NSF/AST Update for the CAA

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Outline of update

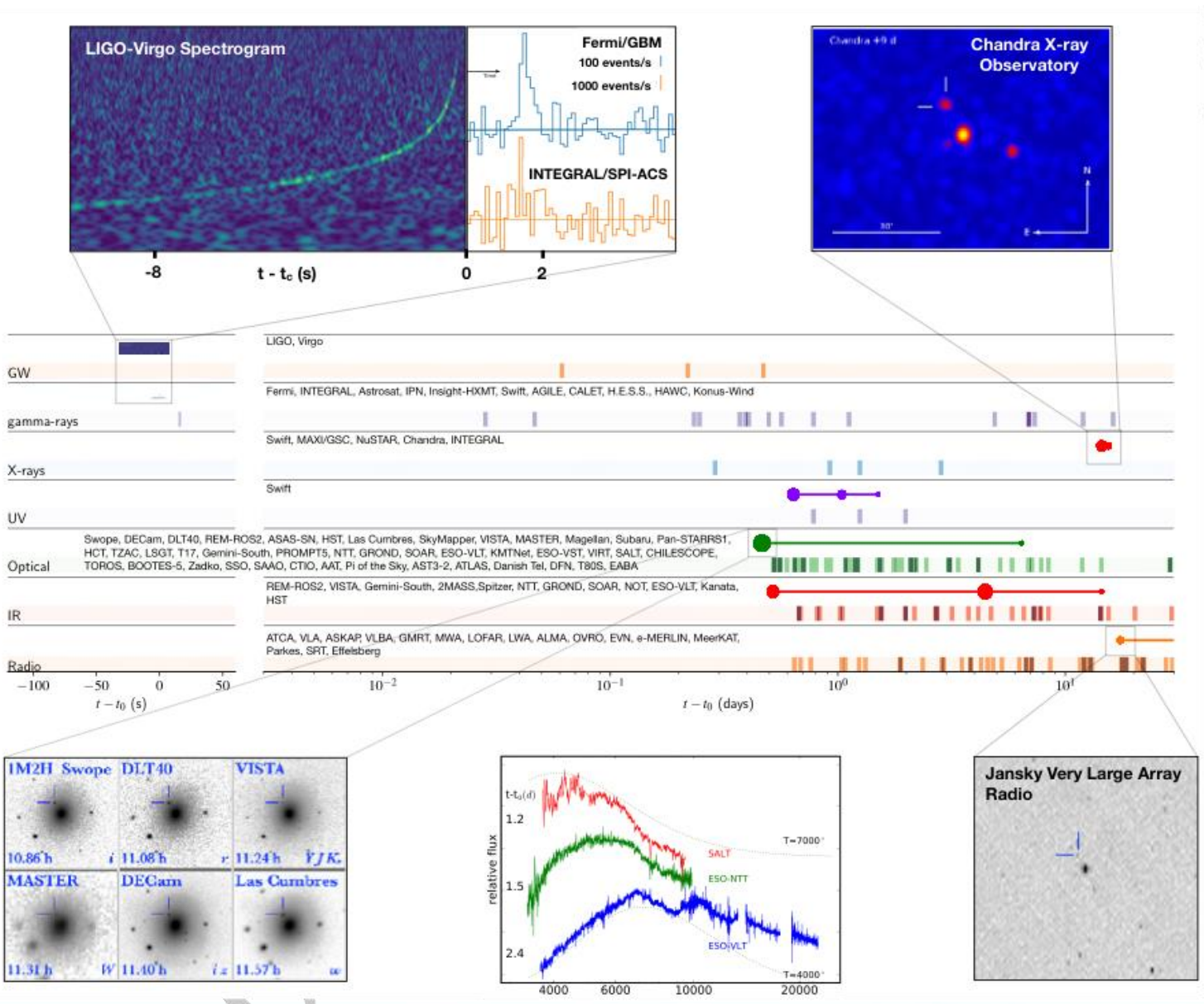
- AST Implementation in a nutshell
- Science result
- NSF Big Ideas
- NSF has moved!
- AST Grants Programs
- Facilities status, including MREFC projects NCOA and on-going facility divestment
- FY 2018 NSF budget and President's Budget Request (PBR)
- FY 2019 PBR
- Astro2020

