AAAC NSF/AST Update

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MPS/AST



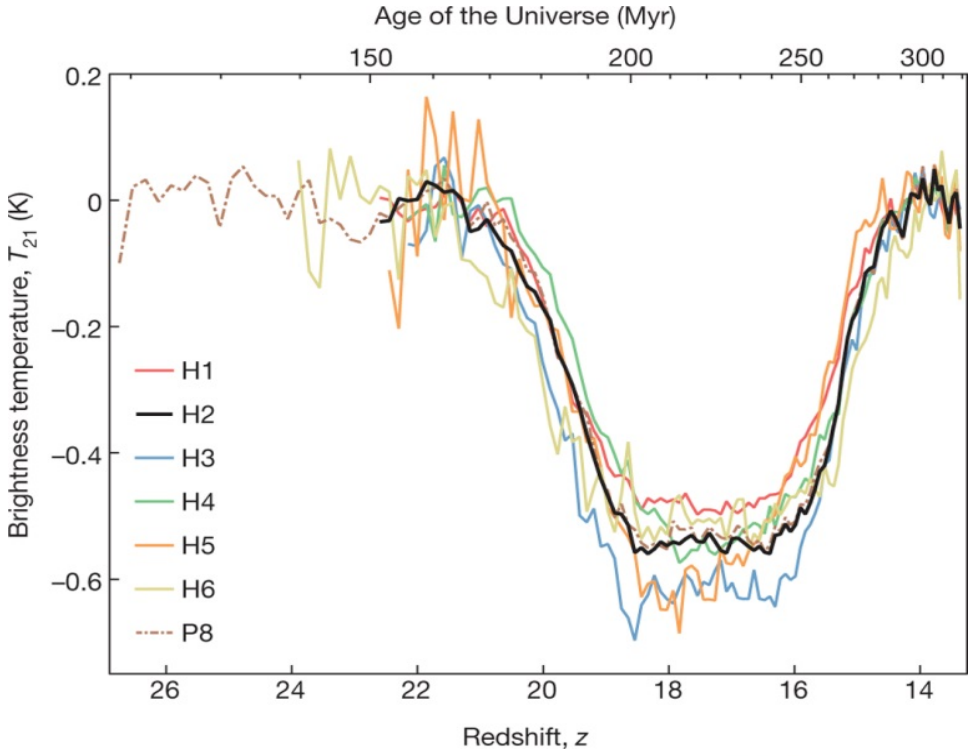




AST Mission: Enable breakthrough science

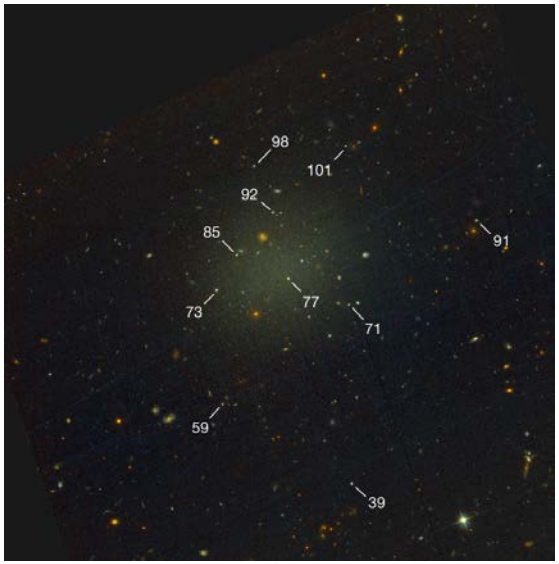
Epoch of First Stars

- J D Bowman *et al. Nature* **555**, 67–70 (2018)
- UV from first stars excites H I to distort CMB by 21 cm absorption
- EDGES low frequency measurement at MRO (Murchison in Australia) – NSF supported project.
- Simultaneous modeling of Galactic synchrotron foreground and high-z 21 cm absorption gives ~0.5K depression at 78 MHz, z~16 – 18.



