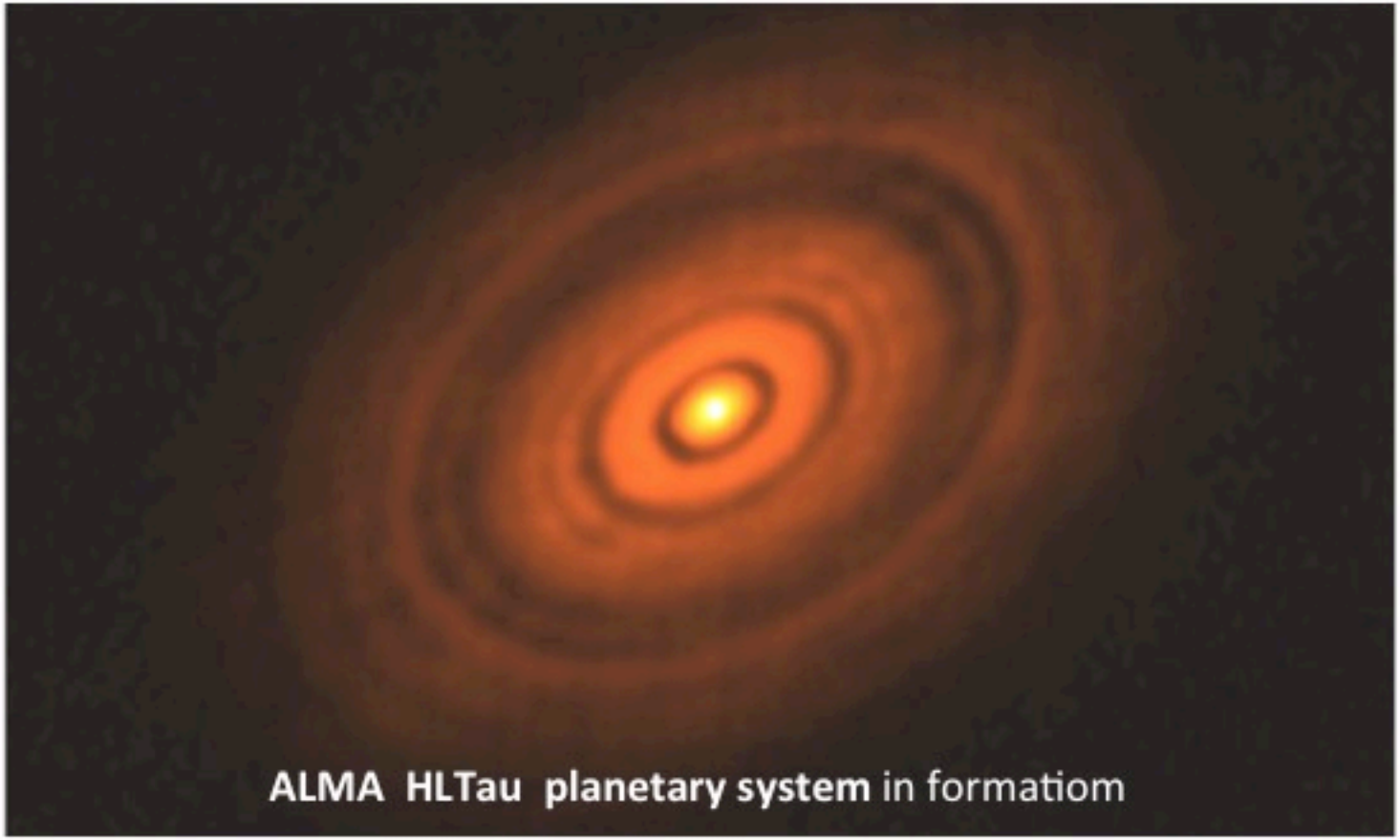
Astronomy and Astrophysics Advisory Committee (AAAC)

Angela Olinto, University of Chicago, Vice-Chair



ALMA HLTau planetary system in formatiom

Report of March 15, 2015

http://www.nsf.gov/mps/ast/aaac/reports/annual/aaac_2015_report.pdf

Astronomy and Astrophysics Advisory Committee (AAAC)

2014-2015

Dr. James Buckley, Washington University St. Louis

Dr. William Cochran, University of Texas at Austin

Dr. Priscilla Cushman, University of Minnesota, Chair

Dr. Craig Hogan, University of Chicago

Dr. David Hogg, New York University

Dr. Klaus Honscheid, The Ohio State University

Dr. Scott Hughes, MIT

Dr. John Johnson, Harvard-SAO Center or Astrophysics

Dr. Angela Olinto, University of Chicago, Vice-Chair

Dr. Paula Szkody, University of Washington

Dr. Angela Speck, University of Missouri

Dr. Suzanne Staggs, Princeton University

Dr. Jean Turner, UCLA

AAAC

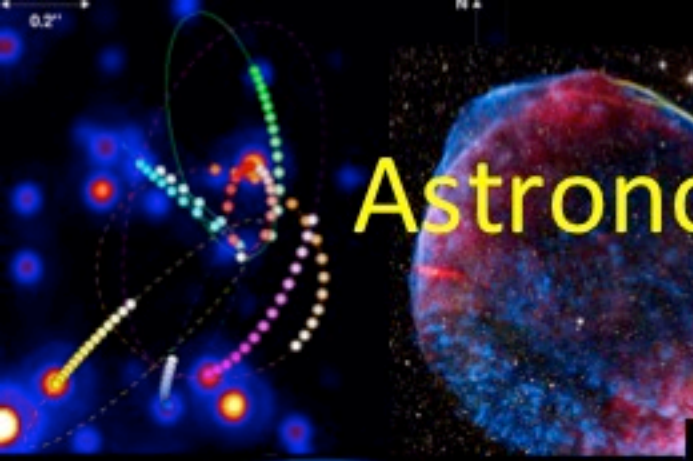
The **Astronomy and Astrophysics Advisory Committee** was established under the **National Science Foundation Authorization Act of 2002 Public Law 107-368** to:

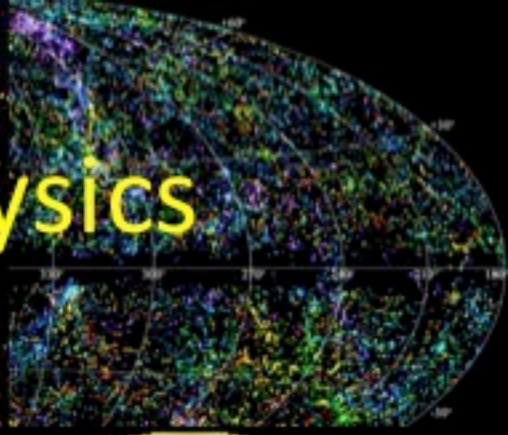
(1) **assess, and make recommendations** regarding, the **coordination** of astronomy and astrophysics programs of the **Foundation and the National Aeronautics and Space Administration, and the Department of Energy**;

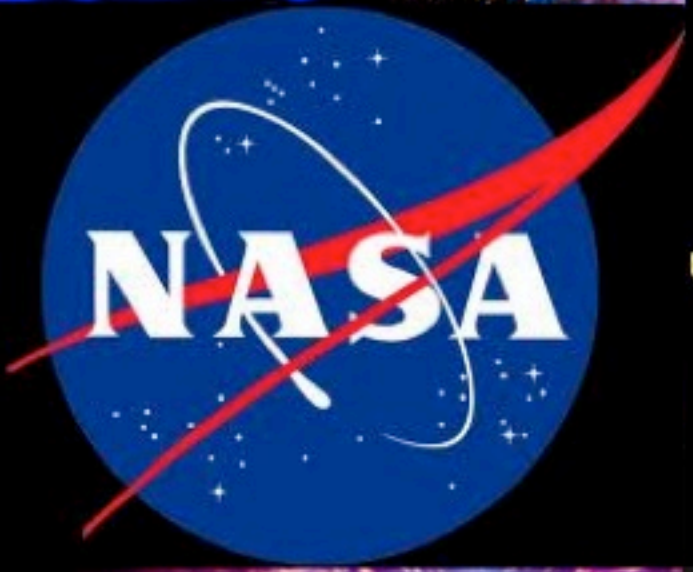
(2) **assess, and make recommendations** regarding, the **status of the activities** of the Foundation and the National Aeronautics and Space Administration, and the Department of Energy **as they relate to the recommendations contained in the National Research Council's 2010 report entitled New Worlds, New Horizons in Astronomy and Astrophysics, and the recommendations contained in subsequent National Research Council reports of a similar nature;**

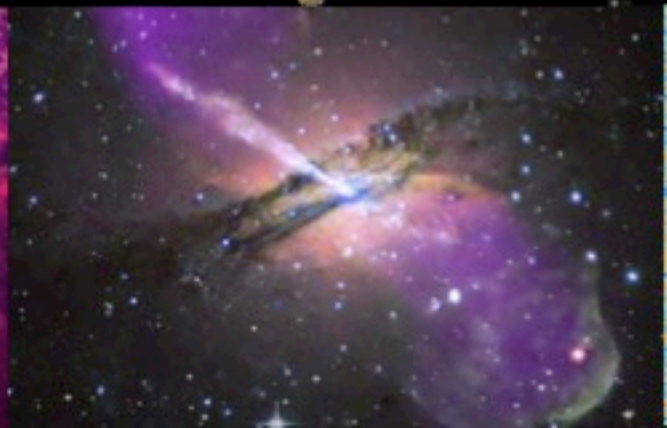
(3) not later than **March 15** of each year, transmit a report to the **Director, the Administrator of the National Aeronautics and Space Administration, the Secretary of Energy, the Committee on Commerce, Science and Transportation of the United States Senate, the Committee on Energy and Natural Resources of the United States Senate, and the Committee on Science, Space, and Technology of the United States House of Representatives**, on the Advisory Committee's findings and recommendations under paragraphs (1) and (2).

