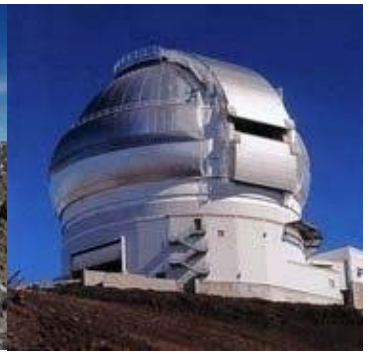
NSF/AST Town Hall

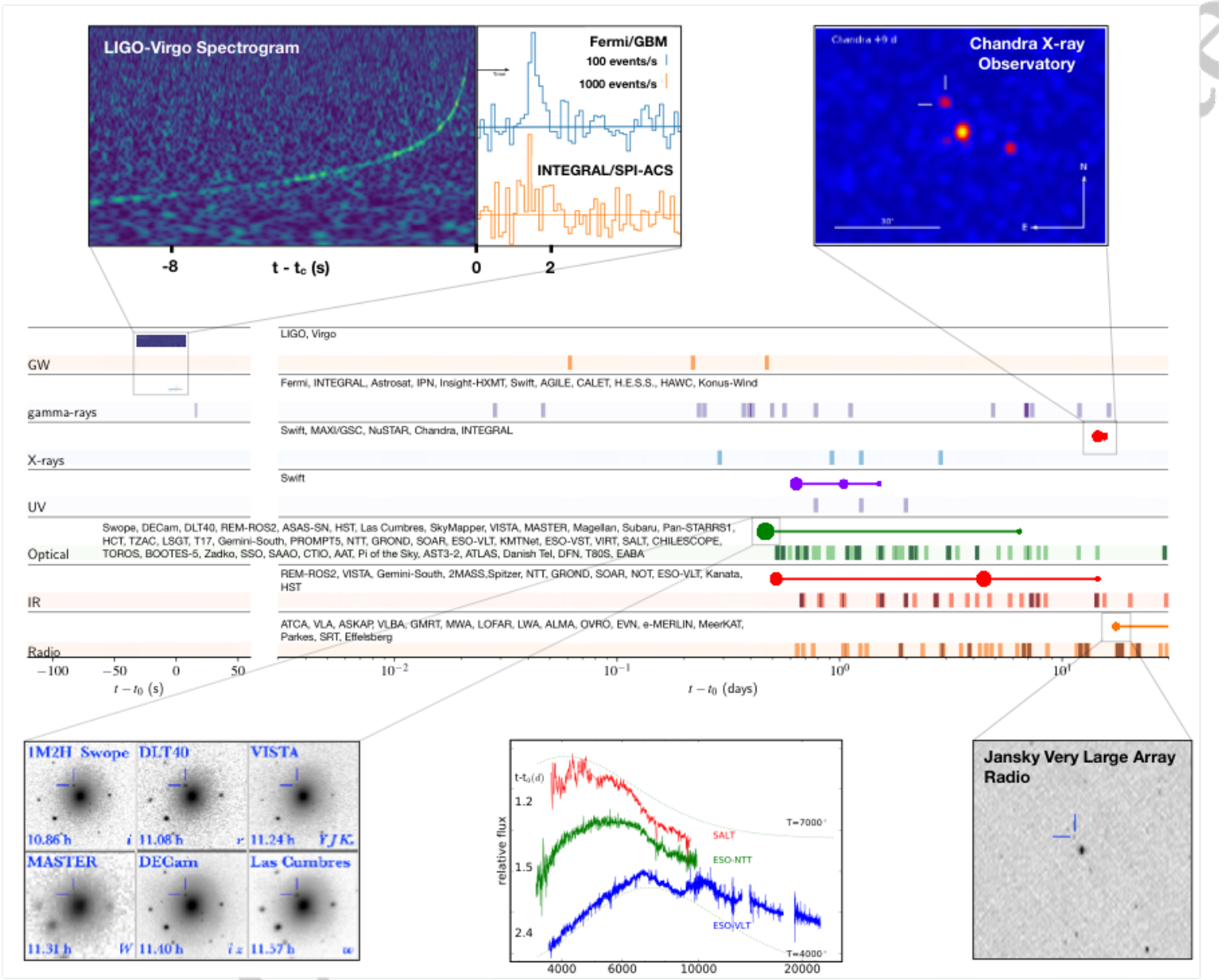
Richard Green

Division Director,
MPS/AST

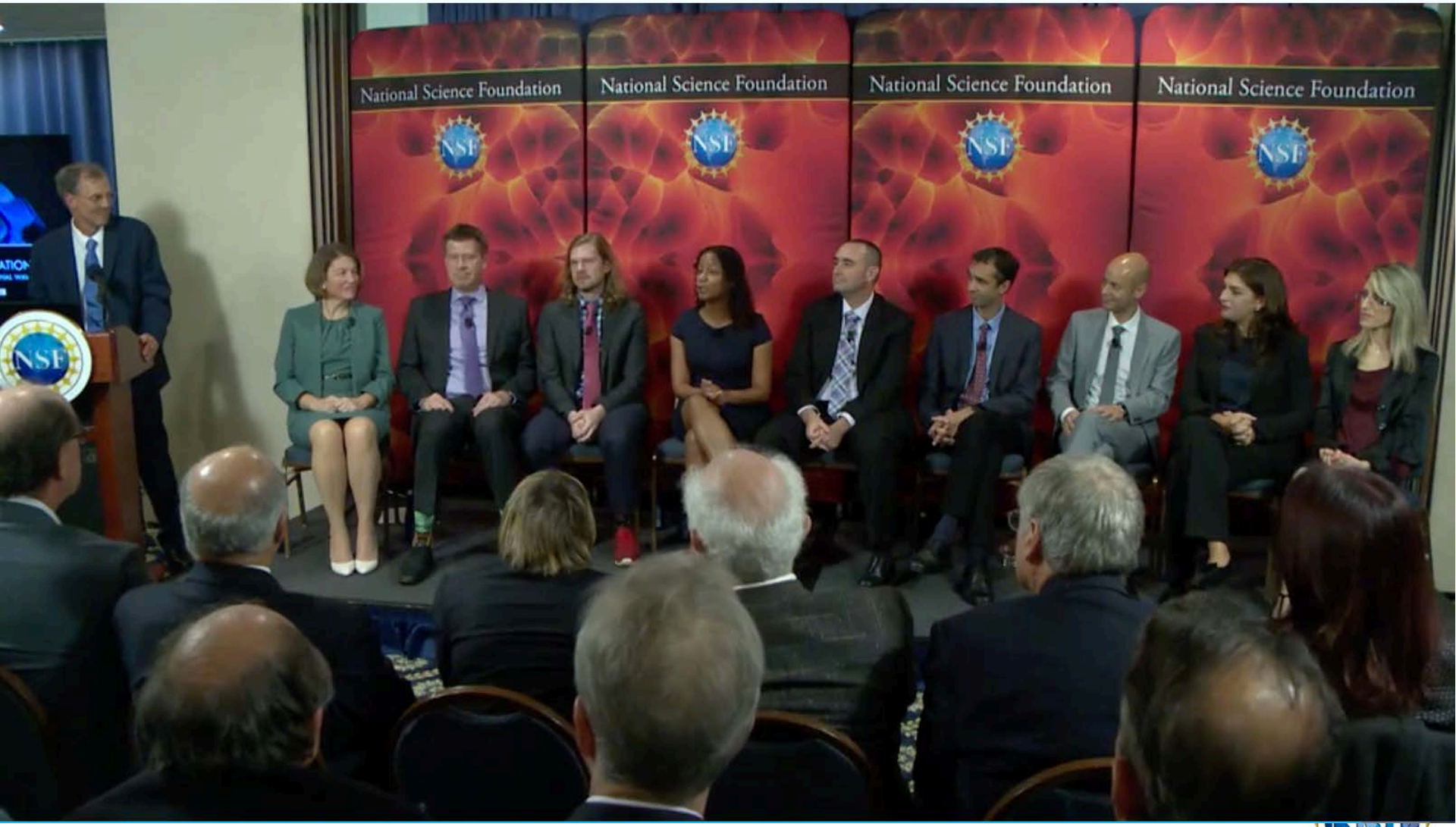


AST Mission: Enable **your** breakthrough science

Binary Neutron Star Merger in NGC 4993



Binary Neutron Star Merger in NGC 4993



NSF's 10 "Big Ideas" for Future Investment

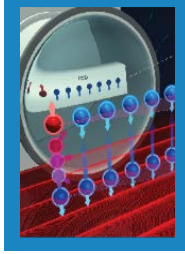
RESEARCH IDEAS

Harnessing Data for 21st Century Science and Engineering

Work at the Human-Technology Frontier: Shaping the Future

Navigating the New Arctic