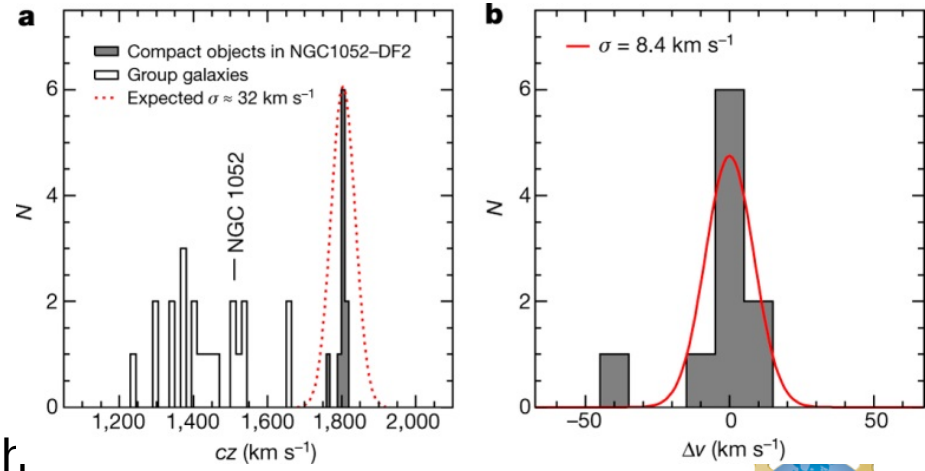
- Depth 2x expectation: best explanation is colder IGM – extra cooling from baryon-DM interactions?
- HOWEVER, Hills et al. (arxiv: 1805.01421) reanalyzed the same data with different functional forms for the Galactic foreground and do not reproduce the feature – stay tuned!

Low-Mass Galaxy without Dark Matter

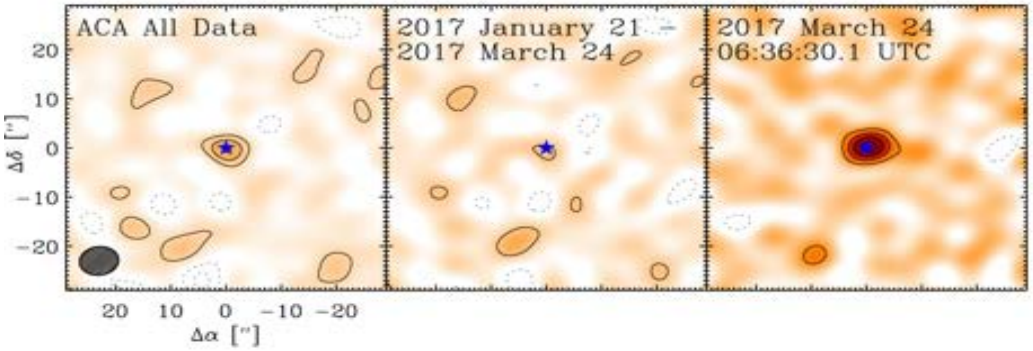


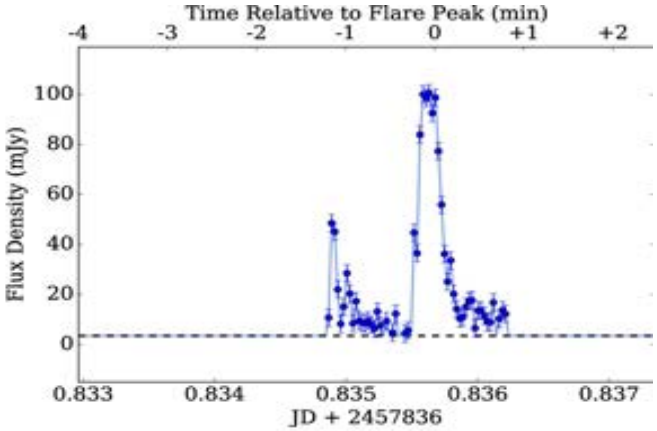
- P van Dokkum *et al. Nature* **555**, 629–632 (2018) studied an ultra-diffuse dwarf galaxy associated with NGC 1052.
- Dragonfly discovery image was extended low surface brightness, while SDSS image contained mostly point sources.
- Gemini image gave mass ~2x10^8 $M_\odot$ and 10 globular cluster-like targets for Keck spectroscopy. (HST ACS image from the paper is shown.)

- Fitted velocity dispersion is 8.4 km/s, intrinsic is 3.2, implying a dynamical mass of <3.4 x 10^8 $M_\odot$.
- The dark matter to baryonic matter ratio is therefore of order unity and consistent with zero.
- The expectation for that ratio is ~400 from local low-mass dwarfs of similar mass.
- Challenging to explain theoretically, although the high local galaxy density may be a factor.

