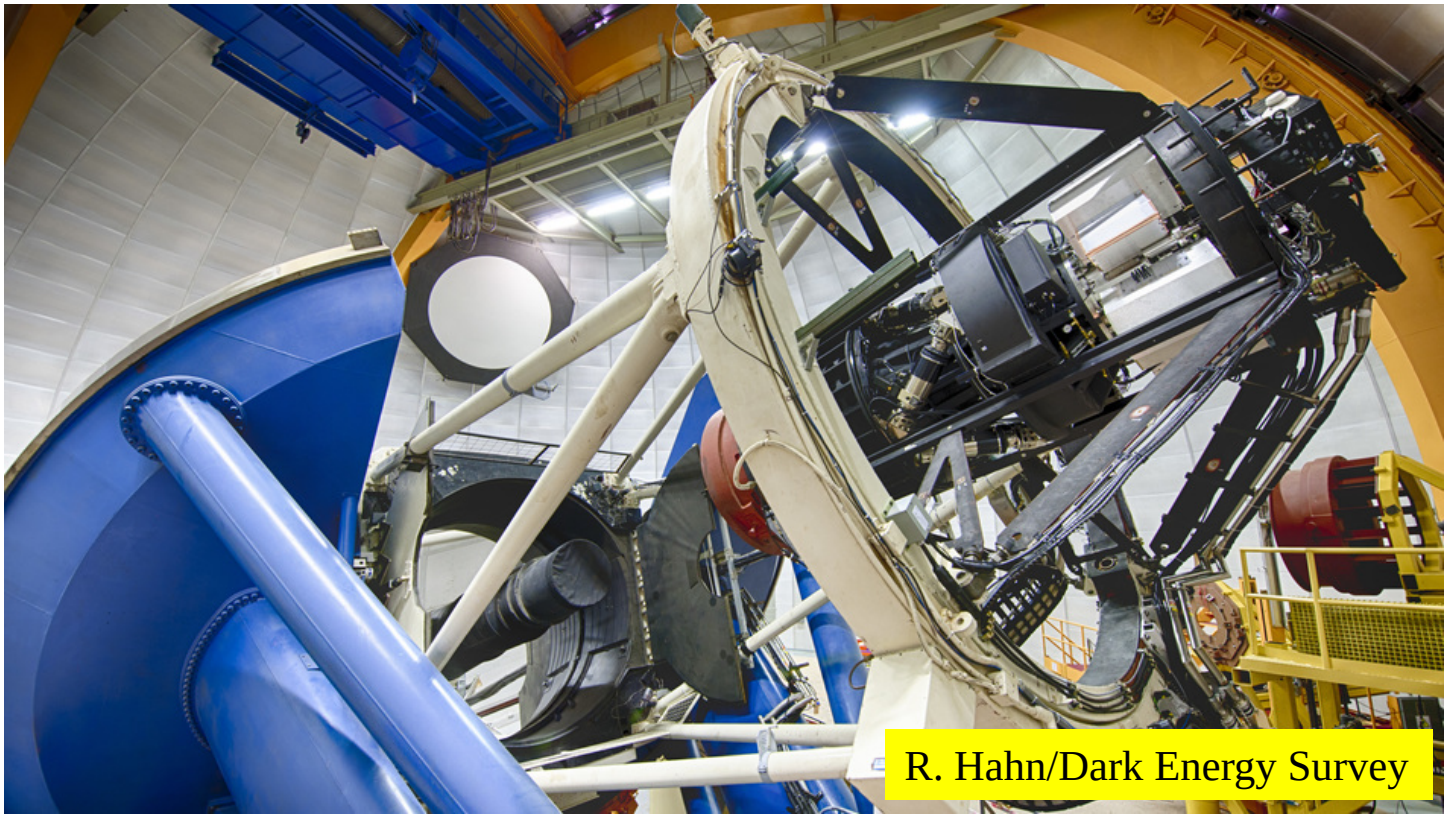
NSF Division of Astronomical Sciences (AST)
CAA Report
October 31, 2016