Windows on the Universe: The Era of Multi-messenger Astrophysics



The Quantum Leap: Leading the Next Quantum Revolution

Understanding the Rules of Life: Predicting Phenotype

PROCESS IDEAS

Mid-scale Research Infrastructure

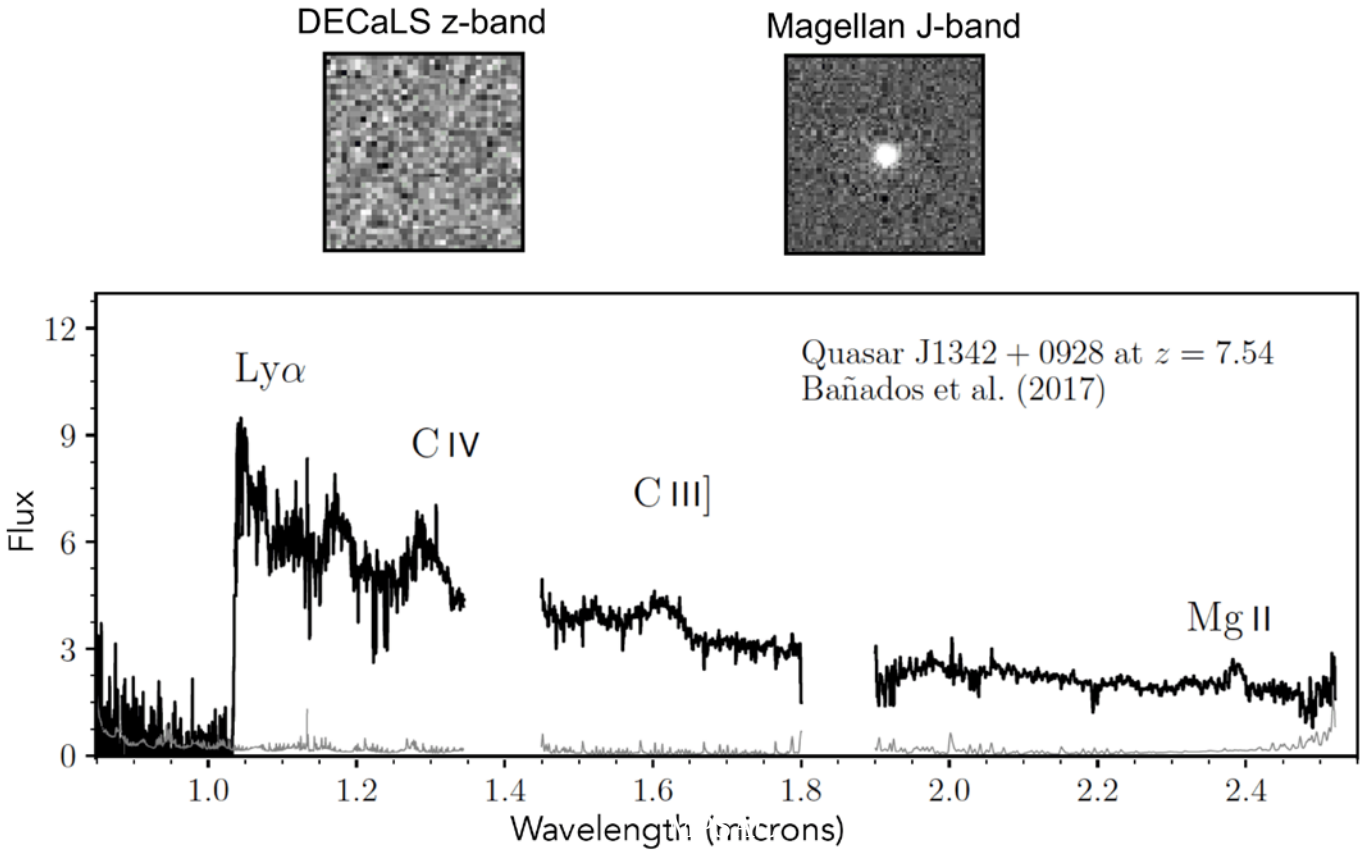
NSF 2026

Growing Convergence Research at NSF

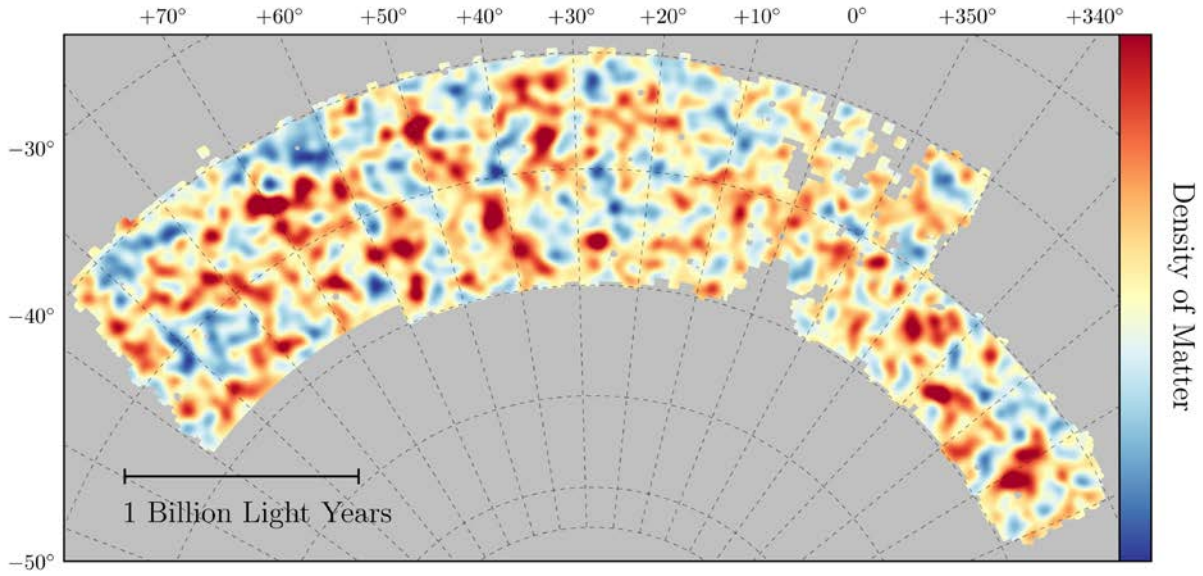
NSF INCLUDES: Enhancing STEM through Diversity and Inclusion

Highest Redshift Quasar

- Bañados et al. in Nature online December 6, 2017.
- 800 million solar mass black hole at 5% of Universe age
- Alpha-product elements in place
- NSF facility, survey, investigators