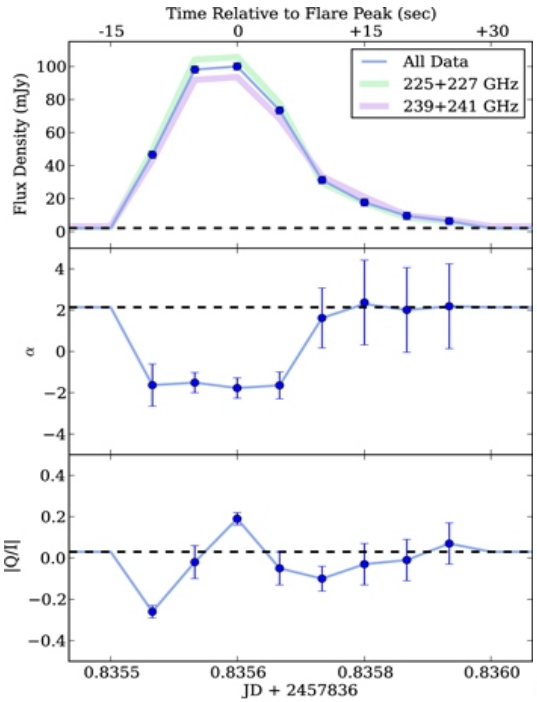


ALMA Detects Strong Flare on Proxima Cen





- Meredith MacGregor et al. (2018 ApJL 855 L2) monitored Proxima Cen with ALMA and the ACA, and caught a strong flare lasting about a minute with peak 1000x brighter than quiescent emission.
- Strong change to steeply falling spectral index at 1.3mm, suggestive of optically thin part of gyrosynchrotron emission, rather than thermal.
- Known very active M dwarf flare star, with X-ray and optical flares; 8/yr >10^{33} erg.
- Associated planet requires effective shielding to be truly habitable.



Inter-Agency Cooperation

- Recommendation: We recommend that DOE, NSF, and NASA continue their successful cooperation in Astronomy and Astrophysics.
- Response: NSF will continue cooperation and collaboration with NASA and DOE to exploit synergies and shared scientific priorities in Astronomy and Astrophysics.
- Current examples for NASA include co-sponsorship of the Decadal Survey, joint NSF-NASA FACA review panels (e.g. your committee), cooperation on space weather and solar research, joint ground-space observations of astrophysical objects (e.g., neutron star mergers), collaboration on the exoplanet research program (WIYN 3.5m telescope), cooperation on Near Earth Object detection and characterization (Arecibo and LSST Observatories), search for techno-signatures, and semi-annual joint NSF-NASA staff meetings.
- Current examples for DOE include the Dark Energy Camera, Dark Energy Survey Instrument (DESI), LSST, and the CMB Task Force.

