NSF Division of Astronomical Sciences (AST) Department Chairs Meeting

November 5, 2016

Jim Ulvestad, Division Director

Ralph Gaume, Acting Deputy Division Director

MPS/AST

High-Level Summary

- Outstanding science opportunities offered/developed
  - ALMA, EVLA, Dark Energy Camera, GPI, DKIST, LSST
  - AAG has been stable, with funding rate inching back above 20%
  - NN-EXPLORE with NASA; telescopes/instruments with DOE
  - NSF requested ~$87M for AST facility construction in FY 2017
  - Second round of MSIP awards made
- Partnerships with NASA and DOE have strengthened
- New collaborations with DoD (LBO) and NOAA (GONG)
- Potential impact of LIGO detection
- Mid-decadal review and Kavli Futures Symposium reports released
- Unknown prospects for budget increases this decade
  - Next 1.5 yr are critical for divestment activities
- Continued progress at the science frontiers

Outline

- AST and NSF Background (Jim/Ralph)
- Science and Facility Highlights (Ralph)
- Individual Investigator Programs (Ralph)
- Budget Outlook, Divestment, and Environmental Reviews (Jim)
- Recent Community Reports (Jim)

AST and NSF Background

AST Leadership

- NSF has opened search for a new Division Director, to replace current Division Director in autumn 2017
- Recruitment committee in place to help identify candidates
  - Roger Blandford, Joel Bregman, Debra Elmegreen, Lyman Page, Caty Pilachowski.
- See Dear Colleague Letters and the detailed job posting under Announcements at www.nsf.gov/ast
- Deputy Division Director
  - Pat Knezek moved to a Senior Advisor role in MPS.
  - Dave Boboltz was Acting Deputy February-June 2016.
  - Ralph Gaume is current Acting Deputy, and will start as Deputy Division Director on November 13.

Division of Astronomical Sciences (AST)

Office of the Division Director

James Ulvestad
Division Director

Ralph Gaume
Deputy Division Director (Acting)

Craig McClure
Program Support Manager

Donna O'Malley
Financial & Operations Specialist

Vernon Pankonin
Senior Advisor

Elizabeth Pentecost
Project Administrator

Administration

Allison Farrow
Program Specialist

Stephanie Hill
Program Assistant (Student)

Diana Phan
Program Analyst

Matthew Viau
Program Specialist

Individual Investigator Programs and Astronomy & Astrophysics Research Grants

James Neff
Program Director
IIP Coordinator; Education & Special Programs (REU, PAARE)

Richard Barvainis
Program Director
Extragalactic Astronomy & Cosmology

Glen Langston
Program Director
Galactic Astronomy

Harshal Gupta
Program Director
Astronomy & Astrophysics Postdoctoral Fellowships

Joan Wrobel
Program Director
CAREER; Extragalactic Astronomy & Cosmology

Faith Vilas
Program Director
Solar and Planetary Research Grants

Joe Pesce
Program Director
Extragalactic Astronomy & Cosmology, Divestment

Hans Krimm
Program Director
Stellar Astronomy & Astrophysics

Peter Kurczynski
Program Director
Advanced Technologies & Instrumentation, Major Research Instrumentation

Linda French
(January 2017)

Facilities, Mid-Scale, & MREFC Projects

Christopher Davis
Program Director
Gemini Observatory

Philip Puxley
Program Director
National Radio Astronomy Observatory

David Boboltz
Program Director
National Solar Observatory

Nigel Sharp
Program Director
Large Synoptic Survey Telescope

Edward Ajhar
Program Director
Green Bank Observatory, Long Baseline Observatory

Vernon Pankonin
National Optical Astronomy Observatory

Ralph Gaume
Arecibo Observatory

Richard Barvainis
Mid-Scale Innovations Program

Philip Puxley
Atacama Large Millimeter Array

ESM

Thomas Wilson
Program Director

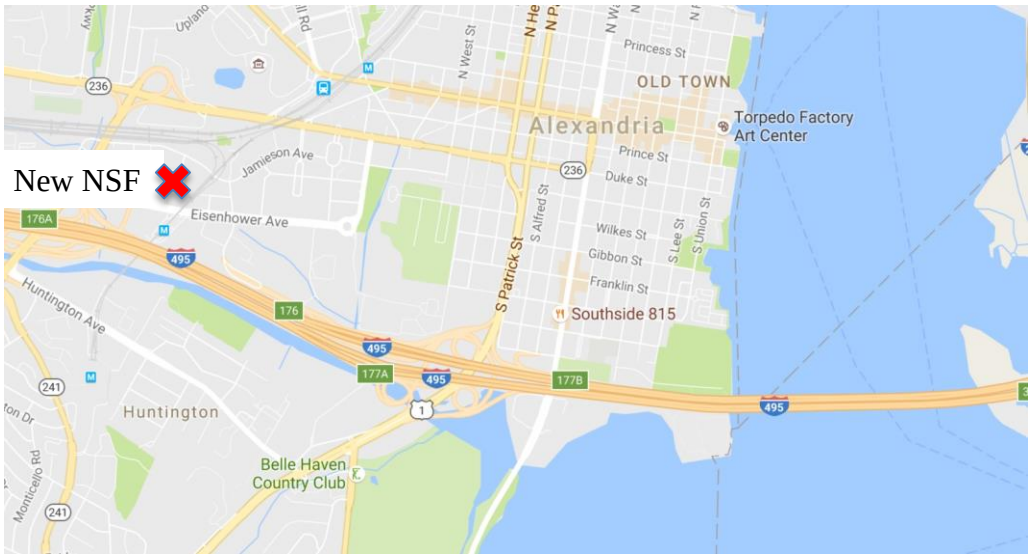
Joe Pesce
Program Director

AST Program Officers

- For the first time in several years, AST will have a full complement of four Intergovernmental Personnel Act (IPA) rotators as of January 2017.
- It is essential that we keep an ongoing flow of IPAs to AST in order to (1) keep fresh ideas and perspectives from the community flowing into NSF, and (2) help achieve the work of conducting merit review of proposals.
- Help from Department Chairs is needed to keep the rotator contingent healthy.

NSF is Moving!

- NSF will move from its current location in Arlington, Virginia to a location in Alexandria, Virginia in July-September 2017.
- The Directorate for Mathematical and Physical Sciences, including AST, is scheduled to move over an extended Labor Day weekend in August/September.



NSF and the Incoming Administration

- Federal government is currently working on a Continuing Resolution for FY 2017 through December 9, 2016.
  - Appropriation path post-November 8 is uncertain.
- Anticipate FY 2018 President's Budget Request will be submitted to Congress in approximately April 2017.
- NSF Director has been discussing 10 "Big Ideas" as potential areas for future NSF investment; "Windows on the Universe" and "Mid-Scale Research" are of high interest to AST.
  - Await future budget requests and appropriations to see if any of these ideas can be pursued.

Some Science and Facility Highlights

LIGO Detection—Congratulations to Team!

The merger of two black holes and the birth of a new one.

<u>Event GW150914</u>

Original black holes:

29 and 36 solar masses ($M_\odot$).

