



# NSF/AST Update AAAC

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# Update Outline



COVID Impacts

Science Highlights

NSF Personnel

AST Program Update

Astro2020 Update

AAAC recommendations 2019/2020

# COVID-19 Impacts



- AST facilities
  - Observing: NRAO (VLA, VLBA), GBO, GONG, Gemini (N).
  - Restarted Construction/Commissioning: **DKIST**.
  - Not Observing: **Arecibo**, Arizona, and Chilean facilities
    - Gemini (S), CTIO, **Rubin Obs.**, KPNO: limited science ops may begin soon.
    - ALMA: ramping up from *Caretaker* to *Extended Caretaker*.
  - Restart risks/costs, **replan** of **MREFC** programs.





In Search of our Cosmic Origins



# COVID-19 Impacts



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    - ALMA: ramping up from *Caretaker* to *Extended Caretaker*.
  - Restart risks/costs, **replan** of **MREFC** programs.
- NSF: *NSF Implementation of OMB Memo M-20-26*
  - Includes (but not limited to):
    - Allowability of salaries and other project activities.
  - Expires September 30, 2020
  - Agencies have discretion on a case-by-case basis: Currently working with awardees.
  - Latest info @ [https://www.nsf.gov/news/special\\_reports/coronavirus/](https://www.nsf.gov/news/special_reports/coronavirus/)

# COVID-19 Impacts: NSF Staff



- March 16: NSF implemented (up to) 100 % telework policy.
  - This is week 28.
  - NSF building was essentially closed to staff until July.
    - Building open for staff, most but continue 100% telework.
  - Flexible staff work schedules, flexible dependent care.
  - No schedule for mandatory *return to office*.
- Work-related travel remains canceled.
- All NSF meetings/panels 100% video conference.
  - In March, AST was in middle of panel season.
  - AST successfully run all panels after mid-March remotely, 2 POs per panel plus Admin support.
  - Remote panels will continue into FY 2021.





# Science Update

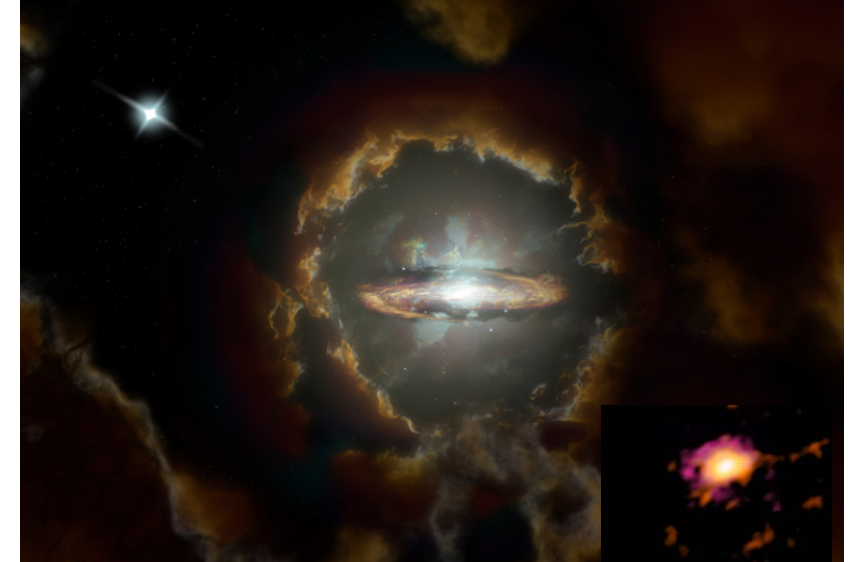
# ALMA: Massive Rotating Disks in Early Universe

- Observations by the ALMA show massive disk galaxies at cosmological distances: 1.5B and 1.4B after the Big Bang
- For Wolfe Disk, ALMA indicates a rotation velocity of 272 km/sec (comparable to the Milky Way).
- Follow-up observations of Wolfe Disk by the Very Large Array and the Hubble Space Telescope show a star formation rate 10x more than that of the Milky Way.
- Such big, fully formed, galaxies are not expected so early in the history of the universe – <1.5 billion years after the Big Bang.
- The results appear in *Nature*, 20 May 2020 (Wolfe disk) and *Nature*, 12 August 2020 (SPT0418-47)

Top Right : An artist's impression of the Wolfe Disk  
(inset) The ALMA radio image of the disk galaxy.

