NSF Town Hall

Debra Fischer

Division Director NSF AST

AST People and the organization

AST National Centers

AST Updates and News: DKIST, Rubin, Arecibo

AST Budget Update

Astro2020

My guiding principles (derived from 1950 Congressional Act)

To advance the understanding of the universe, to promote U.S. scientific leadership, to build a diverse workforce of scientists and engineers, and to enhance the lives of our citizens.

To achieve the mission and to make strategic decisions:

1. Enable scientific advances by providing merit-based research grants and community access to critical enabling research tools: telescopes, instruments, software.
2. Invest in technology development to open new windows on the universe.
3. Support diversity and inclusivity to enable creative and fresh insights into research.
4. Encourage a broad understanding of the astronomical sciences by a diverse population of scientists, policy makers, educators, and the public at large.
5. Foster the exchange of information to advance scientific breakthroughs.

ASTRONOMERS FOR PLANET EARTH

Reduce carbon emissions associated with our research

- Energy budgets of facilities
- Travel (meetings, observing)
- Sharing the astronomical perspective of our planet

Division of Astronomical Sciences (AST)

Management Team

Debra Fischer
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)

Administration

Elizabeth Pentecost
Project Administrator

Matthew Viau
Program Analyst

Allison Farrow
Program Analyst

Renee Adonteng
Program Analyst

Tanner Abraham
Pathways Student

Individual Investigator Programs (IIP)

Hans Krimm
IIP Coordinator

ILead: Stellar Astronomy

Nigel Sharp
Program Director

Lead: Mid-Scale Programs; AAG

Glen Langston
Program Director

Lead: Galactic Astronomy; AAG

Luke Sollitt
Program Director

Lead: Planetary Astronomy; AAG

Sarah Higdon
Program Director

Lead: CAREER; AAG

Zoran Ninkov
Program Director

Lead: Advanced Technology & Instrumentation; AAG

James Higdon
Program Director

Lead: REU Sites; AAG

Andreas Berlind
Program Director

AAG

Andrea Prestwich
Program Director

AAG

Matthew Benacquista
Program Director

Expert

Facilities, & MREFC Projects

Ashley VanderLey
Senior Advisor for Facilities

David Boboltz
Program Director

DKIST

Christopher Davis
Program Director

NOIRLab

Edward Ajhar
Program Director

Vera C. Rubin Observatory

Joe Pesce
Program Director

NRAO; ALMA AAG

Harshal Gupta
Program Director

GBO AAPF; AAG

Martin Still
Program Director

Gemini

Carrie Black
Program Director

NSO

Alison Peck
Program Director

Arecibo

Luca Rizzi
Program Director

Vera C. Rubin Observatory

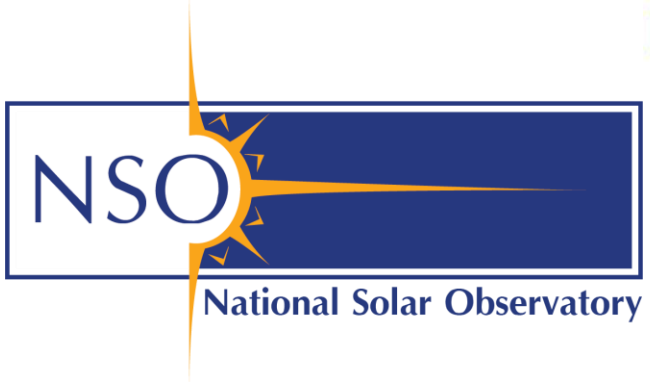
ESM

John Chapin
Special Advisor for Spectrum

Jonathan Williams
Program Director

David Morris
Program Director

The Organization(s)



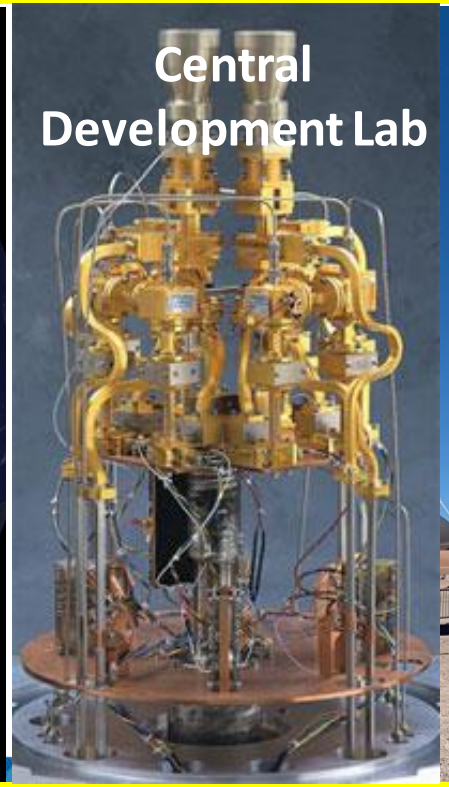
The Organization(s)

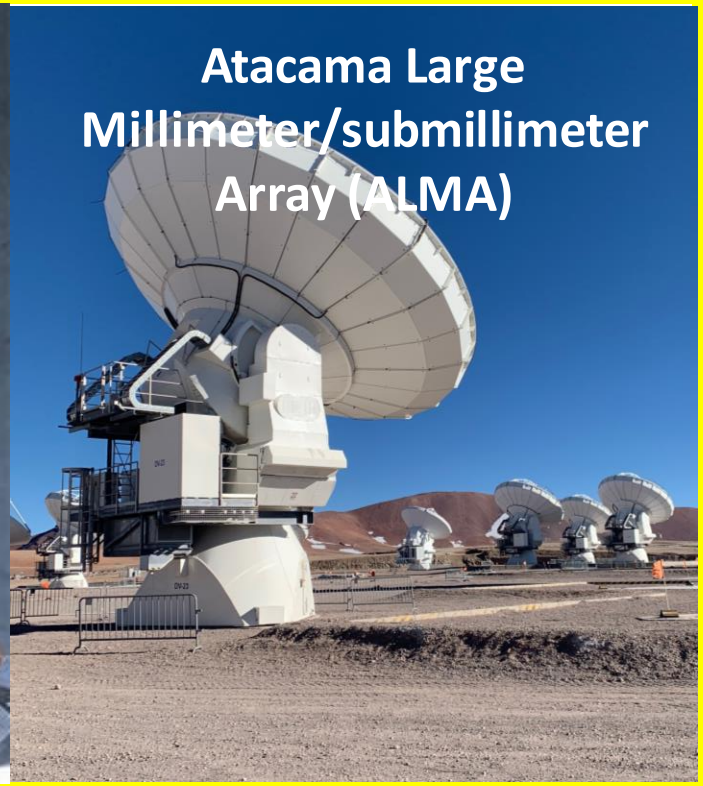
1950 Congressional Act: support basic science across the nation, do not operate laboratories

National Centers

The National Radio Astronomy Observatory (NRAO)

- ALMA, VLA ,and VLBA fully operational
- VLA Sky Survey continues
- ngVLA prototype antenna production in process





Green Bank Observatory

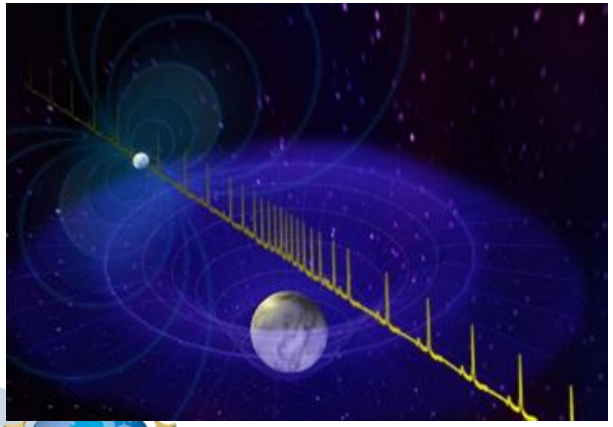
Status and outlook

- New Director: Jim Jackson (October 2020); Karen O'Neil served for 15 years
- Science operations continue with COVID-19 protocols in place
- GBT poised to play key role in Astro2020 high priority areas: pulsar timing; radio cameras; and RFI mitigation
- Key science results and new development (e.g., radar transmitter)

Robert C. Byrd 100 m Green Bank Telescope (GBT)
World's largest fully steerable single dish radio telescope

Science highlights

Pulsar timing/compact objects
Most massive neutron star detected

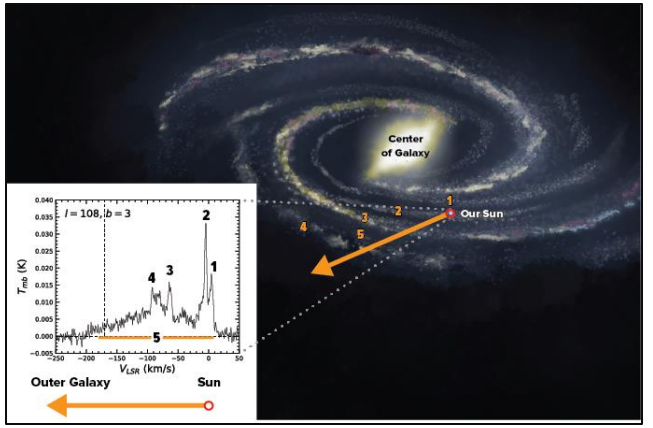


NANOGrav collaboration
Cromartie et al. (2020) *Nature Astron*, **4**, pp 72-76.
Credit: J. Mallusky, GBO/AUI

