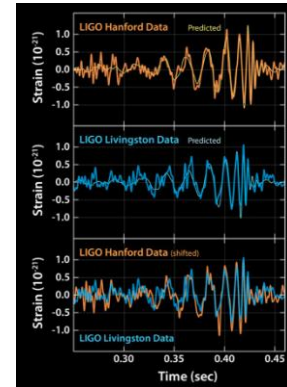


Astro 2020

NSF/AST brief to Panel on RMS Observations from the Ground

Ralph Gaume
Division Director
NSF Division of
Astronomical Sciences



Outline

- NSF Goals for Astro2020
- Science and Big Ideas
- AST Program Status Highlights
- NSF Budgets: Past, Current, & Notional Future
- Questions?



NSF Goals for Astro2020



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.



NSF Goals for Astro2020

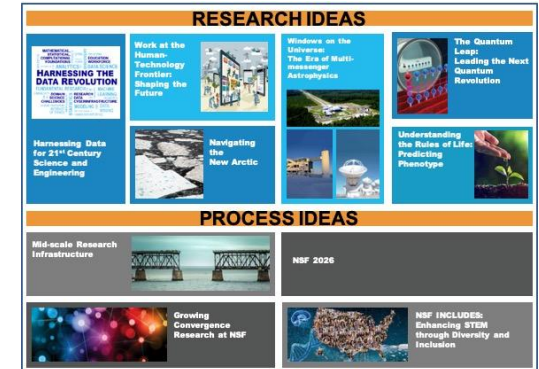
- NSF wants to know:
 - What are science priorities for next decade?
 - What projects address these priorities?
 - Which projects are ready to go now and later?
When?
 - What are costs, risks, development needs of projects?
 - What is the priority order for these projects?
 - What budgets are needed to support the priorities, and are they realistic?



NSF Goals for Astro2020

- NSF wants to know (continued):
 - How does the current NSF portfolio address priorities?
 - What is the state of the profession?
 - Recommendations for the agencies.
- Let NSF sweat implementation details.
 - One NSF Astronomy/Astrophysics program
- Provide clear priorities with explanatory decision rules leading to the priorities.





