

Jim's news advisories on the return of the Hayabusa asteroid sampler probe

Sent: Monday, March 29, 2010 2:35 PM

Subject: Plucky Japanese Probe Nearly Home from Asteroid Odyssey

0. After taking a series of lickings, a still-tickling Japanese space probe which may (or may not) be carrying soil samples from a distant asteroid is due to make a midnight fireball landing in southern Australia about June 10. Nobody ever expected to see it get this far -- and it could yet fail in the final minutes of its seven year odyssey.

1. My 'Spectrum' magazine article on the imminent return to Earth of the asteroid-sampling Japanese 'Hayabusa' probe is on line here:

<http://spectrum.ieee.org/aerospace/robotic-exploration/bringing-back-a-piece-of-heaven>

2. General background on the probe can be found at Wikipedia. Its return to Earth has been delayed by a string of breakdowns and bad luck, but it's overcome them all, to the surprise and growing admiration of outside observers. Link: <http://en.wikipedia.org/wiki/Hayabusa>

3. Latest news from the Japanese space agency is that the probe has completed its ion engine thrusting to place it on a course that passes only several thousand miles above Earth's atmosphere. This last leg is shown here:

[http://www.jaxa.jp/press/2010/03/img/20100327\\_hayabusa.gif](http://www.jaxa.jp/press/2010/03/img/20100327_hayabusa.gif)

4. The next step was supposed to involve firing a small hydrazine-fuelled steering engine to gently edge the flight path lower and lower until it entered the narrow 'corridor' that could allow a safe atmospheric entry.

5. But now suspicions have been confirmed that the hydrazine tank is empty due to a fuel leak several years ago. Controllers will try to nudge the craft onto a safe course with the ion drive, but there is considerable skepticism that this will be possible. It's never been done before.

6. The probe may literally die at the doorstep of its home planet. An observation program has been organized -- it may see only its funeral pyre:

<http://airborne.seti.org/hayabusa/mission.html>

7. Following these recent developments has been made more difficult for well-wishing foreigners by the awkward English translations of some of the press releases.

8. Here is the English section of the press release archive:

<http://www.hayabusa.isas.jaxa.jp/e/index.html>

9. Another excellent source of information is the Planetary Society's blog -  
- for example, Nov. 19, 2009 // by Emily Lakdawalla

<http://www.planetary.org/blog/article/00002221/>

10. A good discussion group with well-informed contributors is here:  
<http://www.unmannedspaceflight.com/index.php?showtopic=1741&st=360>

11. I'll be monitoring. The steering over the next few weeks is critical.

12. When the June landing date arrives, if the fireball is spotted --  
midnight Oz time is mid-morning EST -- it will be visually dramatic and the  
suspense will last all the way to actually finding the parachute-borne  
capsule. If it ever is found.

April 21 Advisory:

Jim Oberg advises:

1. The Japanese Space Agency has revealed hitherto classified information  
on the exact flight plan of its Hayabusa probe, now in the final weeks of its  
seven year odyssey to snatch samples of an asteroid. See

<http://en.wikipedia.org/wiki/Hayabusa>

2. The probe has been bedeviled by half a dozen major hardware failures,  
any one of which might have been adequate to destroy all hope of a  
successful return. But in the greatest space rescue since Apollo-13, flight  
control engineers in Japan developed tricks to overcome each problem.

3. We've been watching this mission with bated breath for years. In 2005  
I wrote (<http://www.msnbc.msn.com/id/10400707/>), "Somewhere beyond  
the far side of the Sun, a battered Japanese space probe is struggling to make  
its critical condition clear to controllers back on Earth so they can diagnose  
the latest problems, develop another set of 'work-around' procedures and  
implement them by remote control. The project's goal, to return from a  
years-long interplanetary odyssey with samples from an asteroid, has been  
teetering on the edge of failure for most of the trip, but the Japanese control  
team has always been able to work something out before."

4. My most recent news story on it is here: "Bringing Back a Piece of  
Heaven" "23 March 2010—A small, severely damaged spacecraft named  
Hayabusa is limping back to Earth with a jury-rigged ion drive that would  
have made Star Trek's Scotty proud. Already seven years into its planned  
five-year mission to retrieve soil samples from an asteroid, the probe faces  
one last round of hazards before its midnight landing in Australia sometime  
in June with a sample canister."

