



CAA March 2024

NSF/MPS/AST Update

R. Chris Smith, AST Division Director (Interim)

Jim Neff, AST Deputy Division Director

On behalf of the NSF's AST team

What we do?

We have ~\$250-300M per year to support U.S. astronomical community:

- We must have next-generation tools, including telescopes and instrumentation, that can support forefront astronomical research (**TOOLS**)
- We must have funding for people to do that research **now** (**SCIENCE**)
- We must develop a next-generation diverse workforce to do new science with next-generation tools (**PEOPLE**)

And

- We must protect our ability to observe the universe from the ground in optical and radio





NSF Top 5 Research News Stories of 2023...

#1: Astronomers Discover closest black hole to Earth

Astronomers using the International Gemini Observatory, operated by NSF's NOIRLab, have discovered the closest-known black hole to Earth. This is the first unambiguous detection of a dormant stellar-mass black hole in the Milky Way. Its close proximity to Earth, a mere 1600 light-years away, offers an intriguing target of study to advance our understanding of the evolution of binary systems.

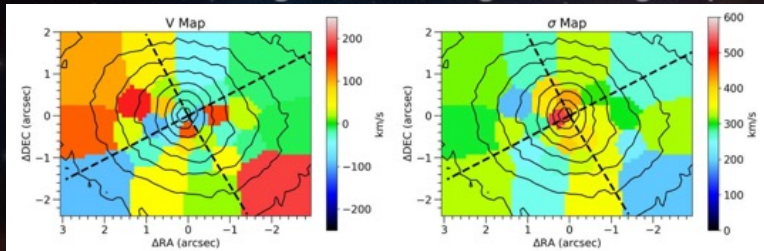
El-Badry et al, MNRAS, 518, Jan2023

Credit: International Gemini Observatory/NOIRLab/NSF/AURA/J.
da Silva/Spaceengine/M. Zaman

Heaviest Supermassive Binary Black Hole

In elliptical galaxy B2 0402+379

A 'fossil cluster' merged into one single massive galaxy



Best Fit Mass

$$2.8^{+0.8} \times 10^{10} M_{\text{sun}}$$

4C +37.11

$Z = 0.055$

GMOS IFU

Observations

7.3 parsecs:
Smallest binary black hole separation
ever directly measured

28 billion solar masses:
Largest combined mass

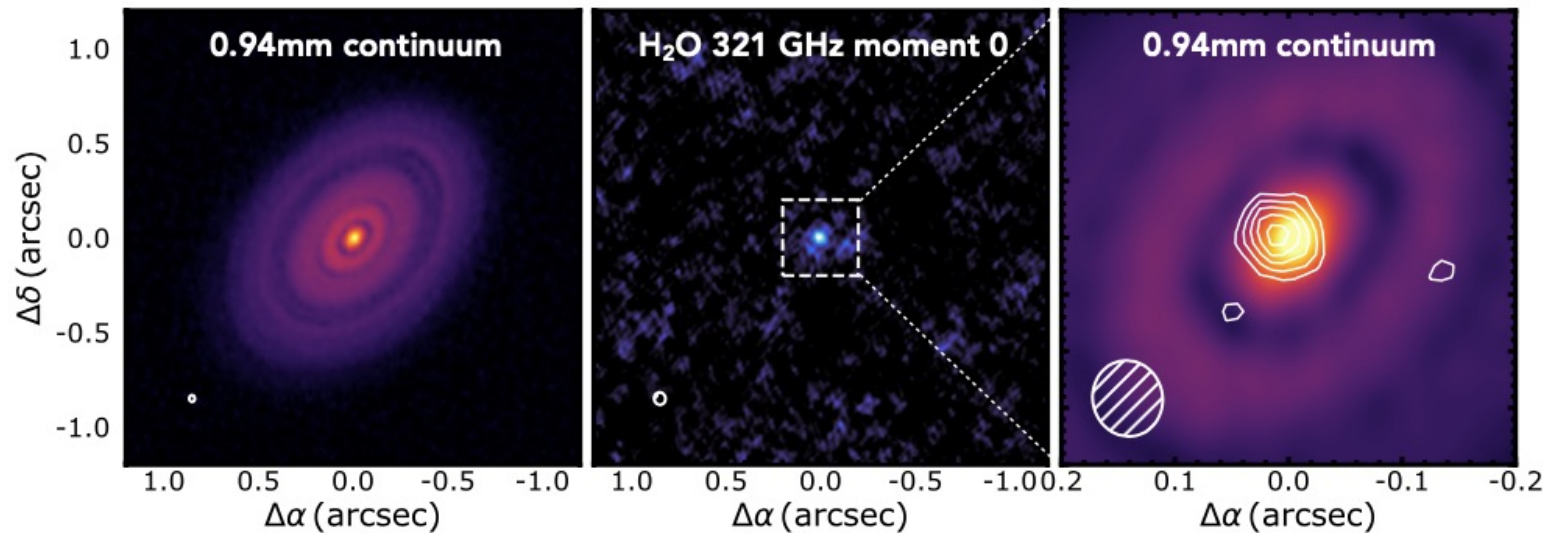
Observed by Gemini North's Gemini Multi-Object Spectrograph (GMOS), operated by NSF's NOIRLab

Suriti et al., 2024, ApJ 960, 110

Credit: NOIRLab/NSF/AURA/J. daSilva/M. Zamani

ALMA finds oceans worth of water in HL Tau

- Water is a key ingredient in the formation of planetary systems, with the water snowline being a prime location for the growth of planetary cores, as well as in the potential formation of life. ALMA observations of emission from water vapor in the protoplanetary disk around the young star HL Tau show very centrally peaked, bright emission at 0.1'' resolution.
- Due to the high dust column density and opacity, these observations probe the water content in the atmosphere of the disk. The spatially resolved water content probes gas in a thermal range down to the water sublimation temperature, implying a lower limit of 3.7 Earth oceans of water vapor in the inner 17 astronomical units.



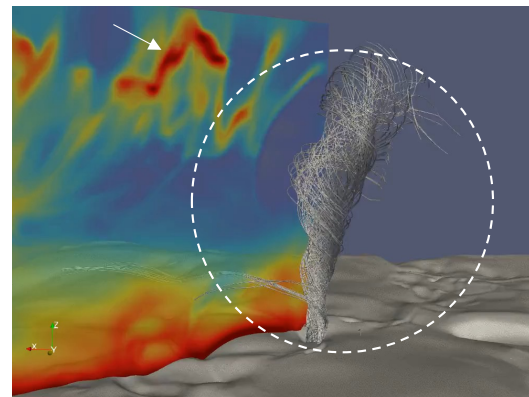
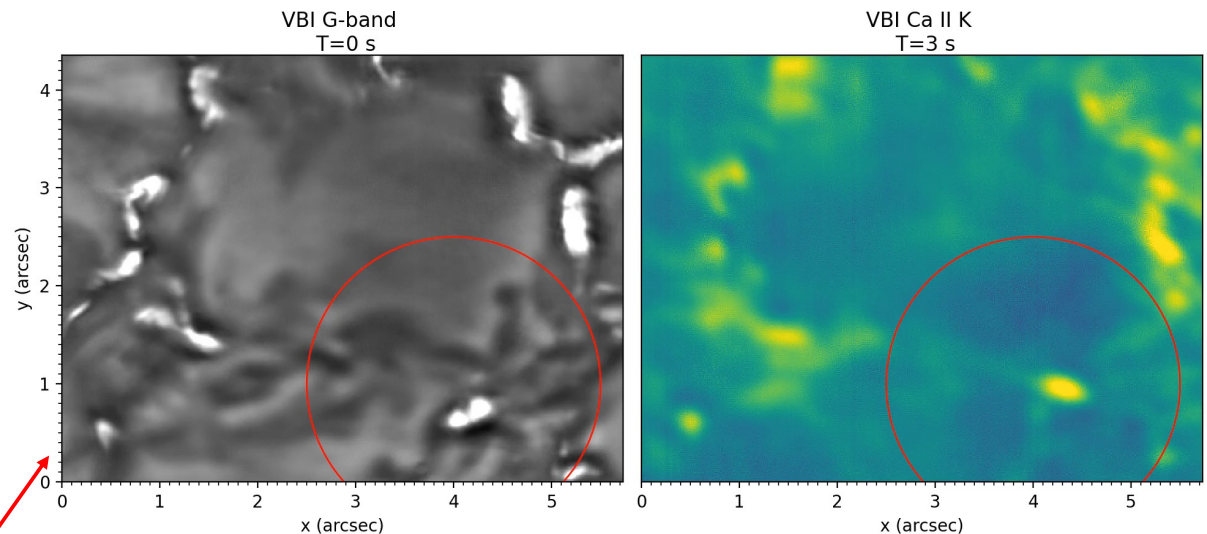
ALMA observations of the 1 mm continuum and water vapor emission from the 1 Myr protostar and protoplanetary disk HL tau (Facchini et al. 2024).

