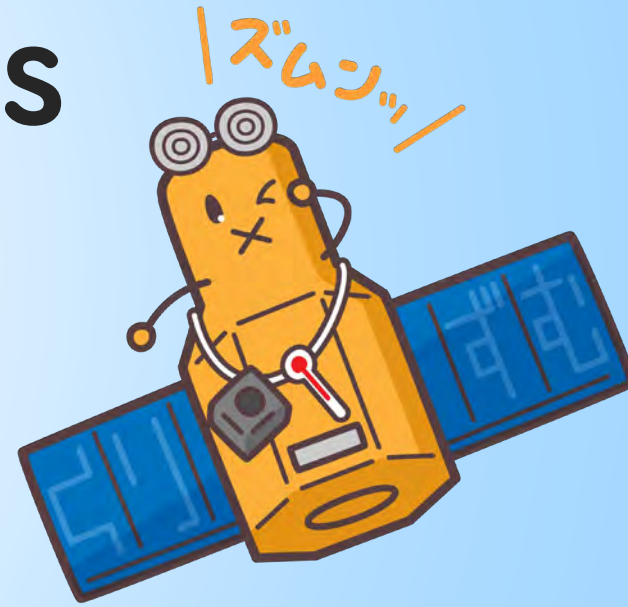
XRISM Science Operations detail and latest status



Yukikatsu Terada (Saitama Univ, JAXA),
On behalf of XRISM Science Operations Team

I. Introduction

Reference for XRISM Science Operations Activities

Science Operations (Ground Design & Flight Detail)

- Terada Y. et al "Detailed design of the science operations for the XRISM mission", JATIS 7, 037001.(2021) 10.1117/1.JATIS.7.3.037001
- Hayashi K. et al "In-orbit science operations for the X-Ray Imaging and Spectroscopy Mission", JATIS 11, 042017.(2025) 10.1117/1.JATIS.11.4.042017
- Terada Y. et al "Development of the Ground High-level Data Processing System for the Science Operations of XRISM", Journal of Space Science Informatics Japan 14, JAXA-RR-24-004 (2024) 10.20637/0002001694

→ This talk(Tue)

Science Operations Development

- Tsuboi Y. et al "XRISM/Xtend transient search: system design and results during the performance verification phase", JATIS 11, 042008.(2025) 10.1117/1.JATIS.11.4.042008 → See Presentation by Yoshimoto(Thu)
- Eguchi S. et al "XRISM pre-pipeline and Singularity: container-based data processing for the X-ray imaging and spectroscopy mission and high-performance computing", JATIS 11, 042013.(2025) 10.1117/1.JATIS.11.4.042013

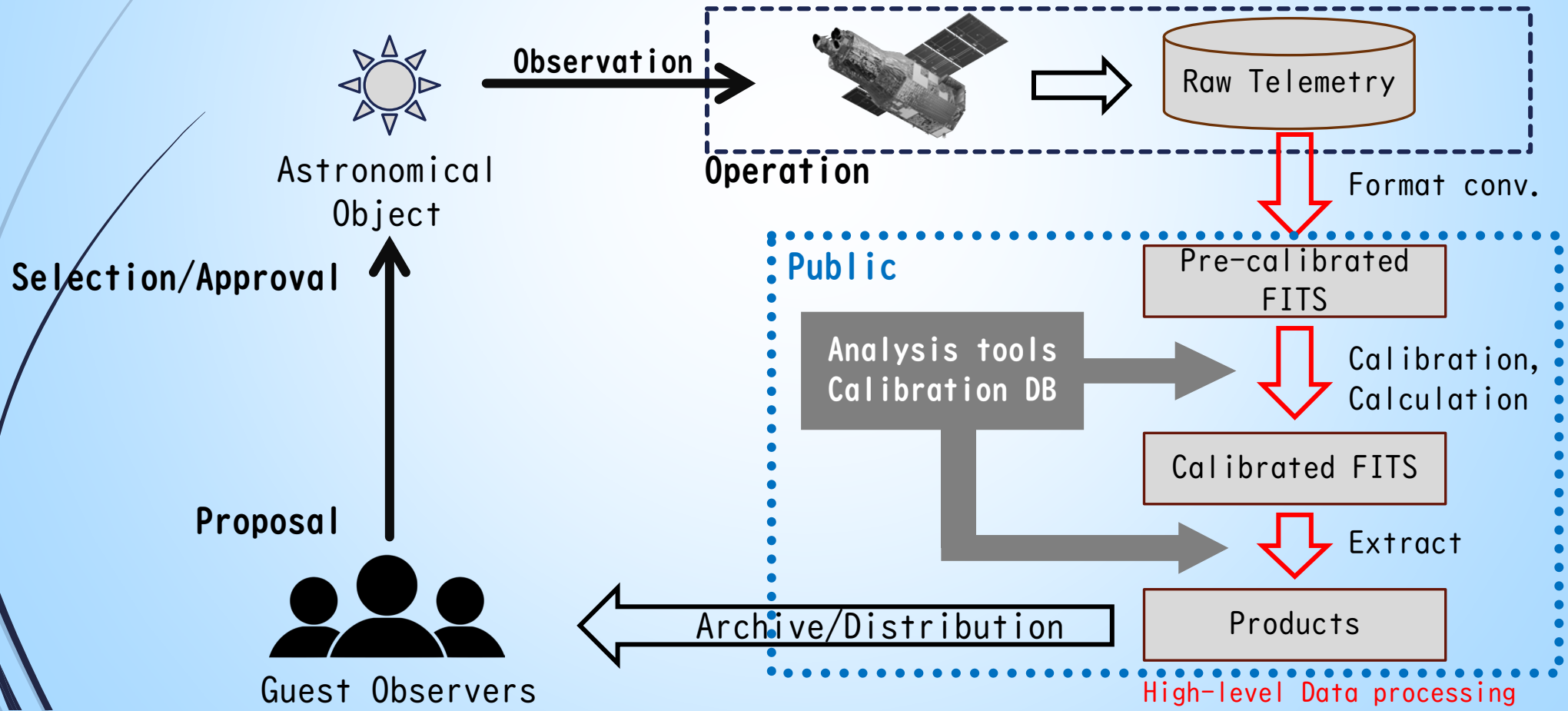
Verification, Calibration, PVO activities

- Kanemaru Y. et al "Evaluation of the pointing accuracy of the X-Ray Imaging and Spectroscopy Mission during the first year", JATIS 11, 042025.(2025) 10.1117/1.JATIS.11.4.042025
- Terada Y. et al "Development of the timing system for the X-ray imaging and spectroscopy mission", JATIS 11, 042007.(2025) 10.1117/1.JATIS.11.4.042007
- Shidatsu M. et al "Verification of the timing system for the X-ray Imaging and Spectroscopy Mission in the GPS unsynchronized mode", JATIS 11, 042012.(2025) 10.1117/1.JATIS.11.4.042012
- Sawada M. et al "Absolute timing calibration of the Resolve microcalorimeter spectrometer on the X-ray Imaging and Spectroscopy Mission", JATIS 11, 042011.(2025) 10.1117/1.JATIS.11.4.042011
- Yoneyama T. et al "Pile-up simulator for XRISM/Xtend onboard the X-ray Imaging and Spectroscopy Mission", JATIS 11, 042010.(2025) 10.1117/1.JATIS.11.4.042010

