AAAC Update

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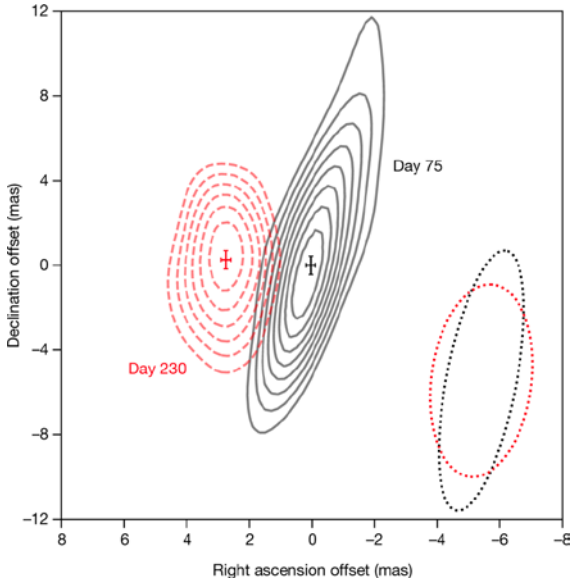
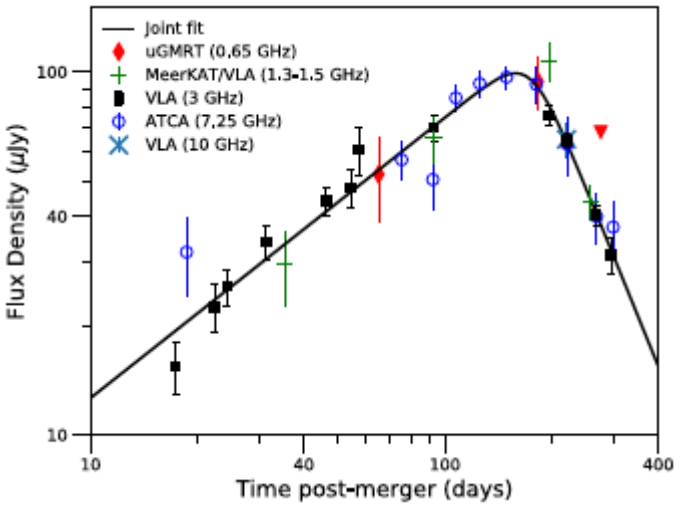
AST Mission: Enable breakthrough science

Jet Breakout from Neutron Star Merger





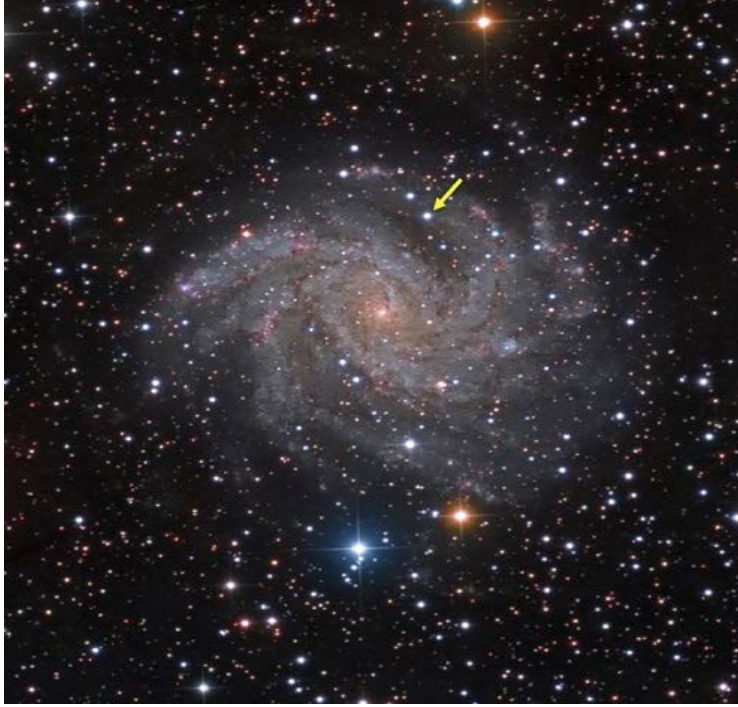
- VLBI observations including GBT showed that the compact radio source showed superluminal motion, consistent with a narrow-angle jet at later times with viewing angle ~20^{o}.
- The sharp inflection in the 0.6-10 GHz light curve suggests initial cocoon-dominated outflow, followed by jet breakout with power-law slope of $t^{-2.2}$.
- Mooley+ 2018, Nature 561, 355; ApJ 868, L11.