Final black hole:

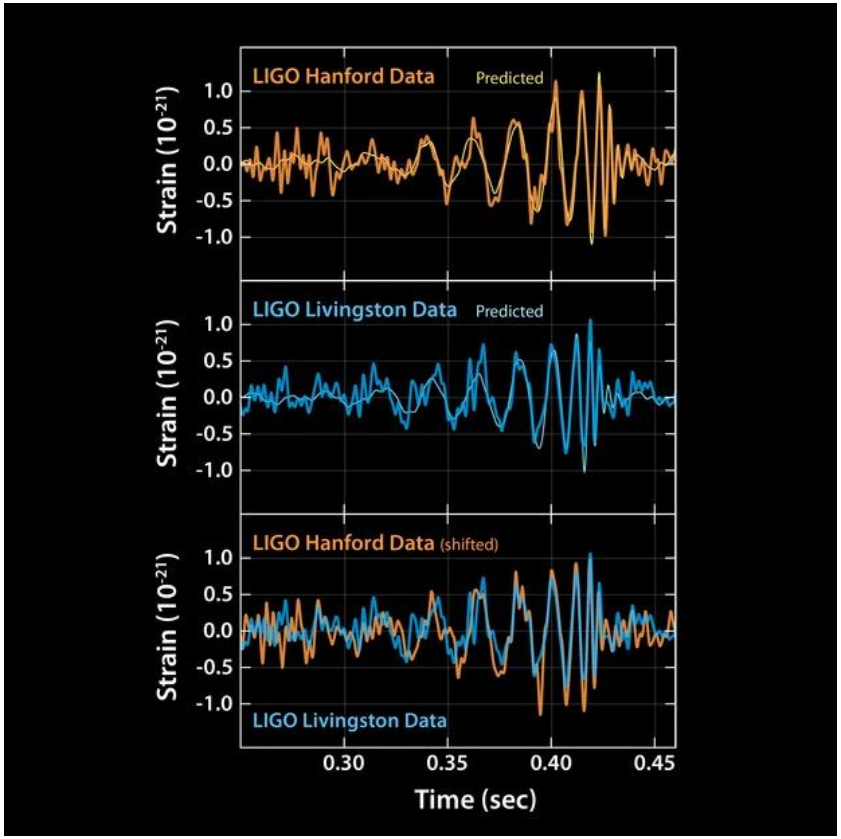
62 $M_\odot$ with dimensionless spin 0.67

Energy emitted: 3 $M_\odot$

Power emitted: 200 $M_\odot$ /s

(140 billion trillion times that of the Sun)

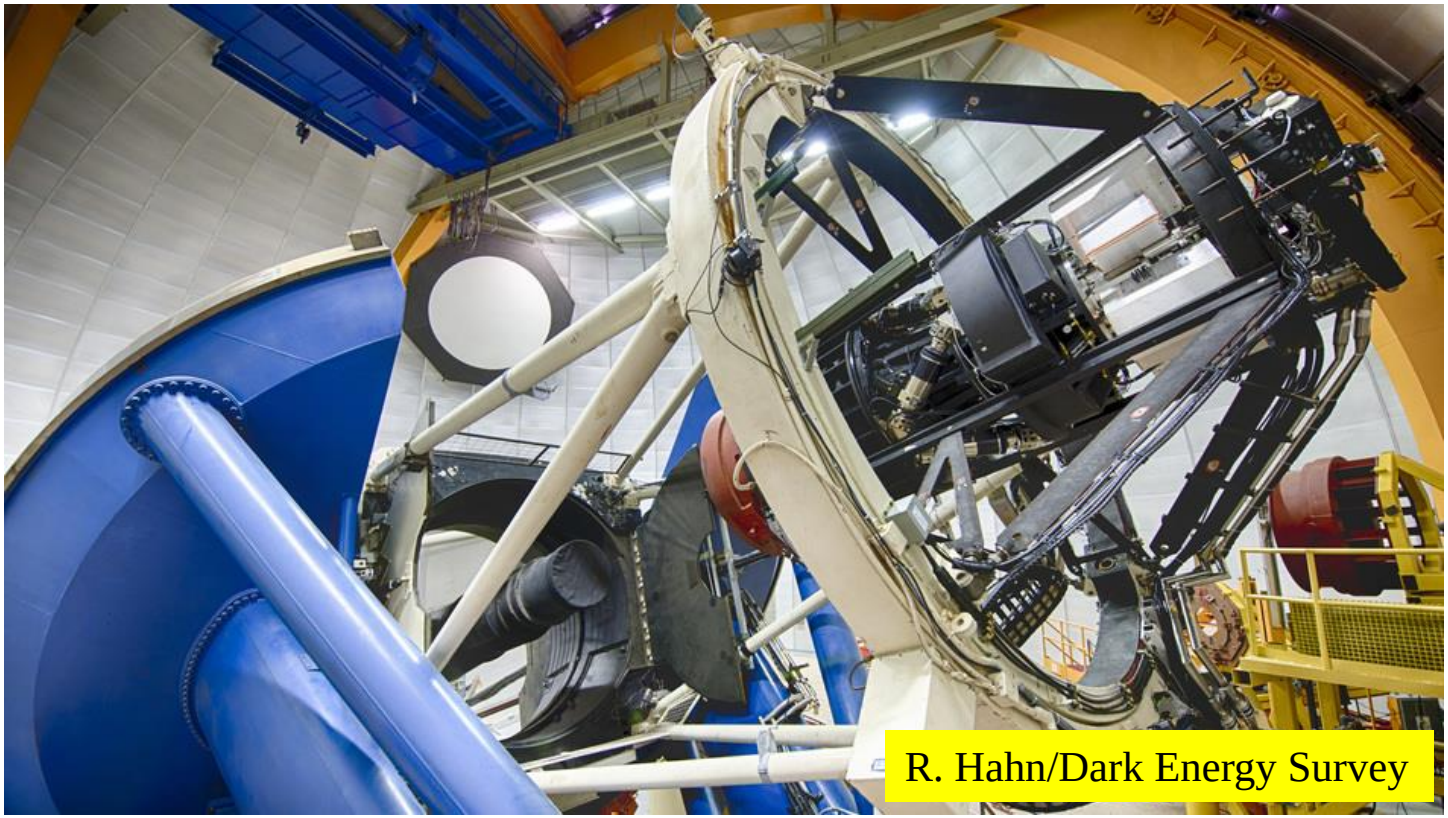
Most powerful explosion recorded not including the Big Bang!



