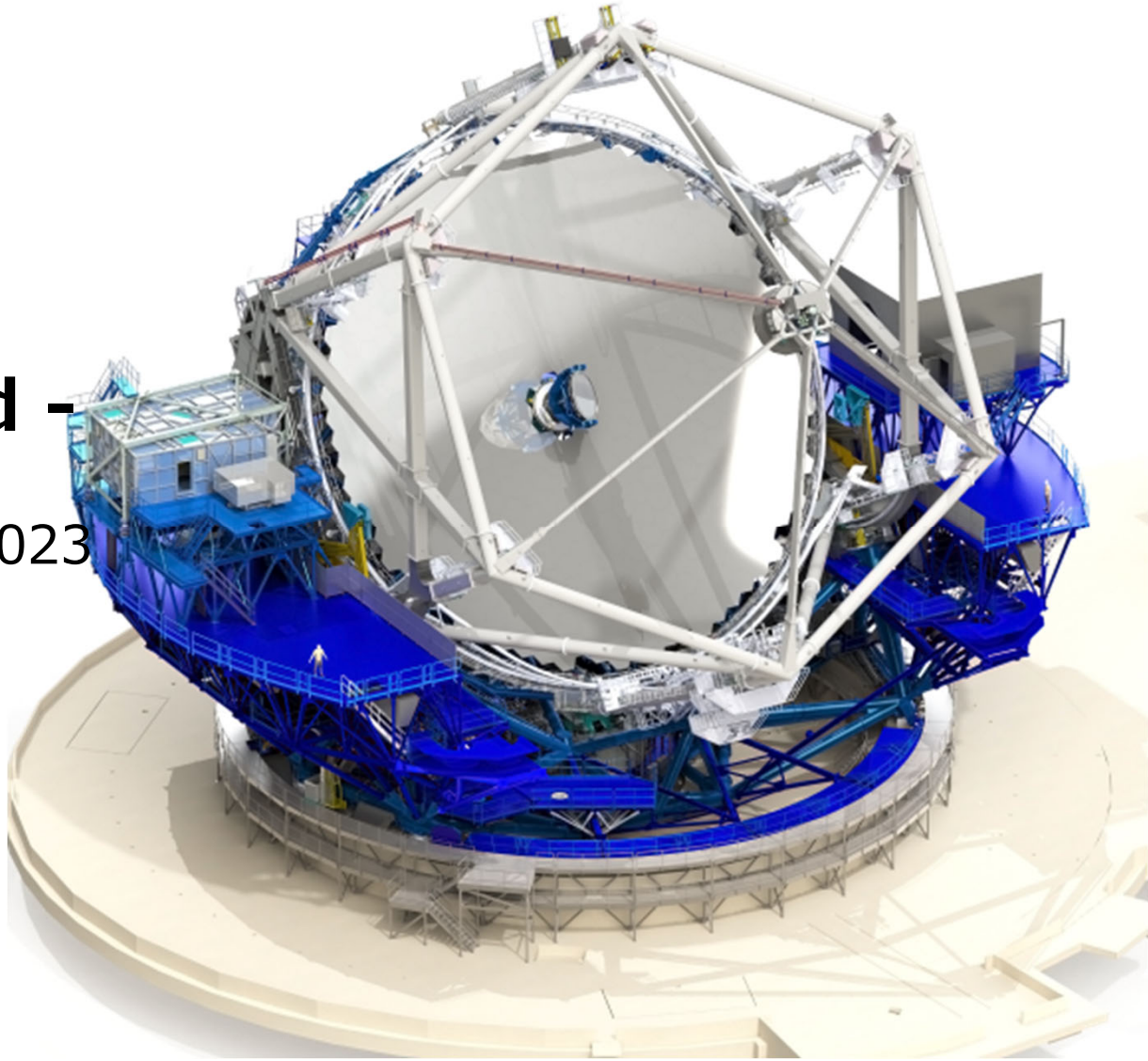
国立天文台
NAOJ
National Astronomical Observatory of Japan

NAOJ
- Now and Going Forward -

NAOJ Future Planning Symposium 2023

13:00-14:00
November 7, 2023

Saku Tsuneta
Director General
NAOJ



Conceptional drawing of TMT

Contents

Profile of NAOJ

National Astronomical Observatory of Japan

Number of Employees (as of April 1, 2023)

Total: 517

- Research and Academic Staff 235
- Engineering Staff 87
- Administrative Staff 195
  (including Research Support Staff)

<Staff Ratio> Female: 31.7% Non-Japanese: 6.6%

・Research:	10.6%	10.6%
・Engineering:	19.5%	4.6%
・Administrative:	62.6%	2.6%

[% of Female and gender balance target value]
***From "Action Plan for Promoting Gender Equality at the National Institutes of Natural Sciences."**

- **Goal 1** % of female researchers: 10.5%
  [17% by the end of FY2027]
  Lecturer or higher 9.1%
  [12% by the end of FY2027]
- **Goal 2** % of females in management positions (section manager and above): 12.5%
  [18% by the end of FY2025]

Number of Students (as of April 1, 2023)

Graduate Students: 71

- Students from SOKENDAI (5-year doctoral program) 31
- Students from Cooperative Universities 29
- Visiting Graduate Students 11

FY 2023 Budget

Management expenses grants, etc. **Approx. 9.73 billion yen**

- Large-scale academic frontier promotion projects (3 projects) Approx. 3.69 billion yen
- Other management expenses grants Approx. 6.04 billion yen

Grants-in-Aid for Scientific Research (as of April 1, 2023) **Approx. 820 million yen**

Facility Maintenance Budget

FY 2023 initial budget

- Subaru Telescope's upgrading Approx. 290 million yen
- ALMA project's upgrading Approx. 140 million yen

FY 2022 supplementary budget

- Subaru Telescope's upgrading and anti-aging measures Approx. 450 million yen
- ALMA project's anti-aging measures Approx. 180 million yen

Publications

Source: InCites (article, review) (as of April 12, 2023)

Citation index (2018-2022 average)

- **# of peer-reviewed papers/year: 609**
- % of citations Top 10% papers: 15.8% (Average of all fields in Japan: 7.9%)
- % of citations Top 1% papers: 3.5% (Average of all fields in Japan: 1.0%)
- % of International collaboration: 80.9% (Average of all fields in Japan: 34.2%)

Publications in Space Science in Japan

Source: InCites (as of June 30, 2023)

World share (2022) : 9.4%

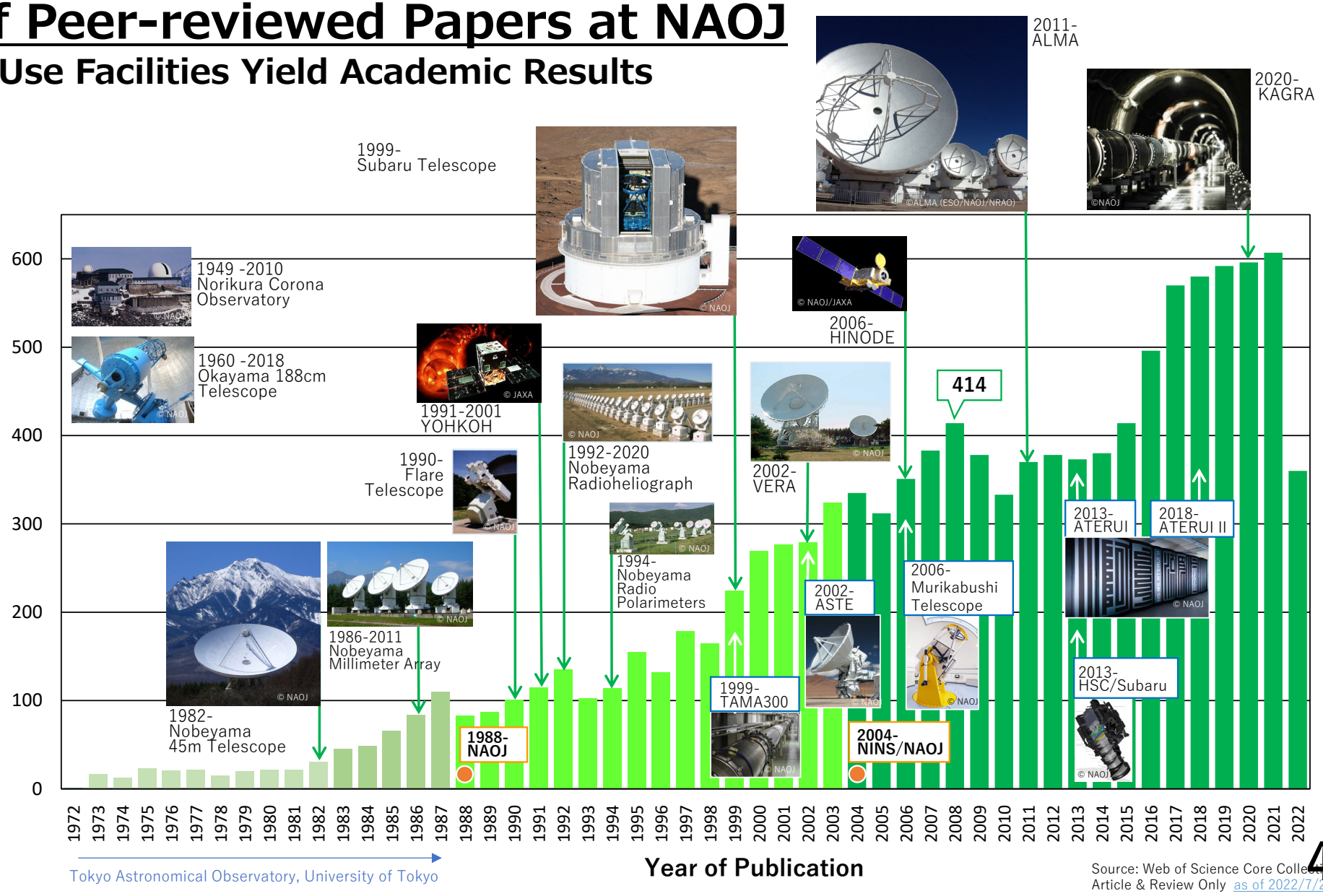
- Among the 22 research fields (ESI22), Space Science ranks the highest.
- % of Japanese members in the International Astronomical Union: 5.5 % (Approximately 1/4 of US members: as of May 1, 2023)

Rate of increase (2012→2022) : +37.1%

- Among the 19 fields of natural science (ESI22), Space Science ranks first relative to the world growth.

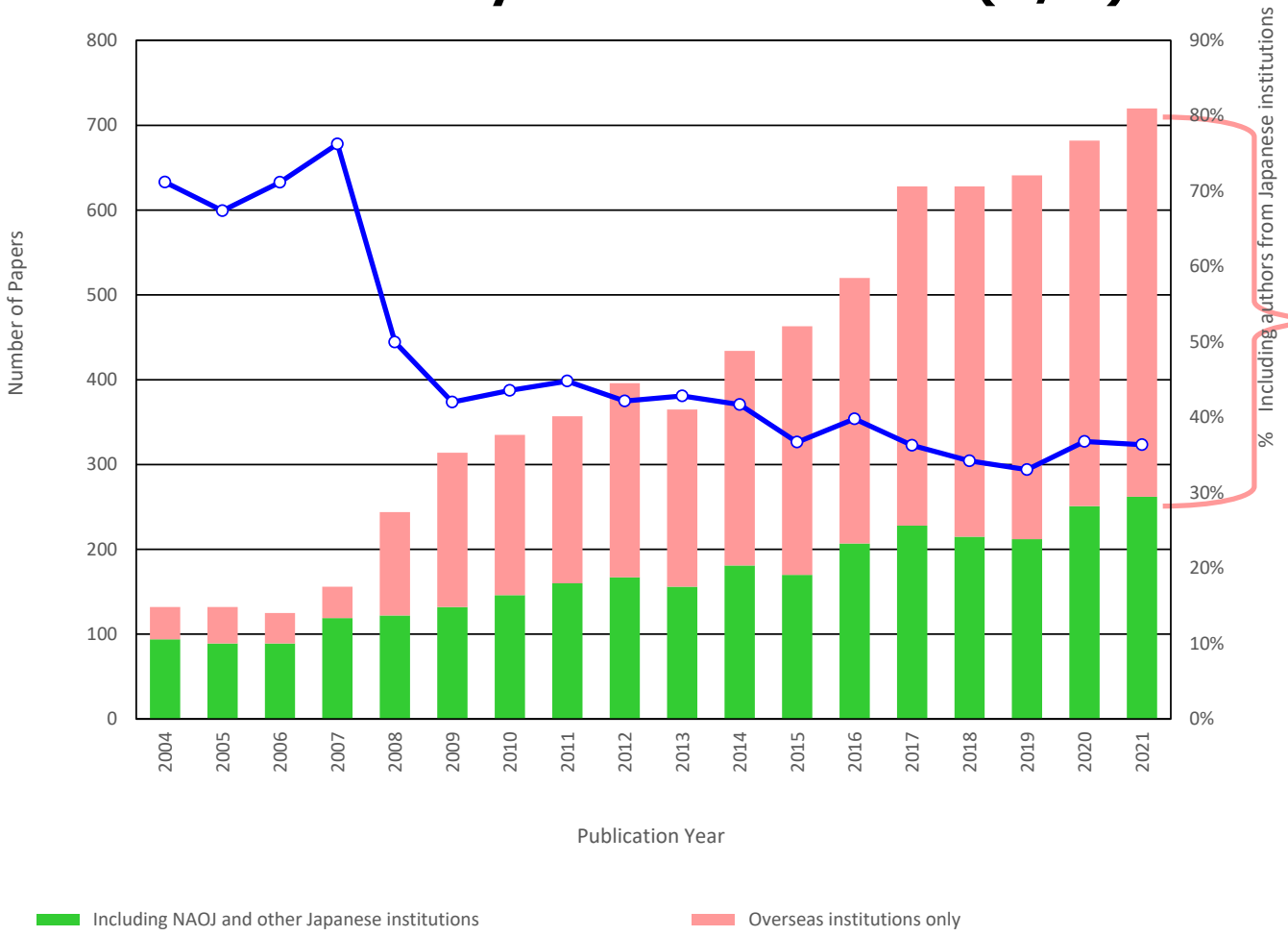
Growth of Peer-reviewed Papers at NAOJ

Joint-Use Facilities Yield Academic Results



Source: Web of Science Core Collection
Article & Review Only as of 2022/7/26

Number of Peer-Reviewed Papers Produced by NAOJ Facilities (1/2)