DSHARP is ALMA imaging survey of 20 protoplanetary disks with ~0.035” (5 AU) FWHM in 1.25 mm continuum emission.

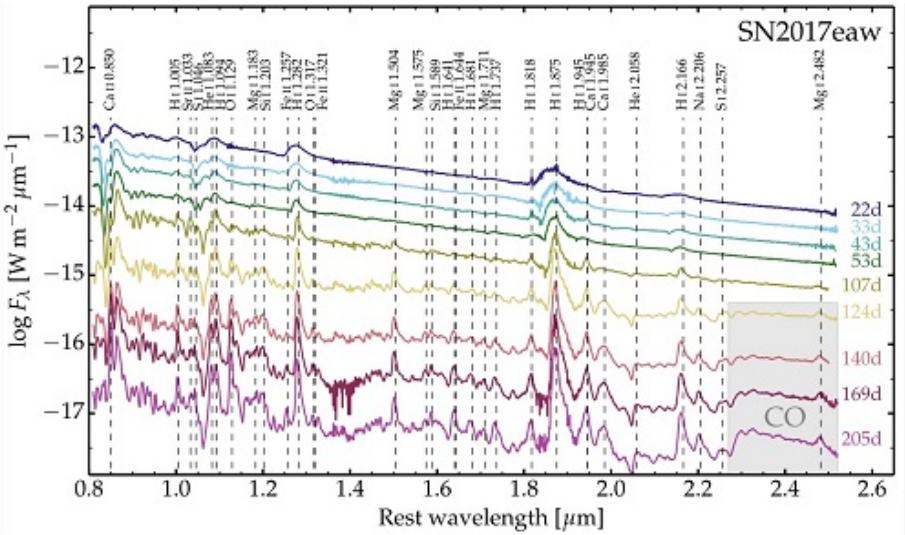
Characterized by concentric narrow emission rings and depleted gaps, sometimes large-scale spiral patterns & small azimuthal asymmetries.

Most compelling interpretation is that gas giants form more quickly than current theory suggests at large distances from host stars.
Disk perturbations observed in dust density allow longer accretion growth time for planetesimals.
Ten papers accepted for publication in ApJ Letters. Data release at https://bulk.cv.nrao.edu/almadata/lp/DSHARP/.

Nearby Core Collapse Supernova Shows Production of CO and Graphitic Dust



SN2017eaw was discovered 5/14/17 in NGC6946, 7 Mpc.
Ten GNIRS spectra were obtained between 22 & 387 days after discovery.
CO and graphitic dust signature clearly detected on Day 124 (and marginally on Day 107).
CO mass consistent with 15 solar mass progenitor, T=1300K
CO effective coolant for dust production – clues about dust in early Universe.



Rho *et al., ApJ Lett,* **864**: L20, 2018

Inter-Agency Cooperation

- Finding: NSF, DOE, and NASA continue to work well together to support the priorities of the astronomy and astrophysics research community, both in collaboration on large managed projects and through coordination of diverse research programs.
- Current examples for NSF-NASA-DOE include
  - Co-sponsorship of the Decadal Survey
  - Joint FACA review panels (e.g. your committee),
- Current examples for NSF-NASA include
  - Formal collaboration on the exoplanet research program with precision radial velocities on the WIYN 3.5m telescope (possible precursor to more comprehensive program recommended by NASEM study)
  - Support of NASA Astrophysics search for techno-signatures
  - Semi-annual joint NSF-NASA astrophysics program officer meetings
  - Joint ground-space observations of astrophysical objects (e.g., neutron star mergers); ground-based time on NSF facilities offered in conjunction with NASA flight mission time allocation.
  - Cooperation on space weather and solar research (Heliophysics Division)
  - Cooperation on Near Earth Object detection and characterization (Arecibo and LSST Observatories) (Planetary Sciences Division)

Inter-Agency Cooperation

- Current examples for NSF-DOE include
  - The Dark Energy Camera survey concluding on the Blanco 4-m Telescope
  - Dark Energy Survey data management support
  - Dark Energy Survey Instrument (DESI) starting commissioning on the Mayall 4-m Telescope
  - LSST, and its dark energy survey science
  - CMB Task Force as AAAC subcommittee
  - Gemini-Blanco-SOAR subcommittee of AAAC

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 that were 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.

