AST Portfolio Review Webinar

October 23, 2012

Portfolio Review Website: http://www.nsf.gov/mps/ast/ast_portfolio_review.jsp

Introduction to MPS/AST Portfolio Review

AST Portfolio Review Webinar

October 23, 2012

Jim Ulvestad, MPS/AST Division Director

Why Conduct a Portfolio Review?

- Foreseeable budgets will not be sufficient to meet the aspirations of the astronomical community

- NRC decadal survey in Astronomy & Astrophysics advised: "If … budget is truly flat … there is no possibility of implementing … the recommended program … without … enacting the recommendations of the first 2006 senior review and/or … a second more drastic … review before mid-decade." (p. 240)

- Such reviews should be carried out periodically in any case, for responsible stewardship of the AST portfolio

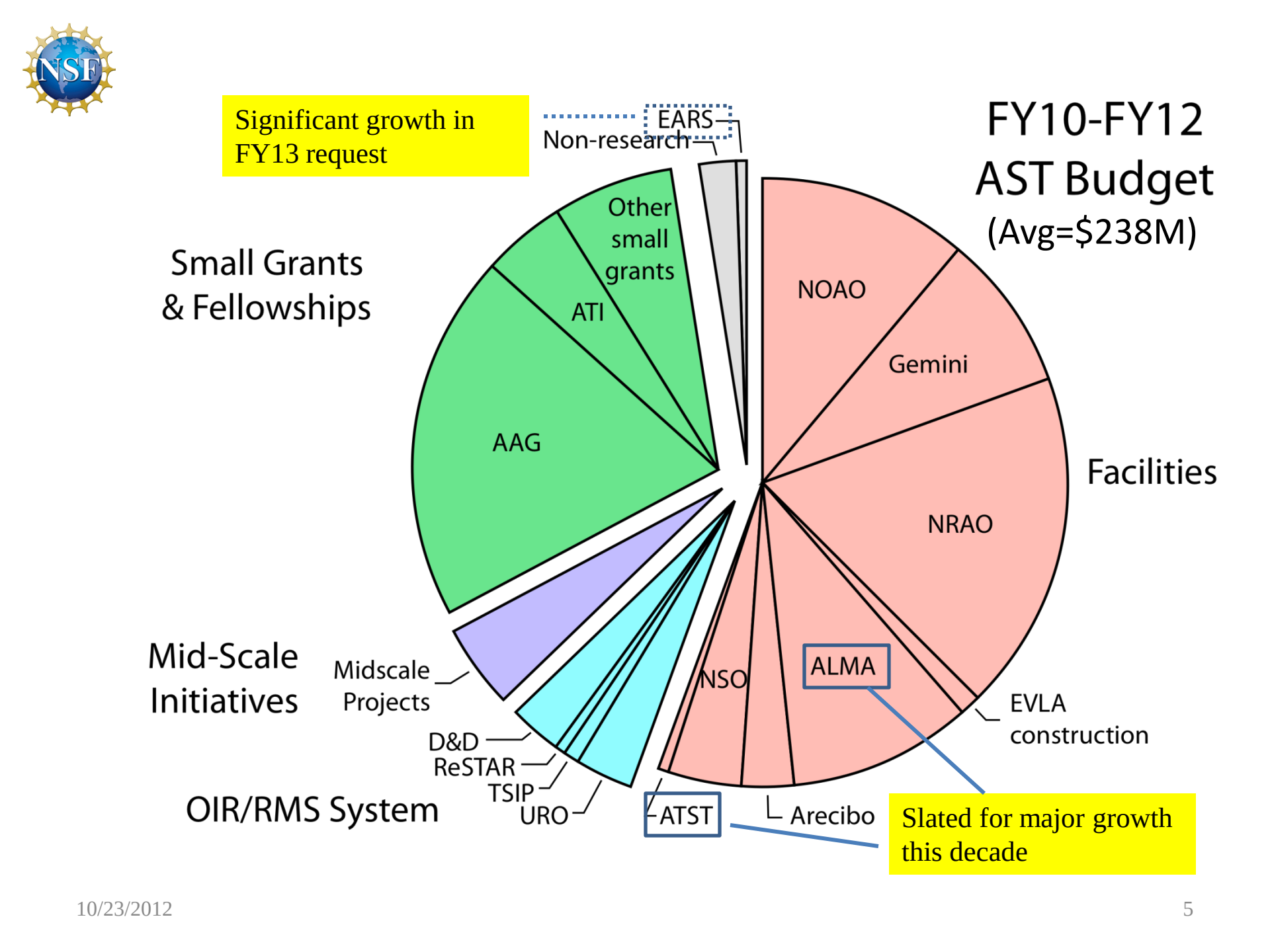
Over-riding Goals

- Foster U.S. leadership in ground-based astronomical research in 2020 and beyond
- Look to the future of scientific advances and our community under a more constrained budget environment
- Achieve the balance that enables the most progress on the key scientific questions from the recent decadal surveys

Facility/PI Balance

- AST is naturally a discipline that relies on state-of-the-art facilities, and thus must pay continual attention to the appropriate balance.

- Historical balance
  - Facility/PI grants ratio evolved from 65/35 in late 1990s to 53/47 by 2008
  - Constrained AST budgets since 2010, combined with ALMA Operations ramp, have shifted the facility/PI ratio to 58/42
  - Balance differs from overall NSF balance (22-27% in research infrastructure) because of the facility-intensive nature of astronomy


Significant growth in FY13 request
FY10-FY12 AST Budget (Avg=$238M)
EARS
Non-research
Other small grants
ATI
AAG
Small Grants & Fellowships
NOAO
Gemini
NRAO
Facilities
EVLA construction
ALMA
NSO
Arecibo
ATST
Midscale Projects
D&D
ReSTAR
TSIP
URO
Mid-Scale Initiatives
OIR/RMS System
Slated for major growth this decade

Starting Points: National Academy Decadal Surveys

- ***New Worlds, New Horizons*** Chapter 2 (Science Frontiers questions) and ***Vision and Voyages*** Chapter 3 are the driving forces

- Boundary conditions: No re-visiting decadal survey recommendations, and science priorities
  - I.e., take decadal surveys as a "given", and interleave their recommendations with existing capabilities

- "Capabilities" includes facilities, programs (including grants), and state of the profession

- External committee of 17 scientists, Chaired by Daniel Eisenstein of Harvard

Subcommittee Makeup

- 17 scientists, chaired by Dr. Daniel Eisenstein (Harvard)
  - Committee was constructed based on many balancing characteristics, including (but not limited to) science area, wavelengths (or theory) used, geographic/gender/ethnic/institutional diversity, career stage, etc.
  - One member of Advisory Committee for Mathematical and Physical Sciences Directorate
  - Employees of national observatories or their managing organizations not included because of conflict-of-interest rules
    - Interests represented by past/present members of users committees, advisory committees, boards, etc.
    - National observatories also asked for targeted input