→ See Presentation by Motogami(Wed)

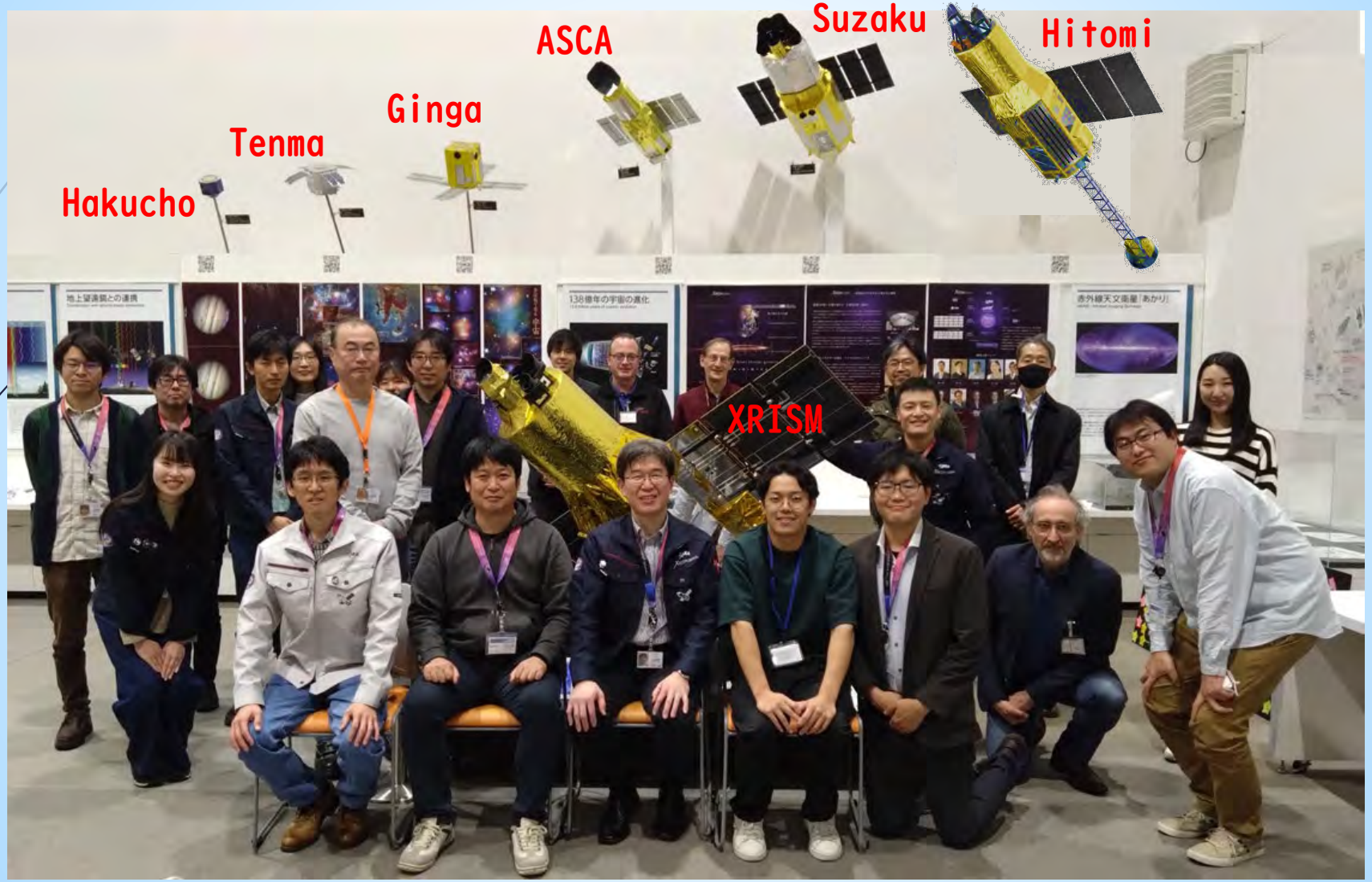
Science Operations – 4 task categories

1. Guest Observer (GO) program and Data distribution
2. Analyses software/CALDB, Pipeline process
3. GO support
4. Performance Verification Optimization (PVO)



2. Review lessons in previous X-ray missions

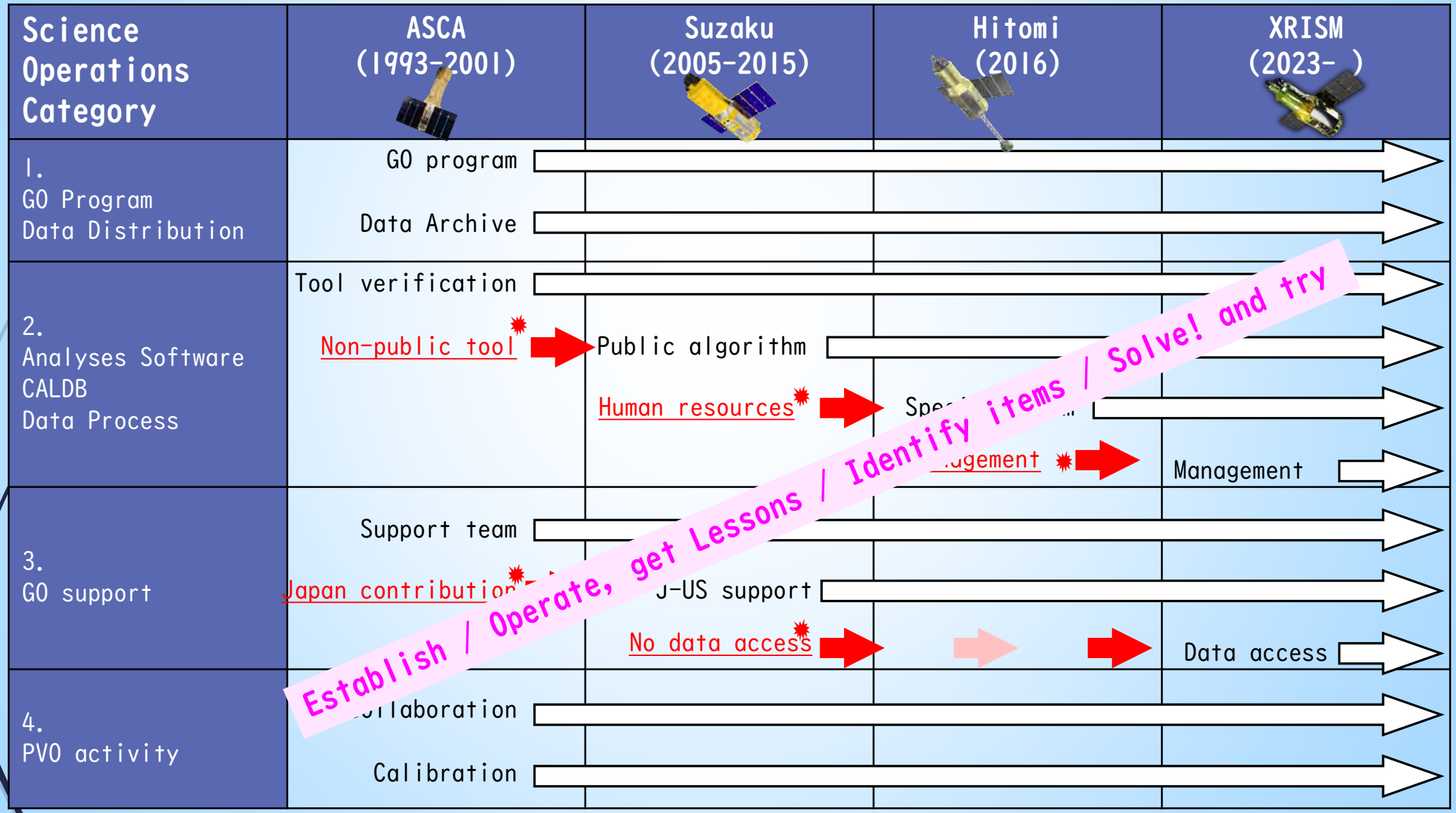
2. First step is to review Lessons.