Astrochemistry
Direct detection of small PAHs

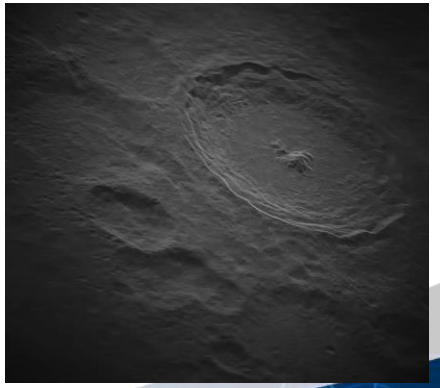
GOTHAM Large Project; PI: B. A. McGuire, MIT
McGuire et al. (2021) *Science*, 371, Issue 6535, pp 1265-1269. +6 papers in *Nature Astronomy* and *ApJ L*
Credit: J. Mallusky, GBO/AUI

Galactic structure
Thick disk of CO-dark gas in Outer Galaxy



Busch et al. (2021) *ApJ*, 914, 72
Credit: J. Mallusky, GBO/AUI

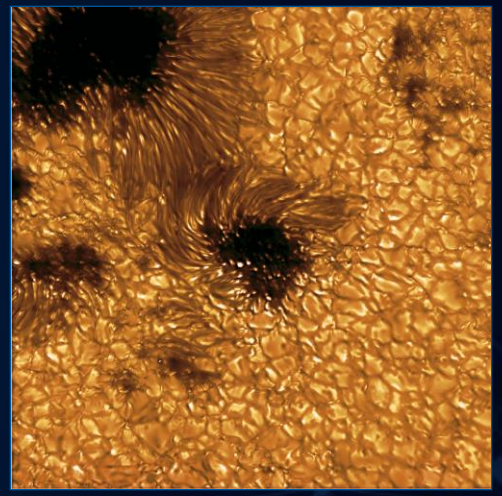
Solar System studies
Radar imaging of Tycho



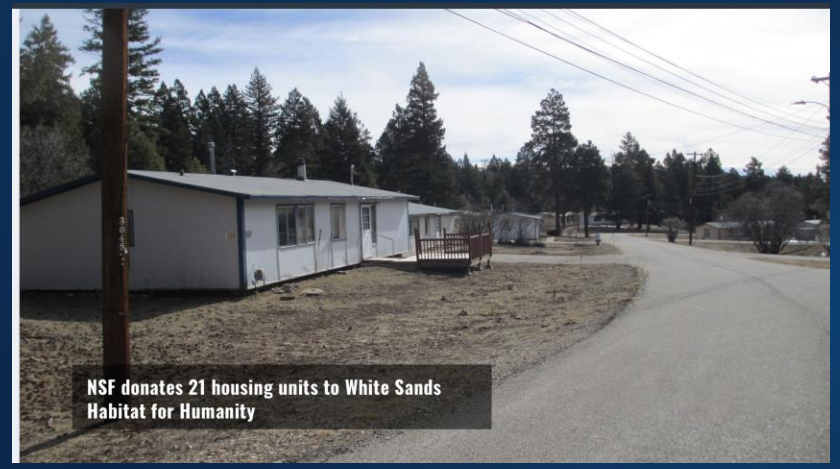
Credit: NRAO/GBO/Raytheon/AUI/NSF

National Solar Observatory

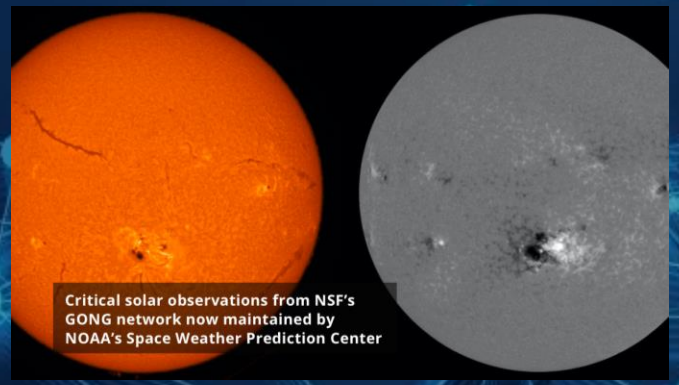
DKIST Operations Begin!
First Observations Planned for February 2022

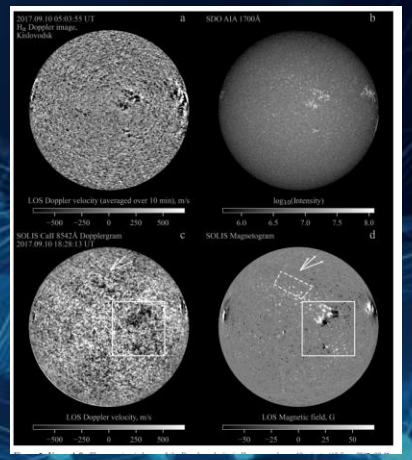


Relocatable Housing Units at Sunspot Solar Observatory Donated to Habitat for Humanity



NSF and NOAA signed a 5 year IAA for GONG operations



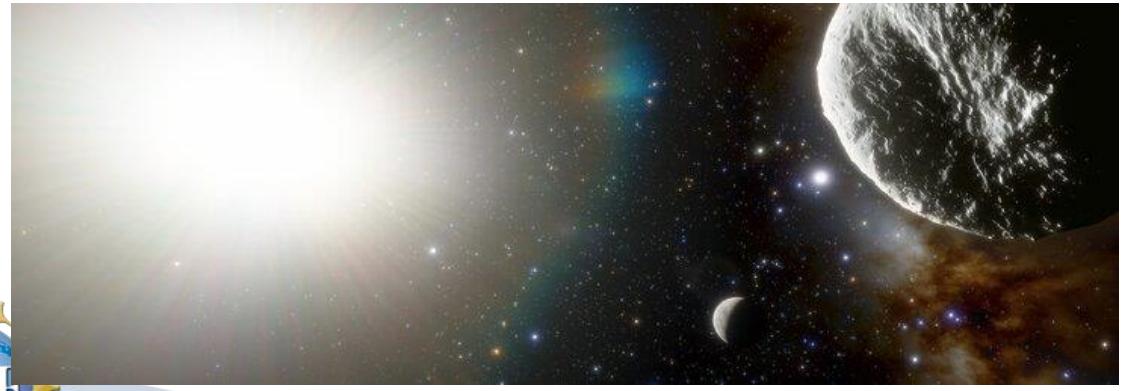


Analysis of 2015 SOLIS data shows roots of the solar wind in the chromosphere.

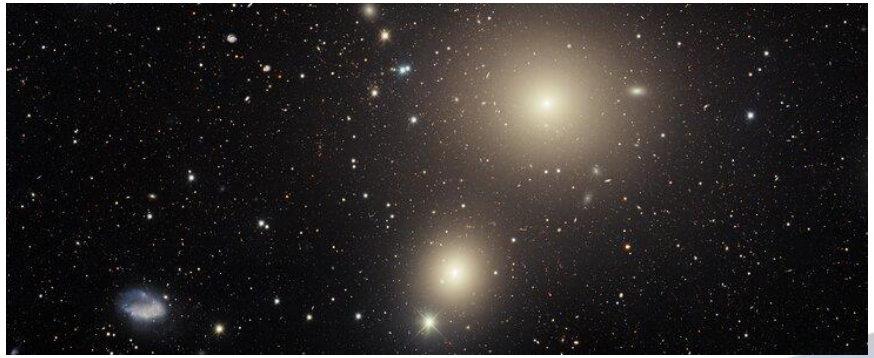
NOIRLab Continues to make major discoveries through 2021

Gemini Observatory helps reveal that a stream of old stars at the fringes of our galaxy is a shredded star cluster

Largest Collection of Free-Floating Planets Found in Milky Way using NOIRLab observations and archival data



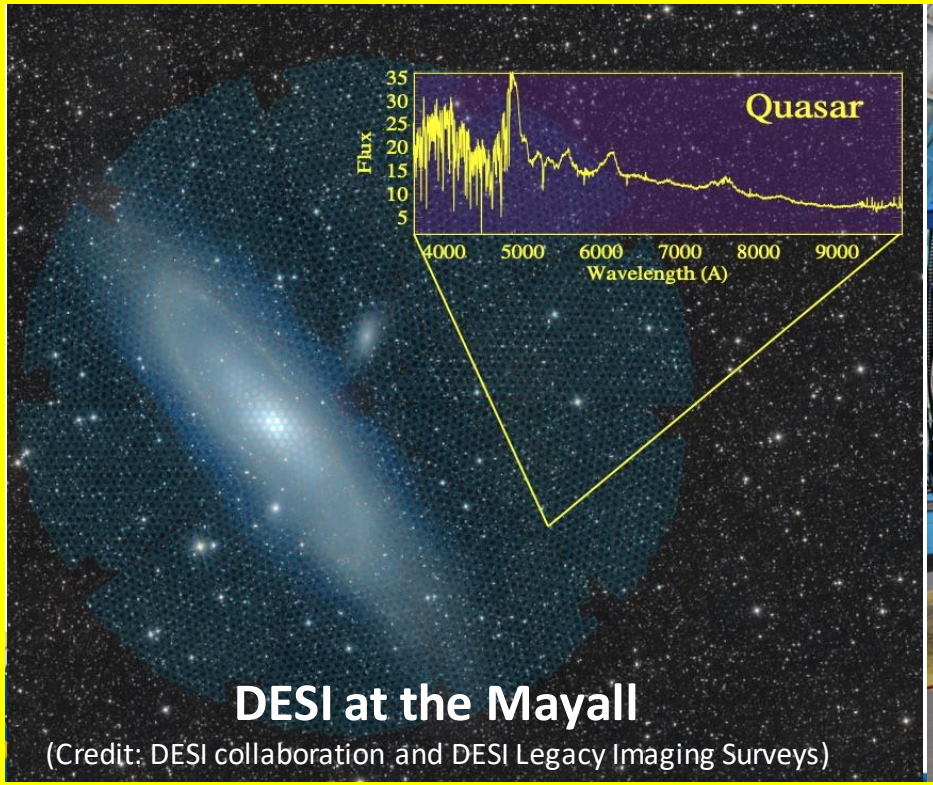
Fastest Orbiting Asteroid Discovered at NOIRLab's CTIO