DKIST/Inouye Early Science: First Evidence for Horizontally Propagating Chromospheric Waves

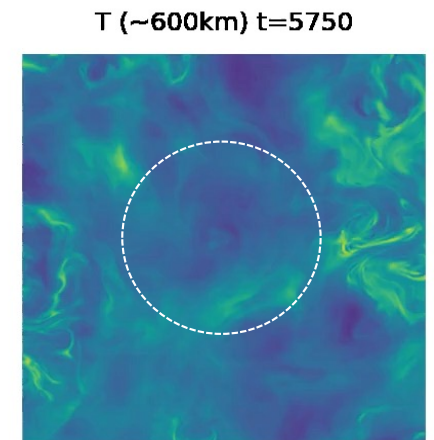
Inouye Observations: Wavefront
emanates from bright point →
localized energy deposition in the solar
chromosphere (C. Fischer, F. Woeger,
T. Rimmele et al. in prep.)

Minor tick marks are
~75 km on the Sun

MHD Simulations: Motions of the
magnetic flux tubes can trigger shock
fronts by pushing the plasma in their
vicinity (snowplow effect), e.g. Steiner
et al. 1998, APJ 495, 468.



3D Simulations Courtesy of V. Gangadharan



Synthesized Ca II K

Science & People: Workforce Development

		Description
AST	AAG	General Astronomy and Astrophysics Grants program
	REU	Research Experience for Undergraduates
	AAPF	Astronomy & Astrophysics Postdoctoral Fellows
	PAARE	Partnerships in Astronomy & Astrophysics Research and Education (institutional)
MPS	ASCEND	Postdocs with potential to broaden participation
	LEAPS	Early career faculty at institutions with little NSF STEM funding
NSF	GRFP	Graduate Student Research Fellowships Program
	CAREER	Faculty early career development for leadership
	GRANTED	Growing Research Access (institutional)

Throughout careers, NSF supports individual investigators with grant funding.

We want your proposals!

Key AST/MPS/NSF programs are devoted to training a diverse workforce and enhancing early careers.



LEAPS-MPS

- Support for pre-tenure faculty
- 24 months
- Up to \$250,000 total costs
- Meant to be a springboard to launch research careers
- **DEADLINE: January 25, 2024**

<https://new.nsf.gov/funding/opportunities/launching-early-career-academic-pathways>



AST Update | CAA March 2024 |

Launching Early-Career Academic Pathways in the Mathematical and Physical Sciences

[← Search for more funding opportunities](#)

i Important information for proposers

All proposals must be submitted in accordance with the requirements specified in this funding opportunity and in the NSF [Proposal & Award Policies & Procedures Guide \(PAPPG\)](#) that is in effect...

Supports the research of pre-tenure faculty in mathematical and physical sciences, with an emphasis on those at institutions that traditionally do not receive significant NSF funding, such as minority-serving, predominantly undergraduate or R2 institutions.

Synopsis

The Launching Early-Career Academic Pathways in the Mathematical and Physical Sciences (LEAPS-MPS) call has an emphasis to help launch the careers of pre-tenure faculty in Mathematical and Physical Sciences (MPS) fields at institutions that do not traditionally receive significant amounts of NSF-MPS funding, such as some minority-serving institutions (MSIs), predominantly undergraduate institutions (PUIs), and Carnegie Research 2 (R2) universities. LEAPS-MPS has the additional goal of achieving excellence through diversity and aims to broaden participation to include members from groups historically excluded and currently underrepresented in the Mathematical and Physical Sciences, including Blacks and African Americans, Hispanics, Latinos, Native Americans, Alaska Natives, Native Hawaiians, and other Native Pacific Islanders.

Expanded PAARE

- Encouraging new partnerships, expanding opportunity to a wider range of institutions
- Fully developed partnership concepts funded up to 5 years
- Shorter-term awards (1 to 2 years) available to develop new partnerships
- **DEADLINE: March 12, 2024**



<https://new.nsf.gov/funding/opportunities/partnerships-astronomy-astrophysics-research>

Partnerships in Astronomy & Astrophysics Research and Education (PAARE)

[← Search for more funding opportunities](#)

i Important information for proposers

All proposals must be submitted in accordance with the requirements specified in this funding opportunity and in the NSF [Proposal & Award Policies & Procedures Guide \(PAPPG\)](#) that is in effect...

Synopsis

The objective of PAARE is to improve the quality and environment of astronomy and astrophysics research and education by stimulating the development of formal, long-term partnerships that provide authentic pathways into the research enterprise and broaden participation in astronomy by encouraging proposals from the full spectrum of talent across society to include individuals from groups that have been historically underrepresented. Partnerships must substantially involve institutions seeking to create opportunities for student and faculty research that will increase the recruitment, retention, and success of these individuals. It is expected that the partnerships will build or strengthen research capacity, as well as foster a diverse, inclusive, and equitable environment for astronomy and astrophysics research and education at the partnering institutions.



Bringing together the Morris and Twin Cities faculty and students

Kapemni program is a partnership between two University of Minnesota (UMN) campuses, designed to provide engaging, thorough, and sustainable introduction of Morris students to astrophysics.

UMN Morris campus serves a large Native American undergraduate student population.

UMN Twin Cities campus features a strong astrophysics program with a broad research portfolio.



Minnesota Partnership to Foster Native American Participation in Astrophysics

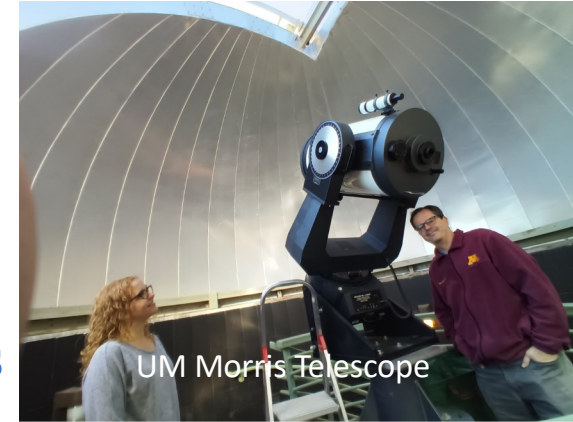
University of Minnesota,
Morris and Twin Cities Campuses

PI: V. Mandic

NSF Award: AST-2318841



Jim Rock presenting at the Workshop on Indigenous Astronomy, UMN Morris campus, Nov. 8 2023.



UM Morris Telescope

Astrophysics courses: online or in person; visits to the Twin Cities campus.

Research projects: integrated in existing research groups at the Twin Cities.

Outreach activities at Morris: Astronomy Days, Workshops on Indigenous Astronomy, public astrophysics lectures, telescope open nights...

Graduate programs: coaching students to prepare for and apply to graduate programs.