AST Division Programs

Individual Investigators
(Lead: James Neff)

- AAG
- CAREER
- AAPF
- ATI
- MRI
- REU
- PAARE

Mid-scale
(Lead: Rich Barvainis)

- MSIP

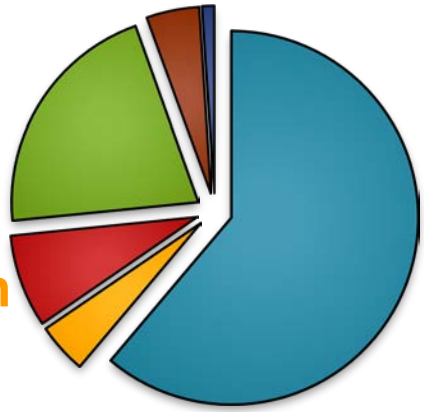
Facilities

- ALMA
- NRAO
- Gemini
- NOAO
- LSST
- Arecibo
- NSO
- GBO

Research

Technology/ Instrumentation

Education and Special Programs



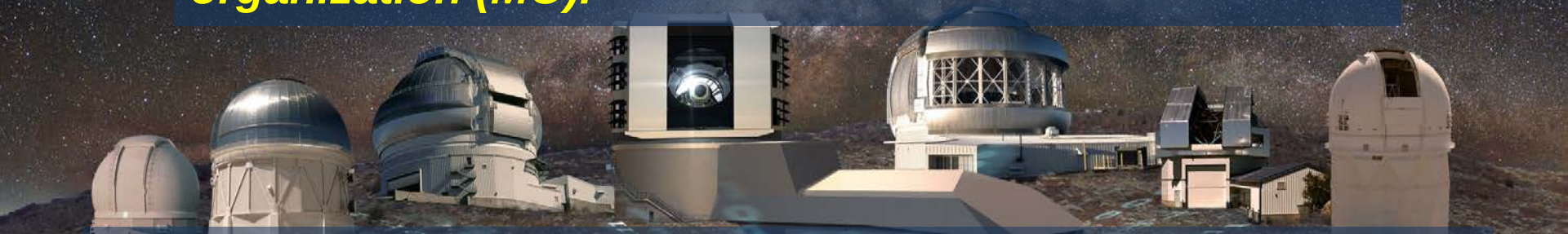
DKIST Telescope Mount, Sept. 2018

- Telescope optics in place and nighttime alignment executed.
- Current challenges largely with instrument completion and delivery.
- Still on schedule and within budget contingency.

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 initiation no later than 1 Oct 2019. Approved by National Science Board to proceed.**
- **LSST operations received initial funding in FY 2019.**

Background is a montage of major facilities under NCOA.

Critical milestones met with AURA submission of several key documents.

FY 2018 Budget

- 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
  - Major upgrade to Gemini N Adaptive Optics system in service of time domain follow-up, stellar populations studies
  - Forward funding DKIST operations for timely completion of data center, supplement for Level 2 data products.
  - Forward funding LSST operations pending NCOA initiation