XRISM Science Operations are designed on basis of Lessons learned from past X-ray missions

Core-to-Core Program

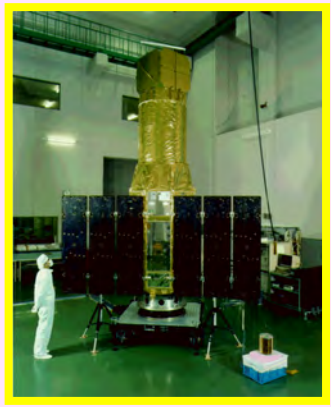
2.1 Lessons learned from Japanese X-ray missions

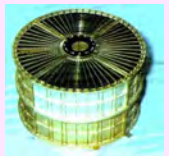


2.2 ASCA (1993 - 2001)

Science Operations Category	ASCA (1993-2001)	(2
1. GO Program Data Distribution	GO program	
	Data Archive	
2. Analyses Software CALDB Data Process	Tool verification	
	Non-public tool	ublic
		uman
3. GO support	Support team	
	Japan contribution	J-
		No data access
4. PVO activity	collaboration	
	Calibration	

Data access





ASCA
XRT+GIS/SIS

(+) First Japan-US collaboration on Sci. Ope.
- GO program, Data Archive, GO support with NASA GOF
- FITS file format, standard ftools style software

(-) Non-public tools exist
- Instrument teams (ITs) can analyze the data by their own tools, which is sometimes unpublic.
- -- unfair : “animal software”

(+) GO support facility started in US
(-) No official user-support group in Japan

2.3 Suzaku (2005 - 2015)

Suzaku XRT+XIS+(XRS), HXD

(+) Avoid Non-Public tools

- All algorithms are public. (sharing the same library between public ftools and IT software)
- Well verified via IT development

(-) Unstable software / Release delay

- Sometimes IT member is not an expert for software.
- Software development is the lower priority for instrument teams.
- Difficult to maintain.

	Suzaku (2005-2015)	Hitomi (2016)	XRISM (2023-)
Public algorithm			
Human resources			
J-US support			
No data access			
collaboration			
Calibration			

(+) GO program & User support in J/US

- Japan-US collaboration cont.
- GOF & Suzaku Helpdesk in Japan
  – tight communication with ITs

(-) No data access rights

- User support activities are limited

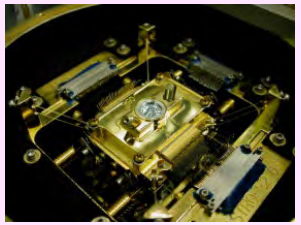
(+) Start collaboration in IACHEC

- Instruments are well calibrated !

4.
PVO activity

2.4 Hitomi (2016 - 2016)

Hitomi
XRT+SXS, SXI, HXT+HXI, SGD

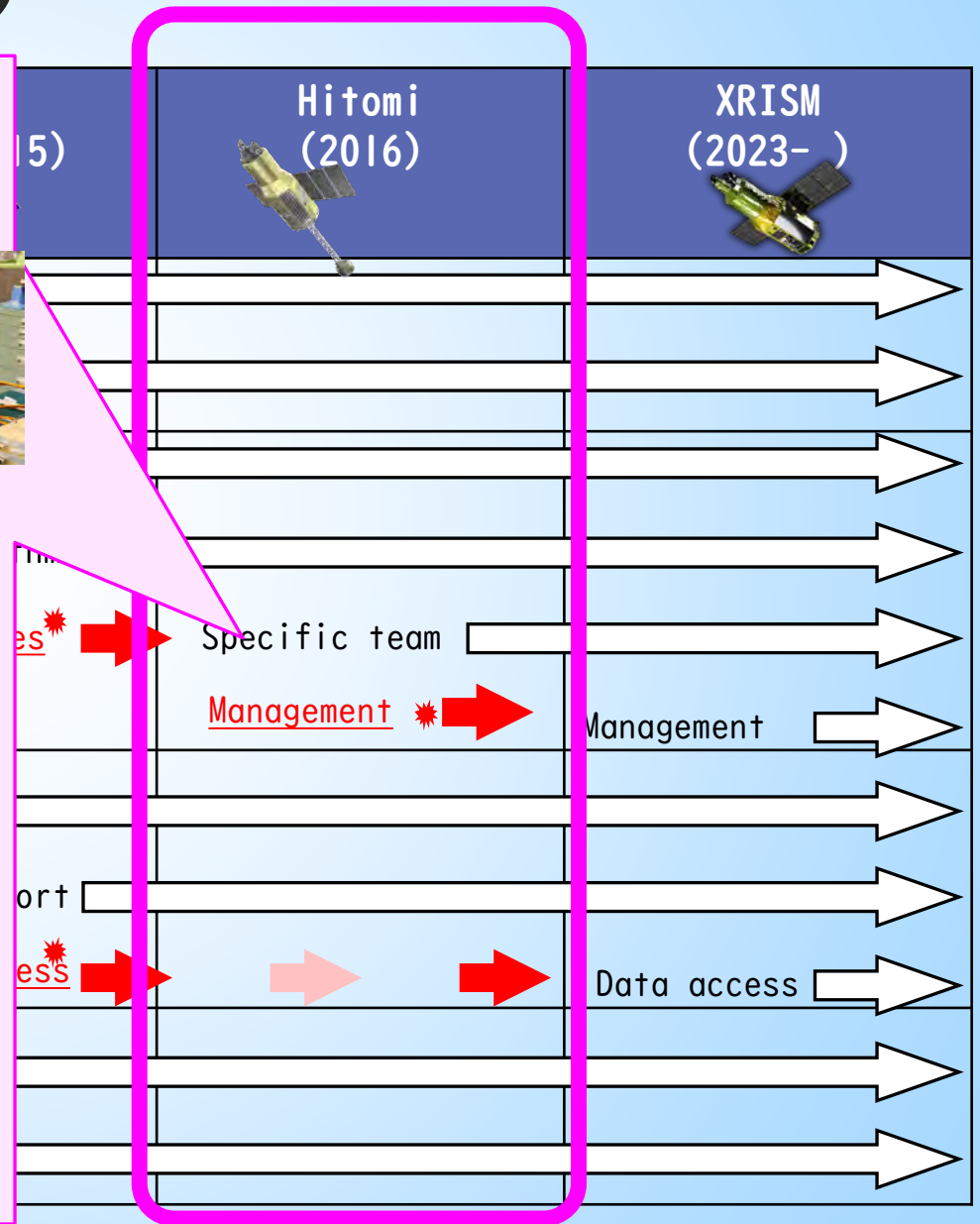


(+) Stable software / non-delay release
- Analyses/pipeline tools were developed by a specific team with programmers (Software calibration team), independent from ITs.
- Well verified/calibrated in collaboration with ITs.