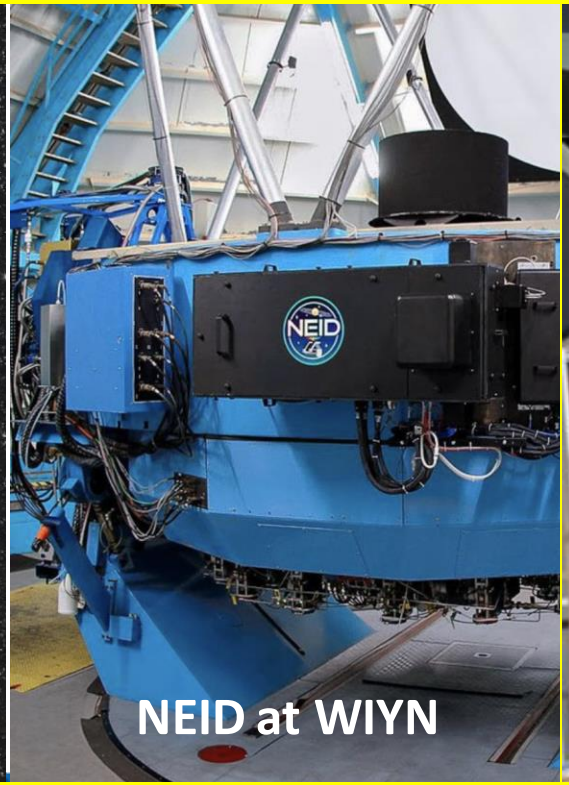
Blanco captures a doomed galaxy falling into the heart of the Fornax Cluster

NOIRLab Observatories

- KPNO, CTIO, and Gemini fully operational through 2021
- DOE's DESI and NASA's NEID instruments commissioned on NOIRLab Telescopes
- NSF funds recommissioning of NEWFIRM/Blanco and ISPI/SOAR (incl. new detector)
- Blanco's Dark Energy Survey Public Data-Release 2 released (6 yrs of data; 5000 sqr degs)
- CSDC's Astro Data Lab incorporates data from DESI Legacy Survey DR9 (among others)



DESI at the Mayall
(Credit: DESI collaboration and DESI Legacy Imaging Surveys)



NEID at WIYN


NEWFIRM shipped to Chile

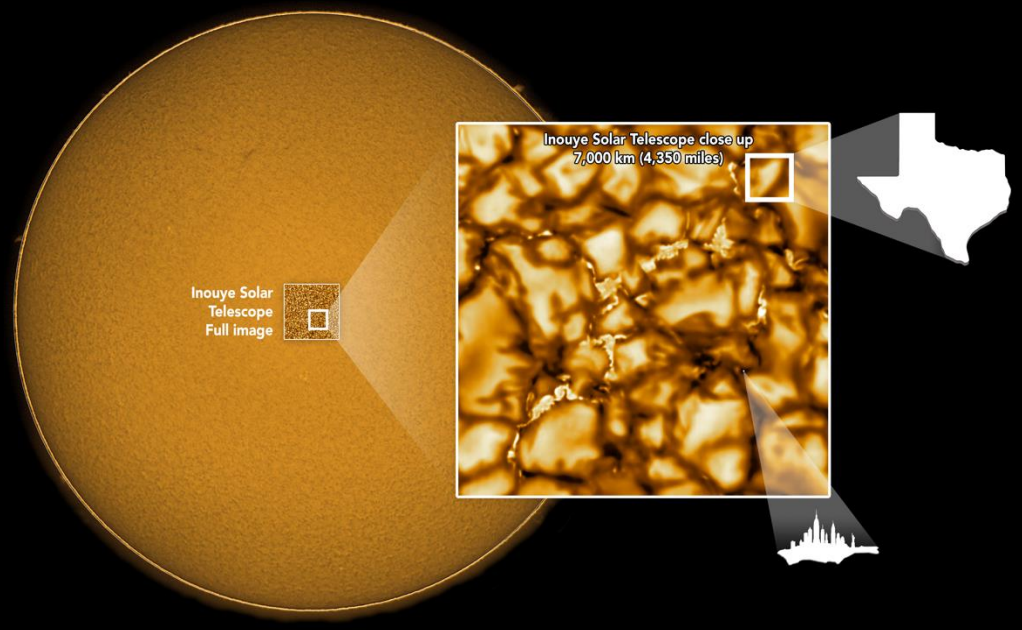

DECam's millionth image!

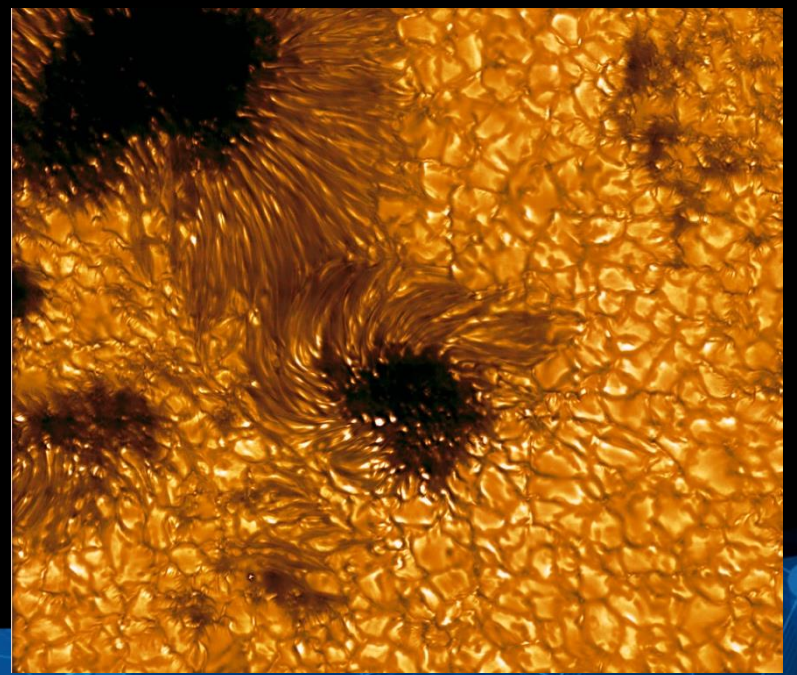
AST Updates and News

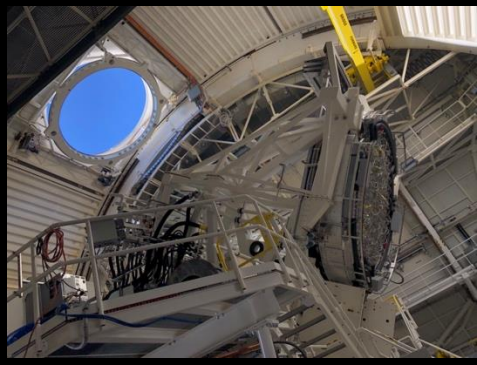
Daniel K. Inouye Solar Telescope

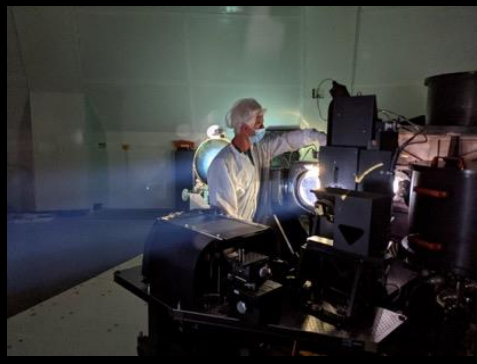
The largest, most powerful solar observatory on planet Earth

Now in operations!