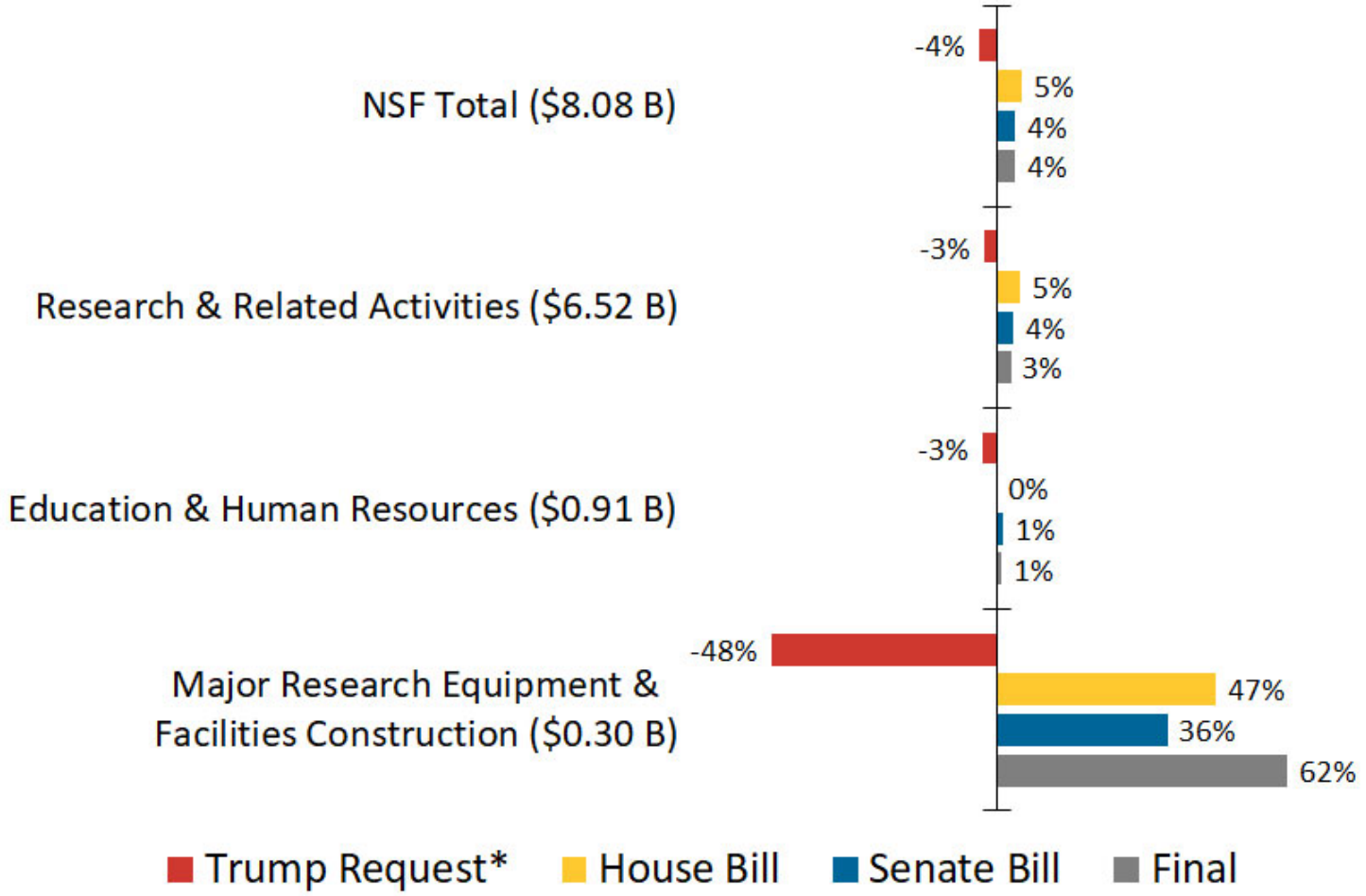
FY 2019 Budget

- Enacted appropriation increases R&RA by 3%.
- MREFC line re-incorporates Antarctic infrastructure; DKIST and LSST at requested levels.
- Directorate and Divisional allocations in process. Will be made pubic with approved Execution Plan.
- NSF's bill was not under consideration for passage before the end of FY 18, so operations after Oct 1 were under a Continuing Resolution until Dec 21st.
- Major 35-day shutdown challenge for AST 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 20 President's Budget Request will be released next month.

