of 2003, Hayabusa has flown toward the near Earth asteroid Itokawa, being propelled by ISAS proprietary ion engines, with the combination of Earth gravity assist.
- As of September 2nd in 2005, Hayabusa is about 1,500 km to Itokawa with 18 km/h.

Ion Engines Cruise & Earth Gravity Assist



Ion Engines Operation History + Earth Swing-by May 19, '04

As of Aug 28th, 2005
Operation: 26,000hour



17 hours prior to swing-by, Earth is photographed at the distance of 300,000 km. It is seen as full moon.

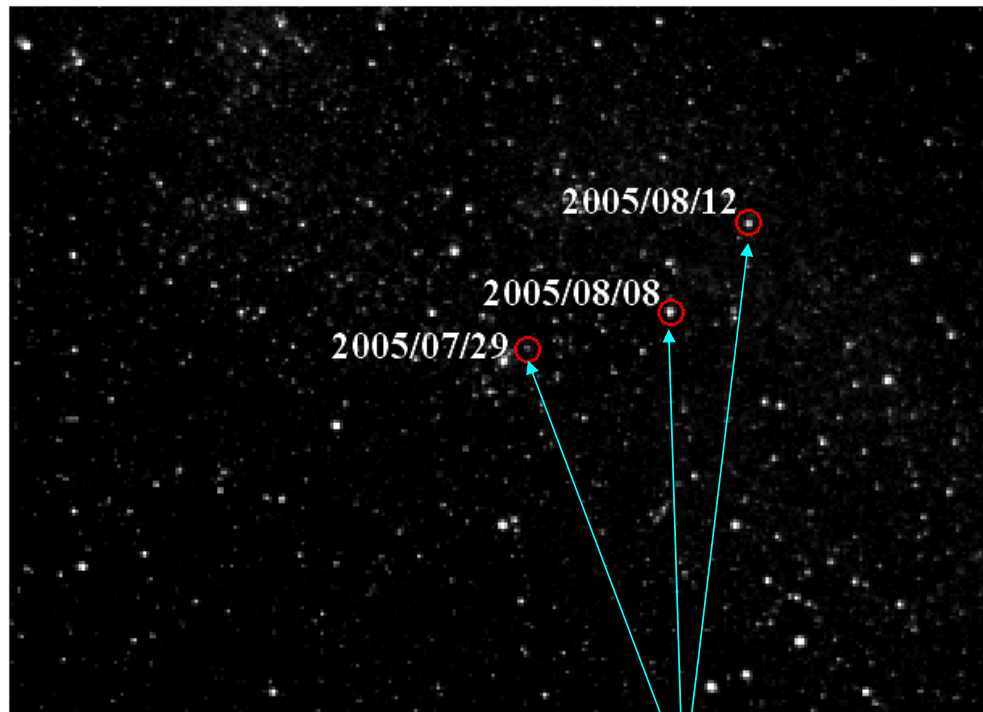


After swing-by, Earth is seen as half moon.

Imaging Itokawa 2005

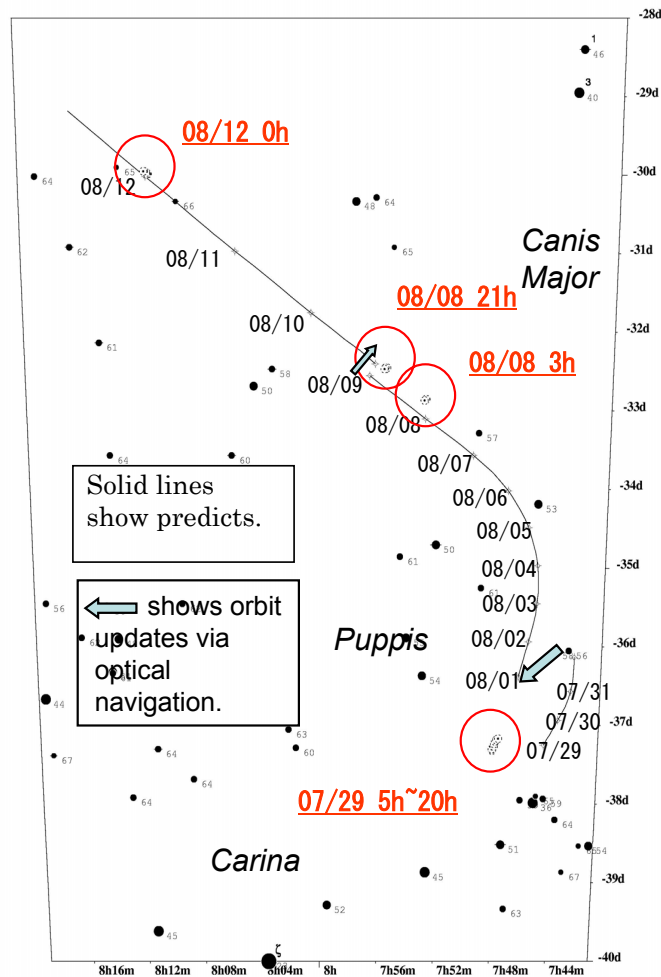
- July 29, 30th, August 8, 9th, August 12th, a series of Star Tracker Images were taken for the optical navigation.
- August 22, 23, August 29th, the onboard Optical Navigation Camera (ONC-T) successfully exposed Itokawa also for the optical navigation.
- Slow speed approach navigation was for the first time demonstrated successfully.

