

Summary of XRSIG Telecon: Response to the loss of Hitomi

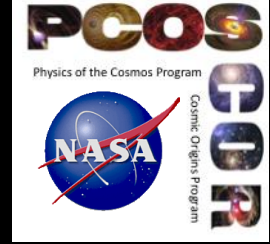
June 8, 2016

Note:

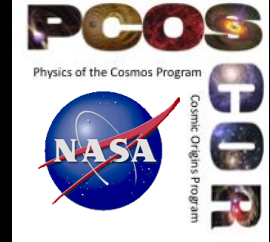
75 X-ray Science Interest Group members participated in this telecon via WebEx. Others participated by telephone only. The XRSIG thanks Rich Kelley & Paul Hertz for their presentations.

Summary prepared by C. Grant, R. Kraft & M. Bautz

Agenda



- Rich Kelley: Hitomi results & SXS performance
- Paul Hertz: Q &A on NASA's perspective
- All: Discussion



Rich Kelley: Results from the Hitomi SXS micro-calorimeter

Instrument Performance

- SXS operated as expected on orbit, exceeding requirements:
 - Spectral resolution FWHM < 5 eV on all pixels
- Calorimeter was ready to operate ~ 1 week after launch
- Filter wheel calibrations taken after Perseus observations
- Able to retro-calibrate Perseus data using ^{55}Fe as instrument was near equilibrium

Rich Kelley: Preliminary results from Hitomi observations of Perseus*

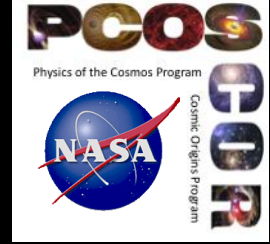


- SXS observed the Perseus cluster four times
 - Be filter in closed gate valve; no throughput $E < 2$ keV;
 - Gate valve transmission $< 50\%$ at 6 keV
 - Cluster center at SE corner of $3' \times 3'$ FOV
 - 22,000 source counts in Fe XXV He- α line complex, 16 bkd cts
- Spectrum around Fe XXV He- α lines:
 - Line widths are small ($\sigma_{1D} < 200$ km s^{-1}) \rightarrow turbulence is low
 - Bulk shear velocity across FOV ~ 150 km s^{-1}
 - Energy in turbulence is only 4% of thermal energy of gas \rightarrow supports reliability of ('hydrostatic') X-ray mass estimates
 - SPEX and APEC poor fits to data \rightarrow resonant scattering is likely important

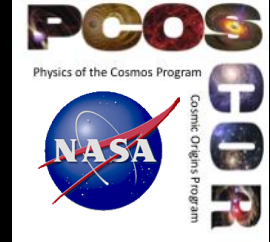
*See Hitomi Collaboration 2016, Nature, accepted

X-ray SIG Telecon 8 June 2016

Advance Questions for NASA from XRSIG



1. Is NASA currently considering an X-ray calorimeter recovery mission (hereafter 'recovery mission')? If so, please describe the process by which decision on a recovery mission would be made; if not, under what circumstances might NASA consider such a mission?
2. Has NASA had any formal communication with JAXA about a recovery mission?
3. Would NASA consider participation in a JAXA-led recovery mission? Would NASA consider a NASA-led recovery mission?
4. If NASA were to consider a recovery mission, would the recovery mission have any (funding, schedule or other programmatic) impact on:
 - a. Explorer missions now in development; or
 - b. Explorer missions now in concept study phase; or
 - c. Explorer missions that might be proposed in response to the anticipated 2016 Explorer AO ?
5. Might a recovery mission be directed, rather than competed?
6. Please comment on the timeline for authorizing (formally starting) a recovery mission. That is, from a programmatic viewpoint, how soon could such a mission be started?



Notes on Paul Hertz's Response to Advance Questions

- Hitomi science remains a high priority; that is why mission was done in the first place. Makes sense to do a recovery mission before Athena. Does not make sense to re-fly Hitomi in Athena era.
- NASA complements JAXA for complete openness in Hitomi failure investigation.
- There are ongoing discussions between JAXA and NASA. It is too early to say if any recovery mission could be a JAXA-led or NASA-led
- No reason to expect increase in astrophysics budget. A recovery mission should be expected to come at the expense of something else.
- Timeline for moving forward is uncertain since there is no precedent. Must include Japanese colleagues at every step.

Notes on Q & A from the floor* (1/4)

- Q What was JAXA's post-Hitomi plan?
A. PH was aware of their plans and that they were looking at 2 classes of missions in astrophysics and other areas. Not sure how this affects their plans.
- Q Would Congress have to approve a recovery mission?
A: Yes – Congress would be a part of the approval process for any change in the NASA Astrophysics program and budget
- Q What was the cost of Hitomi to NASA?
A: PI budget for SXS was \$73M (RK); life-cycle cost including GO program was about \$150M
- Q Would NASA participation in a future JAXA-led mission be contingent on formally addressing issues that led to the Hitomi failure?
A: Just as when NASA has a failure, it commits to investigating a failure, can't imagine either JAXA or NASA would want to go forward unless we addressed all issues that might affect success
- Q Might a recovery mission have improved capabilities?
Q There is no mission, so can't answer. A re-build would be the fastest way and least expensive path, but obviously no decision on a recovery has been made.