(+) More data access right in user support activity
- Suzaku negative item was solved.

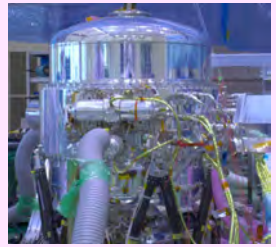
(+) Keep IACHEC collaboration for calibration
- Instruments are well calibrated

(-) Very tough internal communication
- Require tight communication with ITs, operation team, archive team, and PI, organizing committee etc.
- Human resource was limited.



2.5 XRISM (2023 - now)

XRISM
Resolve (XMA+SXS), Xtend (XMA+SXI)

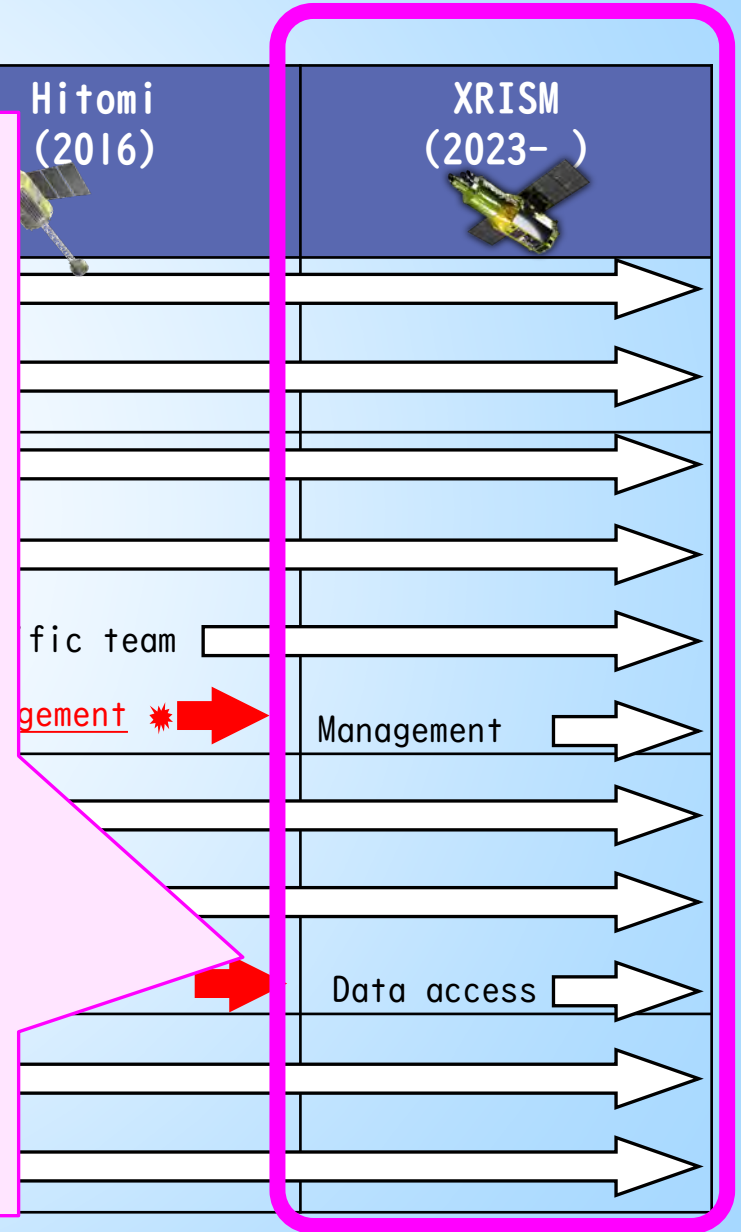


(+) Stable software / non-delay release / GO prog. / support
- Keep same criteria as Hitomi; specific team (Science Operations team), independent from ITs, prepares science operations.
- Developed/operated by members appointed by agencies

(+) Science Operations are designed well before the launch
- Preparation well before launch is Hitomi LL.
- Design/Implementation/Verification & Rehearsal are completed before launch.

(+) Keep IACHEC collaboration for calibration
- Instruments are well calibrated

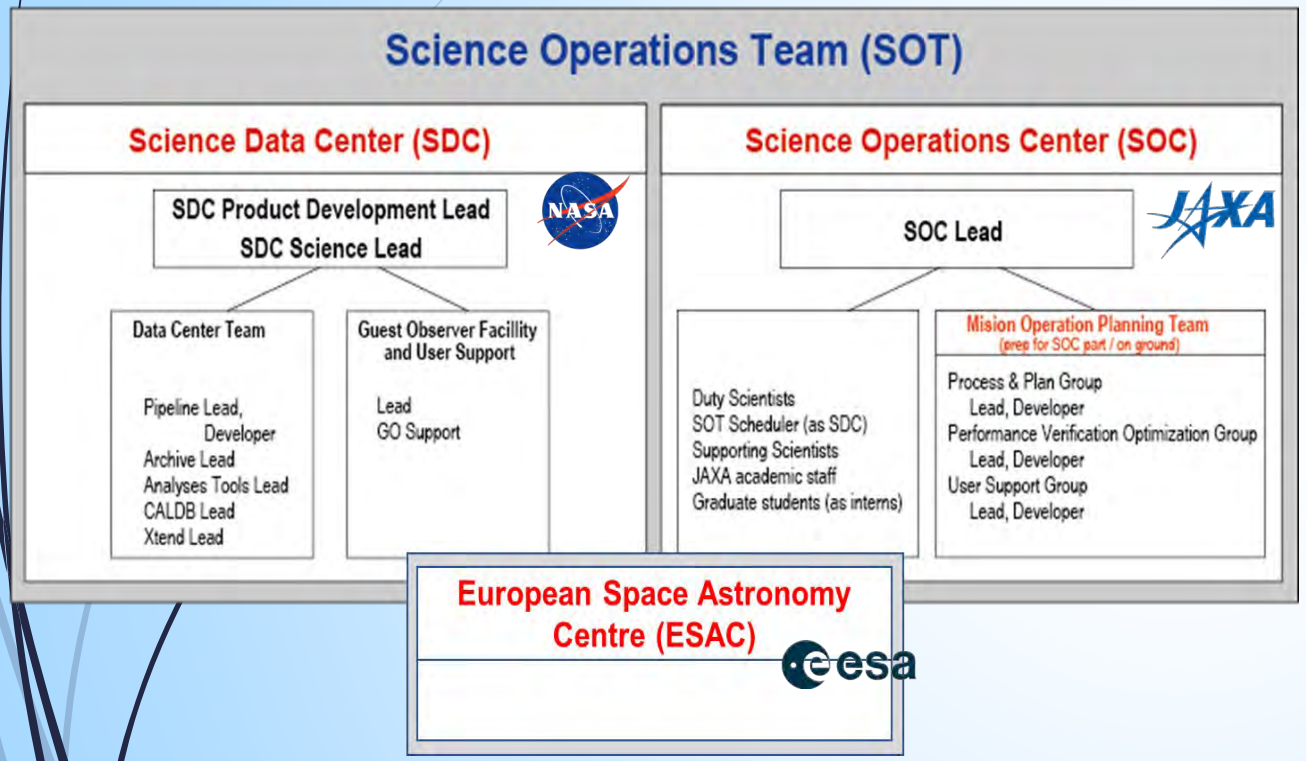
→ No negative item remains! (we believe)



3. XRISM Science Operations Detail

XRISM
Science Operations team

- Operated by JAXA/NASA/ESA



- Developed with mission operations team (MOT) before launch.