AST Implementation

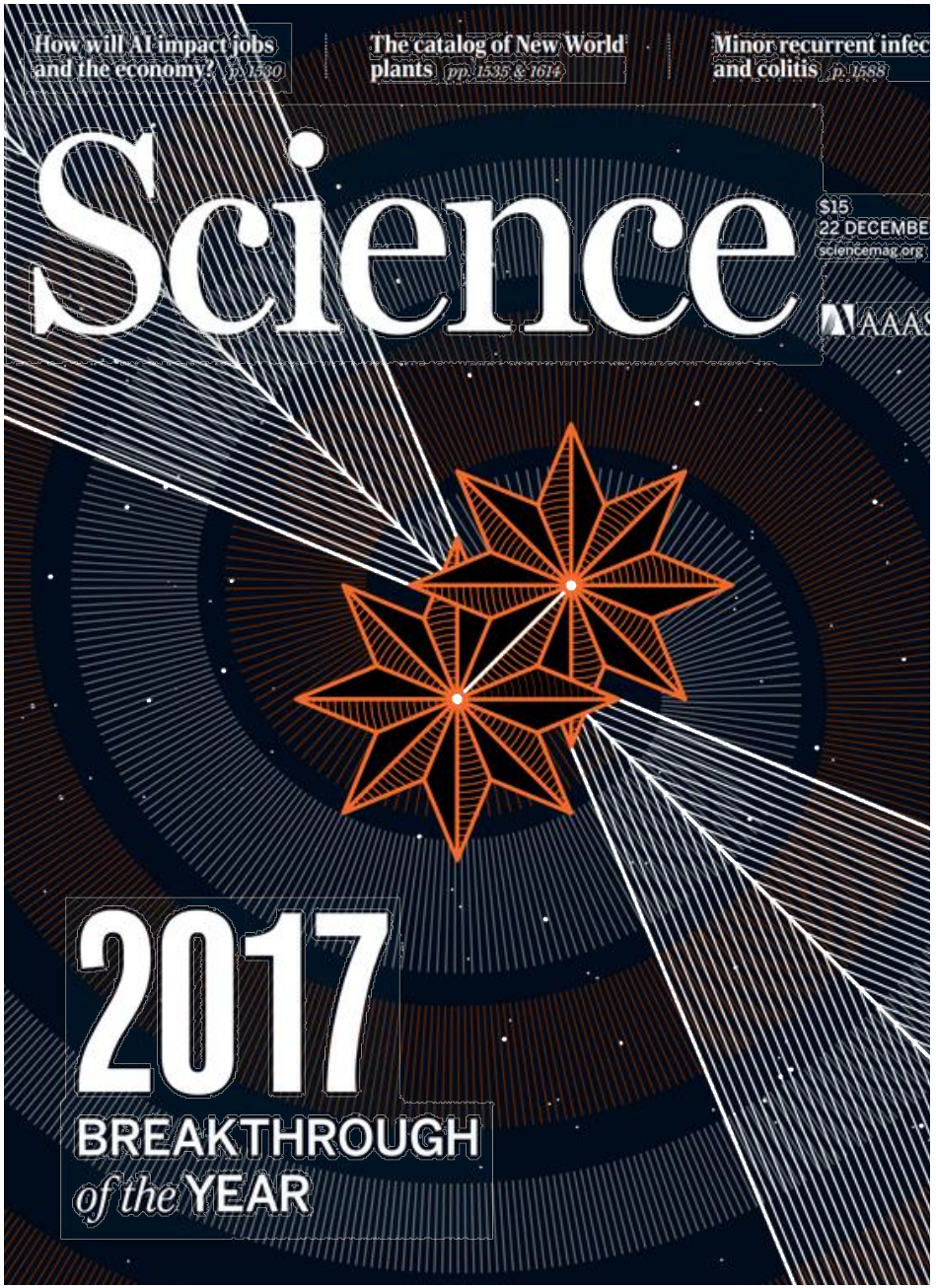
- High-demand Individual Investigator programs.
- Suite of forefront ground-based Optical/IR (OIR), Radio-Millimeter-Submillimeter (RMS), and Solar observing facilities plus for merit-based access to other facilities.
- Construction through the MREFC line of two major new facilities, DKIST and LSST.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