In band signal: 0.2 s from 35 – 250Hz

Peak strain 1×10^{-21} , S/N ~ 24

Blanco Telescope: Dark Energy Camera



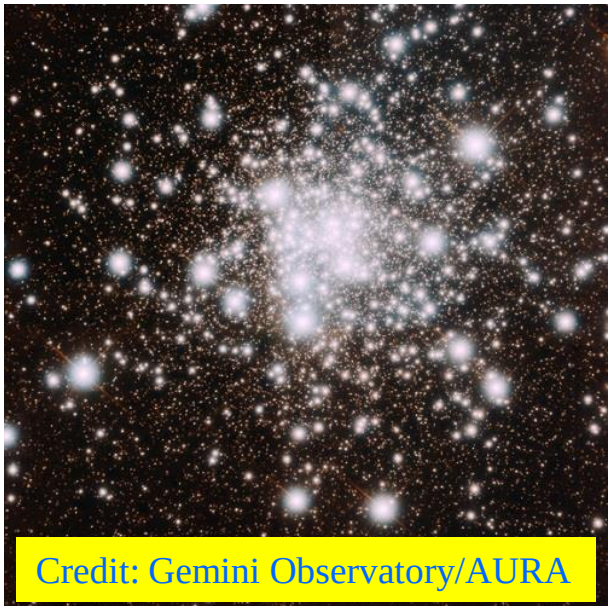
- Dwarf planet 2014 UZ224 discovered in survey image (500 km diameter, at 90 AU from Sun) (Gerdes et al., U. Michigan).
- Comet P/2015 PD229 (Jupiter family of comets) (Cameron et al., U. Rochester).

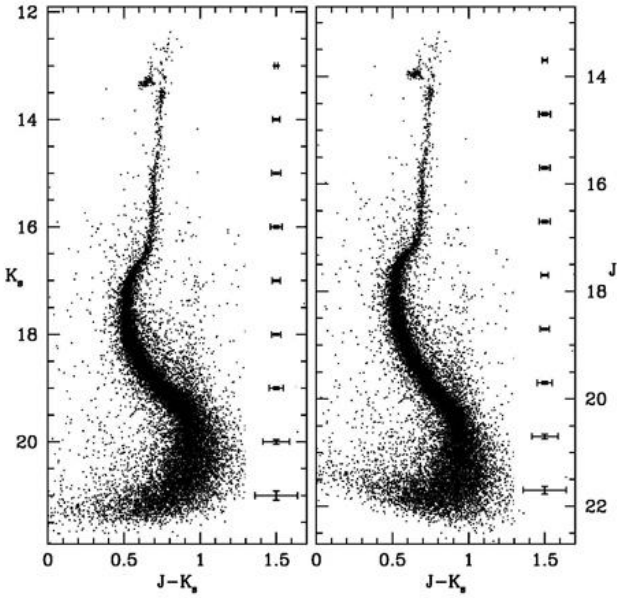
Snow Line in V883 Orionis

- V883 Ori imaged by ALMA in outburst, at 12 AU resolution.
- Abrupt optical depth change at 42 AU attributed to condensation of water at the water-snow line. (Cieza et al., 2016, Nature 535, 258).

NGC 6624

- Bulge globular cluster NGC 6624 imaged in near-IR with Gemini Multi-Conjugate Adaptive Optics (MCAO) system, giving 0.08-arcsec imaging over 93-arcsec field.
- Detected main-sequence "knee," found age of 12.0 +/- 0.5 Gyr, and detected mass segregation, with increased fraction of low-mass stars with increasing distance from core.
- Saracino et al. 2016 (arXiv:1609.02152).

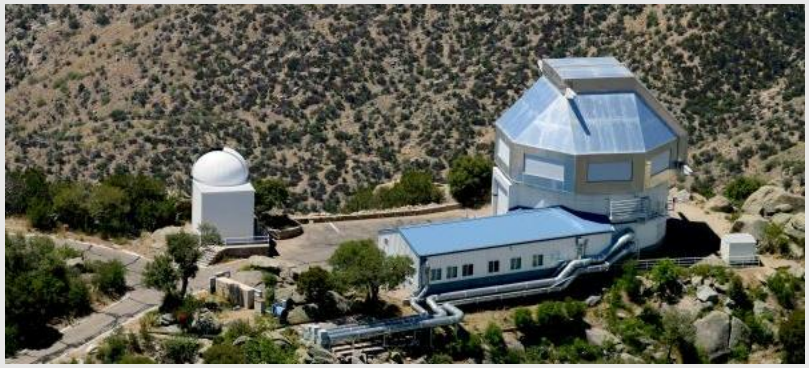




NN·EXPLORE

Partnership for Exoplanet Discovery and Characterization

NN-EXPLORE is a joint NASA / NSF program for exoplanet science

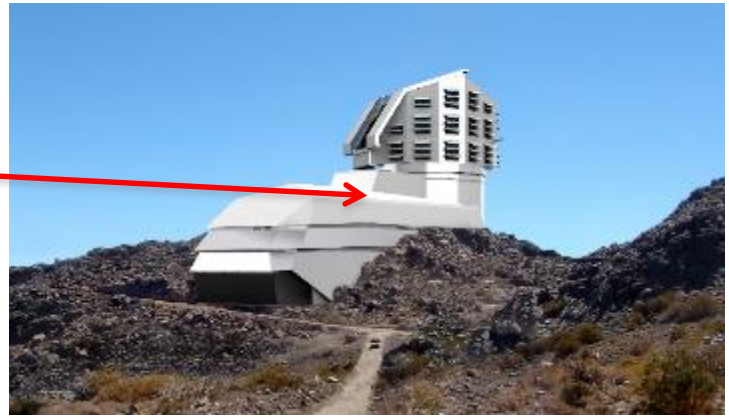
Stage 1: 2015 - 2018	Stage 2: 2018 - TBD
• Exoplanet – targeted GO program with existing instrumentation using NOAO share (~50%) of WIYN 3.5m time • NASA has solicited a facility-class Extreme Precision Doppler Spectrometer (EPDS) for the WIYN telescope. Commissioning in 2018/2019 • Instrument design selected: NEID (NN-Explore Investigations with Doppler Spectroscopy), S. Mahadevan, P.I. (Penn State University)	• Exoplanet-targeted GO and guaranteed time program at WIYN with NEID • Data management system to serve NEID data products (in coordination with NExScI) • Community access to NEID instrument for observations that support NASA missions 

Daniel K. Inouye Solar Telescope (DKIST)

- DKIST will be a 4.2-meter solar telescope to study the Sun at the fundamental 20-km scale of the solar magnetic structures.
- Completion in FY 2020 at Haleakala Observatory (Maui).
- Final appeal of permit recently turned down by Hawaii Supreme Court.
- Top: Current view of DKIST enclosure.
- Bottom: Base ring of Telescope Mount Assembly inside the DKIST enclosure.

Large Synoptic Survey Telescope

- Construction progressing, late 2022 start date for 10-yr survey.
- Updated study of NEO detection capabilities in progress.



M1M3 (primary/tertiary) actuator assembly components

Electromagnetic Spectrum Management

- NSF works with other federal agencies to protect the radio spectrum for scientific users.
- Scientific and commercial landscape is rapidly changing.
  - Passive and active remote sensing, operational communication needs, unmanned aerial vehicles, smallsats, Space-based Internet.
- Multi-directorate group is considering NSF spectrum management strategy for the future.