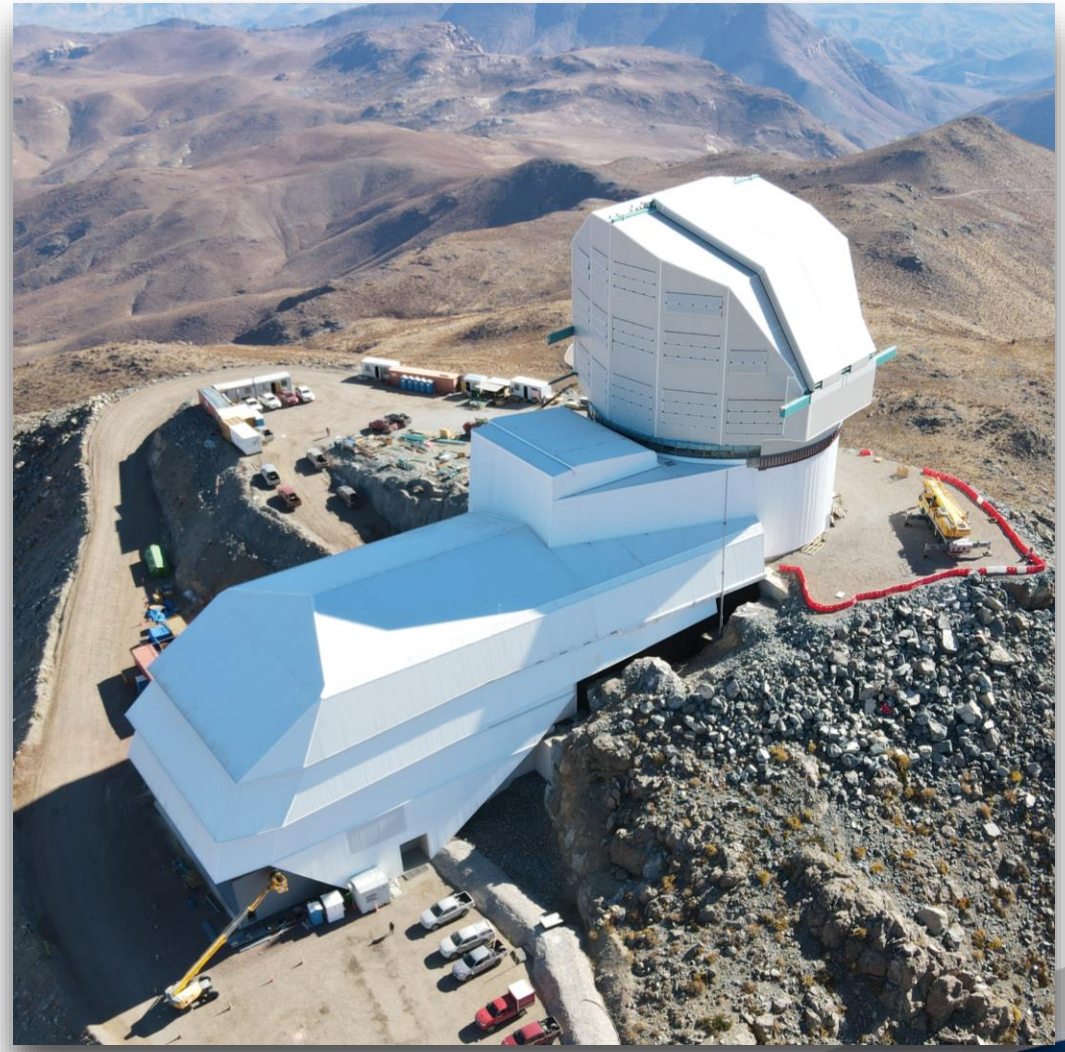
DKIST: Enabling a New Era of Multi-Messenger Astrophysics

- The Sun is our nearest laboratory for stellar astrophysics
- In-situ measurements of particles and fields with Parker Solar Probe and Solar Orbiter
- High-resolution electromagnetic imaging and spectroscopy with DKIST

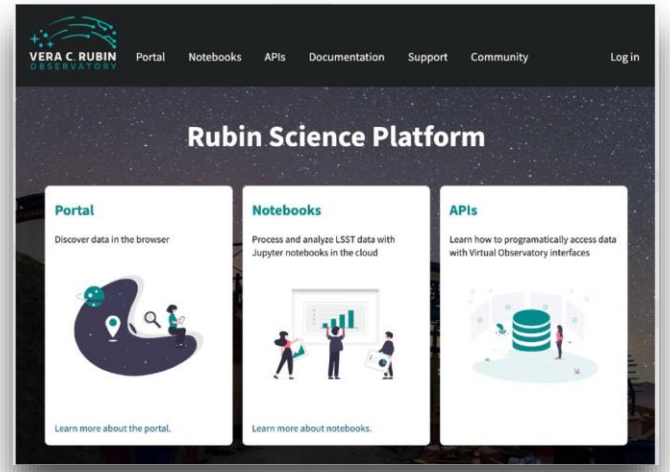
National Science Foundation | U.S. DEPARTMENT OF ENERGY OFFICE OF SCIENCE

VERA C. RUBIN OBSERVATORY

- NSB authorized additional funding to cover known COVID delays to construction (December 2021).
- Construction completion expected July 2024.
- NSF and DOE closely coordinate COVID schedule impacts.
- Good progress on construction through 2021!



Telescope mount top end lifted into dome (Mar. 2021)



Data Preview Zero launched (June 2021)

All filters arrived at SLAC (Sep. 2021)

2021 Highlights

Camera surrogate mass removed and reinserted into the telescope mount assembly (Nov. 2021)

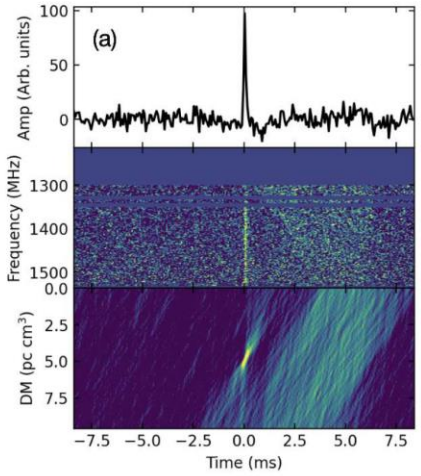
Arecibo Observatory: Current Status

Emergency cleanup is complete!

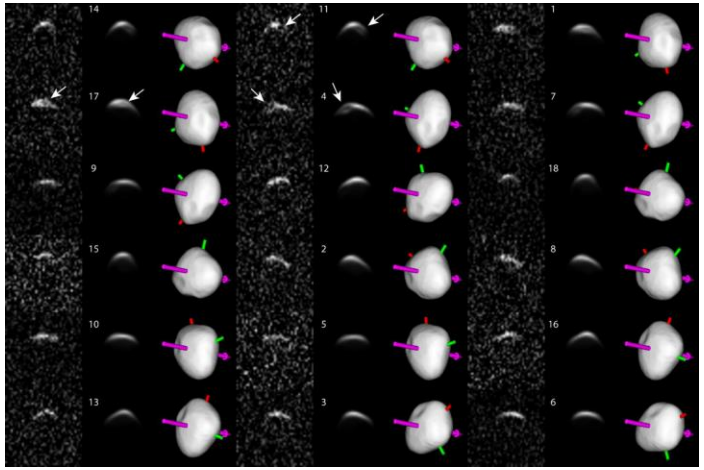
The emergency cleanup team safely removed approximately 14,000 damaged panels, or ~35% of the reflector area. Once the fallen platform (left, Dec 2020) was removed, the team repaired 225 feet of concrete rim wall and installed erosion control measures, including the use of coconut fiber matting and seeding, to secure the slope and encourage native vegetation growth (right, Dec 2021). All debris has been removed, and remaining structures stabilized.

Arecibo Observatory: Current Status

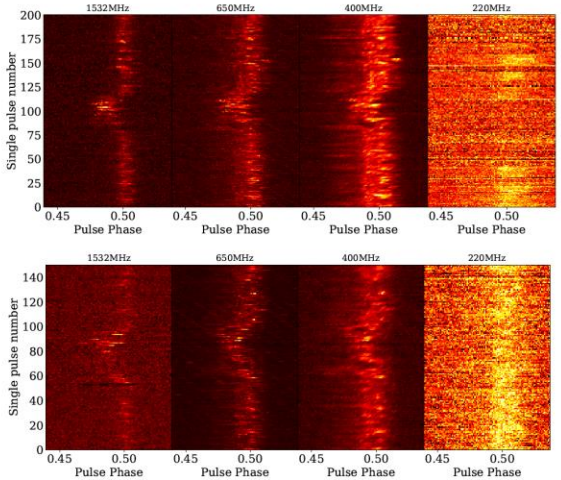
The Arecibo Observatory is still functioning! Educational programs continue (some held virtually due to COVID-19), and scientists continue to analyze and publish existing data. Instrumentation that was not associated with the 305-m telescope, such as the Lidar and other optical observing tools, is being maintained or improved.



Search for fast radio transients (Perera et al, 2022)