Building a Multi-Messenger Astronomy Research and Education Partnership that Creates Pathways to Astronomy Careers from Two HBCUs

NSF Award: AST 2319415

SCSU: Donald Walter, Jennifer Cash

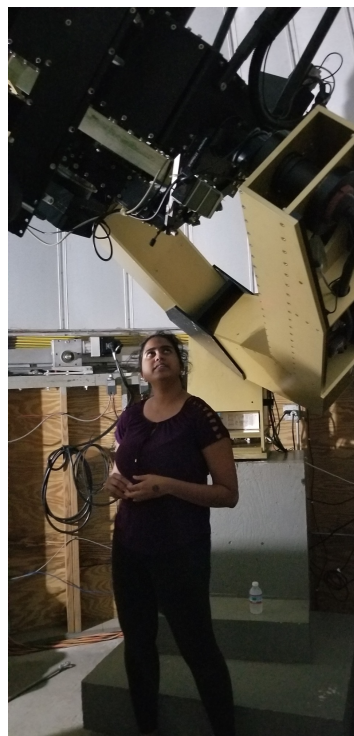
UVI: Dario Carbone, N. Brice Orange

CU: Marco Ajello

Project Mission: Develop an impactful and lasting partnership in astronomy and astrophysics among two HBCUs and an R1 Institution with true pan-directional benefit to all partners.

Project Goals

1. Advance scientific knowledge in time-domain and multi-messenger astronomy (MMA)
2. Establish a model for an MSI/R1 collaboration with pan-institutional benefit
3. Measure the impact of mental health, wellness, and professional development on students and faculty persistence and success in astronomy
4. Produce B.S. and M.S. graduates from minoritized populations for the STEM workforce



AST Update | CAA March 2024 |



LA SERENA SCHOOL FOR DATA SCIENCE

Applied Tools for Data-driven Sciences

- AURA Campus
La Serena - Chile

Applications for in-person August school are being accepted NOW!

DEADLINE: 31 March 2024

http://lssds.aura-astronomy.org/winter_school/

Windows on the Universe Community Report: Establishing the Infrastructure for a Collaborative Multi-messenger Ecosystem

<https://arxiv.org/abs/2401.02063>



What the main challenges for successful MMA
follow-up campaigns?

How should we coordinate MMA follow-up to
reduce operational redundancy?

How should we foster collaboration in the
MMA community?

How can we ensure that the MMA field reaches
its full potential over the next decade?



WINDOWS ON THE UNIVERSE
Establishing the Infrastructure for a
Collaborative Multi-messenger Ecosystem

**16-18
October
2023** **Tucson
Arizona
USA**

Conference in-person registration and abstract deadline: **1 September**
One-page science/infrastructure pitch deadline: **8 September**
Virtual registration deadline: **29 September**

SDC Members
Jennifer Andrews (Gemini/NSF's NOIRLab, Co-Chair) Ryan Lau (NSF's NOIRLab, Co-Chair) Monika Soraisam (Gemini/NSF's NOIRLab, Co-Chair)
Patrick Brady (University of Wisconsin-Milwaukee) Brad Cenko (NASA/USPC) Alessandra Corsi (Texas Tech University) Adam Goldstein (USRA/STI)
Armin Rest (STScI) Jessie Runnau (Vanderbilt University) Hugo A. Reyes Salazar (Penn State) David Sand (University of Arizona/Steward Observatory) Rachel Street (LIGO)

LDC Members
David Jones (Co-Chair) Yuanqun Zhang (Co-Chair)
Jessica Harris Clara Martinez-Vazquez Tom Matheson Bryan Miller Jayadev Rajagopal

AST Update | CAA March 2024 |
<https://noirlab.edu/science/events/websites/MMA2023>

NSF's logo and all other marks are the property of the National Science Foundation. ©2023 NOIRLab NSF 00000001-8000-0000-0000-000000000000

MMA Solicitation

NSF 24-542: Multi-Messenger Coordination for Windows on the Universe

- *“The community has identified the need to better harmonize [ground and space facilities & software] resources and interconnect users. The MMC-WoU program will support the development of pathways or networks to increase the coordination and optimization of follow-up observations for MMA campaigns”*
- Awards anticipated in FY2024
- Anticipated funding \$7.5M, spread over 3-4 awards
- Proposal Deadline: **May 13, 2024**



NEW: AI Institutes for the Astronomical Sciences

- Awards anticipated in FY2024
- Proposal Deadlines
 - Preliminary: Oct 31, 2023
 - Full proposals: Feb 16, 2024
- Expecting to fund 2 Awards: \$16-20M each for 4-5yrs
- In collaboration with Simons Foundation



[← Search for more funding opportunities](#)

i Important information for proposers

All proposals must be submitted in accordance with the requirements specified in this funding opportunity and in the NSF [Proposal & Award Policies & Procedures Guide \(PAPPG\)](#) that is in effect...

Supports the development of new AI Institutes that focus on one of the following themes: astronomical sciences, materials research and new methods for strengthening AI.

TOOLS: Technology & Instrumentation

AST Advanced Technologies
& Instrumentation (ATI)

NSF Major Research
Instrumentation (MRI)

AST Mid-Scale Innovations
program (MSIP)

NSF Mid-Scale Research
Infrastructure 1

NSF Mid-Scale Research
Infrastructure 2

- Broad portfolio of technology development and innovation
- Heavily oversubscribed but critical to keep pressure on!



TOOLS: Major Research Facilities

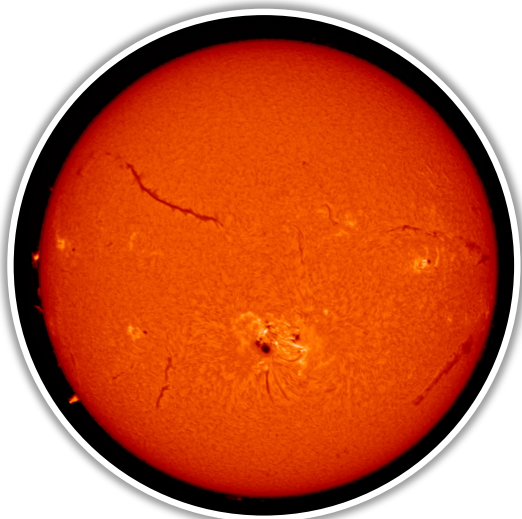
Operated as Federally Funded Research Development Centers (FFRDCs):

- National Solar **Observatory** (DKIST, NISP program including GONG)
- NOIRLab **Observatories**: (Gemini-N, Gemini-S; Mayall, WIYN and tenant telescopes at Kitt Peak; Blanco, SOAR, and tenant telescopes at CTIO; and soon Rubin Observatory operations)
- National Radio Astronomy **Observatory** (VLA, VLBA, ALMA)
 - Green Bank **Observatory**

These facilities give public access to any astronomer with a strong proposal, broadening participation.



NSF National Solar Observatory: The FFRDC for Solar Astronomy in the U.S.