Committee Membership

- Daniel Eisenstein (Chair, Harvard University)
- Joe Miller (Vice-Chair, University of California at Santa Cruz)
- Marcel Agueros (Columbia University)
- Gary Bernstein (University of Pennsylvania)
- Geoffrey Blake (California Institute of Technology)
- John Feldmeier (Youngstown State University)
- Debra Fischer (Yale University)
- Chris Impey (University of Arizona)
- Cornelia Lang (University of Iowa)
- Amy Lovell (Agnes Scott College)
- Melissa McGrath (NASA Marshall Space Flight Center)
- Michael Norman (University of California at San Diego)
- Angela Olinto (University of Chicago)
- Karel Schrijver (Lockheed Martin Advanced Technology Center)
- Michael Skrutskie (University of Virginia)
- Juri Toomre (University of Colorado)
- Rene Walterbos (New Mexico State University)

Two-Phase Committee Charge

1. **Recommend the *critical capabilities* needed over the period from 2015 to 2025 that would enable progress on the science program articulated in the Astronomy & Astrophysics and Planetary Decadal Surveys.** (Not only observational capabilities, but also theoretical, computational, laboratory, research support, workforce, education)

2. **Recommend the *balance of investments* in new and in existing, but evolved, facilities, grants programs, and other activities that would deliver the needed capabilities within the constraints of each of the provided budgetary scenarios.** (May include closure or divestment of facilities, termination of programs and other activities.)

Portfolio Review Timeline

- September 2011: Start
- April 2012: 3rd of 3 face-to-face meetings
- July 13, 2012: Penultimate draft report sent to MPSAC internal reviewers for comment
- July 31 2012: Final draft report submitted to MPS
- August 16, 2012: MPS Advisory Committee telecon and vote on acceptance
- August 31, 2012: MPS/AST Response posted
- Aug-Oct, 2012: Various stakeholder briefings
- October 23, 2012: Community webinar

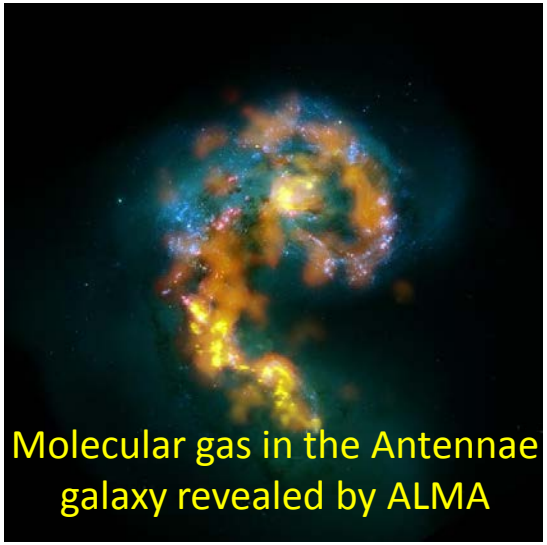
Advancing Astronomy in the Coming Decade: Opportunities and Challenges

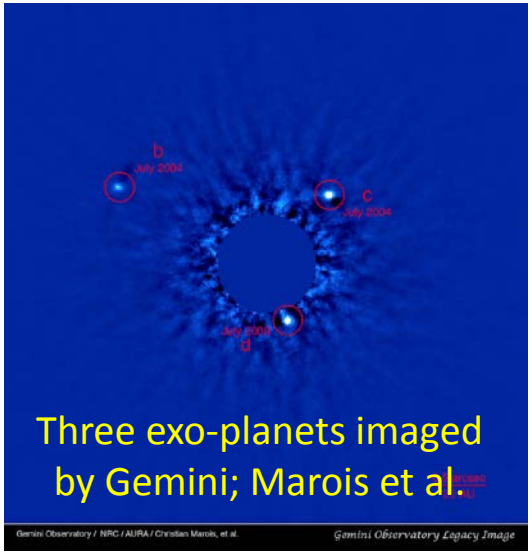
Report of the
National Science Foundation
Division of Astronomical Sciences Portfolio Review Committee

Daniel Eisenstein, Chair

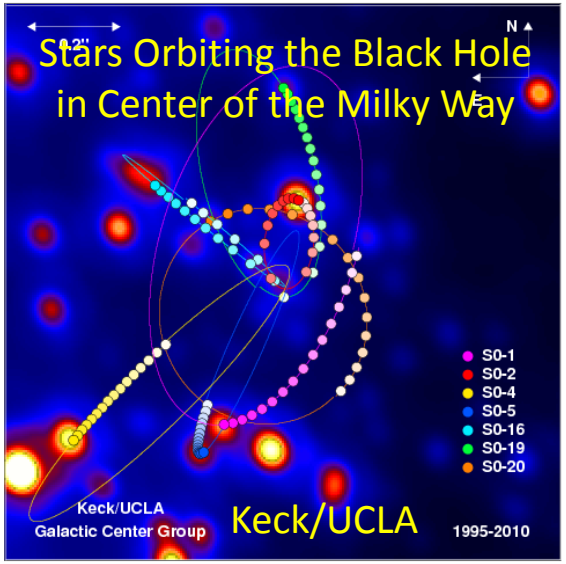
Astronomy in the 21st Century

- We are in a golden age of Astronomy.
- Enormous progress on many fronts: from cosmology to exo-planets to the formation of stars, galaxies, and black holes.
- U.S. has a vigorous and effective leadership position in the field.

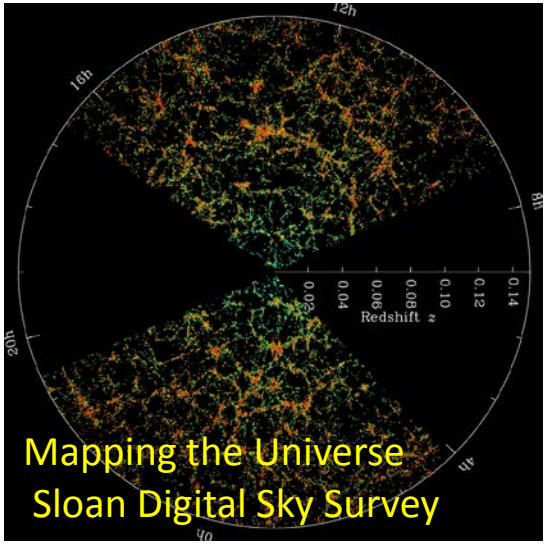

Molecular gas in the Antennae galaxy revealed by ALMA



Three exo-planets imaged by Gemini; Marois et al.



