

## **Moving Beyond the Loss of X-Ray Astronomy Satellite ASTRO-H (“Hitomi”)**

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JAXA made a difficult decision on April 28 to abandon ASTRO-H operations. Having to abandon the satellite without making any full-scale observations was extremely regrettable for those who had been involved in the development of this satellite for many years in both Japan and the United States, and for researchers around the world who were expecting much from ASTRO-H. We were unable to answer the expectations of the people and the government in the arena of space science and exploration, and the burden of responsibility for this lies heavily on the Institute of Space and Astronautical Science (ISAS).

I, as the Director General of this organization, personally feel a deep responsibility for this turn of events and have been exerting all possible effort throughout our organization to analyze what went wrong and what can be done to prevent this from happening in the future.

Based on the anomaly experienced with ASTRO-H, I decided on the following four actions.

- (1) Even if it results in pain for ISAS, we will find all technical and program-related causes ourselves
- (2) Improve development structure for ISAS scientific satellites and probes
- (3) Resume the pursuit of the scientific objectives of the ASTRO-H mission
- (4) Maintain the partnership with NASA and ESA

While I thought it may prove difficult to identify the causes, investigations proceeded at a fast pace. This was due to two things: the teamwork between ISAS and other JAXA departments, and the willingness of the project team and manufacturers involved in this mission to voluntarily disclose information, even if it cast an unfavorable light on themselves.

“Hitomi Experience Report: Investigation of Anomalies Affecting the X-ray Astronomy Satellite “Hitomi” (ASTRO-H)” indicates the high level of teamwork, technical ability and morals of those involved in this mission, and it is within this that I can see a viable bud of revival.

The following four reforms were proposed in this report.

- (1) Overhaul of project management structure within ISAS
- (2) Clarification of division of roles and responsibilities between ISAS and corporations
- (3) Thorough documentation and quality records
- (4) Thorough screenings and reviews

What can be understood from the report is that “the simplest and most obvious things were not done properly”. As such, what I would like to stress here is that the recommended reforms are action items to ensure that “the simplest and most obvious things are thoroughly carried out”.

The Soft X-ray Spectrometer (SXS), jointly developed by Japan and the United States, along with the Hard X-ray Imager and Soft Gamma-ray Detector newly developed in Japan, were all functioning normally and had started to collect some amazing data. The anomaly experienced was the result of inappropriate operations and within the standard part of the satellite itself and was not due to the deterioration of ISAS technology. The failure was within basic operations.

This had already been pointed out in the 2015 New Year’s Edition of ISAS News, and the recommendations prescribed in the report are doable.

Discussions are being conducted, predominantly with project managers within ISAS, on how to make the content of the report into reality and establish an “Action Plan for Reforming the Institute of Space and Astronautical Science Based on the Anomaly Experienced by Hitomi” (as of June 2016). The Action Plan will be applied to other projects, such as SLIM, and a PDCA cycle established, so as to further refine and polish both current and future endeavors.

Excerpt from “*New Year Message*”, *January 2015 Edition of ISAS News*

*However, we cannot simply be too optimistic about ISAS’s future. The reason being that there have been a number of failures over the last decade or so within our work.*

*We were forced to suspend the development of both LUNAR-A (lunar probe) and ASTRO-G (radio astronomical satellite). Neither “Nozomi” (Mars) nor*

*“Akatsuki” (Venus) successfully entered orbits around their respective planets. Propulsion and electrical system issues were the cause for these failures, but these were not necessarily challenging elements of the missions. In more recently developed missions, there have been issues with huge cost increases and schedule delays.*

*What we need to learn from these experiences is that there have been many issues, which require improvement, lurking within the way we have done things in the past. To put it the other way round, if we can solve these issues and implement self-reform, then ISAS can once again make giant leaps forward.*

NASA positions x-ray astronomy as an important research field. However, as NASA does not have a satellite mission dedicated to spectroscopy of high energy resolution. One of its basic strategies has been to develop America’s x-ray astronomy field via international cooperation with ISAS/JAXA.

International expectation toward SXS, jointly developed by the United States and Japan in accordance with this strategy, was extremely high. ESA had also been closely watching and expecting much from ASTRO-H as an academic and technical pacemaker for ATHENA, its L (large)-class x-ray observatory mission (scheduled for launch in around 2028). As such, the strategic medium-class mission by ISAS/JAXA had been firmly incorporated into the scientific roadmap of numerous space organizations around the world. This is not limited to just x-ray astronomy.

Results from initial observations conducted by the SXS on ASTRO-H have been amazing. The implementation of the above reforms, followed by the quick resumption of the pursuit of the ASTRO-H mission’s scientific objectives via the x-ray astronomy community and ISAS working together, is the only way that we can rebuild relationships of trust within international cooperation.

This will need to be done within the framework of the budget prescribed in the new “Basic Plan on Space Policy” and the impact on other space science and exploration missions must be kept to a minimum.

In order to achieve this, when formulating subsequent missions, we need to be thinking about getting maximum academic result from minimum funding (an

increase in funding to deal with recommended reforms must also be considered), while working closely with the space science community so as to minimize the impact on missions already underway or in the planning.

NASA (John M. Grunsfeld, former Associate Administrator for the Science Mission Directorate; Geoff Yoder, Acting Associate Administrator for the Science Mission Directorate) has repeatedly made the following comment: “We appreciate the openness and transparency that our JAXA colleagues have shown. From our standpoint, we look forward to working with JAXA on future scientific satellite and probe programs. We highly evaluate our partnership with JAXA to date.”

We should not flinch in the face of this failure but continue to intrepidly move forward with missions that are either already underway or in the planning.

At that time, ISAS should not stand isolated working on space science alone within JAXA, but rather leverage the overall capacity and teamwork of JAXA, the propelling force behind JAXA space science and JAXA exploration and something which has been highlighted during the investigation of this mission.

It is my sincere desire that this Action Plan enables us to work with others involved in space science, both within and outside our organization, to build innovative execution methods and operation systems for space science projects, to maintain our capacity to work with and present mission concepts that provide attractive science to global academia, and to build highly trustworthy and safe systems.