Star Tracker Images of Itokawa



Itokawa taken by Hayabusa

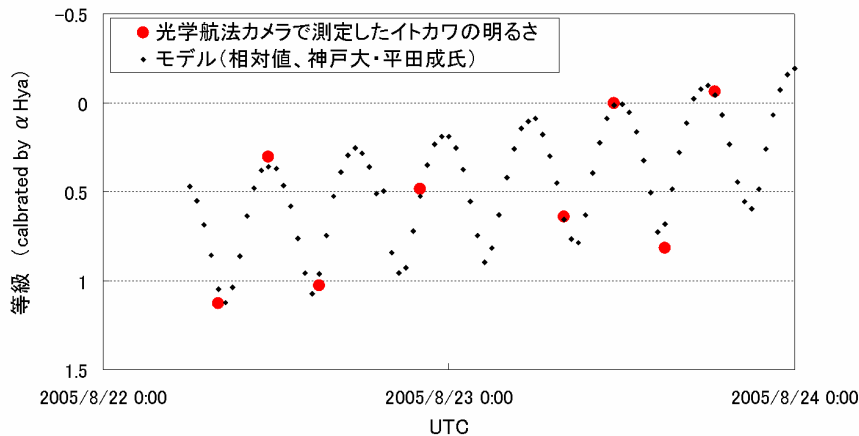
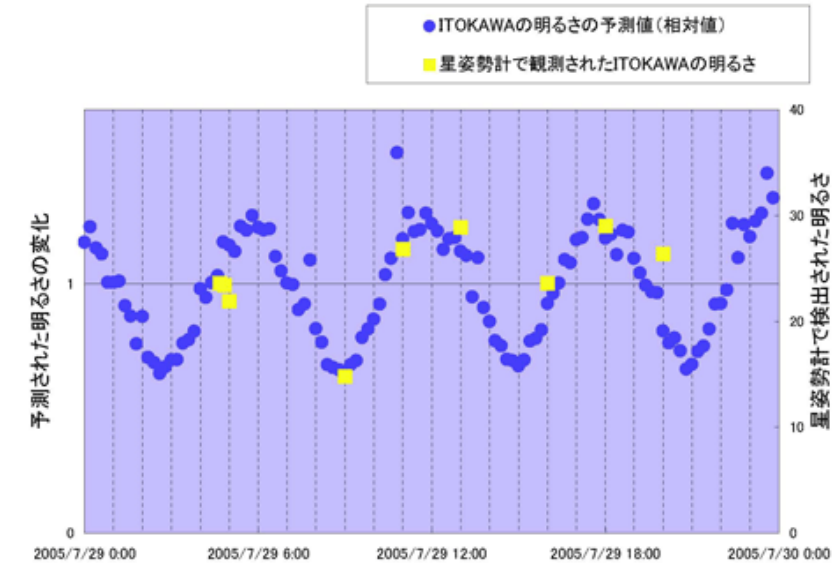
Itokawa against Stars