5. Several serious problems await the final fiery descent to Earth and the  
odds are still against the probe's safe landing and recovery. But the efforts so  
far are inspirational – especially in light of President Obama's announcement

last week that a round trip to an asteroid will be the next big step for American astronauts.

6. A Japanese-language press release has just disclosed that the landing will occur, if all goes well, on June 13 (a Sunday) about 14:00 GMT (11 PM Japan time). The midnight landing was chosen so the landing point is rotating AWAY from the probe and not towards it, which would have increased entry velocity significantly.

7. The Japanese-language JAXA release is here:

[http://www.jaxa.jp/press/2010/04/20100421\\_hayabusa\\_j.html](http://www.jaxa.jp/press/2010/04/20100421_hayabusa_j.html)

8. The press release (not as yet translated into English) also confirms that the landing will be in the Woomera desert "prohibited area". A number of genuine concerns with security and with native rights organizations have kept JAXA from confirming this long-suspected region's selection, until today.

9. Overnight, the Australian Defence ministry also released a bulletin confirming its role in the recovery. The bulletin is here:

<http://www.minister.defence.gov.au/Faulknertpl.cfm?CurrentId=10170>

10. According to the statement, "the Woomera Prohibited Area (WPA) in outback South Australia... is managed by the Department of Defence and is the largest land-based test range in the world."

11. JAXA has also in the last 24 hours initiated an English-language twitter feed about the progress of the probe. The link is here:

<http://www.isas.jaxa.jp/home/hayabusa-live/?catid=34&blogid=6>

12. As of this morning the probe was 13 million miles from Earth and approaching at a rate of about 9000 miles per hour. As it falls into Earth's gravity field in its final hours it will speed up to more than 30,000 miles per hour.

13. The tweet adds that the probe is currently located in the constellation Gemini, but it is of course totally invisible from Earth. Viewed in the night sky over North America, that region is a bit west of directly overhead (and just below the half moon) tonight. But that will change night by night.

14. The schedule between now and landing is as follows.

"TCM" means "Trajectory Correction Maneuver" -- see para 13C

May 5 -- TCM-1 39 days before reentry, 17 million km from the Earth

May 29 -- TCM-2 15 days before reentry, 9 million km

June 6 -- TCM-3 seven days before reentry, 3 million km

June 10 -- TCM-4 three days before reentry, 2 million km

June 12 -- Capsule warming ... one day before reentry, 40,000 km away.

June 13 -- Capsule separation ... three hours before reentry

June 13 -- Capsule landing ... one hour after reentry

15. A summary of the problems this probe has faced, and is still facing, is real scary. Here's my summary:

15A. The course correction engines are out of hydrazine (it all leaked out) BUT adjustments being made by ion engines instead...

15B. ... BUT ion engines are electrically powered and can only fire when solar panels are near to perpendicular to sun....

15C. Four ion engines, and three of them have failed, but two failed units have each different components still workable, so they are used in combination to simulate a non-failed engine.

15D. Attitude control -- three gyroscopes, but two have failed. Remaining gyro used in combination with photon pressure on solar arrays as 'sails' (or as a 'space weather vane').

15E. Capsule radio beacon battery -- probably failed. No signal expected, BUT landing zone is Australian aborigine preserve and their scouts will be out to listen and sniff for the fall of the capsule.

15F. Capsule recovery parachute is radar reflective -- IF it deploys -- and mechanical baro -switch probably WILL trigger small pyro. If not, it crashes to Earth.

16. NASA is supporting this mission with precision tracking from the Goldstone antennas in California.

17. The plan is to lower the fly-by range into the edge of the atmosphere just barely. If something goes wrong and the probe veers off course into Earth, it has a 'suicide plan' to release the remaining ion drive propellant (xenon gas) to push it totally clear of Earth impact.

18. And this all may be for naught. The sample container -- supposed to hold dirt from the asteroid Itokawa -- actually has unknown contents, if any. The sampling unit did not report back on its functioning during two asteroid landings, so it may not have worked. However, the open canister mouth MAY have dislodged soil into the canister.

19. The space drama heightens. The thought that US astronauts will be trying this in the future -- on a much faster trajectory, of course -- also makes the current mission a potential precursor to some of our own.

June 13 advisory

1. The Japanese Hayabusa ("Falcon") probe returning after a seven year voyage to an asteroid is to land in Australia at about 10 AM EDT Sunday.