- Task division between SOC/SDC/ESAC

Core-to-Core Program

Category	SOC	SDC	ESAC
SO1	Proposal support (JAXA)	Proposal support (USA/Canada)	Proposal support (Europe)
(GO)	Web pages for submission	Web pages for submission Proposing systems and tools	Web pages for submission
	Proposal support	Proposal support	Proposal support
	Supporting review process	Supporting review process	Supporting review process
(Data)	Observation scheduling Planning operations	Observation scheduling Planning operations	
	ToO handling MOT interface	Planning tools and personnel	
	Prepipeline process Format conversion	Pipeline process Filling calibrated columns	(No data process)
	Observation database	Metadata for archive	
	Archiving at JAXA Data archive	Archiving at NASA Data archive	(No archive)
	Quick-viewing tool	Calibration database release	Quick-viewing tool
SO2 (Software)	Telemetry check Health check	Development of analysis tools	
	Performance check	Maintenance of calibration database	
SO3	User support (JAXA)	User support (USA/Canada)	User support (Europe)
(Support)	Handling GO questions	Handling GO questions	Handling GO questions
	User guide documents	User guide documents	Documentation
	Researcher webpages	HEASARC webpage	ESAC webpage
	EPO support	EPO support	EPO support
SO4 (PVO)	Calibration operations Analyses Monthly plan	Calibration support Analyses	
	Performance check	Performance check	Performance check
	Analysis threads Daily/monthly check	Analysis threads Postprocess development	Analysis threads
	Xtend transient search		

3.2 Organization structure

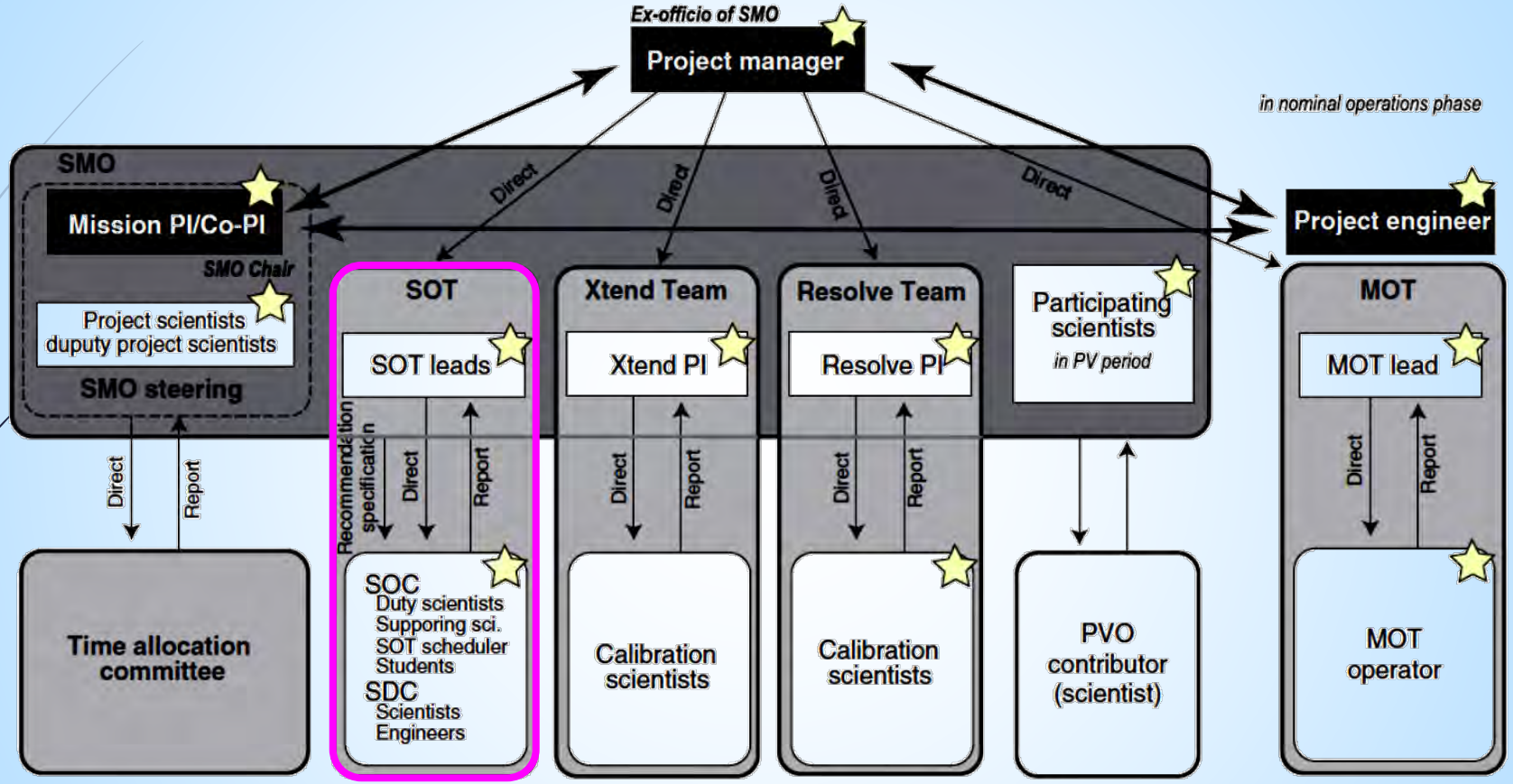
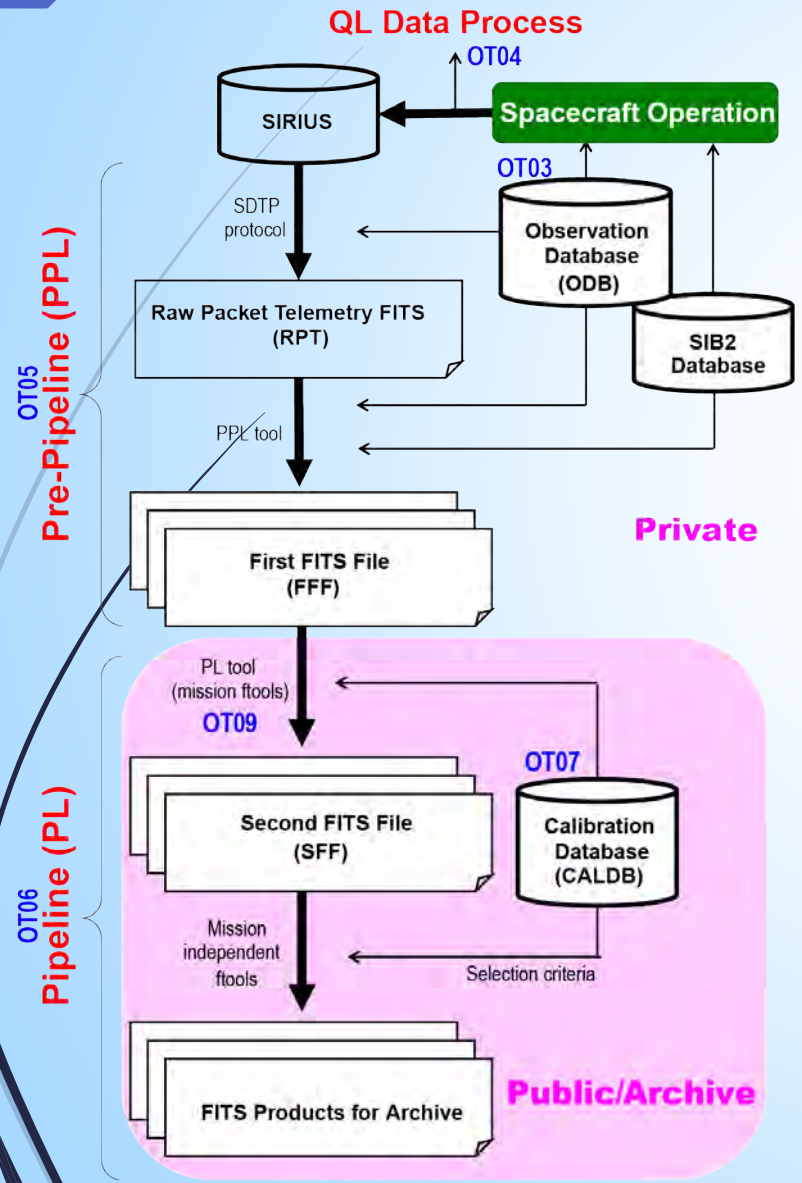