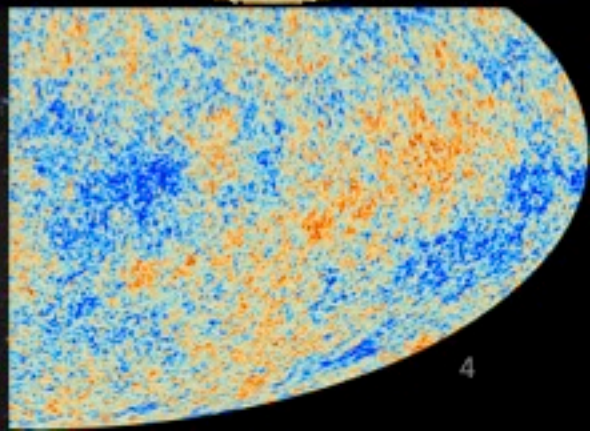
Astronomy & Astrophysics











AAAC Report

Dr. France A. Córdova, Director
National Science Foundation
4201 Wilson Blvd., Suite 1205
Arlington, VA 22230

Mr. Charles F. Bolden, Jr., Administrator
Office of the Administrator
NASA Headquarters
Washington, DC 20546-0001

Dr. Ernest Moniz, Secretary of Energy
U.S. Department of Energy
1000 Independence Ave., SW
Washington, DC 20585

The Honorable John Thune, Chairman
Committee on Commerce, Science and Transportation
United States Senate
Washington, DC 20510

The Honorable Lisa Murkowski, Chairwoman
Committee on Energy & Natural Resources
United States Senate
Washington, DC 20510

The Honorable Lamar Smith, Chairman
Committee on Science, Space and Technology
United States House of Representatives
Washington, DC 20515

cc: Senator Bill Nelson, Ranking Member, Committee on Commerce, Science and Transportation, United States Senate
Senator Maria Cantwell, Ranking Member, Committee on Energy & Natural Resources United States Senate
Representative Eddie Bernice Johnson, Ranking Member, Committee on Science, Space, and Technology, United States House of Representatives
Senator Ted Cruz, Chairman, Subcommittee on Space, Science, and Competitiveness, Committee on Commerce, Science and Transportation, United States Senate
Senator Gary Peters, Ranking Member, Subcommittee on Space, Science, and Competitiveness, Committee on Commerce, Science and Transportation, United States Senate
Senator Richard Shelby, Chairman, Subcommittee on Commerce, Justice, Science, and Related Agencies, Committee on Appropriations, United States Senate
Senator Barbara Mikulski, Ranking Member, Subcommittee on Commerce, Justice, Science, and Related Agencies, Committee on Appropriations, United States Senate
Senator Lamar Alexander, Chairman, Subcommittee on Energy and Water Development, Committee on Appropriations, United States Senate
Senator Dianne Feinstein, Ranking Member, Subcommittee on Energy and Water Development, Committee on Appropriations, United States Senate
Representative Barbara Comstock, Chairwoman, Subcommittee on Research and Technology, Committee on Science, Space and Technology, United States House of Representatives
Representative Daniel Lipinski, Ranking Member, Subcommittee on Research and Technology, Committee on Science, Space and Technology, United States House of Representatives
Representative Mike Simpson, Chairman, Subcommittee on Energy and Water Development and Related Agencies, Committee on Appropriations, United States House of Representatives
Representative Marcy Kaptur, Ranking Member, Subcommittee on Energy and Water Development, Committee on Appropriations, United States House of Representatives
Representative John Culberson, Chairman, Subcommittee on Commerce, Justice, Science and Related Agencies, Committee on Appropriations, United States House of Representatives
Representative Chaka Fattah, Ranking Member, Subcommittee on Commerce, Justice, Science and Related Agencies, Committee on Appropriations, United States House of Representatives
Representative Steven Palazzo, Chairman, Subcommittee on Space, Committee on Science, Space, and Technology, United States House of Representatives
Representative Donna Edwards, Ranking Member, Subcommittee on Space, Committee on Science, Space, and Technology, United States House of Representatives
Dr. Fleming Crim, Assistant Director, Directorate for Mathematical and Physical Sciences, National Science Foundation
Dr. John Grunsfeld, Associate Administrator, Science Mission Directorate, National Aeronautics and Space Administration
Mr. Chuck Gay, Deputy Associate Administrator, Science Mission Directorate, National Aeronautics and Space Administration
Dr. Paul Hertz, Director, Astrophysics Division, Science Mission Directorate, National Aeronautics and Space Administration
Dr. Patricia Dehmer, Deputy Director for Science Programs, Office of Science, U.S. Department of Energy
Dr. James Siegrist, Director, Office of High Energy Physics, U.S. Department of Energy
Dr. Glen Crawford, Division Director, Research and Technology Division, Office of High Energy Physics, U.S. Department of Energy
Dr. Kathleen Turner, Program Manager, Office of High Energy Physics, U.S. Department of Energy
Dr. Jo Handelsman, Associate Director for Science, Office of Science and Technology Policy, Executive Office of the President
Dr. Tamara Dickinson, Principal Asst. Director for Environment and Energy, Office of Science and Technology Policy, Executive Office of the President
Dr. Saul Gonzalez, Assistant Director, Physical Sciences, Office of Science and Technology Policy, Executive Office of the President
Dr. J.D. Kundu, Program Examiner, NSF, Office of Management and Budget
Dr. Grace Hu, Program Examiner, NASA, Office of Management and Budget
Dr. Avital Bar-Shalom, Program Examiner, DOE, Office of Management and Budget
Dr. James Ulvestad, Director, Division of Astronomical Sciences, National Science Foundation
Dr. Patricia Knezek, Deputy Director, Division of Astronomical Sciences, National Science Foundation
Dr. Joan Schmelz, Program Director, Division of Astronomical Sciences, National Science Foundation

Executive Summary

A&Aph directly address the most basic of human desires: **to understand our place in the Universe, its origins, and whether we are alone.**

Past US investments in A&Aph led to US led **technological advances** that fueled **scientific breakthroughs**, **encouraging innovation** and building the **technical expertise** required for our nation to compete in the future.

AAAC report (March 2014-2015):

- reviewed **accomplishments** in A&Aph, concentrating on projects supported by **NSF AST, NASA Astrophysics,** and **DOE OHEP Cosmic Frontier** + some overlaps with **NSF PHY** and **NASA Heliophysics & Planetary.**
- compared current **progress and planning** processes to the implement **NWNH and other NRC reports**; commenting on the **degree of cooperation** between the agencies on projects that are supported jointly.
- considered **HEPAP P5** (Particle Physics Project Prioritization Panel) recommendations for HEP at DOE and NSF in those disciplines that **overlap with A&Aph** .

Overall we are **very impressed** with the **accomplishments by agencies and scientists** given the tight budget environment. **Bold tactical choices and greater cooperation** were made by the agencies in order to keep the intent of the decadal survey on large projects.

International Cooperation

Proposal Pressure

21. Findings; 5. Recommendations

Science Highlights

ALMA:

30 milli-arcseconds resolution 10x sensitivity, HL Tau planetary system formation + ultra-luminous galaxy with gravitationally-lensed image.

NuSTAR

exploding stars, black holes, pulsars, active galaxies, sun, & young supernova Cassiopeia A

Dark Energy Survey (DES)

Completed 2nd season of 5: Largest volume ever observed; survey with 1000 high-redshift supernovae, 20 trans-Neptunian minor planets, 8 new ultra-faint Milky Way companions

ESA *Rosetta* spacecraft

with NASA instruments arrived at Comet 67P/Churyumov–Gerasimenko in august and in November 12, 2014, deployed the Philae landing probe first soft-landing on a comet surface.

Thorne-Żytkow objects (TŻOs) discovered **Magellan Clay** telescope

red supergiant and neutron stars that superficially resemble normal red supergiants

HST observes Fermi Bubbles

Science Highlights

ALMA:

30 milli-arcseconds resolution 10x sensitivity, HL Tau planetary system formation + ultra-luminous galaxy with gravitationally-lensed image.