NISP/GONG/SOLIS

Synoptic, full-disk observations

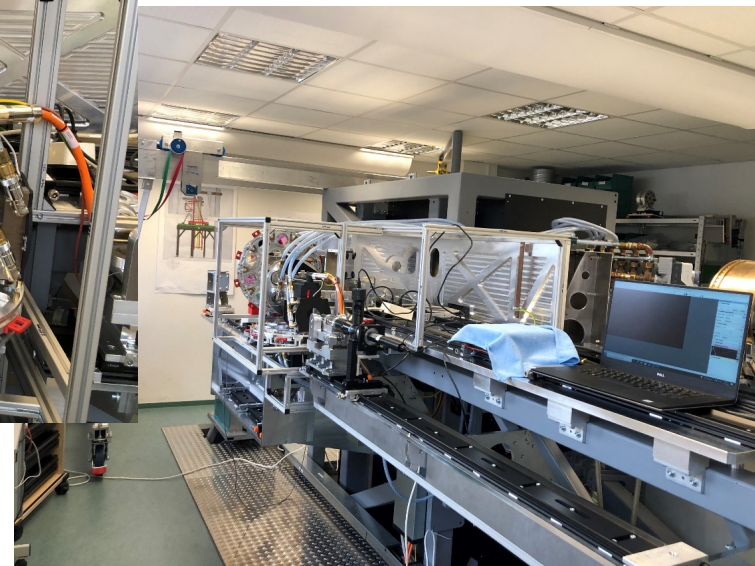
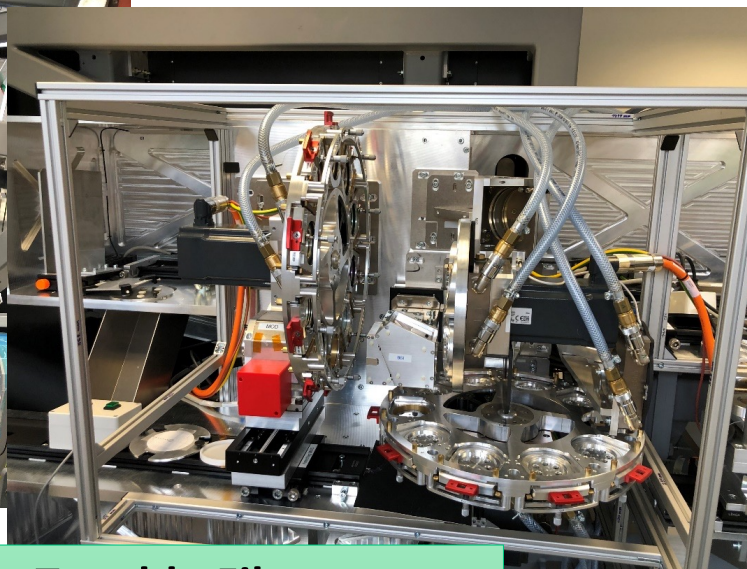
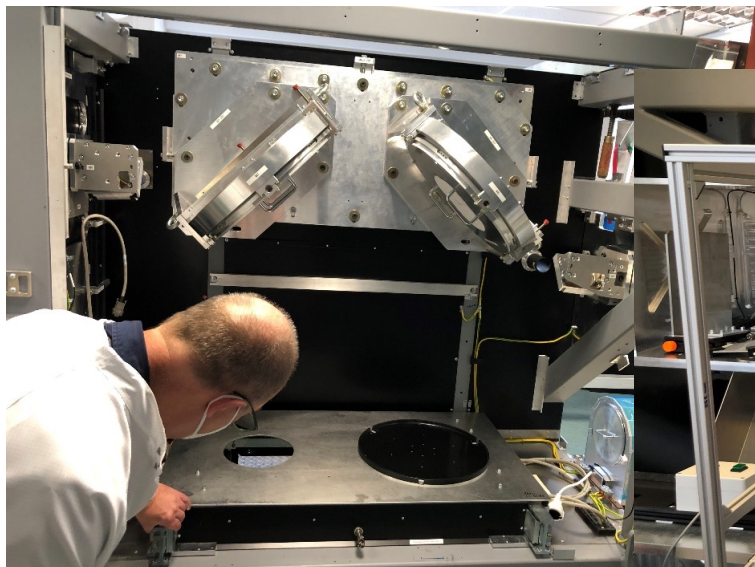


Inouye/DKIST

Targeted, high-resolution observations



Instrument contribution from Germany



**Visible Tunable Filter
Arrived at DKIST late 2023
Integration in 2024**

Sun...Moon...You!

OCTOBER 14, 2023
ANNULAR SOLAR ECLIPSE

APRIL 8, 2024
TOTAL SOLAR ECLIPSE

AAS
AMERICAN
ASTRONOMICAL
SOCIETY



Solar eclipses 2023-2024:

An opportunity to excite interest in STEM. Developing educational packets with protective filters and gratings.

NSF, NSO, NOAA, NCAR, NASA, AAS, ASP, coordinating with philanthropic groups (Simons Foundation and others).

NSF-led live broadcast on April 8th



AAS Call/NSF Funded: Jay M. Pasachoff Solar Eclipse Mini-Grants Program
Citizen CATE 2024 (Citizen Continental-America Telescope Eclipse)

Valentin M Pillet: NSO Director 2013-2024



Thank you Valentin!

Relocation of
the NSO to
Boulder/Maui

Christoph Keller:
May 6, 2024

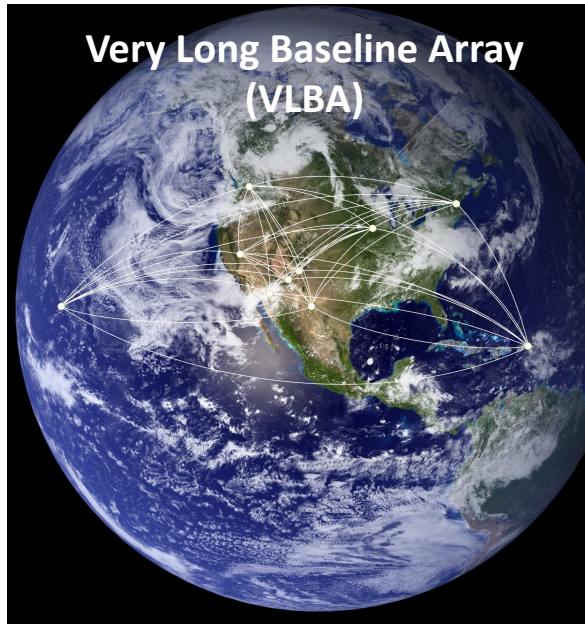


National Radio Astronomy Observatory

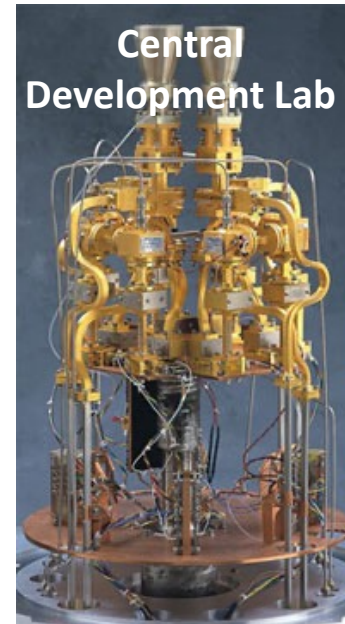
Karl G. Jansky Very Large Array (VLA)



Very Long Baseline Array (VLBA)



Central Development Lab





ALMA recently received a “heart transplant”, a new hydrogen maser for time and frequency reference.

After 10 years of operations, we are entering “middle-aged” facility stage, with eyes starting to consider what comes next. Preparations for new operations models and a new correlator are under way.





- Only large single-dish for U.S. community
- Continues to enable high impact discoveries
- Strong synergy with NRAO