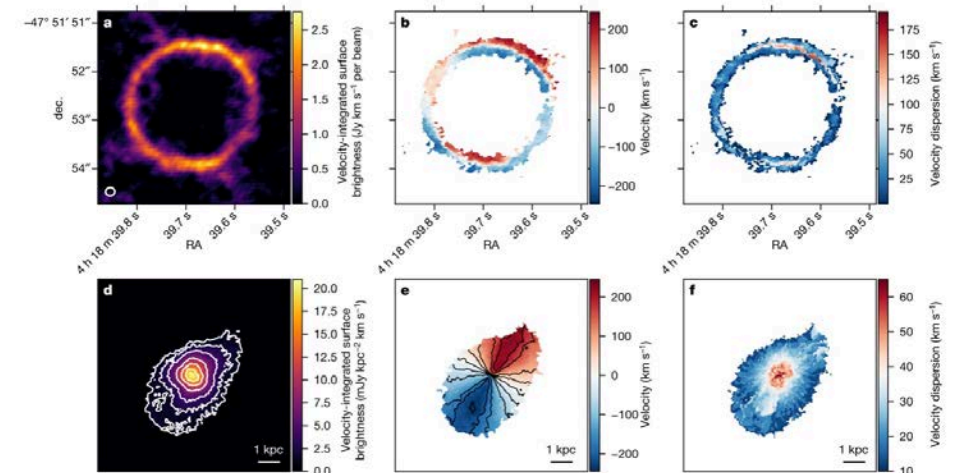
Bottom Right: SPT0418-47 reconstruction and velocity structure

Credits: NRAO/AUI/NSF, S. Dagnello (top) and ALMA (ESO/NAOJ/NRAO), M. Neeleman;  
NRAO/AUI/NSF, S. Dagnello (inset), *Nature*



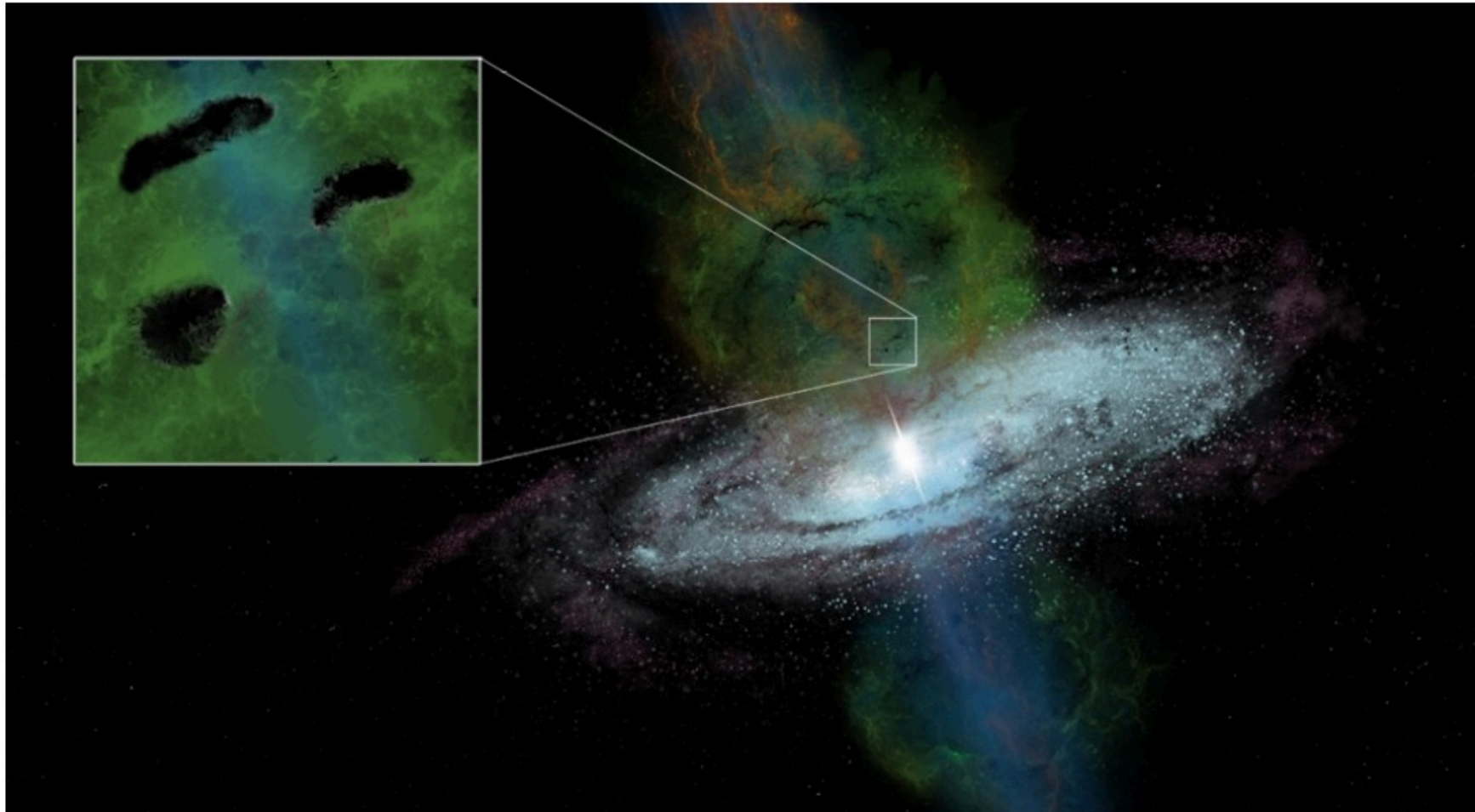
**Fig. 1: [C II] emission from the lensed galaxy SPT0418-47 and source plane reconstruction.**

