



NSF Division of Astronomical Sciences

Senior Review

Town Meetings

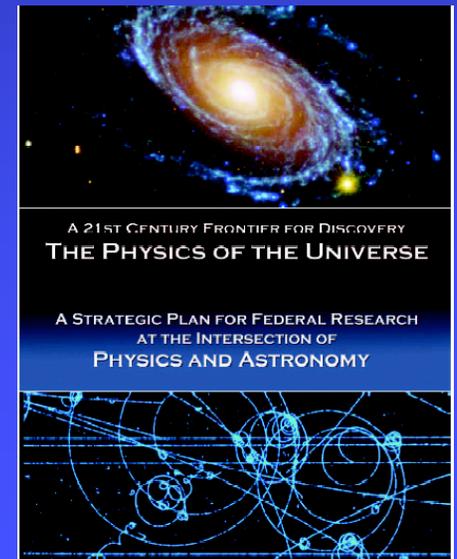
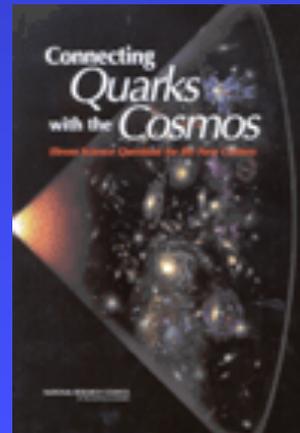


Topics

- Why we need a senior review
 - ◆ Community aspirations
 - ◆ Current resources
 - ◆ Budget prospects
- What is the senior review
 - ◆ Goals
 - ◆ Boundary conditions
- How it is being carried out
 - ◆ Community input
 - ◆ Schedule
 - ◆ Committee activities



Projects Recommended in: Decadal Survey Quarks to the Cosmos Physics of the Universe





Decadal Survey Recommendations

Small Initiatives:

- National Virtual Observatory (NVO)
- Laboratory Astrophysics program
- Low Frequency Array (LOFAR)
- Theory postdoc program
- SOLIS expansion



Decadal Survey Recommendations

Moderate Initiatives:

- Telescope System Instrument Program (TSIP)
- Advanced Technology Solar Telescope (ATST)
- Square Kilometer Array technology development (SKA)*
- Combined Array for Research in Mm-wave Astronomy (CARMA)
- VERITAS
- Frequency Agile Solar Radio Telescope (FASR)
- South Pole Sub-millimeter Telescope

(* = Design/Development)



Decadal Survey Recommendations

Major Initiatives:

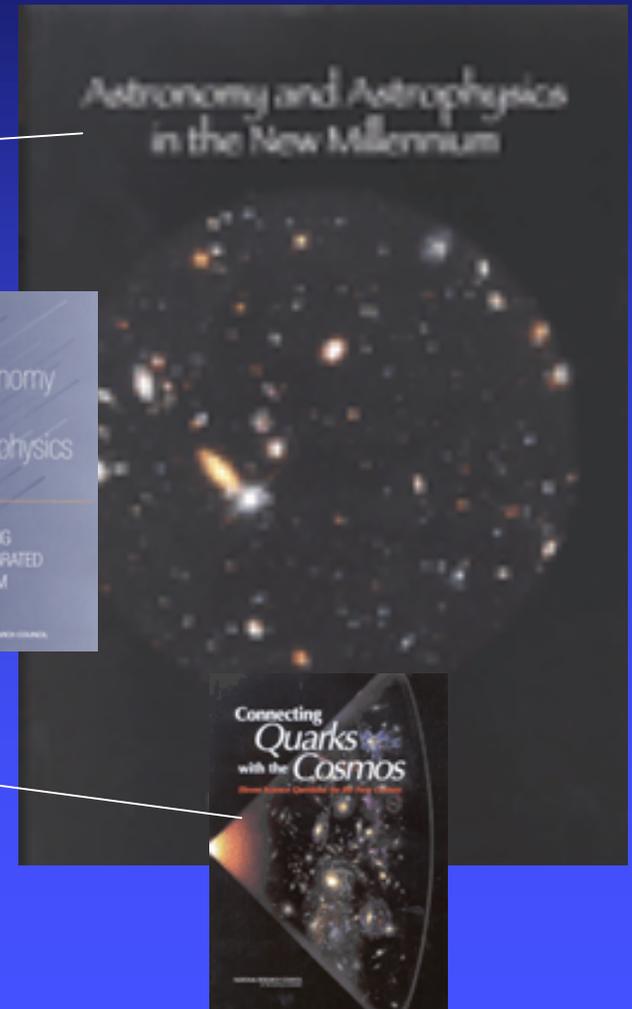
- Atacama Large Millimeter Array (ALMA)
- Giant Segmented Mirror Telescope (GSMT)
- Expanded Very Large Array (EVLA)
- Large Synoptic Survey Telescope (LSST)



Astronomy and Astrophysics Advisory Committee

The confluence of a science, its policy and its management.

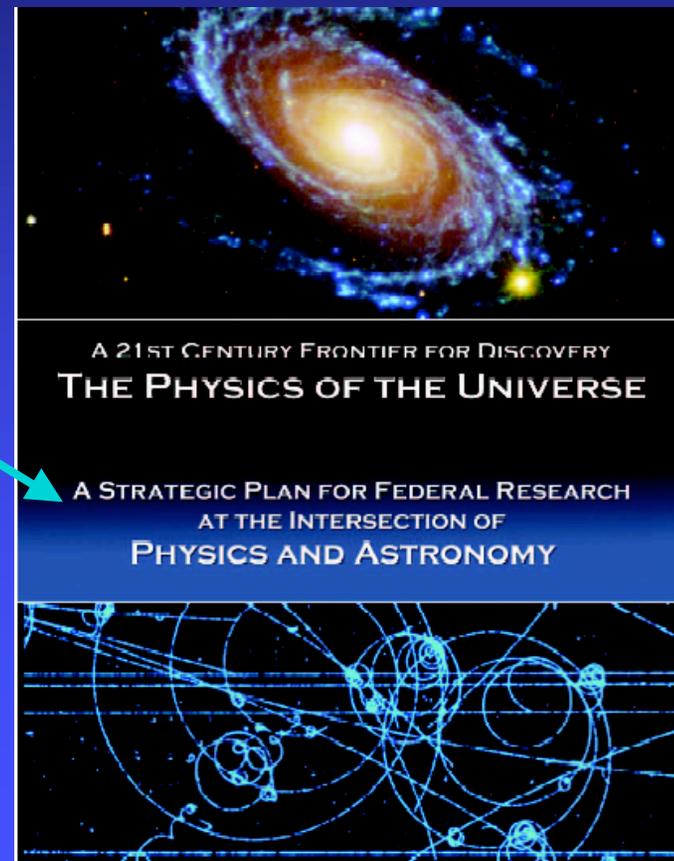
- Coordinated programs among the agencies, facilitated by OSTP
- A single, integrated federal strategy for astronomy and astrophysics research
 - ◆ OSTP-convened planning board
 - ◆ Advisory committee, linked to agency committees
- An interagency initiative on Physics of the Universe
 - ◆ Structures for joint planning
 - ◆ Mechanisms for joint implementation