FY19 Appropriations: NSF

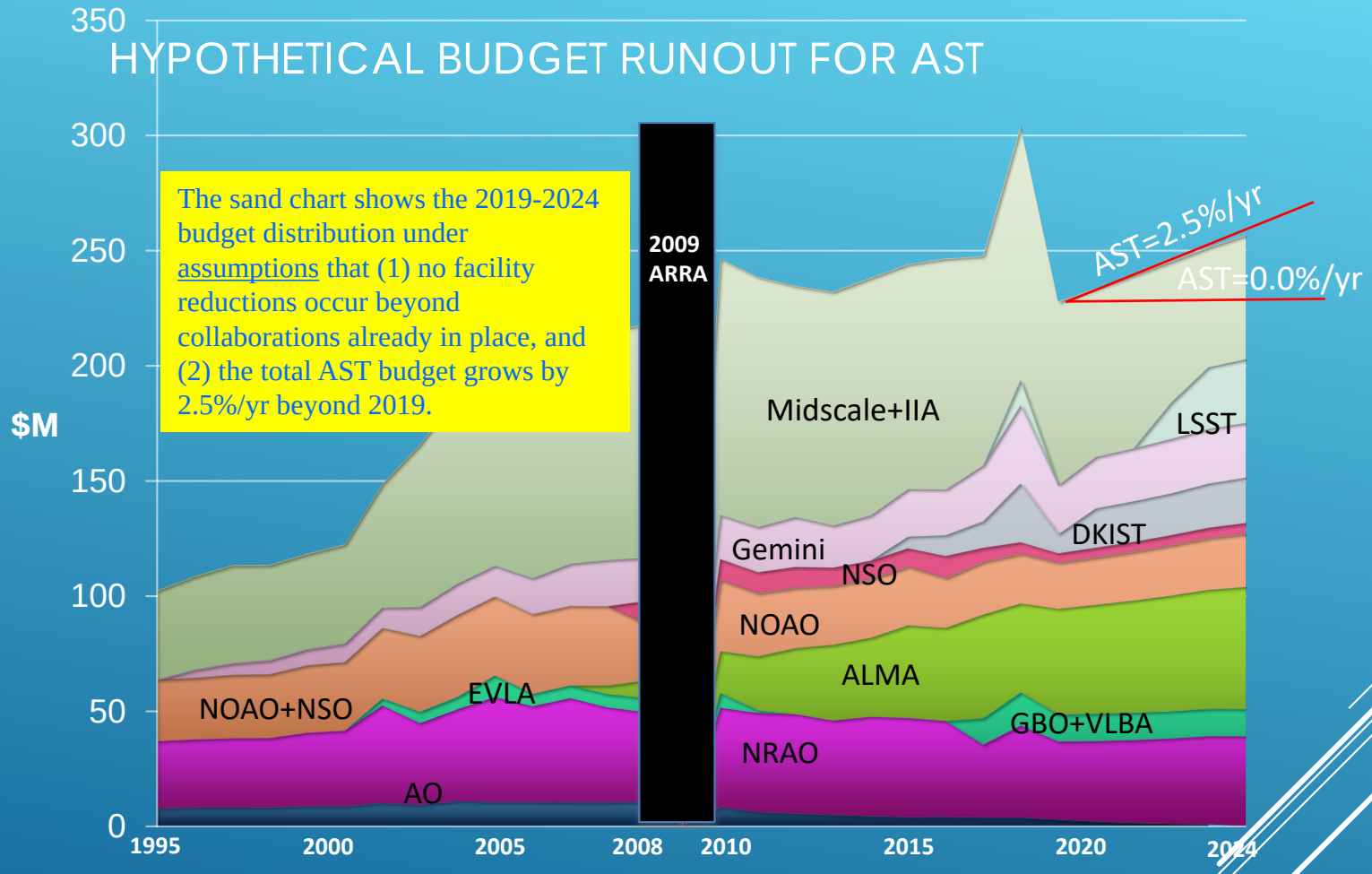
% change from FY18 enacted

$ in ( ) are the FY19 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
$M
350
300
250
200
150
100
50
0
1995
2000
2005
2008
2010
2015
2020
2024
The sand chart shows the 2019-2024 budget distribution under assumptions that (1) no facility reductions occur beyond collaborations already in place, and (2) the total AST budget grows by 2.5%/yr beyond 2019.
2009 ARRA
AST=2.5%/yr
AST=0.0%/yr
Midscale+IIA
LSST
DKIST
Gemini
NSO
NOAO
ALMA
GBO+VLBA
NRAO
NOAO+NSO
EVLA
AO

Divestment Summary

Telescope	Status
KPNO 2.1m	Caltech-led consortium operating for FY 2016-2020.
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; Final Environmental Impact Statement (FEIS) planned for this month; NSB approval pending. MOA in work for new partner; more new partners desired.
LBO/VLBA	Separation from NRAO in FY 2017; 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, along with Yang Ent. and UMET, with plans for increasing share; hurricane recovery funding being deployed.
SOAR	Post-2020 status to be reviewed.