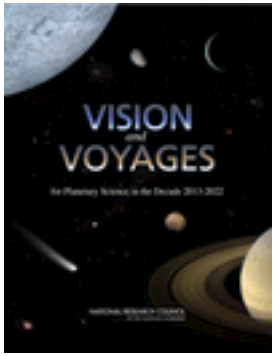
Stars Orbiting the Black Hole in Center of the Milky Way
Keck/UCLA



Mapping the Universe Sloan Digital Sky Survey

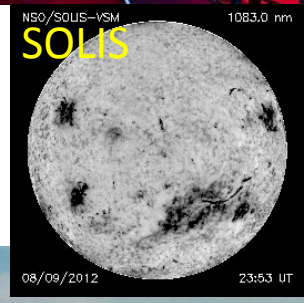
Planning for the Next Decade

- Astronomy sets priorities for major new initiatives via National Academy of Sciences decadal surveys.
  - Most recently, *New Worlds, New Horizons (NWNH)* and *Vision & Voyages (V&V)*.

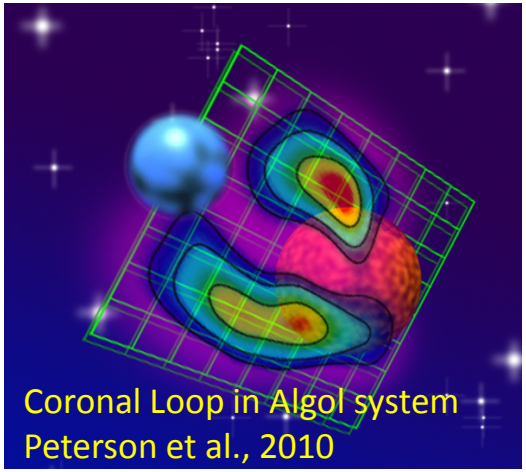


- However, NSF must set priorities between these new initiatives and its current programs and facilities. This is the purpose of our committee.
- Portfolio Reviews are essential for proper stewardship even in strong budget climates. Astronomy is driven by state-of-the-art technology and new ideas. To maintain U.S. leadership in the field, we must balance existing projects and facilities relative to what is possible in the future.
- This task is made more important by the fact that budget forecasts are now more pessimistic than assumed by *NWNH*.

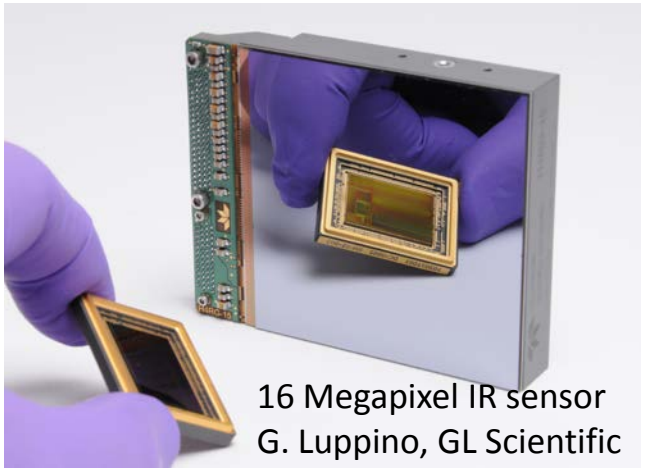
NST/AST: State-of-the-Art Facilities



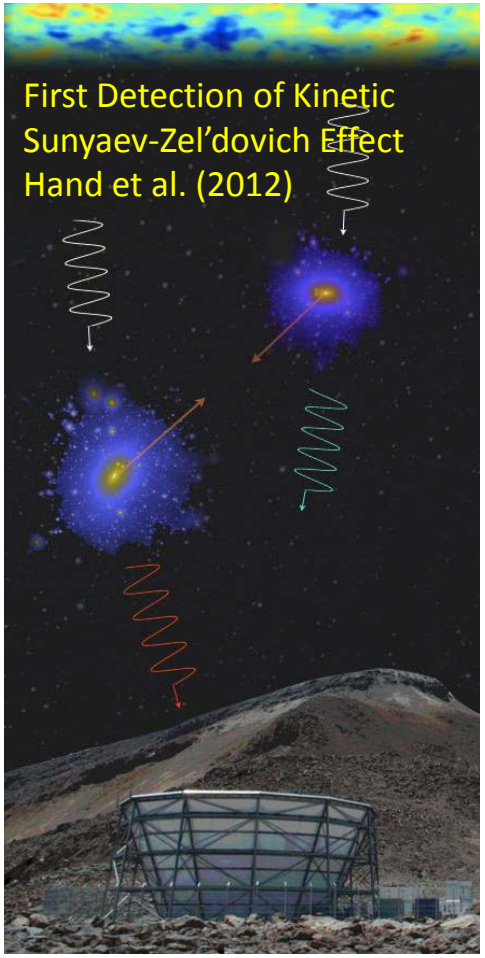
NSF/AST: Vigorous Grants Programs



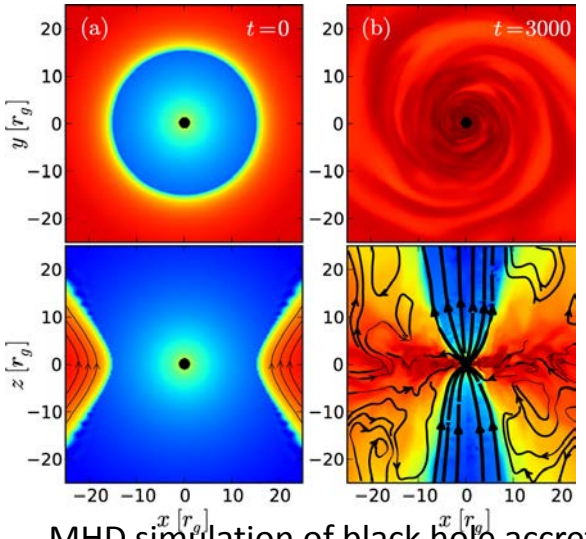
Coronal Loop in Algol system
Peterson et al., 2010



16 Megapixel IR sensor
G. Luppino, GL Scientific



First Detection of Kinetic Sunyaev-Zel'dovich Effect
Hand et al. (2012)