LEGEND: 8h,34d line: 8.0

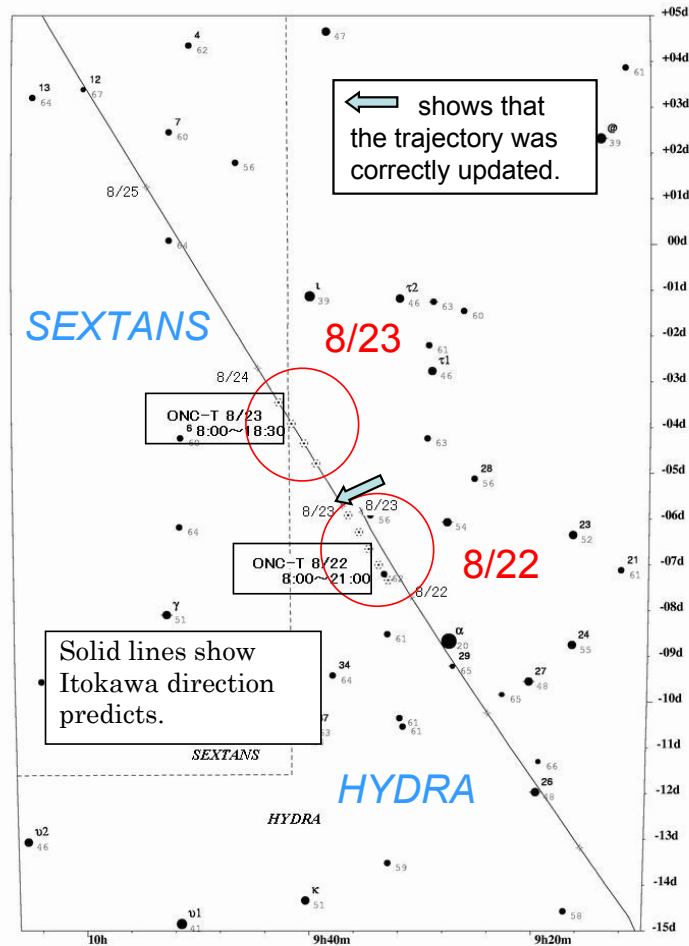
- Circles show Itokawa direction taken by Star Tracker aboard.
- Solid lines represent the Itokawa direction predicted prior to each imagery.

Light Curve of Itokawa



- Compares brightness with predict.
- Coincidence implies the object exposed should be Itokawa.