Binary Neutron Star Merger in NGC 4993

Abbott et al. 2018



AST Mission: Enable breakthrough science



NSF's 10 "Big Ideas" for Future Investment

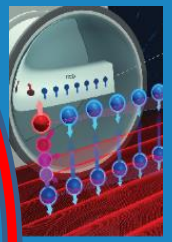
RESEARCH IDEAS

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

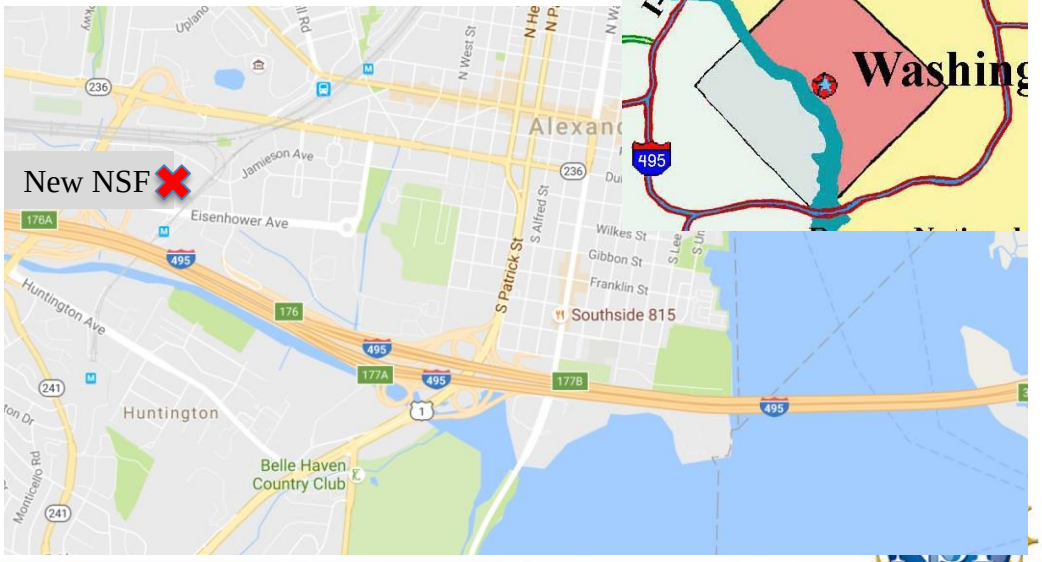
Growing Convergence Research at NSF

NSF INCLUDES: Enhancing STEM through Diversity and Inclusion

NSF has Moved!

Did you notice?

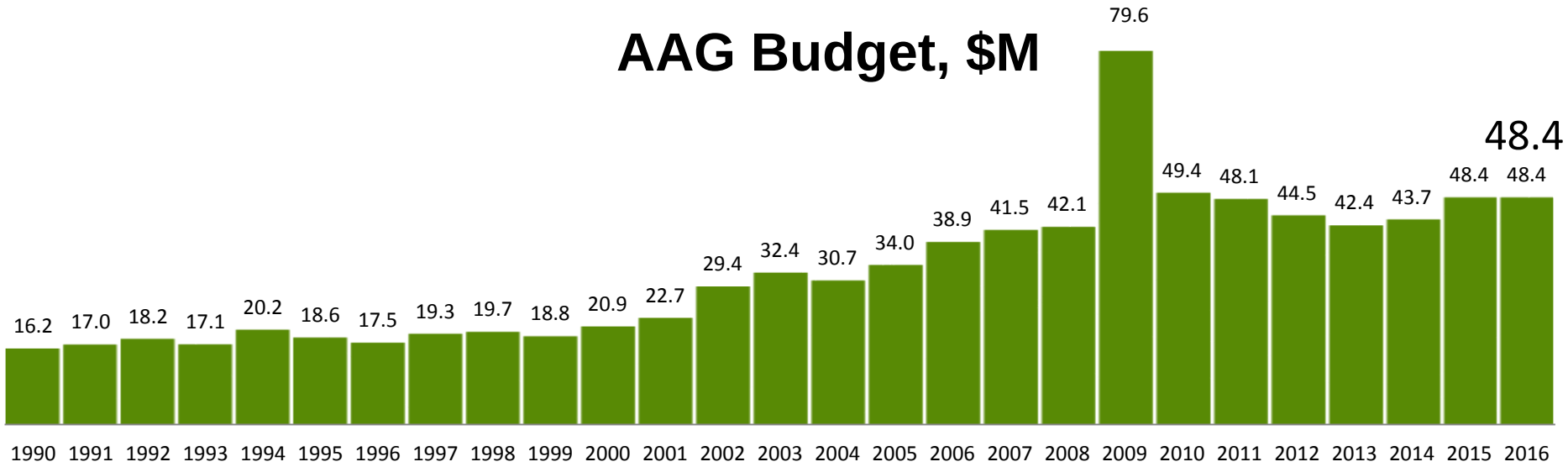
- NSF moved from Arlington to Alexandria Virginia in July-September 2017.
- The Directorate for Mathematical and Physical Sciences, including AST, moved over the extended Labor Day weekend (Sept 2-4).
- Move went amazingly well (with growing pains)

