NSF/AST Update AAAC

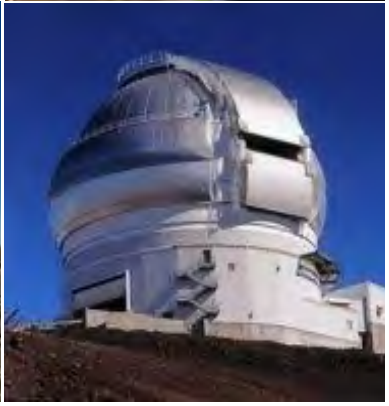
R. Chris Smith

Division Director - Acting

Division of Astronomical Sciences

MPS/NSF

September 28, 2021



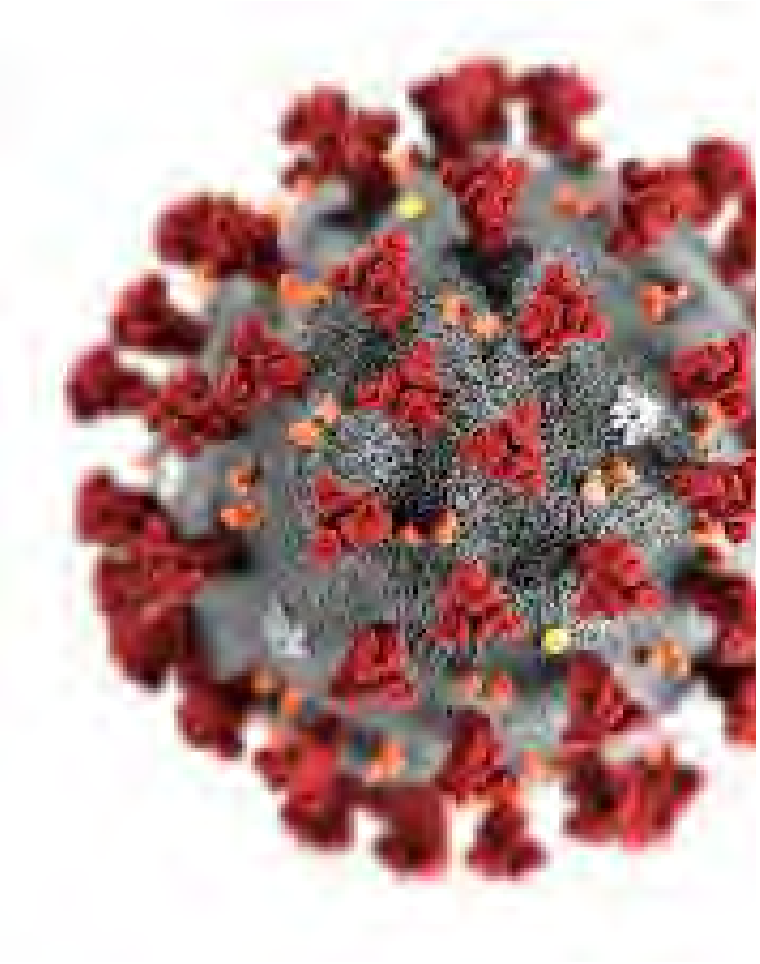
US Decadal Review

Astro 2020 Decadal Survey Report will be published any week now.

NSF and COVID

NSF Operations

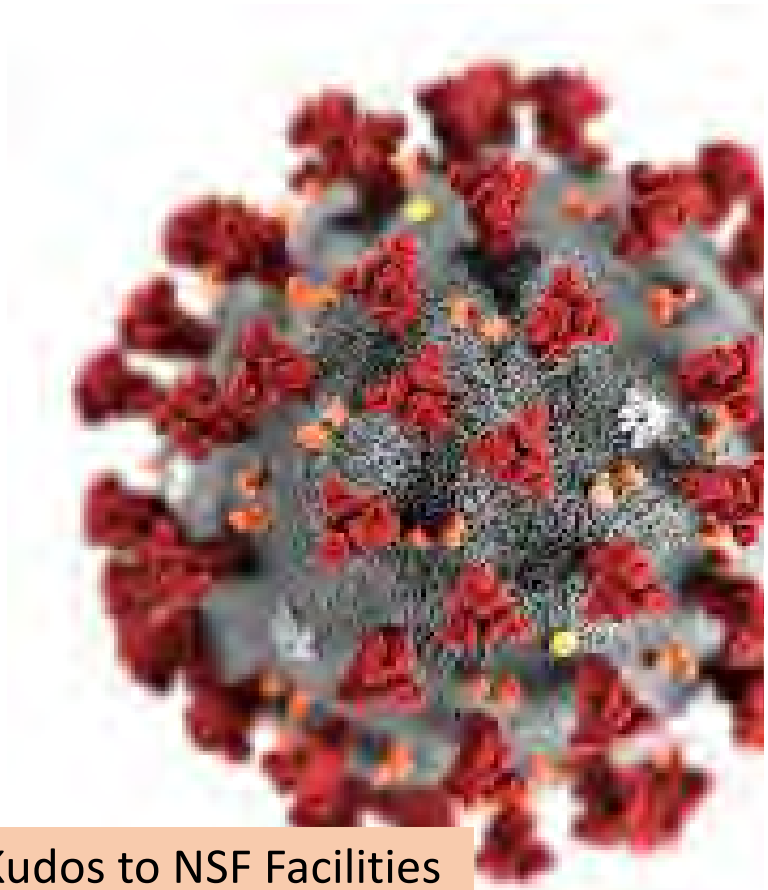
- Most staff still working from home (maximum telework status)
  - Building occupancy limited to 25%
- All meetings and reviews still to be held remotely
  - Includes internal meetings, i.e., no gatherings
- Only essential travel has been permitted
  - time sensitive and impossible to postpone
  - Now transitioning to official travel being allowed (for the vaccinated)