Fig. 3 Organization structure of the XRISM science operations during the nominal operation phase.

- Science operations activities are steered by SMO (Science Management Office)
- Operated by members appointed by space agencies. ★

Core-to-Core Program

3.3 Telemetry data process & tools



Two type of Data process

- Quick Look Data Process(**QLDP**)
- Pre-pipeline Process(**PPL**),Pipeline Process(**PL**)

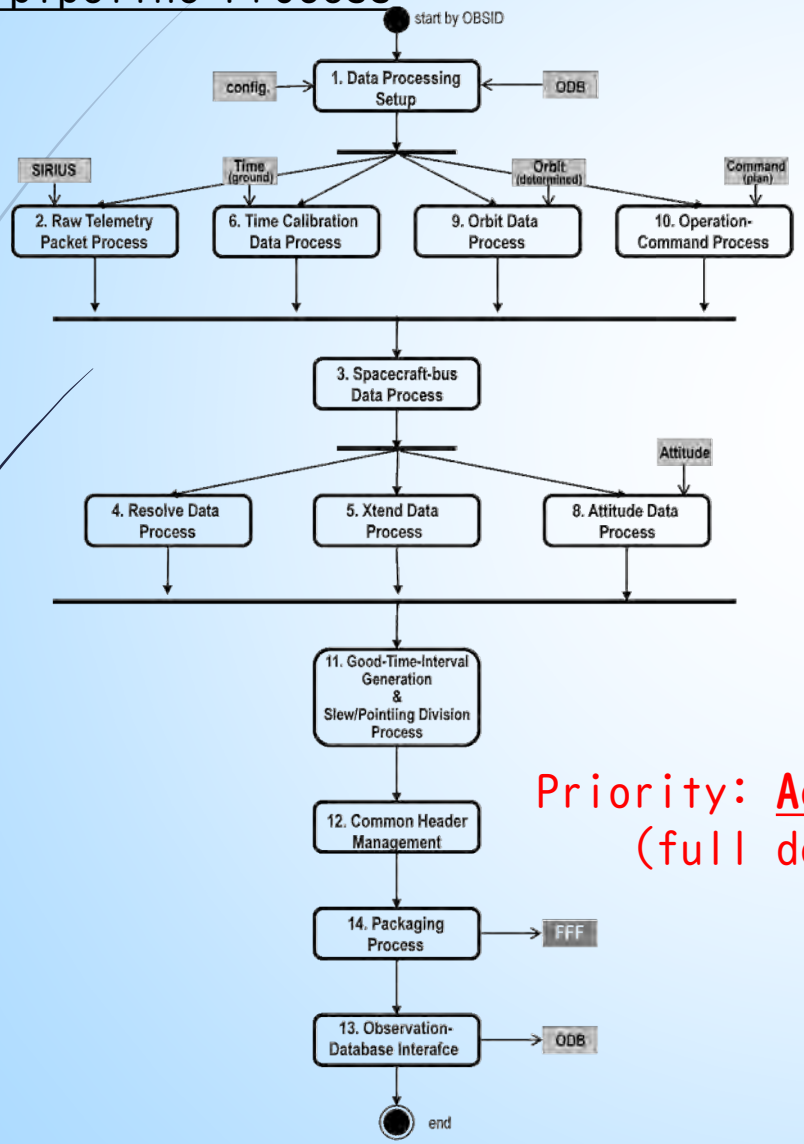
Tools for Science Operations (operation tools;OT)

Table 6 List of science OTs and databases. Steps are defined in Sec. 5.1.

Tool ID	Tools/database	Step	SOT subgroups
OT01	Proposal submission tools	Step 1	SDC, (SOC and ESAC as users)
OT02	Planning tools	Step 1	SDC with SOC
OT03	Observation database	Steps 1 and 2	SOC
OT04	QLDP	Step 2	SOC
OT05	PPL	Step 2	SOC
OT06	PL	Step 2	SDC
OT07	Calibration database	Steps 2 and 3	SDC with SOC and ITs
OT08	Archive quick-viewing tool	Step 2	SOC, (HEASARC), ESAC
OT09	Analysis tools	Step 3	SDC with SOC and ITs
OT10	Conversion tools for researcher webpages	Steps 1, 2, and 3	SOC