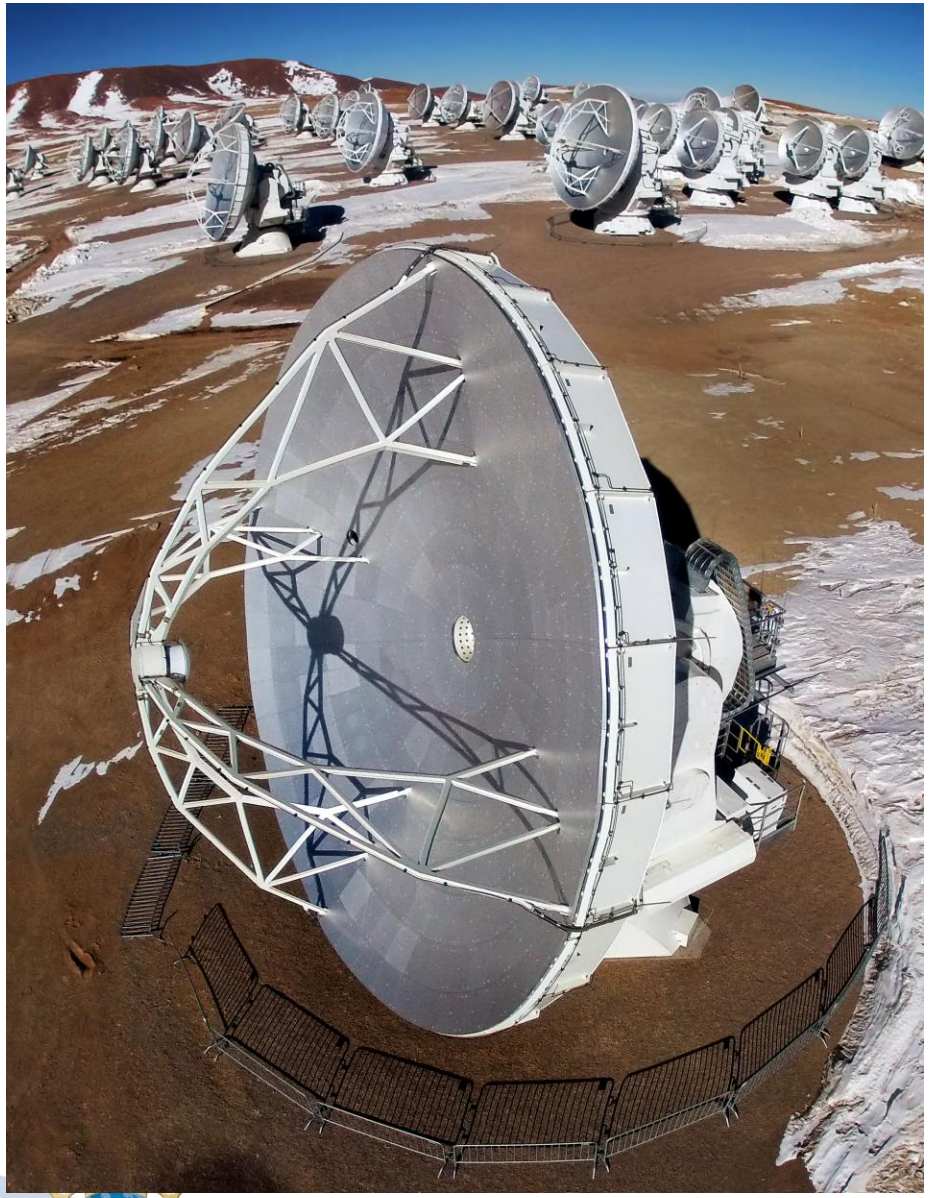


Delay-Doppler imaging of asteroid 16 Psyche (Shepard et al, 2021)



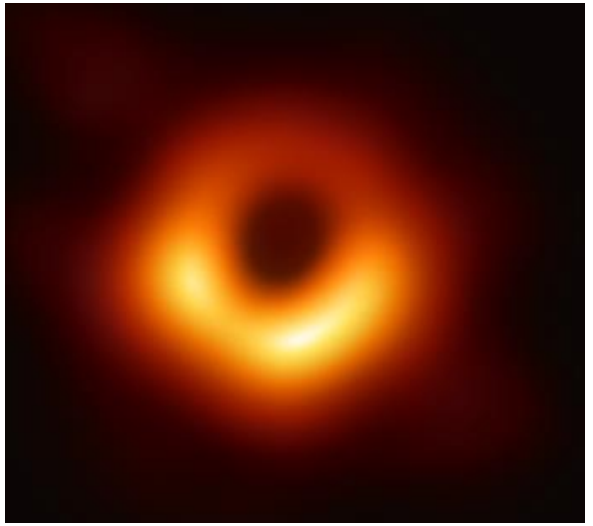
Multifrequency observations of PSR B0919+06 (Rajwade et al, 2021)

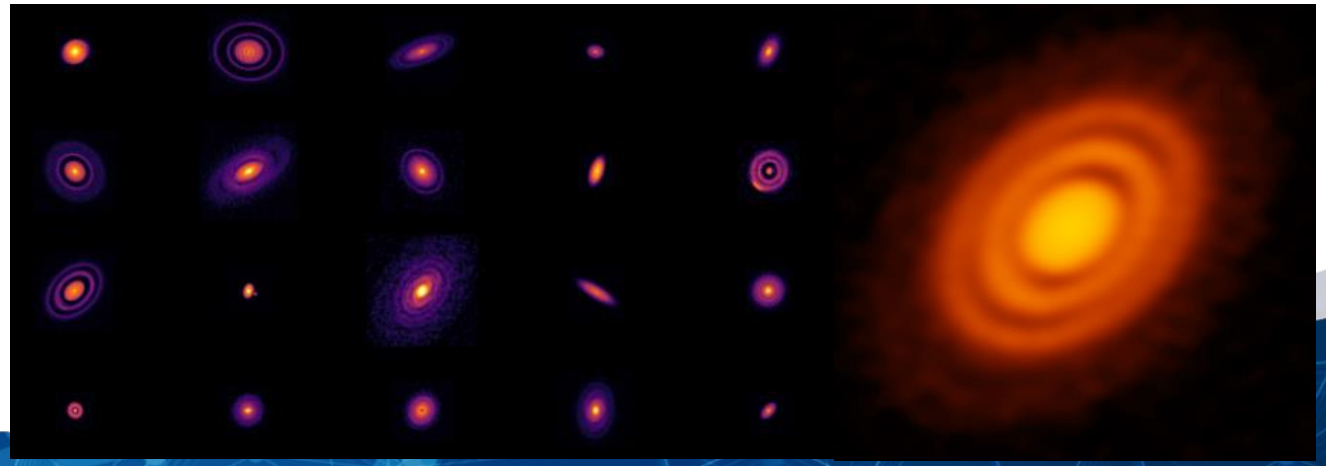
NSF is considering a broad range of options for the future of Arecibo Observatory. No decisions have been made at this time. As with any investments by NSF, proposals for potential new telescopes or other instrumentation, as well as ideas for new educational programs at Arecibo Observatory, must be formally submitted to the agency and will be evaluated according to two main criteria: intellectual merit and broader impacts.



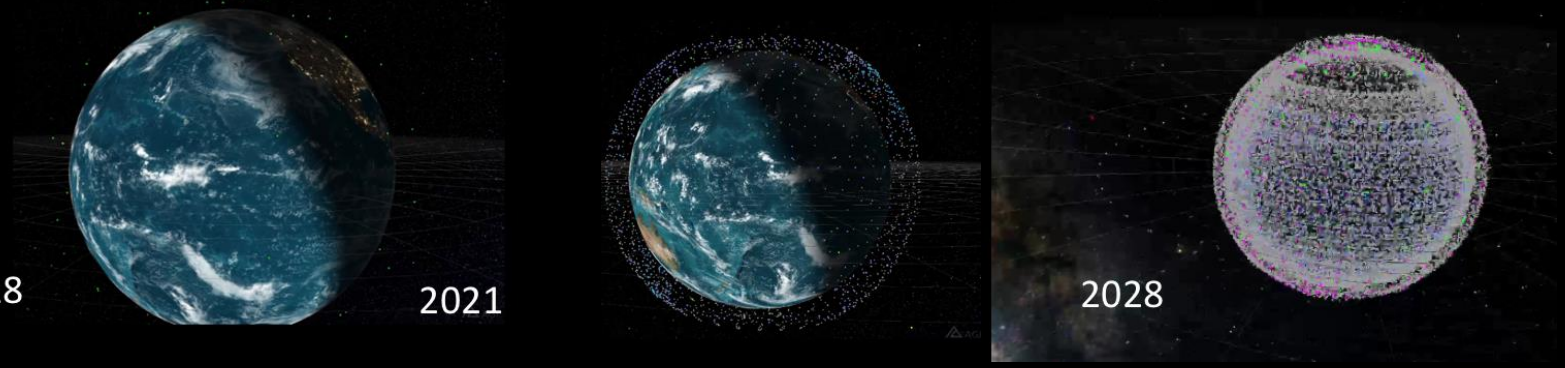
The Atacama Large Millimeter/submillimeter Array (ALMA)

- ALMA is fully operational
- Continuing to break records: 1,765 Cycle 8 proposals for 26,000 hours of 12-m time
- Upgrade to Band 6 receiver approved

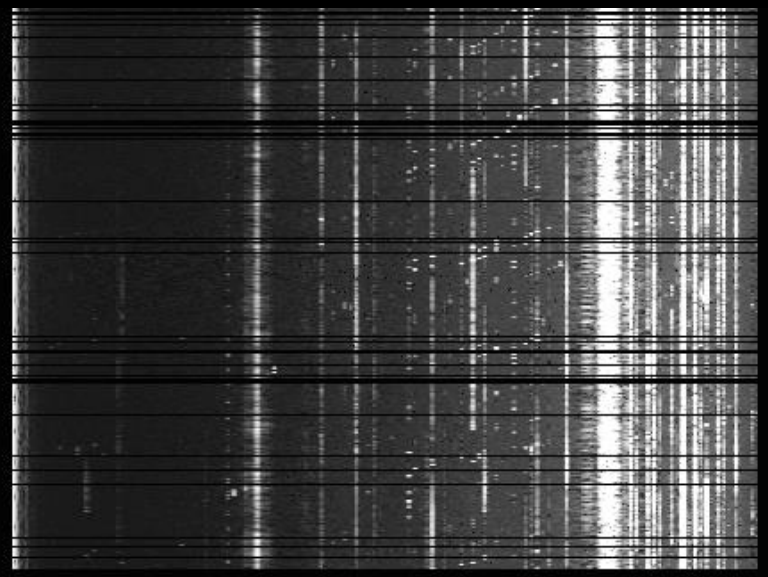




Key issue: Constellations of satellites in low Earth orbit – proposed population exceeding 50,000 in coming decade