Itokawa loci exposed with optically navigated trajectory

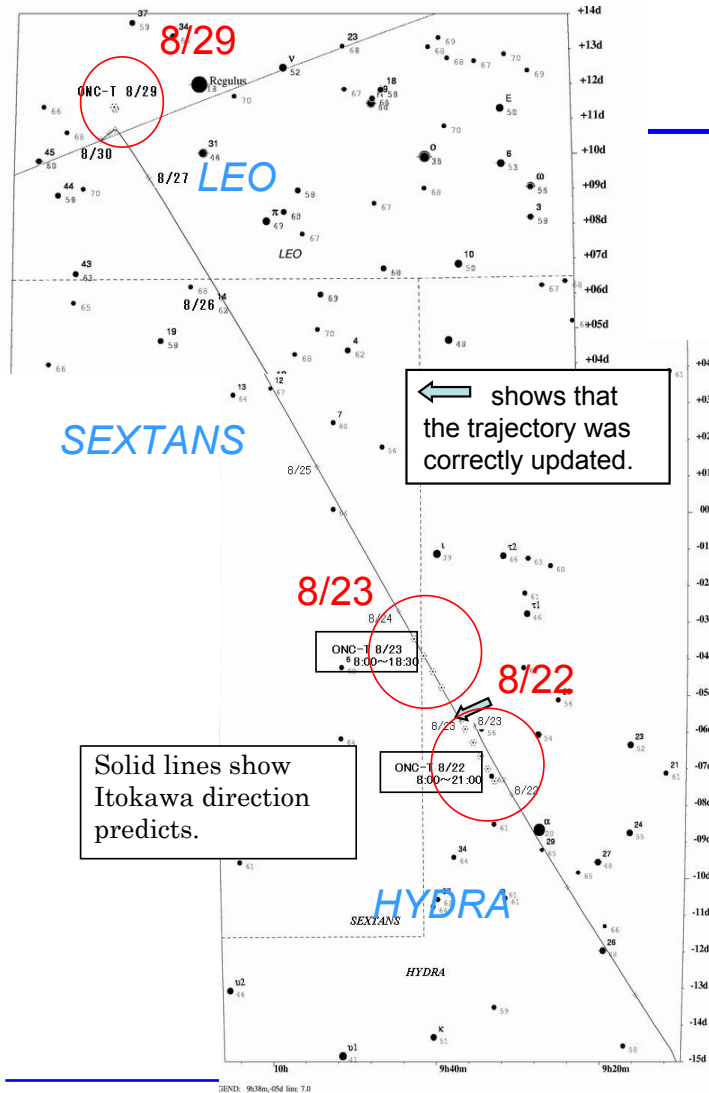


LEGEND: 9h38m, 05d lim: 7.0

2005/9/2

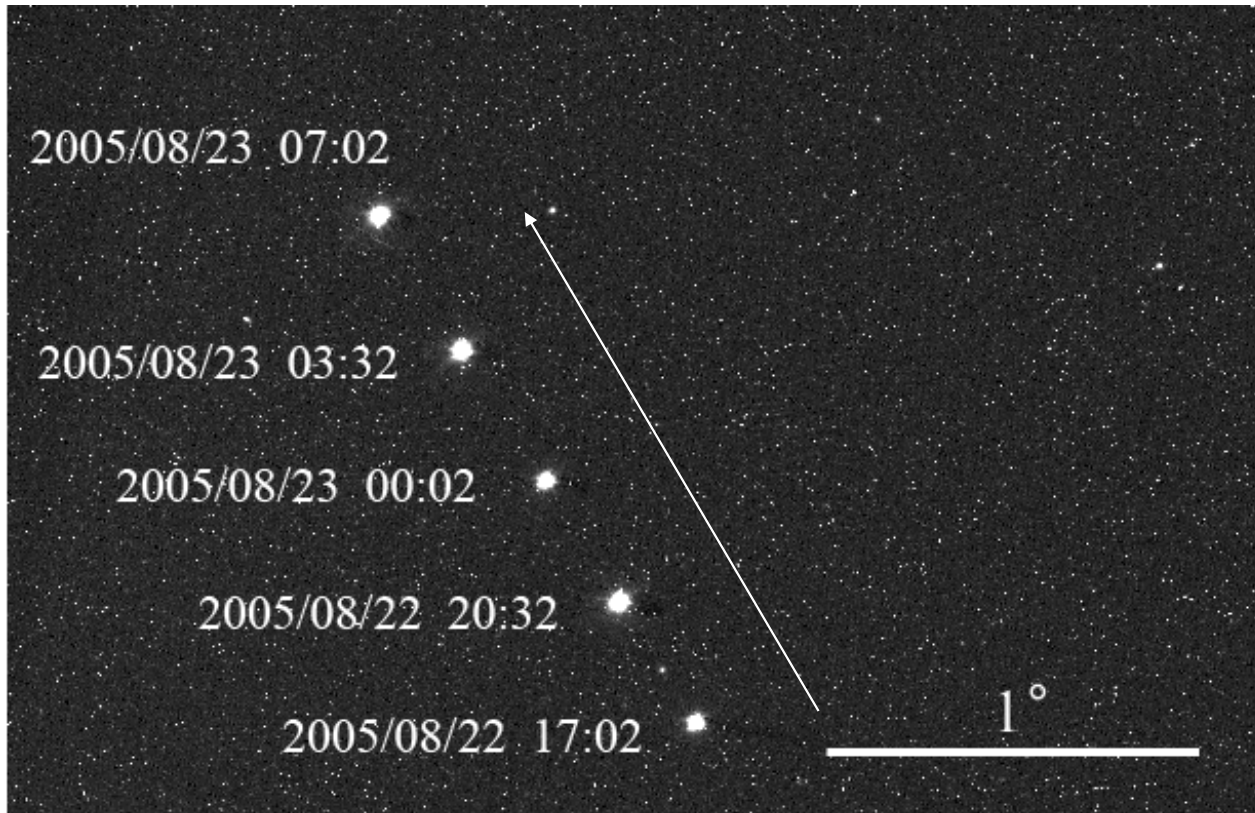
- Circles are Itokawa images taken by Telescopic Optical Navigation Camera (ONC-T).
- Solid lines are Itokawa loci predicted seen from Hayabusa. They were correctly updated, so that the 8/23 images could be on the predict.