The Results and *A Final Step*

- OSTP convened Interagency Working Group (NSF/NASA/DOE) on Physics of the Universe under NSTC
- IWG produced an integrated plan for Physics of the Universe
- Astronomy and Astrophysics Advisory Committee formed – expanded and reformulated by NSF Authorization (NSF/NASA/OSTP)
- *NSF/NASA/DOE and OSTP supported formal addition of DOE to AAAC structure*
- *DOE added – effective 3/15/05*





Physics of the Universe

Summary of Recommendations

Ready for Immediate Investment and Direction Known

Dark Energy

- * NASA and DOE will develop a Joint Dark Energy Mission (JDEM). This mission would best serve the scientific community if launched by the middle of the next decade. Studies of approaches to the JDEM mission undertaken now will identify the best methodology.
- * A high-priority independent approach to place constraints on the nature of Dark Energy will be made by studying the weak lensing produced by Dark Matter. This is a scientific goal of the ground-based Large-aperture Synoptic Survey Telescope (LSST). Significant technology investments to enable the LSST are required, and NSF and DOE will begin technology development of detectors, optical testing, and software algorithms leading to possible construction with first operations in 2012. NASA will contribute their expertise as appropriate.
- * Another priority method to constrain Dark Energy will be to use clusters of galaxies observed by ground-based Cosmic Microwave Background (CMB) and space-based X-ray observations. A coordinated NSF and NASA effort using this technique will provide independent verification and increase the precision of the overall measurements.

Dark Matter, Neutrinos, and Proton Decay

- * NSF will be the lead agency for concept development for an underground facility. NSF will develop a roadmap for underground science by the end of 2004.
- * NSF and DOE will work together to identify a core suite of physics experiments. This will include research and development needs for specific experiments, associated technology needs, physical specifications, and preliminary cost estimates.

Gravity

- * NSF, NASA, and DOE will strengthen numerical relativity research in order to more accurately simulate the sources of gravitational waves.
- * The timely upgrade of Laser Interferometer Gravitational wave Observatory (LIGO) and execution of the Laser Interferometer Space Antenna (LISA) mission are necessary to open this powerful new window on the universe and create the new field of gravitational wave astronomy.

Next Steps for Future Investments

Origin of Heavy Elements

- * DOE and NSF will generate a scientific roadmap for the proposed Rare Isotope Accelerator (RIA) in the context of existing and planned nuclear physics facilities worldwide.
- * DOE and NSF will develop a roadmap that lays out the major components of a national nuclear astrophysics program, including major scientific objectives and milestones, required hardware and facility investments, and an optimization of large-scale simulation efforts.

Birth of the Universe Using Cosmic Microwave Background

- * The three agencies will work together to develop by 2005 a roadmap for decisive measurements of both types of CMB polarization. The roadmap will address needed technology development and ground-based, balloon-based, and space-based CMB polarization measurements.

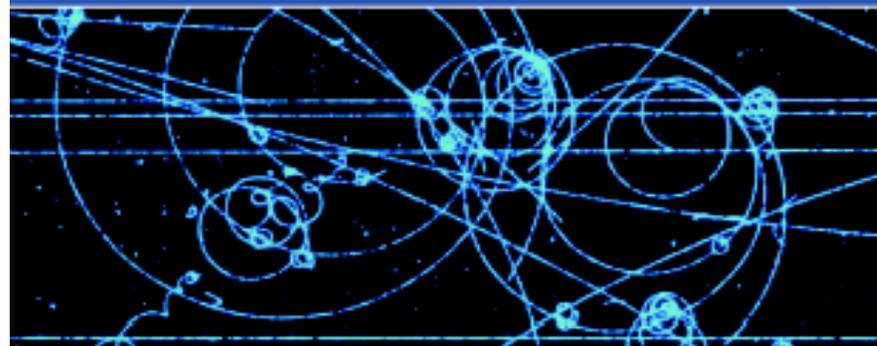
High Density and Temperature Physics

- * In order to develop a balanced, comprehensive program, NSF will work with DOE, NIST, and NASA to develop a science driven roadmap that lays out the major components of a national High Energy Density Physics (HEDP) program, including major scientific objectives and milestones and recommended facility modifications and upgrades.
- * NNSA will add a high energy high-intensity laser capability to at least one of its major compression facilities in order to observe and characterize the dynamic behavior of high-energy-density matter.
- * DOE and NSF will develop a scientific roadmap for the luminosity upgrade of the The Relativistic Heavy Ion Collider (RHIC) in order to maximize the scientific impact of RHIC on High Energy Density (HED) physics.



A 21ST CENTURY FRONTIER FOR DISCOVERY THE PHYSICS OF THE UNIVERSE

A STRATEGIC PLAN FOR FEDERAL RESEARCH AT THE INTERSECTION OF PHYSICS AND ASTRONOMY





Quarks to Cosmos Recommendations Physics of the Universe Plan

Quarks to Cosmos recommendations

- CMB Polarization measurement
- LSST
- Southern Auger array
- Interagency initiative on Physics of the Universe

Physics of the Universe - Highest priority, ready

- LSST
- S-Z effect - coordinated NSF/NASA effort
- Strengthen numerical relativity research - planned in Physics



CMB Roadmap

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Readhead et al.