optical interference

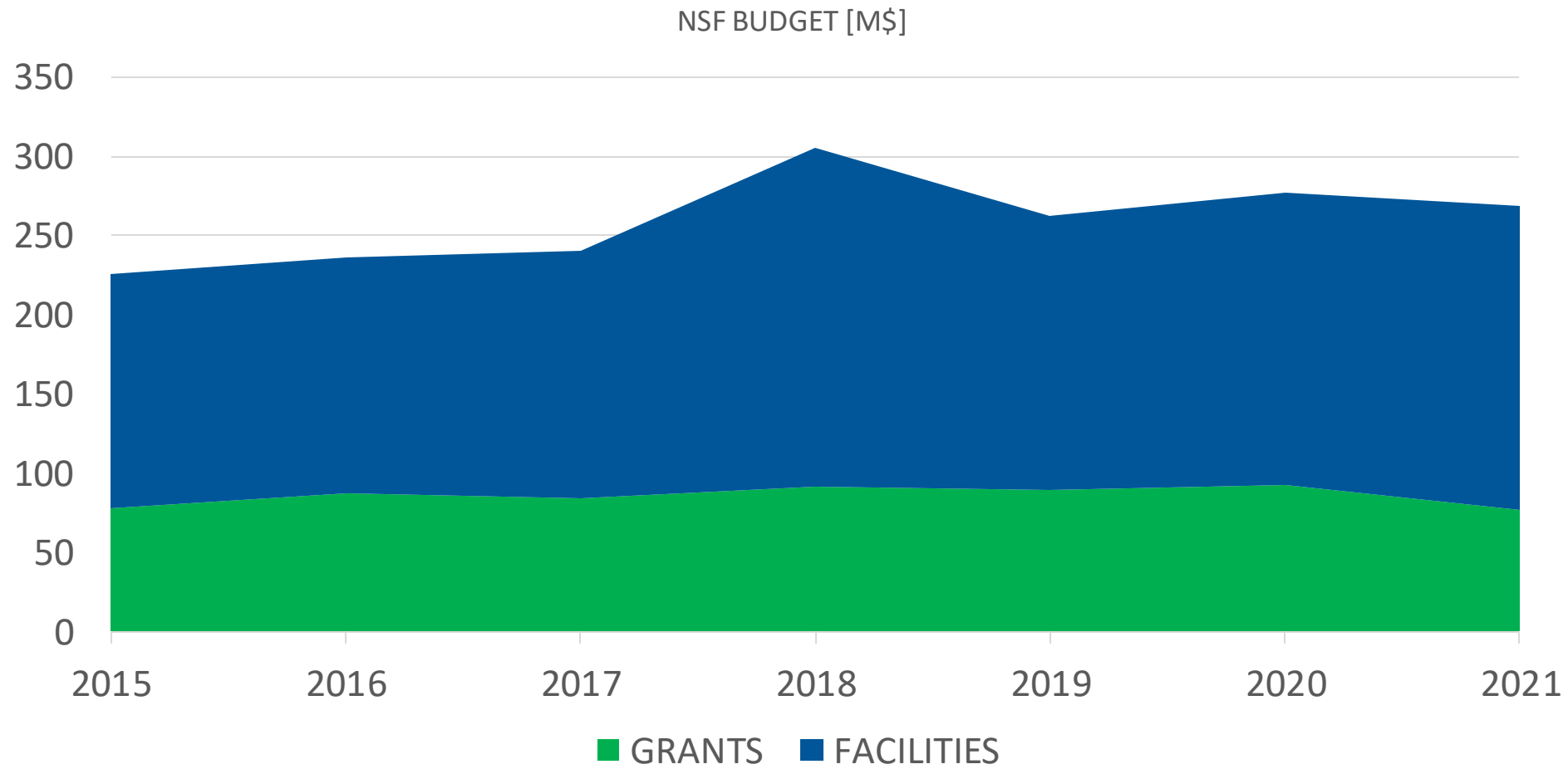


radio interference

Siting telescopes in remote locations is no longer sufficient for protection.

Images: Screen shots from animations based on applications filed with the ITU and the U.S. FCC. Credit: SSC.

The Budget


NSF BUDGET [M$]
350
300
250
200
150
100
50
0
2015
2016
2017
2018
2019
2020
2021
GRANTS
FACILITIES

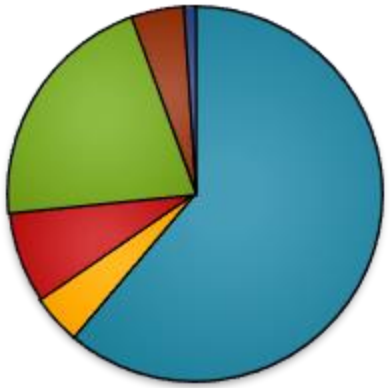
AST Division Programs

Individual Investigators
(Lead: Hans Krimm)

- AAG
- CAREER
- AAPF
- ATI
- * MRI
- REU
- ESP
- PAARE

Mid-scale
(Lead: Nigel Sharp)

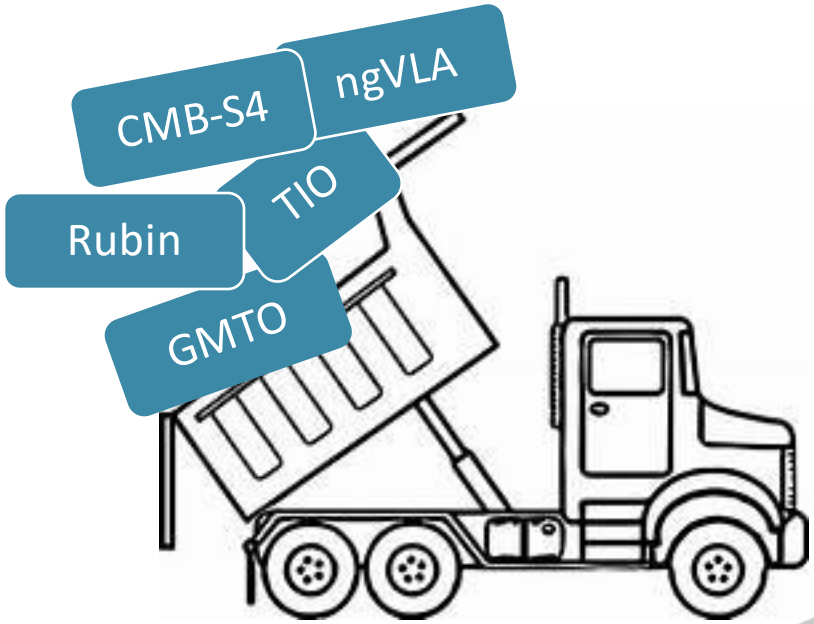
- MSIP
- * MSRI 1
- * MSRI 2



Facilities
(Sr Advisor: Ashley Vanderley)

- ALMA
- GBO
- Arecibo
- Gemini N & S
- NSO
- NSO
- NRAO

Astro 2010 recommendation:
Facilities: 55% of the AST budget (60%)
AAG: 25% of the AST budget (20%)



* Outside AST budget

Astro2020

Astro 2020 recommended: "Start here"

Fund people and develop the workforce

- Augment and protect individual investigator grants
- Build opportunities for diversity in workforce
- Increase transparency (in budgets and proposal statistics)
- Reduce carbon footprint associated with research

Aligned with existing MPS and AST initiatives supporting students, postdocs and early-career faculty from under-represented groups. With a complex future (artificial intelligence, robotics), the NSF workforce development provides a pathway to creative analytical skills and jobs that inherently offer flexibility and adaptability.

Astro2020 midscale recommendations

to support research and workforce:

- Sustain instrumentation
- laboratory astrophysics
- data science and archives

"Mid-scale research infrastructure and cyberinfrastructure….must be growth areas for NSF…" NSB-2018-40

Science-centered

Astro2020 describes a pathway to major scientific breakthroughs
The discoveries will impact the lives of our citizens
The science is timely – the work will be done (hopefully with U.S. leadership)

Astro 2020 Science:

Three science themes addressing fundamental and profound questions for humanity and for understanding our place in the space and time of the Cosmos.

A step-by-step path to discovering habitable worlds and life elsewhere.

Time-domain multi-messenger astrophysics to trace the earliest stages of the observable universe

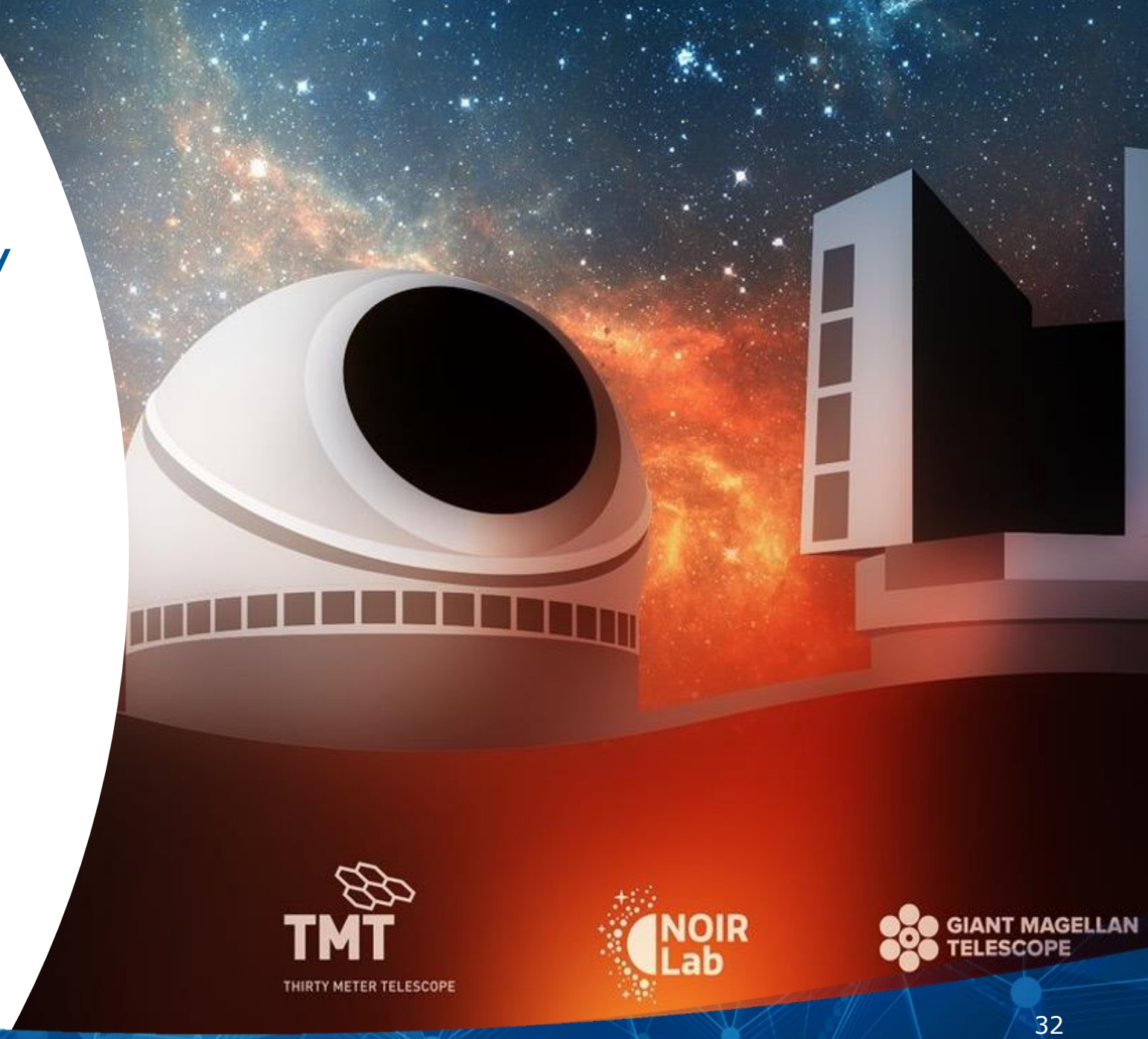
Formation and evolution of stars and galaxies from the Big Bang to today