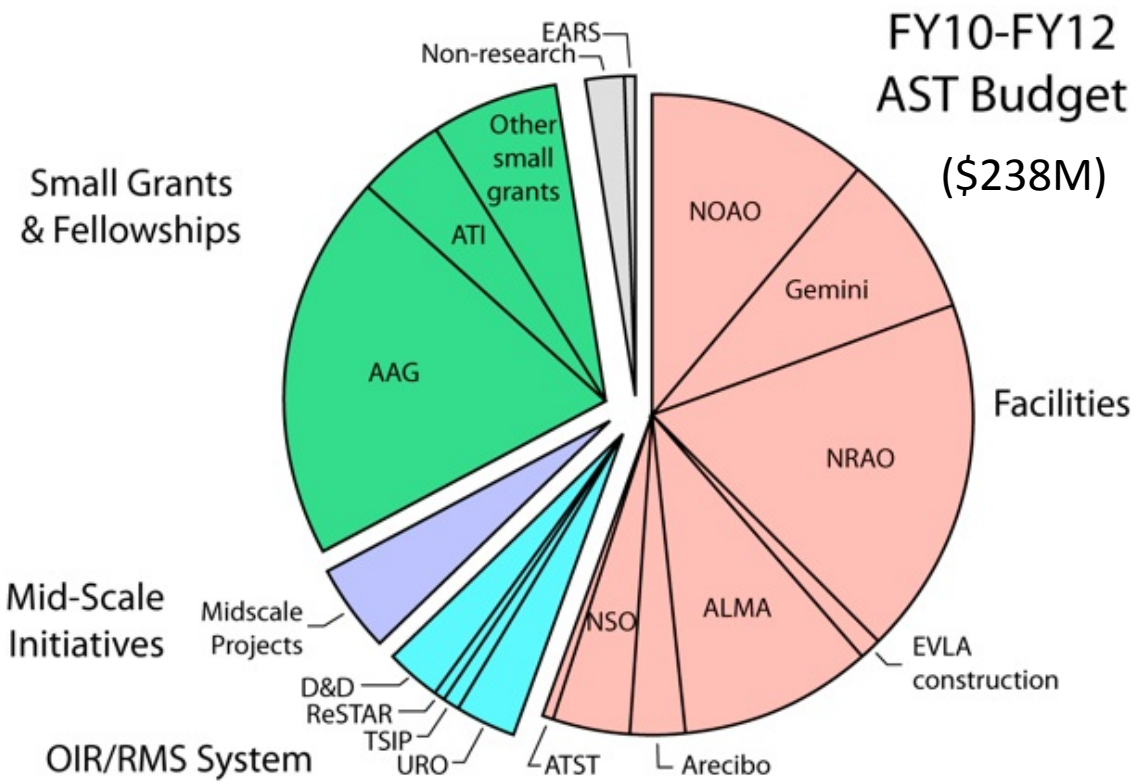


MHD simulation of black hole accretion
Tchekhovskoy & Narayan

Astronomy & Astrophysics
Postdoctoral Fellowship

An Overview of the AST Portfolio

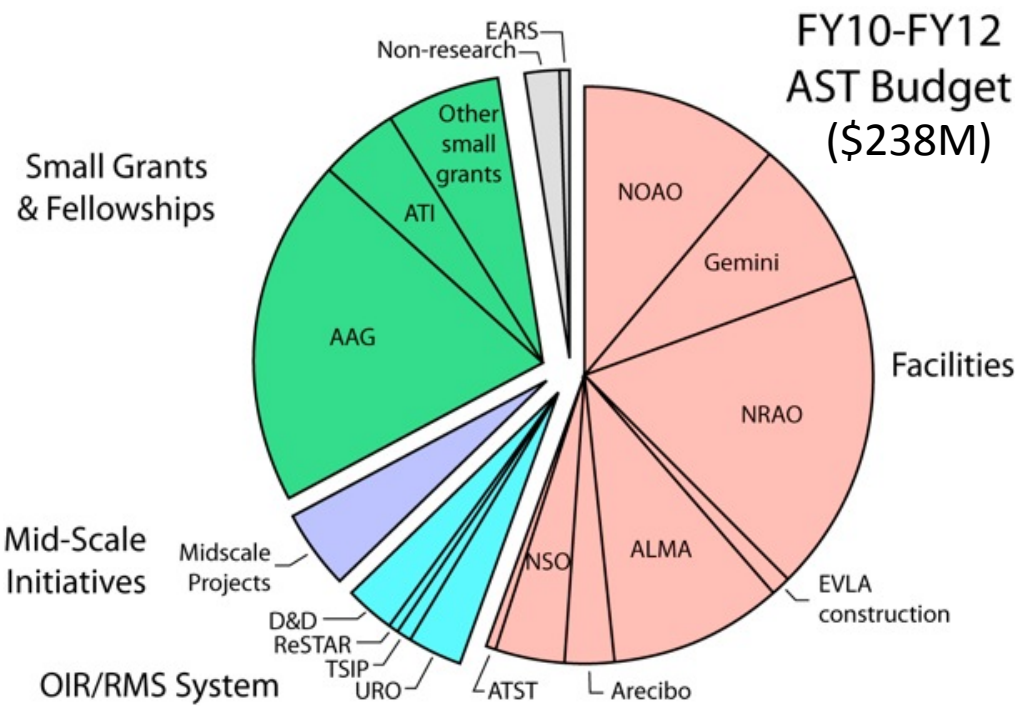
- AST supports a wide variety of activity.
  - State-of-the-art facilities in optical, radio, and solar astronomy.
  - Small-grants programs to support individual researchers.
  - Mid-scale projects, e.g., surveys & instrumentation.
  - Support of instrumentation and operations at non-NSF facilities.
- All of these are important!



Our Report adopts the average of FY10, FY11, and FY12 as today's baseline.