Jim Ulvestad

Ralph Gaume

Vern Pankonin

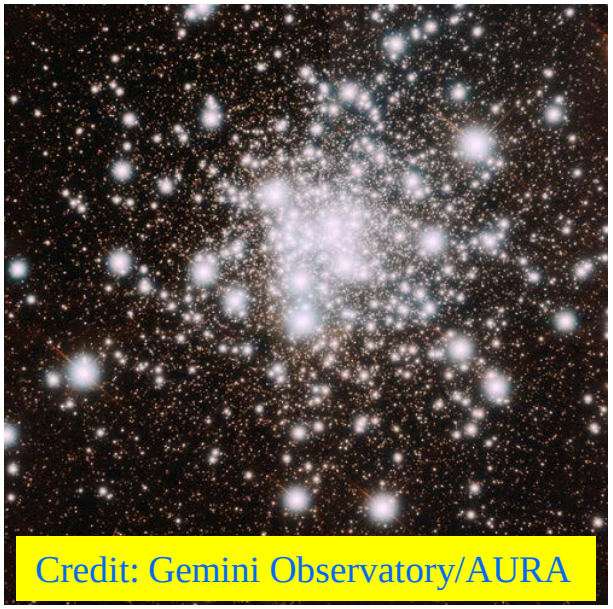
Blanco Telescope: Dark Energy Camera

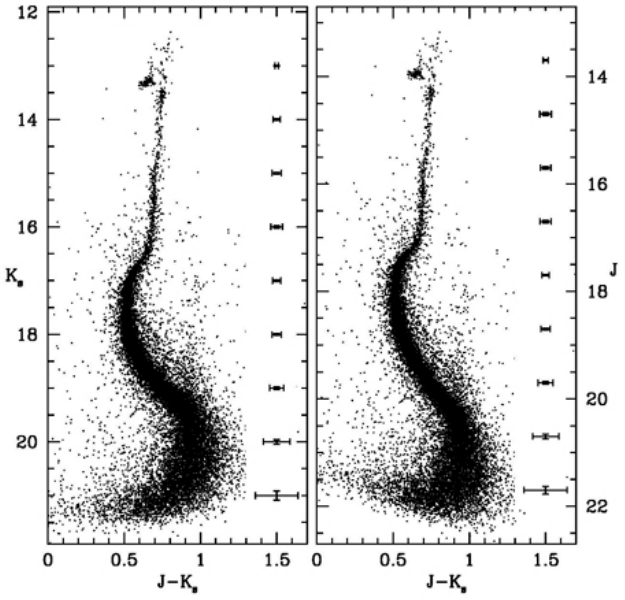


- Dwarf planet 2014 UZ224 discovered in survey image (500 km diameter, at 90 AU from Sun) (Gerdes et al., U. Michigan).
- Comet P/2015 PD229 (Jupiter family of comets) (Cameron et al., U. Rochester).

NGC 6624

- Bulge globular cluster NGC 6624 imaged in multiple near-IR colors 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).



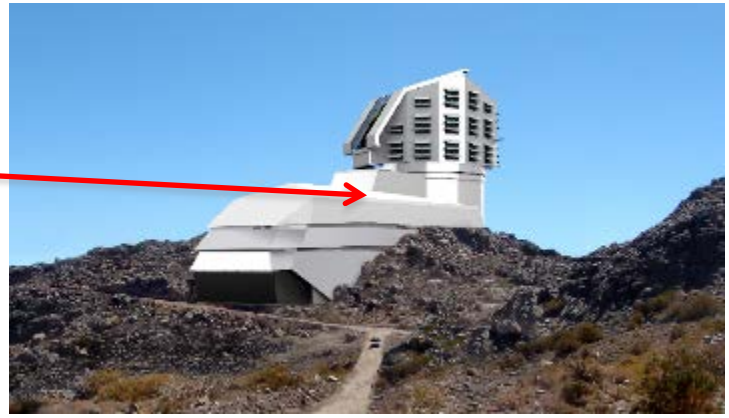


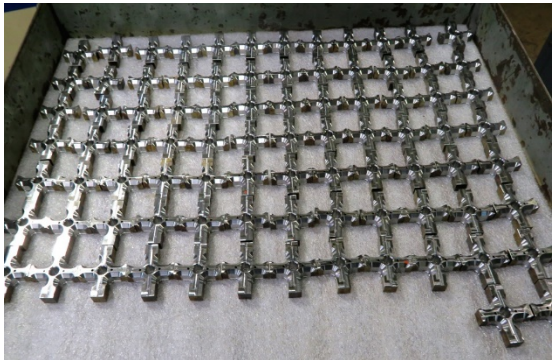
Daniel K. Inouye Solar Telescope (DKIST)

- DKIST will be a 4.2-meter solar telescope, intended to study the Sun at the fundamental 20-km scale of the solar magnetic structures.
- Under construction at Haleakala Observatory on Maui
- Completion scheduled for FY 2020.
- Top: Current view of DKIST enclosure atop Haleakala
- Bottom: Base ring of Telescope Mount Assembly under construction 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.
- Kavli Futures Symposium Report—"Maximizing Science in the Era of LSST: A Community-Based Study of Needed US OIR Capabilities".
  - Sponsored by Kavli Foundation, in response to NSF request to LSST and NOAO.