* Answers from Paul Hertz (PH) unless specifically noted as from Rich Kelley (RK)

Notes on Q & A from the floor* (2/4)

Q To ensure broad appeal and benefit of a future recovery mission, might there be an early GO program with 1st light and calibration observations made public immediately?

A: Great question and suggestion; NASA would think about this if a recovery mission were to occur. It is important to maximize benefit to the entire community

Q Should a white paper be developed to present the science case for a recovery mission?

A: Hitomi had a very strong science case, and PH's personal opinion is that case is not diminished; indeed, early results (e.g., Perseus) strengthen the case. Any white paper input from the community emphasizing that Hitomi science is timely and important can only be helpful

* Answers from Paul Hertz (PH) unless specifically noted as from Rich Kelley (RK)

Notes on Q & A from the floor* (3/4)

Q What did Hitomi cost JAXA?

A: (RK) JAXA quotes about \$300M (RK) but there is no reason to assume JAXA does accounting in the same full-cost manner that NASA does.

Q How important is it to get expressions of support from outside the X-ray community?

A: It is very important. The Astrophysics Division needs to address and optimize the full astrophysics portfolio. If a re-flight impacts areas outside X-ray astronomy, then such support is important. and that is why PH hopes XRSIG will bring this matter to the PHYSPAG and PHYSPAG will bring it to the Astrophysics Subcommittee (APS). Expects this to be a topic at the next APS meeting in July, although by then it is very unlikely that there will be a specific plan to discuss.

* Answers from Paul Hertz (PH) unless specifically noted as from Rich Kelley (RK)

Notes on Q & A from the floor* (4/4)

Q What is the timescale for preparing a useful white paper or expression of support? Before July APS meeting?

A: Anything that comes in by July APS would be helpful. Another milestone is future budget submission to OMB this summer. PH believes all Americans should talk often to Congress about things that are important to them.

Q There are comprehensive white papers on the arXiv showing Hitomi science capability. Where do these fit in?

A: The most useful contribution from a new white paper would be to address the question: Is the science case for Hitomi still important, or have science priorities changed?

Q Is JAXA is envisioning a recovery mission as a single-instrument mission?

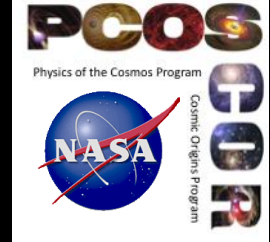
A: PH: can't speak to this; RK: it seems very likely JAXA would envision a reduced mission (compared with Hitomi).

* Answers from Paul Hertz (PH) unless specifically noted as from Rich Kelley (RK)

Summary of Community Discussion *

- There is consensus that the scientific case for a recovery mission is as strong or stronger than it was for Astro-H/Hitomi.
 - The XRSIG was invited to respond to Paul Hertz's request for a white paper on this issue.
- There is consensus that a recovery mission would have to be launched well in advance (~5 years) of Athena to be sensible.
- There is a great deal of community interest in understanding the viability, opportunity costs and scientific tradeoffs of a recovery mission.
- There is particular concern about the impact of a recovery mission on the Astrophysics Explorer program.

*See following slides for more detailed discussion notes



Notes on Community Discussion (1/3) (after Paul Hertz leaves meeting)

More questions for Rich Kelley

- Q: To what extent are SXS flight spares available? RK: To some extent, but don't have full complement. Japanese probably have relatively little.
- Q: How long would it take to rebuild SXS? RK: Instrument could be ready in 4-4.5 yrs.

Notes on Community Discussion (2/3)

Is the science of the recovery mission still interesting?

- Given plans for Athena, how soon must a recovery mission launch to be sensible? Consensus answer: at least five years before Athena. It was noted that Athena launch date (now envisioned as 2028) may change.
- Various expressions that the science case is now stronger than it was for the three previous attempts. Hitomi data set is far richer than any of the pre-launch simulations.
- Broad discussion of implication of flat budgets and merits of trading recovery mission for other future opportunities.
 - Concern that a recovery mission could affect future Explorer AOs.
 - In principle a Mission of Opportunity could be proposed to imminent Explorer AO, but this would seem to require existence of a planned Japanese mission

Notes on Community Discussion (3/3)

- Suggestion was made to construct recovery mission in shortest time possible with a direct rebuild of the XRS as the only science instrument. This minimizes the cost and risk and recovers the key science in the shortest possible timescale.
- It was noted that previous studies (e.g., X-ray Community Science Team) suggest cost of a US-led recovery mission may exceed \$0.5B and would likely come at some expense to the Explorer line. This cost trade-off should be thoroughly investigated.
- Alternatively, a JAXA-led mission would require less support from the US, but there is some concern about the timing of a MOO proposal. NASA could consider a supplemental MOO AO if the Japanese decide to lead a recovery mission.