NSF and COVID

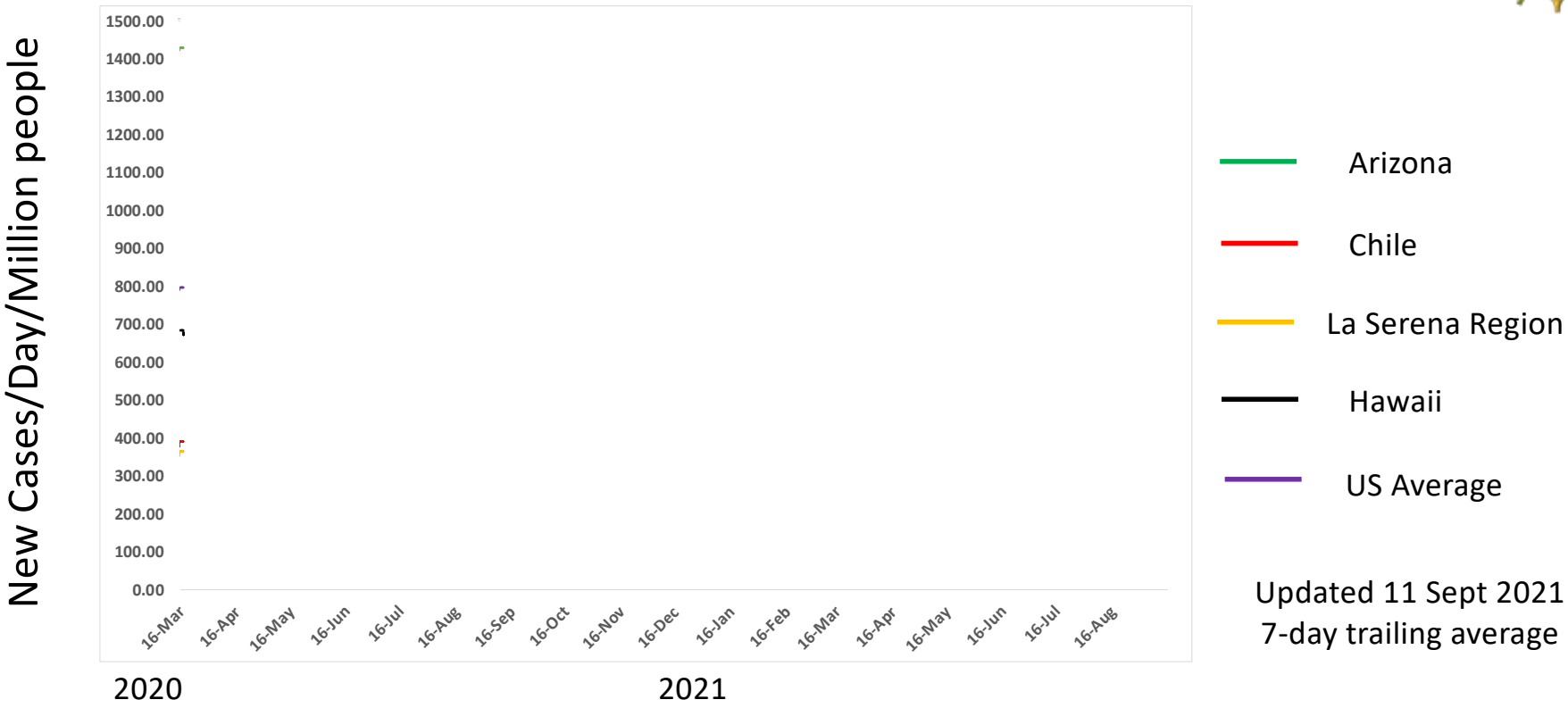
Guidance for Facilities

- Managing Organizations advised to make decisions that keep their staff safe
  - Security of facility also critical
- Follow State Department & OMB guidance on travel; refer to CDC for information on COVID
- Document additional costs incurred that are directly related to COVID-19
- OMB flexibilities: Work with POs and G/AOs on allowability of costs, e.g.
  - COVID-19 testing expenses
  - Staff salaries



Kudos to NSF Facilities staff and management for their outstanding (hard) work!!

COVID Trends at Sites

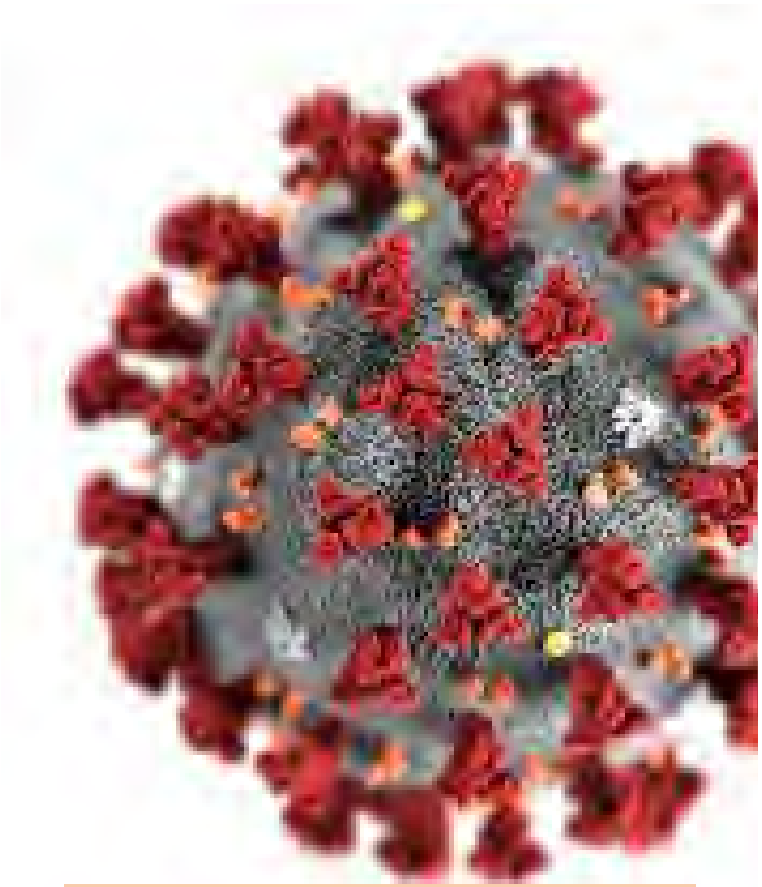


NSF and COVID

Individual Investigator Programs

- Targeted Funding: AST
  - Priority to retain those populations most at risk, including students, postdocs, early faculty
  - Supplements focused on those in last year of grants. Mostly AAG, but some in MSIP and ATI.
  - Additional AAPF funding through ARP

- Targeted Funding: MPS
  - Base funds + ARP funds,
  - supporting Divisions and MPS-wide initiatives
  - MPS-LEAPS pre-tenure faculty awards
  - MPS-Ascend postdoctoral fellowship awards



Both LEAPS and Ascend award portfolios are DEI focused

NSF, MPS, & AST Personnel

NSF Management: Key Players

NSF OFFICE OF THE DIRECTOR

- Sethuraman Panchanathan: 15th NSF Director
- New COO: Karen Marrongelle
- New CORF: Linnea Avallone (Oct 12)



DIRECTORATE FOR MATHEMATICAL AND PHYSICAL SCIENCES (MPS)

- Sean Jones: Assistant Director
- Tie Luo: Deputy Assistant Director


AST Staffing

- AST Division Director: Pending
  - Ralph Gaume retired May 2021
  - Acting DD named in interim: Chris Smith
- New Program Staff
  - Luca Rizzi, will be supporting Rubin and NOIRLab
  - Andreas Berlind, will be supporting Grants, DEI, & Data Science
- New Financial Operations Specialist: Neila Odom-Jefferson

Division of Astronomical Sciences (AST)

Management Team

R. Chris Smith
Acting Division Director

James Neff
Deputy Division Director

Craig McClure
Program Support Manager

Donna O'Malley
Financial & Operations Specialist

Neila Odom-Jefferson
Financial & Operations Specialist (Detail)

Ashley VanderLey
Senior Advisor for Facilities

Administration

Elizabeth Pentecost
Project Administrator

Matthew Viau
Program Analyst

Allison Farrow
Program Analyst

Renee Adonteng
Program Analyst

Tanner Abraham
Program Analyst
Pathways Student

Individual Investigator Programs (IIP)

Hans Krimm
Program Director

IIP Coordinator; Lead: Stellar Astro.