Science and Big Ideas

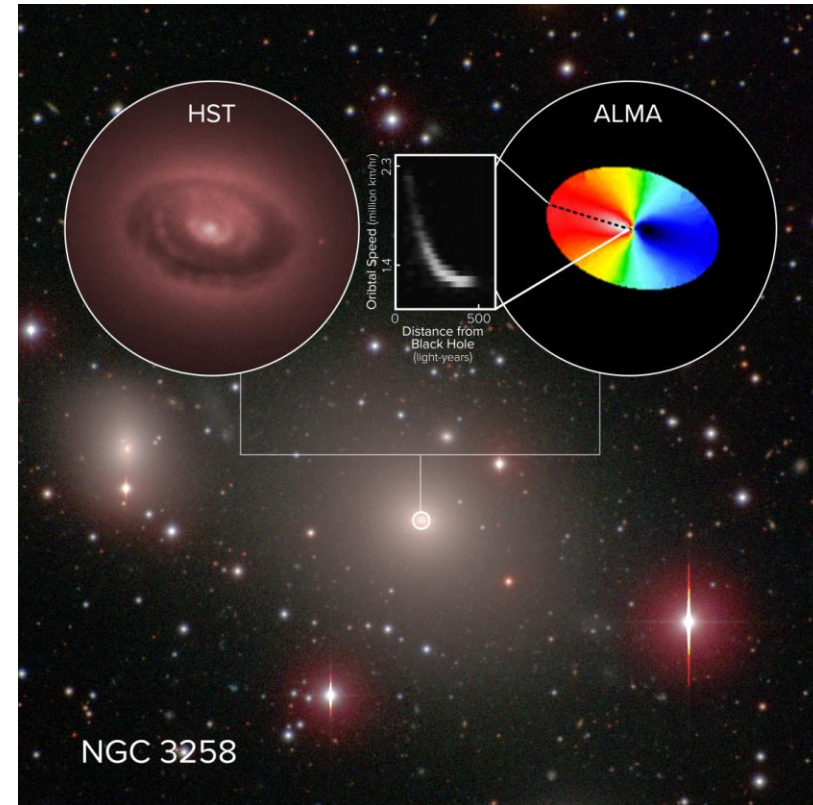


EHT Wins 2020 Breakthrough Prize for Fundamental Physics

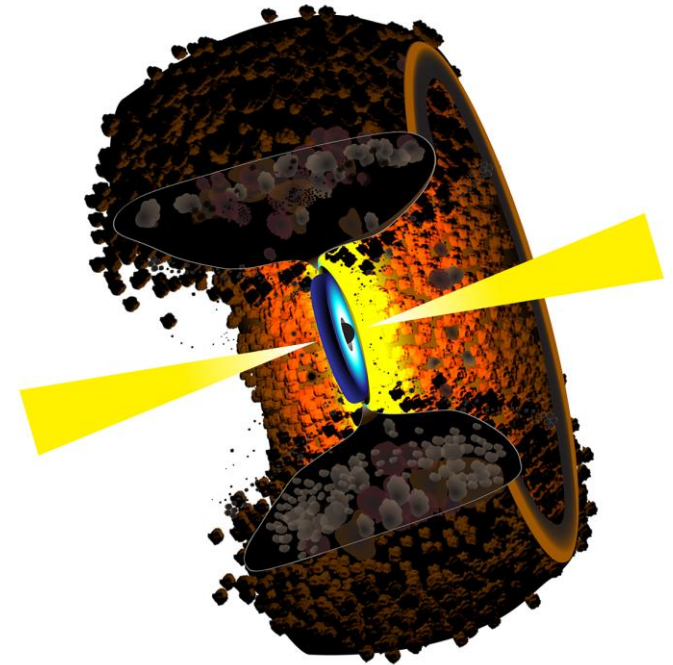
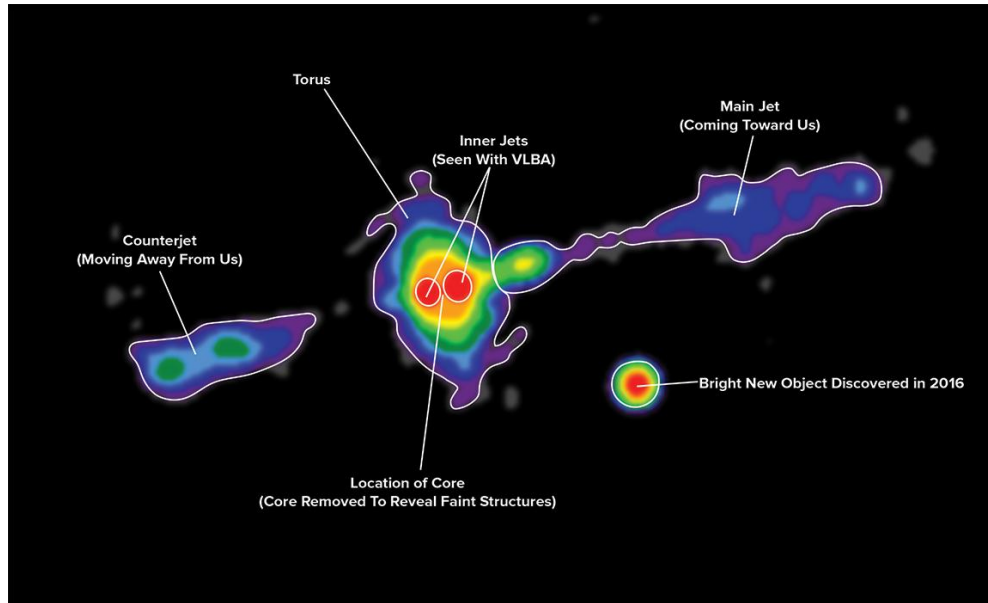


ALMA: SM Black Hole Sphere of Influence

- ALMA CO observations of NGC 3258
 - NGC 3258 elliptical galaxy, distance ~ 100 M ly
- Observed velocity rises from 1 M km/hr to > 3 M km/hr, 500 ly $\rightarrow$ 65 ly from central BH.
- Velocity indicates a SMBH mass of > 2 billion solar masses



VLA: Observations of Cyg A Central Torus



- First image of torus surrounding a SMBH in strong radio galaxy
 - AGN central engine
- Cygnus A, ~ 750 M ly, 2.5 billion solar mass SMBH
- Closest powerful radio galaxy
- Further studies and/or extended to more distant radio galaxies: ngVLA

NSF's 10 "Big Ideas" for Future Investment



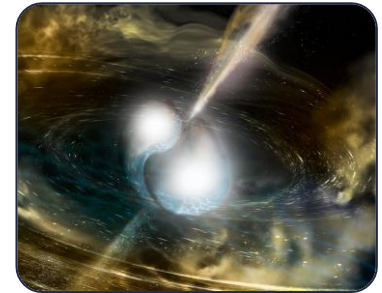
The Era of Multi-Messenger Astrophysics (MMA)

Electromagnetic
Waves

High-energy
Particles

Gravitational
Waves

Goal: To build the capabilities and accelerate the **synergy** and **interoperability** of the three messengers, realizing integrated, multi-messenger explorations of the universe



Artist's
illustration of
binary neutron
star merger

Focus Areas:

- Enhancing and accelerating the theoretical, computational, and observational activities within the scientific community
- Building dedicated midscale experiments and instrumentation
- Exploiting current facilities and developing the next generation of observatories