From: A dynamically cold disk galaxy in the early Universe





# GBT: Blowing in the Wind...



*Nature*, August 19, 2020

Hot wind outflow from Galactic center (Fermi bubbles) are shown to also contain cold clouds of gas.

Some clouds are sufficiently cold and dense to contain CO.

Utilizing GBT, APEX, ATCA

*Artist's conception of molecular clouds entrained in the hot wind from the center of the Milky Way. NSF/GBO/P.Vosteen*

# Arecibo: Asymmetric mass ratios



*Nature*, August 19, 2020

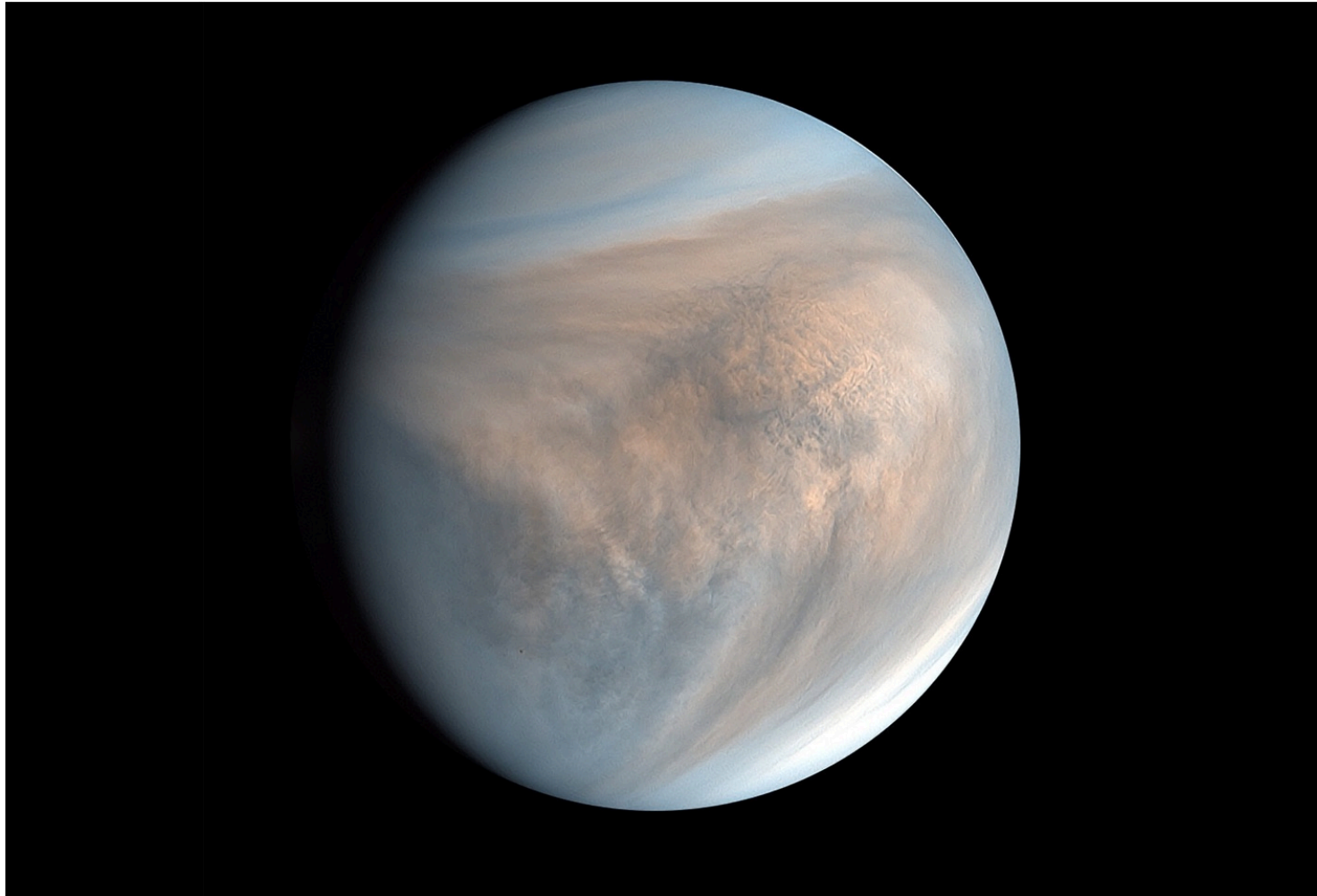
PSRJ1913+1102, 5hr,  $e=0.09$  orbit  
with 1.8 solar radii orbit.