Nigel Sharp
Program Director

Lead: Extragalactic & Cosmology; cross-NSF programs

Glen Langston
Program Director

Lead: Galactic Astronomy

Harshal Gupta
Program Director

Lead: Postdoctoral Fellowships; Lab Astro

Luke Sollitt
Program Director

Lead: Planetary Astronomy

Sarah Higdon
Program Director

Lead: CAREER; AAG

Zoran Ninkov
Program Director

Lead: Advanced Technology & Instrumentation; AAG

James Higdon
Program Director

AAG; SAA, EXC

Matthew Benacquista
Program Director

Expert

Andreas Berlind
Program Director

Lead: Data Science, AAG

Facilities, Mid Scale, & MREFC Projects

Nigel Sharp
Program Director

MSIP; MSRI

David Boboltz
Program Director

DKIST

Christopher Davis
Program Director

NOIRLab

Edward Ajhar
Program Director

Vera C. Rubin Observatory

Joe Pesce
Program Director

NRAO; ALMA

Harshal Gupta
Program Director

GBO

Martin Still
Program Director

Gemini

Carrie Black
Program Director

NSO

Alison Peck
Program Director

Arecibo

Luca Rizzi
Program Director

Vera C. Rubin Observatory

ESM

Ashley VanderLey
Senior Advisor for Facilities

John Chapin
Special Advisor for Spectrum

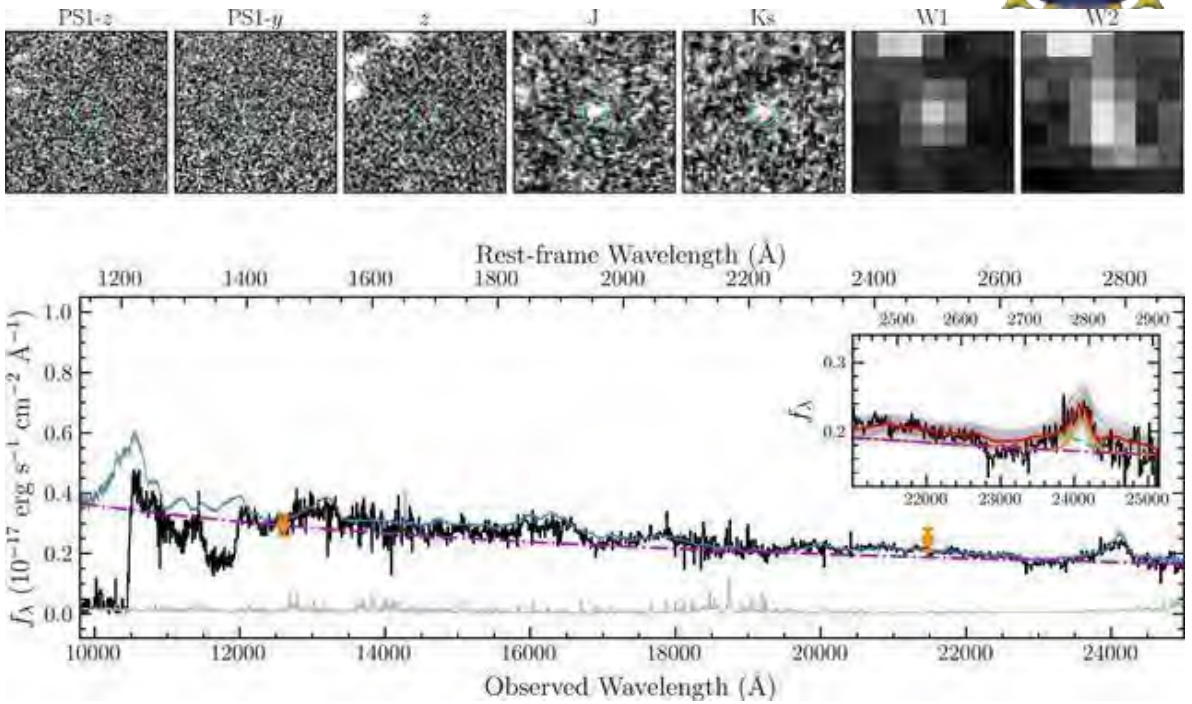
Jonathan Williams
Program Director

David Morris
AAAS Fellow

Science Highlights

Our Optical Universe: Nearby & Distant

Bernardinelli-Bernstien - Most Massive Comet
Blanco DECam

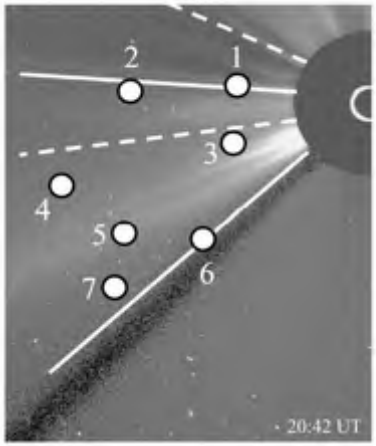


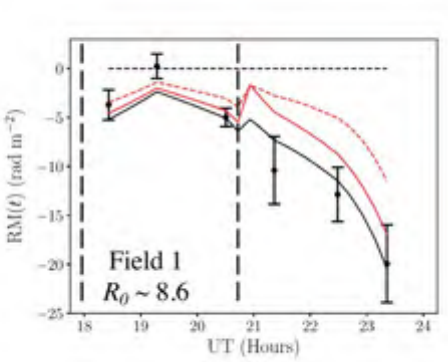
Most Distant Quasars J0313-1806 Z = 7.64
Gemini Flamingos-2 and GNIRS
Wang et al. 2021

VLA measures Magnetic Fields in a CME

- Coronal mass ejections (CME) are the most violent of space weather phenomena, traveling at ~10^3 km/s, with potential for major impact on the Earth.
- Polarization observation with the VLA, coupled with real-time *in situ* density measurements by the Parker Solar Probe, have provided the most precise measurement of the magnetic field in a CME.
- Observations of the rotation measures toward background quasars through a CME yields a magnetic field strength ~ 30 mG at 10 R_o. The fields help to 'sculpt' the CME as it travels from the Sun.

Left: SOHO coronographic image of a CME, showing the location of background radio sources used for Faraday rotation measurements with the VLA. Right: time behavior of the rotation measures with passage of the CME in front of source 1 (Kooi et al. 2021, Solar Physics, 296, 11).





Akamai Workforce Initiative Internship Program:

Advancing Hawaii college students into STEM careers at observatories and beyond

451 local college students have been placed at telescopes and tech companies (2003-21):

- 37% Women
- 23% Native Hawaiian
- 47% All underrepresented minorities (URM)

Located 84% alumni

Akamai 2022 Application Coming Soon!

Akamai is managed by the Institute f
Educators at th U i i f C '
partne

Advancing Inclusive
-Sky Precision AO
on Telescope), University of California
nd Hawaii Community Foundation.

- 88% of alumni stay in STEM across all demographic groups
- 125+ in STEM jobs in Hawaii
- 4 Akamai alumna are now engineers at NSF DKIST on Maui

Facilities Highlights

Daniel K. Inouye Solar Telescope

- On schedule for transition to operations in **Nov 2021**
- Special presentation tomorrow


Vera C. Rubin
Observatory

Construction & System Integration Progressing

Software integration, system verification and issue resolution

Dome Enclosure!