Highlights of AST Program Status



AST Division Programs

Individual Investigators



Mid-scale



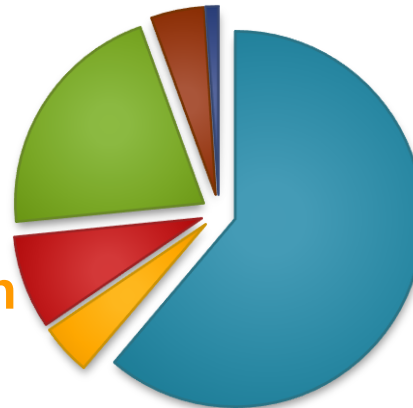
Facilities



Research

Technology/
Instrumentation

Education
and
Special
Programs



* NSF Wide



Forefront Facilities

- Radio-Millimeter-Submillimeter
 - Atacama Large Millimeter-Submillimeter Array
 - Jansky Very Large Array
 - Very Long Baseline Array
 - Green Bank Observatory
 - Arecibo Observatory
- Optical/Infrared
 - Gemini 8-m North and South (+Subaru exchange)
 - Blanco 4-m
 - SOAR 4.2-m
 - WIYN 3.5-m
 - Community access to SMARTS, LBT, CHARA, LCO, AAT
- Solar
 - GONG, SOLIS, DKIST

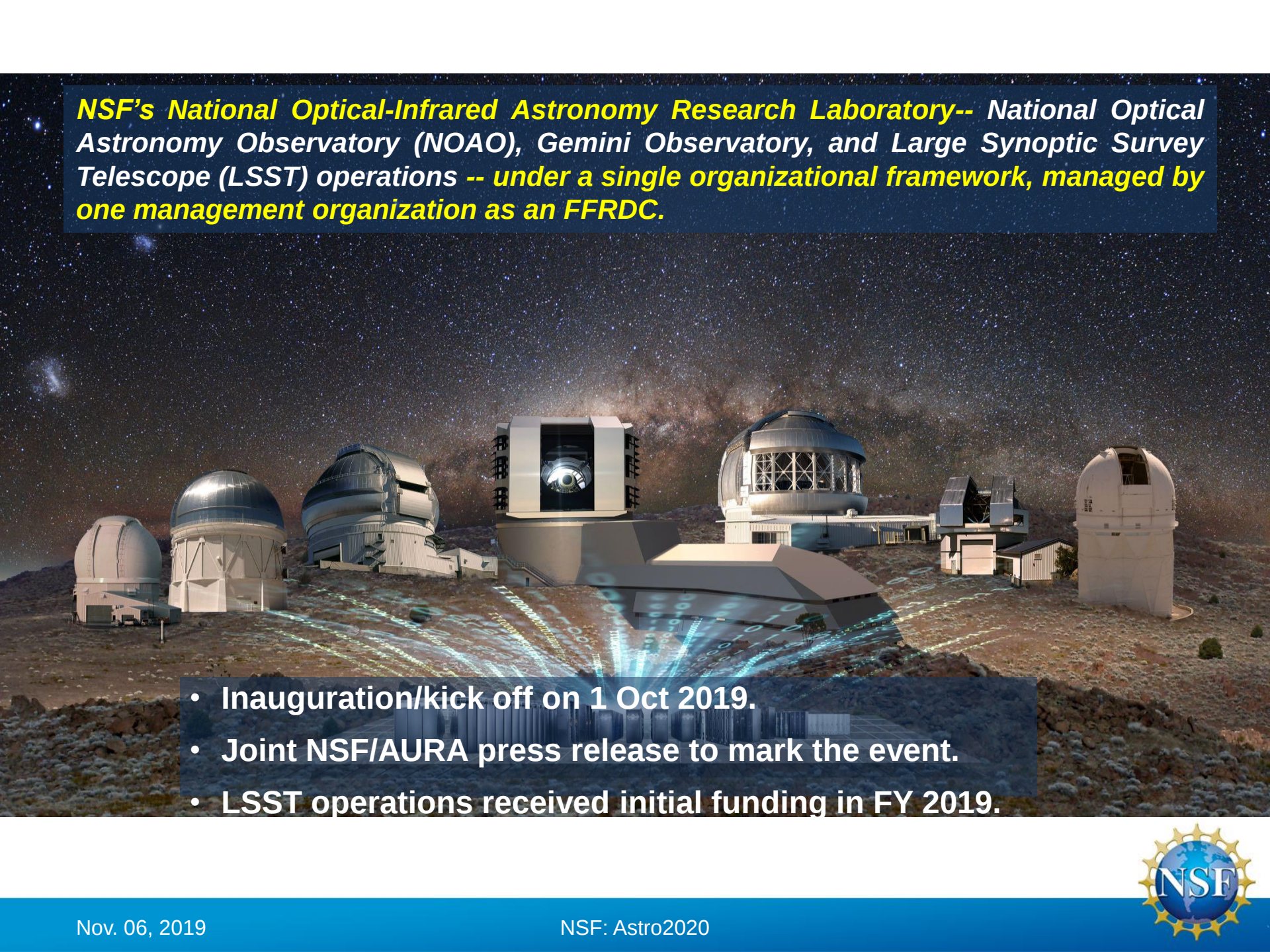


Facility Challenges

- Major 35-day FY 2019 shutdown presented a challenge for NSF in maintaining flow of funds to facilities awardees.
 - Ultimately, none of the AST facilities had to curtail operations.
- As a lesson learned, NSF will maintain 3 months funding in each facility “account” to mitigate against an extended interruption in funding.
 - Carryover funds count toward 3 months.
 - AST received funding in FY 2019 agency funding to address forward funding for facilities with less than 3 months carryover.