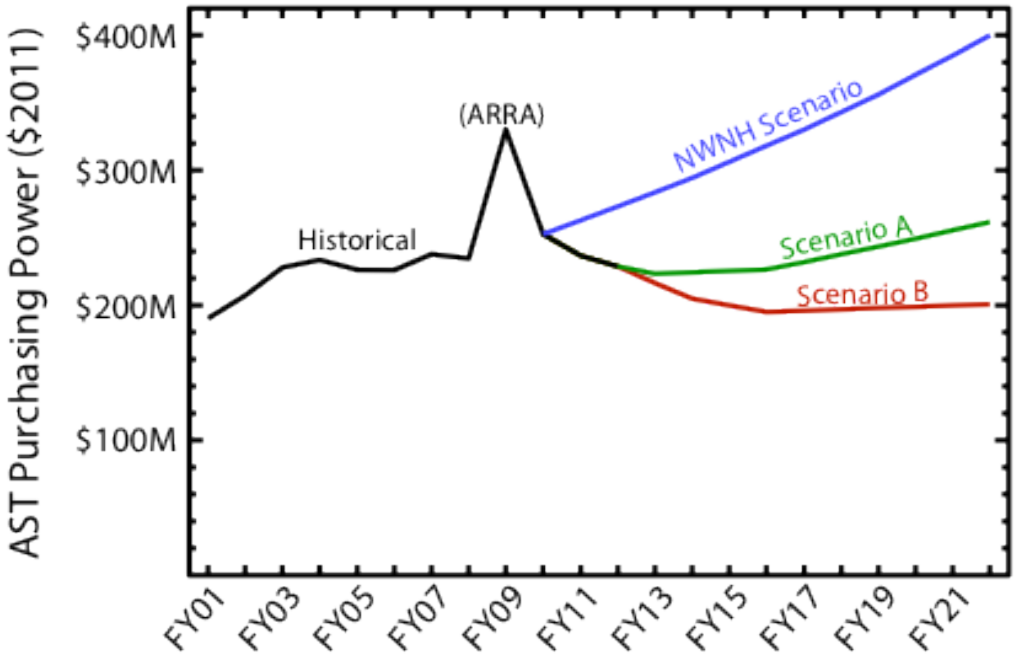
AST Budget Challenge: Part I

- Major new facilities are under construction.
- ALMA operations are ramping up to a U.S. share of about $40M/year (up from $23M in this chart).
- ATST operations later in the decade will ramp up to nearly $20M/year.
- Relative to this pie chart, the added cost is 15%.
- Unless the overall budget increases, this must displace something else.



AST Budget Challenge: Part II

- After correcting for inflation, the AST budget has dropped by 5% in each of FY11 and FY12.

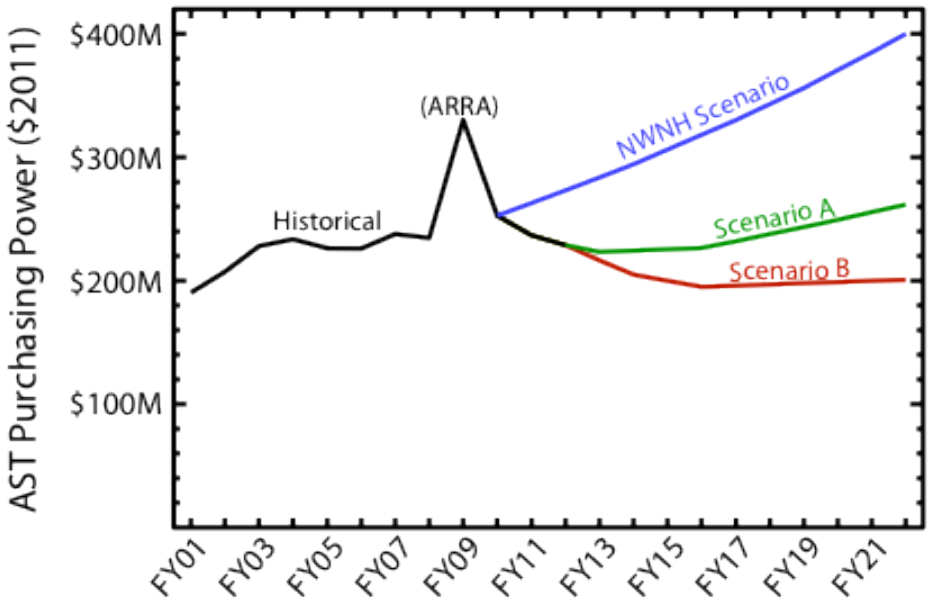


- Looking to the future, it seems unlikely that the AST budget will grow significantly in the next few years.
- Starkly different than the 4% annual growth (post-inflation) assumed in *NWNH*.
  - Note that the FY12 budget is already $45M behind NWNH scenario!

Portfolio Review Budget Scenarios

- We used two budget scenarios supplied by AST.
- Scenario A is more optimistic.
  - Adjusting for inflation, AST purchasing power drops over the next few years to 90% of FY10-12 level, then grows to 106% by FY22.
- Scenario B is more pessimistic.
  - AST purchasing power drops by FY15 to 80% of FY10-12 level, then stays constant to FY22.
- By FY22, these scenarios are only 50-65% of the *NWNH* scenario!

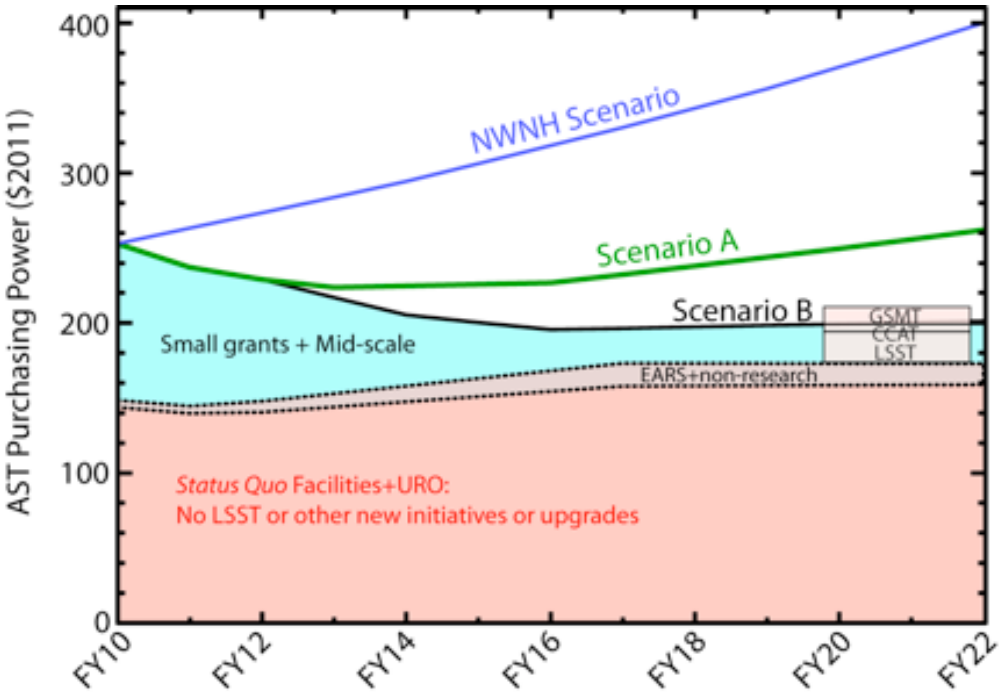
- We stress that these Scenarios do not bound possible futures. We could end up higher than Scenario A or lower than Scenario B!