NuSTAR

exploding stars, black holes, pulsars, active galaxies, sun, & young supernova Cassiopeia A

Dark Energy Survey (DES)

Completed 2nd season of 5: Largest volume ever observed, survey with 1000 high-redshift supernovae, 20 trans-Neptunian minor planets, 8 new ultra-faint Milky Way companions

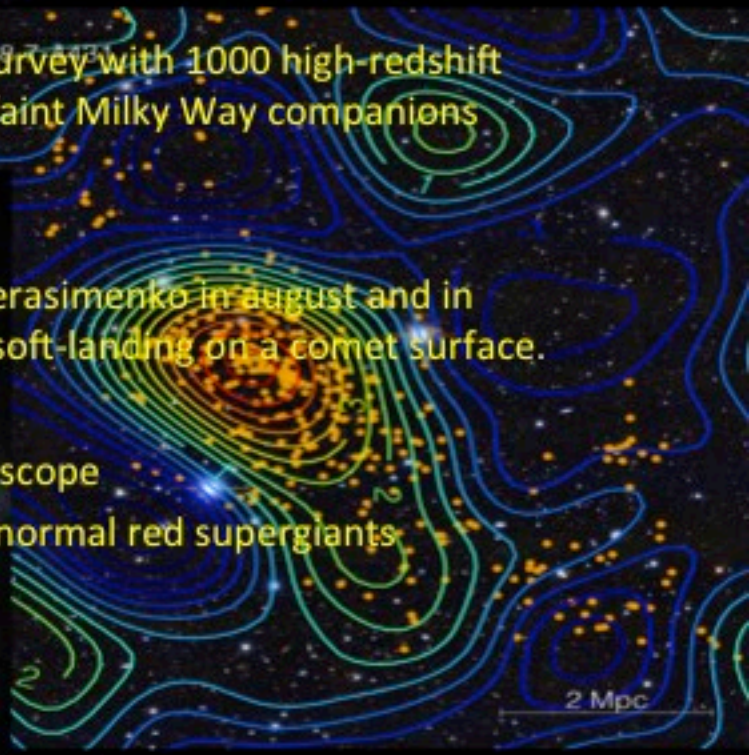
ESA *Rosetta* spacecraft

with NASA instruments arrived at Comet 67P/Churyumov–Gerasimenko in august and in November 12, 2014, deployed the Philae landing probe first soft-landing on a comet surface.

Thorne-Żytkow objects (TŻOs) discovered Magellan Clay telescope

red supergiant and neutron stars that superficially resemble normal red supergiants

HST observes Fermi Bubbles



Interagency Coordination and Cooperation

Some very successful examples:

NSF + DOE: SDSS, DES, VERITAS,…

starting **DESI** at Mayall and **LSST**

NASA + DOE: Fermi Gamma-ray Space Telescope

NASA + NSF: HST + Ground based telescopes

NOAO **WIYN 3.5 m**: NASA-NSF Exoplanet Observational Research (NN-EXPLORE) partnership

*1. FINDING: Thanks to a history of shared scientific goals and coordinated U.S. investment in Astronomy and Astrophysics, the U.S. program has achieved **many advances and breakthroughs over the past year**.*

*2. FINDING: Dealing with complex constraints, **U.S. agencies work well together** to support the priorities of the scientific community, both in collaboration on large managed projects and in coordination of diverse research programs.*

*3. FINDING: **Interagency cooperation and collaboration has increased in the last decade**, to the benefit of the science community.*

Status and Implementation of Decadal Surveys I

*4. FINDING: The **highest priorities of NWNH: WFIRST and LSST are moving forward**.*

*5. FINDING: **NSF/AST and DOE/HEP** have done an excellent job in coordinating their efforts to make sure that **LSST continues to make progress**. Some delays in LSST and associated cost increases have resulted from the federal budget standoffs, but the agencies have provided good management to minimize the impact on the project.*

*6. FINDING: **NASA effort to reformulate the WFIRST-AFTA concept is well underway**. The NASA plan offers the potential for realizing an even more powerful experiment for Dark Energy and Extrasolar planet science in a cost-neutral way.*

*7. FINDING: The **NSF MSIP program is funded at a level well below that envisioned in NWNH**, but is becoming the only mechanism available for funding the high priority activities advocated in NWNH. By combining support for strategic objectives with an unsolicited open call for proposals, the program may become so oversubscribed that it can no longer effectively serve the community.*

NWNH recom $40M/yr – current $14M to FY16 $18.72M (decreasing AAG)

Zwicky Transient Facility, Advanced ACTPol, and the Event Horizon Telescope, HERA

Status and Implementation of Decadal Surveys II

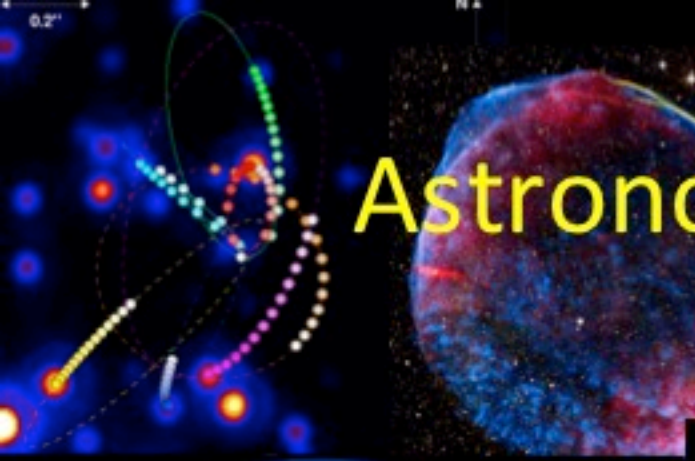
*8. FINDING: Despite budgetary constraints that did not allow progress on recommendations for a U.S. partnership in a large optical/infrared telescope (**GSMT**) and a major new X-ray telescope (**IXO**), the **NSF** is working on a U.S. Participation Plan for the **TMT** and **NASA** is anticipating future U.S. participation in the **ESA ATHENA** project providing future resources for the U.S. ground-based and X-ray communities.*

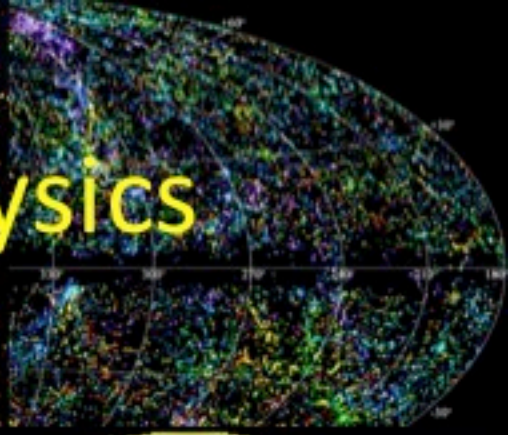
*9. FINDING: **NSF/AST and DOE/HEP** continue to support a strong **dark energy** program with **DES** and a new MIE start for **DESI** in FY2014. Along with **LSST** and **WFIRST/AFTA**, this broad-based program across all three agencies is an **excellent response to NWNH and P5 priorities in dark energy and cosmic acceleration**.*

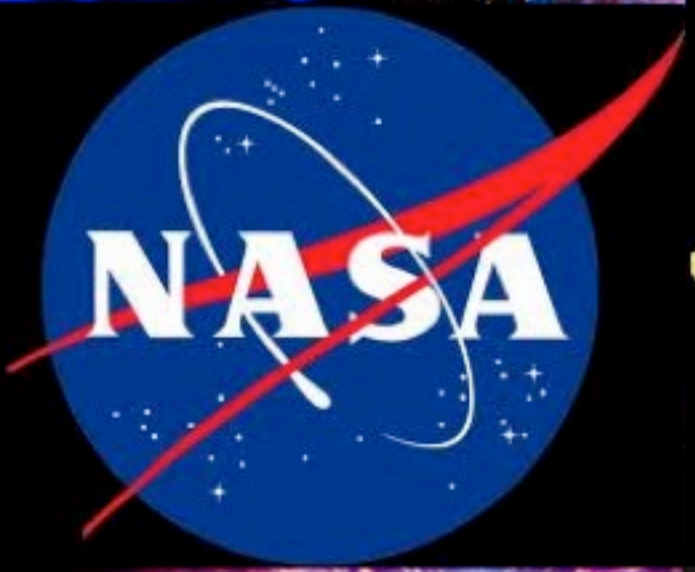
*10. FINDING: **DOE/HEP Cosmic Frontier and NSF/PHY Particle Astrophysics** have selected three **G2 direct detection dark matter** detectors to move forward, **however funding is not at the level recommended**. Both agencies will continue to make the case for funding these at the level needed to carry them out successfully.*