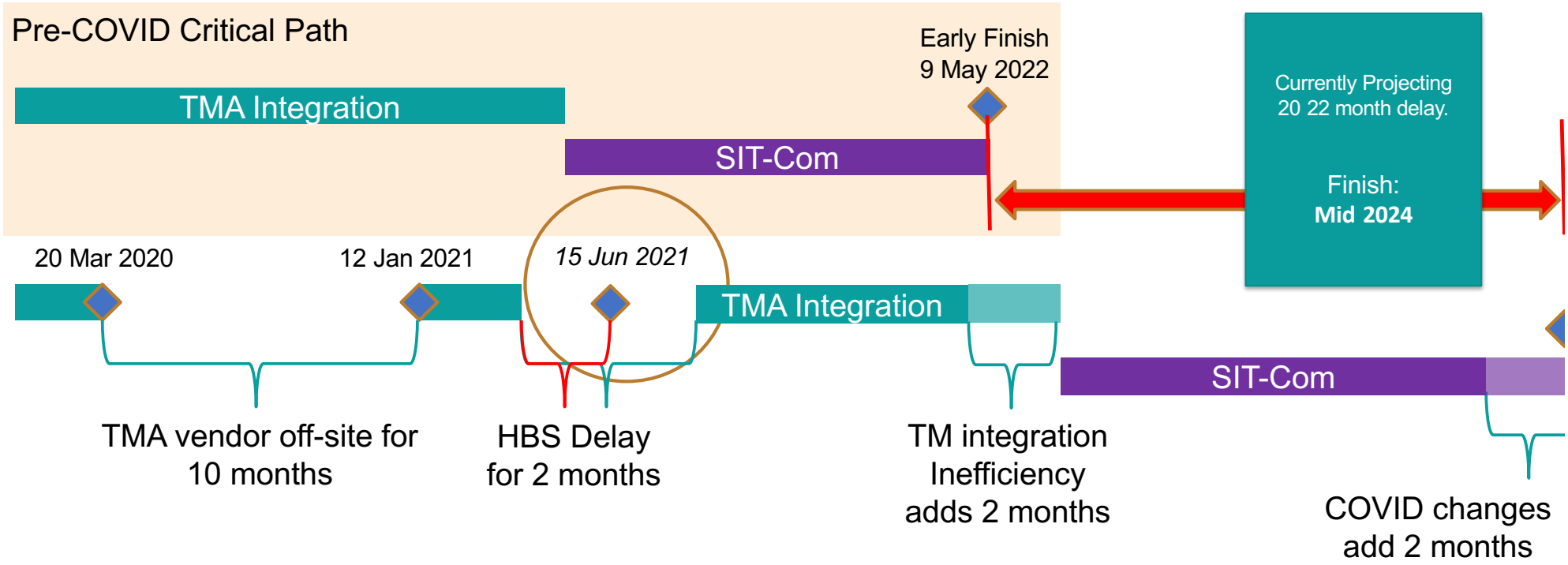
Image from fully integrated ComCam - All 9 sensors show excellent performance

The entire Rubin team has managed to work through the difficult circumstance and made great progress

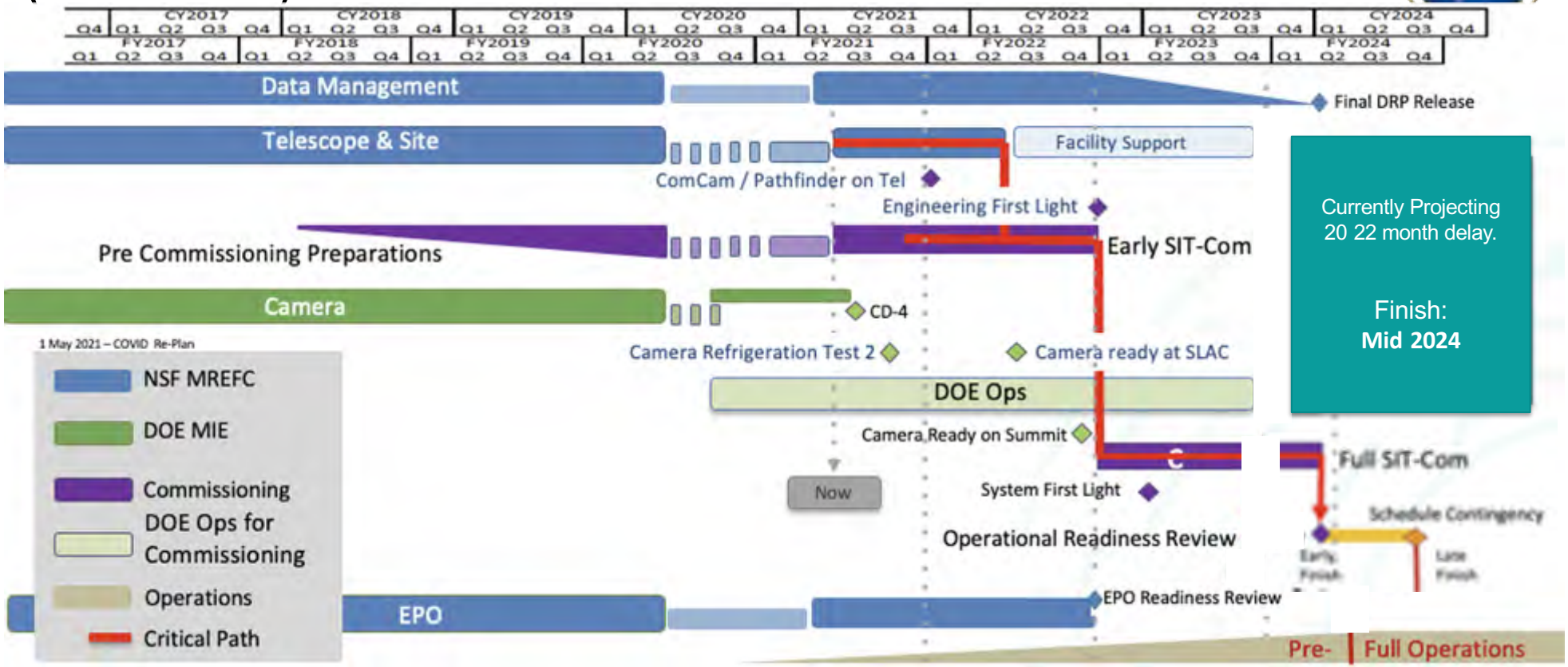
TMA major structure completion

Rebaseline Critical Path Change Analysis

- Rebaseline still underway; COVID impacts still making some elements moving targets



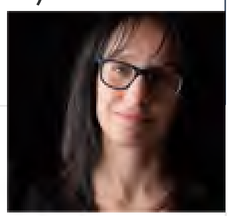
Rubin Forecast Summary Schedule (for now)



Rubin 2021 PCW - Diversity, Equity & Inclusion

Creating and maintaining Diversity in its workforce and community though Equitable and Inclusive practices

- ~7 hours dedicated to DEI
- Anti-racism workshop 2x oversubscribed! (Thurs & Fri)