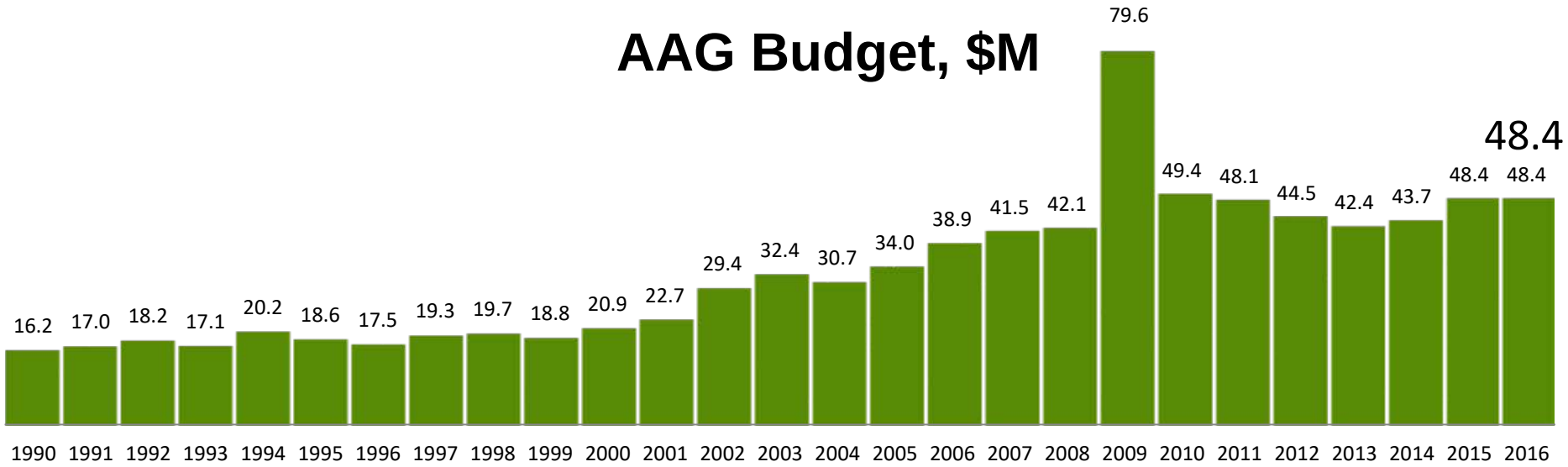
AST Implementation

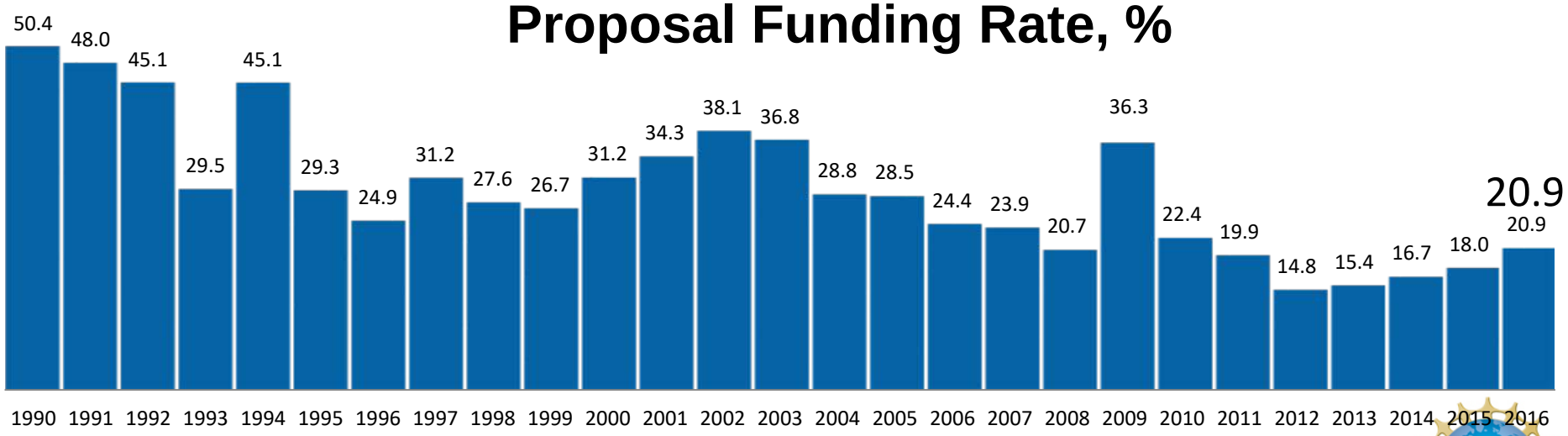
- High-demand Individual Investigator programs.
- Suite of forefront ground-based Optical/IR (OIR), Radio-Millimeter-Submillimeter (RMS), and Solar observing facilities plus data holdings supported by AST for merit-based access.
- Construction through the MREFC line of two major new facilities, DKIST 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.

AAG Funding History, 1990-2016





AST Division Programs

Individual Investigators
(Lead: James Neff)

Success rate

- AAG — 1/6
- CAREER — 1/10
- AAPF — 1/10
- ATI
- MRI
- REU
- PAARE

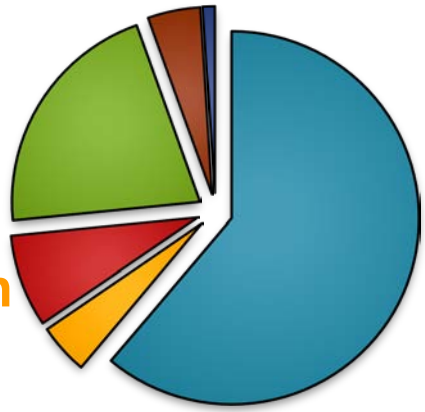
Mid-scale
(Lead: Rich Barvainis)