NSF's National Optical-Infrared Astronomy Research Laboratory-- National Optical Astronomy Observatory (NOAO), Gemini Observatory, and Large Synoptic Survey Telescope (LSST) operations -- under a single organizational framework, managed by one management organization as an FFRDC.

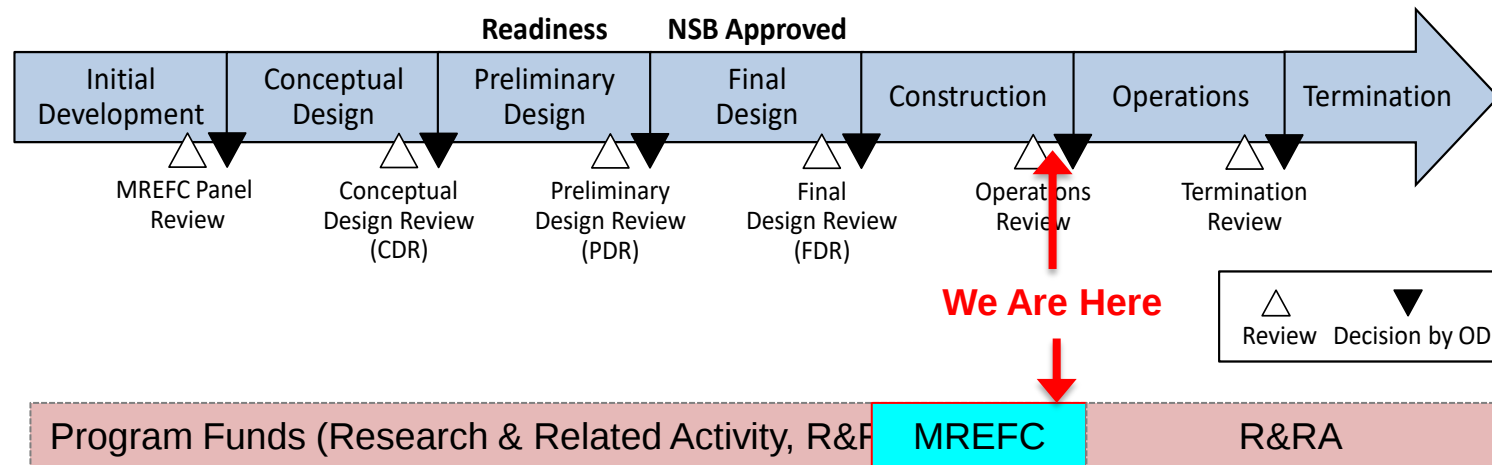
- 
- Inauguration/kick off on 1 Oct 2019.
 - Joint NSF/AURA press release to mark the event.
 - LSST operations received initial funding in FY 2019.

DKI Solar Telescope

DKIST Construction Webcam 2019-10-21 17:09:04



DKIST in the NSF Facility Lifecycle



DKIST Telescope



- Telescope optics in place, M1 & M2 aligned.
- Current challenges largely with instrument completion and delivery, as well as data policy.
- Commissioning of thermal control loops also a significant task.
- Still on schedule and within budget contingency.

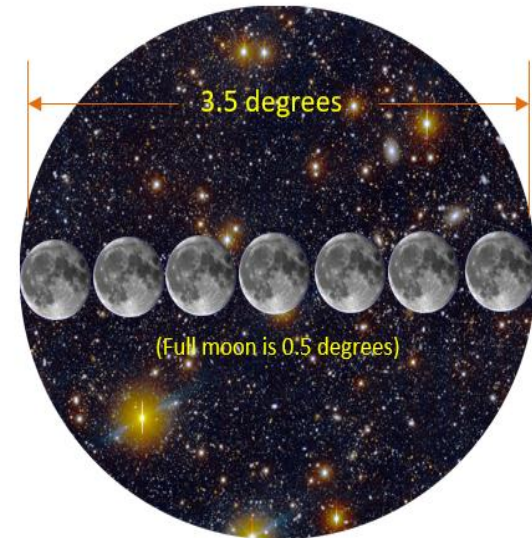
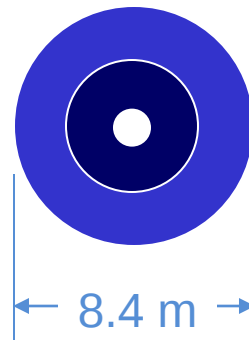


What Makes LSST a Discovery Engine?

Large primary mirror allows *going deep (faint)*.
Large Field of View allows rapid surveying of the entire sky every few nights (*going wide*).