NSF's 10 "Big Ideas" for Future Investment

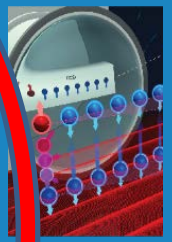
RESEARCH IDEAS

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. Intended to be funded at this level for several years.
- 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. (Pie chart showed ~1/4 for grants, sand chart showed typical level of ~$240M, so 8% of $60M is ~$5M. If astronomers get even ¼ of the Windows funding, total grants $ go up.)

New Solicitations / Dear Colleague Letters

- Windows Dear Colleague Letter specifies using your current favored solicitation (AAG), to be labeled by PI or Program Officer as referring to sources or potential sources of at least 2 messengers.
- HDR solicitation 19-543 describes one or more Ideas Lab(s) on Data-Intensive Research in Science and Engineering (DIRSE) as part of the HDR Institutes activity.
  - The first opportunity in FY 2019 will encourage individuals with compelling data-intensive science and engineering problems and/or technical expertise to self-organize into teams with the aim of developing innovative, collaborative research proposals through an Ideas Lab process.
  - The second opportunity in FY 2019 will encourage applications from teams of researchers proposing frameworks for integrated sets of science and engineering problems and data science solutions.
  - NSF anticipates implementing the subsequent convergence and co-design phase in the 2021 timeframe for HDR Institutes.

New Solicitations / Dear Colleague Letters

- Mid-scale Research Infrastructure-1 (19-537)
  - Design and Implementation projects may comprise any combination of equipment, infrastructure, computational hardware and software, and necessary commissioning.
  - Mid-scale RI-1 "Implementation" projects may have a total project cost ranging from $6 million up to below $20 million.
  - Only Mid-scale RI-1 "Design" projects may request less than $6 million, with a minimum request of $600,000 and a maximum request below $20 million as needed to prepare for a future mid-scale or larger infrastructure implementation project. (Successful award of a Mid-scale RI-1 design project does not imply NSF commitment to future implementation of that project.)
  - Pre-proposals were due February 19th.
- Divisions have the option to (co-)fund highly ranked MSRI proposals that don't win Foundation-level funding.
- AST will still offer MSIP in alternate years.

New Solicitations / Dear Colleague Letters

- Mid-scale Research Infrastructure-2 (19-542)
  - The Mid-scale RI-2 program supports implementation of projects in high states of readiness, i.e., those that have already matured through previous developmental investments. They may comprise any combination of equipment, instrumentation, computational hardware and software, and the necessary commissioning and human capital in support of implementation.
  - Mid-scale RI-2 does not support pre-implementation (early-stage design or development) or post-implementation research, operations or maintenance, the anticipated source(s) of which are expected to be discussed in the proposal.
  - The total cost for Mid-scale RI-2 projects ranges from $20 million to below the minimum award funded by the Major Research Equipment and Facilities Construction (MREFC) Program, currently $70 M.
  - Letters of Intent were due February 8th; Pre-proposals due March 11th.