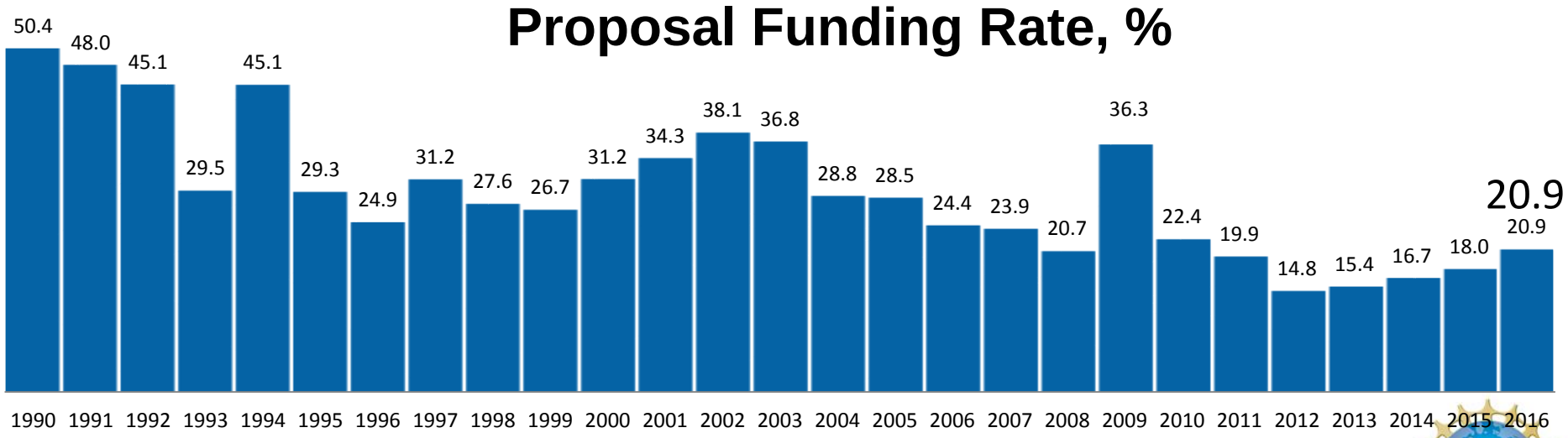


Individual Investigator Programs—1000 proposals/yr

- Astronomy and Astrophysics Research Grants—700 prop.
  - Solar and Planetary (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





Current Facilities

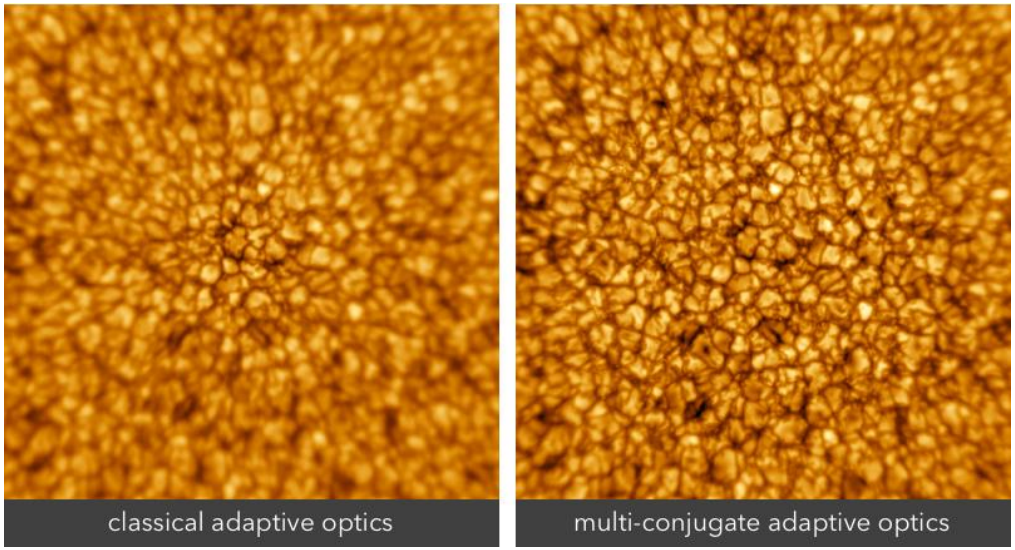
- OIR
  - Gemini North and South 8-m telescopes
  - National Optical Astronomy Observatory
    - CTIO - Blanco and SOAR 4m class telescopes in Chile
    - KPNO - Kitt Peak operations in Arizona
    - Community Science and Data Center
- RMS
  - National Radio Astronomy Observatory
    - ALMA – Atacama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

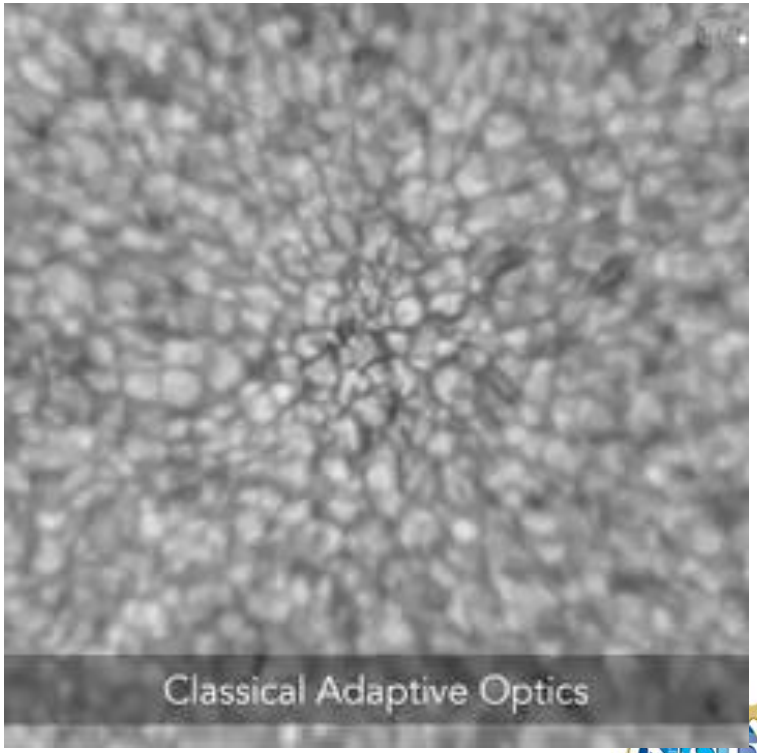
DKIST Current Construction Site

FY 2019 last year of construction funding, completed NLT June 2020

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





LSST Current Construction Site

Operations funding begins 2019. Survey begins early FY 2023. MC analysis indicates 90% confidence LSST is on cost/schedule.