M1M3 (primary/tertiary) actuator assembly components

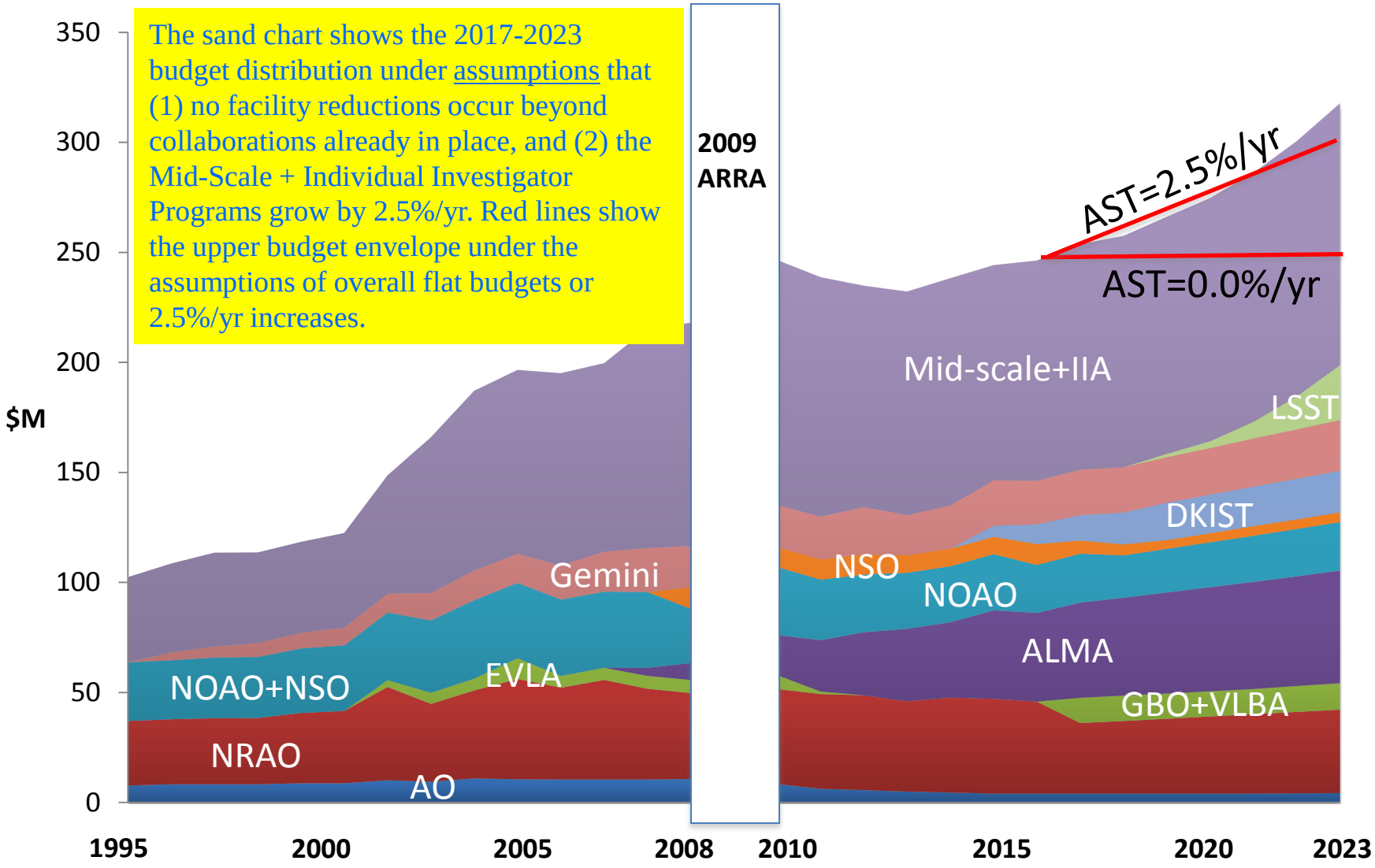
FY 2017 NSF Request by Account ($M)

	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	Change FY15-16	FY17 Request Disc.
NSF Total	7344	7724	7464	+1.6%	7564
NSF R&RA	5934	6186	6034	+1.7%	6079
MPS	1337	1366	1349	+0.9%	1355
AST	245.2	246.5	246.7	+0.6%	247.7
MREFC	200.8	200.3	200.3	---	193.1

Hypothetical Budget Runouts for AST



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 recommendations about some priorities, but did not provide details of instrumental recommendations.
  - AST wrote to NOAO and LSST Directors, requesting more detailed assessment of instrumental requirements (see following slides).
- Several recommendations relating to fostering of community, are logical roles for NOAO, but go well beyond base NOAO scope funded by NSF.
  - NSF has provided direction to NOAO in development of a response plan.
- Overall NSF response published in Dear Colleague Letter NSF 15-115.