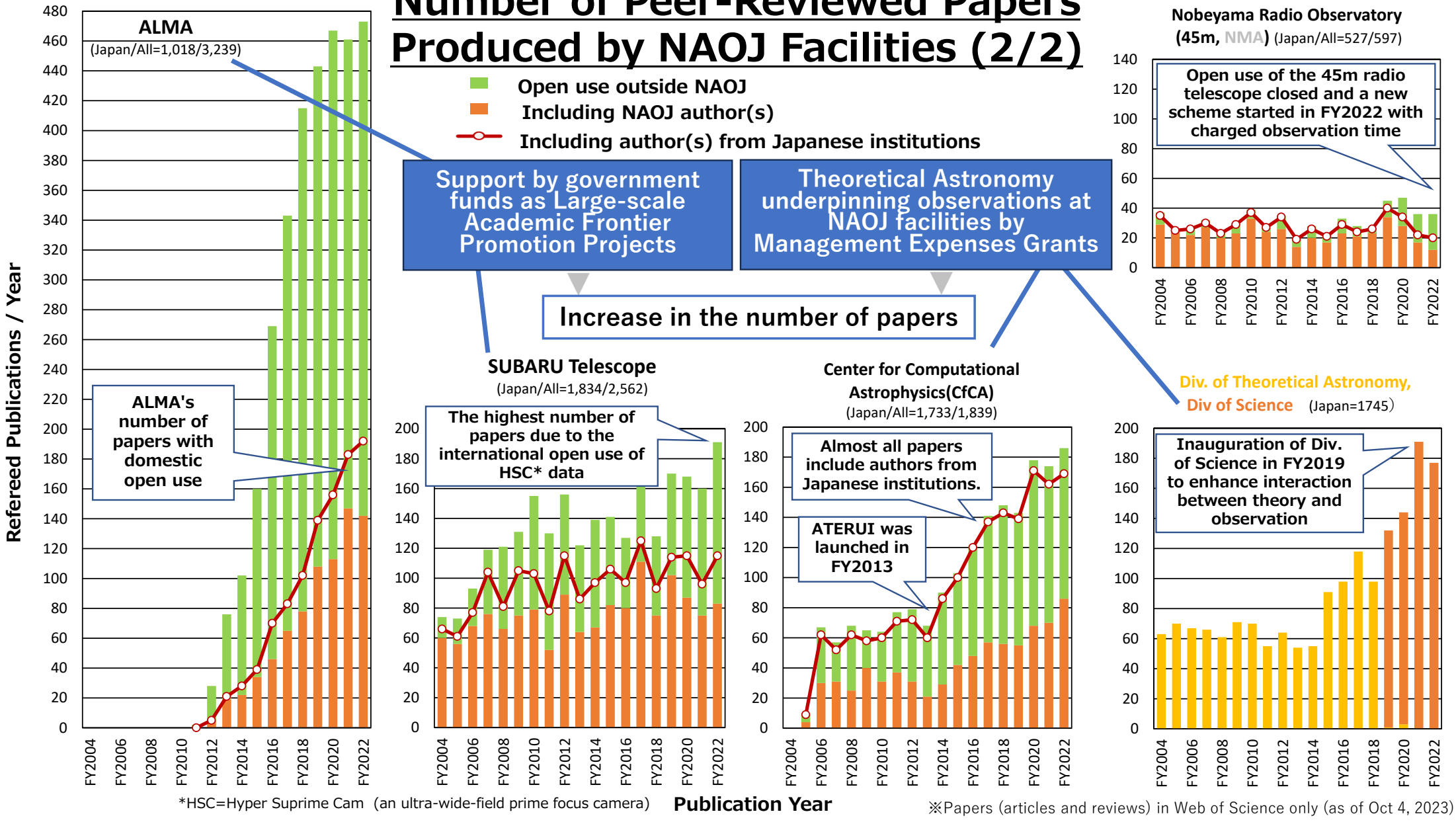
Breakdown of facilities & equipment for papers only from overseas institutions (includes overlap)

- ALMA 44 %
- Hinode 28 %
- Subaru 15 %
- ADC 6 %
- NoRH 4 %
- NoRP 3 %
- CfCA 2 %
- NRO 1 %
- ASTE 1 %

Hinode : JAXA's Solar Observation Satellite (2006-)
ADC : Astronomy Data Center
NoRH : Nobeyama Radioheliograph (1992-2020)
NoRP : Nobeyama Radio Polarimeters (1994-)
CfCA : Center for Computational Astrophysics
NRO : Nobeyama Radio Observatory
ASTE : Atacama Submillimeter Telescope Experiment (2002-)

Papers indexed in Web of Science (article, review only) as of June 21, 2023

Number of Peer-Reviewed Papers Produced by NAOJ Facilities (2/2)

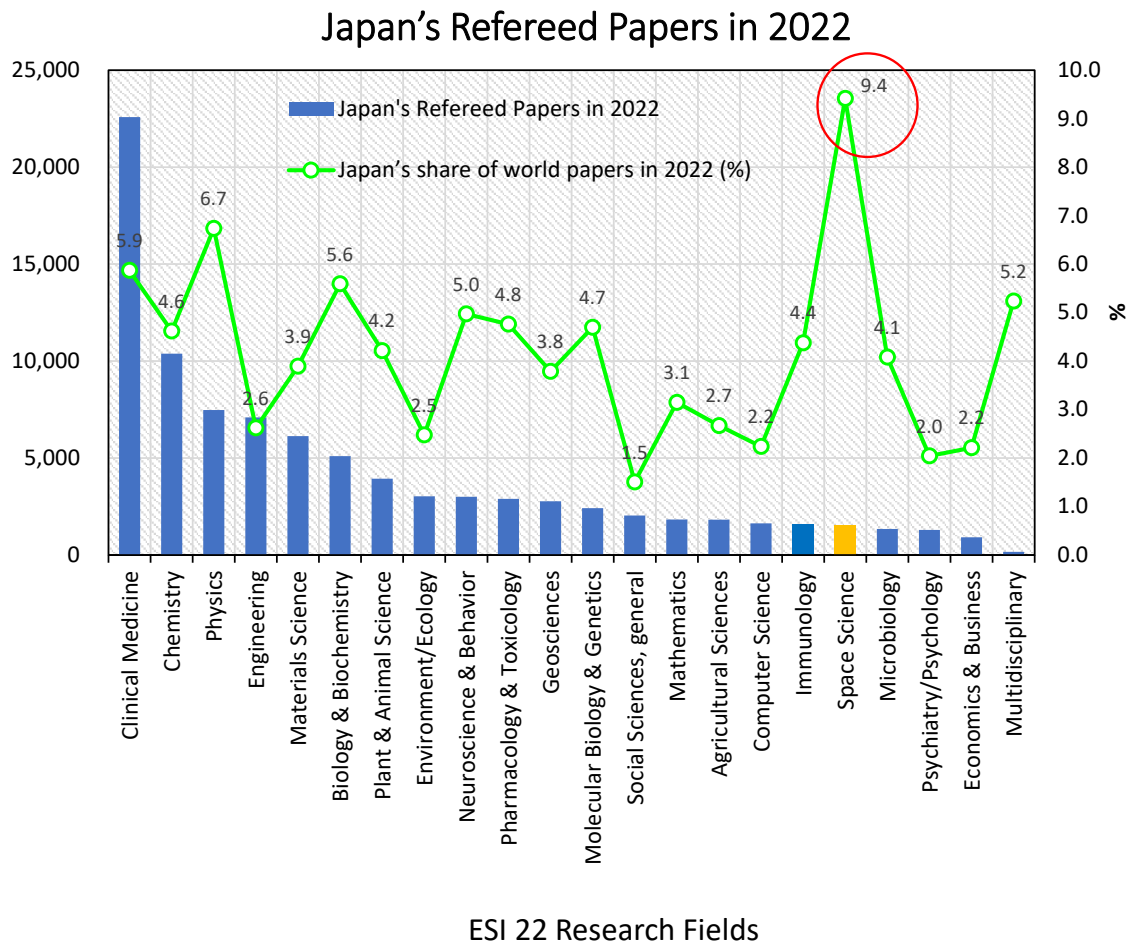


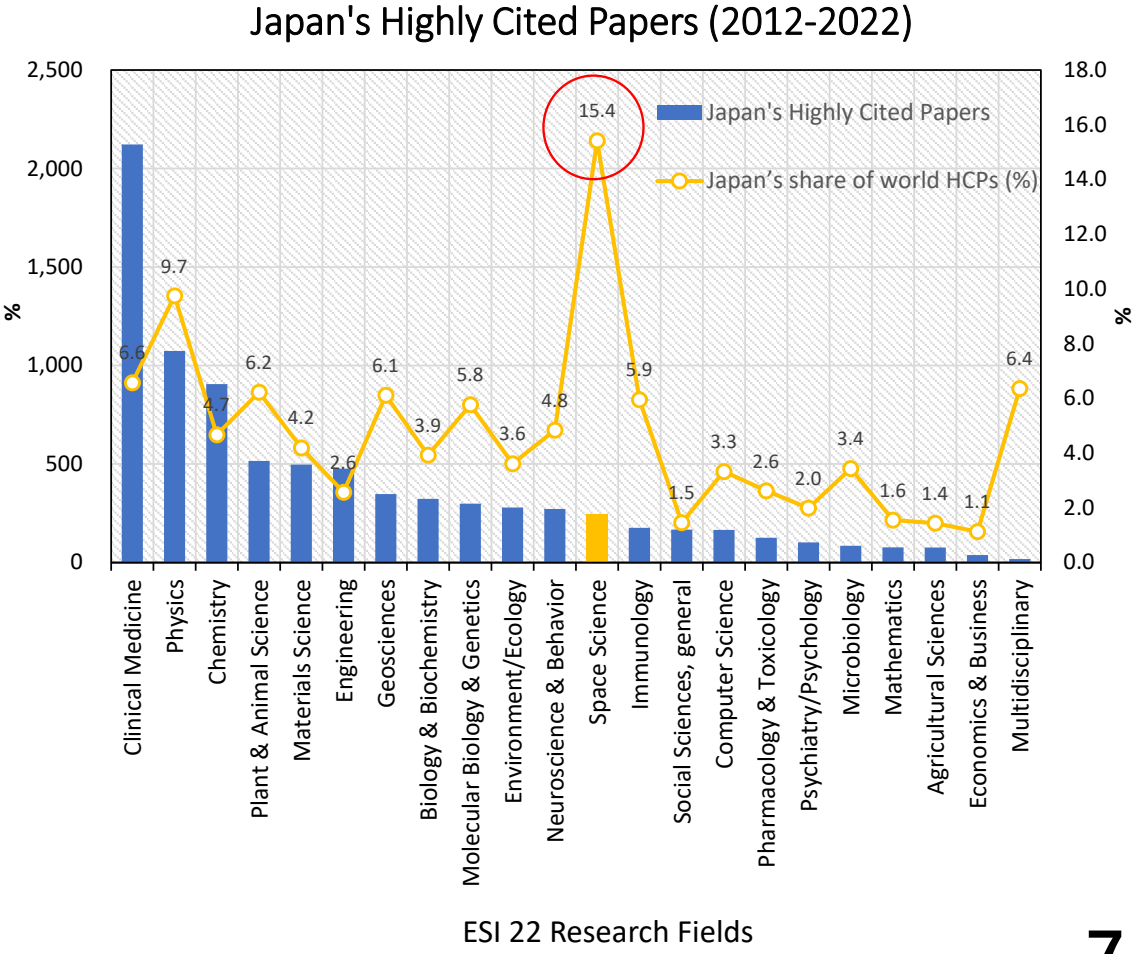
*HSC=Hyper Suprime Cam (an ultra-wide-field prime focus camera)

※Papers (articles and reviews) in Web of Science only (as of Oct 4, 2023)

Japan's Number of Articles and Share of Global Articles by Field in the Web of Science