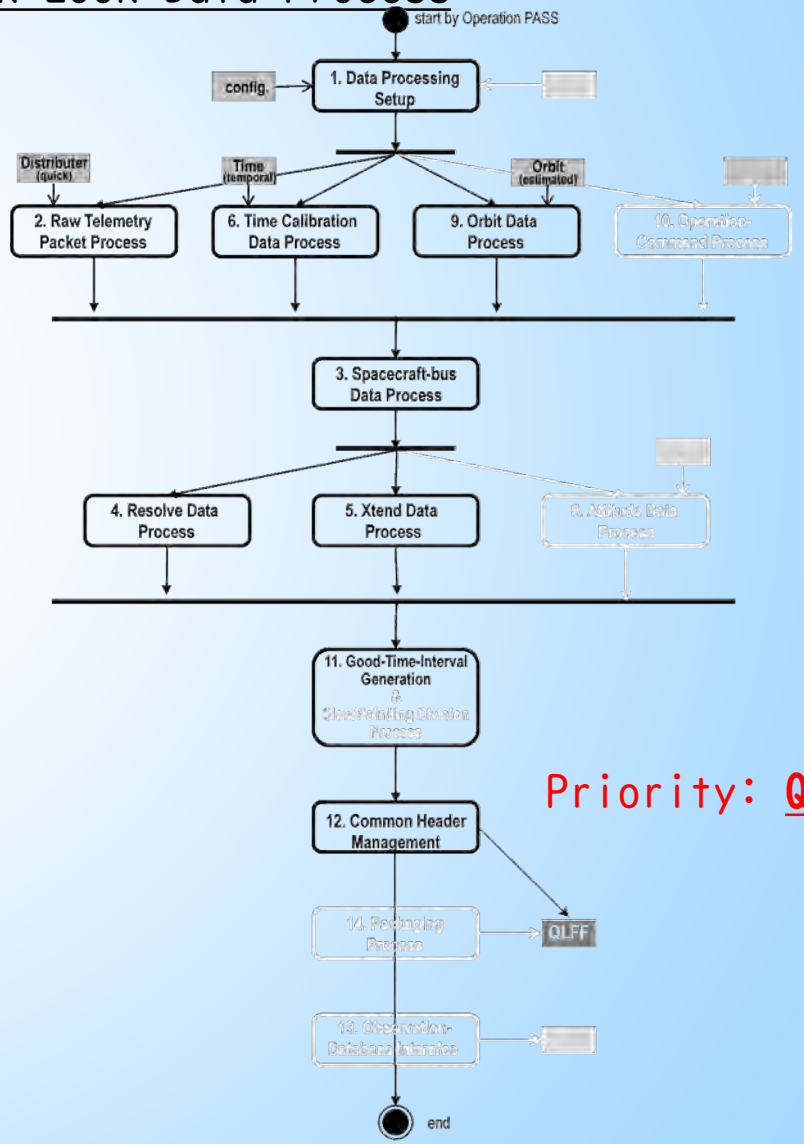
Data Process flow for PPL and QLDP

Pre-pipeline Process



Priority: **Accuracy**
(full data process)

Quick Look Data Process



Priority: **Quickness**

Japan-US-EU “trans-pacific” operations challenge

XRISM Science operations team acts as “one team”

- **Call for Proposal :** semi-simultaneous announcements
- **AO targets :** selection by agencies and merged into one list
- **ToO approval :** selection by one international group among 3 agencies

- **Pre-pipeline (JAXA) / Pipeline process (NASA) :**
  - Simple I/F : FITS file + meta data
  - File transfer via XDTS by NASA
  - hand-shake between SOC (Japan) & SDC (US) … tight communication

- **Archive (JAXA DARTS / NASA HEASARC)**
  - PI notification / report … task division is defined
  - semi-simultaneous data release

- **User support / Helpdesk**
  - share FAQ among agencies
  - weekly/monthly communication (SOC/SDC/GOF/ESAC)

3.4 Science Operation Planning (Normal GO program)

Guest Observer

AO Proposal

Time allocation committee
(JAXA, NASA, ESA)

Planning

Approval target list

Science Operations Team
- Approved target to database
- Long term schedule
- Short term schedule

www

Q&A

Obs. Data
+ Reports

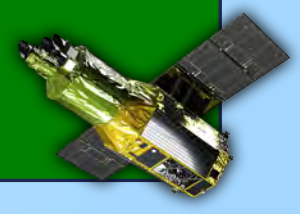
publish
via www

Obs. plan

Science Operations Team
- QL check/report
- PL product check
- User support

Obs. data

Mission Operations team / Flight Operation team
- Spacecraft command preparation
- Execution of mission operation
- Execution of QLDP/PPL



3.5 Planning for Target of Opportunity

ToO types

- Reserved ToO (approved in AO)
- Generic ToO (request to use DDT)

Response time

- 48h(weekday) / 72h (weekend)

Operation Execution

- Communication to spacecraft is limited.
- Perform
  science judgement (SMO)
  & planning (SOT+MOT)
  in parallel.

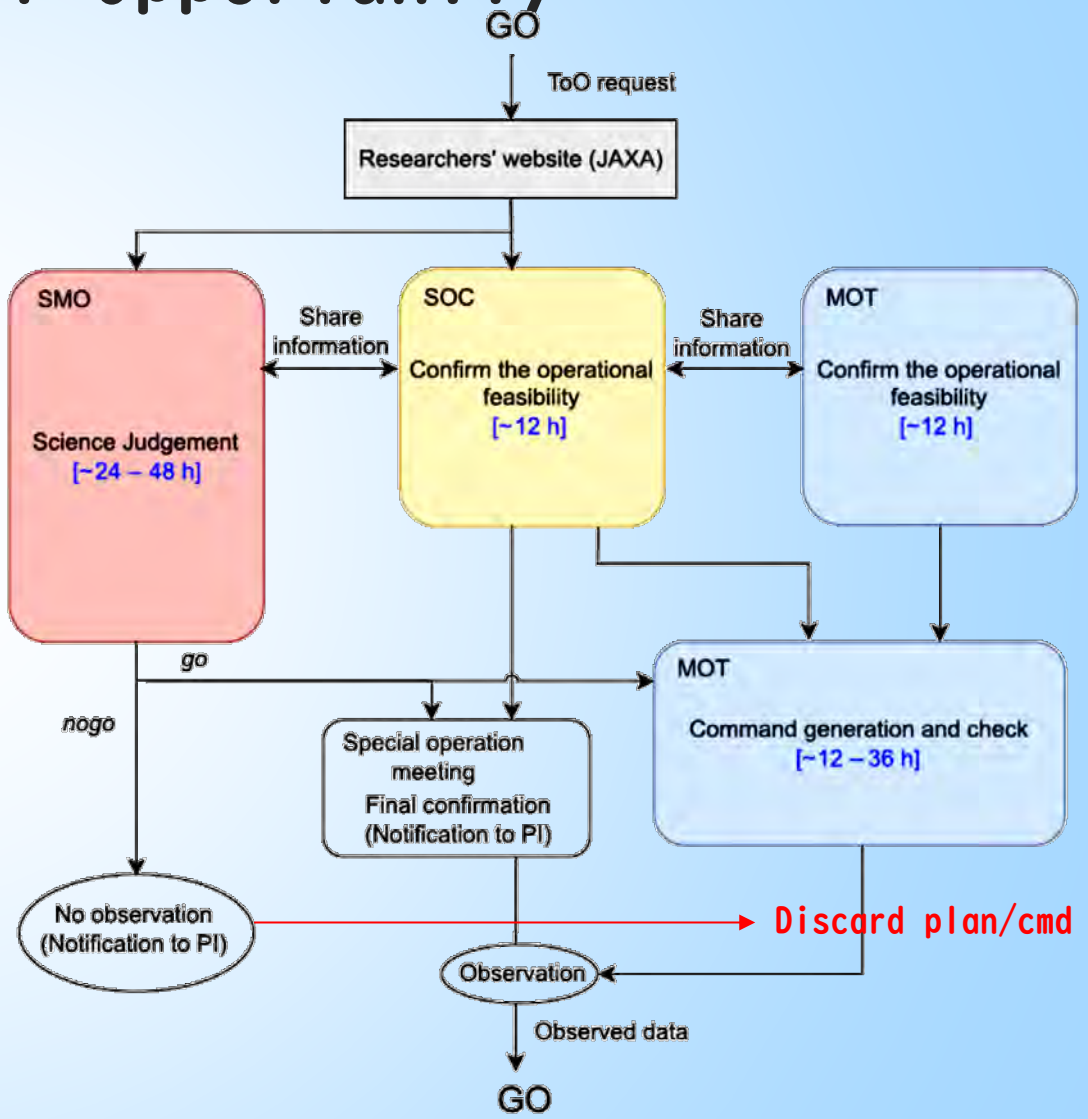


Fig. 2 Flow chart representing the procedure for *XRISM* ToO observation. The blue numbers indicate typical time allocation from a ToO request to the completion of each task.