LSST/NOAO Symposium Report

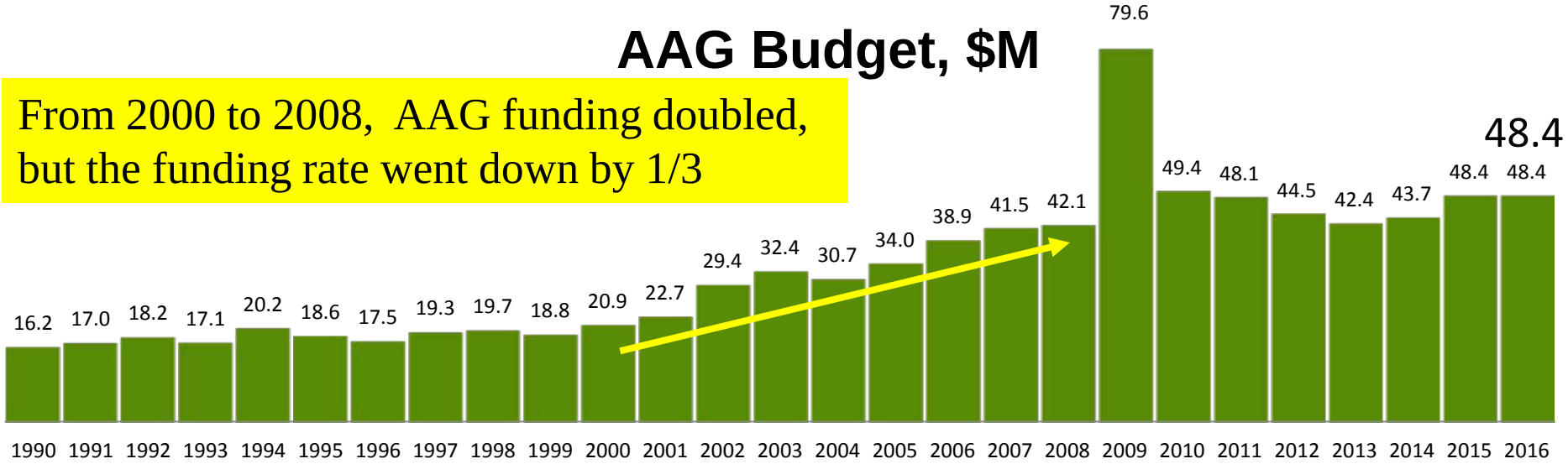
- August 2015: NSF wrote to the AURA President and the LSST and NOAO Directors requesting consideration and prioritization of specific technical capabilities for the US Optical/Infrared Telescope System that are required to fully realize LSST-enabled science.
  - Community working groups set up to consider six representative science cases for LSST.
  - Culminated in May 2016 Kavli Futures Symposium.
- October 2016: Report of the Kavli Futures Symposium "Maximizing Science in the Era of LSST: A Community-Based Study of Needed US OIR Capabilities".
  - 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.

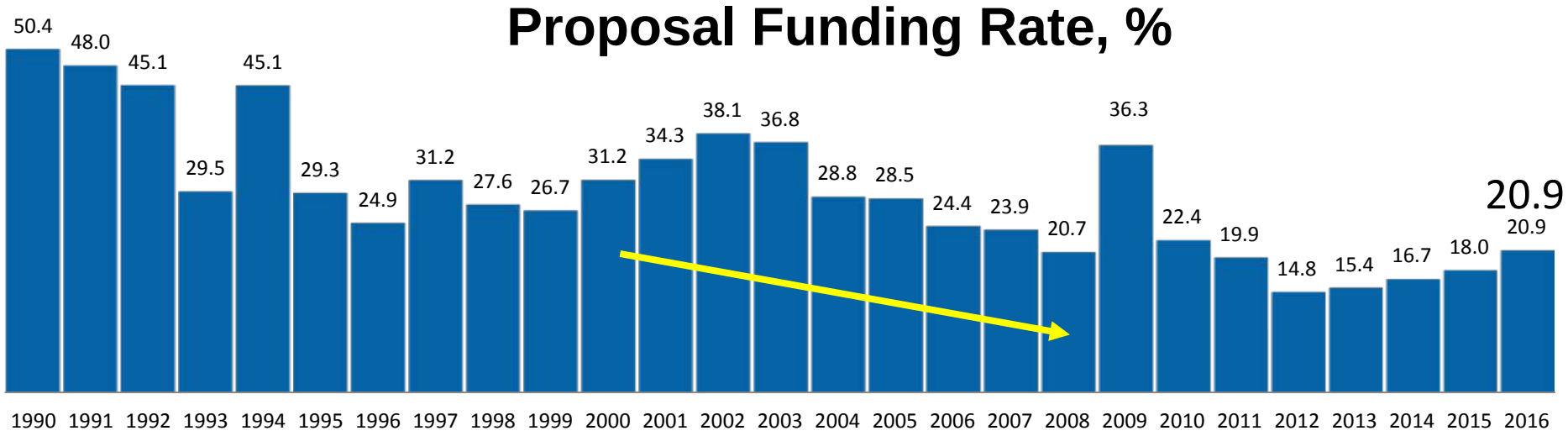
National Center for Night-time OIR Astronomy

