



The View from HQ: Astrophysics at NASA

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Science Budget Strategy

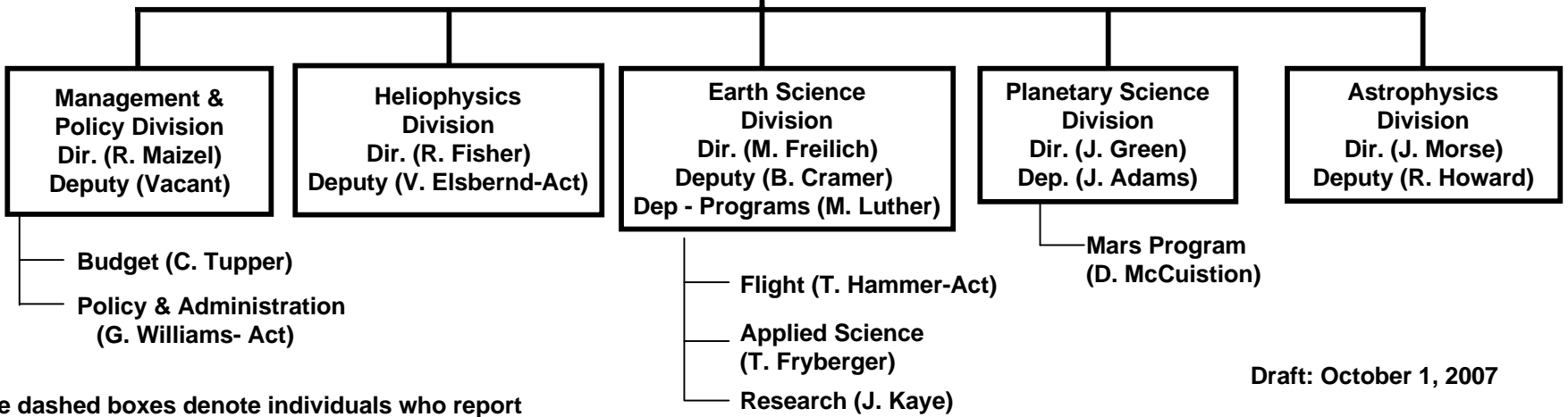
- **After adjusting for Full Cost Simplification, Science gets 1% growth per year after FY07**
 - No change from out-year projections in the FY07 Budget
 - Growth of 2.4% from FY2012 to FY2013
- **Science's goal is to manage each and every one of our Programs and Projects within budget and on schedule**
- **When budget growth does occur, or when science priorities are changed, we propose adjustments as necessary**
- **Strategy for Adjustments**
 - Develop an executable program based on strategic National Academy science priorities



Associate Administrator (AA) (Alan Stern) Deputy AA (Colleen Hartman)	
Deputy AA for Programs (Todd May - Detailee)	AAA for Strategy, Policy & International (Marc Allen)
Chief Scientist (J. Mather) DCS for ES (Randy Friedl) DCS for SS (Andy Cheng)	Senior Advisor for R & A (Yvonne Pendleton)
Senior Advisor for Science Process & Ethics (Paul Hertz)	Special Asst for NEOs and Exploration (Dan Durda)
	Chief of Staff (Jens Feeley - Act)

Chief Engineer
 (K. Ledbetter)

Safety & Mission Assurance
 (P. Martin)