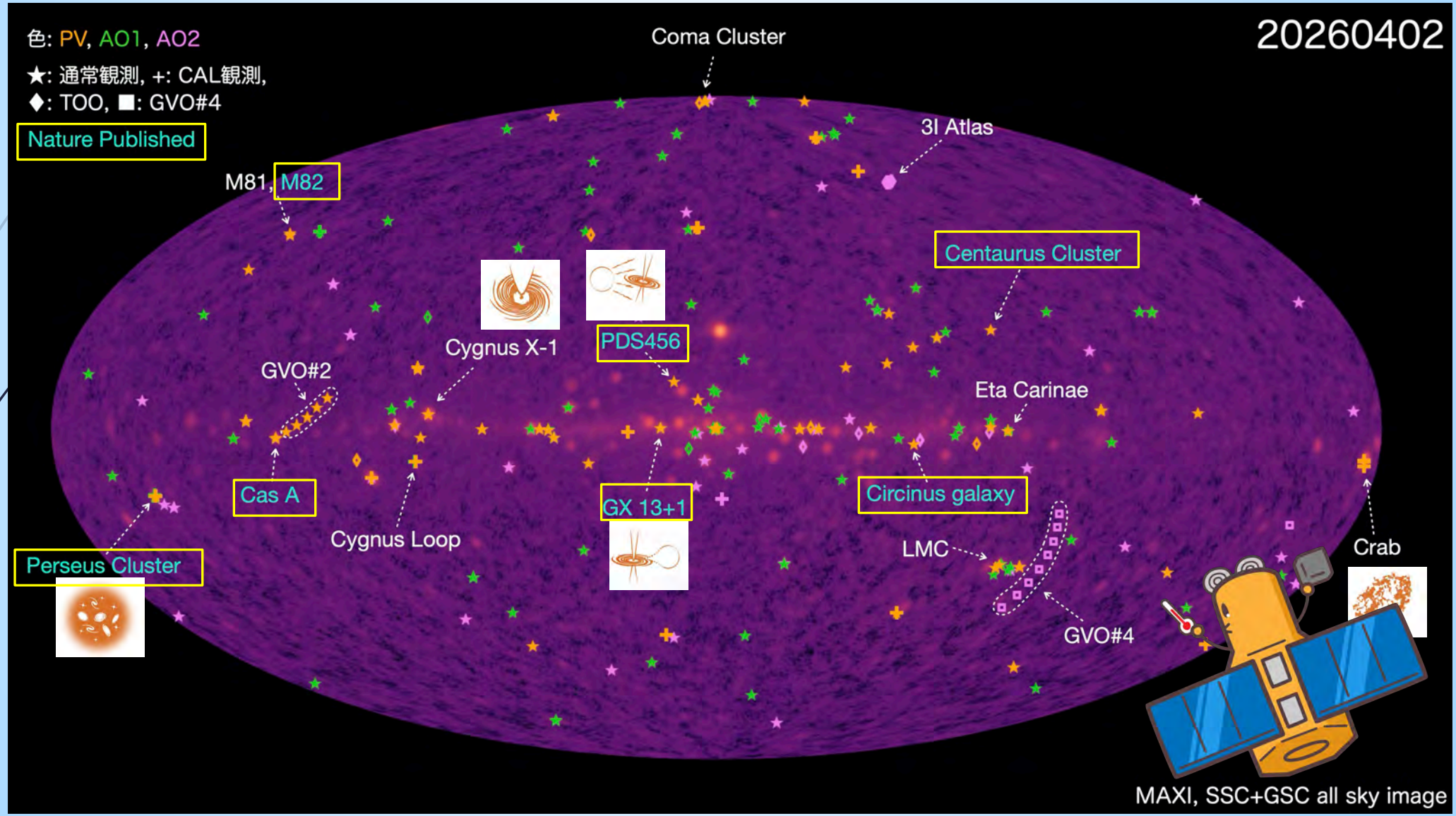
Core-to-Core Program

4. XRISM Science Operations Latest status

XRISM SOT (Japan/US/Eu) 2025.10@Kyoto

XRISM SOT/SOC 2026.3 @ISAS/JAXA

4.1 Performance Verification, AO-1, AO-2, and AO-3



4.2 Target of Opportunity (ToOs)

https://xrism.isas.jaxa.jp/research/observers/generic_too/index.html

Reserved ToO

- 8 observed

Generic ToO (DDT)

- 35 requirements
- 10 observed/planed
- 1 canceled due to flux decay

Accept only historical events.
Best response < 32.7 hours.

Home > observers > **Generic ToO Operations**

- Home
- News & Announcements
- About XRISM
- For Proposers
- For Observers
- Analysis
- Helpdesk
- Useful links

Generic ToO Operations

This is the list of Generic Target of Opportunity (ToO) operations. Observed data (without PGP encrypt) can be downloaded from DARTS and HEASARC after the pipeline processing. The ToO application page is here.

Mnv start time (UT)	Seq	TargetName	Ra	Dec	Exp. (ks)	Resolve	Xtend	Notes
2026-04 (tbd)	902005020	HERCULES_X-1	254.4575	35.3424	30.0	OPEN	1/8	approved no conflict with the pre-approved ToO observation
2026-03 (tbd)	902005010	HERCULES_X-1	254.4575	35.3424	30.0	OPEN	1/8	approved no conflict with the pre-approved ToO observation
2026-02-19T17:24:00	902002020	GS1354-64	209.5405	-64.7348	40.0	OPEN	1/8+bst	observed ATel:17697
2026-02-07T00:19:00	902004010	1A1118-61	170.2382	-61.9167	30.0	OPEN	1/8+bst	observed ATel:17667
2026-01-28T21:13:00	902003010	MAXI_J1543-564	235.8223	-56.4136	50.0	OPEN	1/8	observed ATel:17643
2026-01-20T03:37:00	902002010	GS1354-64	209.5405	-64.7348	100.0	OPEN	1/8+bst	observed ATel:17625
2025-11-28T17:14:00	902001140	C2025_N1	182.4157	-0.2376	60.0 (total)	OPEN	Full	observed ATel:17523
2025-11-28T14:03:00	902001130	C2025_N1	182.5278	-0.2772	60.0 (total)	OPEN	Full	observed
2025-11-					60.0			

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4.3 Xtend Transient Search

X-ray CCD (Xtend) has very large FoV.

→ We perform transient search under the permission by observation PIs

→ The Astronomer's Telegram

Please check the presentation by Yoshimoto

Core-to-Core Program

Thanks!

Questions?