On Feb. 22, 2018 the NSB passed a resolution concurring with the NSF Director approving changes necessary to integrate NOAO, Gemini, and future LSST operations under one administrative framework (NSF's National Center for Optical-Infrared Astronomy)

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	EIS process concluded with issuance of Record of Decision in Nov 2017 . Negotiations nearly complete for new collaborator, reduced NSF share.
SOAR	Post-2020 status to be reviewed.

Arecibo Status

- NSF was near the conclusion of the Environmental Impact Statement process at the time Hurricane Maria hit Puerto Rico
- The facility sustained significant damage, but less than anticipated, considering that it was directly in the path of the hurricane.
- Estimates have been made for repair and restoration; Congress appropriated $16.3M (Bipartisan Budget Act of 2018, Feb. 9) for NSF's hurricane-damaged radio observatories (Arecibo and St. Croix).
- The Observatory has resumed regular scientific operation; impacts are low sensitivity at higher frequencies and limited radar capability for both atmospheric and planetary work.
- The Record of Decision was signed on November 15, 2017, with the preferred alternative being continuing operation with reduced NSF participation.
- Negotiations are now nearly complete with the preferred proposal team University of Central Florida for transition to a new Cooperative Agreement on April 1 with decreased NSF funding.

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.

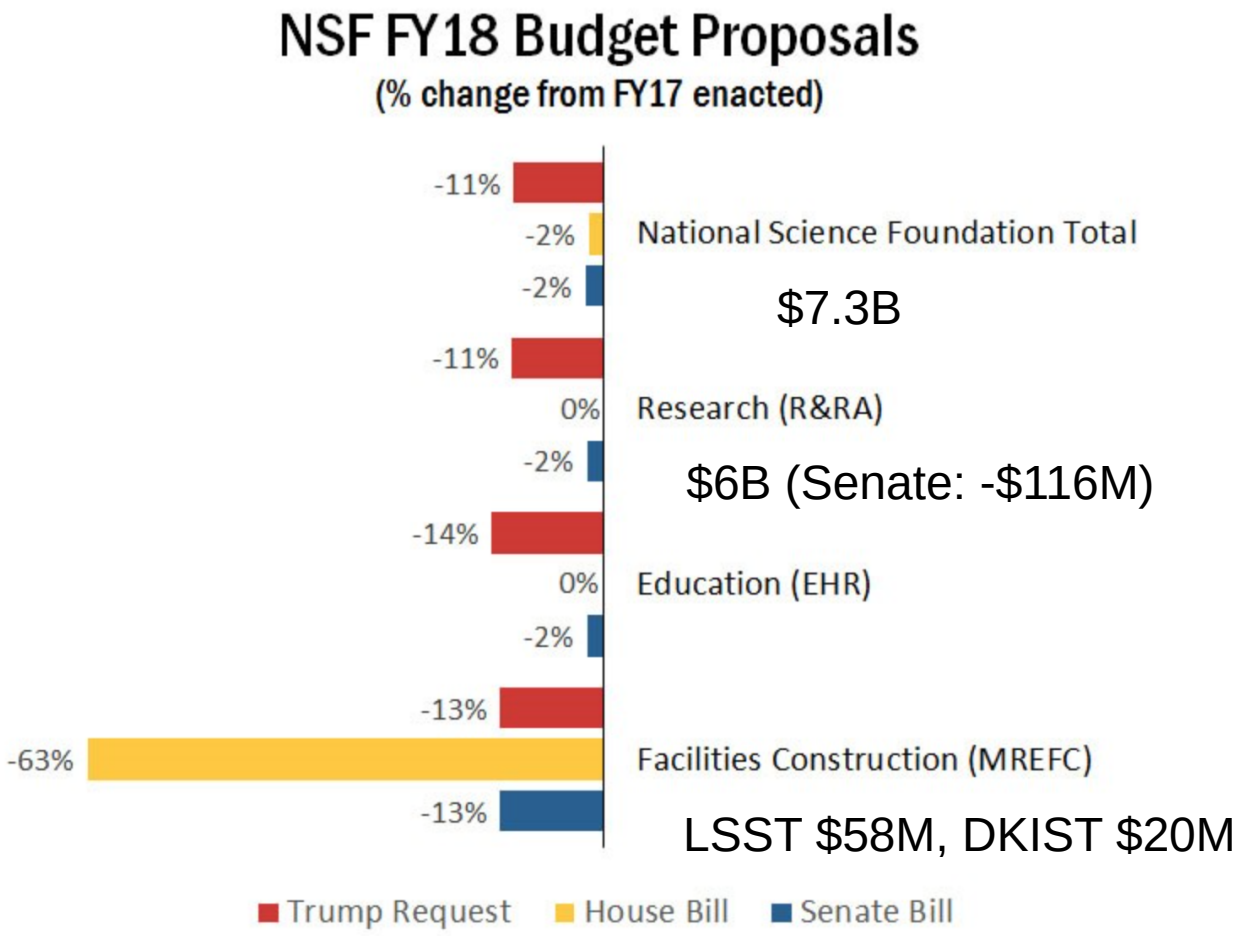