Hayabusa Aug. 28th, 2005



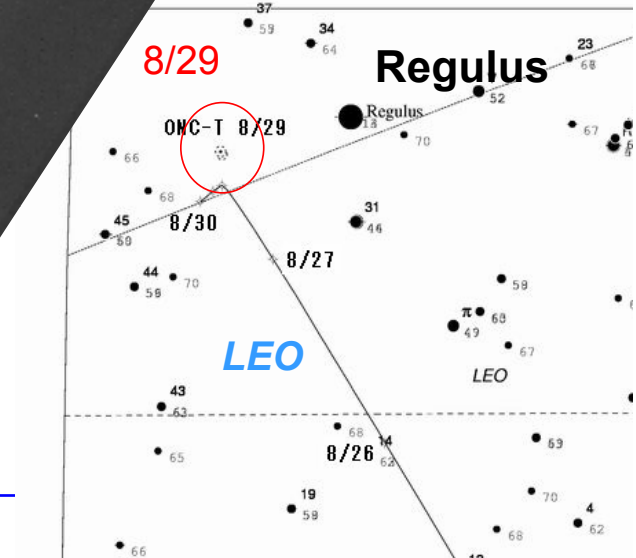
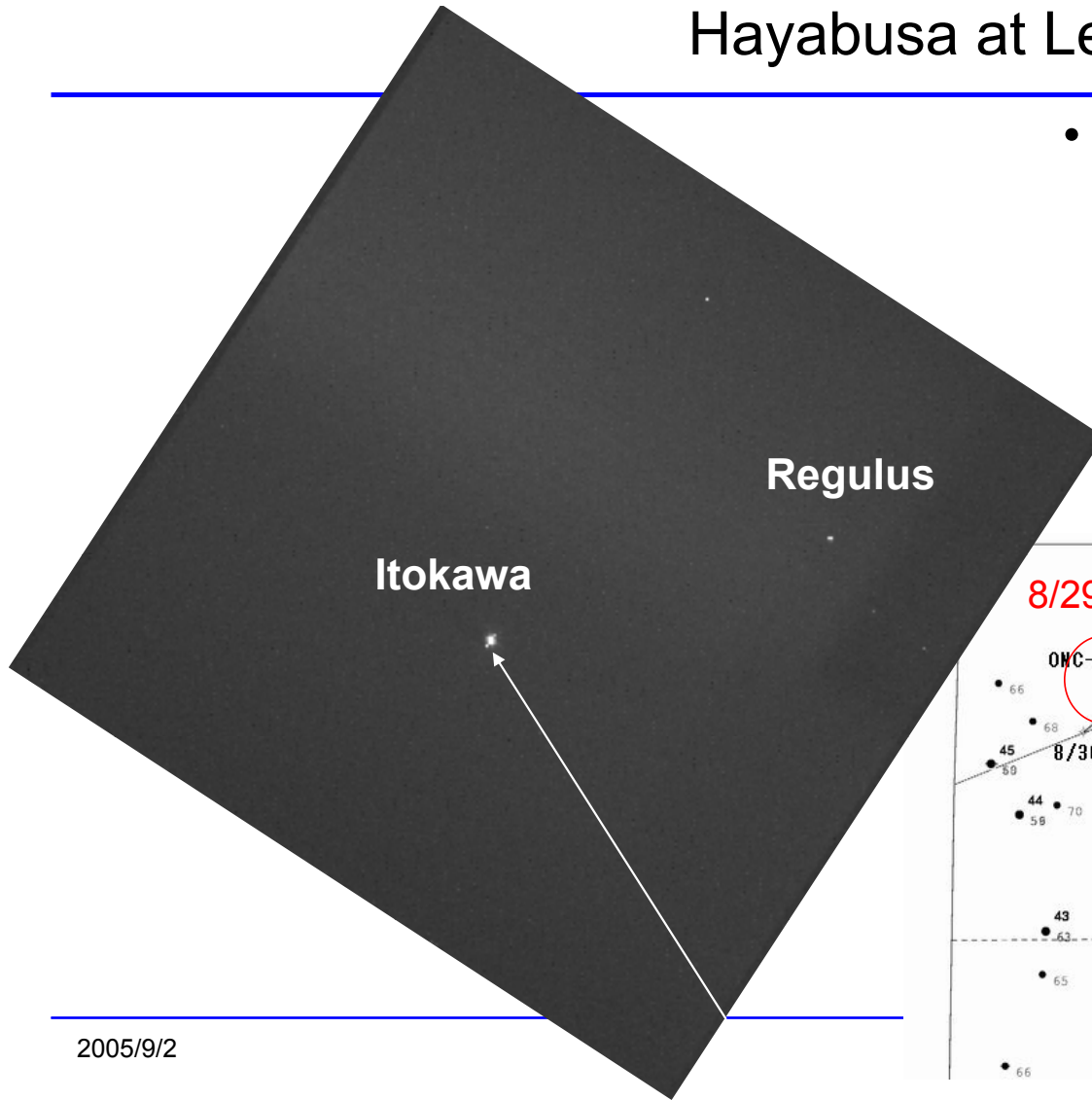
- Hayabusa stopped its ion engines operation on Aug. 28th, and is on the ecliptic plane now, approaching to Itokawa at the distance of 1,500km with 18 km/hour, as of September 2nd.