Dark Energy Survey Determines Cosmological Parameters

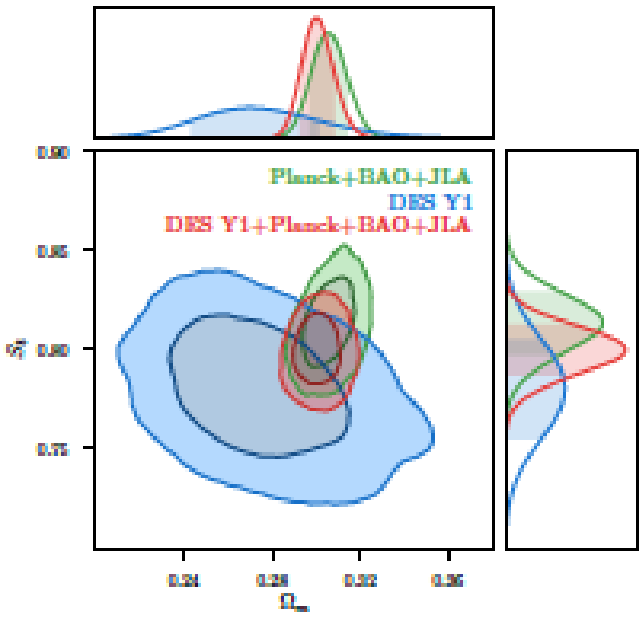


Credit: C. Chang et al,, arxiv:1708.01535 (2017)

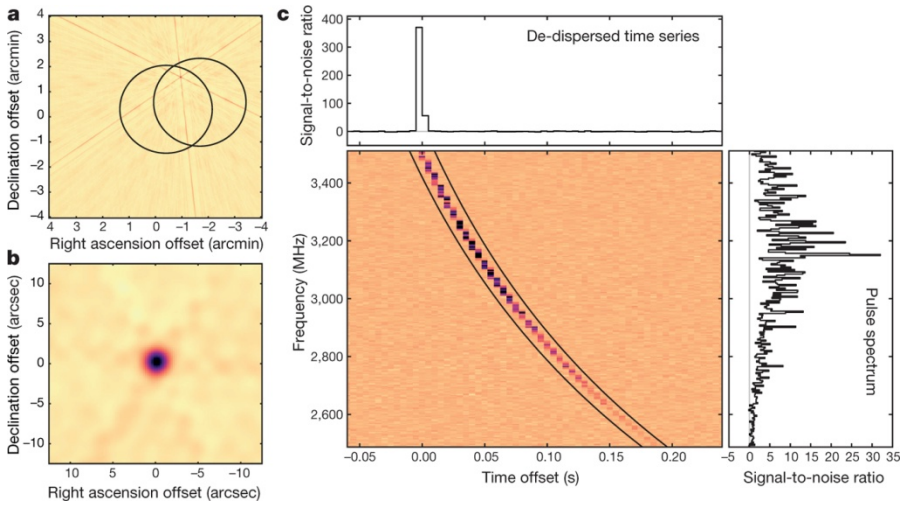
The DES collaboration analyzed the first year of imaging data from the Dark Energy Camera on the NOAO Blanco 4m telescope. Those determinations alone are comparable in accuracy to those of the Planck mission.

Credit: Dark Energy Collaboration, arxiv 1708.01530 (2017)

- They used weak lensing distortion of 26 million source galaxies in four redshift bins (mass map above), and the angular correlation of 650,000 luminous red galaxies for the analysis.
- Combined with other cosmological measures, they derive values for the density of dark energy and dark matter with ~1% uncertainty, and the equation of state to ~4%.
- The investigation is supported jointly by NSF and DOE.



Origin of Fast Radio Burst Identified

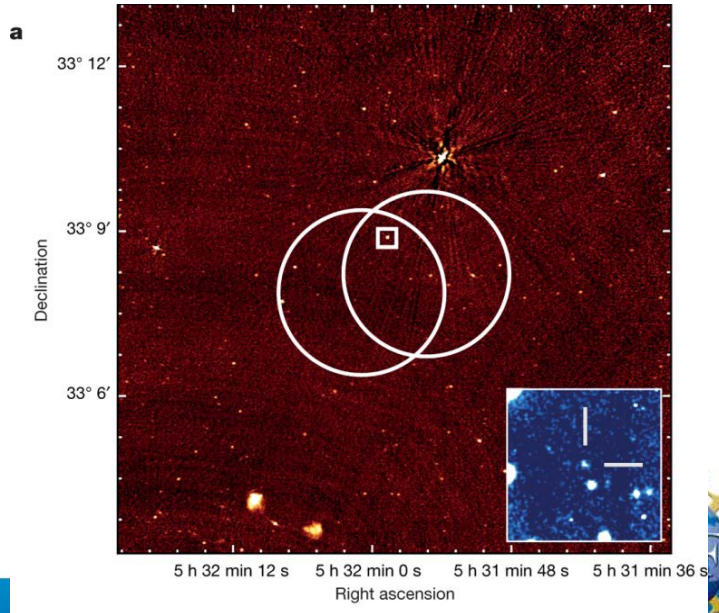


Credit: S Chatterjee *et al. Nature* **541,** 58–61 (2017)

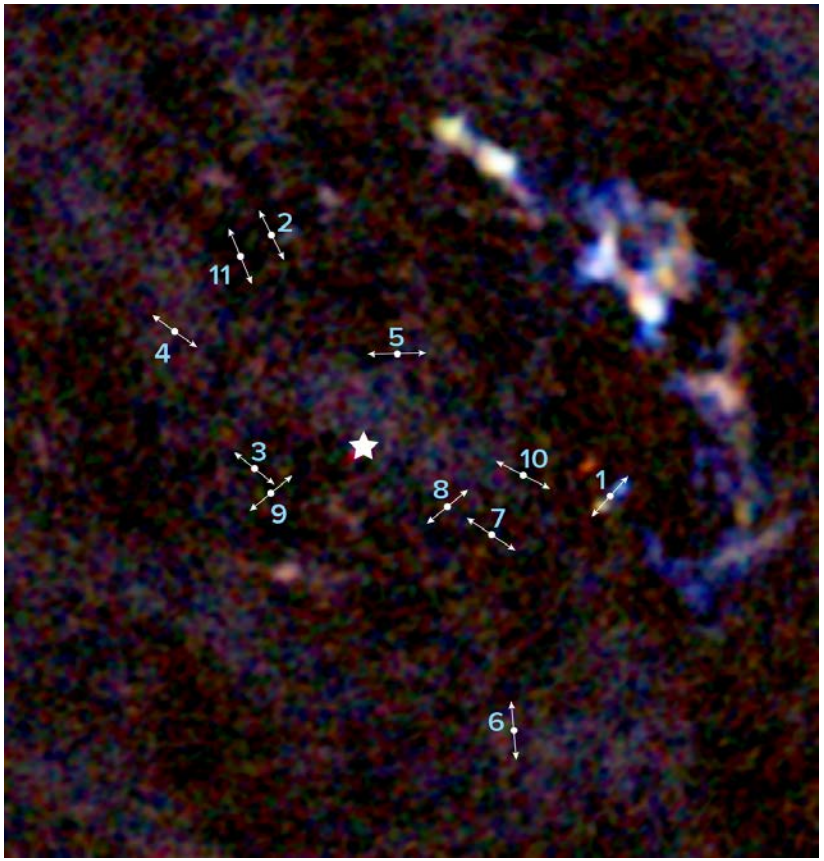
Fast radio bursts last for milli-seconds and are of unknown physical origin. Because the arrival time depends on frequency (central panel), they are thought to be extragalactic with high luminosity.