The Tools

Major facilities needed to make substantial progress on science questions.

Top major facility recommendation: Extremely Large Telescopes (US-ELT)

To study exoplanets, carry out follow-up on faint sources (Rubin discoveries) and track the composition and structure of distant young galaxies as they form.



Two second-ranked major facility recommendations (equal weighting):

(2a) CMB-S4 probe the earliest moments of the universe, seeds of galaxy formation.

(2b) (ngVLA) formation of planets and the earliest galaxies, Earth orientation (GPS and global navigation satellites).


NSF

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	J. Higdon
AAPF	Astronomy & Astrophysics Postdoctoral Fellowships	15 Oct 21	Gupta
AAG	Astronomy & Astrophysics Research Grants	15 Nov 21	Berlind (EXC), Langston (GAL), Krimm (SAA), Sollitt (PLA)
ATI	Advanced Technology and Instrumentation	15 Nov 21	Ninkov
MRI*	Major Research Infrastructure	19 Jan 22	Ninkov
PAARE	Partnerships in Astronomy and Astrophysics Research and Education	7 Feb 22	multiple – contact: Krimm
ESP	Education & Special Programs (no solicitation; PAPPG)	flexible	multiple – contact: Krimm

* NSF-wide solicitations

Note: No new MSIP awards in FY2022

AST Division Programs

Individual Investigators
(Lead: Hans Krimm)

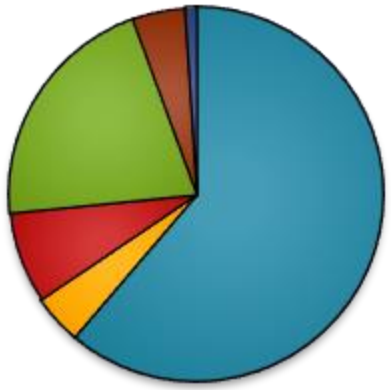
Research
- AAG
- CAREER
- AAPF

Technology/ Instrumentation*
- ATI
- MRI

Education and Special Programs*
- REU Sites & Supplements
- MPS LEAPS & ASCEND
- PAARE

Mid-scale
(Lead: Nigel Sharp)

- MSIP
- * MSRI 1
- * MSRI 2



Facilities
(Sr Advisor: Ashley Vanderley)

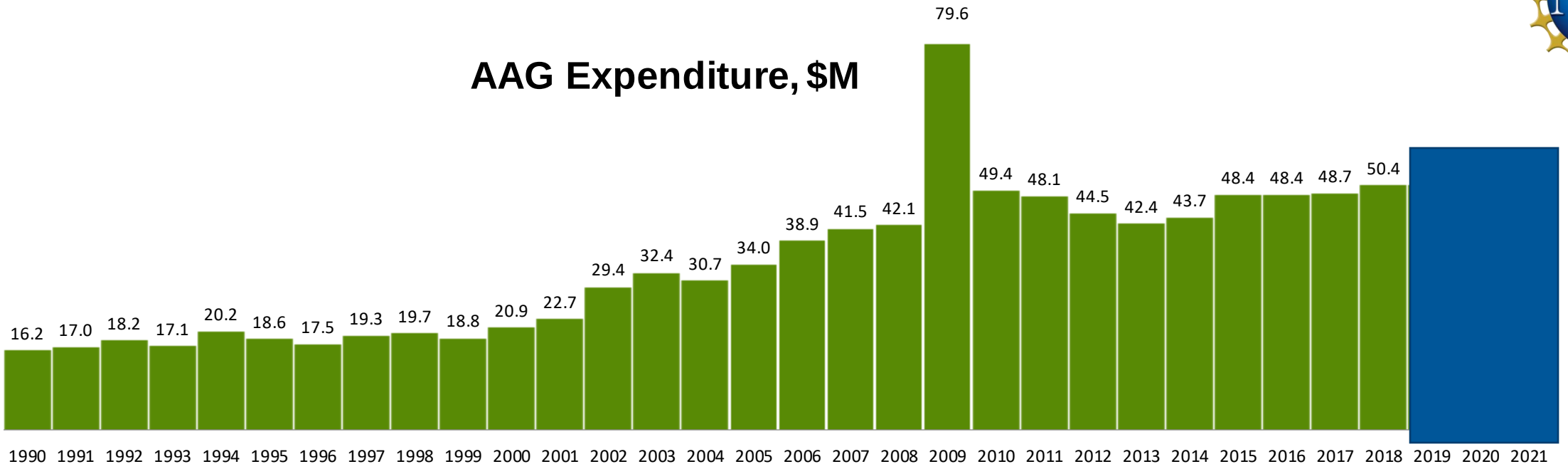
- NRAO
- ALMA
- GBO
- Arecibo

MREFC

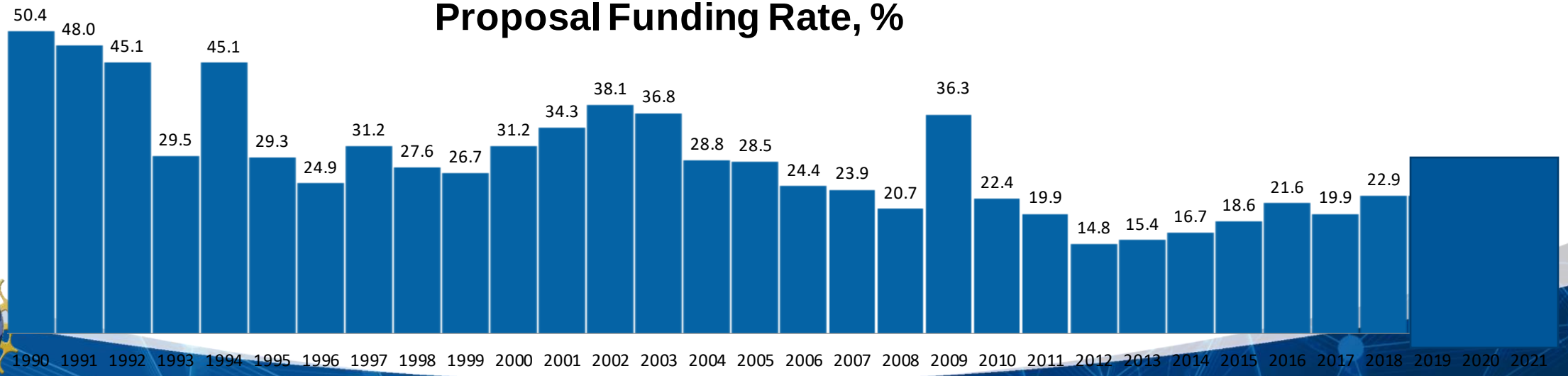
- NSO
- DKIST *
- NOIR Lab
- Rubin *
- Gemini N & S
- MidScale Obs
- Rubin Operations

* Outside AST budget

AAG Expenditure, $M



Proposal Funding Rate, %



Partnerships in Astronomy & Astrophysics Research and Education

- Broaden participation in astronomy
- Partnerships that
  - Strengthen education infrastructure
  - Strengthen research capacity
  - Create opportunities for student and faculty research
- Pathways into the research enterprise
  - Increase recruitment, retention and success
  - Foster a diverse, inclusive and equitable environment

PAARE program Solicitation NSF 22-525

- **Proposal Deadline: 7 February 2022 5 PM submitter's local time**

NSF Funding Opportunities Beyond AST

- Big Ideas
  - Windows on the Universe – MultiMessenger Astrophysics
  - Harnessing the Data Revolution
  - MidScale Research Infrastructure
  - Understanding the Rules of Life
- Education and Human Resources
- Other Crosscutting and NSF-wide Programs
  - Targeted programs in Data Science, Computer Science, Engineering, etc.
  - Cross Directorate programs, e.g. GEO+MPS "GLOW" DCL
- MPS LEAPS and ASCEND…