Itokawa moves in Hydra, taken by ONC-T aboard

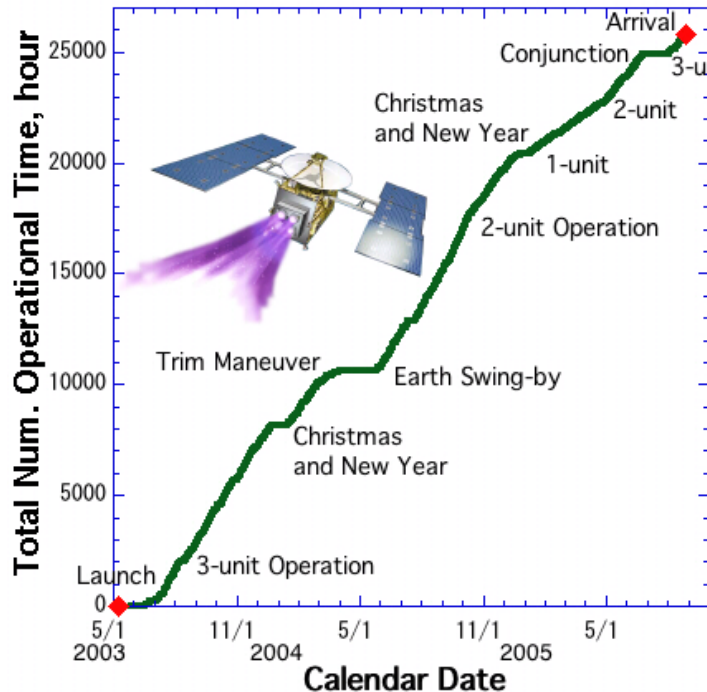


Hayabusa at Leo on Aug 29.

- Any bright star except the brightest Itokawa and Regulus is not exposed at the same time.



Ion Engines completed the Transfer Half of its Cruise



- After the solar conjunction, the microwave discharge ion engines were turned on again at the end of July and accelerated with their full throttling so as to approach to the target.
- For 25,800 hours, the total numbers of space operational time, the engines were driven to generate 1,400m/s delta-V with 22kg xenon propellant.

One Reaction Wheel was broken.

- At the end of July, one reaction wheel was broken. A number of exposures via Star Tracker and Optical Navigation Camera were still taken under the alternative 'Double-reaction-Wheel' attitude control mode.
- The Hayabusa AOCS is designed to accomplish the proximity operation including touching-down & sampling under that 'Double-reaction-Wheel' control.

Proximity Operation Ahead

- Hayabusa comes to 'still' to Itokawa in the middle of September.
- In October, Hayabusa performs a high phase angle observation.
- In November, one Rehearsal plus two Touching-down Samplings are scheduled.
- Early December, Hayabusa leaves Itokawa carrying sample toward Earth, returning it in June of 2007.



Target Marker



MINERVA