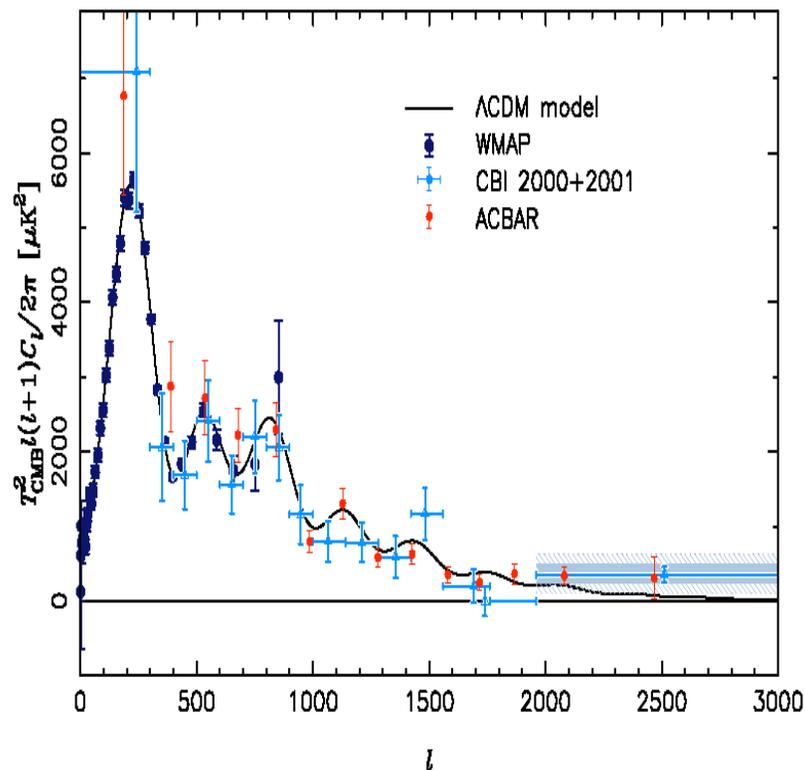


FIG. 13.— The CBI+WMAP+ACBAR Spectrum. The solid black line is the WMAP Λ CDM model with a pure power-law primordial spectrum (`wmap_lcdm_pl_model_1_yr1_v1.txt`). The highest- l ACBAR point has been displaced slightly to lower l for clarity.

- NSF-lead, three agency activity
- Overall look at ground and space approach to CMB and CMB Polarization
- Ground experiments, detector development, background characterization, etc.
- Wide community participation
- Plot path towards CMBPol



Other Inter-agency Efforts under Discussion

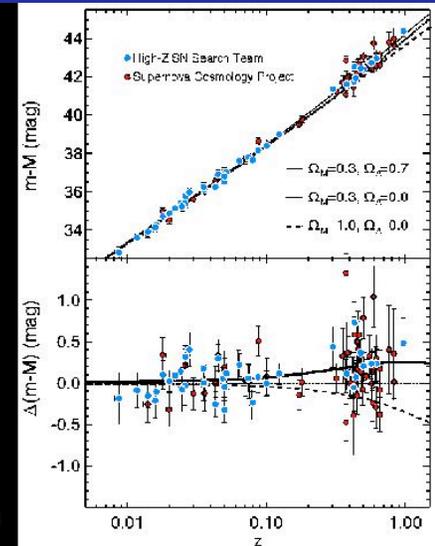
- Joint Dark Energy Task Force
 - ◆ NSF, NASA, DOE
 - ◆ Understand and exploit all probes and inter-dependencies
 - ◆ Emphasis on near- and intermediate term activity
 - ◆ Understand interaction with JDEM, LST

Type Ia supernovae are standardizable candles; observations of many at high redshift test the time evolution of the expansion rate.

Result: the universe is accelerating!

There must be some sort of energy density which doesn't redshift away.

[Riess et al.; Perlmutter et al.]





Building a Sustainable Program

- Promises to be transformational
- Built on underpinnings of community involvement in planning, advice, advocacy and “formal” agency recognition of those structures
- Realistic (ambitious is OK, but....)
- Supportable by the astronomical community
- Supported by the astronomical community (over the long haul – now 15 years)
- Appeals to broader scientific community
- “Understands” and meshes with agency processes (helping to shape them if possible)



VLA

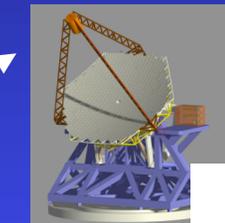
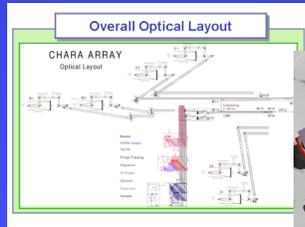
VLA



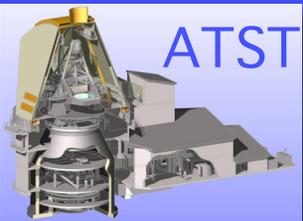
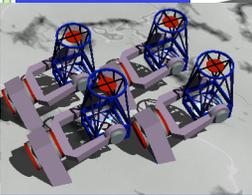
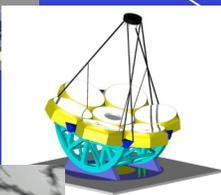
Gemini

Near Term

CHARA



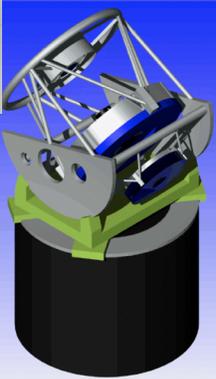
GSMT



ATST

Intermediate Term

LSST

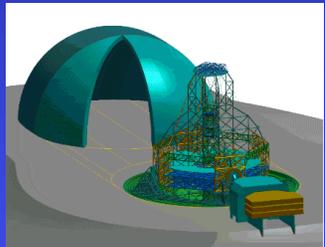


SKA

EVLA Phase II

EVLA I

OWL?