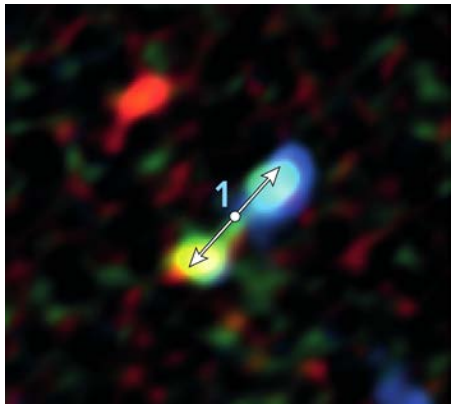
Credit: S Chatterjee *et al. Nature* **541,** 58–61 (2017)

- By capturing bursts from the source FB 121102 at high angular resolution with the VLA and VLBA, Chaterjee et al. were able to localize the celestial position of a source for the first time (small box) and associate it with a 25th mag galaxy from Gemini imaging.
- The galaxy is a nearby dwarf with low heavy element content hosting a persistent radio source, consistent with a low-luminosity active galactic nucleus.



ALMA Finds Proto-stars around the Galaxy's Central Black Hole



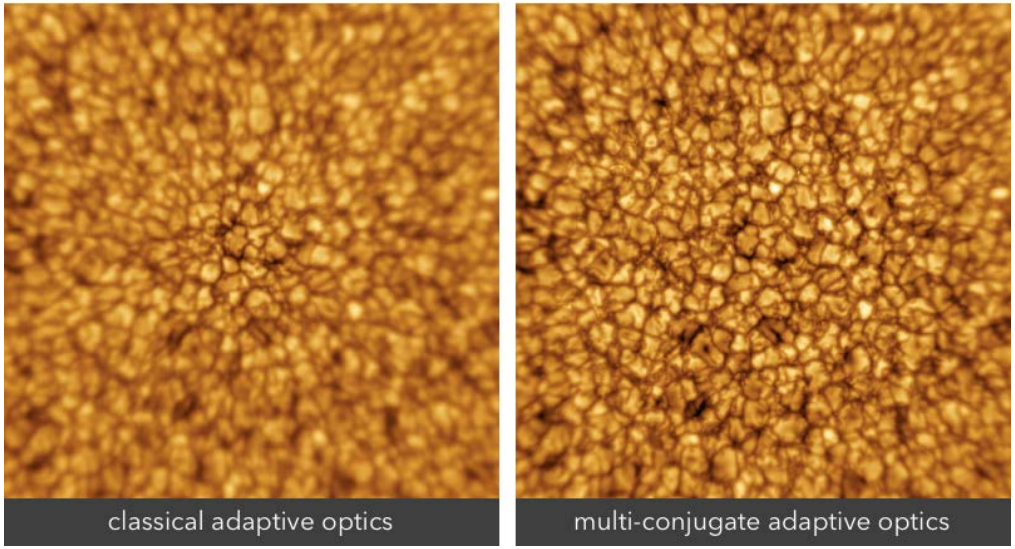


Credit: ALMA (ESO/NAOJ/NRAO), Yusef-Zadeh et al.; B. Saxton (NRAO/AUI/NSF)

- In the turbulent region within 3 light years of the 4 million solar mass black hole at the center of the Milky Way, ALMA has imaged 11 protostars ~6000 years old (Yusef-Zadeh et al. , ApJ Letters, Nov, 2017)
- The Andromeda Galaxy has a disk of young, blue stars around its central black hole.
- Proto-stars collapse in cold, dense clouds, not obviously compatible with the harsh radiation and kinetic environment near a supermassive black hole.

Solar Multi-Conjugate Adaptive Optics (MCAO)

- MCAO under development at Big Bear Solar Observatory
- Uses 3 deformable mirrors to compensate for turbulence at 3 different heights in the atmosphere
- NSO personnel leading the effort
- NSF funded through AST-ATI award and just renewed
- Pathfinder for DKIST next-generation AO system



AST Mission

- The National Science Foundation's Division of Astronomical Sciences has a mission of enabling excellence in US ground-based astronomy.
- The Division invests in three approaches:
  - Supporting the programs of individual investigators,
  - Providing access to world-class research facilities and datasets, and
  - Enabling the development of new instrumentation and next-generation facilities, all through competitive merit review.
- Other aspects distinguish the mission:
  - Encouraging broad understanding of the astronomical sciences by a diverse population of scientists, policy makers, educators, and the public at large
  - Supporting career development for students and early-career professionals.
  - Engaging in numerous interagency and international collaborations.
- The formal mission statement is at https://www.nsf.gov/mps/ast/about.jsp

AST Implementation

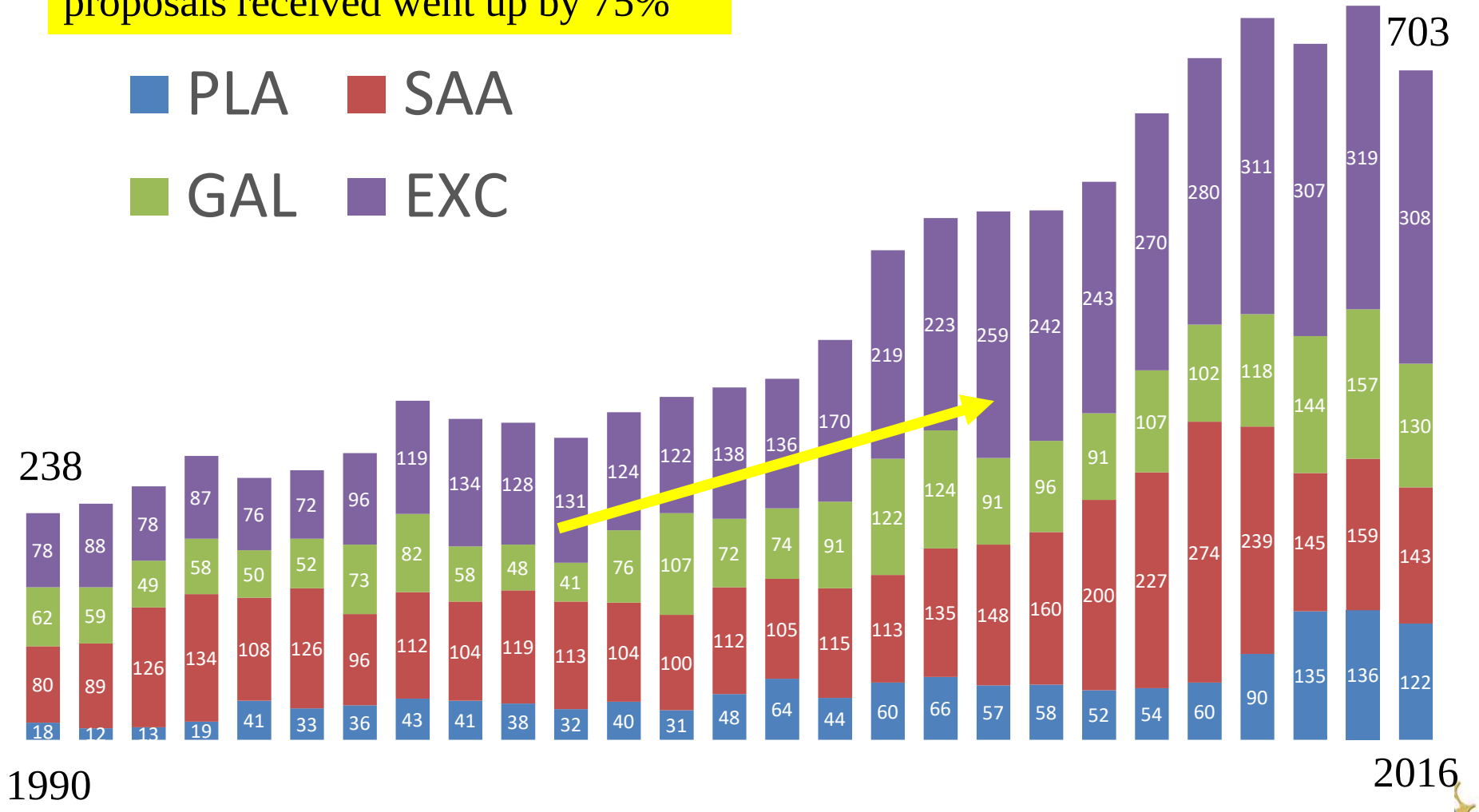
- High-demand Individual Investigator programs.
- Suite of forefront ground-based Optical/IR (OIR), Radio-Millimeter-Submillimeter (RMS), and Solar observing facilities plus data holdings supported by AST for merit-based access.
- Construction through the MREFC line of two major new facilities, DKIST and LSST.
- Reorganization of management of NSF OIR facilities to optimize time-domain science.
- Divestment of facilities given lower priority by external review process to accommodate operations of new facilities and maintain programmatic balance.
- Sponsoring National Academies decadal survey to set future priorities for scientific direction and facilities development.