MSIP

Research

Technology/ Instrumentation

Education and Special Programs



Facilities

- ALMA
- NRAO
- Gemini
- NOAO
- NSO
- Arecibo
- GBO & LBO

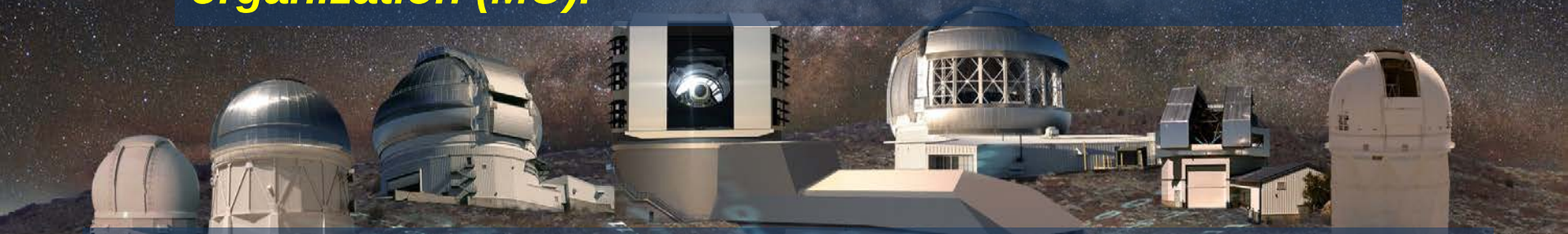
DKIST Current Construction Site

Operations in 2020

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 somewhat after 1 Oct 2018. Approved by National Science Board to proceed.**
- **LSST operations is on track for initial funding in FY 2019.**

Background is a montage of major facilities under NCOA.

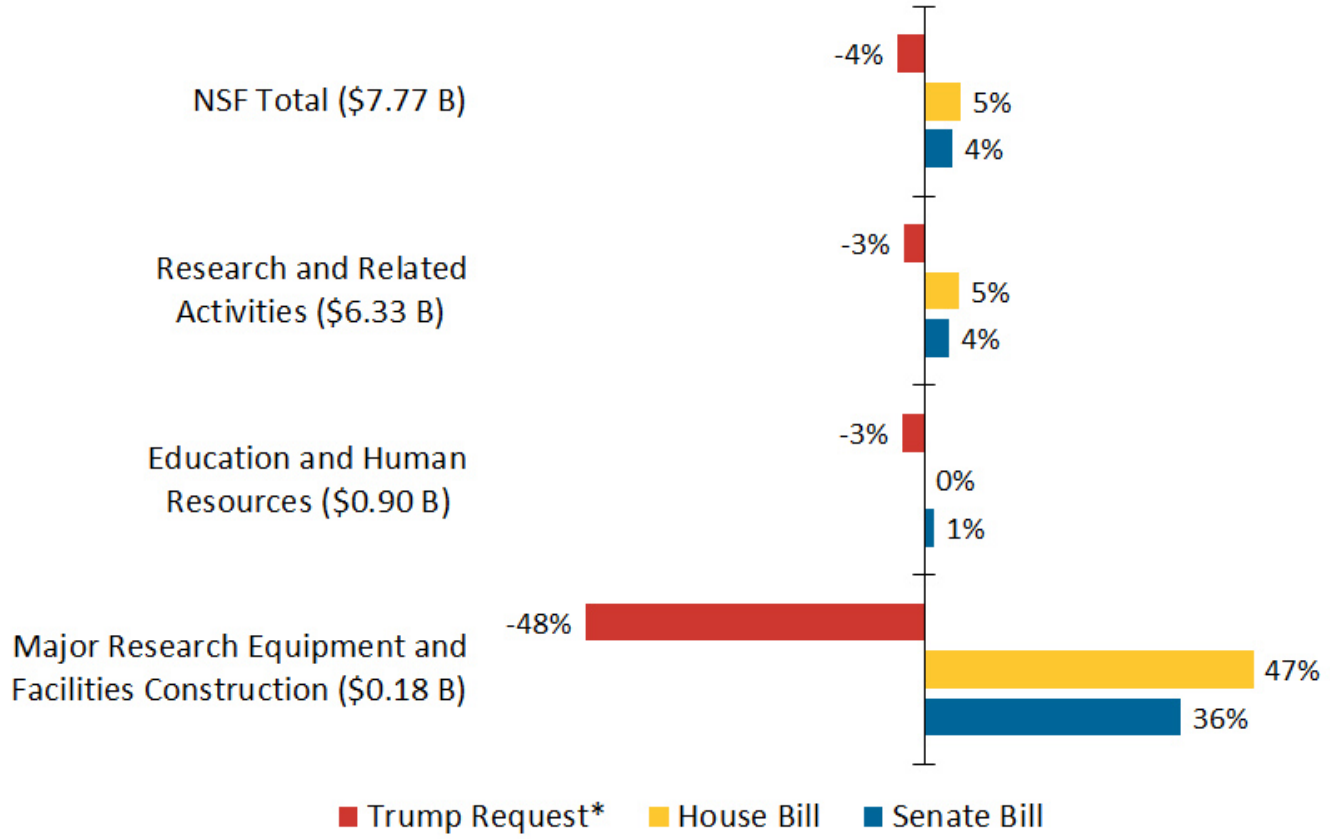
FY 2018 Budget

- Currently waiting for Senate approval of final Execution Plan; can share budget details (with AD permission) only after Plan made public.
- News is generally very good; Congressional appropriations increased Research & Related top line by ~5% over FY2017 enacted.
- AST anticipates favorable allocation with respect to that increase.
- Potential risks to AST budget and operations:
  - Another request from OMB to Congress for consideration of rescission. Backup plans being made accordingly.