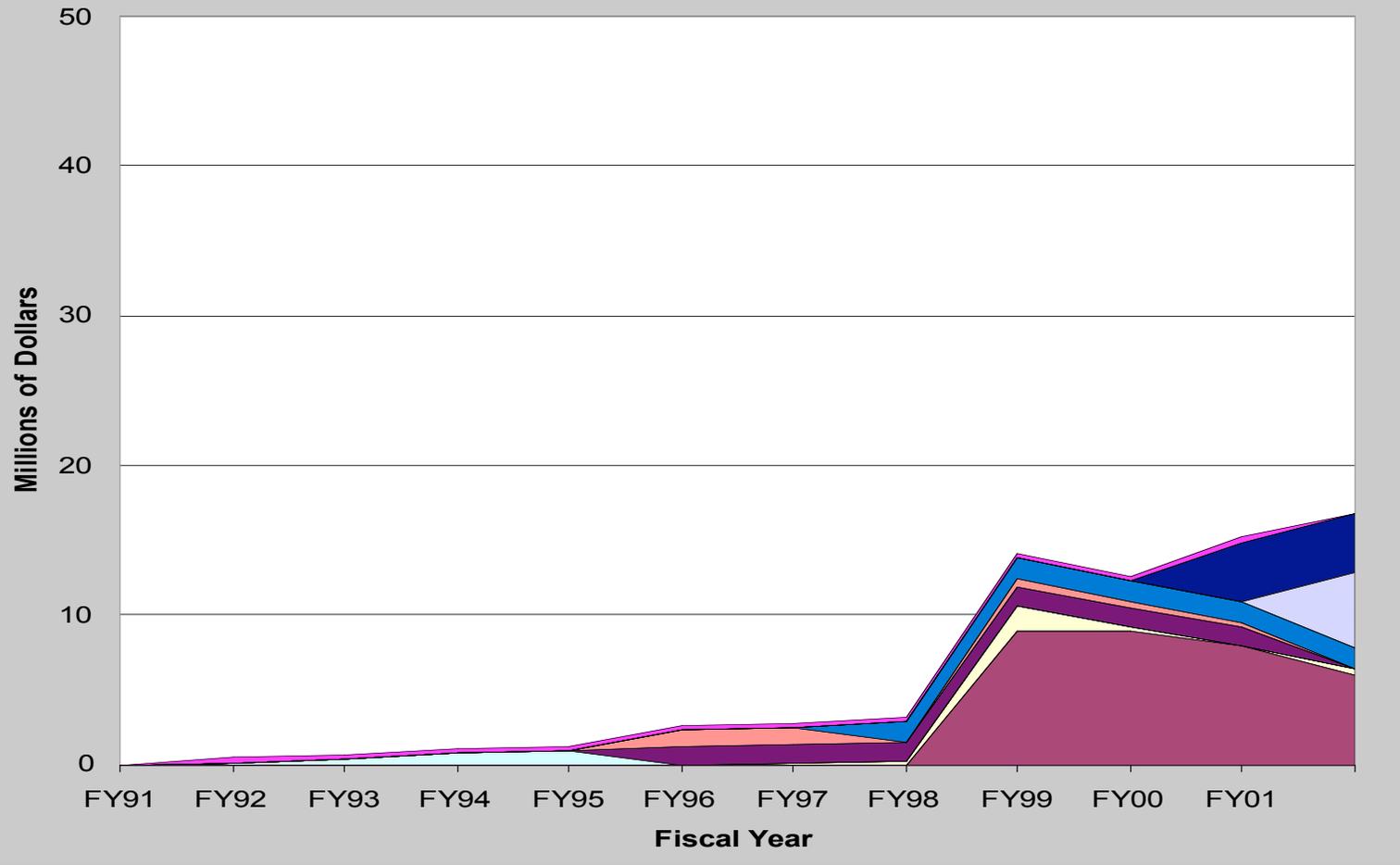


LOI?