**GBO to be reintegrated with
NRAO effective FY 2025**



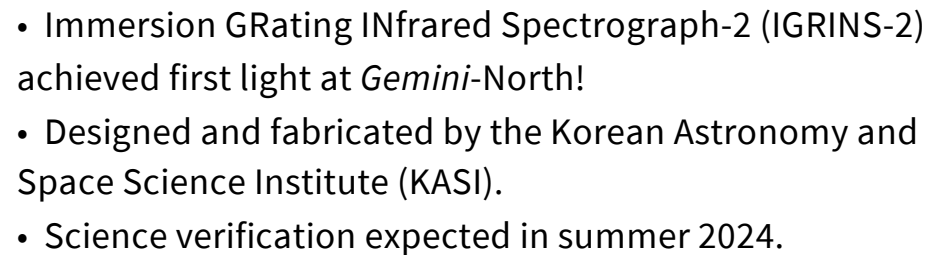
100 m GBT





The OIR ecosystem





INTERNATIONAL
GEMINI
OBSERVATORY

NRC · CNRC

Ministerio de Ciencia,
Tecnología e Innovación
Argentina

AST Update | KASI Korea Astronomy and Space Science Institute | GAA March 2024 |



GHOST First Science Results

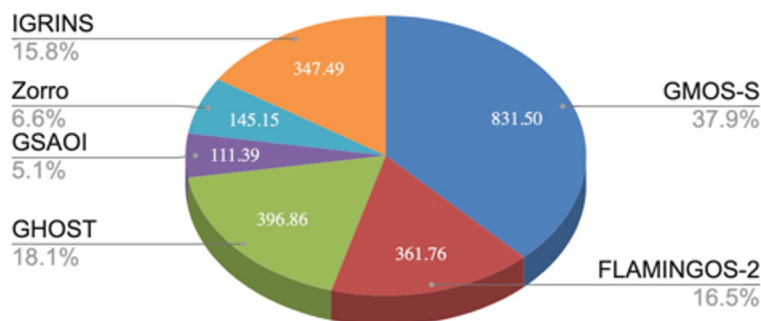


Observing
 Instrumentation
 About
 News
 Gallery
 Learn
 Events

GEMINI OBSERVATORY > OBSERVING > STANDARD SEMESTER PROGRAM > PHASE I: PROPOSING FOR TIME

2024A Call for Proposals

Fraction of Time by Instrument: Gemini South 2024A



THE ASTROPHYSICAL JOURNAL, 955:17 (17pp), 2023 September 20
© 2023. The Author(s). Published by the American Astronomical Society.

<https://doi.org/10.3847/1538-4357/acebc0>

OPEN ACCESS



GHOST Commissioning Science Results: Identifying a New Chemically Peculiar Star in Reticulum II

Christian R. Hayes¹, Kim A. Venn², Fletcher Waller², Jaclyn Jensen², Alan W. McConnachie^{1,2}, John Pazder^{1,2}, Federico Sestito², André Anthony¹, Gabriella Baker³, John Bassett⁴, Joao Bento⁵, Trystyn Berg^{6,7}, Gregory Burley¹, Jurek Brzeski³, Scott Case³, Edward Chapin¹, Timothy Chin³, Eric Chisholm¹, Vladimir Churilov³, Adam Densmore¹, Ruben Diaz⁴, Jennifer Dunn¹, Michael Edgar⁸, Tony Farrell¹, Veronica Firpo⁴, Joeleff Fitzsimmons¹, Juan Font-Serra¹, Javier Fuentes⁴, Colin Ganton¹, Manuel Gomez-Jimenez⁴, Tim Hardy¹, David Henderson⁹, Alexis Hill¹, Brian Hoff¹, Michael Ireland^{1,2}, Venu Kalari¹, Neal Kelly¹, Urs Klauser¹, Yuriy Kondrat¹, Kathleen Labrie⁹, Sam Lambert¹, Lance Luvaul³, Jon Lawrence³, Jordan Lothrop¹, G. Scott Macdonald¹, Slavko Mali³, Steve Margheim¹⁰, Richard McDermid³, Helen McGregor³, Bryan Miller¹, Felipe Miranda¹, Rolf Muller¹, Jon Nielsen¹, Ryan Norbury¹, Oliver Oberdorf⁹, Naveen Pai³, Gabriel Perez², Pablo Prado⁴, Ian Price³, Carlos Quiroz⁴, Vladimir Reshetov¹, Gordon Robertson³, Roque Ruiz-Carmona⁴, Ricardo Salinas⁴, Kim M. Sebo³, Andrew Sheinis¹¹, Matthew Shetrone¹², Keith Shortridge³, Katherine Silversides⁴, Karleyne Silva⁴, Chris Simpson⁹, Greg Smith³, Kei Szeto¹, Julia Tims³, Eduardo Toro⁴, Cristian Urrutia⁴, Sudharshan Venkatesan³, Lewis Waller³, Ivan Wevers¹, Ramunas Wierzbicki¹, Marc White⁵, Peter Young⁵, and Ross Zhelem³

¹ NRC Herzberg Astronomy and Astrophysics Research Centre, 5071 West Saanich Road, Victoria, BC V9E 2E7, Canada; Christian.Hayes@nrc-cnrc.gc.ca, chrishayesastro@gmail.com

- GHOST now provides a high dispersion spectroscopic capability for the community.
- GHOST is working as expected.
- Demand in 2024A was high!
- First results are now in press.



INTERNATIONAL
GEMINI
OBSERVATORY

NRC-CNRC



Ministerio de Ciencia,
Tecnología e Innovación
Argentina

AST Upcoming Space Science Initiative 2024 | KASI Korea Astronomy and Space Science Institute



Gemini Transitions

NSF congratulates and thanks Jen Lotz, outgoing Gemini Director!

Interim Director Scott Dahm serving during AURA's search for a new Gemini Director.

The position will remain open until it is filled. To be considered in the first round of reviews, please submit your application by **Jan 19, 2024**.



Thank you Jen!



INTERNATIONAL
GEMINI
OBSERVATORY

NRC · CNRC



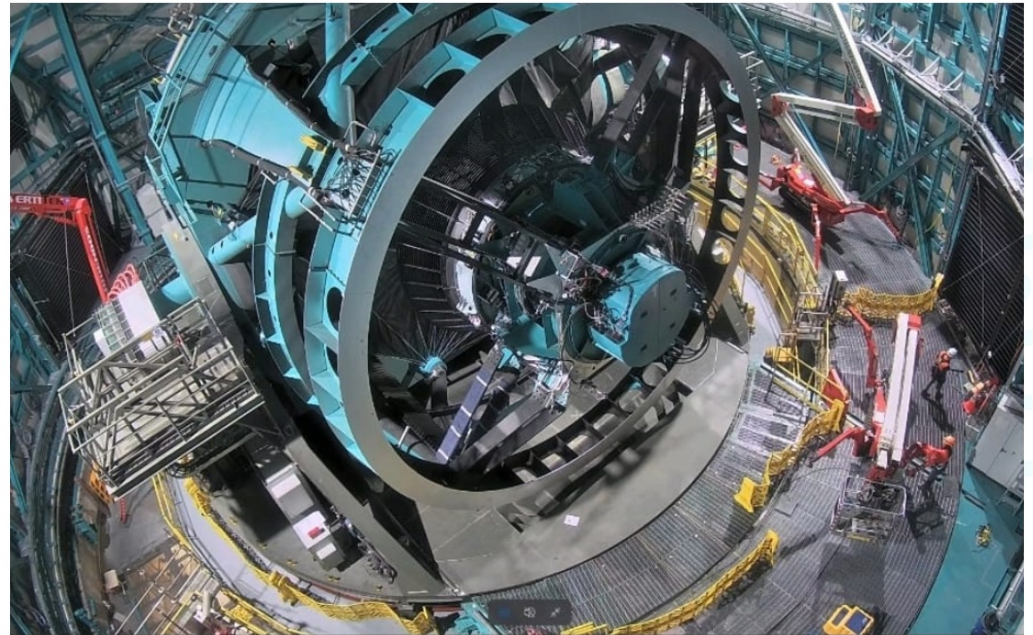
Ministerio de Ciencia,
Tecnología e Innovación
Argentina

AST Updates Space Science Institute 2024 |



Rubin Observatory is deep into System Commissioning with stunning performance

Simonyi Telescope at Rubin is functioning well and performance with surrogate glass optical system is excellent