Extrapolating the Status Quo

- Both scenarios require significant changes within the AST portfolio.
- Extrapolating the current set of facilities forward, plus the ramp-up for ALMA and ATST operations would sharply reduce all grants programs (small and mid-scale).
  - Factor of 1.5 in Scenario A.
  - Factor of 4 in Scenario B!
- Such reductions in grant funding are severe, and in the case of Scenario B, crippling.
- This is before consideration of any NWNH new initiatives.

- This collision is not at the end of the decade! It is upon us even in FY12, and the pressure will amplify in the next few years.



Community Input

- We solicited community input in various forms.
  - Updated program long-range plans (5 year) and vision statements (10-15 year) from Arecibo Observatory, Gemini Observatory, NOAO, NRAO, and NSO.
  - Open call for written input from community, with 3 month response window. AST used AAS town hall and a web document to orient people about the severity of the context and to advertise the call for input.
    - 131 responses, generally very thoughtful.
  - More focused solicitation to Directors and PI's of major OIR and RMS facilities, posing questions about future directions for their facilities and their relation to the OIR and RMS systems.

Critical Capabilities

- We were charged to recommend a set of critical capabilities required to achieve decadal survey science priorities.
- These capabilities are a key metric for our prioritization.
- Technical capabilities, e.g., facilities, instruments, computers.
  - These were derived by studying each of the 20 questions and 6 discovery areas from NWNH (plus the associated mapping from V&V).
  - We itemized critical and supporting capabilities for each question. We ranked the critical capabilities within 4 broad themes (Cosmology and Fundamental Physics, Galaxies, Stars and Stellar Evolution, Planetary Systems and Star Formation) based on the *NWNH* science theme panels.
- Health of the Profession capabilities.
  - We itemized critical capabilities required for stewardship of the field and continued U.S. leadership in astronomy.
- Descriptions are in Chapters 5 & 6; lists on pages 61 & 76.

Committee Portfolios

- We focused on FY17 and FY22 for our portfolios.
- FY17 includes the full ALMA ramp-up and the bulk of the ATST ramp-up. Given that FY14 budgets are already being designed, FY17 is a plausible time frame for AST to implement major recommendations on facilities.
- FY22 brings us to the next decadal survey and could include operations of two top-ranked NWNH priorities: the Large Synoptic Survey Telescope (LSST) and the Cerro Chajnantor Atacama Telescope (CCAT).

Facility Portfolios for FY17

- The facility portfolio takes longer to adjust than the grants portfolio. Responsible divestment takes years.
- To have a major change at a facility by FY17 requires a decision soon, long before we know whether the FY17 AST budget will be more like Scenario A or B.
- Therefore, our recommendations for both scenarios have the same suite of current facilities for FY17.
- Conversely, it is inevitable that the grants programs will have the bulk of the variation between the two Scenarios.

Portfolio Balance

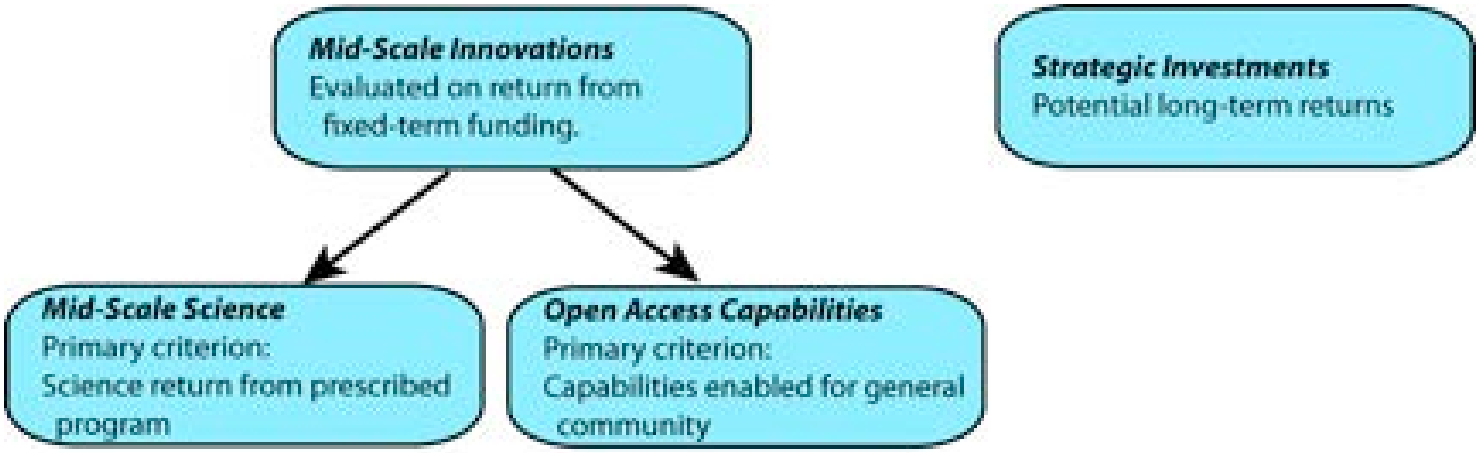
- Astronomy needs both robust grants funding and state-of-the-art facilities. The two work together.
- As we will see, Scenario B will require substantial cuts in both facilities and grants.
- But to be more optimistic in planning for facilities would place the grants program at risk for even more drastic cuts if the hoped-for budget does not materialize.
  - This would be catastrophic: crippling loss of support of science analyses, development of new instruments and technologies, training of next generation of astronomers.
- We therefore recommend that AST plan its portfolio of current facilities assuming the more pessimistic range of forecasts (e.g., Scenario B), with the result that more optimistic budgets (e.g., Scenario A) can have heavier investment in the field through the small-grants and mid-scale programs and through *NWNH*-recommended new facilities.

Recommendations for Small Grants

- Small research (AAG) and instrumentation (ATI) grants should remain top priorities within the AST portfolio.
  - These individual investigator grants are crucial for the scientific output of all of the critical technical capabilities and are central to many of the health of the profession capabilities.
  - Importance was stressed by *NWNH*.
- Additional recommendations for small grants programs in Chapter 7 (pages 79-82).

Recommendations for Mid-Scale Projects

- Many of our critical capabilities could be advanced by surveys, experiments, and instruments at mid-scale project level ($3-50M).
- *NWNH* strongly recommended increased investment at this scale via a formally competed line.
- Our detailed recommendations are found in Chapter 8, pages 83-90.



- We recommend that the Mid-Scale Innovations Program (MSIP) unify all fixed-term mid-scale projects, including the Telescope System Instrumentation Program, the University Radio Observatories, and major instrumentation projects at national observatories.