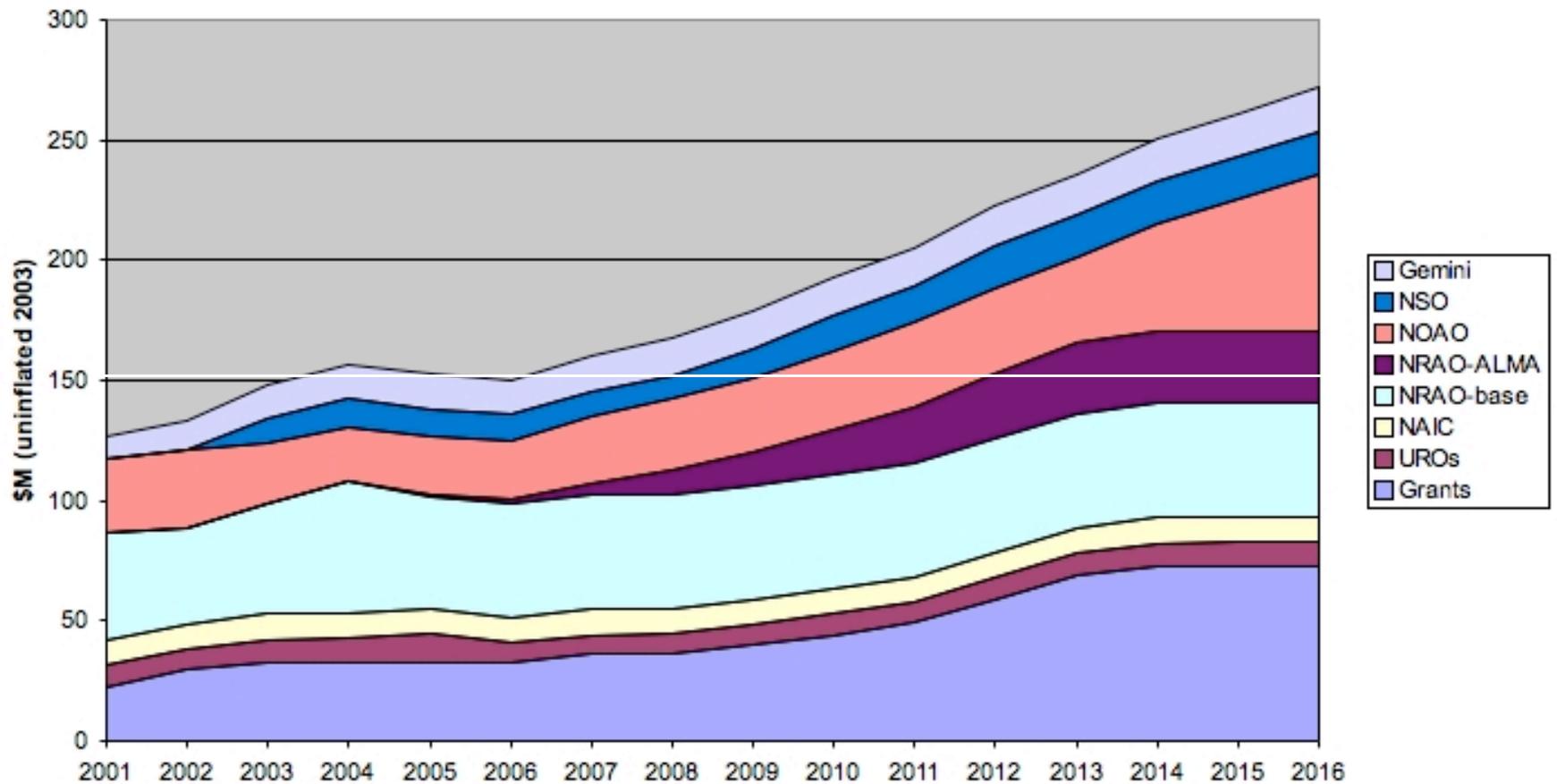
Horizon Facilities



1990s Decadal Survey - Approx.



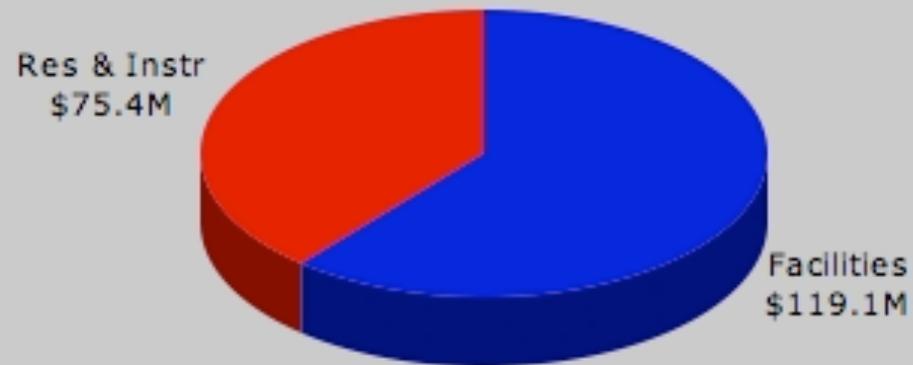
Operating budgets and grant increments to realize the Decadal Survey recommendations





Astronomy Division Budget - FY2005

AST FY2005 Budget





Astronomy Division Budget - FY2005

Facilities - \$119.1 M

National Optical Astronomy Observatory (NOAO)	\$24.1 M
National Solar Observatory (NSO)	\$10.6 M (excludes TSIP, AODP)
Gemini Observatory	\$15.5 M
National Radio Astronomy Observatory (NRAO)	\$47.0 M
National Astronomy & Ionosphere Center (NAIC)	\$10.5 M
University Radio Observatories	\$11.3 M



Astronomy Division Budget - FY2005

Astronomy Research & Instrumentation - \$75.4 M

Astronomy & Astrophysics Research Grants (AAG)

Particle Astrophysics

Education & Special Programs (ESP)

- CAREER, REU, Postdoctoral fellowships

Advanced Technologies & Instrumentation (ATI)

- Technology Development & Design for future facilities

Electromagnetic Spectrum Management (ESM)

Science & Technology Centers (STC)

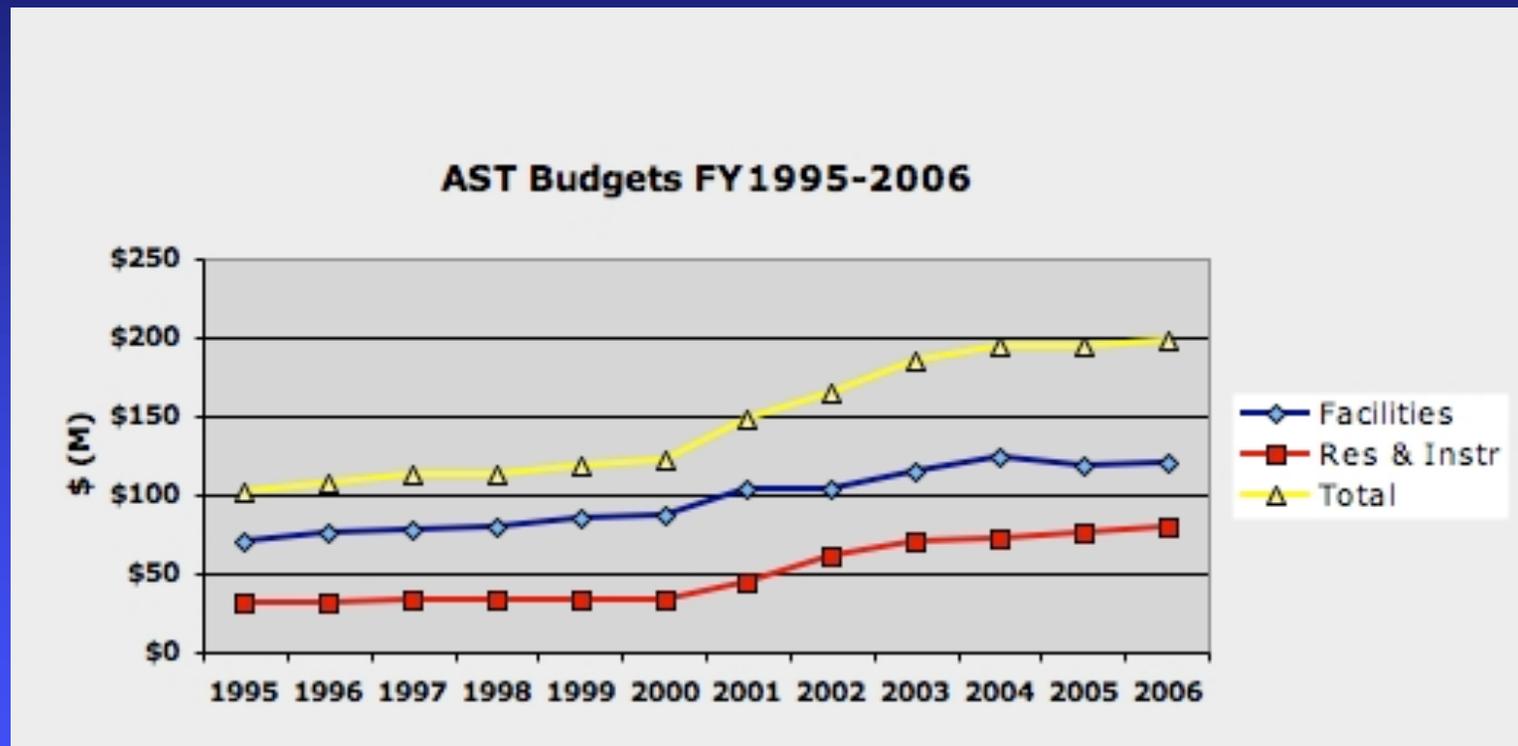
- Center for Adaptive Optics (CfAO)