LSST



AST Facility Transition Summary

Telescope	Status
KPNO 2.1m	Caltech-led consortium operating for FY 2016-2020.
Mayall 4m	DESI; NSF to DOE; NSF/DOE MOA for operations .
WIYN 3.5m	NOAO share to NASA-NSF Exoplanet Observational Research Program; NSF/NASA MOU in place; NASA instrument under development.
GBO	Separation from NRAO in FY 2017; Collaborations in place for operations; MOA for new partner; more new partners desired.
LBO/VLBA	Reintegrated into NRAO; MOA with US Navy in place for 50%.
McMath-Pierce	Funding for utilization as science outreach center.
GONG/SOLIS	GONG refurbishment; Interagency Agreement with NOAA signed to share GONG operations costs. SOLIS moved from Kitt Peak to Big Bear.
Sacramento Pk.	Initial NSF and State funding for consortium led by NMSU; NSO to provide continuing site support; NSB approval for ROD.
Arecibo	UCF new operator, plans to increase funding share from UCF partners; hurricane recovery funding being deployed; staffing challenges.
SOAR	AAAC subcommittee recommended continuing renewal



NSF Budgets: Past & Current



FY 2018 Budget (AST)

- Very good outcome in the end for AST – total \$307M, compared to FY17 actual of \$252M.
- Much of the increase went to one-time specific projects (some dependent on FY19 availability of funds to complete):
 - MSIP, for total funding close to aspirations in NWNH
 - Multi-messenger astrophysics grants
 - VLA infrastructure
 - VLBA fiber
 - Gemini N Adaptive Optics system in service of time domain follow-up, stellar populations studies
 - Early funding of DKIST operations for timely completion of data center, supplement for Level 2 data products.
 - Initial funding of LSST operations ramp for three years.