- 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 to ensure that all the rights and expectations of the partners are met, as stipulated in the governance agreements for those partnerships.
- The overall benefit envisioned is the provision of enhanced science return through coordination of capabilities as LSST moves toward operations.

AAG Funding History, 1990-2016

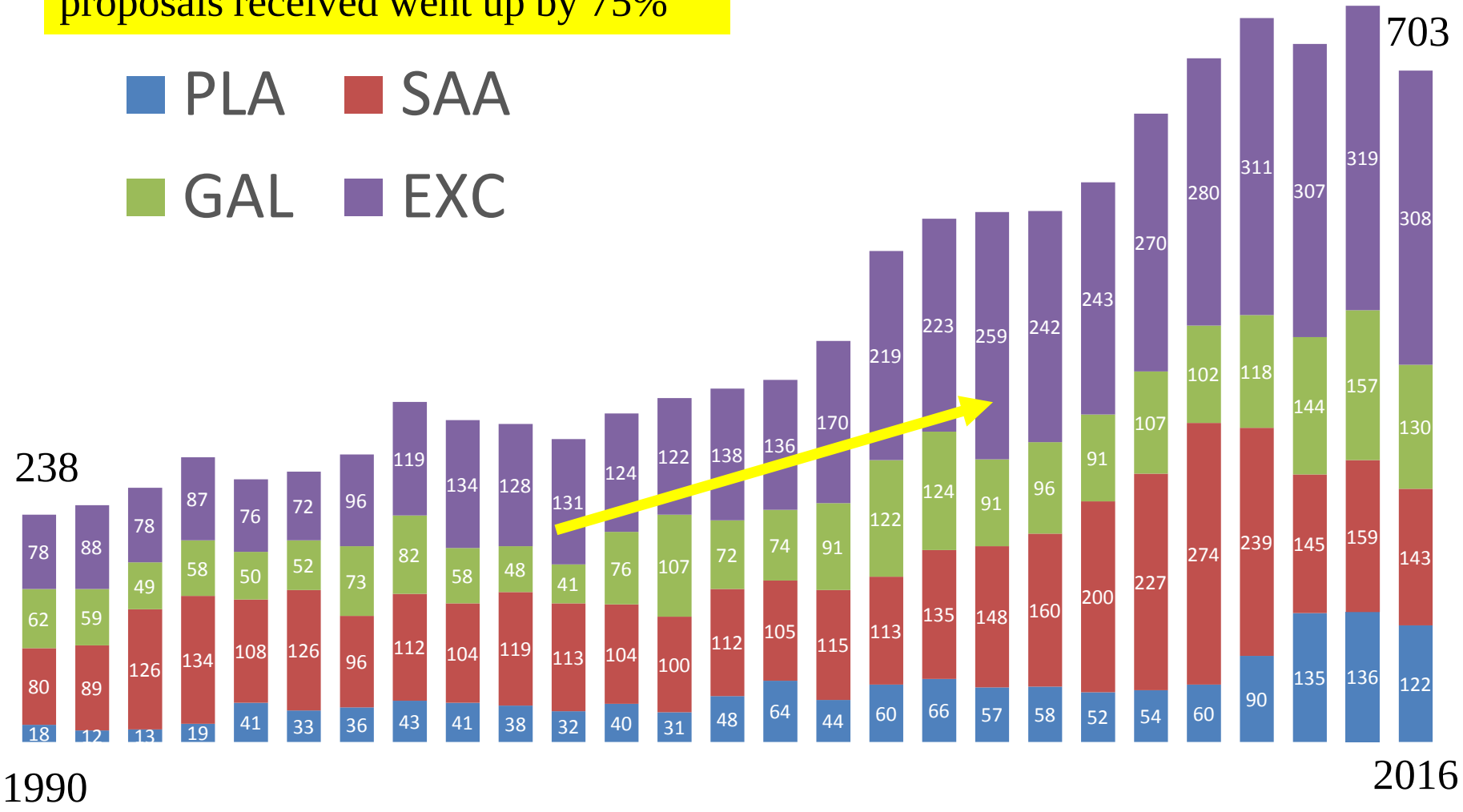
From 2000 to 2008, AAG funding doubled, but the funding rate went down by 1/3





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.