Asymmetric mass merging binary  
neutron star system: 1.62 and 1.27  
solar masses. Largest asymmetry  
observed to date.

Population analysis implies such  
asymmetric systems account for 2% -  
30% of merging binaries

Could explain some anomalous  
properties of GW170817

# ALMA: Phosphine in the cloud decks of Venus



*Nature*, September 14, 2020

ALMA & JCMT

PH<sub>3</sub> origin unknown  
new chemistry?  
life production?

An image of Venus, made with data recorded by Japan's Akatsuki spacecraft in 2016. So close, so similar and very mysterious, the planet is surprising scientists with a chemical signature spotted in its clouds.  
PLANET-C Project Team/JAXA

Venus Phosphine Discovery in Context

Professor Sar...

We are not claiming we have found life on Venus

We are claiming that we have detected phosphine gas whose existence is a mystery:

- either new chemistry
- or possibly life production

zoom

The diagram shows a stylized representation of Venus with a yellowish-orange color scheme. Overlaid on the planet is a spectral line graph with a jagged orange line. Below the planet, there are small, stylized representations of the ALMA and JCMT radio telescope arrays. The word 'zoom' is written in a stylized font at the bottom right.





# NSF Personnel

# NSF Office of the Director



- France Córdova ended a 6-year term as NSF Director March 31.
- Kelvin Droegemeier served as Acting NSF Director April 1 – June 22. Dr. Droegemeier is current Director of OSTP and former member of the National Science Board.
- Sethuraman Panchanathan became the 15<sup>th</sup> NSF Director (23 June 2020).



# Directorate for Mathematical and Physical Sciences (MPS)



- Anne Kinney, Assistant Director (AD) for MPS, left NSF May 1, to become the GSFC Deputy Director in May 2020.



- Sean Jones, named MPS AD Sept 15, served as acting AD since May.



- Tie Luo, Deputy Division Director of the Division of Mathematical Sciences is acting Deputy AD.





# AST Personnel

- Position ended:

- Matthew Benacquista (IPA),
- Kenneth Johnston (Expert)



Peter Kurczynski (IPA)



- New Hires:

- Carrie Black (DKIST)
- Marc Seigar (IPA)



David Morris (AAAS Fellow)

Working on 2 additional perm.

Working on 1 additional IPA.