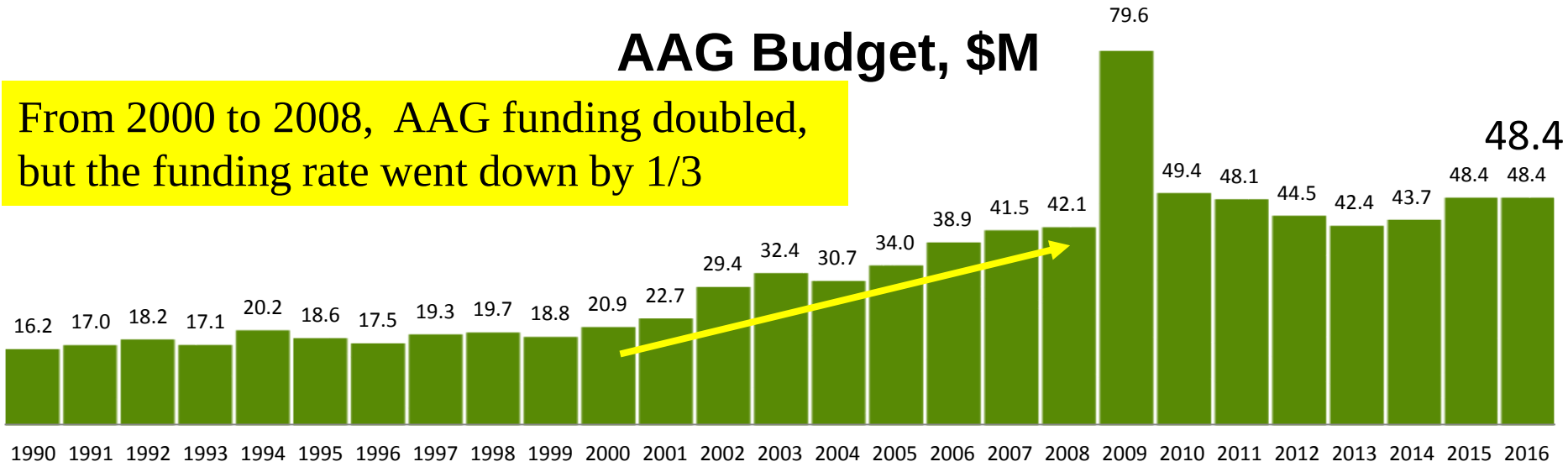
National Science and Technology Council

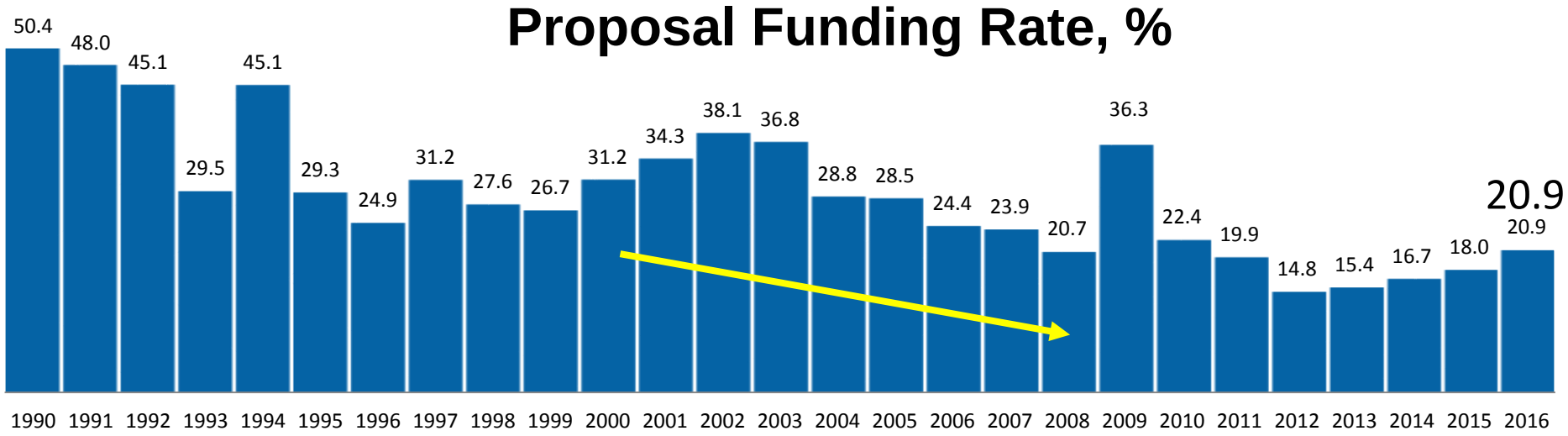
- National Space Weather Strategy (NSWS) and Space Weather Action Plan (SWAP) released in 2015.
  - White House Executive Order on space weather released on October 13.
- Interagency working group, DAMIEN (Detecting And Mitigating the Impact of Earth-bound Near Earth Objects) is working on a strategy akin to the NSWS.

Individual Investigator Programs

AAG Funding History, 1990-2016

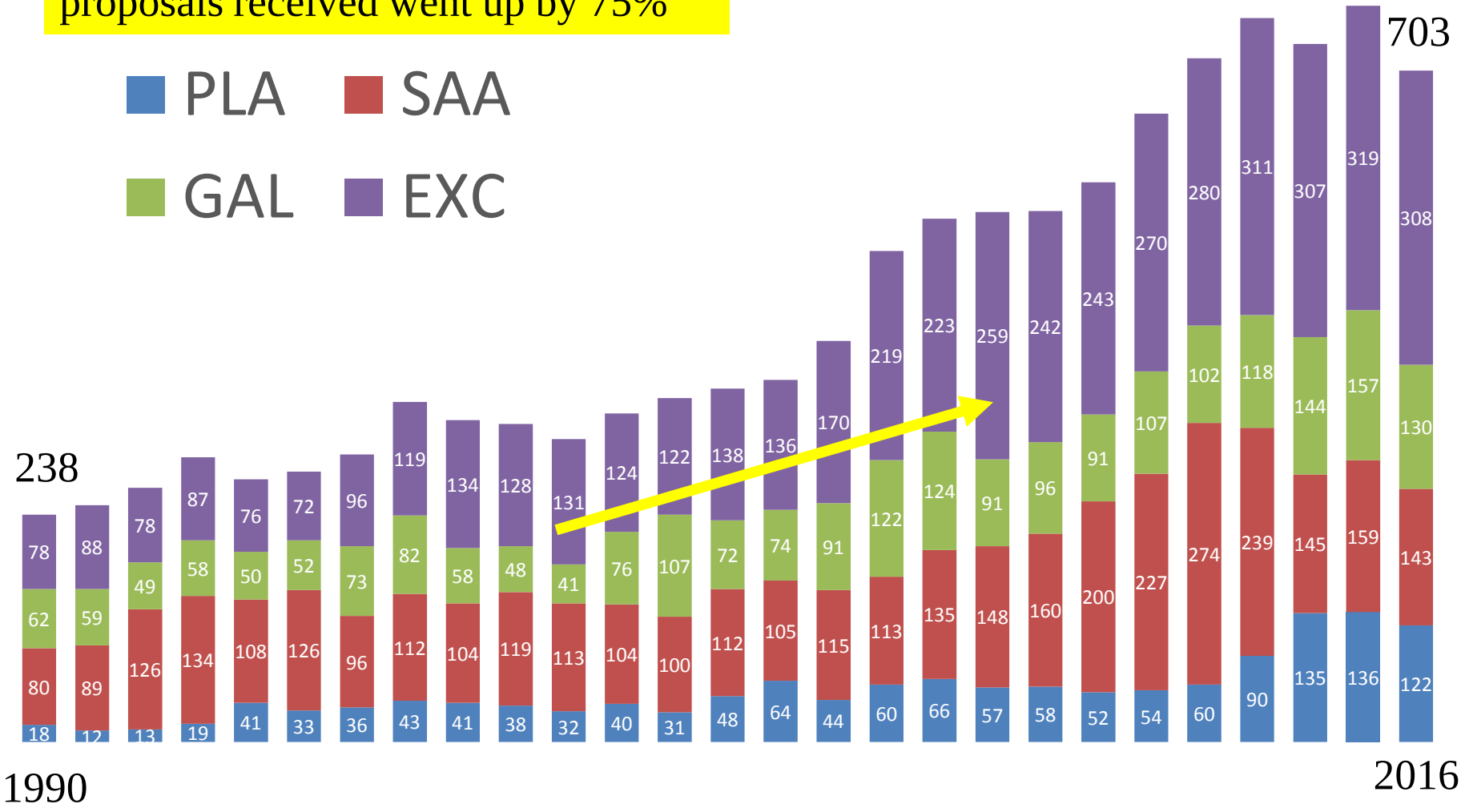
From 2000 to 2008, AAG funding doubled, but the funding rate went down by 1/3