Sacramento Peak divestment status

- EIS scoping meetings held July 21, 2016.
- Draft EIS expected to be released the 1st week of February, public meetings on Draft EIS later in February.
- National Solar Observatory will manage the Sacramento Peak facilities as long as there is operation of the Dunn Solar Telescope .
- New Mexico State University (NMSU) proposed to transition to DST operations by a NMSU-led consortium.
- NMSU proposal funded by NSF ($1.2M) from Sept 2016 for 24 months.
- EIS process expected to conclude in second half of 2018.

Related Divestment Status

- Long Baseline Observatory has operated the VLBA since October 1, 2016, through a CA with AUI.
- US Naval Observatory provides funding to LBO for accurate determination of Earth Orientation Parameters.
- Fortunate that damage to St. Croix station from Hurricane Maria was relatively minor; critical to USNO continuing partnership. Repair funded.
- The Mayall 4m telescope on Kitt Peak had its last public access night with its traditional instrument suite on Jan 31st. It is currently undergoing an upgrade in support of DOE-funded operations of the Dark Energy Spectroscopic Instrument (DESI), starting in 2019.

FY 2018 Budget Proposals



FY 2018 AST budget strategy

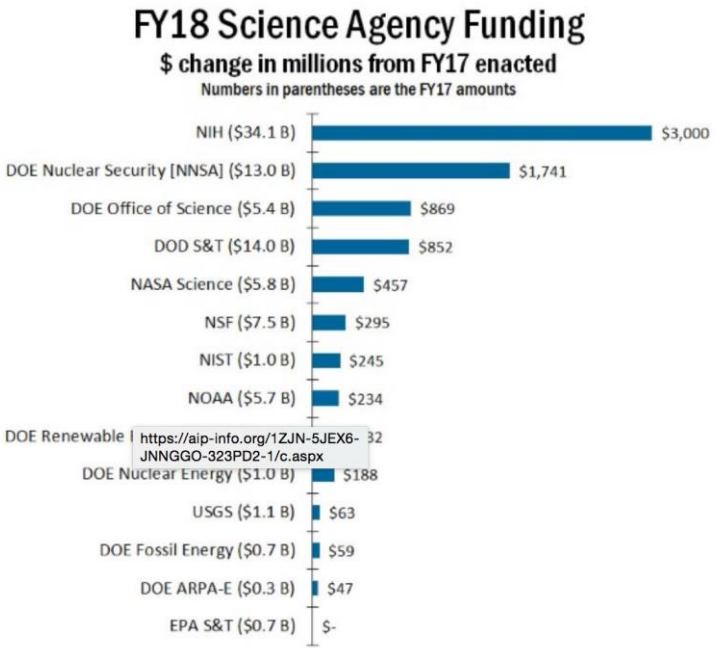
- Reduction ~12% from FY 2017 actual
- Preserve facility funding for FY 2018 PBR
- Reduce grants programs to balance PBR
  - ATI and MSIP program in alternate years
  - Cover ATI continuing grants
  - Reduce FY 2018 MSIP program budget from $20.67M (FY 2017 actuals) to $6M (FY 2018 PBR).