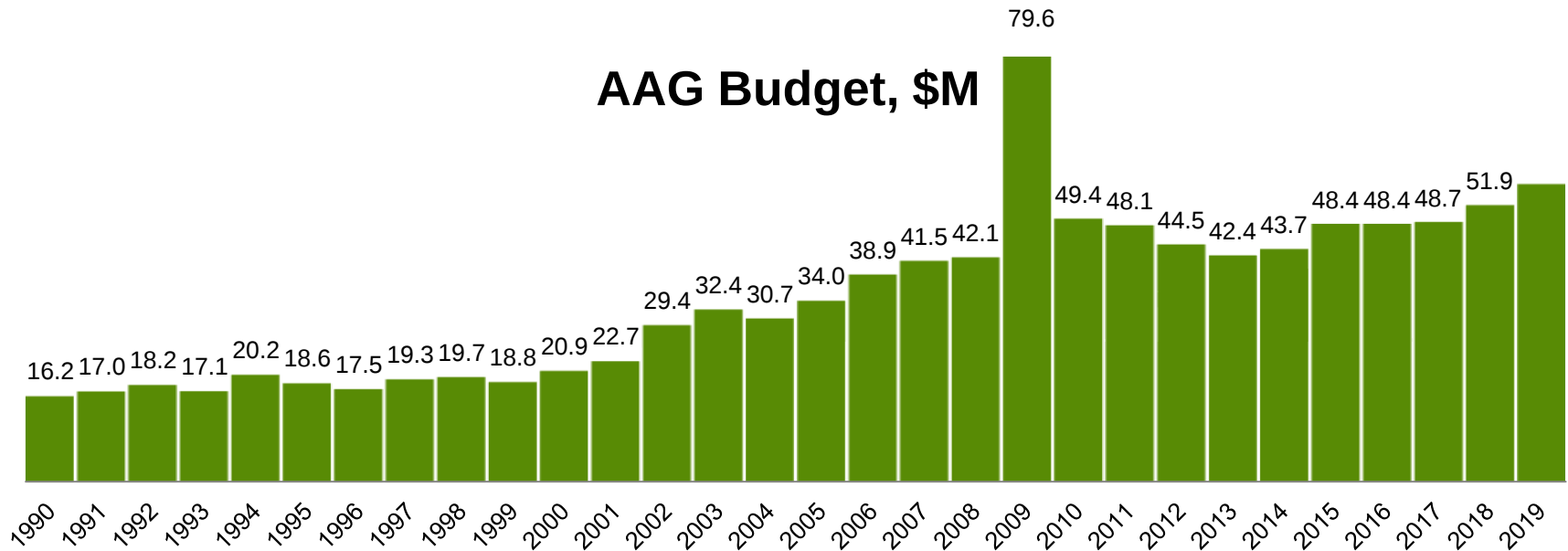


NSF FY 2019 Budget

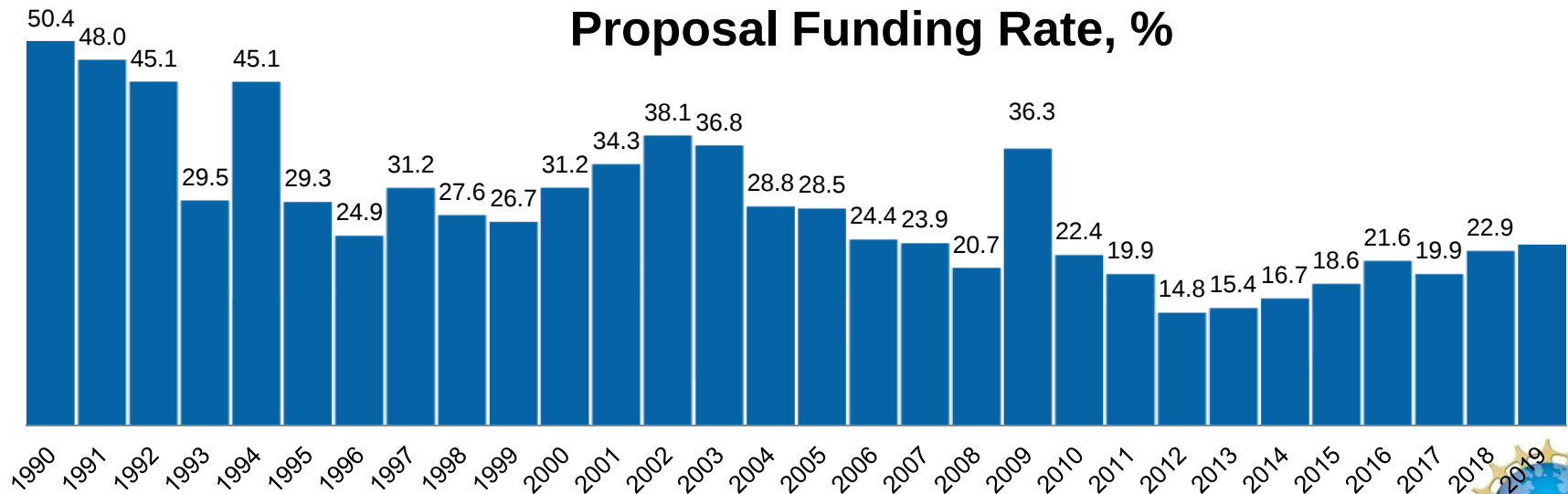
- Enacted Foundation appropriation increases R&RA by 3%.
- MREFC line re-incorporates Antarctic infrastructure; DKIST (final year, Ops begin June 2020) and LSST at requested levels.
- NSF's bill was not under consideration for passage before the end of FY 18, so operations after October 1, 2018 were under a Continuing Resolution until Dec 21st.
- Major 35-day shutdown challenge for NSF was maintaining flow of funds to facilities awardees, particularly those with Chilean labor contracts. OMB allowed cash draws for previously allocated funding, unlike the 2013 shutdown.
- FY 2019 detailed AST budget will be released this fall once budget accounts are reconciled and validated.