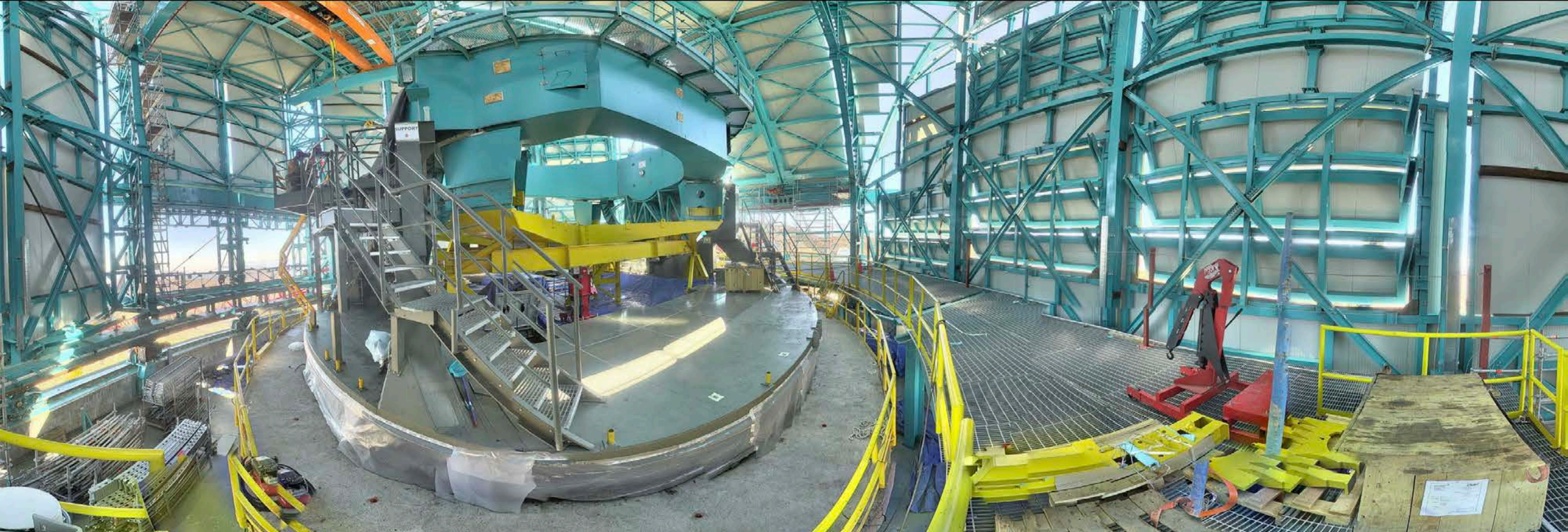


# AST Program Update

# Rubin Observatory: Opening a Window of Discovery on the Dynamic Universe

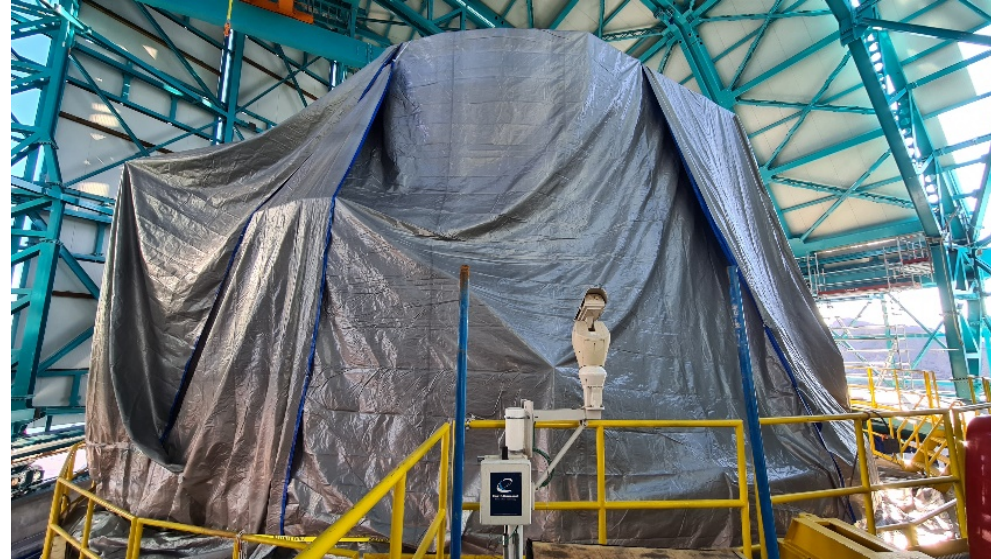








# Current State of the Rubin Obs. Construction



Telescope mount tarped



Electrical boxes, equipment and materials tarped in dome



M1M3 Cell, coating facility, M2 system, Hexapods, all secured and shutdown

Construction paused: **Day for day** schedule slip plus start up and decreased efficiency delays