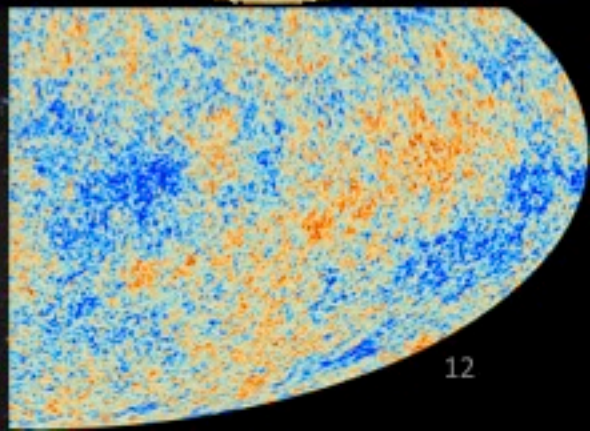
*11. FINDING: The **international CTA consortium** **is moving forward** to build the CTA observatory without **U.S. financial participation**. Despite **positive recommendations in NWNH and the P5 report**, **DOE has declined to support participation of U.S. scientists** in CTA. For NSF, the only available funding mechanisms to support CTA construction are the highly-competed **NSF/AST MSIP program and NSF/PHY Midscale Instrumentation Fund.***

Astronomy & Astrophysics

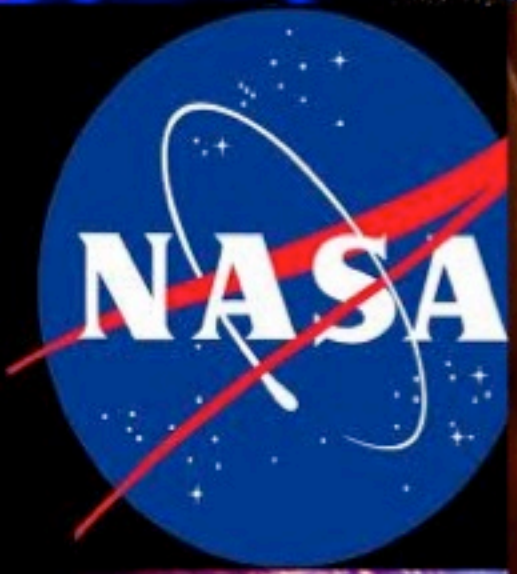


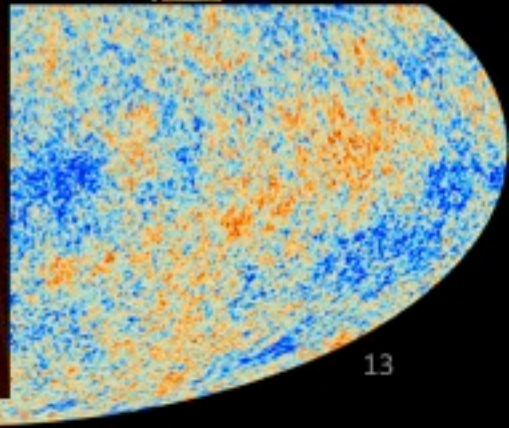






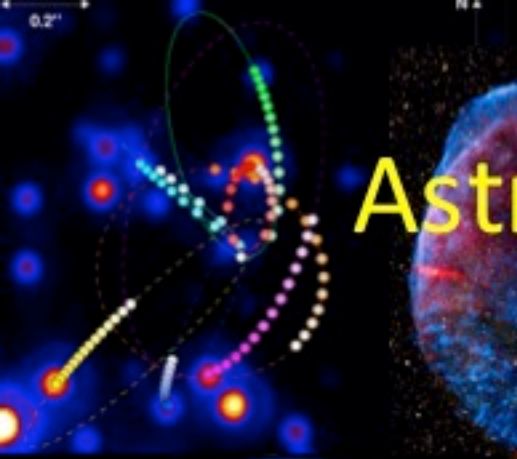
Astronomy & Astrophysics

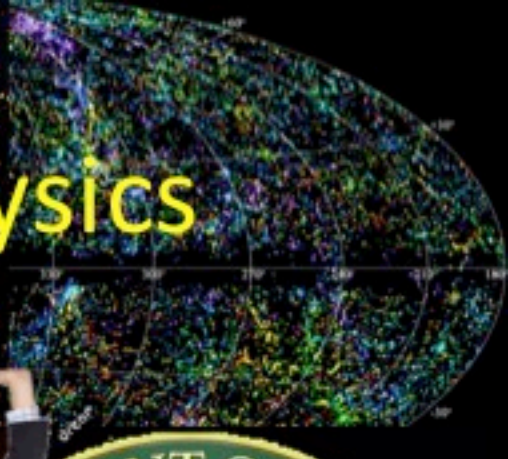


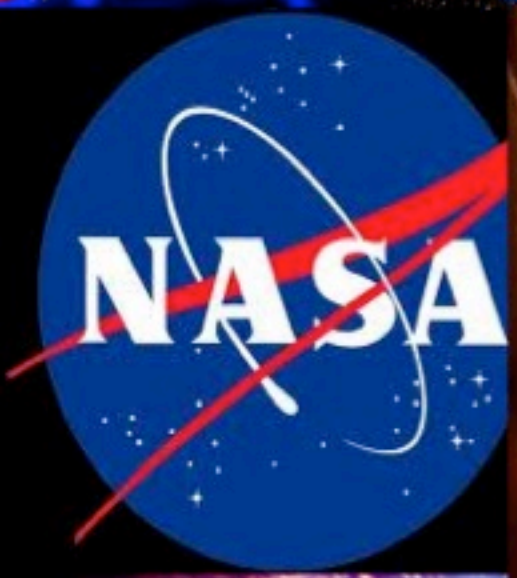


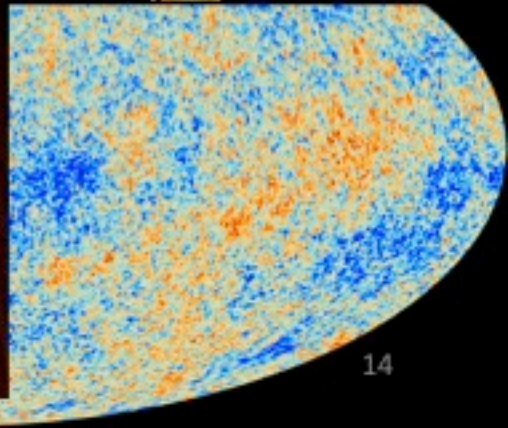
Astronomy & Astrophysics

CTA









Status and Implementation of Decadal Surveys III

12. FINDING: ***Gravitational wave science*** *remains one of the most exciting frontiers of physics and astrophysics, and its* ***future development will benefit greatly from cooperation among the three agencies****.*

13. FINDING: ***CMB science*** *clearly* ***crosses the boundaries of agencies****. As recommended by P5,* ***a larger role of DOE with NSF*** *is important to realize the great scientific potential of this enterprise*

1. RECOMMENDATION: ***We encourage DOE and NSF to continue working toward a plan for the next generation (stage-IV) ground-based CMB observatory***

2. RECOMMENDATION: ***The agencies should continue to pursue international partnerships in order to further accomplish the goals of NWNH. The Principles for Access[1] should guide the process.***

International Coordination and Cooperation

A&Aph is an international enterprise with opportunities for partnerships and challenges

2013-2014 AAAC report:

PRINCIPLES FOR ACCESS TO LARGE ASTROPHYSICS PROJECTS AND FACILITIES

THE PRIMARY GOAL OF THE ASTROPHYSICS COMMUNITY IS TO PRODUCE THE BEST SCIENCE RESULTS

GLOBAL COORDINATION

OPEN DATA

OPEN ACCESS

OPPORTUNITY TO CONTRIBUTE

RECIPROCITY:

Status of the Portfolio Review

KPNO 2.1m telescope: closed in August 2014, and for which NOAO has received proposals for partners to fund operations;

WIYN telescope: part of the new NASA-NSF Exoplanet Observational Research (NN-EXPLORE) partnership;

KPNO Mayall telescope: will host DESI, a survey funded by DOE;

McMath-Pierce Solar telescope and ***Dunn Solar telescope***: solar telescopes for which operating partners are being sought, and engineering studies are under way;

Green Bank Telescope and ***VLBA***: radio telescopes for which operating partners are being sought, and engineering studies are under way;

University Radio Observatories: now fall into the MSIP category. No previously funded facilities have received funding under the new classification and they are seeking partners for continued operation.

Status of the Portfolio Review

14. FINDING: The NSF Division of Astronomical Sciences has done a ***commendable job of finding creative solutions to achieve the divestment recommended by the Portfolio Review*** *without shutting down facilities. These actions serve to* ***reduce their operating budgets and thus to enable key scientific priories in NWNH****.*

15. FINDING: Divestments recommended by the Portfolio Review are proceeding, but at a slower pace due to complexities of the divestment process.