AAG Budget, \$M

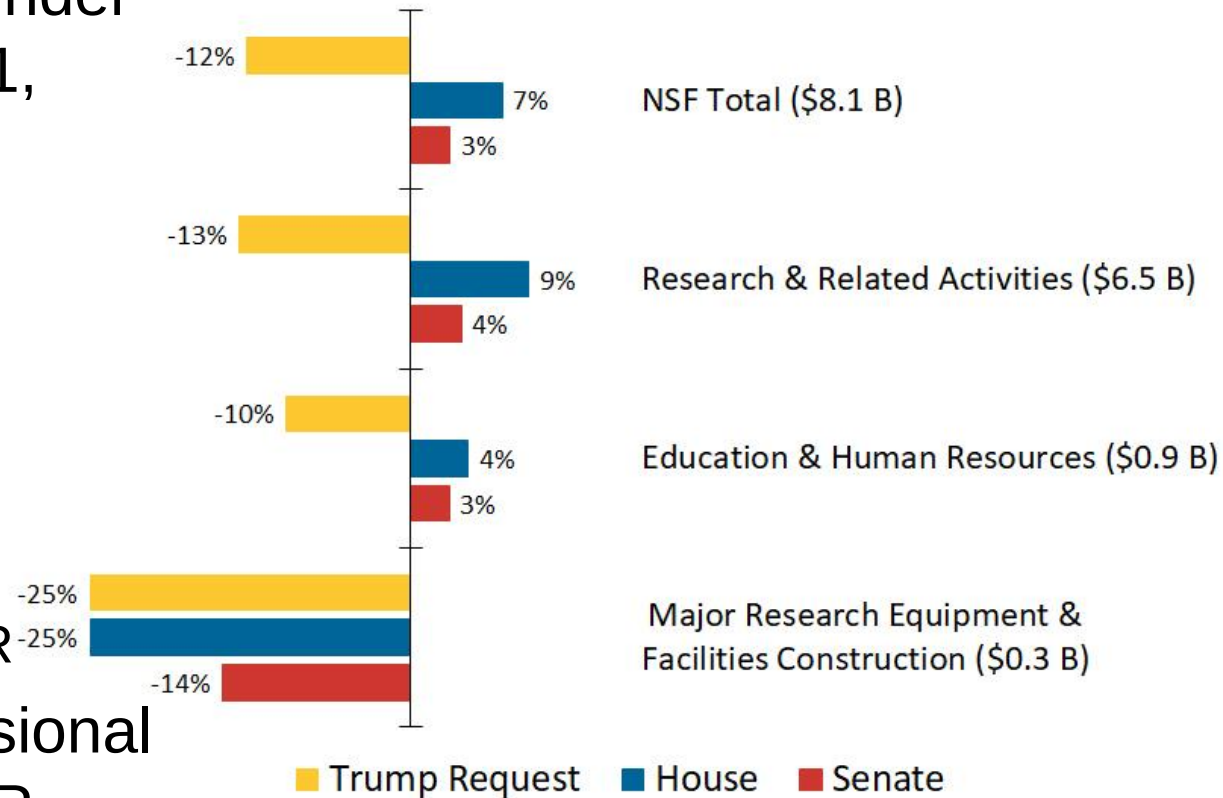


Proposal Funding Rate, %



FY20 Budget Proposals: National Science Foundation

\$ in () are the FY19 enacted



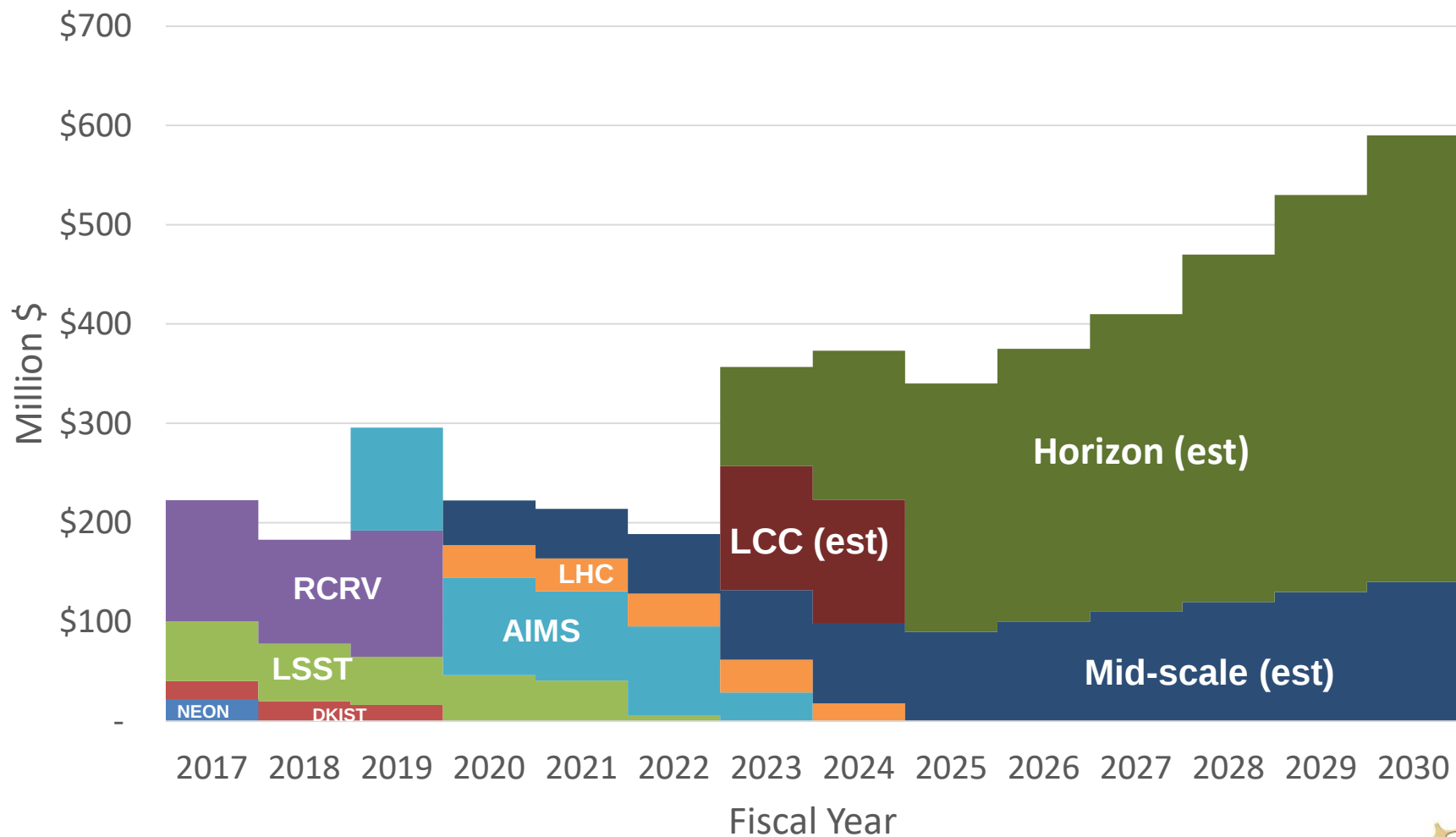
American Institute of Physics | aip.org/fyi