2. Visuals will be limited, and it may take considerable time to locate the capsule. Its operators suspect that the radio beacon's batteries may have died.

3. The disc-shaped landing capsule is about the same diameter as a car steering wheel. Its parachutes will be deployed by a mechanical air pressure sensor that ought to work, but even if not, it would probably survive direct impact with the ground.

4. Finding it is another matter, and the Japanese-Australian team has deployed hi-tech sensors to track its exact descent path and pinpoint where it should reach the ground.

5. To assist them, a team of Australian aborigine wilderness scouts will also search the target area on foot. They believe the best way to track down the scorched landed capsule is to smell it, and that sensor has worked for their people for maybe 50,000 years, so there's a good chance if all hi-tech fails, the ground searchers will succeed.

6. Complicating the visual tracking from a NASA airplane, and the ground radar tracking, is that the main spacecraft 'bus' will hit the atmosphere only about half a mile behind the capsule. It was planned for the 'bus' to fire thrusters to create a much greater separation but those thrusters, like so many other systems on the Hayabusa, broke down during its epic voyage.

7. So tracking will be complicated by nearby debris that wasn't supposed to be so close.

8. To repeat: while it now seems a good bet that the probe is on the planned descent path and will enter Earth's atmosphere where expected, finding it on the ground may take awhile.

9. In the absence of good real-time imagery, some stock footage from the Japanese space Agency (JAXA) can be used.

10. 'Hayabusa' is Japanese for 'falcon', and here's a cartoon of the battered bird limping courageously homeward:

[http://www.jspec.jaxa.jp/activity/images/hayabusa/pic\\_31.jpg](http://www.jspec.jaxa.jp/activity/images/hayabusa/pic_31.jpg)

11. Most insightful coverage of Hayabusa landing -- here:  
<http://planetary.org/blog/>

12. Second best informed discussions -- here:  
<http://forum.nasaspaceflight.com/index.php?topic=7382.45>

13. Graph [humorous] of up-down observer morale throughout Hayabusa mission:

<http://www.unmannedspaceflight.com/index.php?act=attach&type=post&id=21862>

14. Official website: <http://www.isas.jaxa.jp/e/topics/2010/0609.shtml>

15. And check out these Hayabusa \*animes\*  
<http://www.youtube.com/watch?v=fjJVC7LgMIw>  
<http://www.youtube.com/watch?v=WDhiLMTq1SI>

16. I will be available for call in through 2 PM EDT today and for

Skype webcam from my home office soon after that.

17. This is an epic voyage of interplanetary endurance.

18. As such, it is a pioneer for the astronaut-to-asteroid mission that the new White House space plan wants to perform in the mid-2020's in place of Constellation Project.

19. Such a mission would last about a year, using more powerful ion engines.

20. But it would also need the tenacity and ingenuity demonstrated by this plucky probe and its never-say-die operators back on Earth.

June 13 advisory 2

1. My cautious comments about lowering expectations for quick access to great pictures of the probe landing -- were much too pessimistic.

2. Fireball entry from NASA plane:

at <http://airborne.seti.org/hayabusa/index.html>

Hi def vid to be posted on the Ames Research web site soon.

3. Latest news linked here, including ground video of fireball:

<http://planetary.org/blog/>

4. Photo of capsule on the ground from helo, with floodlight:

[http://www.jaxa.jp/press/2010/06/20100614\\_hayabusa4\\_j.html](http://www.jaxa.jp/press/2010/06/20100614_hayabusa4_j.html)

5. Cropped press photo:

<http://www.yomiuri.co.jp/zoom/20100614-OYT9I00298.htm>

6. Now that daylight has arrived, two NASA scientists (including Michael Zolensky) are tasked with approaching the capsule and verifying it is not cracked open -- i.e., verify that the sample containment canister is sealed safely.

7. If the Andromeda Strain is not loose, and the two guys don't die horribly, the canister can be picked up by a Japanese team after aborigine tribal elders verify that there was no defilement of ancestral artifacts.

8. The photo clearly shows the capsule undamaged.

9. Had it crashed or otherwise shown structural failure, the Aussies had prepared some biocidal chemical sprays to douse the area -- and in the process contaminate any samples. But that doesn't look necessary.

PS: Two earlier NASA probes returned dust and solar wind samples from interplanetary space -- my earlier comment (#17) meant to say this is the first return from the surface of a physical object beyond the moon.