# Chile Base Facility mostly complete



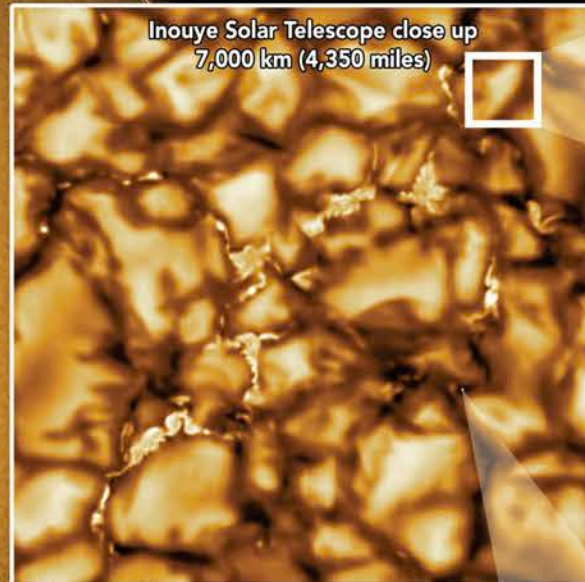




National  
Science  
Foundation

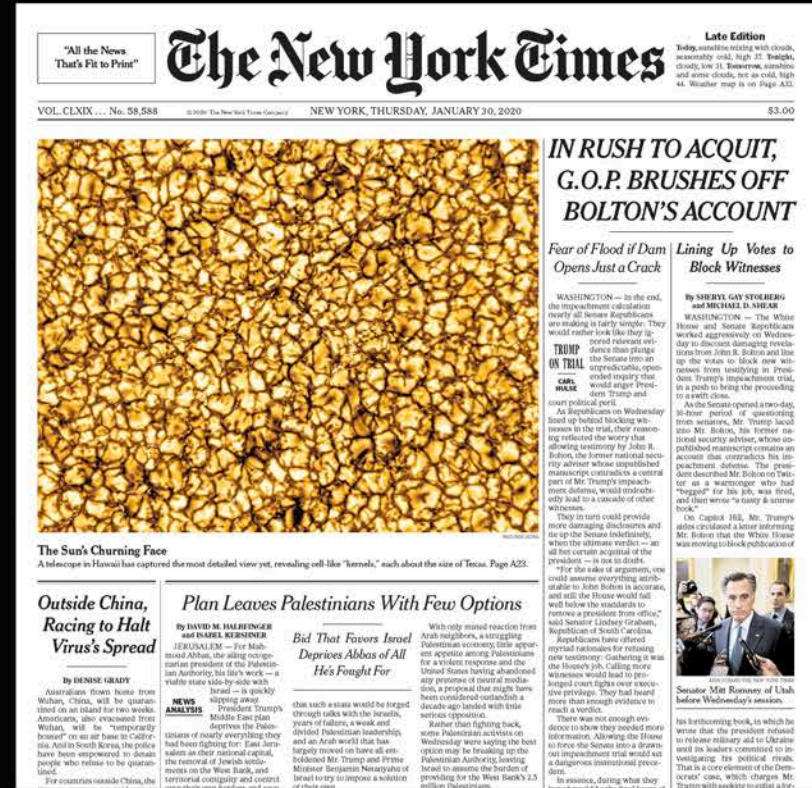
# Daniel K. Inouye Solar Telescope

The Inouye Solar Telescope sees large bubbling cells the size of Texas but can also see tiny features as small as Manhattan Island. This is the first time these tiny features have ever been resolved. The Inouye Solar Telescope is showing us three times more detail than anything we've ever seen before. For more information about this telescope, visit [www.nso.edu](http://www.nso.edu)

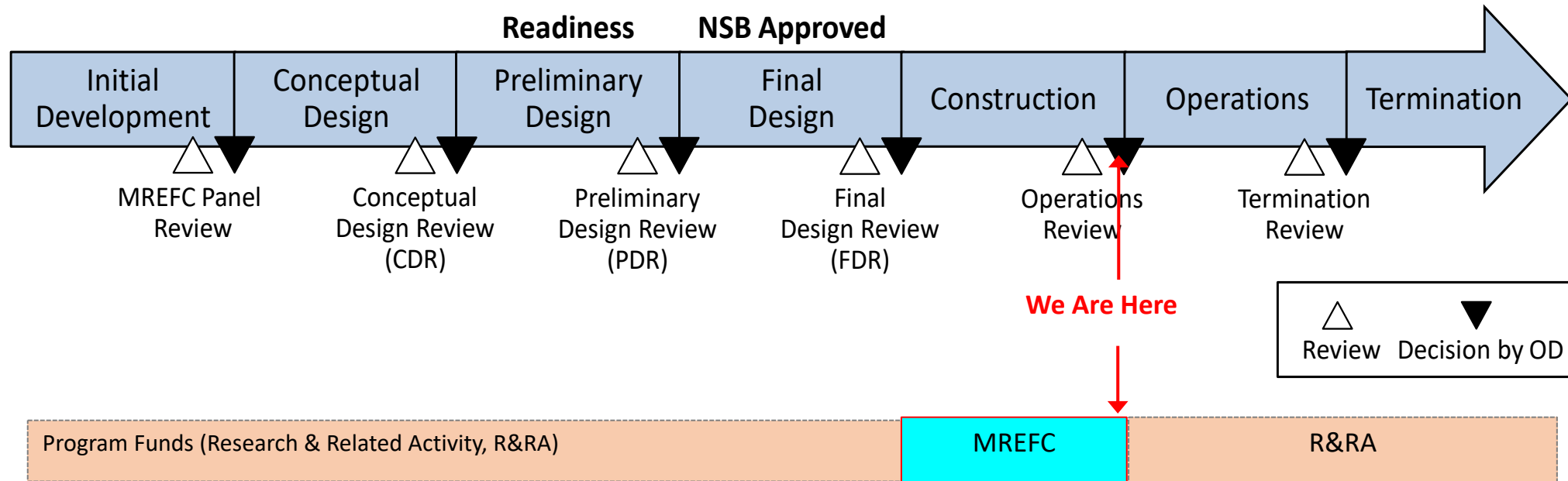


Inouye Solar Telescope close up  
7,000 km (4,350 miles)