NSF Budgets: Notional Future



Notional (Ambitious) Future NSF MREFC Account Profile

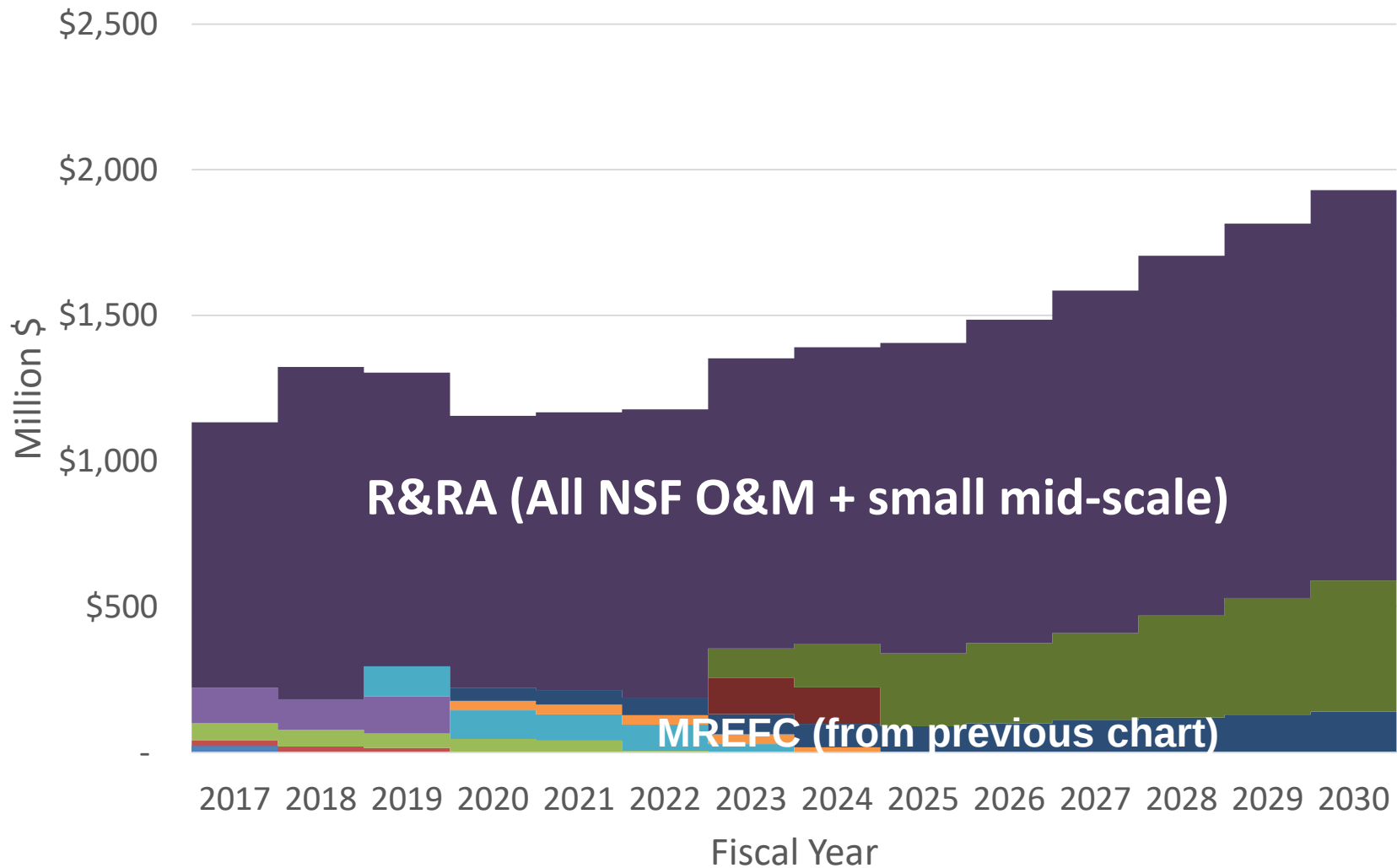


NSF Operations and Maintenance

- NSB: [Study of O & M costs for NSF Facilities](#) May 2018
- Recommendation 1: *NSB and the NSF Director should continue to enhance agency-level ownership of the facility portfolio through processes that elevate strategic and budgetary decision-making.*
 - *...a scientifically robust Foundation-wide strategy that is both transparent and fiscally responsible is critical.*
 - *Planning horizons that are longer than the current 5-year projections required by statute could inform this strategy. The Department of Energy's Office of Science has found notable success using a 10-year planning model.*
 - *While NSB does not believe that it is necessary to establish a central O&M account at this time, greater flexibility in use of the MREFC account would enhance visibility and agency-level ownership.*



Notional (Ambitious) Total NSF Facility + Mid-scale Funding



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.



Questions?