16. FINDING: ***The loss of open access facilities*** *from the NSF portfolio does not come without a* ***cost to the U.S. user communities****, in terms of loss of open nights and access to a variety of instruments and science. This loss is especially critical for the* ***researchers at institutions without their own telescope access*** *or who use ground-based facilities that provide unique science capabilities.*

3.RECOMMENDATION: ***Vigorous activities toward divestments recommended by the Portfolio Review should continue****, along with agency efforts to explore partnerships, interagency cooperation and private resources to maintain some access to these facilities or their capabilities for the U.S.* ***Divestments are necessary to increase the available funding for both strategic and unsolicited midscale and individual investigator programs.***

Mid-Decadal Review

17. FINDING: The ***agencies are commended for their collaboration in developing the mid-decadal survey process****. This is the first mid-decadal review to include the NSF and DOE. They are successfully navigating the uniqueness of each agency, while maintaining a high level of coordination.*

Budget Summary and Impact

Budget in $M	FY 2014	FY 2015	FY 2016 Req.	change 16-15	change 16-14
NASA Astrophysics (NASA/APD)	$678.3	$726.8	$709.1	-2.4%	4.5%
NSF Astronomical Sciences (NSF/AST)	$238.4	$244.2	$246.6	1.0%	3.4%
DOE HEP Cosmic Frontier (DOE/HEP CF)	$96.9	$105.5	$119.3	13.1%	23.1%
Totals	$1,013.6	$1,076.5	$1,075.0	-0.1%	6.1%
James Webb Space Telescope (JWST)	$658.2	$645.4	$620.0	-3.9%	-5.8%
DOE Large Synoptic Survey Telescope (LSST)	$22.0	$35.0	$40.8	16.6%	85.5%
NSF Large Synoptic Survey Telescope (LSST)	$27.5	$79.6	$99.7	25.3%	262.5%
Daniel K. Inouye Solar Telescope (DKIST)	$36.9	$25.1	$20.0	-20.3%	-45.8%

*18. FINDING: The 2016 President's Budget request proposes an overall **6% increase in R&D investment, while astronomy and astrophysics (NAF/AST, NASA/APD, DOE/HEP CF) would be flat (-0.1%)** in nominal dollars before inflation, when large facility/mission construction is not included.*

*4. RECOMENDATION: We urge the agencies and Congress to recognize the important role of basic research to the future of our country, including the special contributions that astronomy and astrophysics can offer. **Additional investments will lead to great advances and breakthroughs and the bold vision for U.S. astronomy and astrophysics endorsed in the NWNH report.***

Proposal Pressures Study Group

AAAC with reps CAA, AAS, NAC

The protracted time of constrained budgets led to **declining success rate of proposals** – leads to waste (time and funds) for scientists and agencies, and discourages the next generation. In response, we have begun a **yearlong** study of the underlying causes of this worrisome trend and the impact it could have on the field, with **a report expected by the end of 2015**.

AAAC
Prisca Cushman, University of Minnesota.
Jim Buckley, Washington University.
Angela Olinto, University of Chicago.
AAS CAPP
Todd Hoeksema, Stanford University.
James Lowenthal, Smith College.
NASA NAC
Brad Peterson, The Ohio State University.
APS
Keivan Stassun Vanderbilt University

Proposal Pressures Study Group

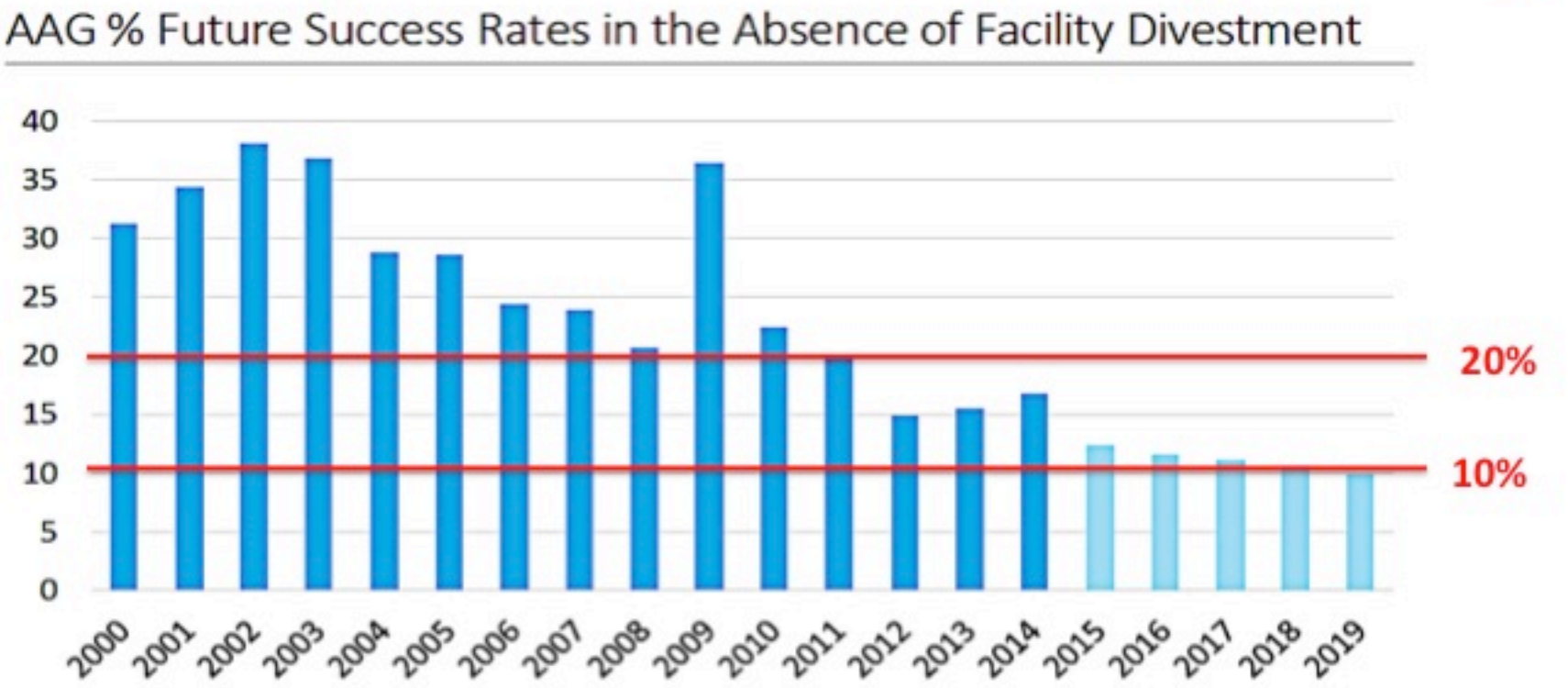
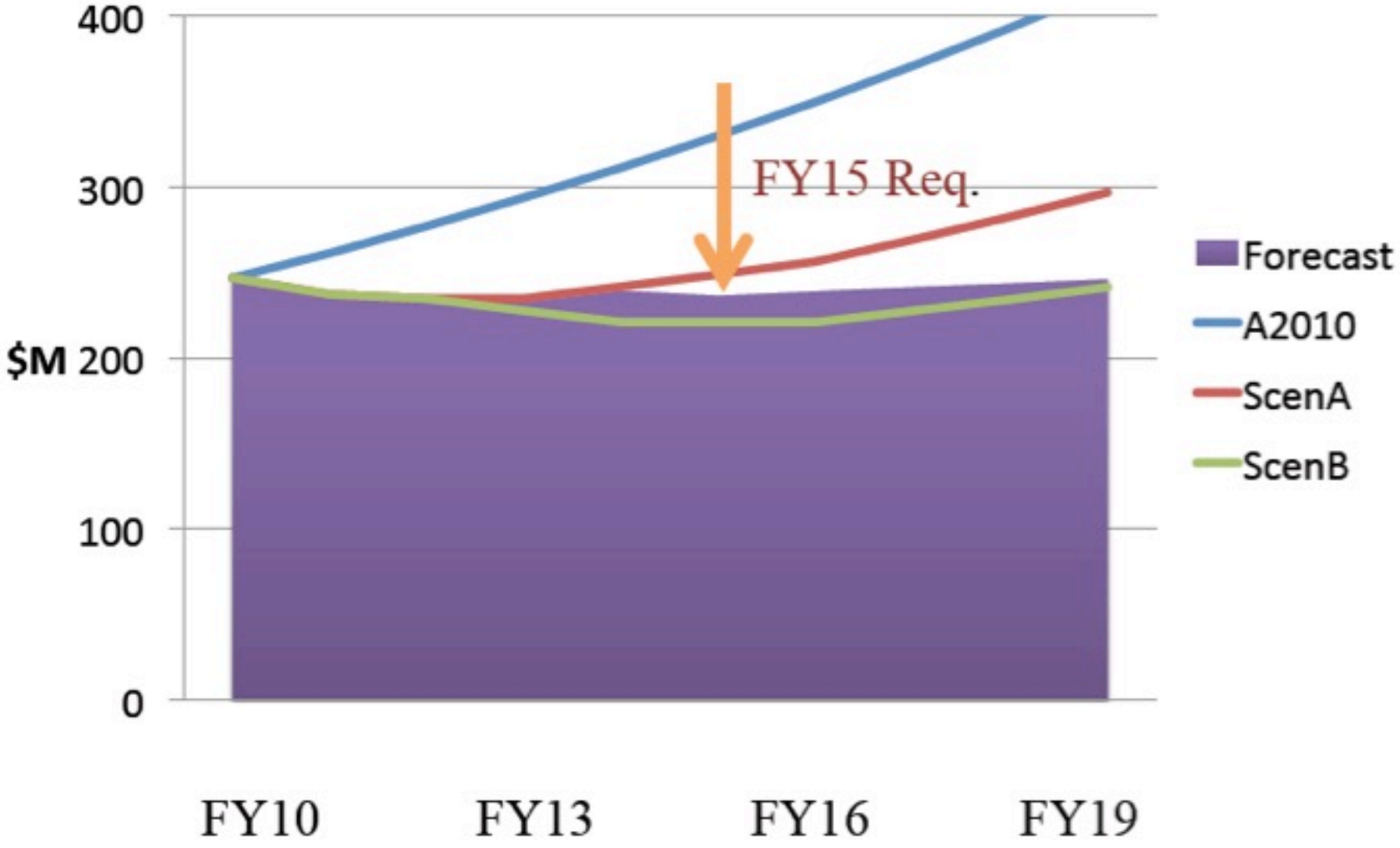