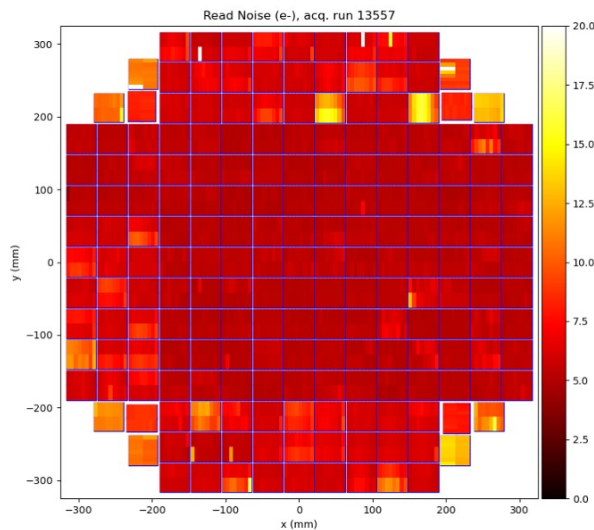


Commissioning Camera is ready for on sky testing when glass is integrated later this year



LSST Camera development from DOE / SLAC partnership is nearing completion

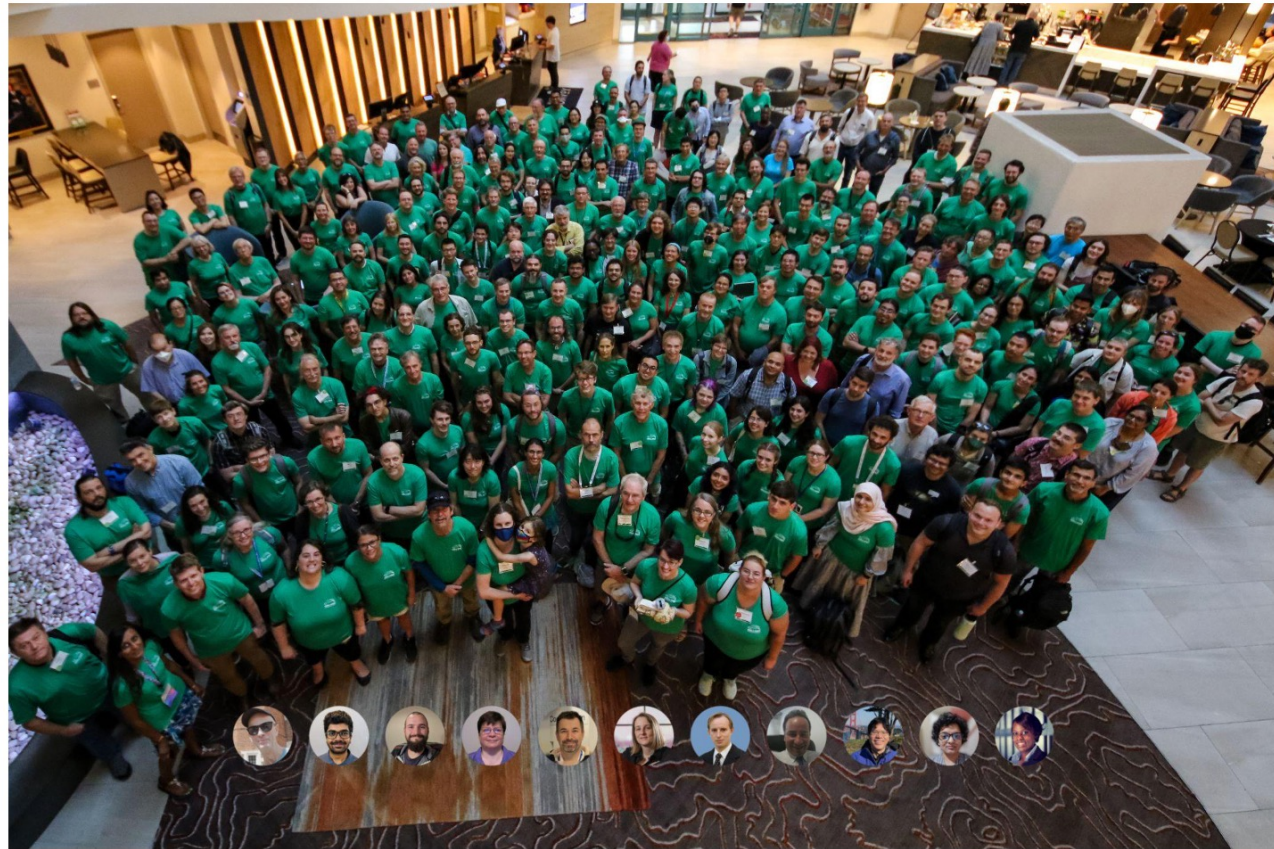
- Camera is fully assembled and has been through 7 weeks of Electro Optical testing
- Final Debugging and system testing in progress at SLAC with expected shipping to be in first half of 2024



Glass Filter Installation

Camera showing L1 lens

Rubin is on track for
ComCam imaging in 2024,
System First Light with the
LSST Camera in 2025 and
smooth transition to
Operations in 2026

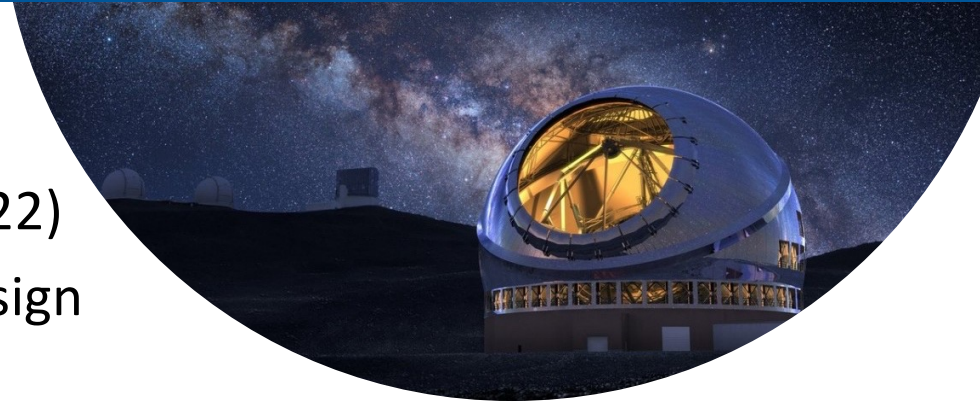


Astro2020 & Major Facilities Recommendations



US-ELT Program

- NSF formally started the TMT environmental review process (Aug 2022)
- US-ELT entered NSF's Major Facility Design Stage in Preliminary Design (Dec 2022)
- TMT and GMT both successfully completed NSF's PDR (Feb 2023)
- MPS Blue Ribbon Panel supported AST plan for moving projects forward (Jun 2023)
- **MPS+AST took projects to Facilities Readiness Panel requesting entry into Final Design (Oct 2023); decision pending**



Astro2020 recommendations: Major Facilities

ngVLA

- **ngVLA project entered NSF's Major Facility Design Stage (in Conceptual Design Phase) in July 2023**
- NRAO design and development program office funded for FY23+FY24
- Informational Presentation to NSB in November 2023



Work on antenna prototype progressing – rollout event in Germany in September 2023