NSF/MPS Priorities and programs

- e.g. Cyberinfrastructure, Math Sciences



AST Budget FY1995-2006





Astronomy Division Budget Growth

Annual budget has grown by 60% since 2000 (\$73 M)

But with \$52M in directed appropriations in FY2001-2004

- \$32M to NRAO
- \$4M to NAIC
- \$4M to NOAO
- \$5M to 'grants'
- \$7M to instrumentation

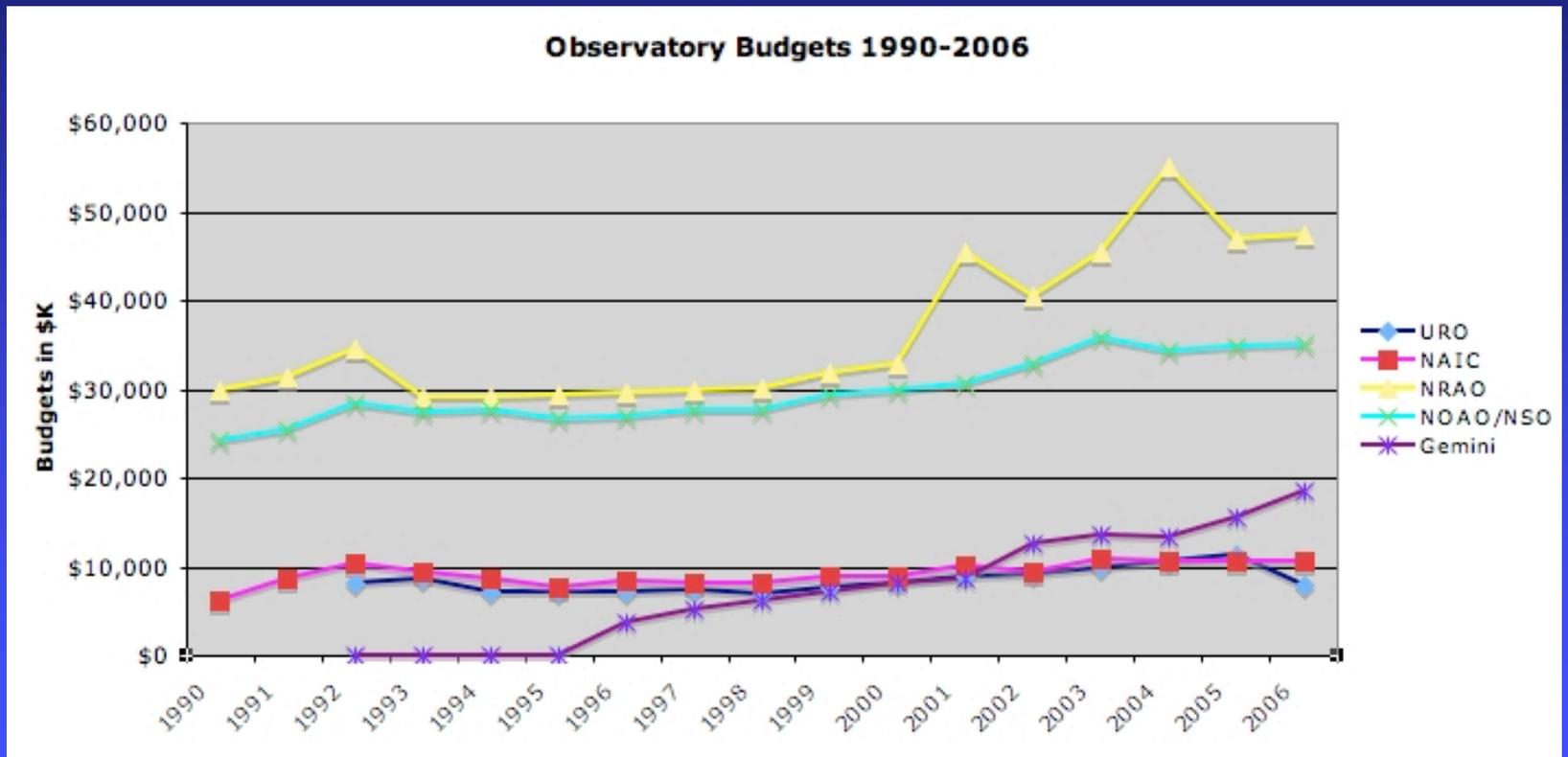
Unable to plan for the increase and limited discretion over its use.

Growth has stopped (FY2005 budget down by \$2M from FY2004)



Astronomy Division Budget Growth

Observatory budgets FY1990 - 2006



How can we afford it?

- Proposals and studies will sharpen cost
- Planning will provide phasing, decision points, down-selects
- Overall plan must meet fiscal reality
- How?