Individual Investigator Programs—1000 proposals/yr

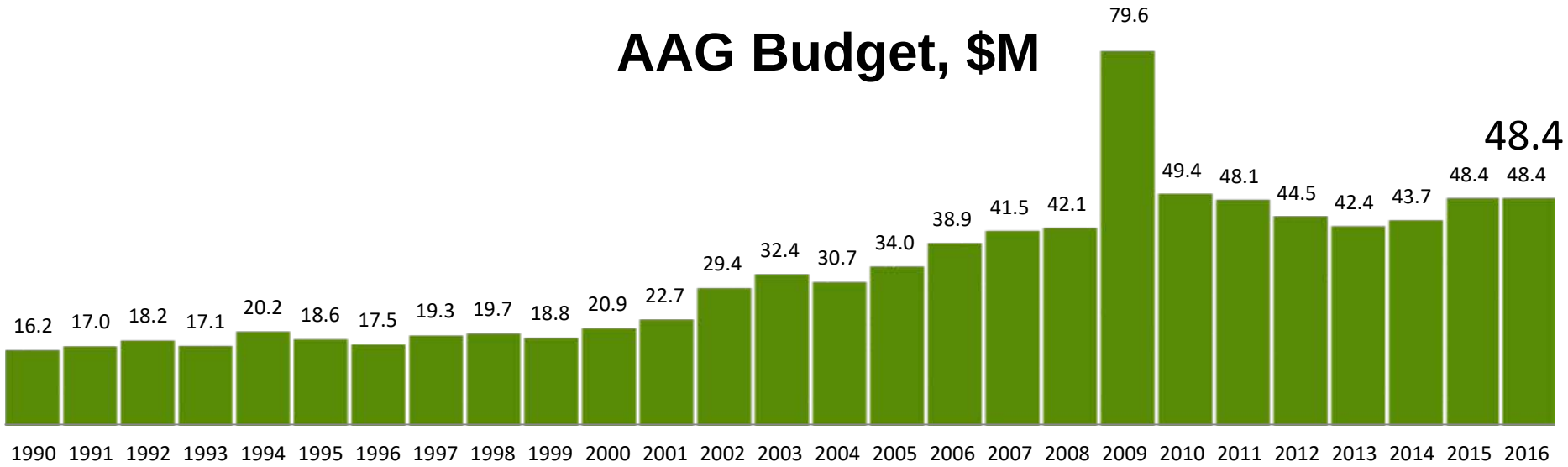
- Astronomy and Astrophysics Research Grants—700 prop.
  - Solar and Planetary (now with no deadline)
  - Stellar Astronomy
  - Galactic Astronomy
  - Extragalactic Astronomy and Cosmology
- Mid-Scale Innovations Program—40 pre-proposals
- Advanced Technologies and Instrumentation—60 prop.
- CAREER—60 prop.
- Astron. and Astrophys. Postdoc. Fellowships—100 prop.
- REU—20 prop.
- Partnerships in Astronomy and Astrophysics Research and Education—5-10 prop.

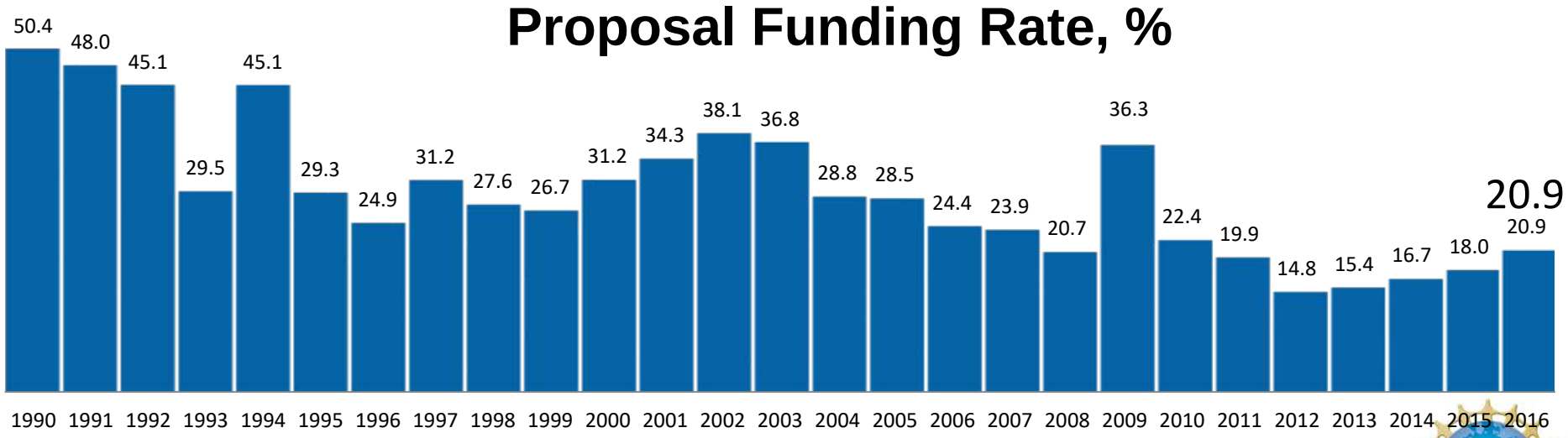
Proposals in AAG, 1990-2016

From 2000 to 2008, the number of proposals received went up by 75%



AAG Funding History, 1990-2016





Current Forefront Facilities

- OIR
  - Gemini North and South 8-m telescopes
  - National Optical Astronomy Observatory
    - CTIO - Blanco and SOAR 4m class telescopes in Chile
    - KPNO - Kitt Peak operations in Arizona
    - Community Science and Data Center
- RMS
  - National Radio Astronomy Observatory
    - ALMA – Atacama Large Millimeter Array - Chile
    - JVLA – Jansky Very Large Array – New Mexico
    - CDL – Central Development Lab – Virginia
- Solar
  - National Solar Observatory
    - Legacy telescopes in NM and AZ transitioning
    - Lab and Data Center in Colorado

DKIST Current Construction Site

Operations in 2019

LSST Current Construction Site

Operations in 2022

NSF's National Center for Optical-Infrared Astronomy (NCOA) integrates the NSF-funded entities -- National Optical Astronomy Observatory (NOAO), Gemini Observatory, and Large Synoptic Survey Telescope (LSST) operations -- under a single organizational framework, managed by one management organization (MO).