AAAC Subcommittee on Gemini, Blanco, & SOAR

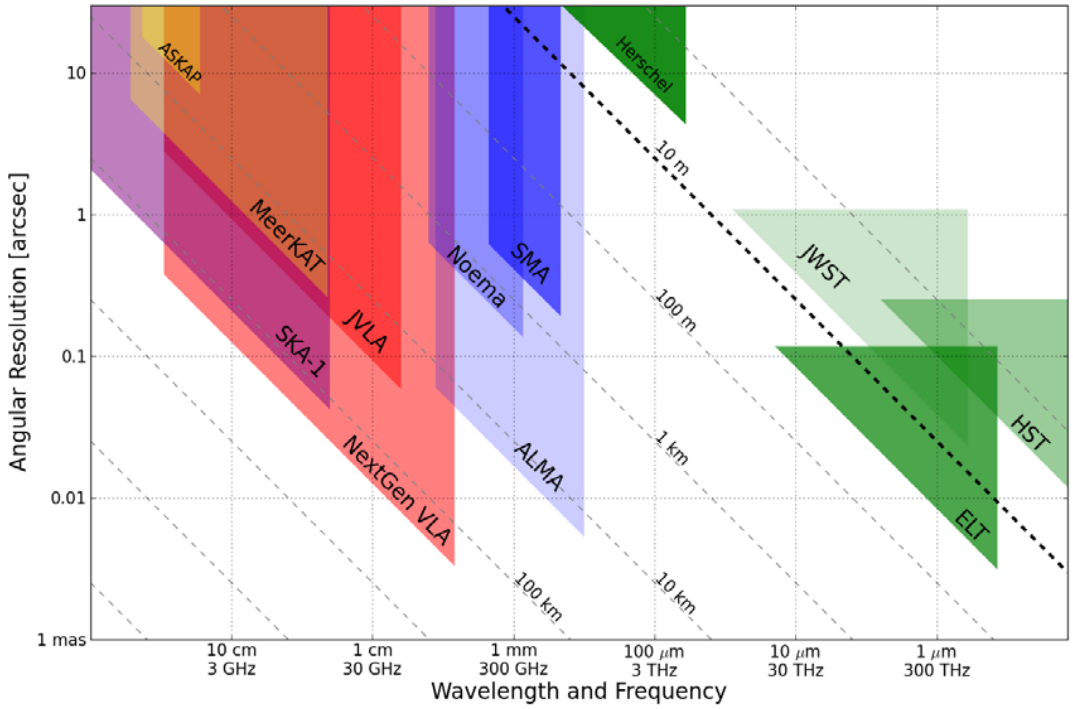
- The Gemini international agreement is up for renewal in 2021; assessment point next year and current partners announced intentions at the Board meeting in Nov.
- SOAR international agreement up in 2020.
- AST and DOE jointly requested AAAC to form an ad hoc subcommittee to evaluate the scientific utility and US community priorities for the telescopes for the next five or so years, as motivation for agency decisions prior to Decadal Survey release.
- Chair is Klaus Honscheid (OSU); the panel is examining a wide range of topics from precision cosmology through time domain/multi-messenger and exoplanets.
- Preliminary briefing to AAAC in early November; final report presented at this meeting.

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.
- NSF is including all ground-based astrophysics (i.e., gravitational wave detection and astro-particle detection) for scientific consideration, not limited to AST.
- AST is supporting development of three major projects, two through activities in national centers, and one through a continuing series of grants. OPP/PHY support a fourth.
- AST does not explicitly support preparation of mid-scale proposals for Decadal submission; these are community-initiated, so the scope and breadth of topics are known only informally to AST.

AST Decadal Survey Preparations

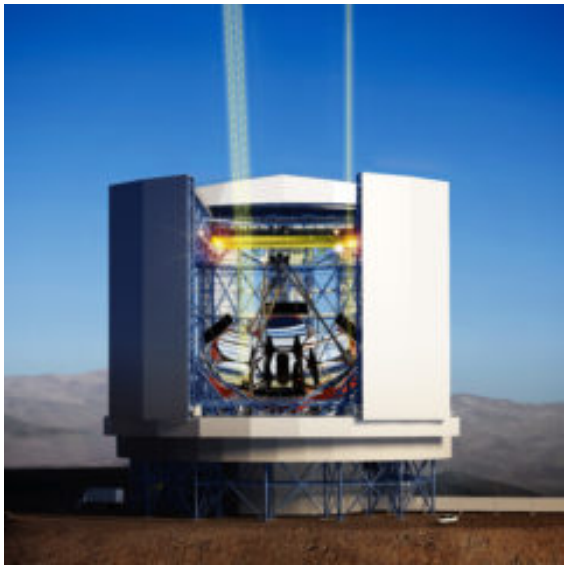
- NRAO held a series of three Kavli-sponsored workshops and one AUI-sponsored to identify and prioritize the key scientific problems the RMS community would address in the coming decade.
- Many of the scientific goals can be achieved with a concept called Next Generation VLA, including
  - Unveiling 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, and science book is linked as ASP Conference 517, with 850+ pages and 285 authors.