Space Science: Highest world share in the number of papers by field

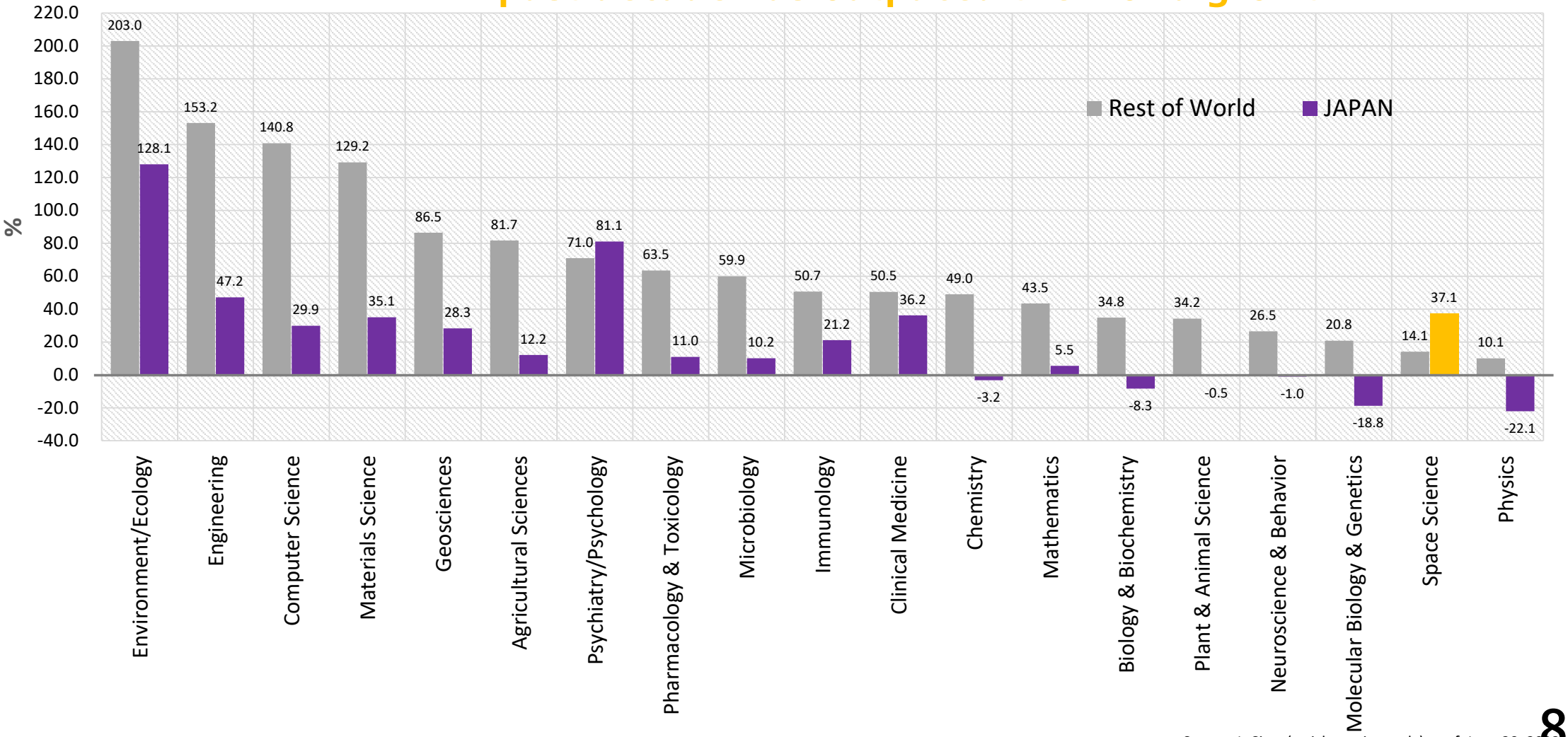




Source: InCites (article, review only) as of June 30, 2023

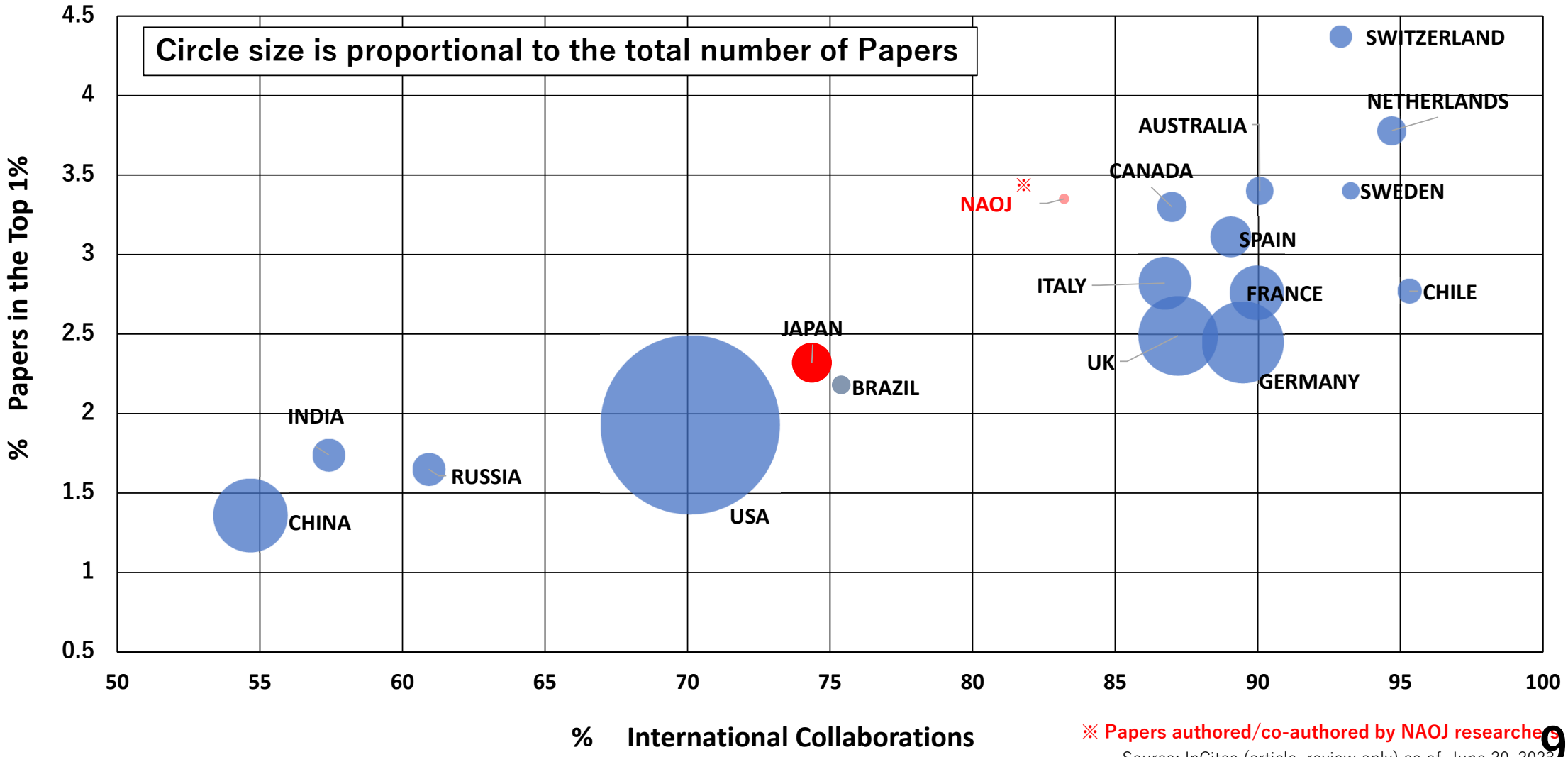
Japan vs World - Relative Change in the Number of Publications from 2012 to 2022

Space Science: Increase in the number of papers in Japan over the past decade has outpaced the world growth



Source: InCites (article, review only) as of June 30, 2022

Publication Output in “Astronomy & Astrophysics” by Country (2018-2022)



※ Papers authored/co-authored by NAOJ researchers

Source: InCites (article, review only) as of June 20, 2023

Status of Publications in Astronomy and Astrophysics by Country(2018-2022)

First Author Papers

	Rank	Number	World Share (Number)	World Share (Top1%)	World Share (Top10%)	Comparison with 2013-2017		
						Increase of #	Difference of World Share (Top1%)	Difference of World Share (Top10%)
Japan	7	5,608	4.7%	7.5%	5.0%	13.7%	**3.6%**	0.0%
The Netherlands	14	2,271	1.9%	5.6%	3.9%	16.5%	2.2%	0.5%
India	6	5,910	5.0%	2.8%	3.1%	54.4%	2.2%	1.7%
China	2	14,582	12.2%	5.4%	9.4%	**76.5%**	1.9%	**4.0%**
Spain	10	3,735	3.1%	4.5%	4.1%	10.6%	1.4%	0.6%
Russia	8	5,256	4.4%	2.1%	1.7%	17.8%	0.7%	0.1%
Korea	15	1,883	1.6%	0.9%	1.2%	3.9%	0.7%	0.4%
Israel	23	1,031	0.9%	0.9%	1.1%	27.3%	0.5%	0.1%
Chile	17	1,556	1.3%	1.4%	1.3%	14.0%	0.3%	-0.1%
UK	3	8,607	7.2%	11.6%	10.6%	12.3%	-1.0%	-1.5%
Canada	11	2,819	2.4%	2.8%	3.1%	5.8%	-1.0%	-0.5%
Switzerland	16	1,764	1.5%	3.4%	3.0%	9.9%	-1.3%	-0.3%
France	9	5,130	4.3%	7.1%	5.7%	**-2.4%**	-1.7%	-2.5%
Germany	4	8,533	7.2%	12.2%	11.6%	3.6%	-1.8%	-1.5%
US	1	28,446	23.9%	44.7%	35.7%	10.9%	**-8.8%**	**-6.4%**

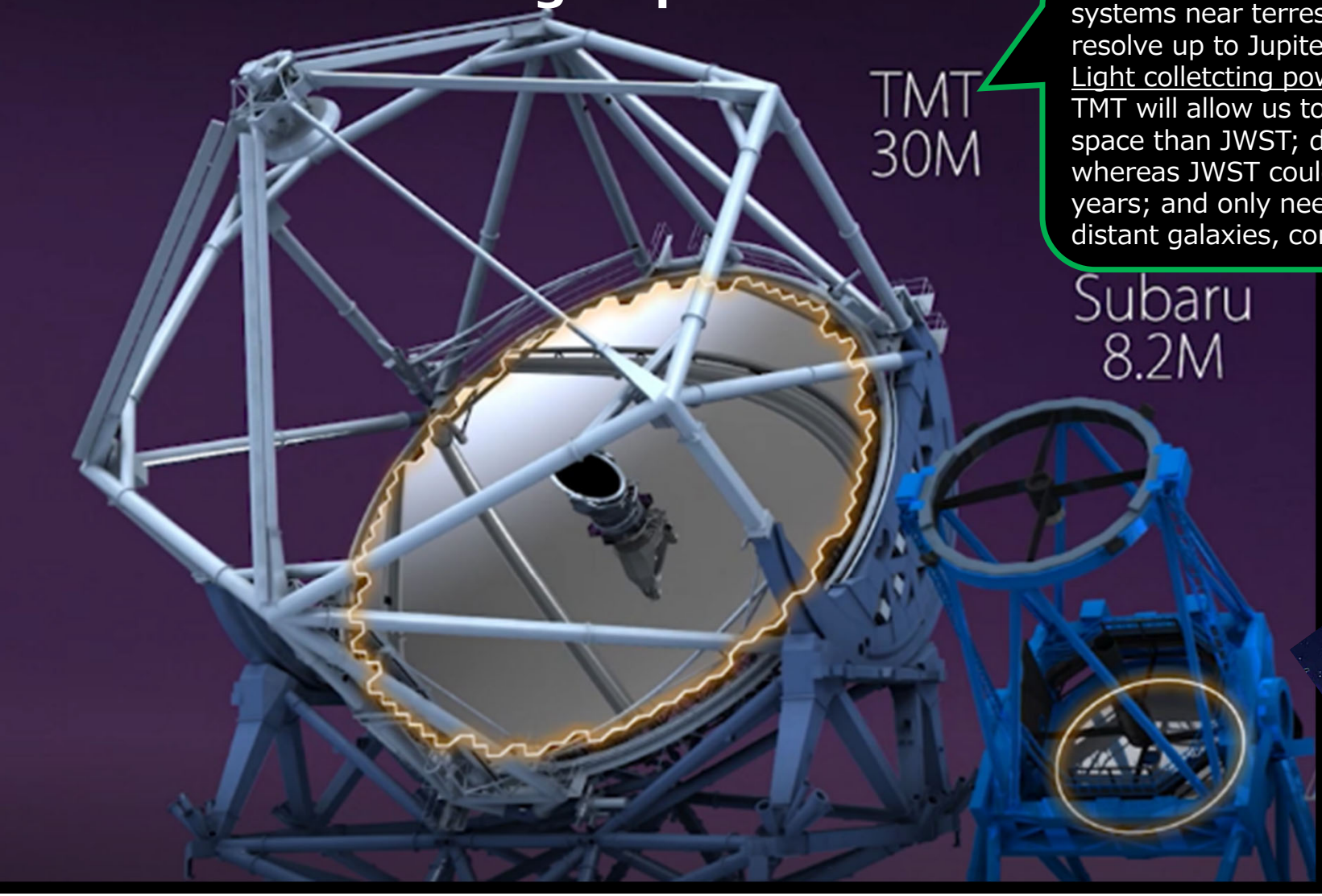
Japan's world share of Top 1% papers has increased in the last five years.
(First author paper ranks first in the world in terms of increase)

2023/6/20 Incites (article, review only)

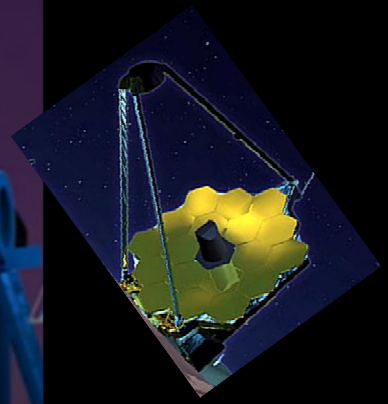
Subaru Telescope (8.2 m), James Webb Space Telescope (JWST 6.5 m) v.s. TMT(30 m)

TMT's Outstanding Capabilities

Resolution: **4.6 times.** TMT can resolve planetary systems near terrestrial orbit, while JWST can only resolve up to Jupiter's orbit.
Light colletcting power/Sensitivity **approx.20 times.** TMT will allow us to: observe about 100 times more space than JWST; detect 10 explosions annually, whereas JWST could detect only 1 case over 10 years; and only need 3 minutes exposure to observe distant galaxies, compared with 1 hour by JWST.



JWST
6.5M



① Changes in TIO Management

Improved TIO governance

NAOJ's initiative in improving TIO governance

- TIO management and its policy for Hawai'i drastically improved.
- **Appointed as Co-Chair of the Board, DG Tsuneta chaired Board meetings**, exercising the leadership in determination of agenda and discussion on substantive matters.
- New Working Groups were established to discuss the budget, the construction site in Hawai'i, and TIO governance. **DG Tsuneta chaired Business Plan WG and led discussion on budget-related material items**.
- **NAOJ TMT Director Usuda has facilitated productive discussion** of the Board and WGs by **closely working with Executive Director and Project Manager** since he was assigned to TIO headquarters in June 2019. He has also **helped to minimize the TIO's operation budget** by accurately understanding the budget and staffing from an internal perspective.
- **Senior Specialist Asaga (NAOJ Finance Controller) leads discussion on cost reduction and budget proposals at the Finance Committee**, leveraging his corporate experience in finance.

② Progress in Hawai‘i Situation (1/2)

Changed TIO’s perspective on Hawai‘i engagement

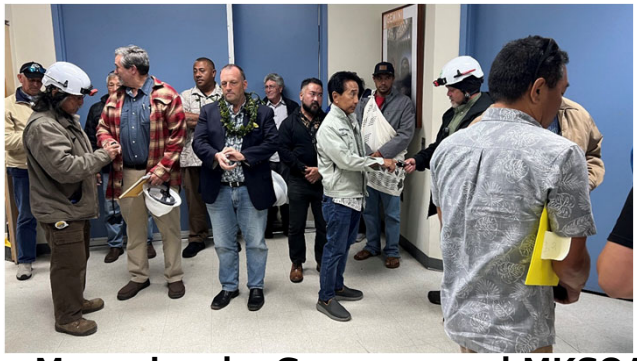
- At the Members Meeting in August 2019, NINS President Komori proposed relocation of TIO HQ to Hawai‘i based on his experience in construction of the National Institute for Fusion Science’s nuclear fusion reactor in 1997 and NAOJ’s experience in construction of the Subaru Telescope. This prompted TIO’ s phased relocation, starting with assignment of Project Manager to Hawai‘i.
- DG Tsuneta and others as TIO board members initiated **dialogue with Native Hawaiian protest leaders** in October 2019 (ho'oponopono).
- **TIO’s Hawai‘i Engagement Team was reshuffled** in 2021 by including Director Usuda and Senior Specialist Kakazu, both of whom had long worked in Hawai‘i, and employing Native Hawaiians.
- Since June 2021, PM Liu, Usuda, et al. have been actively engaging in **dialogue with TMT protestors, including Native Hawaiians**.
- Senior Specialist Kakazu developed an EOBSI Plan that incorporated **educational assistance and workforce development** as part of the proposal to NSF. Well received by NSF Director.

※EOBSI (Educational Outreach and Broader Societal Impacts)

② Progress in Hawai‘i Situation (2/2)

- **New Mauna Kea Management Authority called Mauna Kea Stewardship and Oversight Authority (MKSOA)*** formally started a transition period on July 1, 2023. MKSOA now co-manages the designated area on Maunakea with University of Hawai‘i (UH). MKSOA and UH hold a weekly meeting, setting up the co-management structure.
- **Hawai‘i Governor Green and MKSOA members visited Maunakea and TMT site on August 30, 2023**, accompanied by Subaru Telescope Director Miyazaki. An MKSOA member who is a Hawaiian cultural practitioner and a TMT protestor emphasized the significance of the summit for the Native Hawaiian culture, and also commented that the member was pleased that MKSOA provides the opportunity to talk with many people about Maunakea.
- **Caltech Submillimeter Observatory (CSO) is being decommissioned.** The telescope structure was disassembled and removed in September. The disassembling of the enclosure will be started in Spring 2024. MKSOA assigned three members to oversee the decommissioning process. UH’s Hōkū Ke‘a is also scheduled for decommissioning in 2024.
- On August 17, 2023, **UH Board of Regents adopted the resolution that in coordination with MKSOA, three more observatory sites to be decommissioned will be identified by January 2026.**
- TIO, along with NAOJ, expanded its efforts for dialogue with the local community; it **now engages in constructive dialogue directly with hardline opposition leaders.**

***) State of Hawai‘i established MKSOA that will replace UH to manage the designated area on Maunakea. MKSOA consists of 11 members, including Native Hawaiians and a representative of the Maunakea Observatories.**



Visit to Maunakea by Governor and MKSOA members

③ Progress in NSF Process for TMT Budget

- As a result of NSF's Preliminary Design Review which was conducted from December 2022 to March 2023, the Panel highly evaluated the project in its report submitted to NSF. Given the unprecedented scale of potential budget for the US-ELT Program, Directorate for Mathematical and Physical Science (MPS) convened a Blue Ribbon Panel (BRP) for further review which turned out to be a favorable result (July 2023).
- In response to BRP's result, the Facilities Readiness Panel (FRP) reviewed the project to consider the project's readiness for advancement to Final Design Phase on October 26-27.
- NSF awarded $6.5M to the project in response to one of TIO's proposals for design and development funding.
- NSF is currently identifying consulting parties for the consultation process under the National Historic Preservation Act. A Community Liaison was hired in September 2023 to establish relationships with Native Hawaiian and other communities. NSF is currently developing a study plan to implement with a view to producing a draft EIS.