Figure 1. Projected NSF/AST (AAG) proposal success rate in the absence of facility divestment. If divestment continues on schedule, the budget continues flat, and the number of proposal submissions does not increase substantially, the success rates will remain at roughly 15%. (Data from NSF/AST.)

http://www.nsf.gov/attachments/131083/public/Dan-Evans_AST_Individual_Investigator_Programs-AAAC_Meeting.pdf

NWNH Budget vs. Actual Budget



Proposal Pressures Study Group

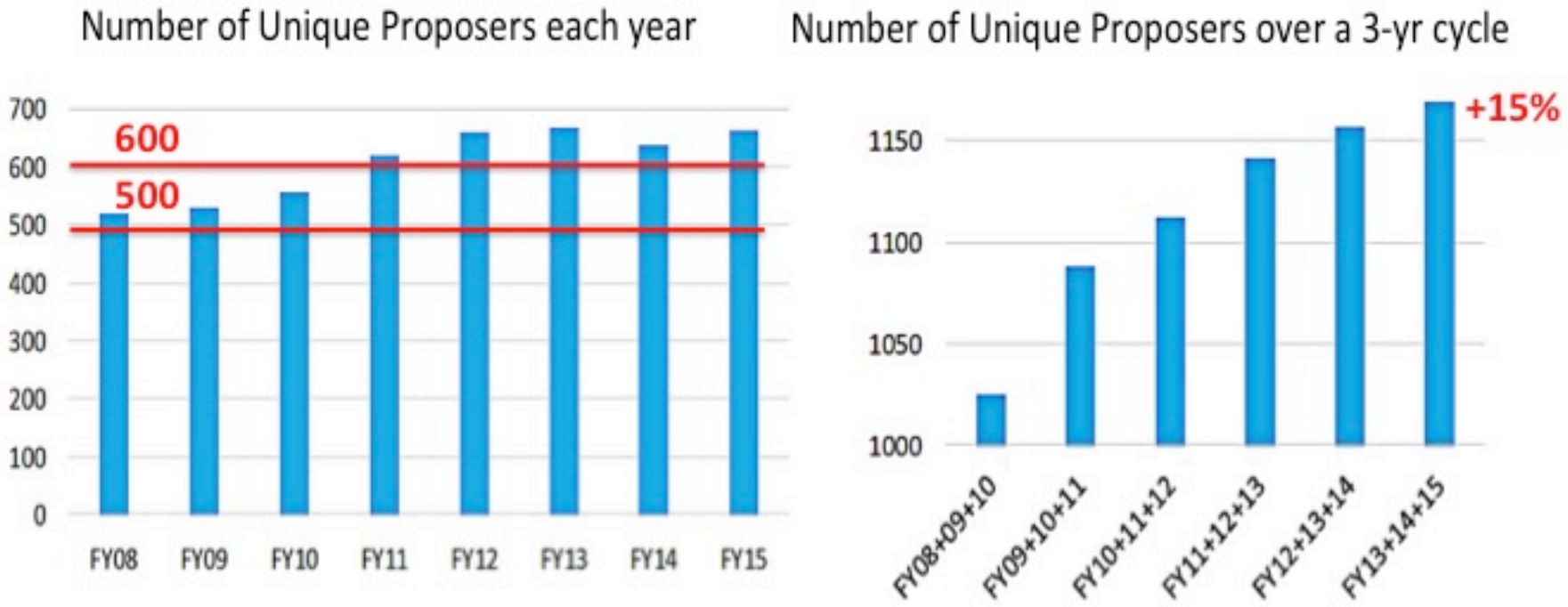


Figure 2. Trending plots showing the number of unique individuals submitting to NSF/AST AAG program as PI each year, as well as the sum over 3 years corresponding to a typical grant cycle. Declined proposals can be re-submitted the next year, but PIs with accepted proposals will not resubmit for the same project until after 3 years. (Data from NSF/AST.)

Proposal Pressures Study Group

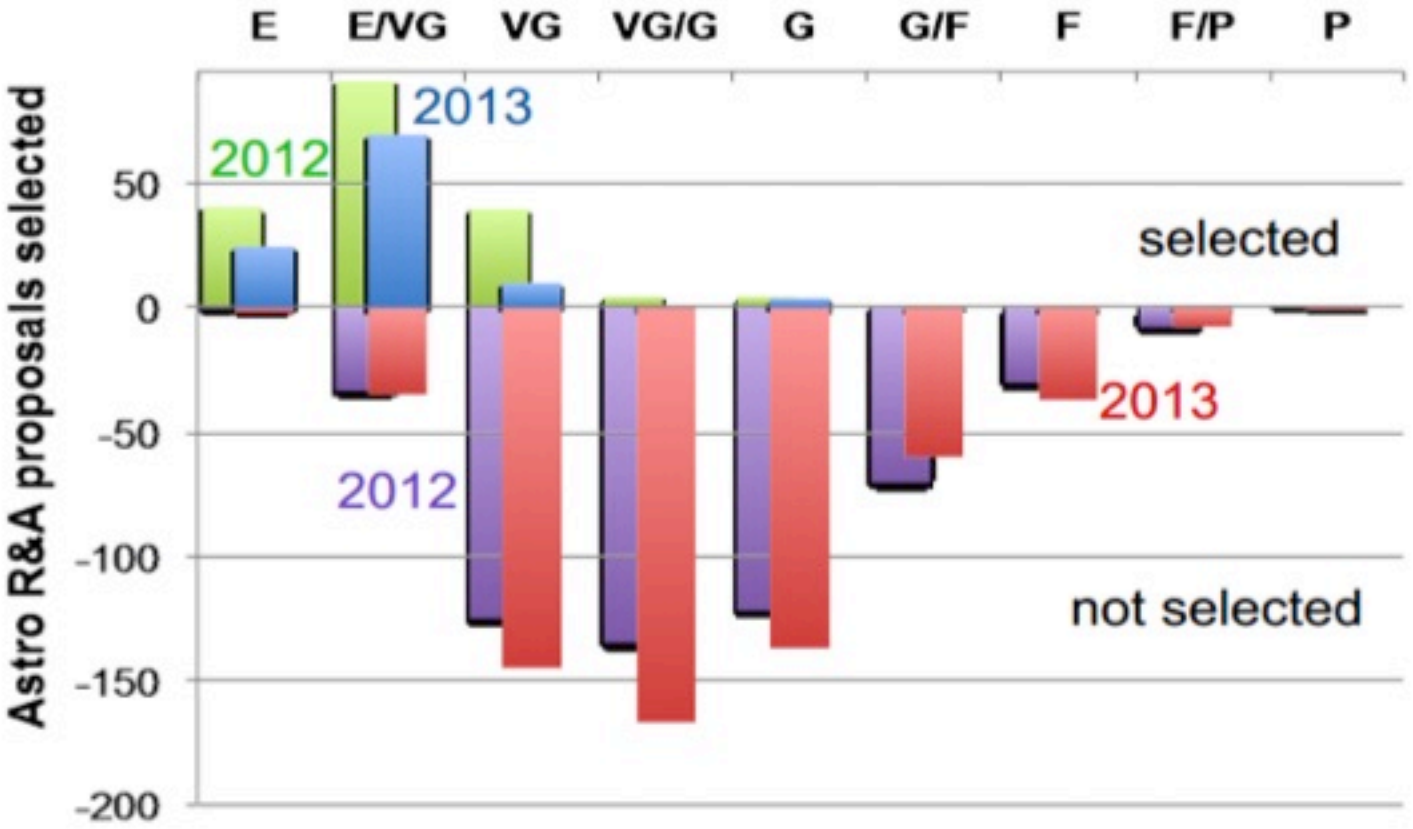
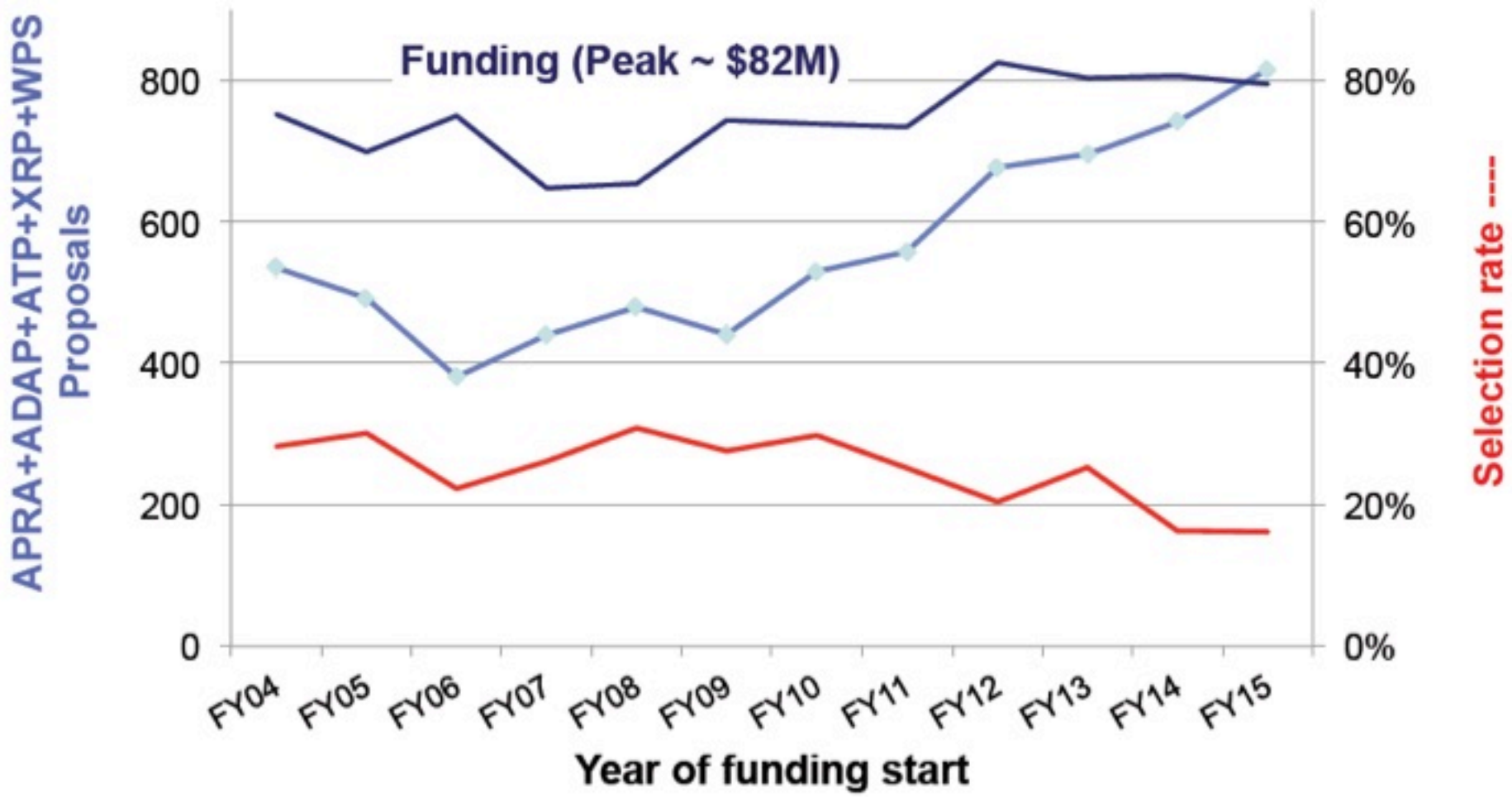