FY19 Spending Proposals: National Science Foundation

% change from FY18 enacted

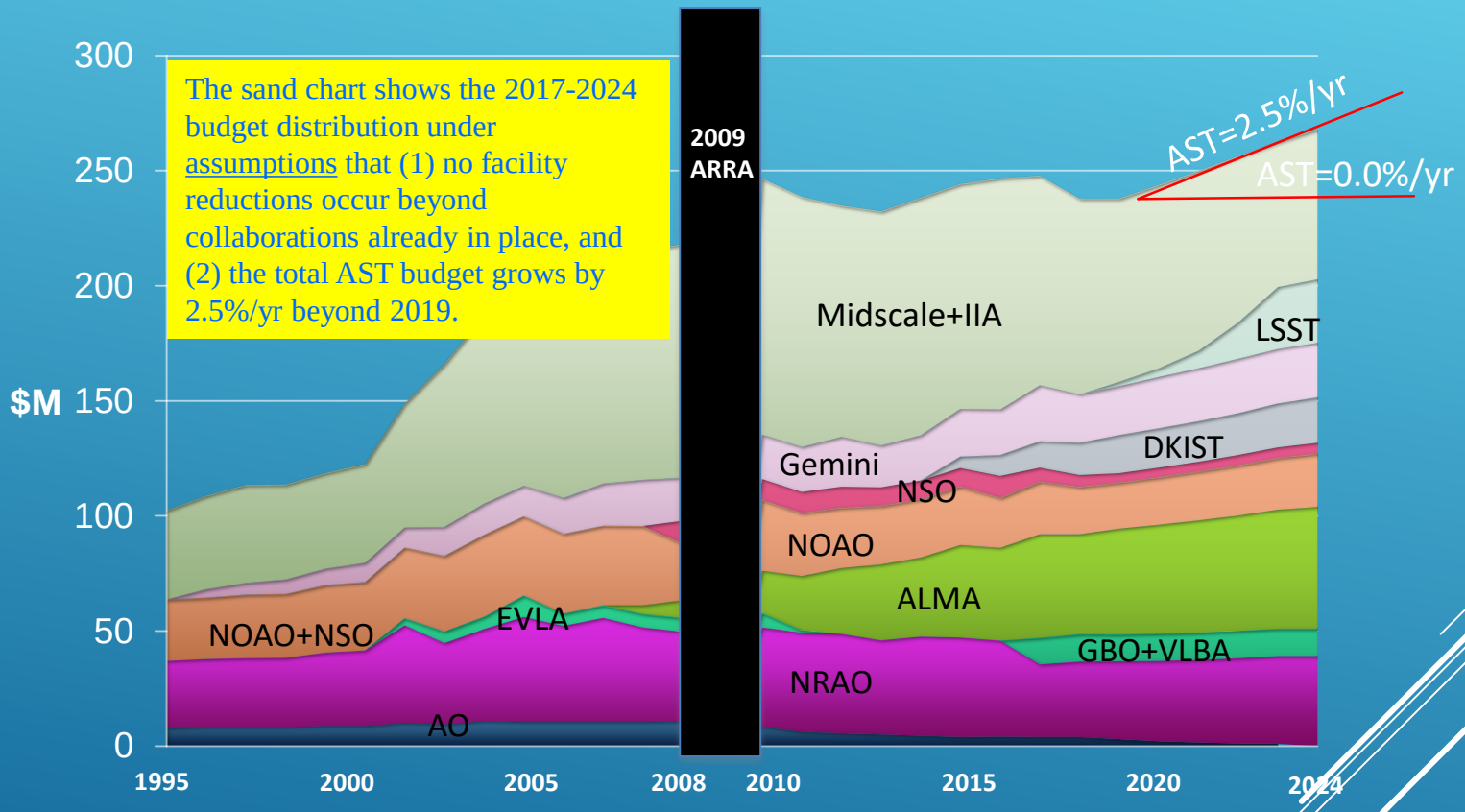
$ in ( ) are the FY18 amounts



*The administration submitted the budget request to Congress before the final amounts for fiscal year 2018 were set.