Credit: mtex

AST Update | CAA March 2024 |

34

Next-generation Very Large Array – Preparing for Prototype Antenna at VLA Site



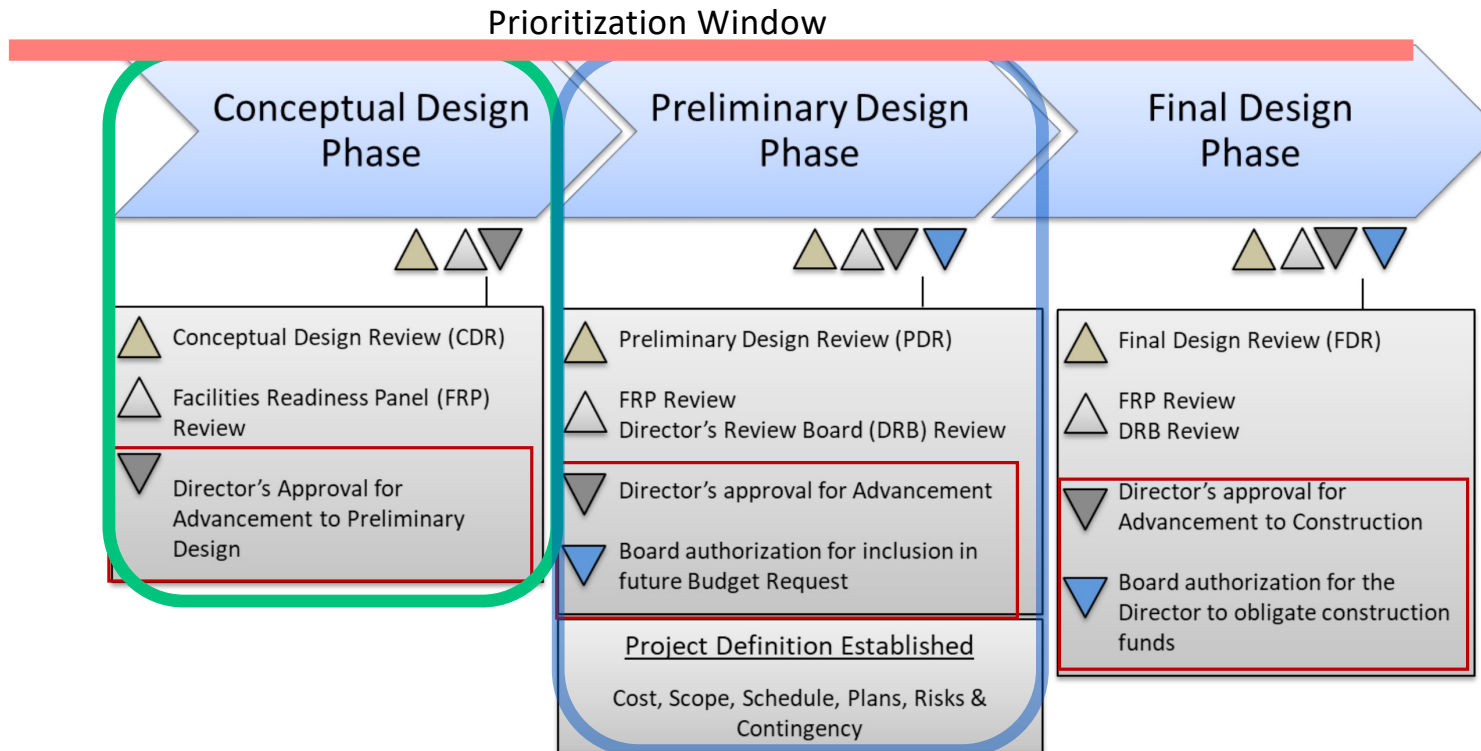
2024-02-24 12:11:39

CMB-S4

- **Moving project toward consideration for entry into NSF's Major Facility Design Stage, Conceptual Design**
 - *Development funding provided in FY23*
- Team developing alternative possible designs with different infrastructure footprints at South Pole (in response to OPP DCL:
<https://www.nsf.gov/pubs/2022/nsf22078/nsf22078.jsp>)
- Both short-term and long-term planning for South Pole activities still evolving, impacting potential plans for CMB-S4



NSF's Major Facilities Design Stage



- Projects can enter at any point before PDR
- **Entry into Design Stage does NOT imply commitment to fund construction**

Source: NSF Major Facilities Guide (Sep. 2019), Figure 2.1.3-2.



Community Vision Requires Prioritization

MPS Advisory Committee (AC) Subcommittee on Facilities and Major Research Infrastructure

- **Assess potential contributions of new Major and Mid-scale infrastructure projects in the context of the MPS portfolio**
- Provide recommendations for (required) MPSAC endorsements of Major Facility projects
- Provide strategic advice on elements of, and the balance of, the evolving MPS research infrastructure portfolio, including Major Facilities and Mid-scale investments
- **Provide guidance on the structure for decisions that will lead to a robust 10-year program of strategic investments in the development, construction, operations, and divestment of MPS major research infrastructure**



Study 1: Established Critical Need

- Provide a summary for MPSAC consideration articulating the importance of major and mid-scale facilities to NSF's scientific leadership and MPS's role in ensuring that its scientific research infrastructure enables the current and future cutting-edge science of the Directorate.
- Report 1:
 - ***The science and technology that will define our future, and power our economy, will only flourish in the U.S. if we sustain a strong scientific ecosystem that includes leading-edge research instruments.***



Study 2: Prioritization of NEW Major Facility Projects

Report 2 posted!

- Provide to MPS a **set of considerations for prioritization** of major facility projects across the competing needs of the communities served by the Directorate that incorporate the financial and societal realities of the scientific enterprise in the 2020s and the current and future needs of MPS communities, in order to ensure a vibrant infrastructure portfolio that delivers the scientific mission of MPS, specifically, and NSF, overall.
- Including
 - Multi-level strategic considerations (Directorate, Agency, Federal priorities)
 - Partnerships and discipline context
 - Current investments in new facilities vs future investments
 - Societal realities; holistic view of broader impacts and broadening participation
 - Balance of risk and reward



<https://www.nsf.gov/mps/advisory/facilities.jsp>

AST Challenge: Major Facilities Full Lifecycle Costs

- Development & Design: Division funding
 - ROM 10-20% of Construction cost
 - Over 5-10 years, sometimes as part of previous facility
- Construction: MREFC funding
- Operations & Maintenance: Division funding
 - ROM 5-10% of Construction cost **per year**
 - 10-50 year commitment
- EXAMPLE for **next generation** facility (in era of BILLION dollar projects)

Development & Design	Construction	O&M
\$150 to 250 million	\$1.5 Billion	~\$100-150 million per year



NSF/MPS/AST Budgets

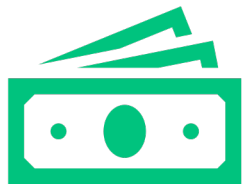


FY24 NSF Realities

- FY23 enacted = \$9.87B*
 - *Including supplements
- FY24 Budget Request = \$11.31B
- FY24 Appropriation = **\$9.06B**
- FY25 Budget Request = \$10.18B



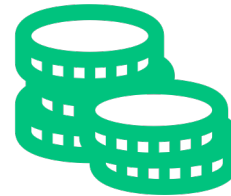
Astro2020 Funding: Major Facilities Initiatives



NSF dedicated \$30M in FY23 to Astro2020 new Major Facilities

Over half of this is going to be dedicated to development and design work on the US ELTs.

The balance put towards continued development of other major facilities prioritized in Astro2020, including CMB-S4, ngVLA, and initial next-gen Gravitational Wave definition.



FY24 implementation currently under consideration



FY25 Top Line

DIRECTORATE FOR MATHEMATICAL AND PHYSICAL SCIENCES (MPS)

\$1,681,630,000

MPS Funding (Dollars in Millions)					
	FY 2023 Base Plan ¹	FY 2024 (TBD)	FY 2025 Request	Change over FY 2023 Base Plan	
				Amount	Percent
Astronomical Sciences (AST)	\$288.21	-	\$318.53	\$30.32	10.5%
Chemistry (CHE)	264.99	-	264.99	-	-
Materials Research (DMR)	334.50	-	345.72	11.22	3.4%
Mathematical Sciences (DMS)	248.40	-	248.40	-	-
Physics (PHY)	308.65	-	312.90	4.25	1.4%
Office of Strategic Initiatives (OSI)	215.20	-	191.09	-24.11	-11.2%
Total	\$1,659.95	-	\$1,681.63	\$21.68	1.3%

¹ For comparability with FY 2025, the FY 2023 levels do not include this organization's share of Mission Support Services that were funded through the R&RA and EDU directorates and offices.



FY25 Request: AST Breakdown

- Significant changes over FY23 Base plan

But

- Some instrumentation grant funding moved into Research
- Some funding from OSI that was used for AST Facilities previously moved to AST Infrastructure
- And remember, this is the request...