DG Tsuneta's Fifth Meeting with NSF in August 2023

- Visited NSF on August 24, 2023 with Mr. Aribayashi, Counselor of the Embassy of Japan in D.C.
- 7 attendees from NSF, including Sean Jones (then MPS Assistant Director), Linnea Avallone (Chief Officer of Research Facilities), Robert Chris Smith (Interim Division Director, Division of Astronomical Sciences (AST)) et al.
- Dr. Tsuneta explained about Japan's contribution and budget status, and made requests, and exchanged opinions regarding NSF participation. NSF expressed interest in NAOJ Advanced Technology Center's industrial use of astronomical technology.

Report on NSF PDR for TMT Project (Executive Summary)

This report is a product of the Preliminary Design Review (PDR) Committee convened by the NSF in support of the US Extremely Large Telescope (ELT) Program. It reports the outcome of the PDR for the Thirty Meter Telescope (TMT) project being constructed by the TMT International Observatory, LLC (TIO).

TIO can be rightfully proud of how far they have already advanced the TMT project and the team they have built. **There are many challenges ahead but the project has clearly demonstrated its ability to recognize and address obstacles.**

The key takeaway from the technical and project management reviews is that **the TMT project is judged to be ready to proceed into the NSF Final Design Phase** (FDP). As identified by TIO, ~82% of the deliverables, weighted by total projected cost, are already in the TMT FDP or beyond. **Excellent systems engineering processes and practices are in use and the basic architecture is evolutionary from the Keck Telescope and overall low risk**. Due to reasonable prioritization of available funding there are still elements in preliminary or conceptual design phases, however these represent schedule risks more than technical risks. The high risk items not yet at preliminary design level are the fabrication of the secondary and tertiary mirrors, and the tertiary mirror tracking. There is still a risk that the phase discontinuities across the wide top-end struts have not been adequately analyzed to determine if mitigations are needed. The TIO proposed FDP activities are appropriate, however a number of modest refinements have been recommended in this report. The cost contingency estimates should be consolidated during the FDP.

The major program risk for the TMT project is the site. TIO is doing impressive work with the Hawaiian community to garner support for the preferred Mauna Kea site. It will be critical that TIO takes every measure to minimize environmental impact out of respect for and obligation to the native people who have traditionally stewarded this land. The permitting and design work for the alternate site at Observatorio del Roque de los Muchachos (ORM) **are in place and the site is well suited to carrying out the core science of TMT. In addition, the team has fairly well thought out backup plans if needed**.

Confidential

National Science Foundation

Report on the

Preliminary Design Review
of the
United States Extremely Large Telescope Program
Thirty Meter Telescope

Session 1: December 12th – 16th, 2022
Session 2: January 30th – February 3rd,
2023 Final Panel Report: March 2, 2023

bold and underlined by NAOJ)

④ Prospects for TMT Project

- **Consensus-building in Hawai'i:** The foundation for consensus-building is being laid out through MKSOA's start of full-fledged activities and Native Hawaiian communities' hopes pinned on MKSOA. NSF stresses its cooperation with MKSOA to consult with the local community. The direct dialogue between TIO/NAOJ and Native Hawaiian and other communities is helping to build this foundation. TIO/NAOJ will work with MKSOA and NSF to encourage the consensus-building process.
- **NSF Participation:** In response to Astro2020's recommendation of the project as a top priority, NSF is fully aware of the community's expectations and need for the US-ELT Program. Given the unprecedented scale of US-ELTP's budget request, NSF is considering it carefully, therefore taking longer than usual. The progress in NSF's process is not obvious for external parties, but NSF is moving the process toward advancement to the Final Design Review and securing of the construction funding.
- **Domestic Process**: MEXT and Council for Science and Technology are fully informed of and understand the achievement status of the project and NAOJ's work that is underway since the suspension of onsite construction. The budget request includes the additional funding required for TIO's continuation of business. NAOJ thinks the Roadmap 2023's selection of the project is needed for Japan's steady contribution to the project.

Progress on Consensus building in Hawai'i

U.S. government's enhanced engagement

NSF engaged in informal dialogues (~2021)

Published notice of intent to commence environmental and other processes

Succeeded in public meetings to exchange viewpoints in Hawai'i Island (2022)

Executed contract with Community Liaison and work with MKSOA

Will hold NHPA Sec. 106 meetings

Conclusion of agreement

Hawai'i's executive and legislative branches' joint work

Established WG under State Legislature to discuss new Maunakea management

Act 255 formed Mauna Kea Stewardship and Oversight Authority (**MKSOA**) to take over stewardship of the mountaintop from University of Hawai'i (UH).

Transition period started in July 2023, with annual budget of $14M and employment of staff

In coordination with MKSOA, UH will identify up to 3 telescopes to be decommissioned, in addition to 2 telescopes currently being decommissioned

MKSOA's consensus over TMT construction

TIO's policy shift

Reshuffled TIO leadership.
Reorganized Hawai'i engagement team.
Substantially increased NAOJ's involvement in TIO.

Ongoing direct dialogues with opposition groups

Proposed education and internship programs to NSF

Continued educational support in Hawai'i Island

Maunakea Observatories' partnership

Meetings of Directors of Maunakea Observatories (MKO)

Agreed to establish Maunakea Alliance for advancement of astronomy in Hawai'i on October 26, 2022

Discussion about MKO's future with MKSOA & relevant agencies

Work on issues with one voice by MKO, together with TMT

Direct dialogue with hard-line opposition leaders

5 sessions of ho'oponopono, traditional Hawaiian practice for reconciliation 2019~2020

Activities by Hawaii Executive Collaborative

Alleviation of long-standing issues in Hawai'i through future-oriented dialogue

Key Highlights of the FY 2024 Budget Request

- Advancing International Collaboration through Research with the Large Optical-Infrared Telescope (**Subaru Telescope 2.0**)
  - **Requested an increase** over the previous year's budget to cover expenses **for anti-aging measures and upgrading telescope functions**, in addition to the operating budget for the steady promotion of advanced research through the Subaru Telescope.
- **ALMA2 Project**: Atacama Large Millimeter/submillimeter Array in Search of the Origins of the Universe and Life
  - **Requested an increase** over the previous year's budget **for anti-aging measures and upgrading telescope functions**, in addition to the operating expenses for the steady promotion of international collaborative research through ALMA.
- **Thirty Meter Optical-Infrared Telescope (TMT)**
  - **Payment of contributions from each TMT partner country, as stipulated in the TMT Contributions Agreement, will be completed in FY 2023.**
  - **However, given the present circumstances regarding the consensus-building process with residents, requested an increase over the previous year's budget to cover additional contributions for maintaining international cooperation.**

NAOJ's two funding sources
Management Expenses Grants and Frontier Budget

Management Expenses Grant	Frontier budget
Covers for the expenses of the organization that excludes the expenses for Large-scale Academic Frontier Promotion Projects.	In 2012, MEXT established the Large-scale Academic Frontier Project to provide stable and continued support for major infrastructure projects that will create international research hubs. This funding is designed to respond swiftly and effectively to international competition and cooperation, reflecting a long-term plan called the Roadmap developed by a committee of MEXT's Council for Science and Technology (科学技術・学術審議会, CST).
The amount of funding is fixed, and its use is no specified.	A budget request must be submitted and reviewed for appropriation every year.
As this grant continues to be reduced, academic institutions are encouraged to seek alternative competitive funding sources. A portion of the grant is allocated on a merit basis, which expedites competition.	CST's committee formulates the Roadmap from the perspective of clarifying priorities in promoting large-scale projects. Based on the Roadmap and in consultation with CST, MEXT determines projects to be launched.
This grants supports Mizusawa VLBI Observatory, Nobeyama Radio Observatory, CfCA, all the other projects, 3 centers (ATC, ADC, PRC), labor costs, and general expenses.	Currently, the Frontier budget supports Subaru Telescope, ALMA, and TMT

NAOJ's World-renowned Large Observational Facilities

Large Optical-infrared "Subaru Telescope 2.0"
=Joint use and observations by researchers worldwide=

Subaru Telescope upgraded to Subaru Telescope 2.0

[Features]

- The only large telescope in the world capable of ultra wide-field observations.
- 8.2-meter diameter primary mirror, one of the largest monolithic mirrors polished to the world's highest precision
- Leading the world through the development of new science instruments using cutting-edge technologies

[Site]

Near the summit of Maunakea, Hawai'i, US (altitude: approx. 4,200m)

Cost: approx. 39.5 billion JPY

Construction Period: JFY 1991~1999

Large Radio Telescope "ALMA2"
=International collaboration between Japan, US, and EU=

Atacama Large Millimeter/sub millimeter Array

[Features]

A gigantic radio telescope capable of observing millimeter to submillimeter waves.

- ifty-four 12-meter antennas, and twelve 7-meter antennas (66 in total)
- Antenna configuration capable of reaching 16 km in diameter (equivalent to area encircled by the Yamanote-line)

[Site]

Atacama Desert, Chile(altitude: 5,000m)

Cost: approx. 25.1 billion JPY

Construction Period: JFY 2004~2013

30 m Optical Infrared Telescope "TMT"
=Promoted by Japan, US, India, and Canada=

TMT=Thirty Meter Telescope

[Features]

An optical infrared telescope with an aperture of 30 m, enabling up to 3 times finer spatial resolution, 10 times larger light collecting power, and 100 times higher sensitivity than 8-10 m class telescopes.

- Japan is in charge of producing the telescope structure and primary mirror
- Japan offers a unique scientific strategy by using TMT with the wide-field Subaru Telescope

[Planned Site]

Near the summit of Maunakea, Hawai'i, US (altitude: 4,012m)

Cost: approx. 41.5 billion JPY (Cost will increase due to delay of construction)

Period: aiming for completion in FY 2034

NAOJ's three large-scale projects open the door to new astronomy

① Are there other life-hosting planets besides Earth? (Subaru, ALMA, TMT)
② What is the true nature of dark matter and dark energy? (Subaru, TMT)
③ How did the Universe begin? (ALMA, Subaru, TMT)

Large-scale Academic Frontier Promotion Project

- In 2012, MEXT established the Large-scale Academic Frontier Project to provide stable and continued support for major infrastructure projects that will create international research hubs.
- **This funding is designed to respond swiftly and appropriately to international competition and cooperation, reflecting a long-term plan called the Roadmap developed by a committee of MEXT's Council for Science and Technology (科学技術・学術審議会, CST).**
- The fiscal 2022 budget was 33.7 billion yen.
- Currently, it has 14 ongoing projects based on the annual plan.

Flow of selection of projects before 2021

- **The Science Council of Japan (日本学術会議)** formulated a **"Master plan"** based on broad science research communities' visions.
- **CST** formulated a **"Roadmap"** from the perspective of clarifying priorities in promoting large-scale projects, referring to the Master Plan.
- Based on the Roadmap, **MEXT** considered new projects that should be launched immediately in consultation with CST, and made **budget requests**.

Large-scale Academic Frontier Promotion Project (as of 2022)

List of large-scale academic research projects

Large-scale academic frontier promotion project (11 projects)

"Efforts to Strengthen Research Capabilities of Universities
- Toward the Formation of Diverse Research Universities –
September 16, 2020, National University Research Institutes and Centers Conference Standing Committee (2nd meeting)
From University Research Infrastructure Development Division, Research Promotion Bureau

Relationship between the Master Plan of the Science Council of Japan (日本学術会議) and the Roadmap of MEXT Council for Science and Technology (科学技術・学術審議会)

(September 2, 2010, MEXT Council for Science and Technology, Science Subcommittee, Research Environment Infrastructure Subcommittee, Working Group on Large-Scale Scientific Research Projects)

https://www.mext.go.jp/component/b_menu/shingi/toushin/icsFiles/afieldfile/2010/10/29/1298715_2.pdf

2. Formulation of roadmap

The Science Council of Japan proposed a "Master Plan" (March 2010)・・・Consists of 43 research plans in 7 fields (each plan is evaluated from a scientific perspective)

The working group sets the evaluation perspective, conducts interviews etc. for each research plan and formulates a Roadmap.

[Contents of Roadmap]

・Outline of the plan ・implementation body ・required expenses ・plan period ・evaluation results ・main advantages, etc. ・main issues and points to consider, etc.

*The Roadmap does not guarantee budget measures, but it is material that should be fully considered when promoting related measures.

*The Roadmap will be revised periodically based on future revisions to the Master Plan.