American Institute of Physics | aip.org/fyi

HYPOTHETICAL BUDGET RUNOUT FOR AST



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

New Solicitations / Dear Colleague Letters

- The FY 2019 President's Budget request allocates $30M each for Windows on the Universe and Harnessing the Data Revolution and $60M for mid-scale projects.
- These programs can support the rich mix of ground-based data acquisition, development of systems and structures for end-user data science (search for lower σ GW events in the data stream post facto), and the theoretical modeling required for interpretation and prediction.
- Some solicitations already appearing (CESER), so watch the NSF website.
- These "off the top" investments in key future directions result in a ~8% reduction of core funding for AST in the PBR, given the flat top line request. Astronomers are well positioned to compete and win a larger total of research support than a flat-funded core grants program.
- More creative approaches may give access to Rules of Life (astrobiology) and Quantum Leap (BH entropy, quantum tels.).

Divestment Summary

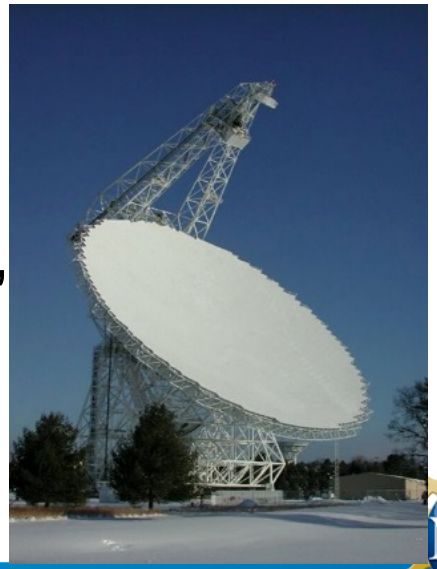
Telescope	Status
KPNO 2.1m	Caltech-led consortium (Robo-AO) operating for FY 2016-2018.
Mayall 4m	Slated for DESI; bridge from NSF to DOE; NSF/DOE MOU for transition.
WIYN 3.5m	NOAO share to NASA-NSF Exoplanet Observational Research Program; NSF/NASA MOU in place; NASA instrument under development.
GBO	Separation from NRAO in FY 2017; ~30% external support now for basic scope; Draft Environmental Impact Statement (EIS) issued on Nov. 8,'17.
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.	Initial NSF and State funding for consortium led by NMSU; NSO to provide continuing site support; started EIS process; completion this CY.
Arecibo	EIS Record of Decision in Nov 2017. UCF new operator as of April 1 with plans for increasing share; some transition difficulties to be worked out.
SOAR	Post-2020 status to be reviewed.

Arecibo Status

- New award for operations given to the University of Central Florida, in partnership with Universidad Metropolitan (PR) and Yang Enterprises.
- The 5-year performance period began April 1st.
- Smooth transition of technical staff; more issues with scientific staff.
- Routine observing, but limitations in planetary and atmospheric radar, high-frequency sensitivity.
- $14.3M of hurricane relief funding appropriated; highest priority is power stability, with generator repairs and installation of backup solar system as first actions.

Green Bank divestment status

- Draft EIS released Nov. 10th, followed by 45-day public comment period.
- Public meetings for comment on Draft EIS held Nov 30th.
- Jan 2018: Draft EIS public comment period ended
- Fall 2018: Final EIS anticipated; extension of current CA.
- Feb 2019: NSB Action Item on Record of Decision (ROD)
  - ROD issued
- Additional external funding needed.
- In FY 2017, Green Bank received 30% of $12.4M base budget from non-NSF sources: Breakthrough Prize Foundation, University of West Virginia, and others.
- NSF/AST currently working to secure additional funding commitments.



Sacramento Peak divestment status

- Draft EIS released on February 8th with no preferred alternative; public meeting on 2/28.
- NSO ceased operating Sacramento Peak for public science at the end of FY 2017. If DST continues operation, NSO can support the infrastructure at least until DKIST is in full operation.