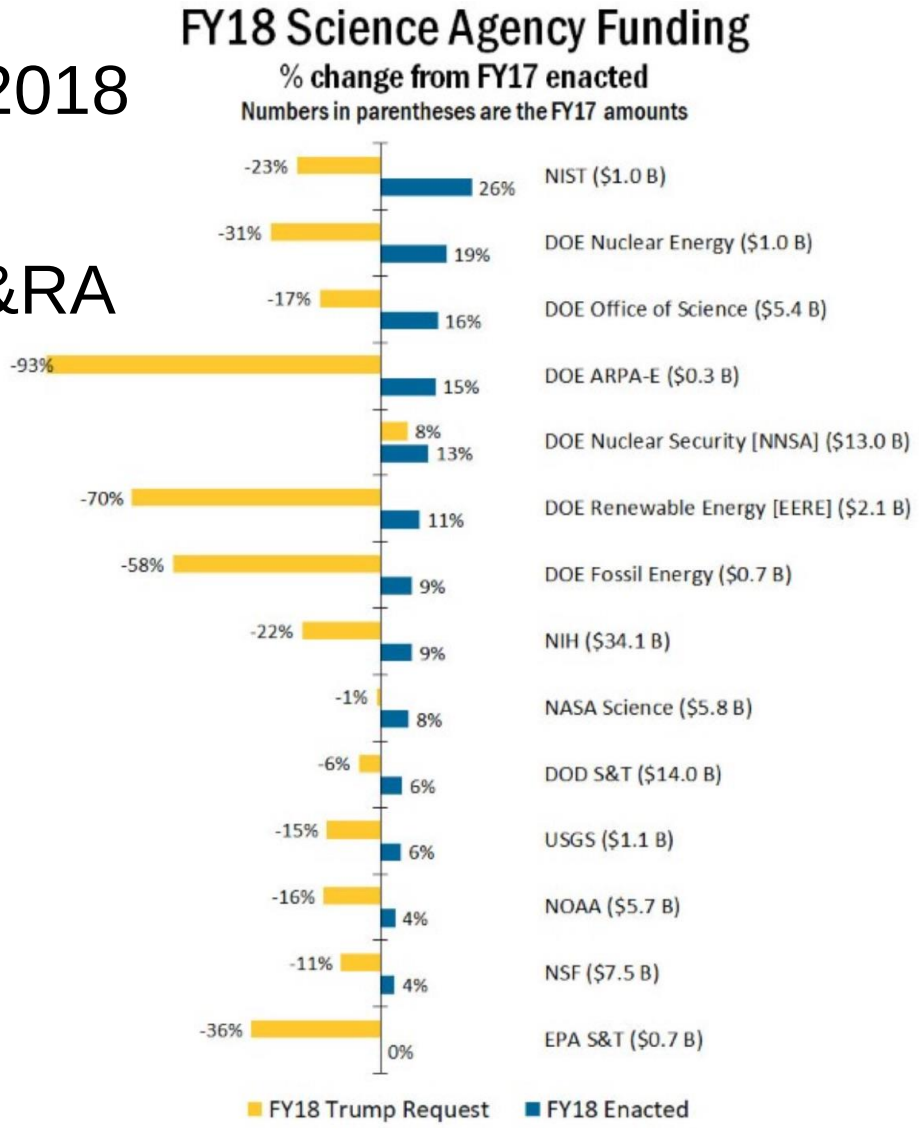
Bipartisan Budget Act of 2018

- Became law on February 9, 2018
- Suspended debt ceiling through March 1, 2019
  - Raised discretionary spending caps:
    - 2018 → $80B defense, $63B non-defense
    - 2019 → $85B defense, $65B non-defense
  - (another) CR through March 23, 2018
  - $90B Hurricane relief ($16.3M for NSF radio observatories)

Consolidated Appropriations Act, 2018

- Became law March 23, 2018
- NSF top line ~$295M
- NSF ~6% increase in R&RA
- MREFC fully funded
  - DKIST and LSST