Proposals in AAG, 1990-2016

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



Changes in AST AAG Program for FY 2017

- For FY 2017, AST will run a pilot program with NO PROPOSAL DEADLINE for the Planetary/Exoplanetary and Solar portions of the Astronomy and Astrophysics Research Grants (AAG) program.
  - Purposes: Understand and resolve issues with proposal handling and merit review; alleviate impact of life events for proposers; investigate impact on proposal load over the year; enable proposal file updates for minor errors.
  - Solicitation NSF 16-602: Solar and Planetary Research Grants (SPG).
  - Declined proposals may not be resubmitted for 12 months.
- The rest of AAG will run as before, with a November 15, 2016 proposal deadline (Solicitation 16-574).
- Budget breakdowns between AAG and SPG will remain similar to FY 2016.

Other Individual Investigator News

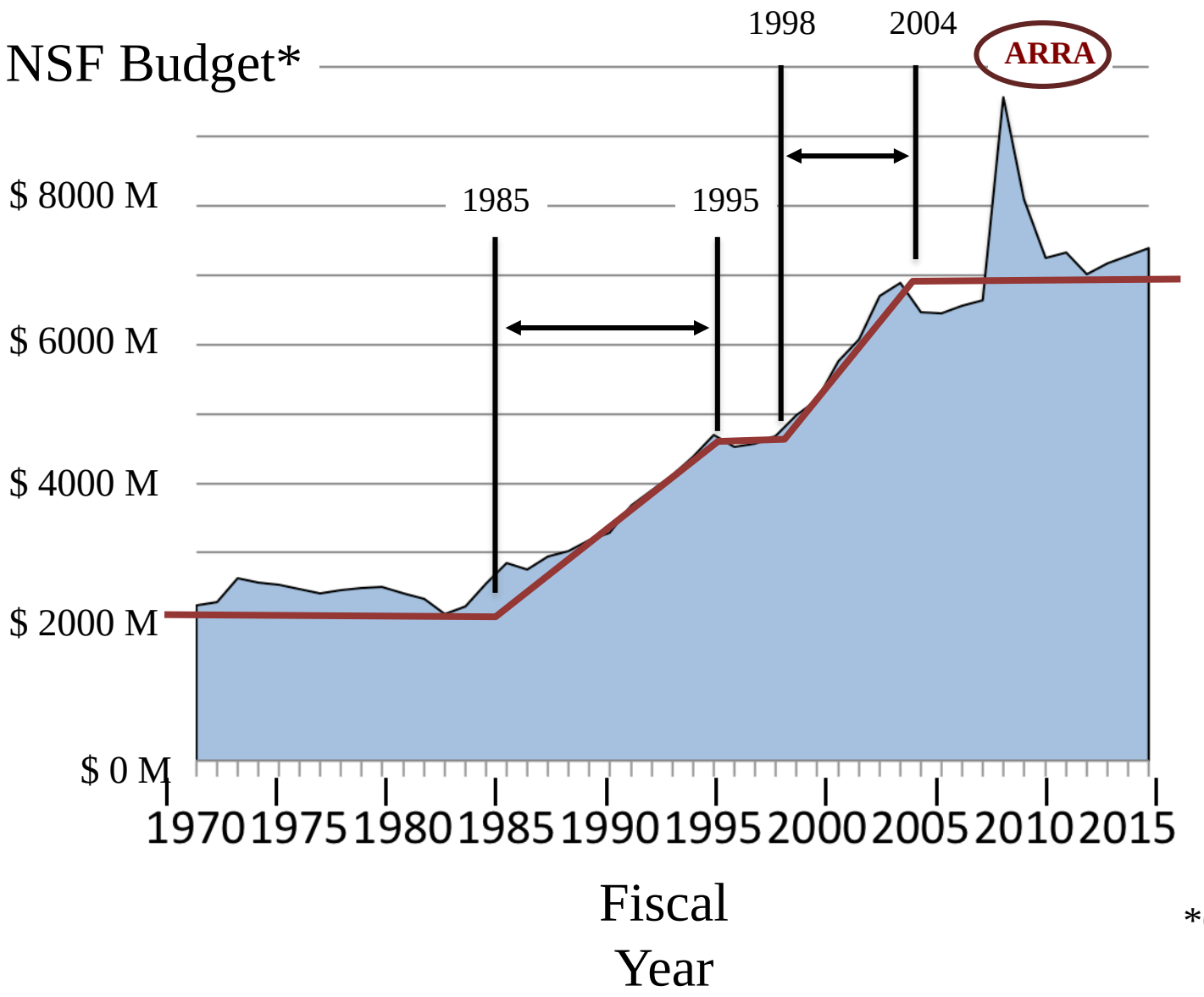
- CAREER, AAPF, and REU programs have remained fairly stable in funding for a number of years
- Advanced Technologies and Instrumentation (ATI) has been reduced somewhat over the past several years.
  - AST plans an internal analysis of the Mid-Scale Innovations Program (MSIP), ATI, and the AST portion of the NSF-wide Major Research Instrumentation program to ensure that these have clear and distinct goals.
- Partnerships in Astronomy and Astrophysics Research and Education (PAARE) is currently running every other year.
  - AST hopes to conduct an analysis of this program to see whether it should be continued in its current form.