- **NCOA is on schedule for stand-up about 1 Oct 2018.**
- **LSST operations is on track for initial funding in FY 2019.**

Background is a montage of major facilities under NCOA.

Participate in the NCOA Town Hall on Thursday at 12:45.

Background: AST Divestment

- AST Portfolio Review Report (MPSAC subcommittee) recommended divesting a number of telescopes from AST budget.
- Divestment needed to enable support of new highest priority facilities, while balancing support for individual investigator science.
- The process shows AST's seriousness in changing the complement of cutting edge national facilities and is scoped to save $10-15M/yr for new operations.
- Subsequent AST actions:
  - Pursued funding collaborations aggressively.
  - Solicited input on innovative operations models.
  - Carried out engineering feasibility studies and baseline environmental reviews for many facilities.
  - Embarked on preparation of formal Environmental Impact Statements (EIS) as part of the decision process for three facilities: Arecibo, Green Bank, Sacramento Peak.
- Status officially updated by NSF Dear Colleague Letter 17-079, April 27, 2017.

Divestment Summary

Telescope	Status
KPNO 2.1m	Caltech-led consortium (Robo-AO) operating for FY 2016-2018.
Mayall 4m	Slated for DESI; bridge from NSF to DOE; NSF/DOE MOU for transition.
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; ~30% collaboration for basic scope; Draft Environmental Impact Statement (EIS) issued on Nov. 8, 2017.
LBO/VLBA	Separation from NRAO in FY 2017; MOA with US Navy in place for 50%.
McMath-Pierce	No obvious partner opportunities; possible public education use.
GONG/SOLIS	GONG refurbishment; Interagency Agreement with NOAA signed to share GONG operations costs. SOLIS moved from Kitt Peak to Big Bear.
Sacramento Pk.	Possible consortium but funding challenges; NSF funded NMSU for transition to consortium; started EIS process; completion in 2018.
Arecibo	Formal EIS process concluded with issuance of Record of Decision today. Negotiations to begin for new collaborator with reduced NSF share.
SOAR	Post-2020 status to be reviewed.

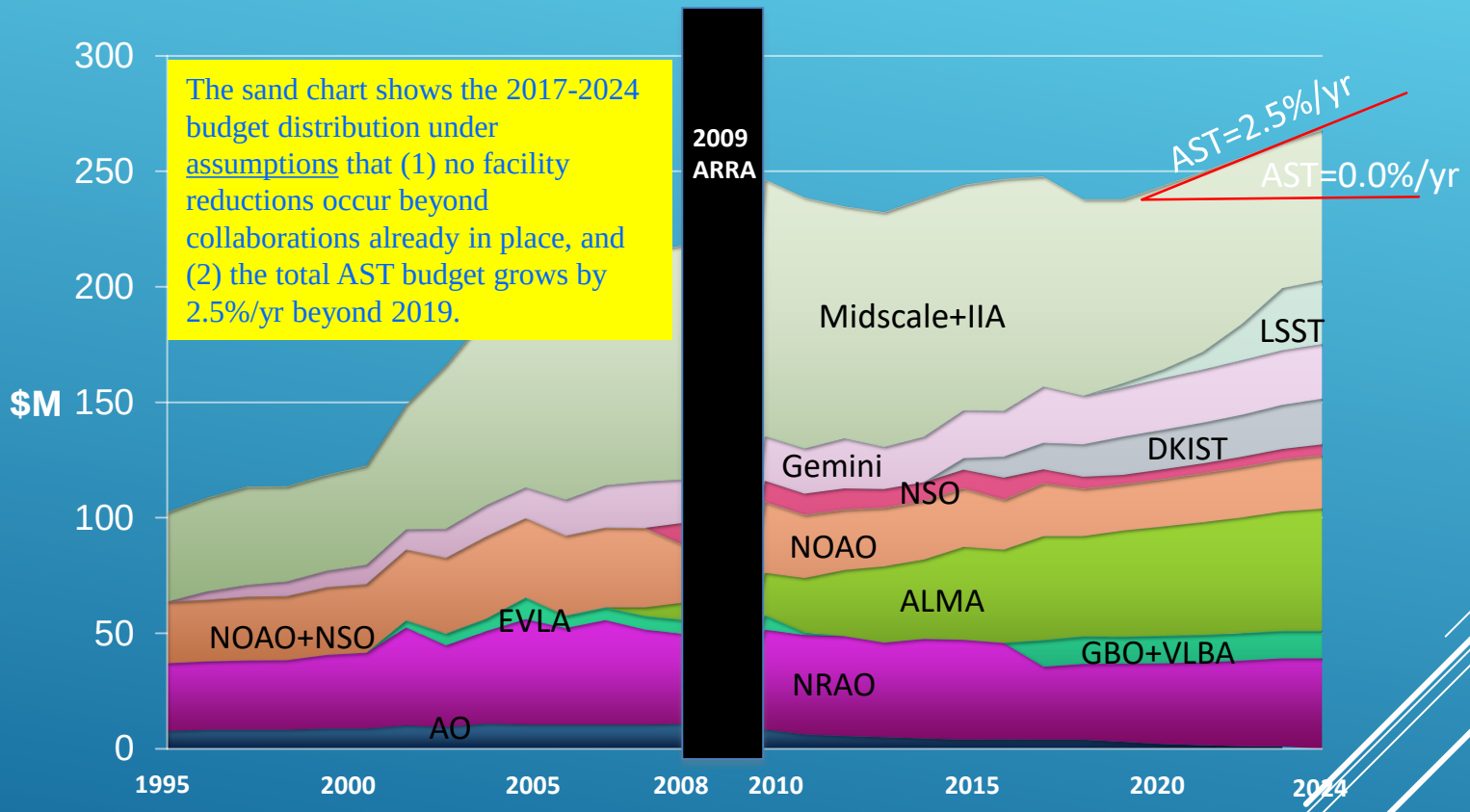
Budget Planning

- The necessity for divestment has been driven by our community's success in winning support for development of new facilities, which require operational support.
- AST planning must consider multiple levels:
  - As an executive agency, we must submit a budget based on OMB guidance. In the previous administration, that was an increase, now a decrease from previous levels.
  - Congressional appropriation for the last several years has been essentially flat in real dollars, so we consider that possibility in proposing changes that might not be required.
  - We retain the optimism that increased support can eventually be found for new facilities and their operations.

AST Budget Considerations

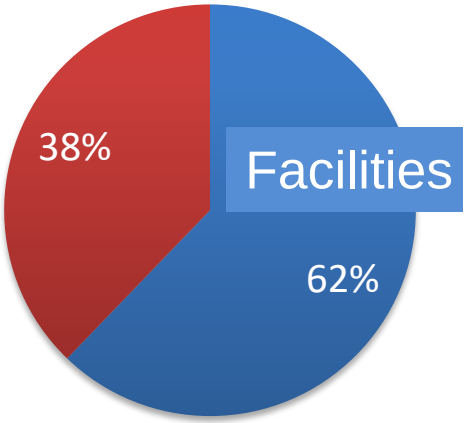
- NSF practice is that operations costs of MREFC-funded major new facilities are borne by the Division that is the host discipline.
- AST is absorbing DKIST operations into current budget planning.
- LSST operations are the next wedge. In the event of continued flat funding (or less) and no change in policy, a major realignment of facility support will be required to preserve a balance with the grants program.
- In the short term, the reduction in the FY18 President's budget was allocated to Individual Investigator and instrumentation grants, with some restoration possible at Congressional appropriations levels. (With no restoration, success rate predicted to be ~18%.)