LSSTC 2020 Enabling Science Proposal

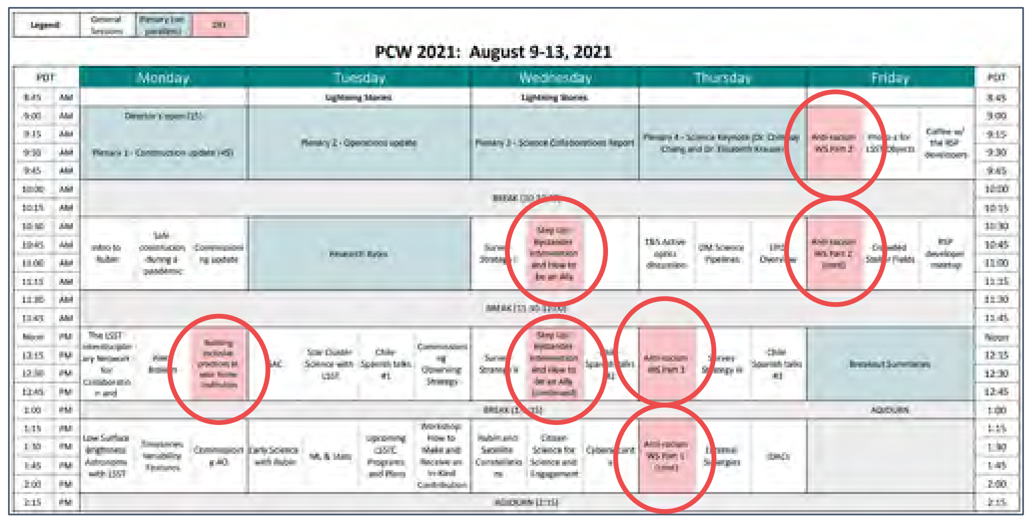
Workshop on systemic racism and its relation to equity, diversity, and inclusion during the 2021 Rubin PCW

Andrés Plazas, Princeton University/Rubin Observatory, aplazas@astro.princeton.edu
Federica Bianco, University of Delaware, fbianco@udel.edu

Co-PIs and Collaborators

Open sessions:

- Building inclusive practices (Mon)
- Bystander intervention, being an ally (Wed)




Rubin Observatory Operations plan under development;
NSF component led by NOIRLab, DOE by SLAC

NSF's National Optical-infrared Astronomy Research Laboratory
(NOIRLab)

Formerly NOAO

MSO
Mid-Scale Observatories

- Kitt Peak National Observatory
  - Mayall
  - WIYN
- Cerro Tololo Inter-American Observatory
  - Blanco
  - SOAR

CSDC
Community Science & Data Center

International Gemini Observatory

Vera C. Rubin Observatory Operations

Gemini Observatory

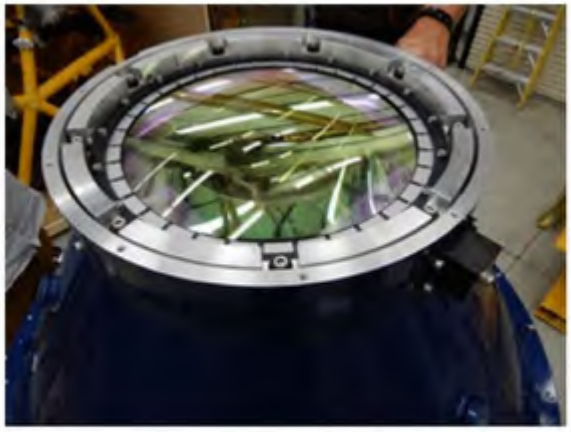
International Partnership

- The current six-year Gemini partner International Agreement expires Dec 31, 2021
- A renewal of the existing agreement with six-year duration, a mid-point assessment and ~similar partner shares is supported by all Participants
- The Gemini Board have approved an increase in the shares of the Republic of Korea from 5% to 7%.
- The Gemini Board have approved a decrease in the shares of Argentina from 3% to 2%.
- The NSF Director has signed the International Agreement for 2022-27 and the document is now being passed between the partners for signatures.

Instruments Ready to Deploy

GHOST High-Resolution Spectrograph in the Gemini South Dome

Waiting for the Project Team to come to Chile



NEWFIRM wide-field IR Imager being packed up for travel to Chile

Will go on Blanco for IR time-domain and MMA follow-up, while ISPI will go to SOAR

Windows on the Universe
Center for Astronomical Outreach

- Public education center for all NSF-supported facilities. Planetarium, Science on a Sphere, Exhibits, Virtual Control Room(s), Public Programs
- Construction and refurbishment has begun
- Exhibit designs pending/phased
- Engagement with Tohono O'odham Nation (TON) ongoing
  - Tribal Historic Preservation Officer updated on project
  - Site visit from the TON Chairman

ASP Award to Lars Christensen

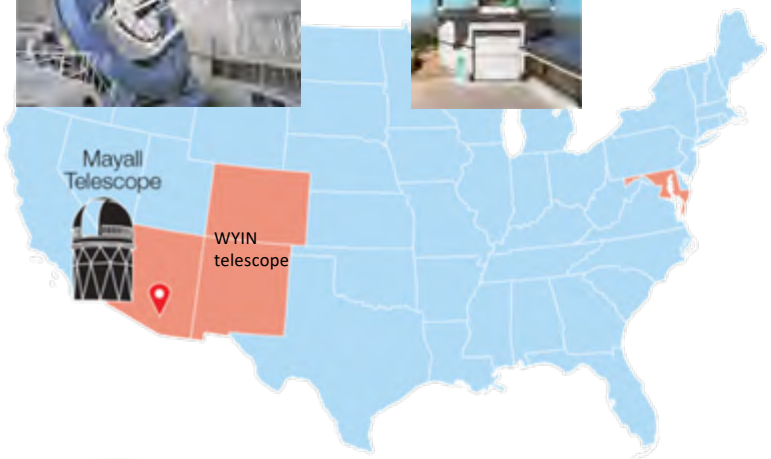
THE **KLUMPKE-ROBERTS AWARD FOR 2021** GOES TO **LARS LINDBERG CHRISTENSEN**, HEAD OF COMMUNICATIONS, EDUCATION AND ENGAGEMENT AT NATIONAL SCIENCE FOUNDATION'S NOIRLAB FOR MORE THAN 30 YEARS IN BRINGING SCIENCE TO THE PUBLIC AND INCREASING ITS AWARENESS OF THE UNIVERSE AND ITS ROLE IN HUMAN UNDERSTANDING.

Awarded to an individual or individuals who have made outstanding contributions to the public understanding and appreciation of astronomy, the Astronomical Society of the Pacific's Klumpke-Roberts Award for 2021 goes to Lars Lindberg Christensen, Head of Communications, Education, and Engagement at NSF's NOIRLab. The award recognizes Christensen for more than 30 years of bringing science to the public and increasing awareness of the Universe and its role in human understanding.