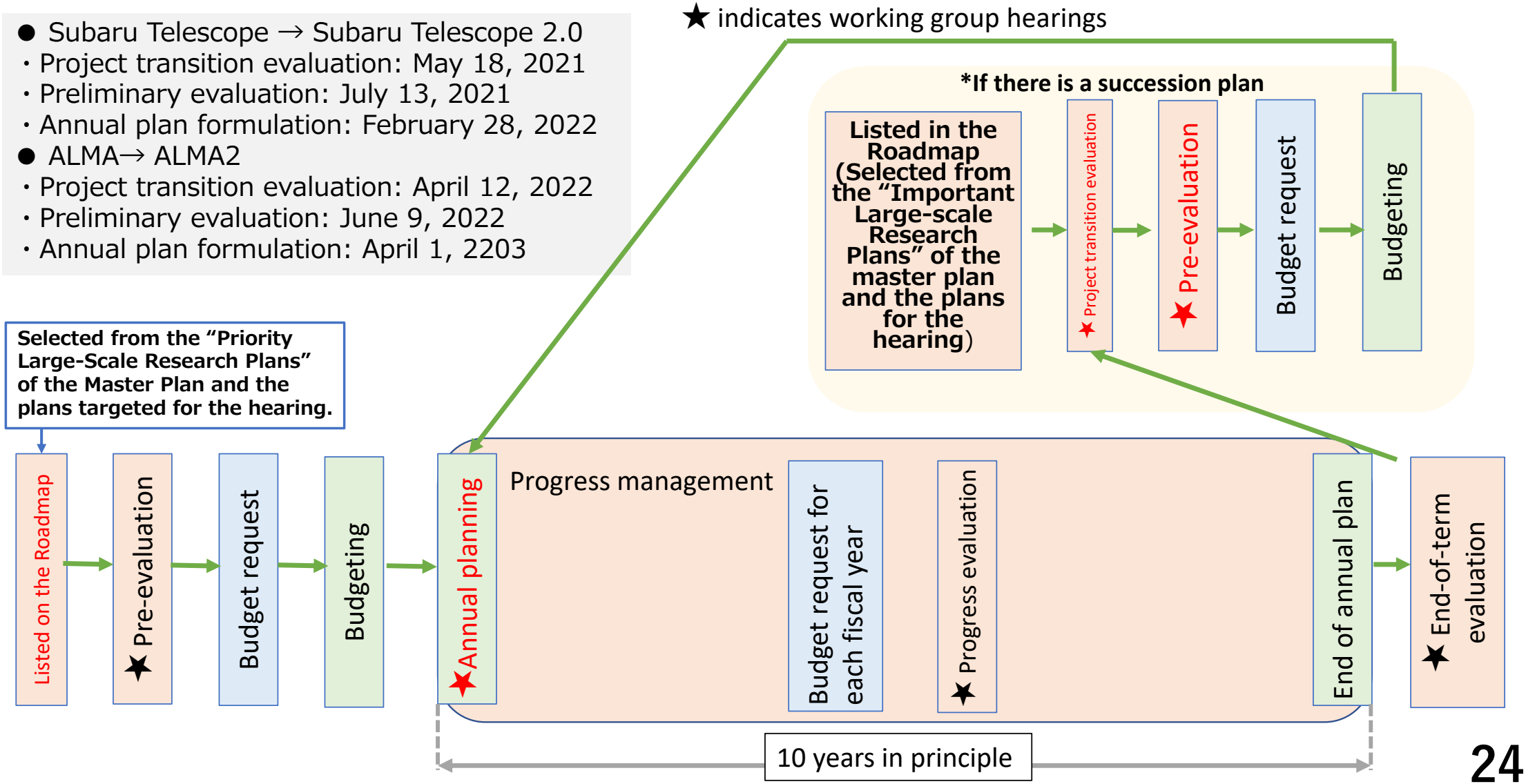
(2) Consideration based on the Master Plan

- The roadmap does not guarantee budgetary measures, but it is appropriate to use it as a material that should be fully considered when promoting related measures.
- Based on the Master Plan evaluated purely from a scientific point of view, the evaluation results, prominent advantages, issues, and points to consider for each research plan are organized from the viewpoint of clarifying the priority in promoting large-scale projects.

Large-scale Project Promotion (Frontier Project Management) Flow

★ indicates working group hearings

- Subaru Telescope → Subaru Telescope 2.0
  - Project transition evaluation: May 18, 2021
  - Preliminary evaluation: July 13, 2021
  - Annual plan formulation: February 28, 2022
- ALMA→ ALMA2
  - Project transition evaluation: April 12, 2022
  - Preliminary evaluation: June 9, 2022
  - Annual plan formulation: April 1, 2203



“Roadmap 2020” Listed Plans

*Working Group on Large Scientific Research Projects Research Environment Infrastructure Subcommittee, Science Committee, Council for Science and Technology

The MEXT's Council for Science and Technology (科学技術・学術審議会) reviewed 60 plans and listed 15 on Roadmap 2020.

1. terminated projects

- **TMT (Master Plan 2020 not adopted)**
- SPICA (Master Plan 2020 not adopted)
- LHD (Nuclear Fusion) (Master Plan 2020 was not adopted. Frontier project ended in 2022, but the budget has been requested as an academic research infrastructure project since 2022.)

2. Planned to end

- KAGRA (gravitational waves) (Frontier project ended FY 2022, evaluation at the end of FY 2023)

LiteBIRD has been adopted three consecutive times in 2014, 2017, and 2020, in both Master Plan and Roadmap.

- Quest for the origins and evolution of Universe and matter with high-intensity proton beams (High Energy Accelerator Research Organization)
- ALMA2: A Giant Millimeter/submillimeter Telescope in Search of our Cosmic Origins (National Institutes of Natural Sciences, National Astronomical Observatory of Japan)

“From Efforts to Strengthen Research Capabilities of Universities - Toward the Formation of Diverse Research Universities - September 16, 2020 National University Research Institutes and Centers Conference Standing Committee (2nd meeting) University Research Infrastructure Development Division, Research Promotion Bureau (translated by NAOJ)

Large-scale Cryogenic Gravitational Wave Telescope KAGRA (The University of Tokyo, Institute for Cosmic Ray Research)

Subaru Telescope 2.0 - Super Wide Field Large Optical-Infrared Telescope (National Institutes of Natural Sciences, National Astronomical Observatory of Japan)

LiteBIRD - A Satellite for Exploring the Universe before the Hot Big Bang with Measurements of Cosmic Microwave Background Polarization (Japan Aerospace Exploration Agency)

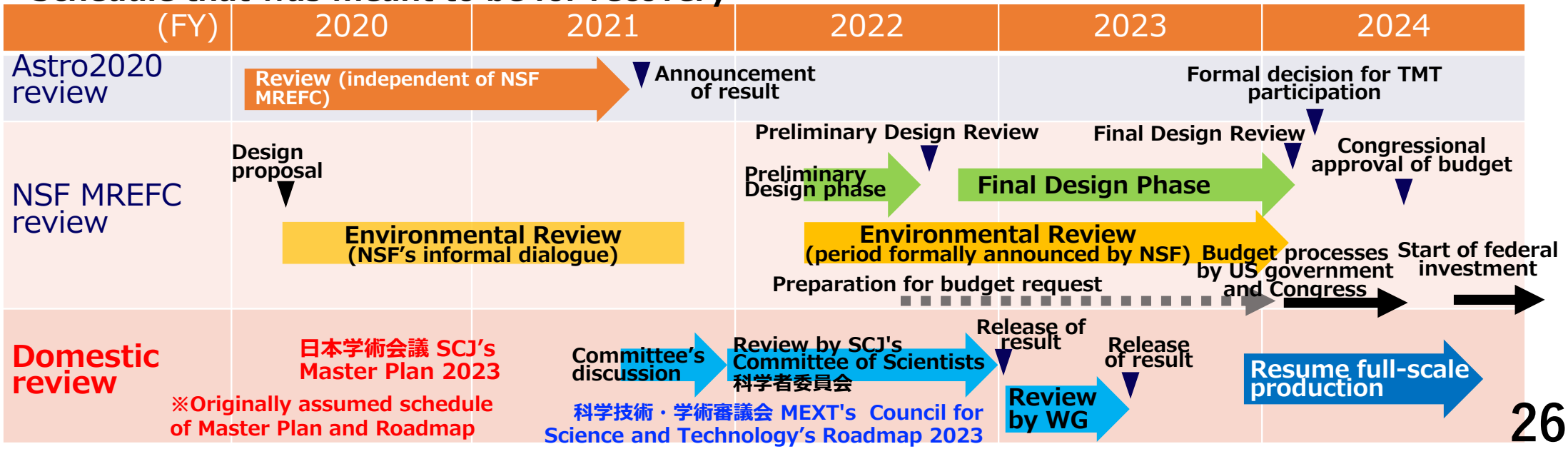
- **New developments in neutrino physics at Super-Kamiokande**(The University of Tokyo, Institute for Cosmic Ray Research)
- **N ext-generation academic research platform for promoting research data utilization, circulation, and management** (Research Organization of Information and Systems National Institute of Informatics)
- **Attosecond Laser Facility (ALFA)** (The University of Tokyo)
- **Building and Developing Spintronics Research Infrastructure and Network** (The University of Tokyo)

*Parentheses are implementing organization (core institution)
*Underlined are successor plans (8 plans) for Large-Scale Academic Frontier Promotion Projects

Science Council of Japan (日本学術会議) did not select TMT in Master Plan 2020, which seriously risked continuation of the large-scale international collaboration

TMT Project is an international collaboration where the partner countries have invested a significant amount of funding, and the development and construction work is steadily ongoing. In order for Japan to continue its work in accordance with TIO's master schedule**, it was essential for the project to be listed as a priority project in the Master Plan 2020 of Science Council of Japan (SCJ, 日本学術会議), and subsequently be selected in the MEXT Roadmap 2020, and continuously obtain the budget. While NSF is considering its participation in the US-ELTP, Japan's status became a serious concern.**

Schedule that was meant to be for recovery



End-term Evaluation Report on Large Scientific Research Projects, dated August 21, 2023

"Promotion of Thirty-Meter Optical/Infrared Telescope (TMT) Project"

Working Group on Large Scientific Research Projects, Research Environment Infrastructure Subcommittee, Science Committee, Council for Science and Technology MEXT

- In the annual plan previously submitted, the project was scheduled for start of 9-year-long construction in FY 2013 with completion in FY 2021. However, **due to unforeseen circumstances for the executing institution, on-site construction have been stalled since April 2015**. Please note that, **based on the understanding that external factors have delayed the project**, the WG reviewed the executing institute's role and achievement in accordance with criteria defined related to the evaluation of management.
- **Despite delays in the entire project due to a series of unexpected events, NAOJ has steadfastly assumed the responsibilities for its in-kind work to the extent possible**.
- The WG acknowledges that **NAOJ has significantly contributed to the overall project**. NAOJ introduced such measures for improving TIO's operational structure as a shift of the headquarters to Hawai'i and a reshuffle of its Hawai'i engagement team. Furthermore, starting with relocation of NAOJ TMT Project Manager and other staff members to Hawai'i, NAOJ's broad range of activities have helped to gain the local communities' understanding of the project.
- The WG recognizes **NAOJ's key role in advancing the project has strengthened the nation's trust and presence.** NAOJ has been fully participating in the project, taking the initiative in strengthening TIO's governance and reorganizing the project management structure, as well as assigning some NAOJ staff members to Hawai'i to actively carry out the community engagement activities to deepen trust and to continuously help with the communities' needs.
- Notwithstanding the suspension of on-site construction work, **the TMT project remains academically significant. It is expected to deliver scientific results which will be critical not only for astronomy but also for other areas of physics and Earth and planetary science.**
- **The issues surrounding the construction site in Hawai'i are not just TMT-specific matters, but have a major impact on consideration of the role of science in the society. The WG hopes lessons learned from this project will be widely shared with other large-scale projects under international collaboration.**

(original in Japanese, translated by NAOJ)

Future Plan for Science Promotion (未来の学術振興構想) and MEXT Roadmap

Past

- Apr. 2021: NAOJ submitted Letter of Intent for large projects of Master Plan 2023.
- **Sep. 2021: Group of Optical and Infrared Astronomers recommended TMT as the first priority large-scale project.**

～SCJ decided not to formulate the Master Plan any longer～

- Jan. 2022: SCJ's Astronomy and Astrophysics Committee determines the priorities of large projects for recommendation.
- Sep. 2022: Hearing and review by Scientists' Committee's WG for projects and funding consideration
- Jan. 2023: Master Plan 2023 is formulated and released
- Jan. 2023: SCJ's WG establishes evaluation criteria
- Spring 2023 : WG's hearing of research projects
- Summer 2023: Roadmap 2023 is formulated and released

Science Council of Japan (SCJ) "Future Plan for Science Promotion" 未来の学術振興構想

- Apr. 2021: NAOJ submitted Letter of Intent for large projects of Master Plan 2023.
- **Sep. 2021: Group of Optical and Infrared Astronomers recommended TMT as the first priority large-scale project.**

～SCJ decided not to formulate the Master Plan any longer～

- **Jun. 2022:SCJ announced the Master Plan will be replaced with the Future Plan for Science Promotion 未来の学術振興構想 which consists of the Grand Vision and the Plan for Science Research.**
- Jun. to Dec. 2022: SCJ widely invited proposals for the Medium to Long-term Research Strategy (Vision proposals and Science Research Plan proposals).
- Dec. 2022～: SCJ started reviewing proposals, and examining the Grand Vision.
- **Sep. 2023: SCJ's Future Plan for Science Promotion was formulated and released.**

MEXT's Council for Science and Technology "Roadmap"

～SCJ decided not to formulate the Master Plan any longer～

- Nov. 2022**: WG for MEXT's Council for Science and Technology started to discuss the basic policy for formulating its own roadmap in response to SCJ's decision not to issue the Master Plan.**
- Dec. 2022: The draft Policy for Formulating the Roadmap 2023 was developed, and public comments were solicited.
- May 2023: Call for proposals (by June 30)
- Nov. 2023: Hearing for review
- **Nov. to Dec. 2023: Roadmap 2023 will be formulated and released.**

Basic Concept Roadmap Formulation Policy for Promoting Large Scientific Research Projects

December 7, 2022, Working Group on Large Scientific Research Projects

- Until now, this Working Group has been formulating a basic concept "Roadmap" for promoting Large Scientific Research Projects, referencing the "Master Plan for Large Scientific Research Plans" formulated by the Science Council of Japan（日本学術会議）. **Because the Science Council of Japan has decided not to formulate a "Master Plan" like before, this Working Group（学術審議会作業部会）will formulate basic policies** to proceed with the selection process based on its policy regarding developing a Roadmap.
- Plans for Roadmap 2023 will be solicited from the public and selected after document review and hearing review.
- Eligible plans and proponents must have an implementation period of 5 to 10 years and a total budget more than **several billion yen and less than 200 billion yen**, which exceeds large-scale scientific research grants.
- The proposer shall be the head of a university (National/Public/Private universities, Interuniversity Research Institute Corporations, etc.) or a department (Dean of a Faculty/Graduate School, Director of a Joint Use Center Institution, etc.).

Completion date of the current plan for Large-Scale Academic Frontier Promotion Projects

	Subaru →	Subaru 2.0 (*1)	ALMA →	ALMA 2 (*1)	TMT
End of Current Annual Plan	FY 2021	FY 2031	FY 2022	FY 2032	**FY 2021**
Succession Plan	Subaru 2.0	Subaru 3.0?	ALMA 2	ALMA3?	**Under Review**
Road Map Status	–	Listed as Subaru 2.0 on RM2020		Listed as ALMA2 on RM2020	**Under Review**

(*1) A large-scale project working group conducted the business transition evaluation, preliminary assessment, and formulation of an annual plan for these project, and subsequently they were allowed to proceed to the next 10-yr plan.