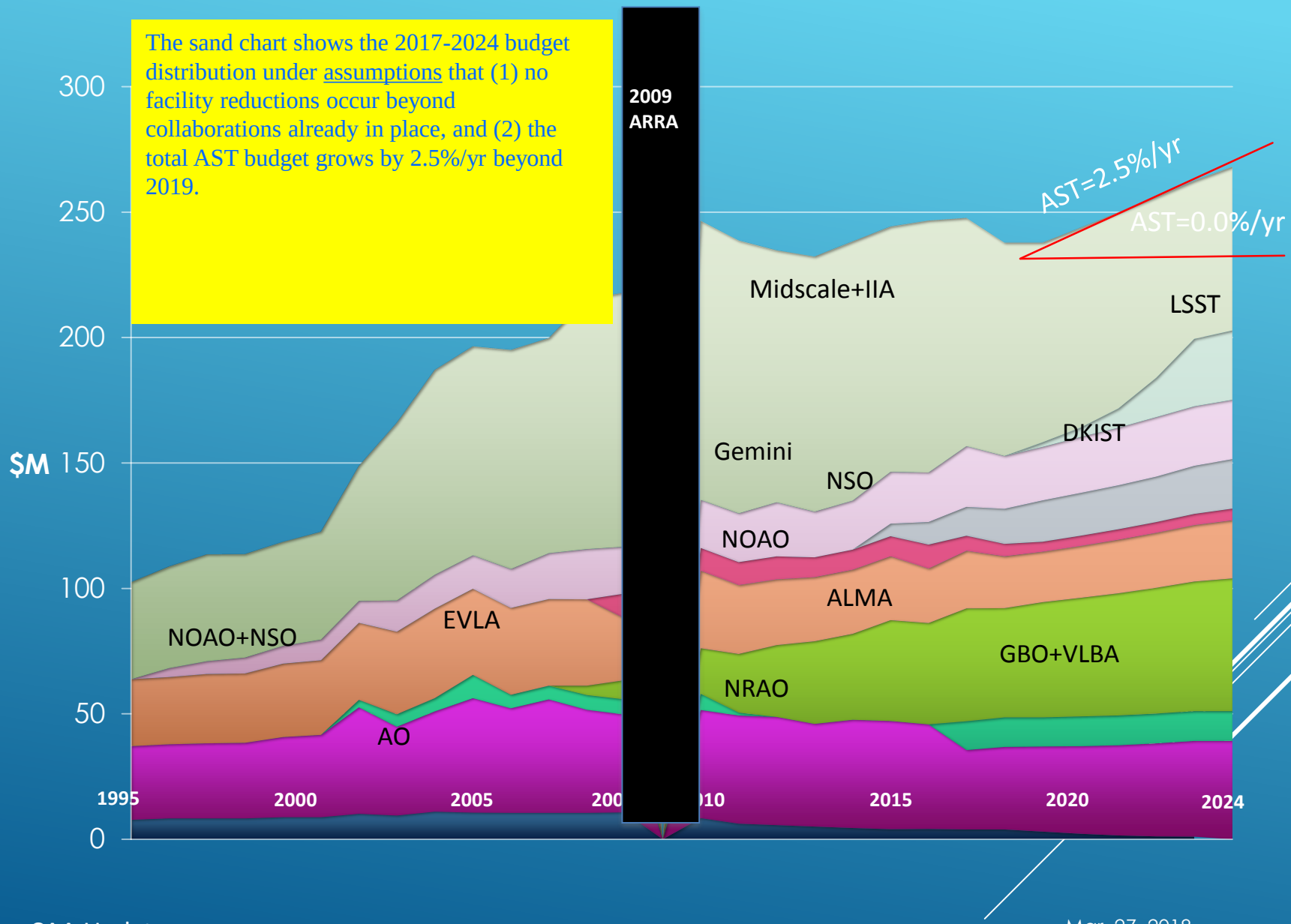
2019 President's Budget Request

- Initially, NSF budget -29.5% from FY 2017 enacted.
  - Cut propagated to AST budget
- White House Budget Addendum added $2.2B to FY 2019 PBR for NSF
  - NSF 2019 PBR essentially flat wrt FY 2017
- NSF reworked PBR to account for the addendum
  - AST PBR budget -8.4% from FY 2017 actuals
  - Preserve facilities budgets
  - Continue to offer ATI and MSIP in alternate years
    - ATI fully funded at $8M in FY 2019
  - ~11% reduction in grants
- NSF reserved $30M in each of 6 Big Ideas
- Process Big ideas share $102.5M (Mid-Scale: $60M)

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.

HYPOTHETICAL BUDGET RUNOUT FOR AST

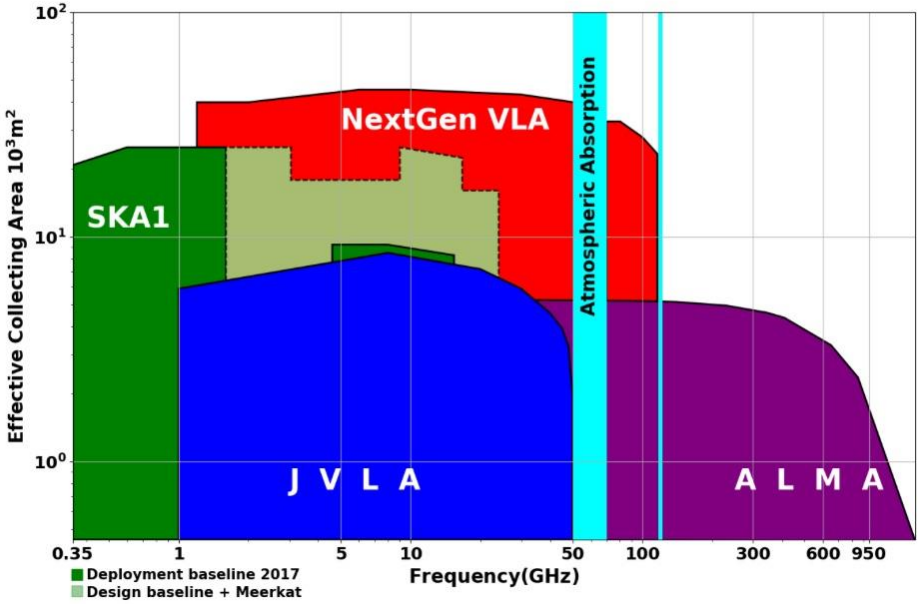


Decadal Survey

- 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.
- That proposal will be reviewed jointly on behalf of NSF/AST and NASA Astrophysics Division.

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
- Discussion and planning at 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.
- Scheduling: Helpful for Astro2020 to finish as soon as possible so that top-ranked have opportunity to compete for early-decade MREFC funding.