NSF Budget Authority Projection





“Senior Review”

- Responds to:
 - ◆ Decade Survey recommendation re: facilities
 - ◆ Calls for examination of balance in AST portfolio
- Made imperative by:
 - ◆ Budget outlook
 - ◆ Ambitions of the community
 - ◆ AST budget growth



“Senior Review”

◆ AST retreat

- ◆ Established understanding of need and goals
- ◆ Self-examination of balance
- ◆ Identified issues that NSF and community must address
- ◆ First time this has been undertaken by AST

◆ AST retreat “conclusions”

- ◆ IF significant progress is to be made on development of major recommendations, ~\$30M per year of free energy in AST budget must be identified.
 - ◆ Implications for program may be profound
 - ◆ Balance: grants program (AAG) must be held sacrosanct
 - ◆ Free energy will come from non-AAG portion of AST portfolio
-
- ◆ Endorsed by Committee of Visitors and Astronomy and Astrophysics Advisory Committee



“Senior Review”

◆ Boundary Conditions

- ◆ AST budget will grow no faster than inflation for the remainder of the decade
- ◆ Unrestricted grants program (AAG) will be protected
- ◆ New facilities reviewed only 5-10 years after becoming operational
- ◆ Adjustments in balance must be realistic and realizable
- ◆ Committee will not revisit priorities and recommendations of community reports
- ◆ Committee will not consider individual projects or proposals or determine how funds are to be distributed
- ◆ Committee will not make site visits to individual facilities
- ◆ Recommendations must be based on well-understood criteria
- ◆ Ample opportunity for community input

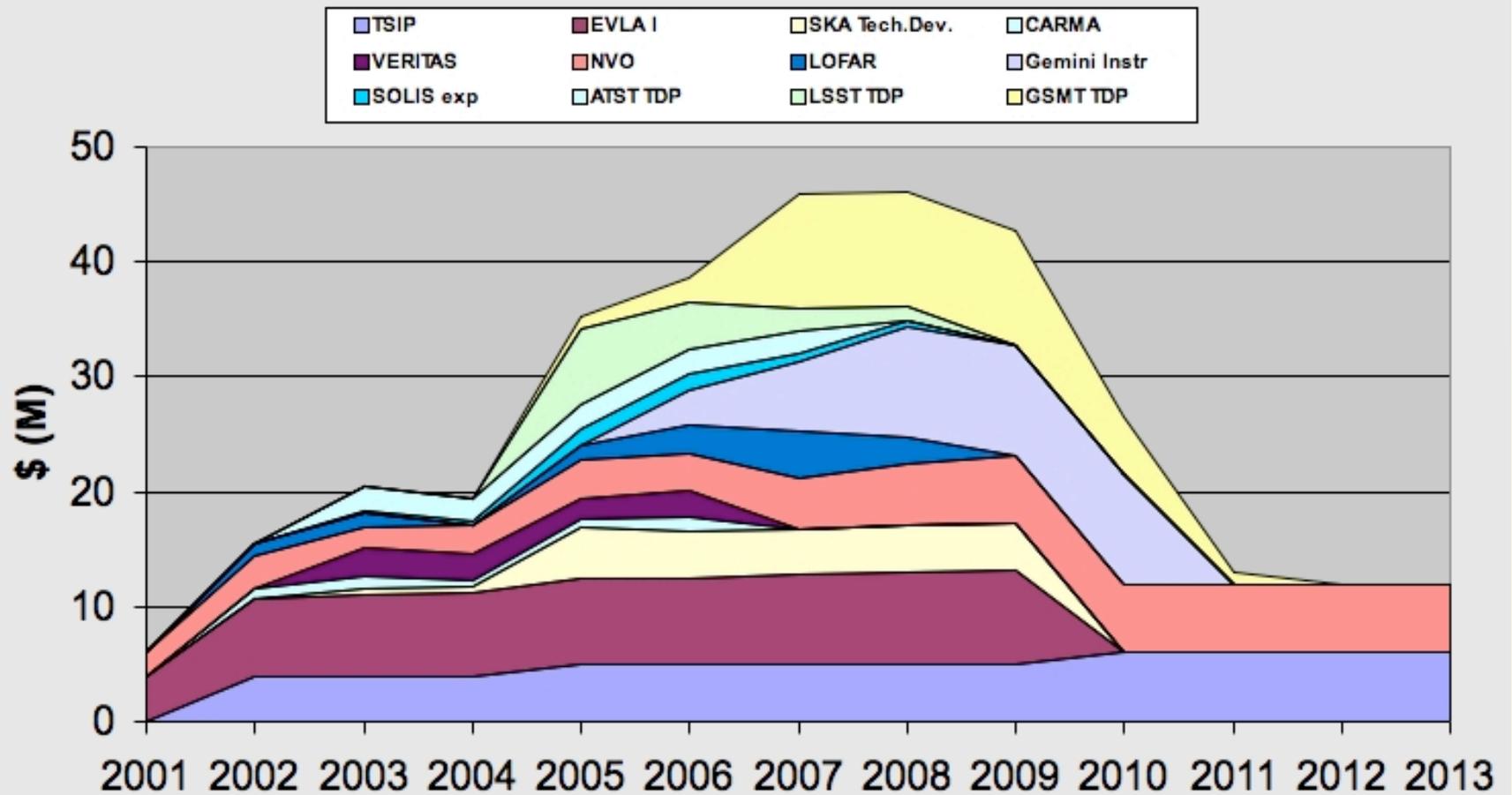


“Senior Review”