Issues on MEXT's Large-scale Academic Frontiers Project

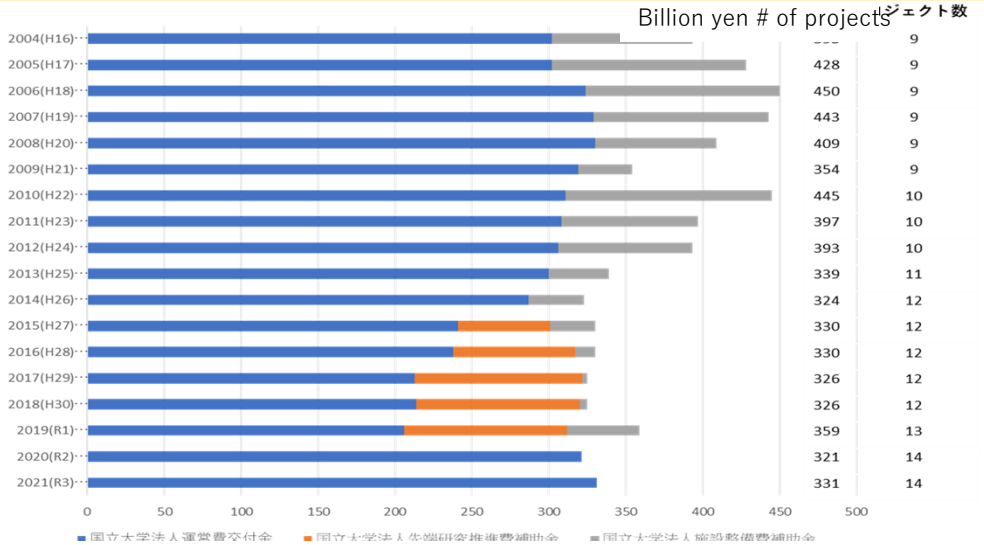
- **The budget for MEXT's Large-scale Academic Frontiers Project has never increased since its inception in 2012:** The purpose of this Project is to "strategically and systematically promote large-scale missions through stable and continuous support." However, falling under the Management Expenses Grant that continues to decline, the Project's budget has never expanded since its launch, in spite of an increase in the number of programs it endorses.
- **Given the nature of research facilities, a budget for operating expenses from the government is essential:** A facility that can be also used for non-academic purposes may be able to access funding that covers its operating expenses. However, given the nature of large research facilities which are mainly used by universities, the government's budget continues to be essential to operate and maintain them.
- **No exit strategy to close programs:** As explained right above, it is indispensable to maintain and enhance academic research through the government's continued allocation of budget. As no specific exit strategy is in place to close the Project's programs, new large programs are less likely to be adopted.
- **Increasingly reliant on subsidies, with a decreasing budget for operating expenses:** Amid a decrease in the Management Expenses Grant that can be spent on the operating expenses, NAOJ has to depend on subsidies to cover the operating expense of its projects, including a national university corporation's advanced research subsidy for ALMA and a facility maintenance subsidy for the TMT project. The problem with this is NAOJ has not been able to secure the budget for the Subaru Telescope and ALMA's current operating expenditure.

Issues Facing Large-Scale Academic Frontier Promotion Projects

Trends in the Budget for National University Corporation Operating Expenses Grants

From the materials of the “Study Committee on the State of National University Corporation Operating Expenses Grants during the Fourth Medium-Term Target Period” (2021.6.18)

Trends in the Budget for Large-Scale Academic Frontier Promotion Projects

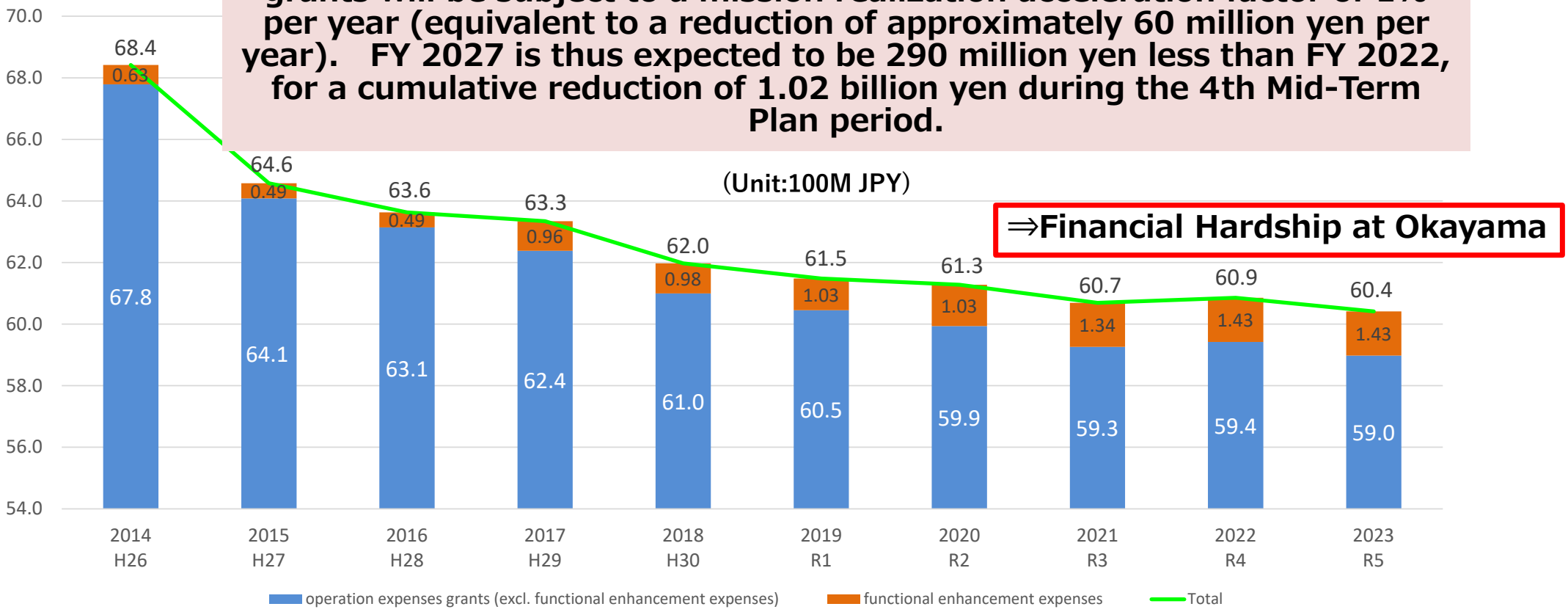


From the materials of the “Working Group on Large Scientific Research Projects” (2019.4.23)

FY 2022 budget is 33.7 billion yen

FY 2023 Operation Expenses Grants (NAOJ)

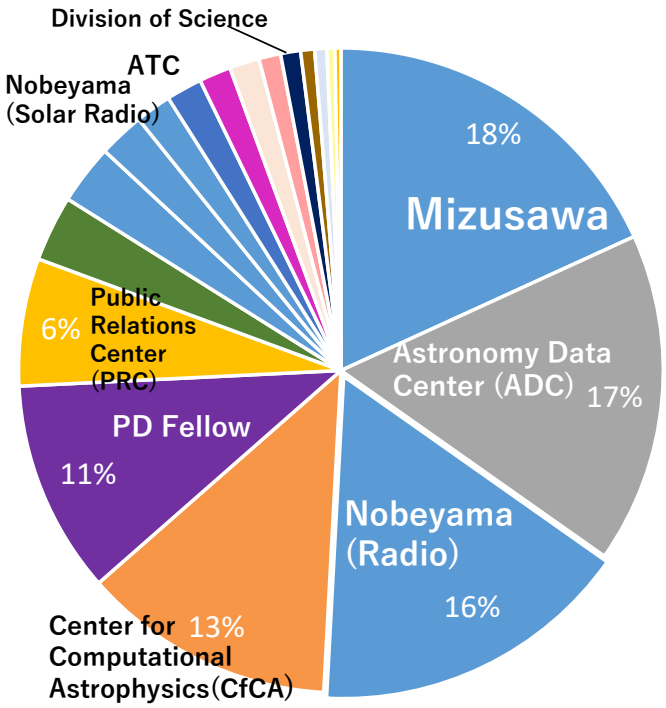
During the 4th Mid-Term Plan period (FY 2022-27), operation expenses grants will be subject to a mission realization acceleration factor of 1% per year (equivalent to a reduction of approximately 60 million yen per year). FY 2027 is thus expected to be 290 million yen less than FY 2022, for a cumulative reduction of 1.02 billion yen during the 4th Mid-Term Plan period.



※ allocations for functional enhancement expenses are for missions and strategies to be realized after FY 2022 (R4)

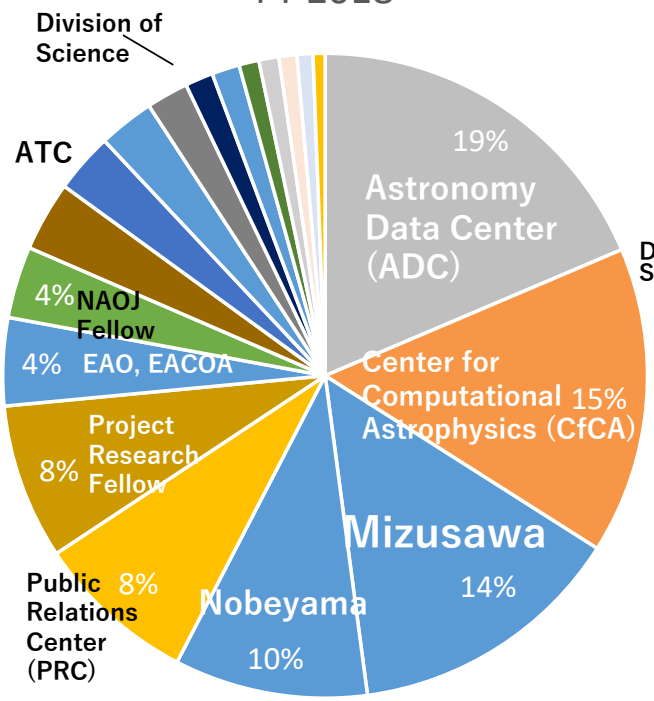
FY 2012, FY 2018, FY 2022 Operation Expenses Grants(1/2)

FY 2012



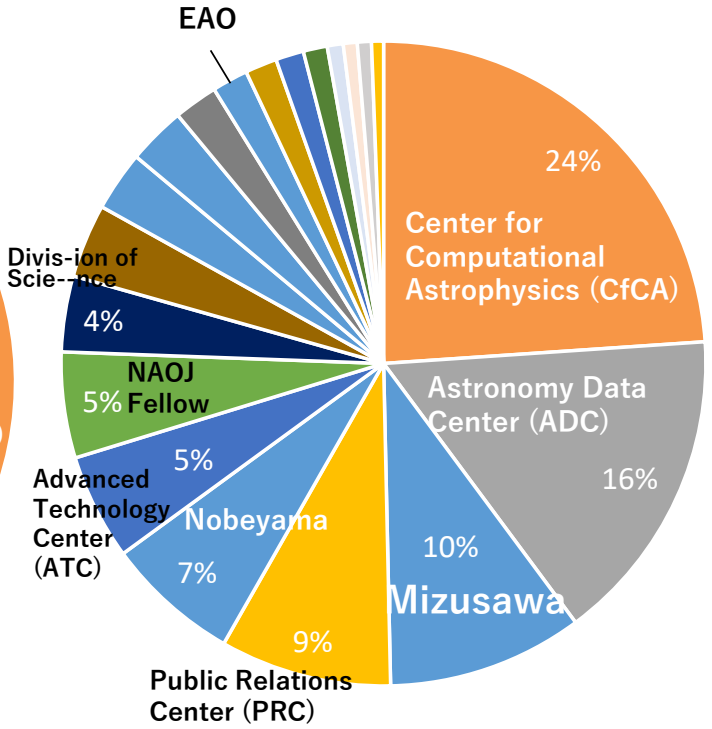
Breakdown of 2.63 billion yen out of the total 6.86 billion yen for operation expenses grants (excluding expenses for permanent staff, administration dept., and IT security)
※Division of Science refers to the total for all 5 divisions, including the divisions of Optical and Infrared Astronomy, Radio Astronomy, Division of Theoretical Astronomy, and Solar and Plasma Astrophysics

FY 2018



Breakdown of 2.8 billion yen out of the total 6.1 billion yen for operation expenses grants (excluding expenses for permanent staff, administration dept., and IT security)
※In FY 2018, allocations for EAO and EACOA were organized under one budget

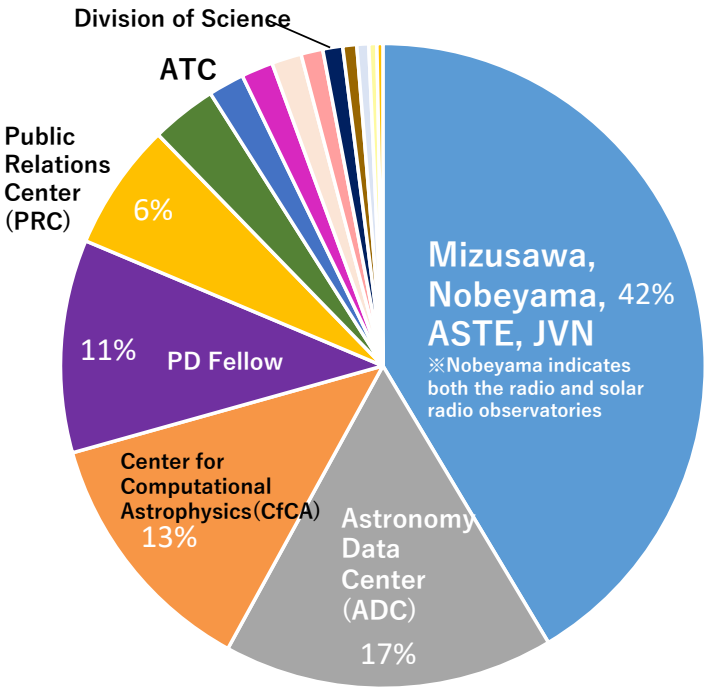
FY 2022



Breakdown of 1.93 billion yen out of the total 5.94 billion yen for operation expenses grants (excluding expenses for permanent staff, administration dept., and IT security)

FY 2012, FY 2018, FY 2022 Operation Expenses Grants(2/2)

FY 2012



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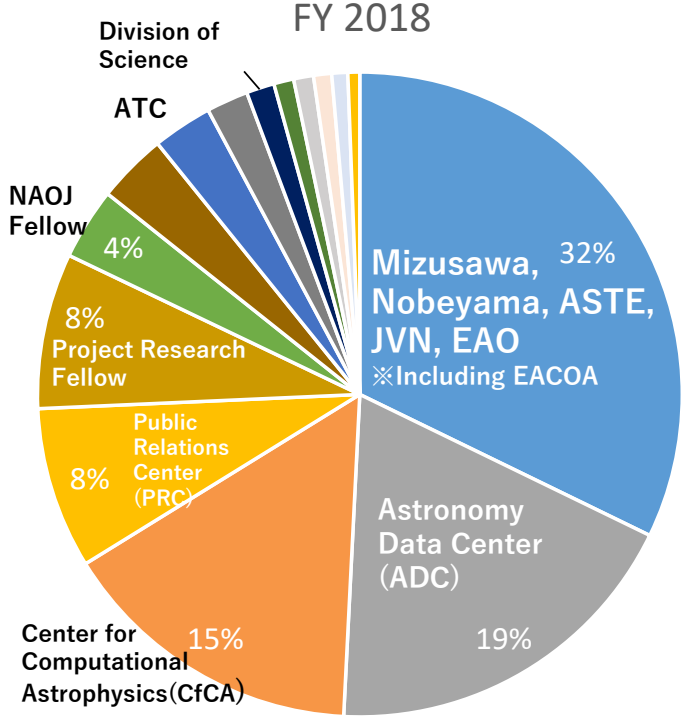
FY 2018