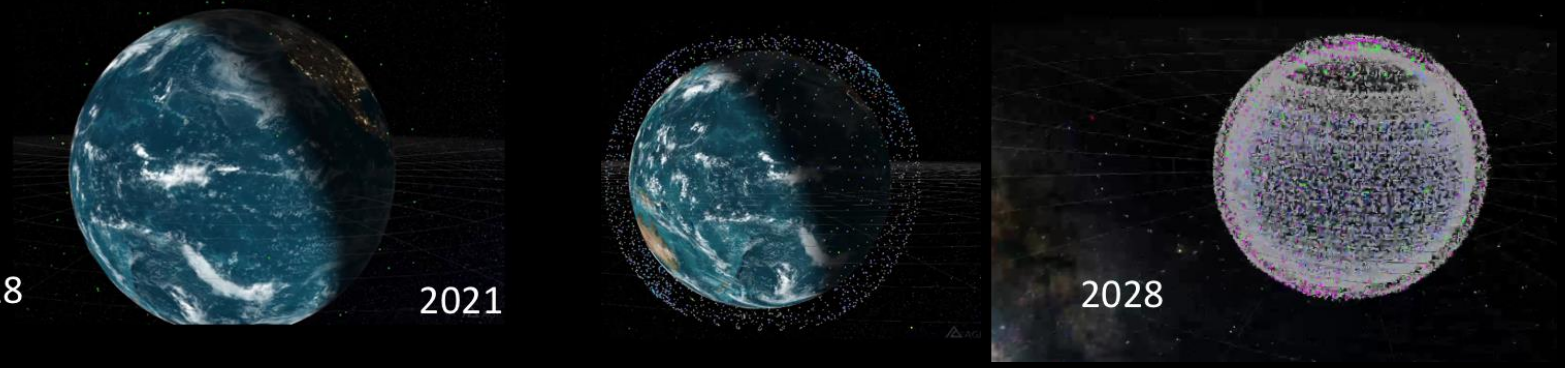
- MPS-Ascend = Mathematical and Physical Sciences Ascending Postdoctoral Research Fellowships
  - Supports postdoctoral fellows who will broaden the participation of groups that are underrepresented in MPS fields in the U.S.
  - Facilitates career development and transition to a faculty position
  - Six Astronomy awards made in FY21; review process underway for FY22

- MPS-LEAPS = Launching Early-Career Academic Pathways in the Mathematical and Physical Sciences
  - Emphasis on supporting pre-tenure faculty at minority-serving institutions (MSIs), predominantly undergraduate institutions (PUIs), and Carnegie Research 2 (R2) universities
  - Similar to CAREER with additional focus on broadening participation
  - Three Astronomy awards made in FY21; review process underway for FY22

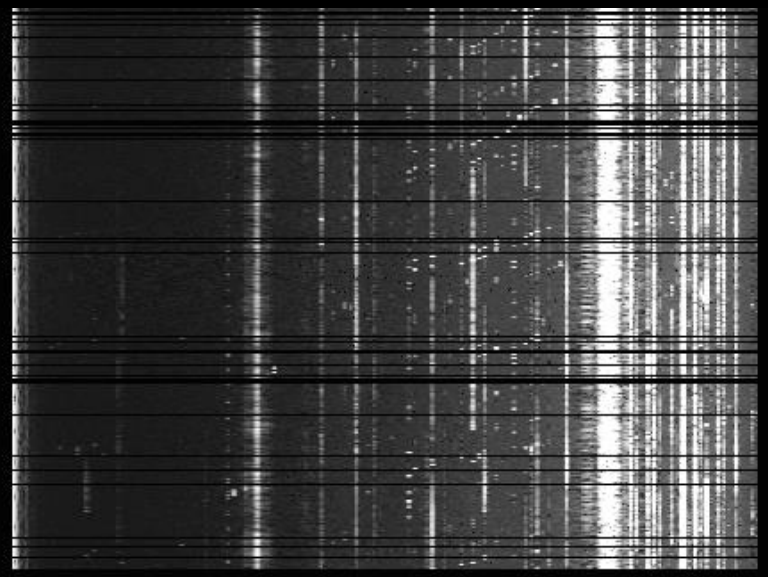
For Further Information (nsf.gov/ast)

- PAPPG: web search for "NSF 22-1" or… https://www.nsf.gov/pubs/policydocs/pappg22_1/nsf22_1.pdf
- Proposal preparation & submission: research.gov (fastlane.nsf.gov is phasing out; grants.gov may also be used)
- Award Administration: PAPPG and research.gov; for more details… https://www.nsf.gov/awards/managing/
- Volunteer to be a reviewer: https://www.surveymonkey.com/r/nsfastpanels
- Most recent Committee of Visitors report and response: https://www.nsf.gov/mps/advisory/cov.jsp
- Apply to be a "rotator": Send cover letter and CV to ast-ipa@nsf.gov

Key issue: Constellations of satellites in low Earth orbit – proposed population exceeding 50,000 in coming decade



optical interference



radio interference

Siting telescopes in remote locations is no longer sufficient for protection.

Images: Screen shots from animations based on applications filed with the ITU and the U.S. FCC. Credit: SSC.

Recent NSF activities related to new satellite constellations

Optical and Infrared

- 2 NSF-funded workshops: NOIRLab + AAS
  - SATCON1 – July 2020
  - SATCON2 – July 2021
- NSF's Rubin Observatory working closely with satellite operators
- NSF/Satellite Industry Association joint technical presentation for the USA to UN Committee on the Peaceful Uses of Outer Space (COPUOS)

Radio Frequency

- Spectrum coordination agreements
  - SpaceX (signed 2019)
    - Being updated (new & modified FCC license)
  - Other US-licensed operators to come
- R&D on satellite interference mitigation/coexistence
  - Spectrum Innovation Initiative
  - SWIFT program

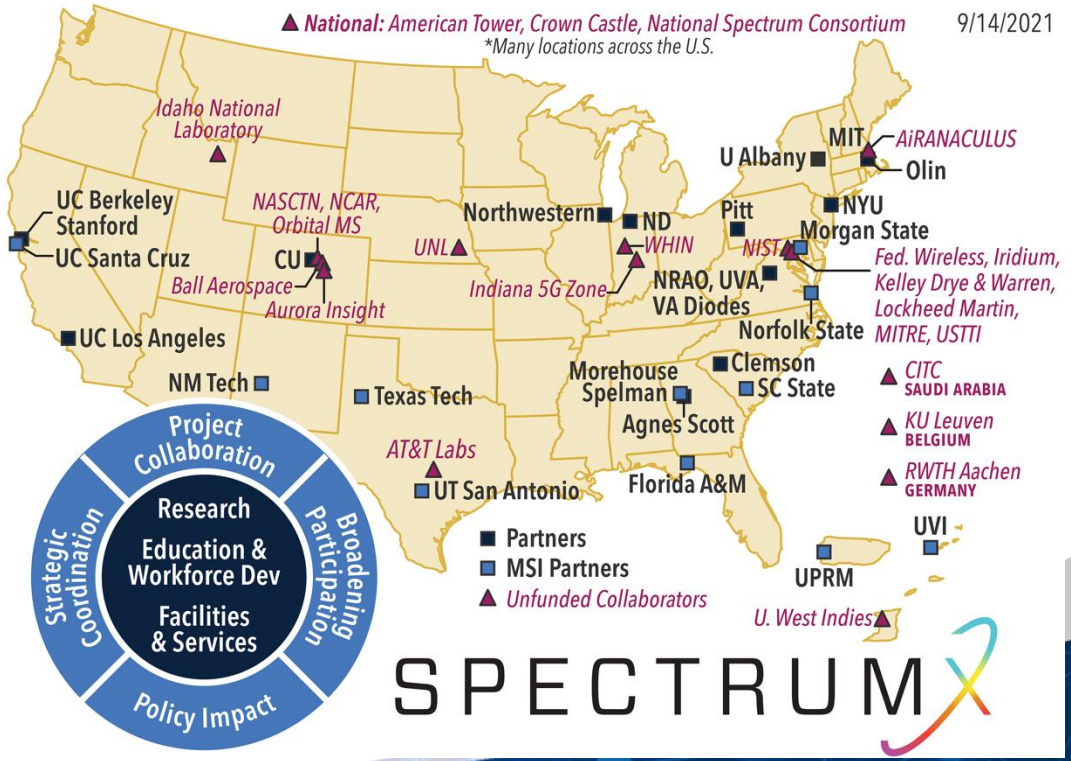
- NSF-supported JASON study (July 2021)
  - Optical impacts on NSF/Rubin Observatory
  - Mitigation opportunities
  - Good practices for satellite vendors
- Analytic study of radio interference, including
  - Single-dish telescopes
  - Interferometers
  - Cosmic Microwave Background-Stage 4

SATCON1: https://aas[illegible]ations-2-workshop
NSF/SIA briefing to UN COPUOS: https://www.unoosa.org/[illegible]/technical-presentations.html
JASON study: https://www.nsf.gov/news/special_reports/jasonreportconstellations/

SpectrumX: An NSF Spectrum Innovation Center (September 2021)

- The first national center focused on the transformation of radio spectrum management
  - Research, Collaboration and Workforce
- Maximize the benefits of the radio spectrum for society – Center has a strong focus on passive services, including radio astronomy

- A partnership on multiple levels
  - Created by NSF under MOA with NTIA, FCC
  - Participants: 29 institutions (12 minority serving)
    - led by University of Notre Dame
    - grow into a hub for all stakeholders
  - Expertise: convergence across field boundaries
    - communications, passive science, sensing, radio technology, policy/economics, data science, control systems
- Federal investment $25m over 5 years



SpectrumX site: https://