Recommendations for Facilities I

- The committee ranks ALMA, ATST, VLA, Gemini-South, Blanco, and Dunn Solar Telescope as essential facilities.
  - ALMA, Expanded VLA, ATST are all new and world leading.
  - Blanco 4-m is commissioning the Dark Energy Camera (DEC), best in class until LSST.
  - Gemini-South 8-m will have compelling instruments and strong synergy with ALMA, Blanco/DEC, and LSST. U.S. has comparatively few southern hemisphere large telescopes.
  - The Dunn is crucial for a smooth build-up to ATST's science capabilities. We recommend that the Dunn be operated until two years before ATST first light, similar to NSO plan.

Recommendations for Facilities II

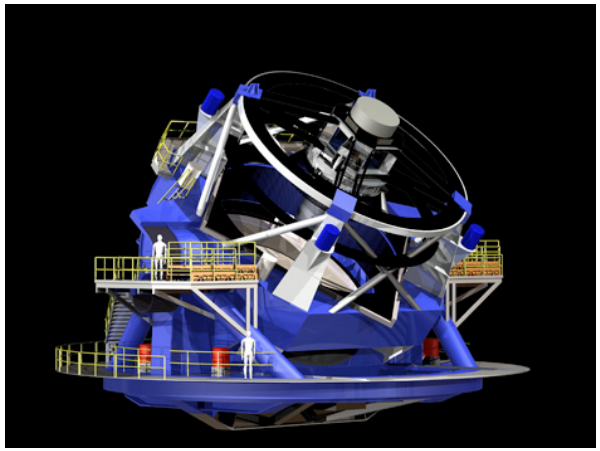
- We recommend continuation of operations at Gemini-North, Arecibo, SOAR, and the NSO Integrated Solar Program (NISP).
  - Gemini-North is our highest ranked OIR facility in the northern hemisphere.
  - Arecibo is the world's largest single-dish radio telescope and radar source; it is under a cost-sharing agreement at least through FY16.
  - SOAR 4-m telescope was built under a partnership agreement that lasts until 2018. We recommend that AST not renege on that agreement.
  - We recommend that NISP be required to find cost sharing to reduce AST costs to $2M/yr.
  - Later in the decade, we recommend that AST reevaluate its participation in Arecibo and SOAR in light of science opportunities and updated budget forecasts.
  - Additional recommendations in Chapters 9, 10, & 11.

Recommendations for Facilities III

- We recommend that AST divest from the Mayall 4-m, WIYN 3.5-m, 2.1-m, and McMath-Pierce telescopes at Kitt Peak, the Green Bank Telescope, and the Very Long Baseline Array.
  - The committee understands that these facilities still have considerable science merit and that divestment from them will have significant impact on many people.
  - However, within realistic budgets, these facilities clearly rank below FY17 opportunities elsewhere in the portfolio, particularly in the grants program.
- Divestment does not necessarily mean closure! We expect that AST will explore many different options, including finding new organizations, agencies, or NSF divisions to fund and operate the facilities. However, the end of AST funding will likely mean an end to open-access time on these facilities.

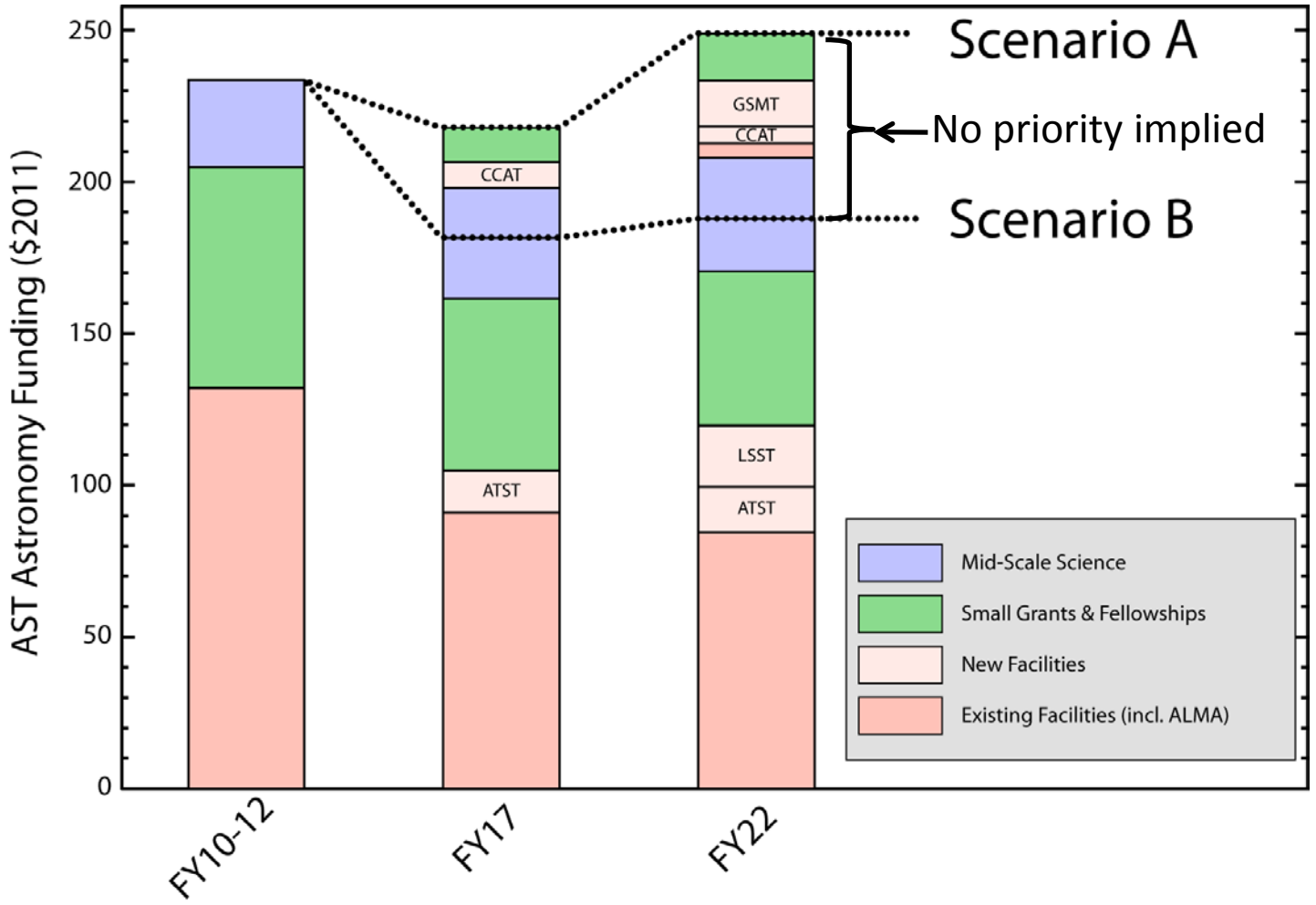
Recommendations for NWNH New Facilities

- We recommend that LSST construction begin with an MREFC start in FY14.
  - LSST is the top-ranked large project in *NWNH*; our committee similarly judges it to be of very high value.
  - Important to note that LSST construction funds come from MREFC and hence do not worsen the AST budget crunch that is expected over the next 5 years.