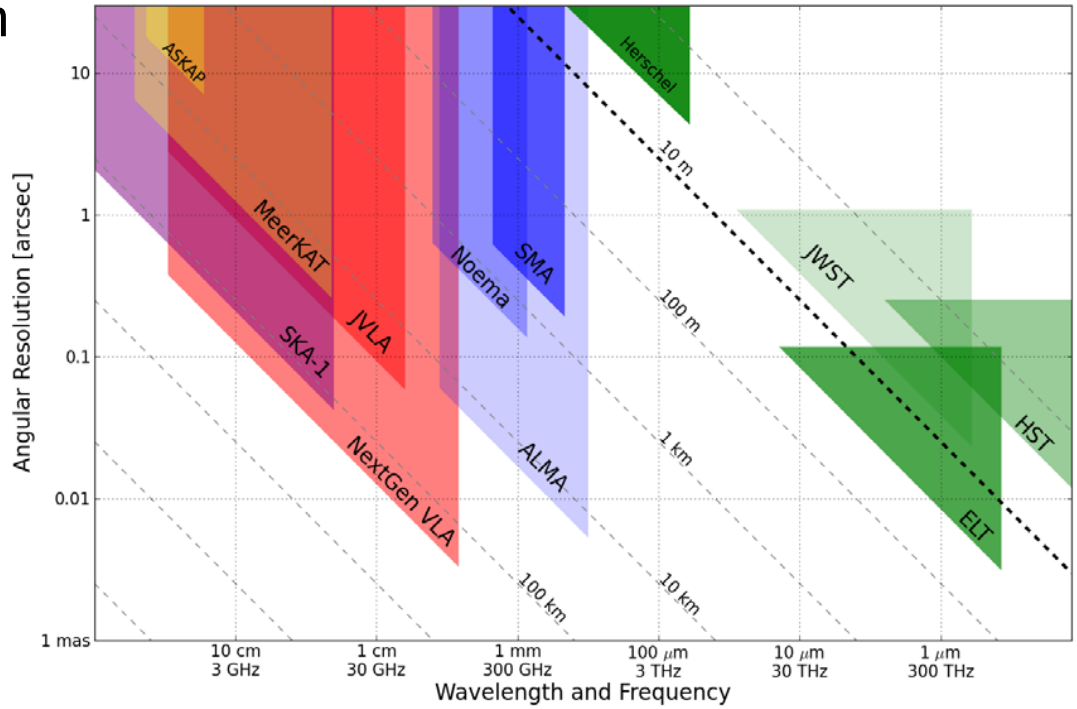
- New Mexico State University (NMSU) proposed to transition to operations by a NMSU-led consortium; The State of New Mexico recently awarded a $273K one-year grant to NMSU to start July 1, 2018, with the possibility for funding in future years. NMSU proposal funded by NSF ($1.2M) from Sept 2016 for 24 months.
- EIS process expected to conclude in second half of 2018.

Decadal Survey

- Planning is now well underway for input to the next Astronomy & Astrophysics 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.
- Agencies and National Academies are now all but converged on the Statement of Task; the entire process is then organized by the Academies.
- They submit a proposal for NSF's share, anticipated to be received next month.
- That proposal will be reviewed jointly on behalf of NSF/AST and NASA Astrophysics Division.
- NSF is including all ground-based astrophysics for project prioritization, not limited to AST.

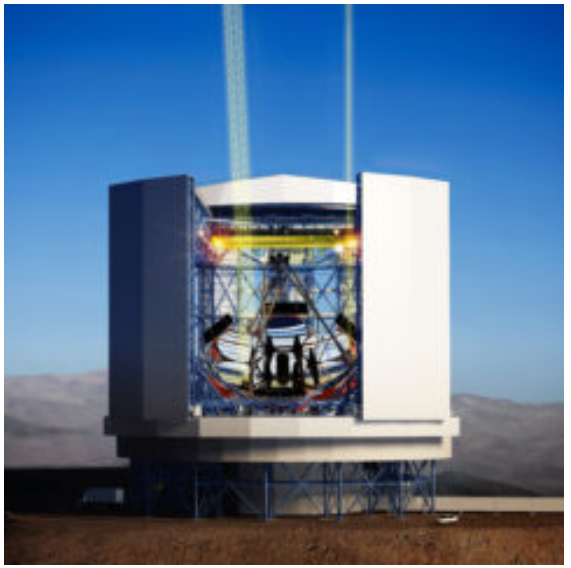
AST Decadal Survey Preparations

- 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 coordinating with the TMT and GMT projects to develop a community science case requiring time on both telescopes.
- The approach will be based on key science programs, requiring substantial allocations of time.
- Definition through Kavli-sponsored workshop(s)
- The projects have met with NSF to understand the conditions and reviews required by the law under the AICA so that award(s) can be made.
- New NSB report addresses how to handle lifecycle costs beyond scope of individual Divisions.



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.

Challenges in Getting Budget Advice

- NSF at June 27th without a final Execution Plan for FY18.
- Increasing Agency concern about sharing non-public data.
  - Current or future year data not part of publicly released plan or request are strictly embargoed.
  - Detailed data not publicly available underlying publicly accessible numbers now require special permission and justification for release. (e.g., proposal success rates)
- Helpful for AAAC to advise which indicators are most useful for your ongoing evaluation of programmatic balance.