Breakdown of 2.8 billion yen out of the total 6.1 billion yen for operation expenses grants (excluding expenses for permanent staff, administration dept., and IT security)
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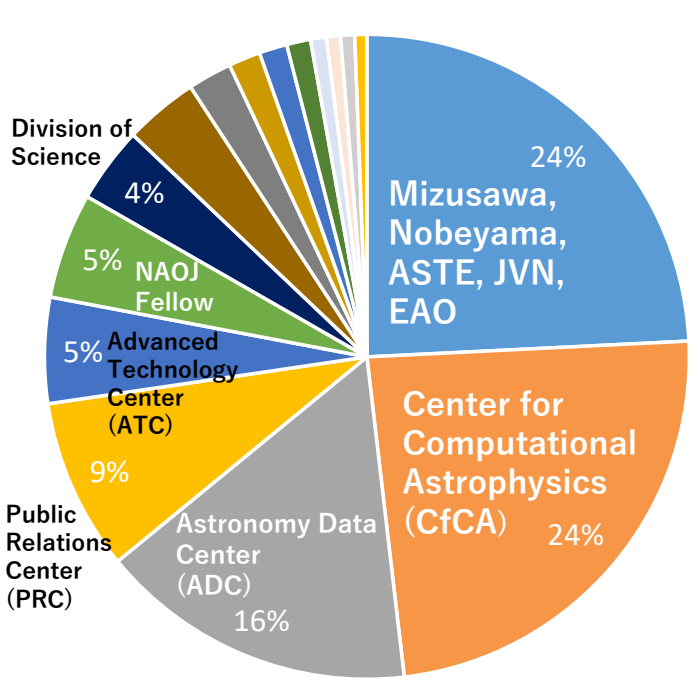
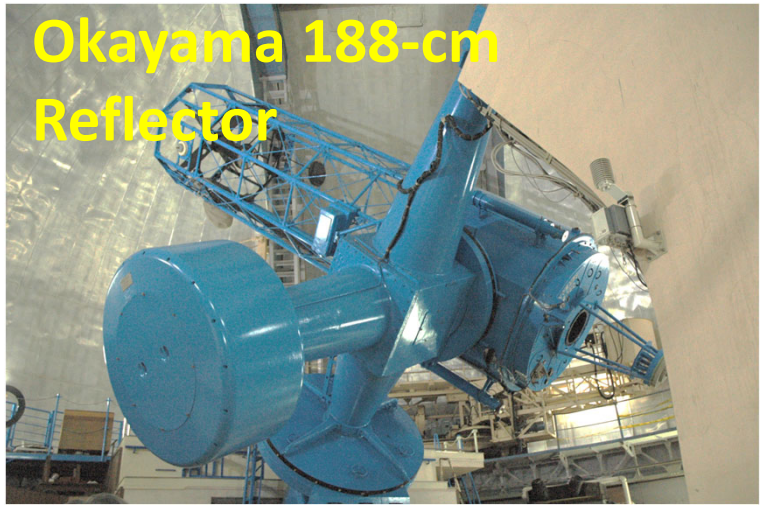
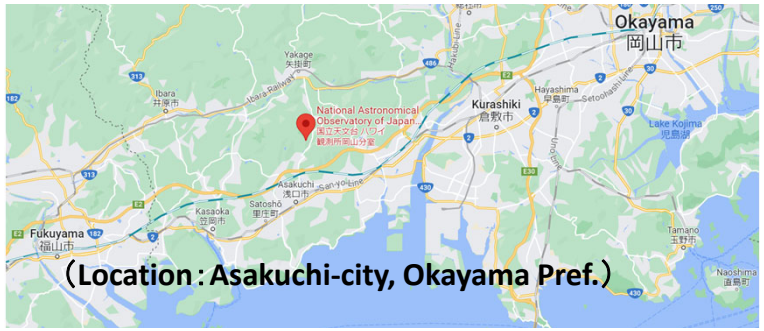
FY 2022



Breakdown of 1.93 billion yen out of the total 5.94 billion yen for operation expenses grants (excluding expenses for permanent staff, administration dept., and IT security)



- Began operation in 1960 (7th largest telescope in the world at that time).
- As of 2023, it is still the third largest in Japan.
- The observing instruments are continuously updated with the latest equipment.
- In FY 2018, the operation was shifted to a tripartite agreement between NAOJ, Tokyo Institute of Technology, and Asakuchi City.
- Almost all nights are intensively used for projects centered on the search for exoplanets.



（Location：Asakuchi-city, Okayama Pref.）

Dome accident

On September 29, 2022, the upper door fell down.

【How the accident happened】

- In the evening, when the slit doors were opened as usual, the upper door fell and collided with the dome structure (upper right photo, circled in red). The door can only be closed to 60 % of opening.
- The cause is presumed to be that the lower door opened while the upper door was caught and stuck on a damaged part of the upper door rail (steel plate), and after the upper door was separated from the lower door, the upper door fell freely.
- The damage to the rail section is assumed to be due to rapid aging for some reason (although ongoing maintenance has been performed).

【Post-accident measures】

- The day after the accident, an investigation was initiated with a local company that had been performing maintenance in recent years.
- Staff members of Okayama branch took measures to prevent rainwater from entering the slit door, and as of September 2023, these measures were almost completed.
- It has been confirmed that there is no damage to the 188cm telescope itself.
- The status of the accident was reported to Asakuchi City and Yakage Town (Oct. and Nov. 2022).
- The status was reported to Tokyo Institute of Technology and related researchers (Oct. 2022).
- As of October 2023, we are discussing specific restoration plans with several companies.

Tokyo Inst. of Tech. and Asakuchi City have requested early restoration, but observations have been suspended since the accident.

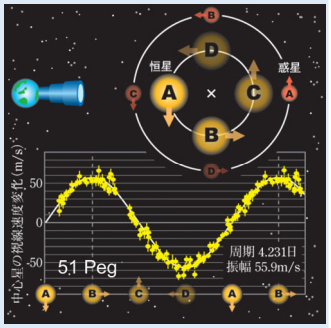
Scientific Achievements and Future Plans of the Okayama 188-cm Reflector Telescope

Long-term, frequent and continuous observation is essential to strategically produce results on exoplanets.
Subaru Telescope is difficult to use for such a purpose, and a dedicated telescope such as the Okayama 188-cm Reflector is needed.

Scientific results to date

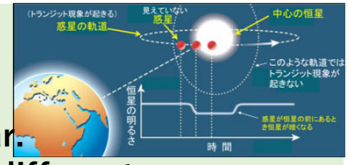
①Doppler technique (Spectrograph HIDES)

- ✓ Measurements of stellar wobble from hundreds to 1 m/s using iodine cell.
- ✓ The 188-cm telescope has discovered more than 50 planets since the early 2000s. It accounts for 30% of the world's planet discoveries around giant stars.
- ✓ As can be seen from the orbital periods of planets in the Solar System(Saturn ~30 years), stable and precise measurements over a long period of several decades are required.



②Transit method (Imager MuSCAT)

- ✓ Observation of a very small "shadow" of a planet as it passes in front of a star
- ✓ Differences in atmospheric opacity at different wavelengths enable atmospheric composition analysis.
- ✓ At the 188-cm telescope observations began in 2014 and a terrestrial planet was discovered taking advantage of the world-class photometry accuracy of ~0.2m mag.
- ✓ A global network has been established with three (very recently four) instruments of the same type for continuous 24-hour observations.



Goals for the next 10 years

Spectroscopic observation by HIDES

- ✓ Continue the search for another 10 years in regions as far as Saturn's orbit (i.e. half orbital period of 15 years), and reveal the planetary systems beyond the snow line (the boundary between where water exists in liquid and solid form, thought to lie between Mars and Jupiter in the Solar System).
- ✓ Search for terrestrial planets in roughly Earth-like or longer orbits by improving the accuracy (~ several 10 cm/s) using an astronomical comb.
- ✓ Search for a " second Solar System" and verify the (non)singularity of the Solar System.

Photometric observation by MuSCAT

- ✓ Planet discovery and characterization with high precision and high reliability by linking observations with three (very recently four) MuSCAT series instruments with space telescopes.
- ✓ The 188-cm telescope is one of the three longitude poles for continuous 24-hour observations, together with those in Europe and the continental United States.

Long-term goals

- ✓ Understanding the formation and evolution of planetary systems around Sun-like to slightly more massive stars.
- ✓ Discovery of a "second Solar System" in the solar neighborhood, bridging to research by TMT.

Development of Quantum Observational Technology using Okayama 188-cm Reflector Telescope

Goals for the next 10 years

Astronomy comb (+High Dispersion Spectrograph) Key Items for Exoplanet Search by Line-of-sight Velocimetry

Experiment with Astro-COMB at Okayama Branch
To be extended to Subaru Telescope 2.0 and TMT

- **Okayama Branch has been collaborating with AIST since 2014, aiming at a measurement accuracy in the range of several tens of cm/s using the world's most advanced technology**
- **For astronomical combs, it is important to match the performance of the comb to that of the spectrometer with respect to the wavelength range, etc.**
- **Development and experiments at the observation site is indispensable, and the Okayama Branch in Japan is the optimal site.**
- **AIST's astronomical combs have significant advantages in terms of durability and wide wavelength coverage.**

Phase I (project already started)
Line-of-sight velocity precision ~70 cm/s

Pursuit of high efficiency, high stability, and high precision with current spectrometer and comb

- Okayama
  - Improvement of the current Astro-COMB2 and stabilization of the current high dispersion spectrometer HIDES
- Subaru Telescope 2.0
  - Astro-COMB3 (under development based on COMB2, Kiban-A)
  - Improving the stability of the current high dispersion spectrograph HDS by adopting fiber feeding and other techniques.

Phase II (shifted by 5 years)
Line-of-sight velocity precision ~several 10 cm/s

Next generation observation with a new spectrometer (vacuumized) for ultra-stabilization and a new comb

- Okayama
  - Development of a new spectrometer in a vacuum chamber
  - Further development of broadband astronomical comb with AIST(COM4)
  - High efficiency due to the image slicer
- Subaru Telescope 2.0
  - Development of a new spectrograph with a vacuum chamber (ABC has started to study the possibility)
  - Utilization of the AIST Astro-COMB4 developed in Okayama
  - Miniaturization and ultra-stabilization of the spectrometer by extreme adaptive optics
- Further applications to a TMT 2nd generation instrument

<u>Dual approach to TMT research</u>: The 188-cm telescope has advantages in terms of frequency of observation due to its dedicated use and Subaru Telescope 2.0's large aperture is better for fainter objects. The target objects do not overlap.

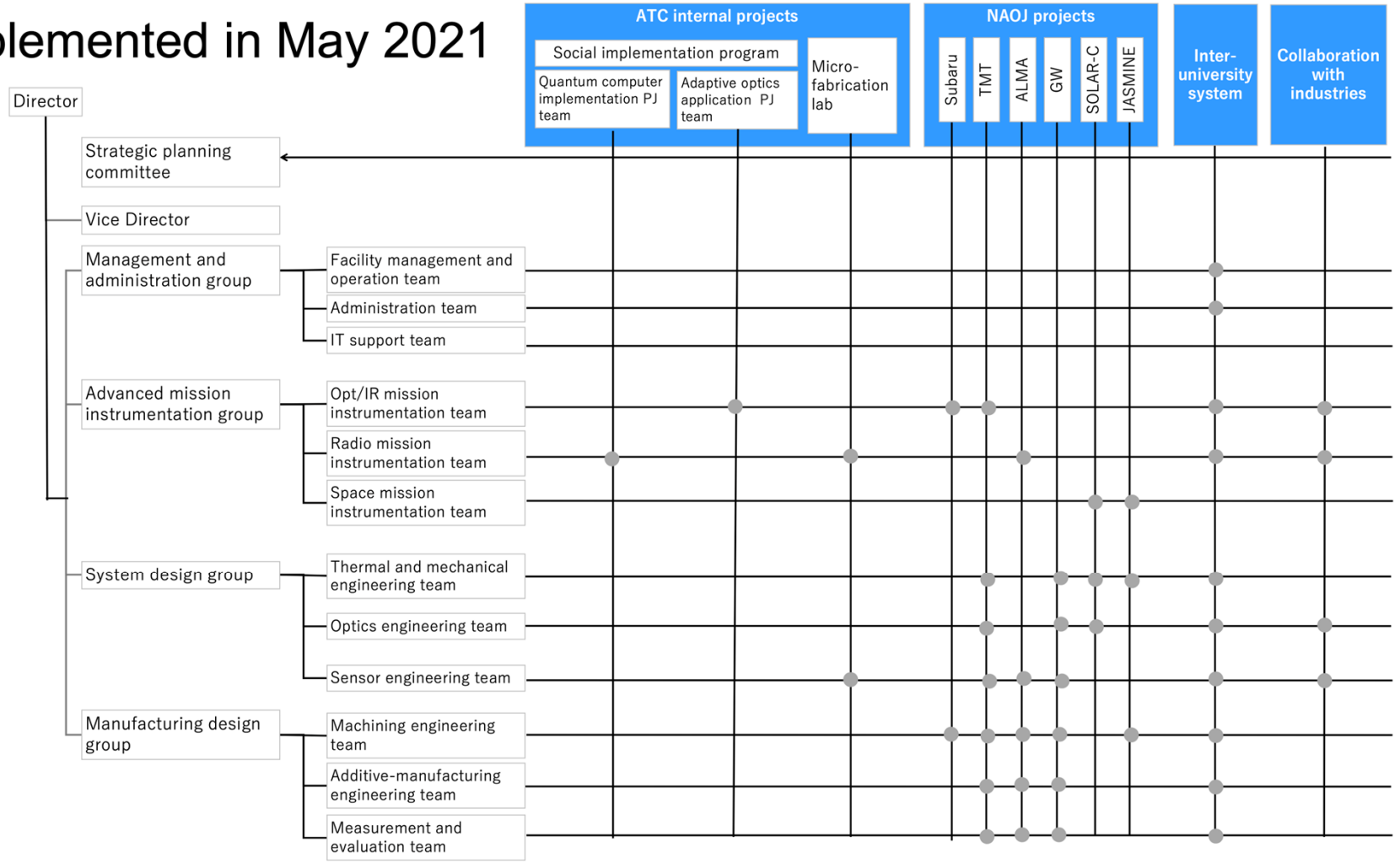
Future Vision and Reorganization of Astronomical Data Center 36
Big Data, Astroinformatics, Open Science

NAOJ, in principle, permanently archives all acquired observational data and opens to the world in a usable form.