CAA Questions

Giant Segmented Mirror Telescope-1

- *CAA: Updates on NSF/GSMT possibilities, including the NOAO study on options for involvement.*
  - Response: There is no NOAO study on options for NSF involvement in GSMT. There is a planning award to the TMT Observatory Corporation, which includes options for NSF participation as a deliverable. TMT has proactively engaged the US community in scientific planning, with NOAO acting as the facilitator on behalf of the US community. NSF has not yet received the report on options.

Giant Segmented Mirror Telescope-2

- *CAA: 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?*
  - Response: AST does not receive out-year guidance budgets for planning. 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).
  - "Recommendation 10.5: In our Scenario A [higher of 2 budget scenarios], we recommend that AST contribute of order $20M/yr to GSMT late in the decade."
  - The AST budget is presently closer to Scenario B than to Scenario A. Meaningful GSMT participation that would include any operations commitment is not possible in this scenario without severe impacts to other higher priority decadal survey priorities.

New Worlds, New Horizons: A Midterm Assessment

- *CAA: What is NSF's response to the findings and recommendations of the mid-decadal review?*
  - General Response: We appreciate the numerous findings that recognize the choices that have been necessary, and that NSF made those choices in a way that remained true to the decadal survey.
- *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."*
  - Response: NSF is very actively pursuing divestment, including partnerships, collaborations, and development of three Environmental Impact Statements.
  - Savings forecasted to date are approximately $10-12 million, compared to ~$40 million recommended by Portfolio Review.
  - These savings, together with other difficult programmatic decisions, have enabled the Astronomy and Astrophysics Research Grants (AAG) program to return to the same level as FY 2010 and FY 2011, while bringing ALMA into full operations and starting the Mid-Scale Innovations Program.

NWNH Midterm--Divestment

- What Does "Divest" Mean?
  - The recommendation 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 continued availability of NSF telescope assets for some fraction of their time, for some portion of the research community.

NWNH Midterm-Divestment Summary
(as of October 31, 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

NWNH Midterm-Formal Environmental Review

- 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.

New Worlds, New Horizons: A Midterm Assessment

- *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."*

- Response: This recommendation is aimed primarily at the larger NSF, not just at AST. It has contributed to an ongoing discussion about the challenges of balancing facility operations with other elements of the AST program. The outcome of that discussion is unknown at present.

2020 Decadal

- *CAA: What is the NSF doing to plan for the 2020 Decadal:*
  - *Within AST, MPS, and the agency?*
  - *In generating or sponsoring activities for members of the community?*
- Response: AST is concerned about its potential ability to commit to operations costs of new large facilities beyond LSST and to maintain program balance. Thus the primary preparation for Astro 2020 is to continue make progress on facility divestment. Overall planning is generally driven by the community, and NSF has awarded no proposals (MSIP Track 3) for design and development aimed at the 2020 Decadal.
  - NSF requested the Kavli Futures Symposium process.
  - The "Big Ideas" being discussed by NSF this year as possible future initiatives include "Windows on the Universe" and a new NSF mid-scale program. AST and MPS are actively engaged. These depend on future budget requests and appropriations.
  - Delivery of ALMA, DKIST, and LSST science, as called out by the Midterm Report, remains a higher priority than starting new facilities in the current budget environment.
  - Consideration of establishment of a formal "prime mission" length for large ground facilities may be a topic of interest for the 2020 Decadal.

Facility Operations Costs

- *CAA: What are the prospects for including operations costs in future new major large-scale research facilities or otherwise covering operations costs without impacting existing grant programs?*
  - Response: See response to the mid-decadal Recommendation 3.2.
  - Discussions are part of internal agency deliberative processes and future budget preparations; results will be seen from changes or lack of changes in future budget requests and appropriations.
  - The National Center discussed previously has potential for some savings in future operations costs.

MSIP Strategy

- *CAA: What is your strategy for balancing new MSIP awards versus other programs (grants and observatory operations) for the remainder of this decade?*
  - Response: AST has reached the maximum possible funding for MSIP ($18-19 million/yr) within the current budget envelope.
  - If there are not adequate savings from divestment or other efficiencies, compared to appropriated budgets, it is likely that smaller individual investigator awards will be protected to the extent possible, at the expense of MSIP.
  - This priority to individual investigator awards will enable the maximum scientific exploitation of the highest priority facilities identified in the 2012 Portfolio Review, including the new and upcoming facilities named in mid-decadal Recommendation 3.2.