MSIP Round 1&2 Awards

Awarded Proposal	PI	Total NSF Funds	Yr Funded
Zwicky Transient Facility	Kulkarni	$9.0M	FY 2014
Advanced ACTPol	Staggs	$10.0M	FY 2014
H Epoch of Reionization Array	Parsons	$2.1M	FY 2014
Event Horizon Telescope	Doeleman	$6.5M	FY 2015
POLARBEAR	Lee	$5.0M	FY 2015
NANOGrav Phys Frontier Ctr	Siemens	$14.5M (AST 20%)	FY 2015
CARMA closeout	Carlstrom	$2.0M	FY 2014
CLASS-CMB, Large Ang. Scale	Bennett	$4.4M	FY 2016
TolTEC, mm camera on LMT	Wilson	$6.1M	FY 2016/17
HERA	Parsons	$9.5M	FY 2016/17
SuMIRE (Subaru galaxy surv.)	Strauss	$5.5M	FY 2016
CHARA (open access)	ten Brummelaar	$3.9M	FY 2016
Las Cumbres (open access)	Boroson	$3.0M	FY 2016/17

Budget Outlook, Divestment, and Environmental Reviews

NSF Funding History



*Constant 2014$

FY 2017 NSF Request by Account ($M)

	FY 2016 Estimate	FY 2017 Discretionary		FY 2017 Mandatory	House Approp.	Sen. Approp
Research & Related Activities	$ 6034	$ 6079	0.8%	$ 346	$ 6079	$ 6034
Education & Human Resources	880	899	2.1%	54	880	880
Major Res Equip & Facilities Const.	200	193	-3.6%		87	247
Agency Ops & Award Mgmt.	330	373	13%		340	330
National Science Board	4	4			4	4
Inspector General	15	15			15	15
Total NSF	**$ 7463**	**$ 7564**	**1.3%**	**$ 400**	**$ 7405**	**7510**

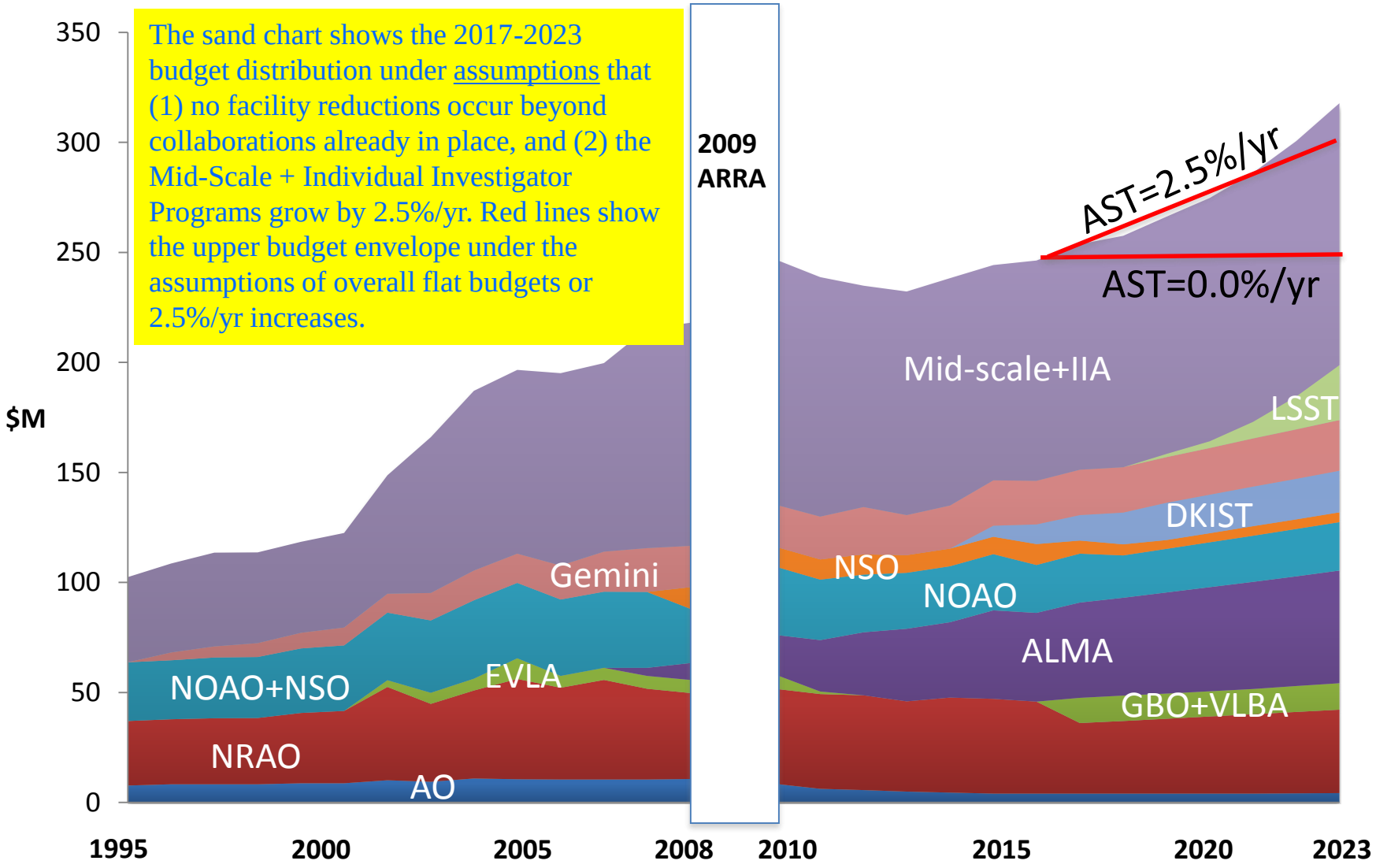
FY 2017 Budget Request--AST

$M	FY15 Actual	FY16 Request	FY16 Estimate	FY17 Request Disc.
NSF Total	7344	7724	7464	7564
NSF R&RA	5934	6186	6034	6079
MPS	1337	1366	1349	1355
AST	245.2	246.5	246.7	247.7
MREFC	200.8	200.3	200.3	193.1

Decadal Survey and Portfolio Review

- AST relies on National Academy of Sciences decadal surveys in setting long-term priorities for ground-based astronomy program.
  - *New Worlds, New Horizons in Astronomy and Astrophysics (NWNH)* assumed substantial NSF budget increases.
  - *NWNH* recommended carrying out a Senior Review before mid-decade to free up funds for new initiatives and scientific exploitation of existing and new capabilities.
- Portfolio Review Committee was commissioned to recommend program that could best address the *NWNH* and *Visions and Voyages* science questions.
  - Committee report was delivered in August 2012.
  - Recommended a balance of small, medium, and large programs that would require divestment of numerous operating facilities from AST budget.

Hypothetical Budget Runouts for AST



2016 AAAC and Mid-Decadal Recommendations

- *March 2016 AAAC Recommendations*
  - Urged full programmatic funding from Congress
  - Recommended "strong efforts by NSF for facility divestment"

- *August 2016 NAS Mid-Decadal Review Recommendations*
  - Recommendation 3-1: Proceed with divestment
  - Recommendation 3-2 (to larger NSF): Preserve ability to exploit capital investments in facilities by relieving tension between facility operations costs and programmatic balance

What Does “Divestment” Mean?