Figure 3: Number of NASA Astrophysics R&A proposals selected (above zero on vertical axis) or declined (below zero) in FY12 and FY13.

Astrophysics ROSES selection rates



Proposal Pressures Study Group

19. FINDING. *Over the last decade,* ***the number of individuals submitting proposals to NSF and NASA in the fields of astronomy and astrophysics is increasing faster than the funding profile, causing a corresponding drop in selection rate.*** *A* ***larger fraction of very good to excellent proposals are unsuccessful now than in the past****. Such a* ***low selection rate for*** *very good proposals* ***is incompatible with the healthy individual investigator programs recommended by NWNH,*** *and may represent* ***a significant loss of science.***

20. FINDING. *After accounting for changes in agency opportunities,* ***NSF and NASA data show that the PIs submitting these proposals have remained a relatively stable demographic entity*** *in terms of race, gender, number of years since PhD, and type of Institution.*

21. FINDING. ***A falling success rate impacts both researchers and agencies****. Researchers spend a larger fraction of time re-submitting proposals and serving on multiple review panels. Agencies must deal with an increased workload, staffing problems, and ensuring fair review panels with sufficient reviewers.*

5. RECOMMENDATION: *The* ***agencies should continue to work with the astronomy and astrophysics community to clarify and quantify the underlying factors contributing to the declining success rate seen at NASA and NSF, and develop data-driven ideas for managing the problem.***

Thank you

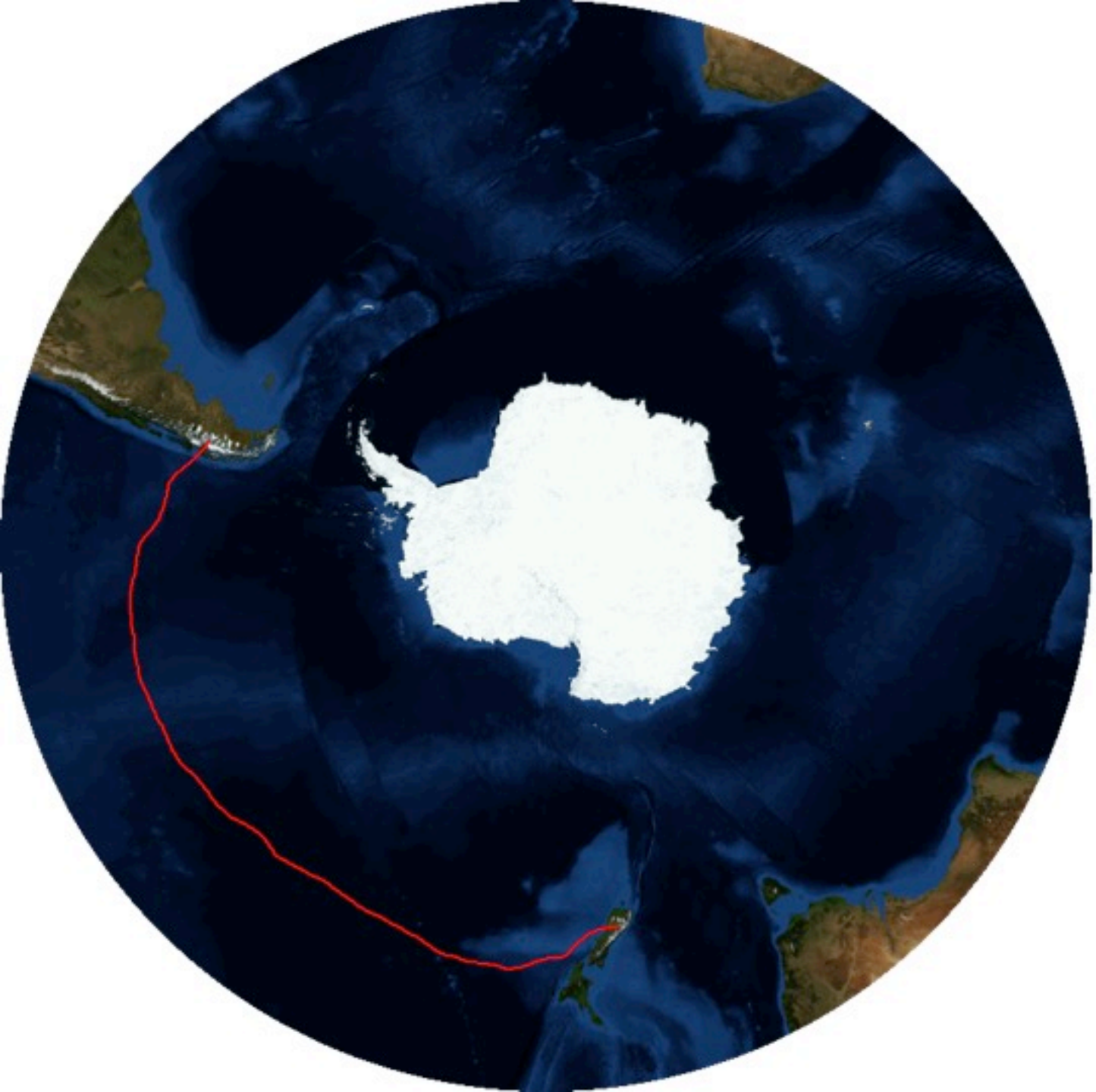
1. RECOMMENDATION: We encourage DOE and NSF to continue working toward a plan for the next generation ***(stage-IV) ground-based CMB observatory***

2. RECOMMENDATION: The agencies should continue to ***pursue international partnerships*** in order to further accomplish the goals of NWNH. ***The Principles for Access***[1] should guide the process

3.RECOMMENDATION: Vigorous activities toward ***divestments*** recommended by the ***Portfolio Review*** should continue, along with agency efforts to explore partnerships, interagency cooperation and private resources to maintain some access to these facilities or their capabilities for the U.S. Divestments are necessary to increase the available funding for both strategic and unsolicited midscale and individual investigator programs.