HYPOTHETICAL BUDGET RUNOUT FOR AST

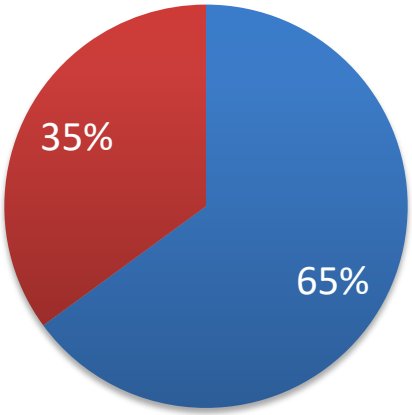


Historical Funding Breakdown

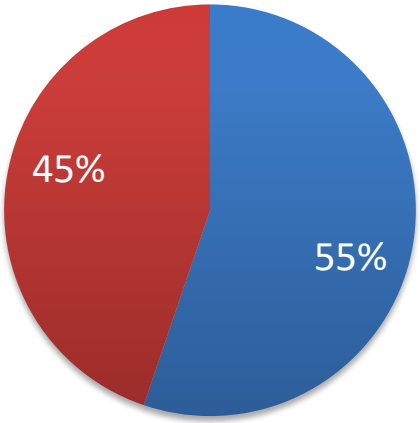
1995



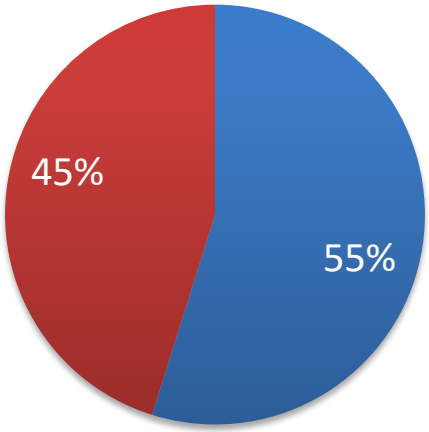
2000



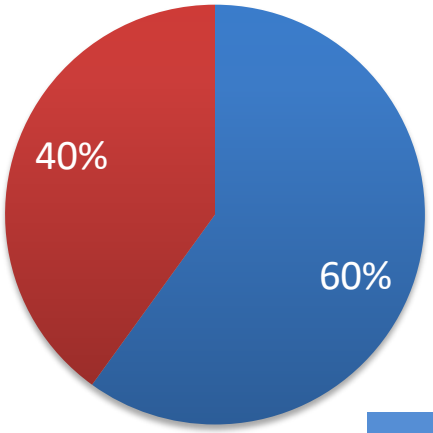
2005



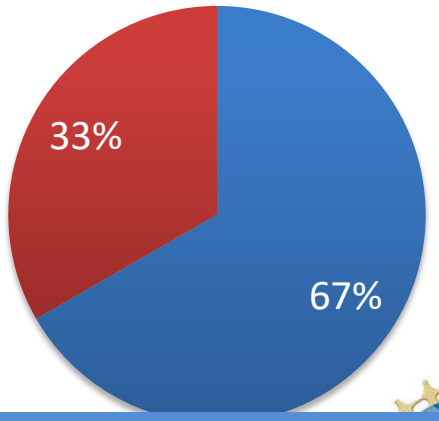
2010



2015

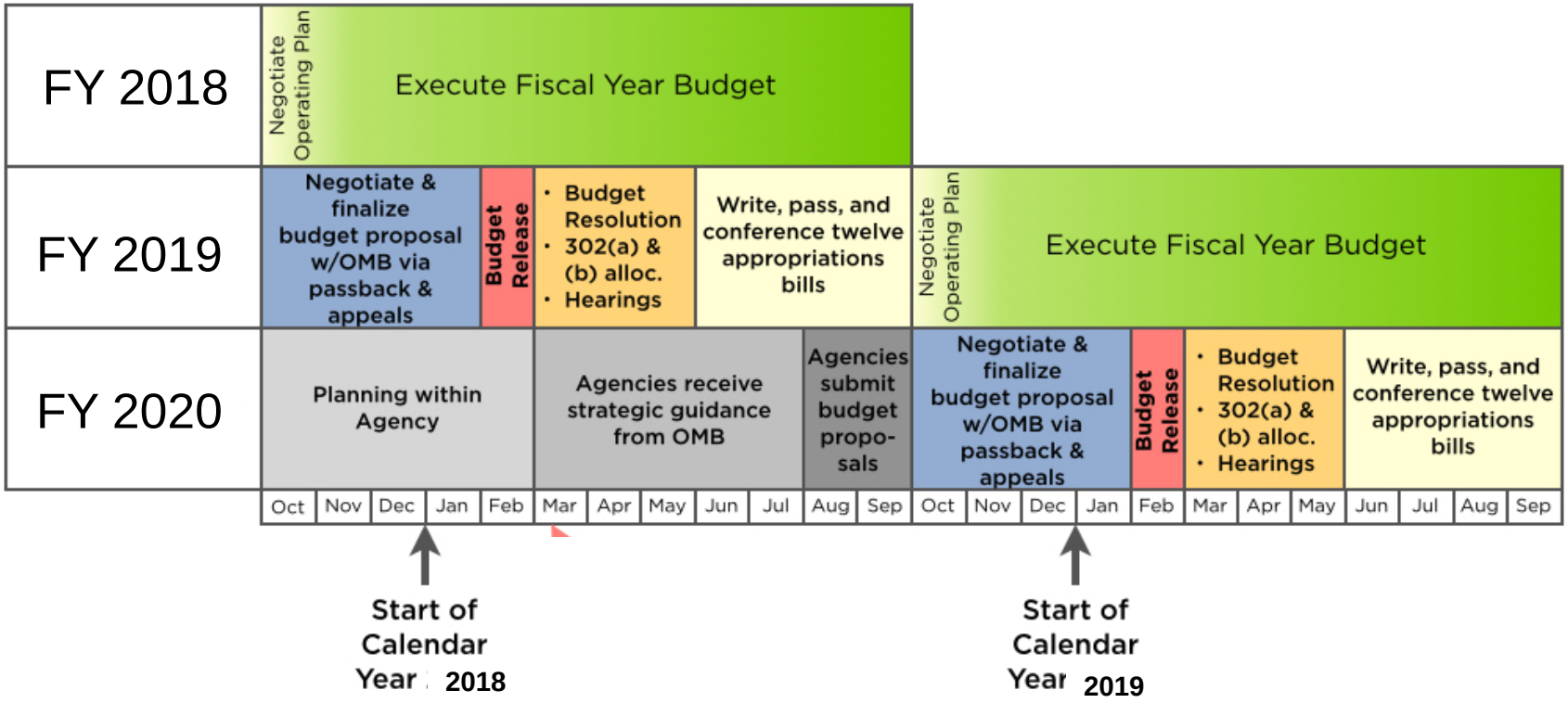


2020?