AST Decadal Survey Preparations

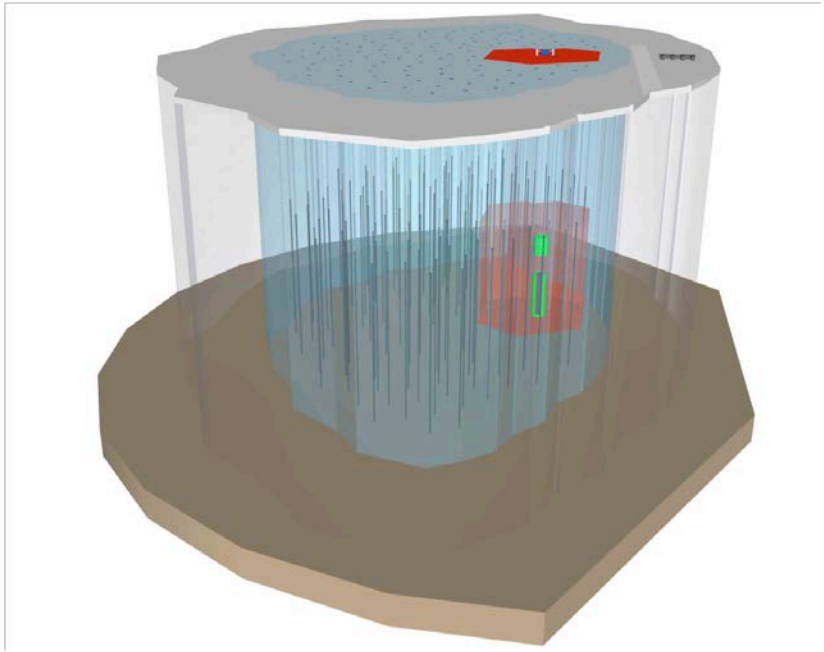
- NOAO is coordinating with the TMT and GMT projects to develop a community science case requiring time on both telescopes through the new US ELT Program. AURA seeking Dave Silva replacement.
- The approach will be based on key science programs, requiring substantial allocations of time.
- Over 200 community scientists working on defining the case.
- The projects have met with NSF to understand the conditions and reviews required by the law under the AICA for awards.
- 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 10/23/17.
- Prioritized for DOE support in P5 report.

IceCube-Gen2



- Purpose is in-depth exploration of neutrino Universe in the PeV to EeV range with hundreds of detections above 100 TeV.
- Double the current spacing of photometer strings detecting Cherenkov flashes from 125 to 250 meters and doubling the deployed instrumentation will extend volume to ten cubic kilometers.

- Precision IceCube Next Generation Upgrade (PINGU) denser subarray (shown in green) targets precision measurements of the atmospheric oscillation parameters and the determination of the neutrino mass hierarchy as well as the search for dark matter.
- Proposed surface radio array will detect air showers to allow for vetoing to enhance sensitivity.
- Development supported by OPP and PHY, but part of Decadal considerations for NSF astrophysics.

NSB Report to Congress on Operations Costs

- Linked to NSB website: https://www.nsf.gov/nsb/publications/2018/NSB-2018-17-Operations-and-Maintenance-Report-to-Congress.pdf
- Finds that O&M costs for large facilities developed under MREFC can exceed the 'host' Division's capacity to absorb them fully, in analogy to the original reasons to establish the MREFC line for construction in the first place.
- Recommends Foundation-level ownership of the facilities portfolio with strategic ability to manage support.
- Foundation-level allocation of O&M funds could be possible as supplement to Division-level funding for initial cost sharing (5-10 years max at <50%).
- Foundation-level O&M funding could be used to smooth the transition from construction to operations.
- It could also be used when a Division needed to divest but the Foundation had strategic interest in continuation.

NSF Anticipated Outcomes for this Meeting

- Discussion and acceptance of Gemini-Blanco-SOAR subcommittee report.
- Shared thoughts on Agency framing for Decadal Survey advice on major projects spanning ground-based astrophysics.
- Advice on the Agency budget envelope trends that would be required for MREFC accommodation of one or more possible next generation projects.
- Planning for production of the annual report.