MSIP Process

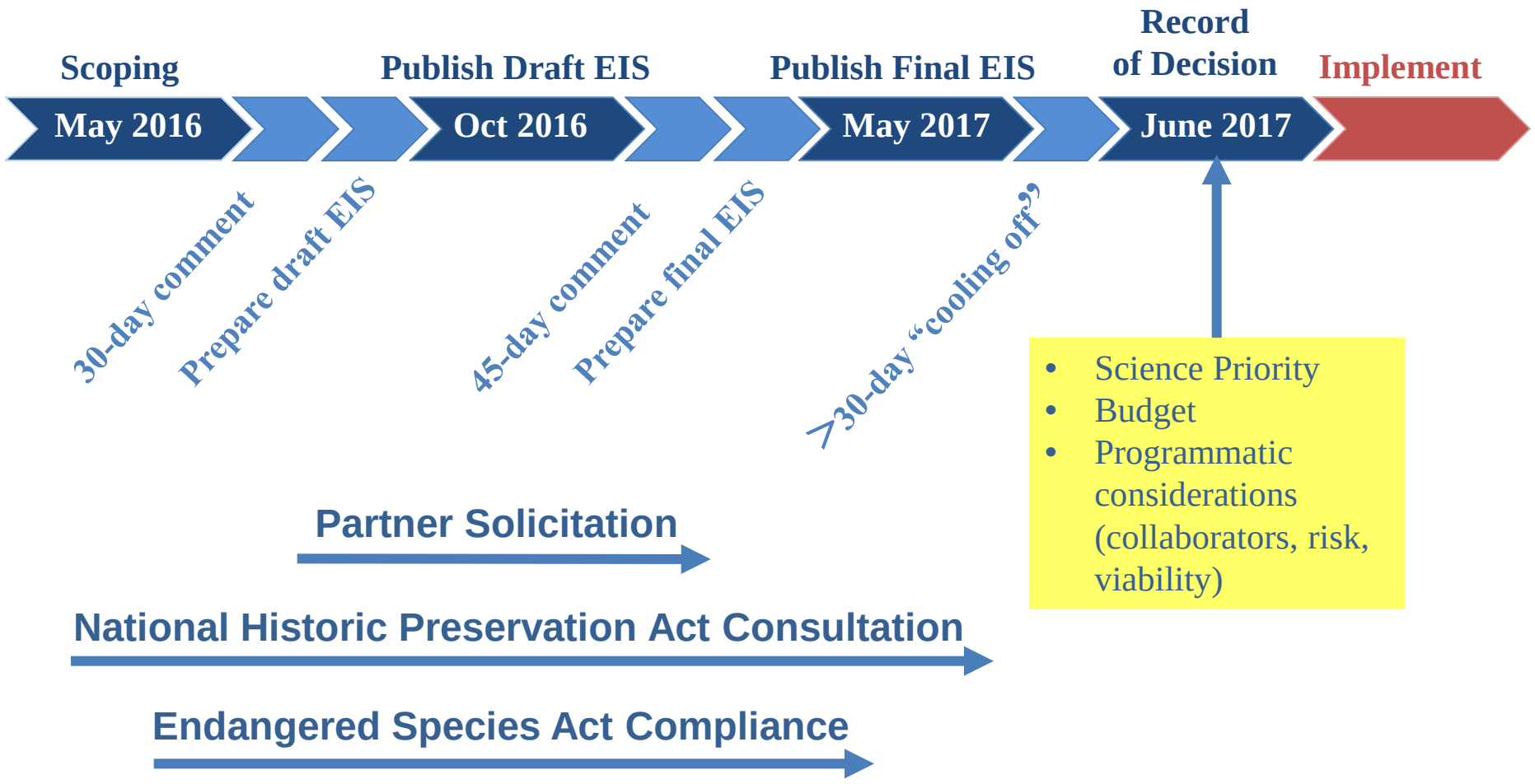
- *CAA: The perception is that the MSIP program process makes it challenging to support traditional general-purpose instrument facilities (such as were formerly funded by TSIP) on 6-10m telescopes - please discuss how such projects would work in the MSIP guidelines/framework and review process?*
  - Response: AST changed its review process during the second MSIP round to consider open-access proposals separately.
  - The most competitive open-access OIR proposals received were from CHARA and Las Cumbres Global Telescope network, both of which were funded. The Subaru deep-galaxy survey proposal will result in open data sets, but not community observing time.
  - TSIP had funding rates that typically were 50% or higher, whereas the overall MSIP funding rate at current budget levels is no higher than 20% of pre-proposals. Thus we would need to receive ~5 TSIP-like pre-proposals to have a strong likelihood of funding 1.