Inouye Solar  
Telescope  
Full image



# DKIST in the NSF Facility Lifecycle







# DKIST Restart

- March 17, 2020: site construction was halted.
- May 29, 2020: NSO held a restart review. DKIST site construction approved for Phase I restart.
- June 4, 2020: DKIST site construction restarted.
  - Phase 1 entails:
    - Telework. Some high-priority activities allowed on site.
    - Directorate approval and scheduling required for high-priority activities.
    - PPE & social distancing strictly enforced.
    - On-site workforce split into two teams/shifts to reduce worker density and enable continuity of construction activities.
    - Hawaii quarantine requirements remain in place.
- The DKIST Project Management office is in the process of estimating cost/schedule impacts of the site construction stoppage.





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





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



## Formerly NOAO

### MSO

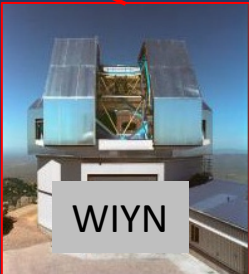
Mid-Scale Observatories

Kitt Peak  
National  
Observatory

Cerro Tololo  
Inter-American  
Observatory



Mayall



WIYN



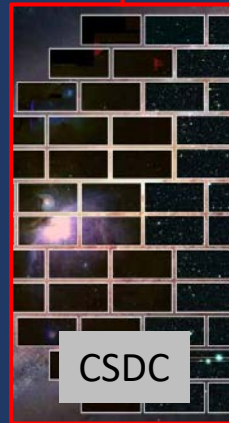
Blanco



SOAR

### CSDC

Community  
Science &  
Data Center

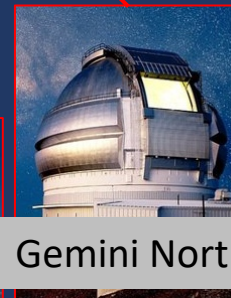


CSDC

International  
**Gemini**  
Observatory



Gemini South



Gemini North

### Vera C. Rubin Observatory Operations



Rubin

# Arecibo Update



- Aug 10, 2020
- One of 12 Auxiliary Cables detached from the Tower 4 socket
- Installed in 1990s to help support Gregorian feed (300,000 pounds)
- **Safety is #1 Priority**
- Three firms hired to coordinate investigation, analysis and repair planning
- Structural model underway (since Aug 17)
- Safety plan will follow
- Next: Removal and subsequent forensic analysis of cable/socket



# Maunakea

- NSF is a Maunakea stakeholder: VLBA (MK) and Gemini (N).
- NSF has received US-ELT planning and design proposals from TMT, GMT, & NOIRLab.
- Recognizing that construction of TMT on Maunakea is a sensitive issue, NSF has begun informal outreach efforts with stakeholders, including Native Hawaiians to listen to and seek an understanding of viewpoints.



# Internet Satellites and Ground Based Optical Telescopes



- About 7,000 satellites in CelesTrak catalog
- Internet satellites: SpaceX Starlink, Amazon, OneWeb, Telesat, etc.
  - SpaceX: 30,000
    - Launch in batches of 60, ~twice per month.
  - Amazon/Kuiper: 3236
  - OneWeb: 47,844
  - Telesat: 1,671
- Internet satellites typically will be in LEO, up to ~1,000 km altitude.

# NSF Investment



- NSF funded workshop: “Satellite Constellations 1 Workshop” June 29-July 2
  - NSF’s NOIRLab and AAS
  - Goal: *Work collectively toward effective solutions to mitigate impacts*
  - Four working groups:
    - Synthesizing observational results and identifying future observing program needs
    - Examining the current status of simulations
    - Exploring mitigation through satellite ground measurements, detector performance, ops strategies
    - Developing metrics for Optical/IR.
  - SATCON1 Report **released**.
- NSF funded JASON study: Considers impacts and mitigations at optical and other wavelengths. **Letter report** and full report to be **posted on AST web site**
- Rubin Observatory continues to work closely with companies launching satellites to understand causes of optical brightness and to find mutually acceptable solutions.
- NSF will continue to engage satellite vendors:
  - Radio Spectrum Management role.
  - Discuss identified metrics and mitigation opportunities with NSF facilities.