MPS Divisions

MPS Division Funding by Category¹

(Dollars in Millions)

	FY 2023 Base Plan	FY 2024 (TBD)	FY 2025 Request	Change over FY 2023 Base Plan	
				Amount	Percent
AST	\$288.21	-	\$318.53	\$30.32	10.5%
Research	68.40	-	78.89	10.49	15.3%
Education	4.60	-	4.60	-	-
Infrastructure	215.21	-	235.04	19.83	9.2%
CHE	\$264.99	-	\$264.99	-	-
Research	251.05	-	251.05	-	-
Education	4.04	-	4.54	0.50	12.4%
Infrastructure	9.90	-	9.40	-0.50	-5.1%
DMR	\$334.50	-	\$345.72	\$11.22	3.4%
Research	282.11	-	275.61	-6.50	-2.3%
Education	3.00	-	3.00	-	-
Infrastructure	49.39	-	67.11	17.72	35.9%
DMS	\$248.40	-	\$248.40	-	-
Research	235.04	-	235.40	0.36	0.2%
Education	13.36	-	13.00	-0.36	-2.7%
PHY	\$308.65	-	\$312.90	\$4.25	1.4%
Research	212.32	-	212.80	0.48	0.2%
Education	5.02	-	5.02	-	-
Infrastructure	91.31	-	95.08	3.77	4.1%
OSI	\$215.20	-	\$191.09	-\$24.11	-11.2%
Research	146.75	-	132.70	-14.05	-9.6%
Education	10.00	-	10.62	0.62	6.2%
Infrastructure	58.45	-	47.77	-10.68	-18.3%

¹ For comparability with FY 2025, the FY 2023 levels do not include this organization's share of Mission Support Services that were funded through the R&RA and EDU directorates and offices.



Facilities Operations: Current & Future

Discussions of Operations funding continue at all levels within NSF (Director's Office/CORF, Directorate, Division)

- Widely understood problem, from NSB down
- All working toward NSF-wide resolution

Can't assume NSF will resolve AST facilities operations funding dilemma

Have to take a HARD look at prioritization

- Current facilities operations (WITHIN three FFRDCs)
 - Telescopes and user support
 - Archives, data products, and user support
- Full lifecycle of new facilities
 - Inouye Concept of Operations review
 - Ongoing review of 10yr LSST at Rubin Observatory
 - Understanding how US ELT and ngVLA operations fit within the respective FFRDCs



AST is exploring the best way to move forward with community engagement

MREFC: A look back... FY20 Request

Well-established MREFC account with future estimates based on reviewed and approved known projects...

“To be considered for MREFC funding, NSF requires that a project represent an exceptional opportunity to enable research and education. The project should be transformative in nature, with the potential to shift the paradigm in scientific understanding. The major research infrastructure projects included in this budget request meet these criteria based on NSF and National Science Board review and approval.”

MREFC Overview

The Major Research Equipment and Facilities Construction account supports the acquisition, construction, and commissioning of major and mid-scale research infrastructure that provide unique capabilities at the frontiers of science and engineering. Initial planning, design, and post-construction operations and maintenance are funded through the R&RA account.

MREFC Account Funding, by Project

(Dollars in Millions)

	FY 2018 Actual	FY 2019 Enacted	FY 2020 Request	FY 2021 Estimate	FY 2022 Estimate	FY 2023 Estimate	FY 2024 Estimate	FY 2025 Estimate
AIMS	-	\$103.70	\$97.89	\$90.00	\$90.00	\$28.81	-	-
DKIST ¹	18.24	16.13	-	-	-	-	-	-
HL-LHC Upgrade	-	-	33.00	33.00	33.00	33.00	18.00	-
LSST ¹	66.70	48.82	46.34	40.75	5.36	-	-	-
Mid-scale Research Infrastructure ²	-	-	45.00	TBD	TBD	TBD	TBD	TBD
NEON ³	12.79	-	-	-	-	-	-	-
RCRV ¹	88.00	127.09	-	-	-	-	-	-
Dedicated Construction Oversight ⁴	0.56	[1.00]	1.00	1.00	1.00	1.00	1.00	1.00
Total	\$186.30	\$295.74	\$223.23	\$164.75	\$129.36	\$62.81	\$19.00	\$1.00



MREFC: A look FORWARD... FY25 Request

“Beyond the costs of potential future major facility projects currently under review, NSF also anticipates that the size of its requests for the MREFC account will further increase to a total of \$500.0 million by the end of the decade. This increase reflects both the anticipated growth in the cost of major research infrastructure, and NSF’s intent to increase its investments in facilities to maintain U.S. leadership in key science and engineering research areas. This proposed outyear funding estimate additionally allows for a more predictable annual request within the MREFC account.”

The MREFC account supports the acquisition, construction, and commissioning of major facilities and larger mid-scale research infrastructure that provide unique capabilities at the frontiers of science and engineering. Initial development and design and post-construction operations and maintenance are funded through the R&RA account.

MREFC Account Funding, by Project
(Dollars in Millions)

	FY 2023 Base Plan	FY 2024 Request	FY 2025 Request	FY 2026 Estimate	FY 2027 Estimate	FY 2028 Estimate	FY 2029 Estimate	FY 2030 Estimate
Antarctic Infrastructure Recapitalization (AIR)	\$60.00	\$60.00	\$60.00	\$60.00	\$60.00	\$60.00	\$60.00	\$60.00
HL-Large Hadron Collider Upgrade	33.00	38.00	-	-	-	-	-	-
Leadership-Class Computing Facility (LCCF)	-	93.00	154.00	226.00	47.00	-	-	-
Mid-scale Research Infrastructure, Track 2 ²	76.25	105.06	85.00	90.00	100.00	100.00	100.00	100.00
Regional Class Research Vessel (RCRV)	1.98	-	-	-	-	-	-	-
Vera C. Rubin Observatory (Rubin)	15.00	7.61	-	-	-	-	-	-
Future Priority Projects ³	-	-	-	8.00	206.00	264.00	289.00	339.00
Dedicated Construction Oversight	1.88	1.88	1.88	1.88	1.88	1.88	1.88	1.88
Total	\$187.23	\$304.67	\$300.00	\$385.00	\$414.00	\$425.00	\$450.00	\$500.00

¹ A total of \$361.32 million was carried forward from FY 2023 to FY 2024: \$74.04 million for Mid-scale RI, \$209.76 million for AIR, \$8.53 million for RCRV, \$39.07 million for HL-LHC Upgrade, \$20.89 million for Rubin, and \$1.58 million for Dedicated Construction Oversight. The remaining \$7.45 million consists of funds from recoveries from old projects not funded in FY 2023.

² Outyear amounts are for planning purposes only. NSF will evaluate Mid-scale RI in the context of agency priorities for future budget submissions.

³ Represents escalating funding amounts increasing NSF’s MREFC portfolio to a total of \$500.0 million by the end of the decade and does not reflect policy decisions on project-specific investments. Increases reflect both anticipated growth in cost of major research infrastructure, as well as NSF’s intent to increase investments in facilities to maintain U.S. leadership in key science and engineering research areas.





NSB Recommendations

Resolution:

RESOLVED, that the National Science Board endorses the National Science Foundation's continued support for the USELT program and, pending the outcome of the appropriate internal review process, recommends that the Total Project Cost not exceed the Major Research Equipment and Facilities Construction account investment of \$1.6 billion proposed by Astro2020.

Statement:

- The USELT Total Project Cost to NSF does not exceed the \$1.6 billion MREFC investment proposed by Astro2020.
- NSF discuss with the Board during the May 2024 meeting its plan to select which of the two candidate telescopes the Agency plans to continue to support, including estimated costs and a timeline for the project.
- NSF discuss with the Board during the May 2024 meeting its progress in developing a long-term agency strategy for MREFC projects.



Footnote: Pathways to Discovery in Astronomy and Astrophysics for the 2020s, Table S.6; pg. K-14; in real year dollars as of 2020, from NSF's Major Research Equipment and Facilities Construction account