MSIP Round 1 and 2 Awards, FY 2016-2017

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

Backups/extras

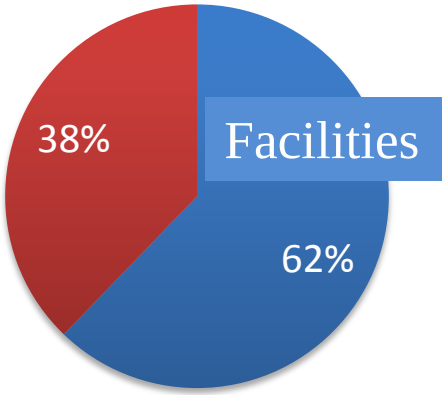
Example: Target Dates for Arecibo EIS



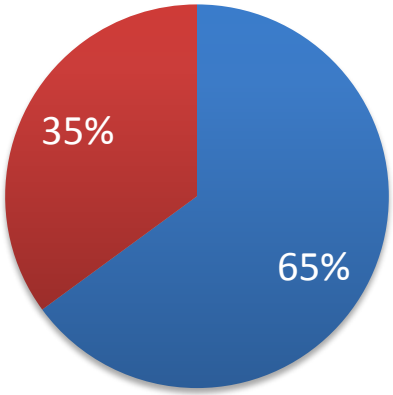
Sac Peak and Green Bank are on similar paths, 2-6 months behind Arecibo

Historical Funding Breakdown

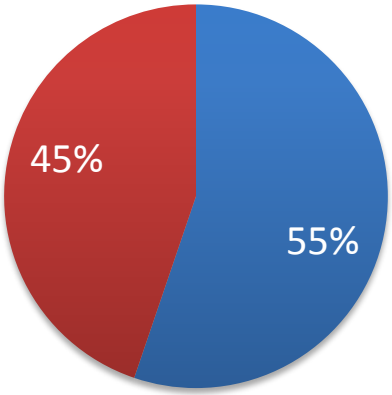
1995



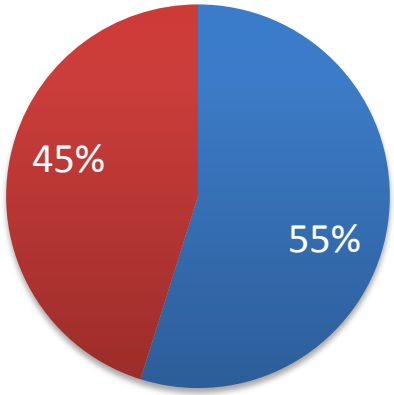
2000



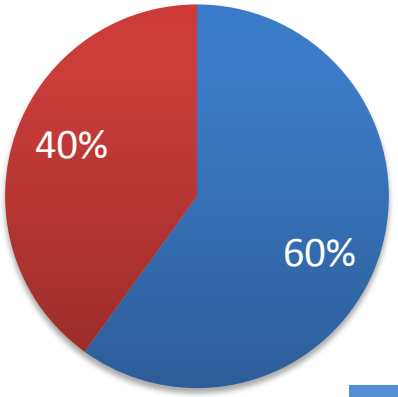
2005



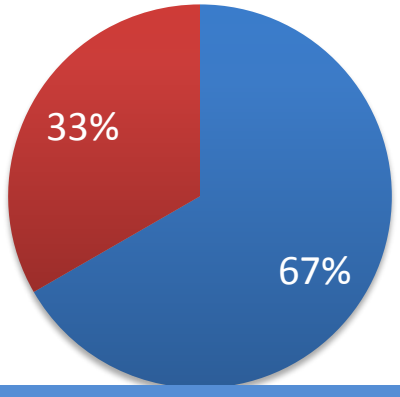
2010



2015



2020?



Assumes flat budget, currently planned facility evolution.

Community Recommendations to NSF

- August 2012: AST Portfolio Review (recommended by decadal survey) recommended a number of facilities for divestment, and others for future consideration, depending on budget and other factors.
- March 2016: Astronomy and Astrophysics Advisory Committee Recommendation: "Strong efforts by NSF for facility divestment should continue as fast as is practical."
- April 2016: GEO/AGS Portfolio Review (Recommendation 9.11): Recommendation to reduce GEO/AGS contribution to Arecibo operations from $4.1 million/yr to $1.1 million/yr by 2020. (MPS/AST also spent $4.1 million in FY 2016)
- August 2016: National Academies mid-term decadal assessment (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."

Acronym Dictionary

- AAG=Astron. & Astrophys. Research Grants
- ALMA=Atacama Large Mm/submm Array
- AR=Arecibo
- AST=NSF Division of Astronomical Sciences
- 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
- 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
- NHPA=National Historic Preservation Act
- 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
- 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