- The recommendations of the Portfolio Review Committee solely referred to removal of the funding of telescopes from the NSF/AST budget.
- Telescopes recommended for divestment are still important, and in some cases unique assets for astronomical research or other related uses.
- Hence the preferred divestment alternative, pursued vigorously by NSF since 2012, has been to find funding collaborations that enable some continued availability of NSF telescope assets for the research community.

Divestment Summary
(as of November 5, 2016)

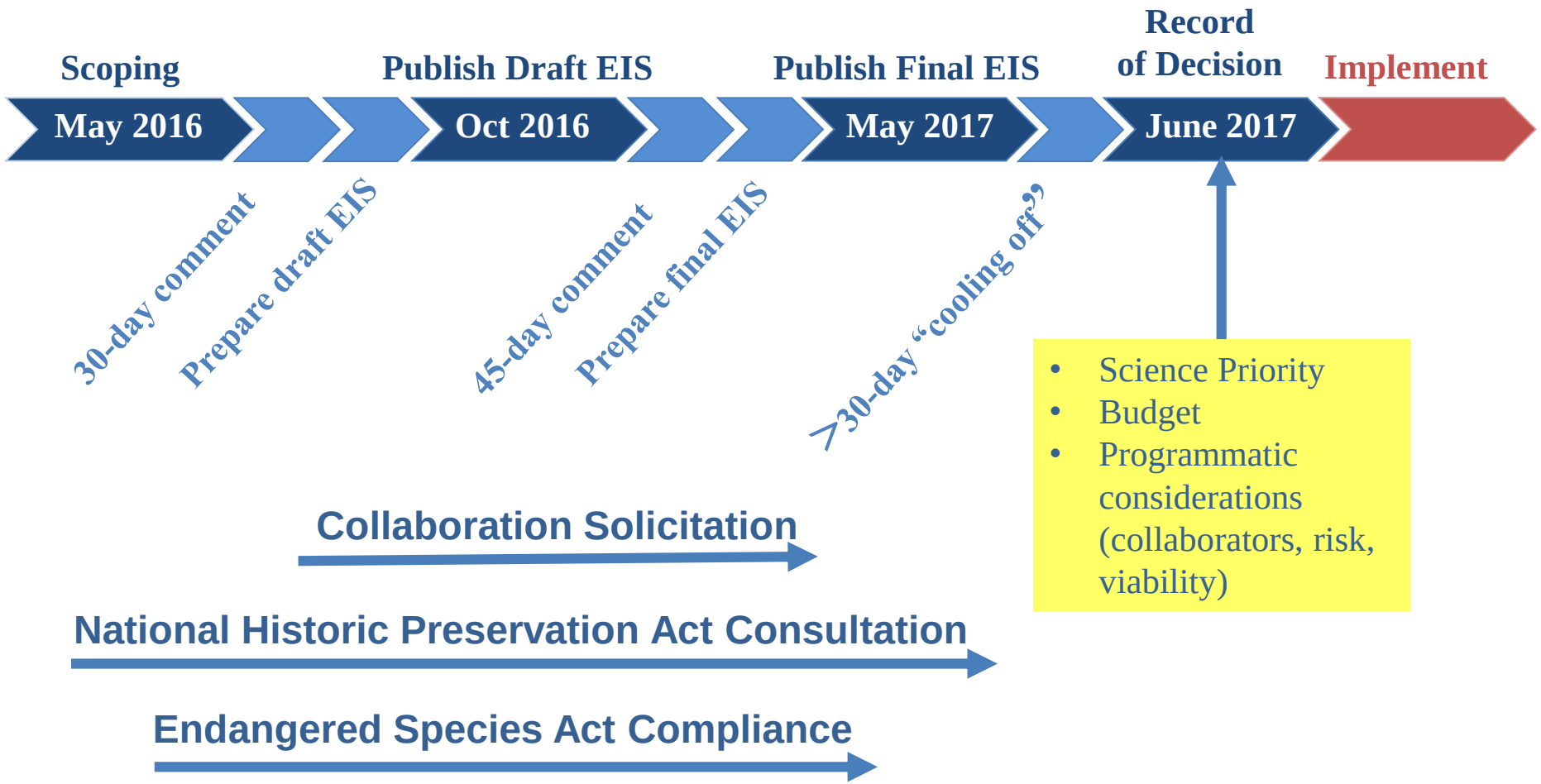
Telescope	Status
KPNO 2.1m	Caltech-led consortium (Robo-AO) operating for FY 2016-2018.
Mayall 4m	Slated for DESI; bridge from NSF to DOE; NSF/DOE MOU for transition.
WIYN 3.5m	NOAO share to NASA-NSF Exoplanet Observational Research Program; NSF/NASA MOU in place; NASA instrument selected.
GBO	Separation from NRAO in FY 2017; ~25% collaboration for basic scope; started Environmental Impact Statement (EIS) process on October 19.
LBO/VLBA	Separation from NRAO in FY 2017; MOA with US Navy in place for 50%.
McMath-Pierce	No obvious partner opportunities; very small user community.
GONG/SOLIS	SOLIS is off Kitt Peak; GONG refurbishment; Interagency Agreement with NOAA signed (NOAA sharing GONG operations costs).
Sacramento Pk.	University consortium in development, and NSF funded NMSU for transition to consortium; started EIS process; completion in 2017.
Arecibo	Formal EIS process under way, and issuance of Record of Decision targeted for 2017. Draft EIS released October 28.
SOAR	Post-2020 status to be reviewed.

Environmental Reviews-Targeted Timeline

- May 2016: Initiated Environmental Impact Statement (EIS) process and consultation under National Historic Preservation Act (NHPA) Section 106 for Arecibo.
- July 2016: Began EIS and NHPA process for Sacramento Peak Observatory.
- October 2016: Began EIS and NHPA process for Green Bank Observatory.
- FY 2017: Consider EIS and NHPA process for McMath-Pierce Solar Telescope.
- June 2017-Early 2018: Conclude formal environmental reviews and consideration of alternatives. Select preferred alternatives in Record of Decision, which incorporates environmental reviews and many other considerations. Begin implementation.

- No decisions have been made, or will be made until issuing a Record Of Decision for a facility or telescope under formal consideration.

Target Dates for Arecibo Environmental Impact Statement (EIS)



Sac Peak and Green Bank are on similar paths, 2-6 months behind Arecibo.

Other Recent Community Reports

Elmegreen OIR Report

- April 2015: National Academies delivered report on "Optimizing the U.S. Ground-Based Optical and Infrared Astronomy System" (aka Elmegreen report).
  - Report made prioritized recommendations, but did not attempt to provide details of instrument requirements (see later discussion of Kavli Futures Symposium).
- Overall NSF response published in Dear Colleague Letter NSF 15-115.
- Several recommendations related to NOAO fostering of community, which go well beyond base scope funded by NOAO; under discussion/development with NOAO.