Past Honorees:

Carl Sagan
Isaac Asimov
Dava Sobel
Phillip Morrison
Heidi Hammel
Patrick Moore
Fred Hoyle

Structural Integrity Survey



NSF's NOIRLab

NSF's Radio Observatories managed by AUI

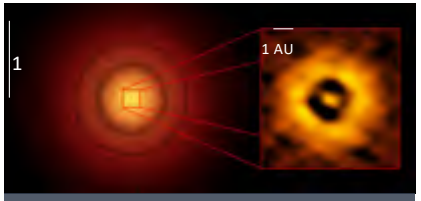
Complementary & synergistic capabilities

Balanced scientific portfolio

GBT ammonia spectral map of Orion Nebula star forming region (Friesen et al. 2017)

Allow studies of:

- Very large to very small scales
- Virtually all of astronomy & astrophysics



ALMA image of TW Hya protoplanetary disk (Andrews et al. 2016)

ALMA renewal/upgrades

- First light on a set of Band 1 receivers on Aug 14, 2021
  - New window: 6-8.5mm
  - Led by Taiwan's ASIAA, with support from NRAO's CDL for critical components
- NRAO is leading upgrade to Band 6
  - the workhorse of ALMA, 53% of all publications include it
  - for the same observing time, sensitivity improved by 1.4x for spectral line and 2x for continuum

Arecibo Observatory: Status

Area of reflector where platform and azimuth arm fell – removed debris, tested soil, placed anti-erosion matting to foster regrowth of vegetation

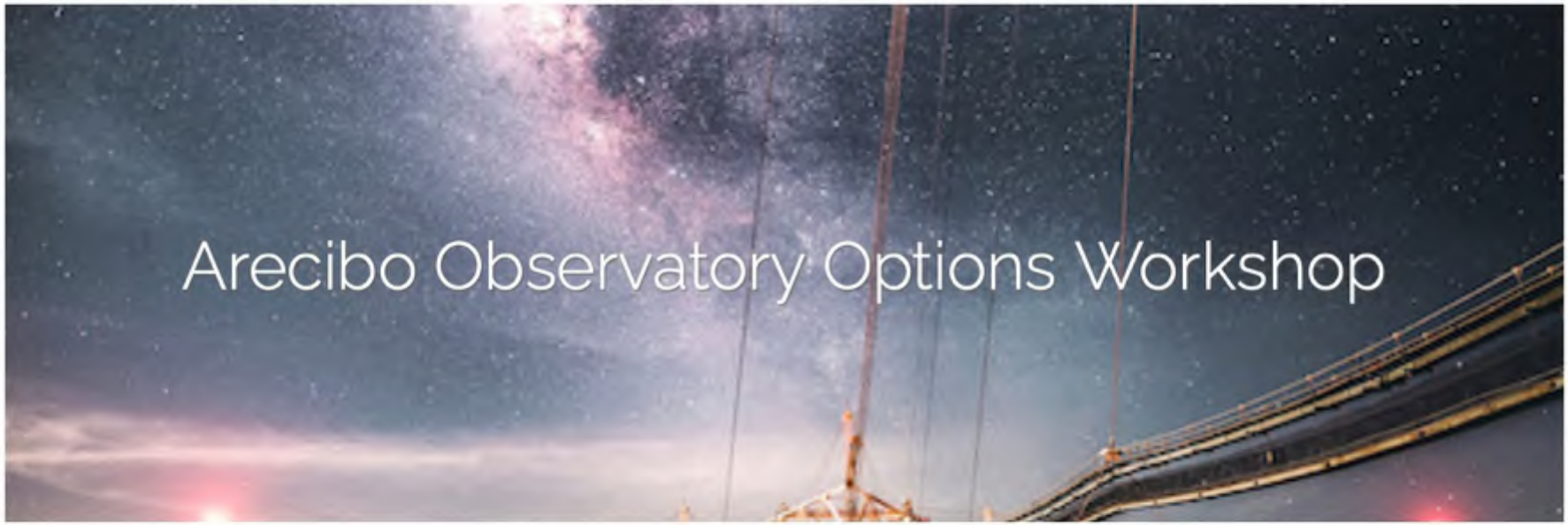
December 10, 2020

Now

All photos credit UCF/TT/DHG

- Focus now turning to future of Arecibo Observatory

Arecibo Observatory: Future



Arecibo Observatory Options Workshop

An Interactive Workshop to Explore Novel Ideas for Future Scientific, Educational, and Cultural Activities with the Arecibo Observatory

Timeline and Important Dates

Event	Summary	Duration	Event Date
Overview	Presentation of the situation at the Arecibo Observatory, current activities and constraints, and a review of the goals of the workshop	2 hours (12:00 ET)	**April 2**
Technology Training 'Happy Hour'	An opportunity for participants to try out the technology they will be using, and allow individuals to get to know the other participants	2 hours (4:00 ET)	**June 2**
Call to Action & Kickoff	Orientation for participants to the scope of the workshop, and discussion of the criteria for success	4 hours (12:00 ET)	**June 4**
Divergent Thinking	To engage in multiple rounds of ideation	4 hours (12:00 ET)	**June 10**
Stewarding	Participants provide feedback and help flesh out others' ideas	4 hours (12:00 ET)	**June 14**
Team Formation	Teams form to write up their ideas	2 hours (12:00 ET)	**June 16**
Collecting Feedback	Teams share preliminary outlines/drafts and solicit feedback before proceeding with their writing.	2 hours (12:00 ET)	**June 18**
Closing Session	Team give their final papers/presentations.	3 hours (12:00 ET)	**June 28**

Workshop Outcomes

- More than 100 community members, spanning a range of ages, genders, professions, and backgrounds, registered for this event.
  - Including participants from observatories and educational institutions in Puerto Rico and beyond, and also individuals from various walks of life who had spent time at the Observatory in early careers or had grown up there.
- Outcomes spanned a range of concepts
  - From cutting edge technological projects
  - to multidisciplinary research centers which would develop human resources on the island, foster community engagement and build closer collaborations with academic institutions on the island, across the U.S. and Latin America, and the world
- NSF is encouraging the teams from the workshop and others to develop their ideas into proposals that can be acted on

Cyber Infrastructure and Cyber Security

- 2021 JASON Study on CyberSecurity underway
  - Engagement with AST, NRAO, NOIRLab, and others – June 2021
- NSF Cyber Security Summit for Large Facilities, Oct 12-19
  - Organized by *TrustedCI*, the NSF CyberSecurity Center of Excellence
  - Includes Large Facility webinar on Cyber Infrastructure & Security
- NSF Large Facilities Workshop/Webinar – October 14
  - 2 sessions: Cyber Infrastructure; Cyber Security
  - Registration Link: **https://nsf.zoomgov.com/webinar/register/WN_5Ed9PWMrQEGhq9ud70jxXw**

Protecting NSF cyberinfrastructure (CI) since 2012. The mission of Trusted CI is to lead in the development of an NSF Cybersecurity Ecosystem with the workforce, knowledge, processes, and cyberinfrastructure that enables trustworthy science and NSF's vision of a nation that is a global leader in research and innovation. Are you an NSF project in need of cybersecurity help? Contact us.