AST Budget: 2020, 2021, 2022







Astro2020:

# NSF Investments



- NSF has invested in the development of several large projects that have been proposed to Astro 2020
  - CMB S4: MSRI-1 award for Interim Project Office through to MREFC-PDR
  - US-ELT: Funded AURA to 1) NOIRLab-based Program office, 2) risk reduction and development of GMT adaptive optics lab testbeds and prototypes
  - ngVLA: funded some design and development work



Introductory slide from July 2019  
Presentation

# NSF Goals for Astro2020

- Astro2020 will be most effective if it is *aspirational, inspirational, and transformative*.
- Astro2020 will be most effective if it is based on *community consensus science priorities*.
- The agencies are the *customers*. Astro2020 will be conducted independently of the customer, but must provide *recommendations, clear priorities, and actionable advice* to the customer.

Summary slide from July 2019  
Presentation

# Summary

- Astro2020 will be most effective if it is *aspirational, inspirational, and transformative*.
- Astro2020 will be most effective if it is based on *community consensus science priorities*.
- Let NSF sweat implementation details.
- Provide clear priorities with explanatory decision rules leading to the priorities.





# Explanatory Decision Rules:

## Astro2020 Statement of Task

### Item #4:

- Utilize and recommend decision rules, where appropriate, for the comprehensive research strategy that can accommodate significant but reasonable deviations in the projected budget or changes in urgency precipitated by new discoveries or unanticipated competitive activities



# AAAC recommendations 2019/2020



# AAAC recommendations

- NASA and NSF should continue to collaborate on inter-agency initiatives such as NEID that have significant community impact.
  - We're happy to do that!
- The AAAC encourages ongoing NASA/NSF coordination, through the Planetary Defense Coordination Office, to clearly define the role that existing and future ground-based astrophysics surveys and facilities can play in the discovery and characterization of NEOs.
  - NSF is working closely with NASA PDCO on coordination: Arecibo, GBO, Rubin

# AAAC recommendations

- The AAAC recommends that the NSF should continue to work with international astronomy agencies involved in radio astronomy to create and preserve geographical radio quiet zones.
  - Work proposed to continue in FY2021 per Pres. Budget Request
- The AAAC recommends that NASA, NSF, and DOE/Cosmic Frontier develop a coordinated strategy to address the short-term impacts of the Starlink program on their facilities and missions, as well as the longer-term definition of policies to address the impact of future mega-constellations.
  - NSF and DOE are coordinating on Rubin Observatory impacts.



# AAAC recommendations

- Given the inter-agency response required to fully maximize the science benefits of prompt EM follow up to GW events, we recommend that NSF and NASA continue to explore ways for current and planned facilities and missions to communicate, coordinate, and optimize for prompt GW-EM follow-up.
  - NSF has been supporting development within NOIRLab/CSDC and Astronomical Event Observatory Network (AEON)
- NASA/APD, NSF/AST, and DOE/Cosmic Frontier should learn from each others' initiatives and evaluate adopting joint priorities and policies across their Diversity and Inclusion efforts.
  - Joint presentation tomorrow

# AAAC recommendations

- NASA, NSF, and DOE/Cosmic Frontier should report annually to the AAAC on their diversity and inclusion initiatives, and where possible provide quantitative evaluations of the impacts of these initiatives. The agencies should furthermore report on efforts to remove implicit bias in proposal reviews.
  - Support. Potential topic for future AAAC meeting.
- The AAAC recommends that the agencies adopt or maintain policies regarding postdoctoral fellows to support the community of early-career scientists in astronomy and astrophysics.
  - NSF continues to support Astronomy and Astrophysics Postdoctoral Fellowship (AAPF) program



# AAAC recommendations

- We recommend that NSF continue to offer the MSIP program within the AST division in parallel with, but separate from the NSF-wide MRI and MSRI calls. We further recommend that NSF strive to stabilize the MSIP funding level cycle-over-cycle.
  - Agreed. MSIP ran in FY 2020.
- The AAAC urges NSF and DOE to put in place a long-term operations plan that will, while maintaining a balanced overall portfolio, ensure that the US science community can capitalize on the substantial investment in the Rubin Observatory.
  - Underway. See tomorrow's talk

# AAAC recommendations

- NSF should report their budget forecasts and implementations to the AAAC so as best to overlap with the other agency report timelines.
  - Potential way forward, discussed earlier.



# Discussion