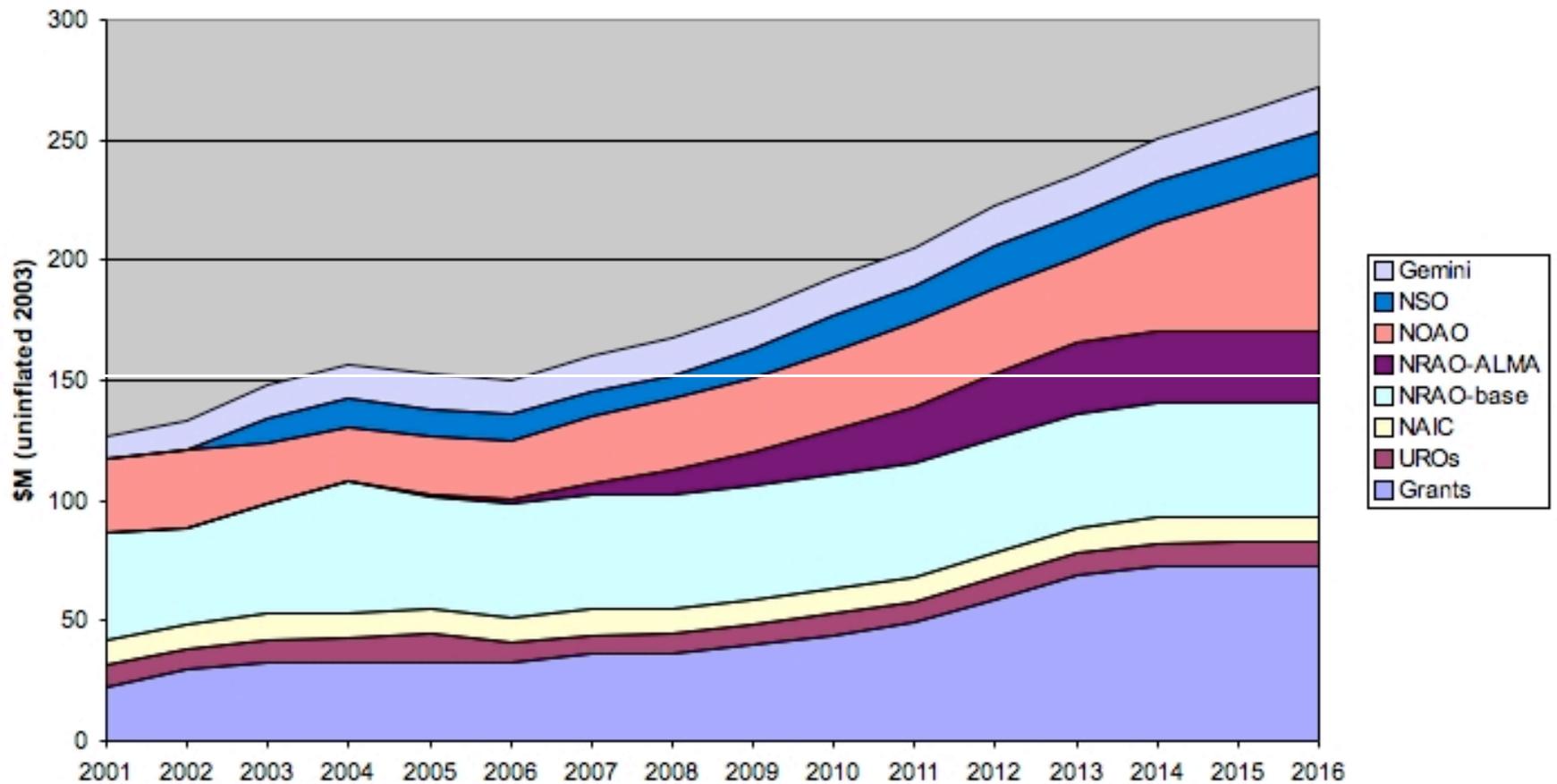
◆ Goals

- ◆ Examine impact and gains of redistributing ~\$30M of annual spending from AST funds
 - ◆ Obtained through selective reduction in operations of existing facilities and reallocation of instrumentation and development programs
 - ◆ Generate \$30M per year by FY2011
 - ◆ Recommend appropriate balance between making progress on new projects and reinvesting in existing high priority components of existing programs and facilities
-
- ◆ Results will inform FY2008 budget development (i.e. change will not be visible immediately)
 - ◆ May be additional costs associated with reprogramming

Decadal Survey moderate initiatives and technology development



Operating budgets and grant increments to realize the Decadal Survey recommendations





“Senior Review”

◆ What has been done

- ◆ Letters to National Observatory directors (NOAO, NSO, NRAO, NAIC, Gemini) requesting input by end of July 2005
 - Case for, and priority of, each component of their facilities, with a defensible cost for each
 - Build the case for a forward-looking observatory operation, with highest priority components in FY2011
 - Provide estimate of cost and timescale associated with divestiture of each component
- ◆ Directed them to
 - Seek input from their communities
 - Evaluate facilities and capabilities with carefully defined metrics (common to all facilities)
 - Consider systemic issues such as complementarity, uniqueness, role in training and technical innovation.
 - Explore new operating modes
- ◆ Submissions received and available on the web



“Senior Review”

- ◆ What has been done (cont)
 - ◆ Established web site for information
 - ◆ Scheduled regional town meetings for community input
 - ◆ AST visiting all facilities to meet with staff and management
 - ◆ AST exploring implications of all issues identified. e.g. facility closure, divestiture



“Senior Review”

◆ What has been done (cont)

Convened a committee of representatives of the community
(subcommittee of MPS Advisory Committee)

- Roger Blandford - Stanford (Chair)

- ◆ Tom Ayres - Colorado
- ◆ Donald Backer - UC Berkeley
- ◆ John Carlstrom - Chicago
- ◆ Karl Gebhardt - Texas, Austin
- ◆ Lynne Hillenbrand - Caltech
- ◆ Craig Hogan - U. Washington
- ◆ John Huchra - Harvard
- ◆ Elizabeth Lada - U. Florida
- ◆ Malcolm Longair - Cambridge
- ◆ J. Patrick Looney - Brookhaven
- ◆ Bruce Partridge - Haverford
- ◆ Vera Rubin - Carnegie/DTM



“Senior Review”

- ◆ What has been done (cont)
 - ◆ Charge posted on the web
http://www.nsf.gov/mps/ast/ast_senior_review.jsp
 - ◆ First meeting of committee 19-21 October
 - Includes sessions with facilities managers and directors



“Senior Review”

- ◆ Next steps
 - ◆ Expect to have at least two additional meetings of committee
 - January AAS - opportunity for public comment?
 - Late March
 - ◆ Request report by 31 March 2006
 - But committee to take as much time as needed
 - ◆ Continued interest in community input -
 - http://www.nsf.gov/mps/ast/ast_senior_review.jsp
 - Email - astsenior-review@nsf.gov
 - Contact us



The Question

- “We recognize that this will be a difficult task and that the end result may well be that some facilities are judged to be no longer viable under the circumstances. We also recognize that the landscape of U.S. astronomy could almost certainly change dramatically as a result of some these actions. The question for all of us is to judge whether these changes are viable and lead to a vital and sustainable future, or whether the pace and scope of change necessary to realize the cumulative aspirations of the community under severely constrained budgets are too drastic.”