TRUSTED CI
THE NSF CYBERSECURITY CENTER OF EXCELLENCE

Protection of Dark Skies/Satellite Constellations

- 2020 Jason Report on the *Impacts of Large Satellite Constellations* is now available (NSF website)

- SATCON1 (Jun/Jul 2020) and SATCON2 (Jul 2021) Workshops,
  - NSF-funded, NOIRLab-led in collaboration with AAS

- IAU Conference: *Dark & Quiet Skies for Science and Society*
  - Requested by the UN's Committee on the Peaceful Uses of Outer Space (COPUOS), the UN Office for Outer Space Affairs
  - La Palma, October 2021

- IAU Center for the *Protection of the Dark Sky from Satellite Constellation Interference*

Maunakea Informal Outreach

- NSF has held meetings with individuals and small groups over last year with people from all sides of the spectrum of opinions (“talk story”)
- Pace of meetings has slowed to a few per month
- Astro2020 and other factors will inform decision whether to move forward with US ELT
- In the meantime, looking at MK lease situation
  - Including VLBA site

Programs

AST Division Programs

Individual Investigators
(Lead: Hans Krimm)

Research
- AAG
- CAREER *
- AAPF

Technology/ Instrumentation
- ATI
- MRI *

Education and Special Programs
- REU *
- ESP

Mid-scale
(Lead: Nigel Sharp)

- MSIP
- MSRI-1 *
- MSRI-2 *

AST Budget Allocation

Facilities
(Sr Advisor: Ashley Vanderley)

- NRAO
- ALMA
- GBO
- Arecibo

MREFC
- NSO
- NOIR Lab
- Gemini Obs
- MidScale Obs
- CSDC

* NSF Wide

FY 2022 Programs and Deadlines

Acronym	Program Name	Deadline	Program Lead
CAREER*	Faculty Early Career Development Program	26 Jul 21	S. Higdon
REU Sites*	Research Experiences for Undergraduates	25 Aug 21	Seigar
AAPF	Astronomy & Astrophysics Postdoctoral Fellowships	15 Oct 21	Gupta
AAG	Astronomy & Astrophysics Research Grants	15 Nov 21	Multiple
ESP	Education and Special Programs	none	Langston
ATI	Advanced Technology and Instrumentation	15 Nov 21	Ninkov
MRI*	Major Research Infrastructure	19 Jan 22	Ninkov
MSIP	Mid-scale Innovations Program	FY23?	Sharp
MSRI-1*	Mid-scale Research Infrastructure-1	FY23?	Sharp
MSRI-2*	Mid-scale Research Infrastructure-2	20 Sept 21 (by invitation)	Sharp

* NSF-wide solicitations

Recent Program Highlights

Mathematical and Physical Sciences Ascending Postdoctoral Research Fellowships – MPS-Ascend (NSF 21-573)

- Purpose: To support postdoctoral Fellows who will broaden the participation of groups that are significantly underrepresented in MPS fields in the U.S., enabling them to develop as future leaders in science.
- Intent: To recognize and support beginning investigators of significant potential in research experiences that will broaden perspectives, facilitate interdisciplinary interactions, and help broaden participation within MPS fields.
- Awards will support research in any scientific area within the purview of the five MPS Divisions: the Divisions of Astronomical Sciences (AST), Chemistry (CHE), Materials Research (DMR), Mathematical Sciences (DMS), and Physics (PHY).
  - Fellowships are awards to individuals, not institutions, and are administered by the Fellows.
- https://beta.nsf.gov/funding/opportunities/mathematical-and-physical-sciences-ascending-postdoctoral-research

Launching Early-Career Academic Pathways in the Mathematical and Physical Sciences – LEAPS-MPS (NSF 21-570)

- Emphasis: Helping to launch the careers of **pre-tenure faculty** in Mathematical and Physical Sciences (MPS) fields at **minority-serving institutions (MSIs**), **predominantly undergraduate institutions (PUIs)**, and **Carnegie Research 2 (R2) universities**,

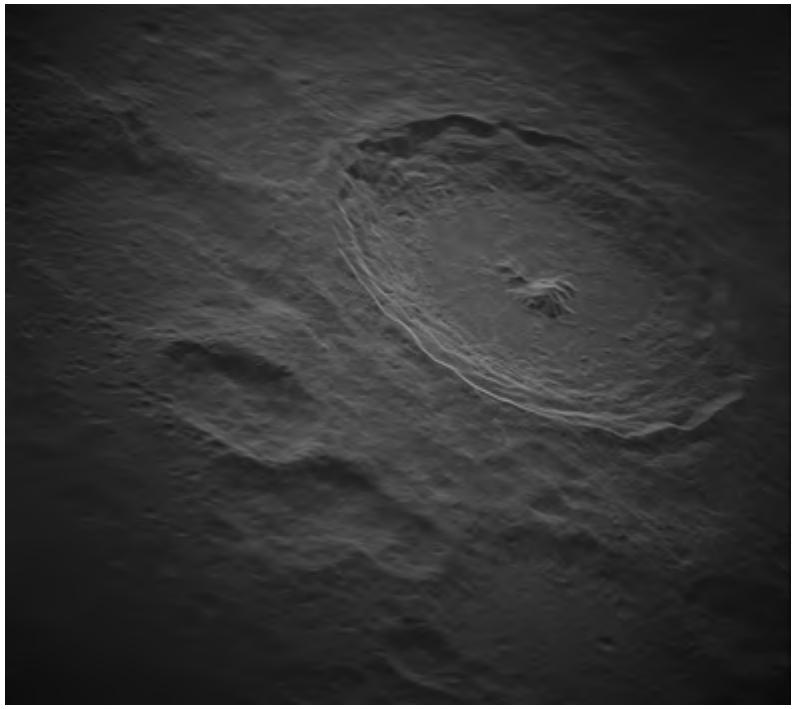
- Intent: Initiating viable independent research programs for researchers attempting to launch their research careers in MPS supported fields.

- Goal: Achieving excellence through diversity and broadening participation to include members from groups underrepresented in the Mathematical and Physical Sciences, including Blacks and African Americans, Hispanics, Native Americans, Alaska Natives, and Native Hawaiians, and other Pacific Islanders.

- https://beta.nsf.gov/funding/opportunities/launching-early-career-academic-pathways-mathematical-and-physical-sciences

MSRI-1: Next Generation Radar Designs

- Partnership between AUI/NRAO+GBO & Ratheon
- Goal: an integrated technical design for new scientific and space domain awareness radar capabilities
- Conceptual designs for
  - High-power high frequency phased-array radar transmitter for GBT
  - Medium-power phased-array modular transmitter system for deployment on antennas like ngVLA prototype design.
- Funding partially from AST with support from Director's office



Credit: NRAO/GBO/Raytheon/NSF/AU

Center for Advanced Radio Sciences and Engineering

- Award for ~ $15 million over 5 years to establish this Center in Puerto Rico at UPR Mayagüez
- Co-funded by EPSCoR, AST, and MPS/OMA , this strategic investment includes
  - catalyzing new faculty lines
  - postdoctoral fellowships and graduate student support
  - an annual conference
  - significant funding towards institutional collaborations at other Puerto Rico institutions
  - faculty seed grants for summer research programs
  - Industry collaboration for active radio frequency interference cancellation pilot
  - collaborative work with the Arecibo Observatory with an aim to build scientific and engineering capacity
- The radio spectrum is becoming increasingly congested and scientific uses of the spectrum need to coexist with many active users such as communications and radar; the Puerto Rico Coordination Zone at the Arecibo Observatory makes the location an ideal laboratory for radio sciences R&D
- Includes support for diversity, equity and inclusion with funding for partnership with the UPRM Centro Universitario para el Acceso (CUA) program which provides educational opportunities for economically disadvantaged youth, as well as the NRAO Radio Astronomy Data Imaging and Analysis Lab (RADIAL)
- Complementary to NSF's Spectrum Innovation Initiative and ESM unit efforts (see separate presentation)