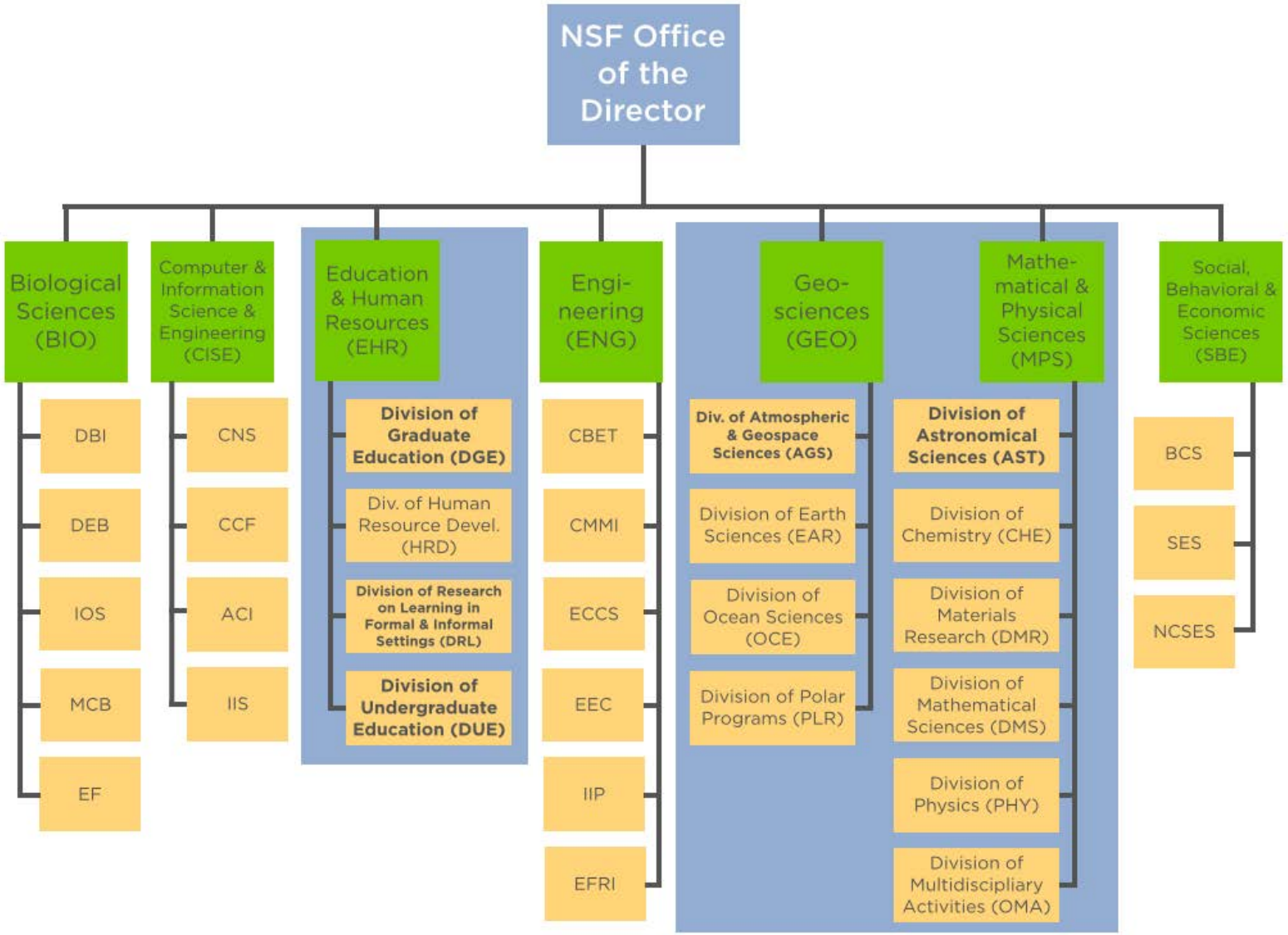
Assumes flat budget, currently planned facility evolution.

National Budget Process – NSF is Agency in the Executive Branch, subject to OMB Guidance



Adapted from budget process presentation by Matt Hourihan (AAAS)
http://www.aaas.org/page/presentations

AST is one of five (~equally funded) Divisions within MPS

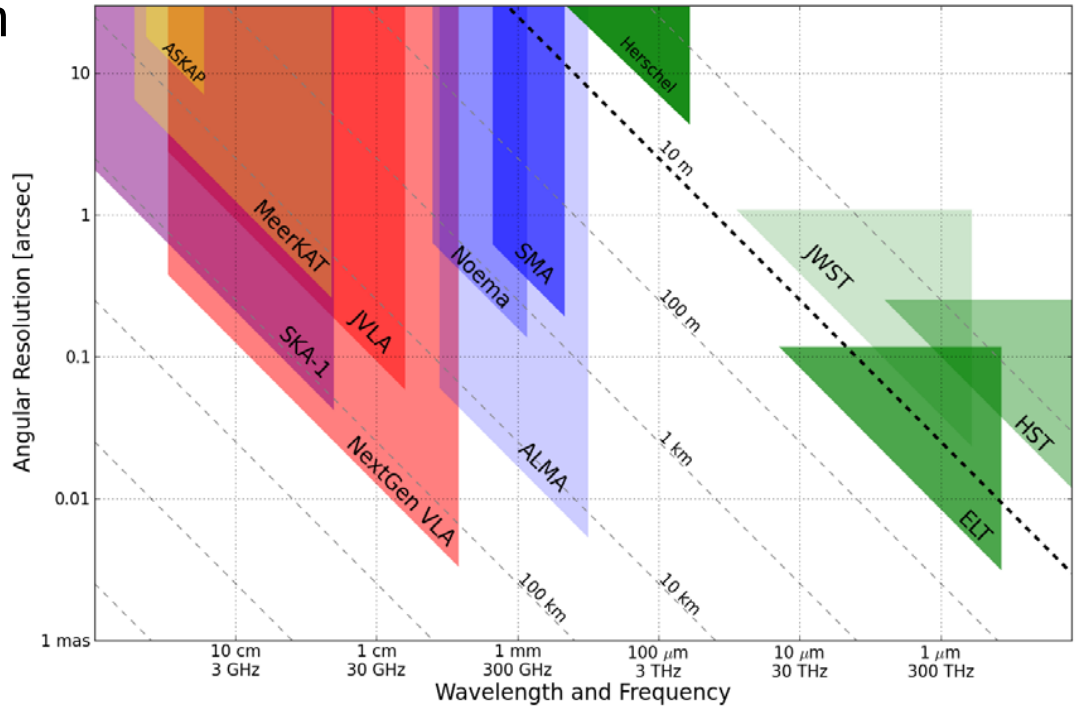


Decadal Survey

- Planning is now well underway for input to the next Decadal Survey.
- NSF/AST and NASA Astrophysics Division are the primary sponsors of the survey. DOE Cosmic Frontier in the Office of Science is also a sponsor.
- We provide a charge to the National Academies, then the entire process is organized by them.
- They submit a proposal for NSF's share, anticipated to be received this spring.
- See the Decadal Survey Town Hall on Wednesday evening.

AST Decadal Survey Preparations

- NRAO held a series of three Kavli-sponsored workshops to identify and prioritize the key scientific problems the RMS community would address in the coming decade.
- Many of the scientific goals can be achieved with a concept called Next Generation VLA, including
  - •Unveiling the Formation of Solar System Analogues
  - •Probing the Initial Conditions for Planetary Systems and Life with Astrochemistry
- •Funded technical concept studies are underway within NRAO



AST Decadal Survey Preparations

- NOAO is collecting OIR community white papers
- Submissions for public meeting Feb 20-21, 2018.
- Topics addressed to date include
  - Community participation in GSMT science
  - Dedicated wide-field spectroscopic survey telescope
  - Enhanced time-domain telescope network (GW follow-up)
  - Data science development for LSST and other large datasets

Cosmic Microwave Background (CMB)

- CMB Stage 4 goals: testing inflation, determining the number and masses of the neutrinos, constraining possible new light relic particles, providing precise constraints on the nature of dark energy, and testing general relativity on large scales.
- Two sites: South Pole and Atacama
- Fourteen small (0.5m) telescopes and three large (6m) telescopes, with 512K total detectors
- Report released to AAAC by its subcommittee on 10/23.

Decadal Survey

- We are now approaching the end of the current decade, with LSST development as a notable success.
- Other large projects in the 2010 queue will need to compete for a new prioritization in the 2020 survey.
- Reasonable expectation from recent past experience is that only the top-ranked large project will have a chance to be supported in the coming decade.

- NST/AST remains optimistic that we can leverage a vital, competitive research program for our dynamic community.