National Center for Night-time OIR Astronomy

- September 2016: After numerous discussions with AURA management and Observatory leadership, NSF provided guidance to AURA on planning a National Center.
  - Purpose, mission and scope of a single administrative organization to coordinate resources among LSST operations, Gemini Observatory, and continuing NOAO programs.
  - AURA is to deliver to NSF a proposed plan for this National Center, with a targeted delivery date of mid-2017.
  - Separately, the potential National Center is being discussed with Gemini, LSST, and NOAO partners.
- The overall benefit envisioned is the provision of enhanced science return through coordination of capabilities as LSST moves toward operations.

Giant Segmented Mirror Telescope (GSMT)

- *Recent Question from NAS Committee on Astronomy and Astrophysics: Is "meaningful participation in a GSMT feasible with your foreseeable "in-guide" budget? When might such participation be feasible, and at what impact to other programs?*
  - AST has stated previously that AST contributions to a GSMT would not be possible until after FY 2020, if then.
  - Portfolio Review Committee recommended no AST investment in GSMT in Scenario B (lower funding scenario), which is closest to the current budget situation.
  - Meaningful GSMT participation that would include any operations commitment is not possible in the current budget environment without severe impacts to higher priority decadal survey priorities.

LSST/NOAO Symposium Report

- August 2015: NSF wrote to the AURA President and the LSST and NOAO Directors requesting consideration and prioritization of specific technical capabilities for the US Optical/Infrared Telescope System that are required to fully realize LSST-enabled science, using 6-8 representative science cases.

- October 2016: Report of the Kavli Futures Symposium "Maximizing Science in the Era of LSST: A Community-Based Study of Needed US OIR Capabilities".
  - Considered six baseline science cases, and addressed prioritized needs and prospects for specific instrumental capabilities needed to address those science cases.

2016 AAAC Recommendation and CMB-S4

- *<u>Recommendation</u>: "We encourage DOE, NSF, and university community to continue working toward a plan for a future (Stage 4) ground-based CMB experiment."*

- Response: NSF (AST, PHY, PLR) and DOE/HEP are actively coordinating and working with the science community.
- Last week, NSF and DOE charged AAAC to form a subcommittee to develop a strawman project concept that can be used for agencies' planning purposes. Charles Lawrence (JPL) has agreed to chair this committee.
- The P5 committee recommended CMB-S4 as a strategic initiative, but this was not an *NWNH* recommendation. NSF currently plans to evaluate CMB-S4 funding within established core programs.

High-Level Summary

- Outstanding science opportunities offered/developed
  - ALMA, EVLA, Dark Energy Camera, GPI, DKIST, LSST
  - AAG has been stable, with funding rate inching back above 20%
  - NN-EXPLORE with NASA; telescopes/instruments with DOE
  - NSF requested ~$87M for AST facility construction in FY 2017
  - Second round of MSIP awards made
- Partnerships with NASA and DOE have strengthened
- New collaborations with DoD (LBO) and NOAA (GONG)
- Potential impact of LIGO detection
- Mid-decadal review and Kavli Futures Symposium reports released
- Unknown prospects for budget increases this decade
  - Next 1.5 yr are critical for divestment activities
- Continued progress at the science frontiers

Backups/extras

2016 Community Recommendations-1

- *March 2016 AAAC Recommendation: "We urge that full programmatic funding required by the three agencies to execute their FY 2017 plans, as described in their budget requests, be provided."*

- *August 2016 NAS Mid-Decadal Review Recommendation 3-2: "The NSF and the National Science Board should consider actions that would preserve the ability of the astronomical community to fully exploit the Foundation's capital investments in ALMA, DKIST, LSST, and other facilities. Without such action, the community will be unable to do so because at current budget levels the anticipated facilities operations costs are not consistent with the program balance that ensures scientific productivity."*

2016 Community Recommendations-2

- *March 2016 AAAAC Recommendation: "Strong efforts by NSF for facility divestment should continue as fast as is practical. Efforts to explore partnerships, interagency cooperation and private resources to maintain some access to facilities for the US community that may mitigate the loss of open access should continue. Transferring the cost of operating a facility outside of the NSF/AST budget is preferable to complete loss of a capability from the suite of capabilities used by US researchers."*

- *August 2016 NAS Mid-decadal review Recommendation 3-1: "National Science Foundation (NSF) should proceed with divestment from ground-based facilities which have a lower scientific impact, implementing the recommendations of the NSF [AST] Portfolio Review, that is essential to sustaining the scientific vitality of the U.S. ground-based astronomy program as new facilities come into operation."*

Kavli Symposium Recommendations-Summary

- Six LSST science cases ranged from Small Bodies in the Solar System to Cosmic Structure and Cosmology.
- For each science topic, capabilities were classified as Critical, Very Important, or Important.
- Critical capabilities for more than one science case
  - Optical wide-field imager on 3-10m telescope.
  - Multi-Object Spectrograph (R=5000, 0.35-1.3 micron) on 3-30m telescope.
  - OIR single-object spectrograph (R=1000-5000, 0.35-2.5 micron).
  - OIR multi-object spectrograph (R>20,000) on 8-30m telescope.
- Estimated required time for specific LSST science cases, and also noted existing (or in development) instruments that could fulfill the needs, as well as holes in availability for the general U.S. community.

Acronym Dictionary

- AAG=Astron. & Astrophys. Research Grants
- ALMA=Atacama Large Mm/submm Array
- AR=Arecibo
- AST=NSF Division of Astronomical Sciences
- DAMIEN=Detecting And Mitigating the Impact of Earth-bound Near Earth Object
- DESI=Dark Energy Spectroscopic Instrument
- DKIST=Daniel K. Inouye Solar Telescope
- DoD=Department of Defense
- DOE=Department of Energy
- EIS=Environmental Impact Statement
- EVLA=Expanded Very Large Array
- GBO=Green Bank Observatory
- GONG=Global Oscillations Network Group
- GPI=Gemini Planet Imager
- IPA=Intergovernmental Personnel Act
- LBO=Long Baseline Observatory
- LIGO=Laser Interferometer Gravitational-wave Observatory
- LSST=Large Synoptic Survey Telescope
- MPS=NSF Directorate for Mathematical and Physical Sciences
- MREFC=Major Research Equipment & Facility Construction
- MSIP=Mid-Scale Innovations Program
- NASA=National Aeronautics and Space Administration
- NN-EXPLORE=NASA-NSF Exoplanet Observational Research partnership
- NOAA=Natl Oceanic and Atmos. Admin.
- NOAO=National Optical Astronomy Observatory
- NRAO=National Radio Astronomy Observatory
- NRC=National Research Council
- NSO=National Solar Observatory
- NWNH=New Worlds, New Horizons
- OIR=Optical/Infrared
- OMB=Office of Management and Budget
- PHY=NSF Division of Physics
- R&RA=Research and Related Activities
- SOAR=Southern Astrophysical Research Telescope
- SOLIS=Synoptic Optical Long-term Investigations of the Sun
- SPG=Solar and Planetary Research Grants