Budgets: FY2022, FY2023

FY2022 Request

- Total FY2022 REQUEST shows strong support in AST funding
- Support for major new Astro2020 initiatives will come from the top line
  - Arecibo cleanup costs wrapping up, still shared
- At MPS level, probable continued investments in LEAPS and Ascend programs to promote broader participation
- **House mark for NSF top line down from request (+14% vs +20%)**

DIVISION OF ASTRONOMICAL SCIENCES (AST) **$294,050,000 +$17,000,000 / 6.1%**

AST Funding
(Dollars in Millions)

	FY 2020 Actual	FY 2021 Estimate	FY 2022 Request	Change over FY 2021 Estimate Amount	Change over FY 2021 Estimate Percent
Total	**$279.10**	**$277.05**	**$294.05**	**$17.00**	**6.1%**
Research	**64.99**	**52.92**	**72.47**	**19.55**	**36.9%**
CAREER	4.74	4.81	4.81	-	-
Education	**4.27**	**4.60**	**5.10**	**0.50**	**10.9%**
Infrastructure	**209.85**	**219.53**	**216.48**	**-3.05**	**-1.4%**
Arecibo Observatory[1]	3.75	12.68	8.00	-4.68	-36.9%
AST Portfolio Review Implementation	0.05	-	-	-	N/A
Green Bank Observatory[2]	9.42	8.90	9.12	0.22	2.5%
Midscale Research Infrastructure	23.30	20.80	19.50	-1.30	-6.3%
National Radio Astronomy Observatory (NRAO)	85.75	88.13	91.16	3.03	3.4%
NRAO O&M	*38.48*	*39.45*	*40.53*	*1.08*	*2.7%*
Atacama Large Millimeter Array (ALMA)	*47.27*	*48.68*	*50.63*	*1.95*	*4.0%*
National Solar Observatory (NSO)	21.79	22.09	25.46	3.37	15.3%
NSO O&M	*4.78*	*4.55*	*5.88*	*1.33*	*29.2%*
Daniel K. Inouye Solar Telescope (DKIST) O&M[3]	*17.01*	*17.54*	*19.58*	*2.04*	*11.6%*
NSF's National Optical-Infrared Astronomy Research Lab (NOIRLab)	57.86	57.93	54.44	-3.49	-6.0%
NOIRLab O&M (Mid-Scale Observatories & Community Science and Data Center)[4]	*35.54*	*29.95*	*26.26*	*-3.69*	*-12.3%*
Gemini Observatory O&M	*22.31*	*22.98*	*22.98*	-	-
Vera C. Rubin Observatory O&M	*0.01*	*5.00*	*5.20*	*0.20*	*4.0%*
Research Resources	7.92	7.00	8.80	1.80	25.7%

[1] Includes $28.88 million in FY 2021 and $15.0 million in FY 2022 in supplemental funding for cleanup of the Arecibo site.

[2] FY 2020 Actual includes $1.75 million from a technical deobligation/reobligation action from a previous award.

[3] FY 2021 Estimate excludes funding of $2.0 million for cultural mitigation activities as agreed to during the compliance process.

[4] Includes $2.0 million in FY 2020 for transition activities associated with the creation of NOIRLab, as well as special projects funding of $13.63 million in FY 2020, $9.44 million in FY 2021, and $5.13 million in FY 2022.

FY2022 Request: MREFC

- Request shows completion of DKIST,
- Request supports completion of Rubin with additional funding to support COVID impacts. **Further delays will impact eventual FY23 request.**

MREFC Account Funding, by Project

(Dollars in Millions)

	FY 2020 Actual	FY 2021 Estimate[1]	FY 2022 Request	FY 2023 Estimate	FY 2024 Estimate	FY 2025 Estimate	FY 2026 Estimate	FY 2027 Estimate
Antarctic Infrastructure Recapitalization	$48.78	$90.00	$90.00	$60.00	$60.00	TBD	TBD	TBD
DKIST	-	-	-	-	-	-	-	-
HL-LHC Upgrade	33.00	33.00	36.00	33.00	18.00	-	-	-
Mid-scale Research Infrastructure[2]	-	76.25	76.25	76.25	76.25	76.25	76.25	76.25
NEON	0.74	-	-	-	-	-	-	-
RCRV	25.00	-	5.00	15.00	-	-	-	-
Vera C. Rubin Observatory	46.35	40.75	40.75	15.00	-	-	-	-
Dedicated Construction Oversight	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Total	**$154.84**	**$241.00**	**$249.00**	**$200.25**	**$155.25**	**$77.25**	**$77.25**	**$77.25**

[1] A total of $129.35 million was carried forward from FY 2020 into FY 2021: $29.71 million for AIMS, $9.40 million for DKIST, $65.0 million for Mid-scale RI, $10.97 million for RCRV, $10.07 million for the Rubin Observatory, and $780,000 for Dedicated Construction Oversight.

[2] Outyear amounts are for planning purposes only. NSF will evaluate Mid-Scale Research Infrastructure in the context of agency priorities for future budget submissions.

FY2023 Request

- Given the **continued** delay in Astro2020 release, it will be challenging to work in large investments for the new recommendations
  - We are actively exploring scenarios to try to prepare options and requests

- *Will be balancing Grants with*
  - *Maintenance requirements of middle-aged Major Facilities*
  - *Major Facilities O&M, including Rubin Operations*
  - *Funding development & design of next generation facilities*

DIVISION OF ASTRONOMICAL SCIENCES (AST)

AST Funding
(Dollars in Millions)

	FY 2020 Actual	FY 2021 Estimate	FY 2022 Request	Change over FY 2021 Estimate Amount	Change over FY 2021 Estimate Percent
Total	$279.10	$277.05	$294.05	$17.00	6.1%
Research	64.99	52.92	72.47	19.55	36.9%
CAREER	4.74	4.81	4.81	-	-
Education	4.27	4.60	5.10	0.50	10.9%
Infrastructure	209.85	219.53	216.48	-3.05	-1.4%
Arecibo Observatory[1]	3.75	12.68	8.00	-4.68	-36.9%
AST Portfolio Review Implementation	0.05	-	-	-	N/A
Green Bank Observatory[2]	9.42	8.90	9.12	0.22	2.5%
Midscale Research Infrastructure	23.30	20.80	19.50	-1.30	-6.3%
National Radio Astronomy Observatory (NRAO)	85.75	88.13	91.16	3.03	3.4%
NRAO O&M	*38.48*	*39.45*	*40.53*	*1.08*	*2.7%*
Atacama Large Millimeter Array (ALMA)	*47.27*	*48.68*	*50.63*	*1.95*	*4.0%*
National Solar Observatory (NSO)	21.79	22.09	25.46	3.37	15.3%
NSO O&M	*4.78*	*4.55*	*5.88*	*1.33*	*29.2%*
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Questions?