- We recommend that AST provide partial funding to CCAT later in the decade, if funding for other mid-scale projects exceeds $30M/year (about halfway between Scenario A and B).
- In Scenario A, we recommend that AST contribute $20M/year to Giant Segmented Mirror Telescope (GSMT) late in the decade.
- We recommend that support for the Atmospheric Cerenkov Telescope Array (ACTA) be considered at lower priority than the above. This will require budgets at least as strong as Scenario A.

Recommended Portfolios



- Inflation-adjusted graph of the major portfolio components.

Recommended Portfolio: Scenario B in FY17

- In FY17, Scenario B funding is only 78% of the purchasing power of FY10-FY12 baseline, and we have significant increases in ALMA and ATST operations funding.
- The result is severe pressure on all portions of the budget.
  - Small-grants funding drops to 78% of FY10-12 baseline.
  - Mid-scale grant funding drops to 72% of baseline.
  - Observatory funding drops to 79% of baseline.
  - No funding for CCAT or GSMT, so LSST is the only NWNH major recommendation pursued!
- The committee regards this level of small-grants and mid-scale funding as highly stressed. This is despite the difficult facility divestments already described!
  - Essential for AST to hedge against deeper cuts in the grants program.

Recommended Portfolio: Scenario A in FY17

- Scenario A in FY17 has "only" a 7% drop in purchasing power compared to FY10-12.
- Scenario A achieves a stronger grants program (but still well short of the augmentations recommended in *NWNH*).
  - Small grants funded at 94% of FY10-12 baseline.
  - Mid-scale grants funding increased to 128% of baseline, nearly double that of Scenario B.
  - Overall, grants funding at 103% of baseline.
- Observatories at 86% of FY10-12 baseline.
  - CCAT construction share of $10M/year recommended.
- Instrumentation and other mid-scale projects would be much better supported, leading to better use of the continuing AST and non-AST facilities.
  - Some of these grants will return open-access telescope time.

FY22 Recommended Portfolios

- In Scenario A, by FY22, AST budget has recovered to 106% of FY10-12 purchasing power.
- This allows substantial investment in the field, achieving more of the *NWNH* recommendations.
  - $49M/yr in mid-scale grants.
  - LSST operations share.
  - CCAT operations share.
  - $20M/yr for GSMT funding (booked as a facility, although it could be executed through the MSIP for instrumentation).
- In Scenario B, in FY22 AST budget remains at only 80% of FY10-12 purchasing power.
- LSST operations ramp up produces additional budget pressure. Grants funding dips by another 10%.
- Additional divestments or more cost savings in continuing facilities may be needed!
- Further details on all portfolios are in Chapter 10.1, pages 118-129. Table on page 123.

Summary

- The combination of increasing operations costs for ALMA and ATST with the expectations of a flat or contracting budget force a major redistribution of the AST budget in the next few years.
- Our Scenario B portfolio contains significant reductions in current facilities, small grants, and mid-scale projects; LSST would be the only major *NWNH* initiative pursued.
  - These facility divestments must occur promptly or we risk even larger cuts to the grants program and a severe imbalance in the field.
- Our Scenario A portfolio invests more heavily in grants, particularly mid-scale projects, as well as in CCAT and eventually GSMT. By investing more in instrumentation and mid-scale collaborations, we can keep the remaining facilities (both AST and non-AST) more competitive and return some time to open-access use.

Looking Forward

- While the economic climate is a severe challenge, we remain optimistic that the AST portfolio will remain a vibrant force in astronomical research. The coming decade has enormous opportunities in astronomy!
- New world-leading facilities in ALMA, ATST, Expanded VLA, and LSST. In stronger budget scenarios, AST can collaborate in CCAT and GSMT.
- The MSIP and small-grants programs will allow AST to foster the best peer-reviewed ideas, to develop new technologies and instruments, maintain the health of the profession, and leverage the opportunities at non-AST facilities.
- A broad and balanced AST portfolio will be central to the continued success of U.S. astronomy.

NSF Response to Portfolio Review

Jim Ulvestad, MPS/AST Division Director

NSF Response to PR Report

- NSF response document issued on August 31.
- NSF must decide on nature of divestments near the end of CY 2013 in order to realize significant savings by FY 2017.
  - No decisions have been made by NSF; discussions within NSF will lead to President's FY14 budget request, which is then subject to action by Congress.
  - Divesting a telescope does not need to imply closing a site.
  - Emphasize principle of divestment in a responsible manner.
  - Intersection with management competitions?
- Agree with Committee assessment that failure to act on their recommendations will reduce grants program four-fold in Scenario B
  - Resulting grants success rate would be in 3%-4% range.
  - This success rate would essentially end NSF research funding of the U.S. astronomy community.
  - Committee found this risk unacceptable.

Categorized Responses

- Grants: 7 specific recommendations; aim to keep research and instrumentation grant programs at high priority, try to maintain the recommended programs, begin small Theory & Computation Network; otherwise, starting new programs is unlikely except in Budget Scenario exceeding the more optimistic scenario

- Midscale: General agreement with idea to merge a number of programs into single competed line; ability to start a midscale program will depend on budget levels and NSF/OMB approval to start the line

- Facilities: Reminder that divestments are needed to support ramps for ALMA and ATST, NOT to enable LSST. Expect to make divestment decisions near end of CY 2013. Will be open to supplying bridge funding, support for infrastructure, as appropriate.

Concluding Thoughts

- Science is viewed very highly by executive and legislative branches of government
  - BUT economic times are very difficult
  - NSF (and AST) budget is not on a doubling track
- AST must make choices to sustain the astronomy enterprise and enable cutting-edge science
  - State-of-the-art facilities need funds to operate, and astronomers need funds for research/training
  - In flat-funding situation, ability to foster a more diverse workforce is particularly hard hit
  - Portfolio review committee did an outstanding job with a very difficult problem
  - AST is committed to robust future for ground-based astronomy