4. RECOMENDATION: We urge the agencies and Congress ***to recognize the important role of basic research*** to the future of our country, including the special contributions that astronomy and astrophysics can offer. Additional investments will lead to great advances and breakthroughs and the bold vision for U.S. astronomy and astrophysics endorsed in the NWNH report.

5. RECOMMENDATION: The agencies should continue to work with the astronomy and astrophysics community to clarify and ***quantify the underlying factors contributing to the declining success rate*** seen at NASA and NSF, and develop data-driven ideas for managing the problem.

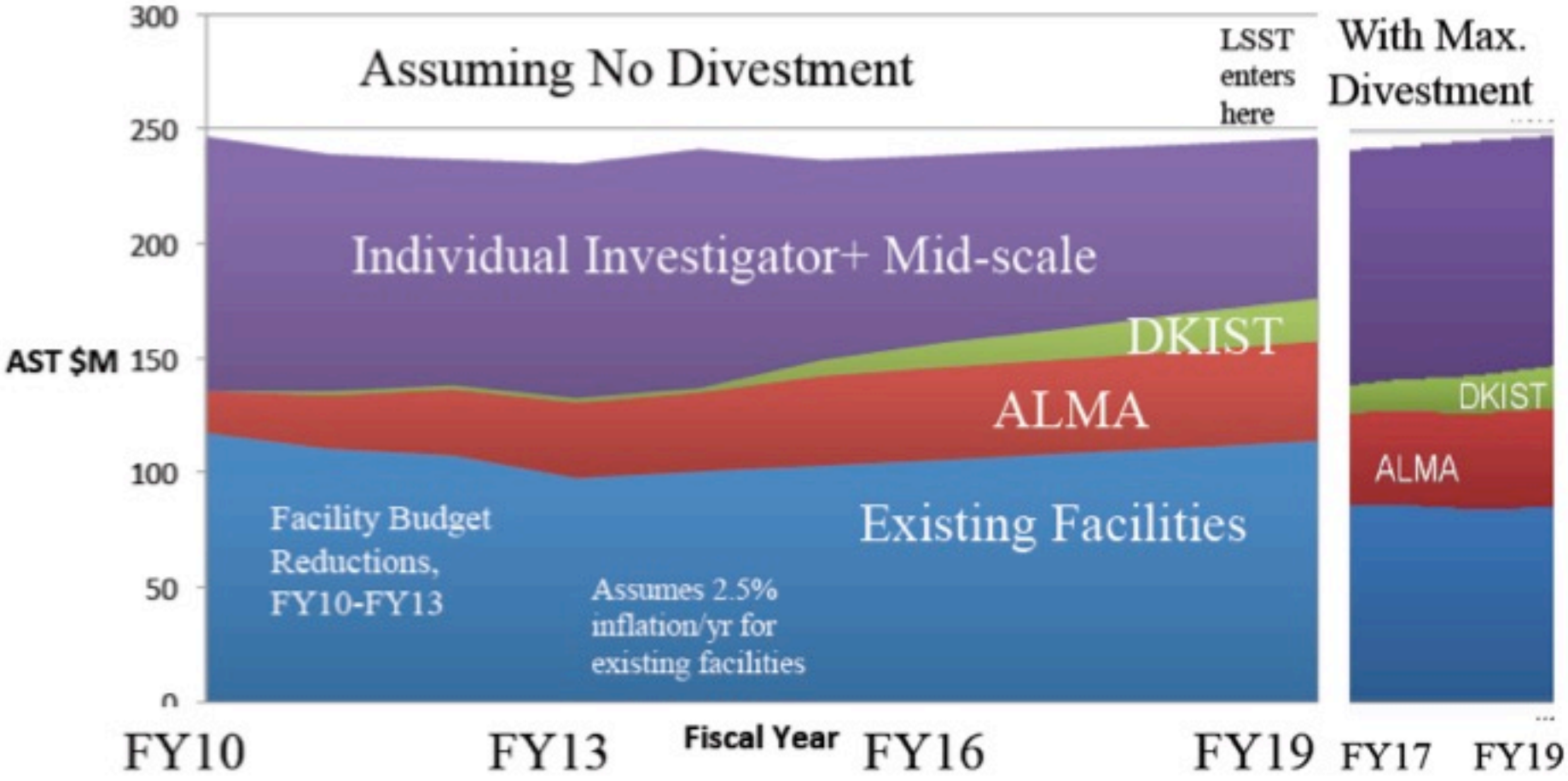


Payload position as of:
17:44:17Z 04/01/15

Latitude: 48°18.76 S
Longitude: 72°29.21 W
Altitude: 109775 Feet
59.37 Knots @ 99.00°

Back Up

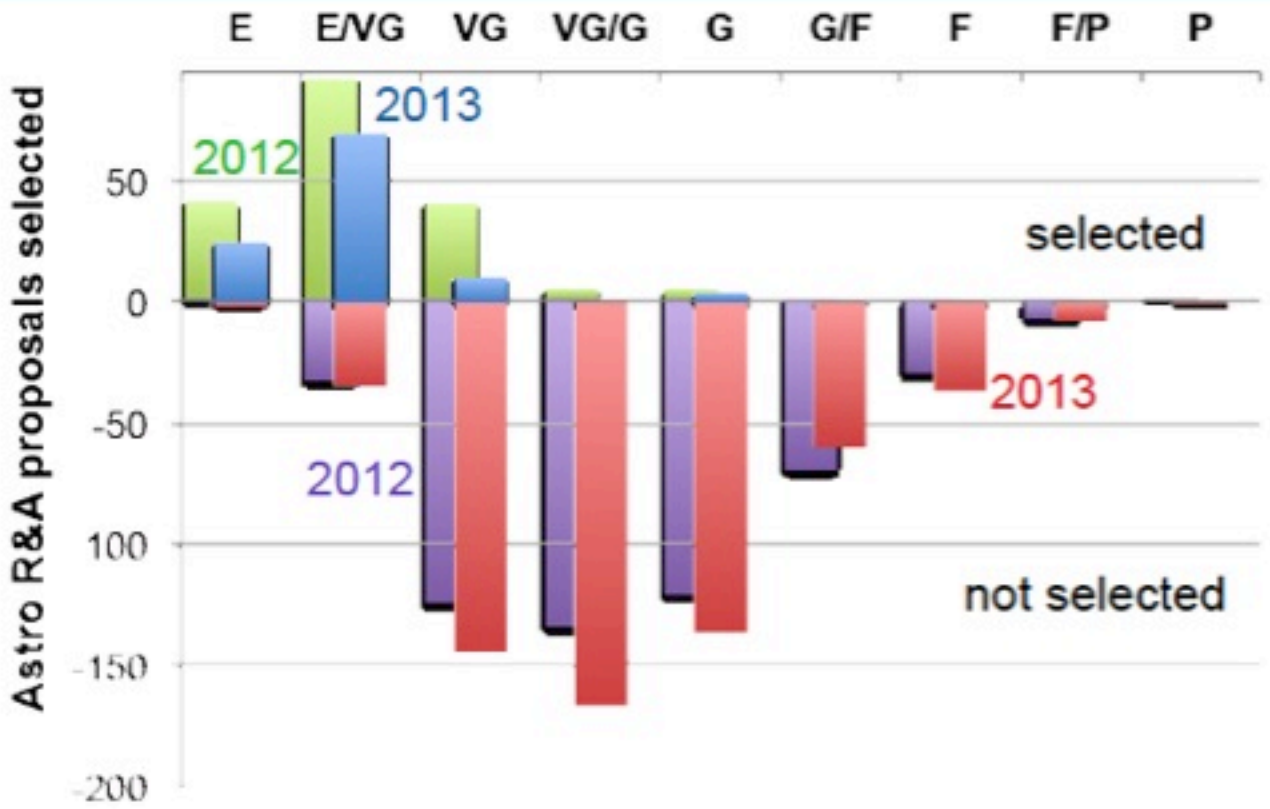
AST Portfolio Scenarios



AST budget assumption: FY15=Request, 1%/yr growth thereafter

J. Ulvestad NSF

Astrophysics ROSES selections by rating



Of 726 proposals to the Astrophysics core R&A program (ADAP, APRA, SAT, ATP, OSS) in 2012, 25% were selected (green); 75% were declined (purple). Of 339 proposals rated VG or better, 51% were selected.

Of 713 proposals to these programs in 2013, 17% were selected (blue); 83% were declined (red). Of 299 proposals rated VG or better, 39% were selected.