- A large amount of observational data produced by Subaru Telescope, ALMA, Nobeyama, Okayama, Mizusawa, and university-owned telescopes have been archived and released independently due to historical circumstances. **Strengthen cooperation among these archives and consolidate multiple archives. In addition, organize a group of archive-related staffs across NAOJ to gather the best of technology, knowledge, and experience.**
- We are entering an "era of huge data", in which the amount of observational data is exploding with the evolution of observing instruments. To sustain archive operation, we are collaborating with other research institutes in the field of information technologies to evaluate and introduce new technologies such as cloud computing.
- Even in the era of huge data, where it is technically and economically impossible to archive all raw data, we are also searching and validating technologies such as lossy data compression that can selectively preserve only vital information to ensure the revalidation of scientific results.
- Strengthen cooperation between astronomical supercomputers, archive systems, and data analysis systems. Establish a "regional data center" for the Rubin Observatory, the ESA Euclid satellite, etc., and promote cooperation between the observation facilities of NAOJ and these advanced observation facilities.
- **Furthermore, utilizing these computer resources will create a research base for astronomical big data and AI analysis called astroinformatics.**
- By publishing and sharing the aggregated huge astronomical data assets as open data through the observatory, NAOJ will become a hub for research institutes and industries pioneering data analysis technology.
- **To accept data from university telescopes and continue to open the archives to the public in the era of huge data, it is essential to secure an operational budget. Therefore, it is also necessary to make NAOJ's efforts visible by concluding MOUs with university presidents.**

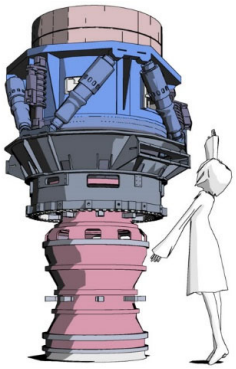
Organization Structure

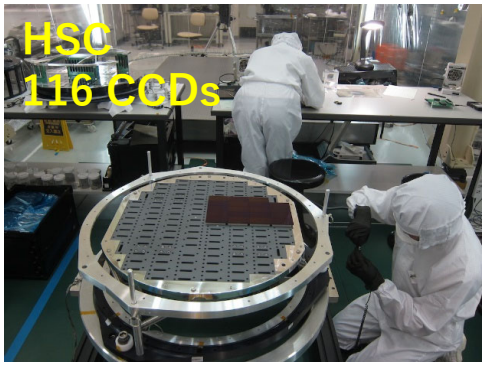
Implemented in May 2021



Achievements

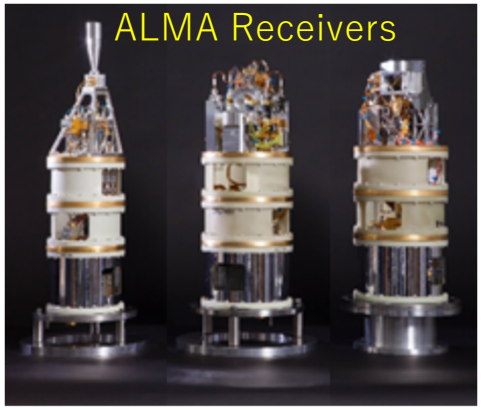
1) Instruments for Subaru Telescope:
Suprime-Cam (Prime-focus camera), Adaptive optics, Hyper Suprime Cam (1.5deg FoV prime focus camera), etc

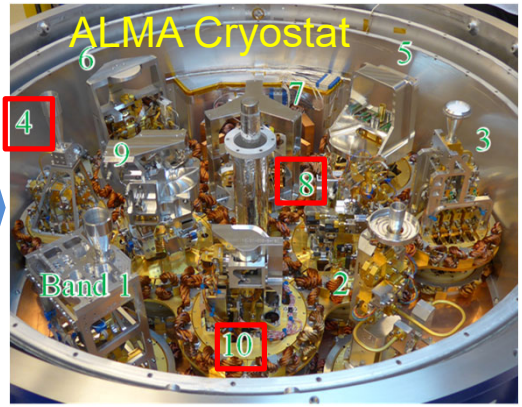




2) ALMA receivers:
Bands 4, 8, 10 receivers, 73 units for each band and 219 in total. Band 10 was the most challenging high frequency receiver for ALMA. ATC developed all the mixers and the systems in-house.

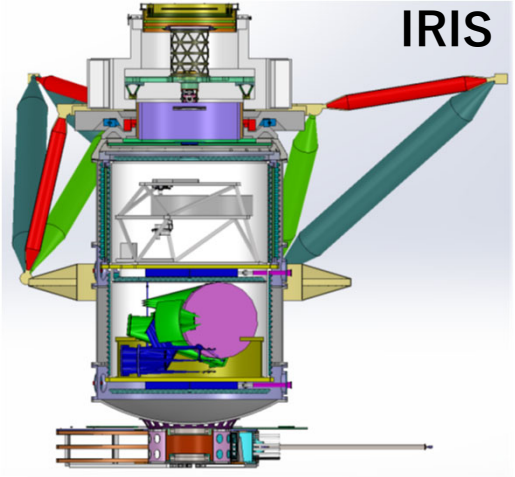
3) Space Instruments
Hinode (50 cm Solar telescope), CLASP (sounding rocket for Solar Ly-α spectroscopy)



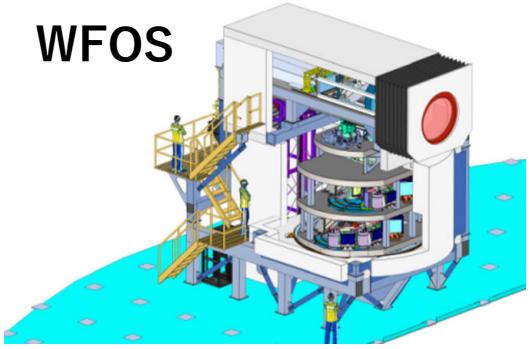


Current Activities

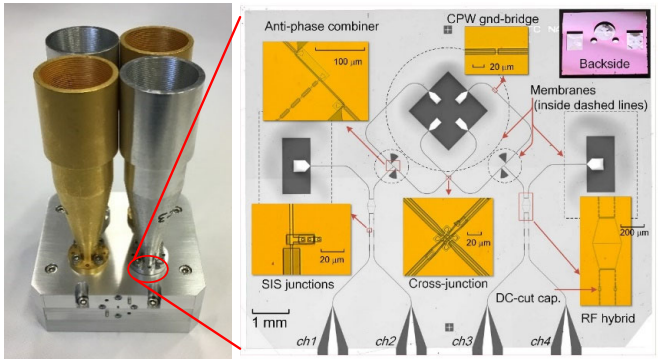
1) **TMT instruments** : IRIS (IR imager & spectrograph) imager development and WFOS
2) **KAGRA** : Optics, vibration isolation system
3) **ALMA next gen. receivers** : WidebandRF/IF of Band 8 and 10, Band 1, 2, Multi-beam, etc.
4) **Infrared detector** : InGaAs image sensor with low-noise CMOS readout circuit
5) **Space programs** : SOLAR-C, JASMINE Detector System

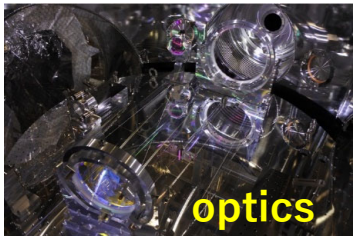


WFOS



Multi-beam receiver



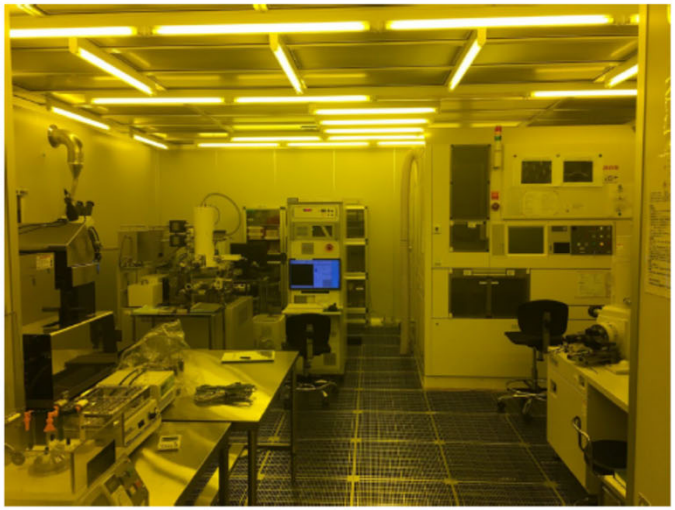


KAGRA

NAOJ's Social Implementation
From 'Technologies for Astronomy' to 'Technologies for Everyday Life'

NAOJ is working to leverage discoveries and technologies gained from astronomy to swiftly and efficiently tackle multidisciplinary challenges

With its world-class research and equipment and in response to strong demand from industry for joint research and development, NAOJ's Advanced Technology Center (ATC) and Industry Liaison Office are advancing the Social Implementation Program.



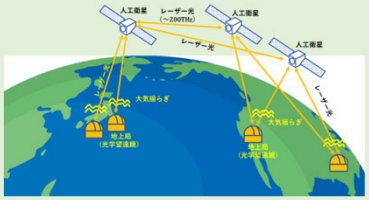
Astronomy Provides Versatile Solutions to Quantum Technology

AIST's Optical Frequency Comb (super-precise measure produced by laser sources. Nobel Prize in Physics in 2005) will be employed for TMT and other leading telescopes to discover Earth-like planets and directly detect expansion of the Universe.

Testing AIST's Comb at NAOJ Okayama Branch

Subaru Telescope's Adaptive Optics (AO) can dramatically improve space optical telecommunication

Ministry of Internal Affairs and Communication: R&D for next-generation AO device for optical satellite communication



Subaru Telescope's AO increases resolution of biological telescopes

Japanese Patent No. 6394850,Patent Application No. 2013-195943
Japanese Patent No. 6693030, Patent Application No. 2017-214103
US10254538, 15/023281
US11422636, 16/283175

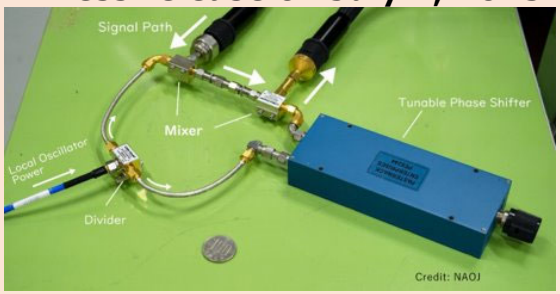
From ALMA Telescope Technologies to Quantum Computers and Beyond 5G/6G

Mighty Superconducting Amplifiers for a fault-tolerant universal quantum computer

Japanese Patent No. 7017752
US: 10680567 B2
Press release on March 20, 2023

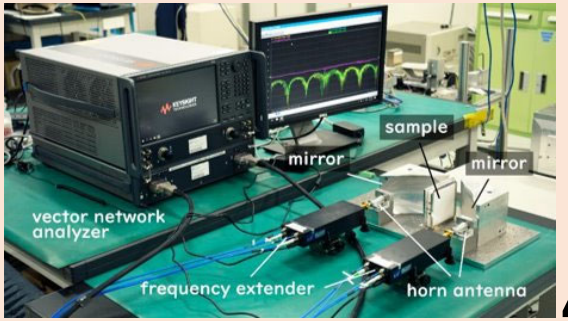
Novel Microwave Isolator for New Radio Cameras and Quantum Computers

Japanese Patent No. 2022-172655
US Application No. 18/485,112
Press release on July 4, 2023



Accurate Measurement of Permittivity Advances Radio Telescope Receiver and Next Generation Telecommunication Network

Currently in process for patent application



The Diet Members' Association for Frontiers of Astronomy

[Rationale]

Astronomy will allow humanity to open new frontiers, such as the elucidation of dark energy and the formation of celestial objects in the early Universe, the direct observation of Earth-like planets, and the search for the origin of life. It will also contribute to future innovations by utilizing cutting-edge science and technology, including information and communication science, and optical and electronic engineering. In addition, as a "future science," astronomy is expected to play an increasingly important role in nurturing the dreams of many young people and children and developing human resources with the science literacy necessary to live in future society.

To lead the academic frontier in astronomy, the government must strengthen its support for providing necessary resources, such as the development of larger and more sophisticated research facilities and equipment.

To this end, a non-partisan group of volunteer Diet members has come together to form the "Diet Members' Association for Frontiers of Astronomy," with the goal of studying various issues related to astronomy and providing strong support for Japanese astronomy and related basic research.

[Members (as of 2022.11.7)]

<House of Representatives>

Hajime FUNADA, Kisaburo TOKAI, Ryu SHIONOYA (Chair), Shigeki SATO, Masaharu NAKAGAWA, Tatsuya ITO, Motohisa FURUKAWA, Atushi OSHIMA, Keitaro OHNO (Secretariat), Takayuki KOBAYASHI, Taido TANOSE, and 9 others

<House of Councillors>

Masaji MATSUYAMA (Chief Secretary), Hideki NIIZUMA, and 6 others

[Past Meetings]

○August 28, 2019 Inaugural meeting
○October 17, 2019 Second meeting
○November 20, 2019 Third meeting
○November 27, 2020 Fourth meeting
○November 30, 2022 Fifth meeting
○November 09, 2023 sixth meeting

Communication with Domestic and International Policymakers

Visits at the NAOJ Mitaka Campus

Mr. Yanagi, Senior Deputy Minister of MEXT:
received an overview of NAOJ's projects and the role that NAOJ plays in Japanese astronomy and **exchanged opinions on NAOJ's past contributions and future plans for the TMT project.**

2023.4.17
Mr. Ide, Vice-Minister of MEXT

2023.5.1
Mr. Hoshino, State Minister of Cabinet

2023.6.27
Mr. Yanagi, Senior Deputy Minister of MEXT

Cooperation at NAOJ

Dr. Zurbuchen, Associate Administrator for the NASA Science Mission Directorate and his Delegation (2022.12.1)
Discussed a wide range of topics, including expectations for TMT, based on the advancement of international cooperation in ground-based and space-borne astronomical research. In particular, **expressed their expectations in having Japan join NASA's very large missions in the 2030s.**

Signed MOU with the University of Tokyo for the operation of the TAO telescope (2023.4.10)
The President of the University of Tokyo and the Director General of NAOJ renewed the MOU for operational cooperation of the nearly completed 6.5 m aperture infrared telescope at the Atacama Observatory **in hopes that the mutual cooperation between universities and Inter-University Research Institutes will lead to the creation of new scientific results in the future.**

Certificate of Appreciation Presented to Former Governor Ige of the State of Hawai`i (2023.5.8)
During Mr. Ige's visit to Japan to be inducted into the Order of the Rising Sun, NINS and NAOJ presented the former governor with a certificate of appreciation for his support for astronomy at Mauna Kea and his efforts to foster mutual understanding within the community throughout the eight years of his two terms.

Summary

- We have taken every opportunity to advance TMT for the past five and a half years. In comparison to 2019, when on-site construction was prevented, remarkable progress has been made in the situation in Hawai'i, NSF's process for federal funding, and MEXT's understanding of the project. Although it will take more time to secure a pathway forward, TMT can be achieved. For TMT's success, it is important that the astronomical community in Japan unite to speak with one voice.
- Operation expenses grants are not expected to increase in the future. NAOJ must make an effort to diversify budget sources. To this end, it is necessary to enhance the role and capabilities of the Advanced Technology Center.