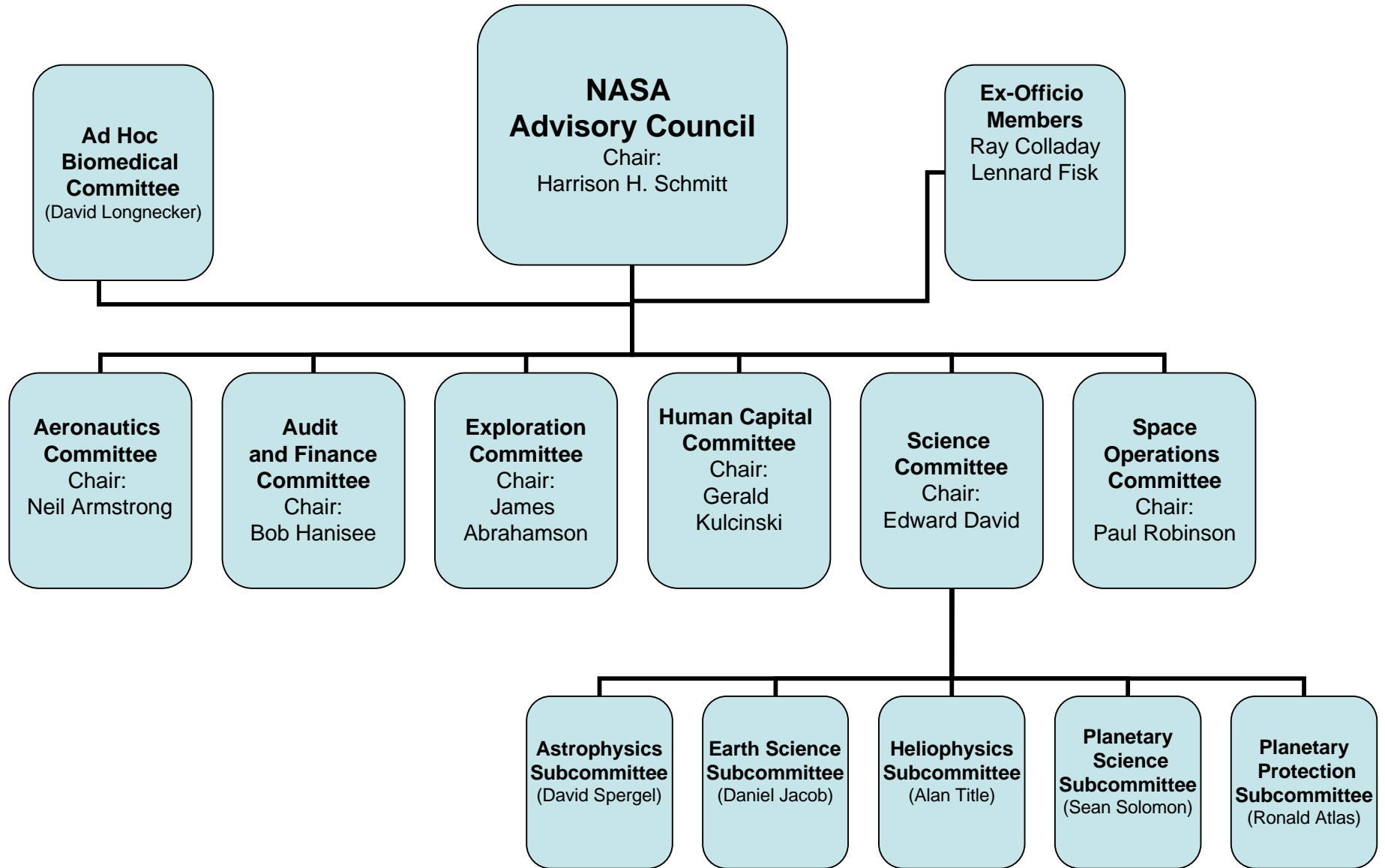


Blue dashed boxes denote individuals who report to other organizations, but support SMD

Draft: October 1, 2007



NASA Advisory Council Structure





Astrophysics Directions

- **Numerous recent community reports call for re-establishing balance among small, medium, and large missions in the Astrophysics program:**
 - Astronomy & Astrophysics Advisory Committee 2007 Annual Report: *“The balance between small, medium and large programs in the NASA Astrophysics Division has been undermined. The AAAC recommends that the funding “wedge” in FY09/10 be used to add some funding for R&A and small missions, to rebalance the program.”*
 - NRC 2007 NASA Astrophysics Program Assessment report: Recommendation #1: *“NASA should optimize the projected scientific return from its Astrophysics Program by ensuring a diversified portfolio of large and small missions that reflect the scientific priorities of the decadal review and by investing in the work required to bring science missions to their full potential: e.g., technology development, data analysis, data archiving, and theory.”*



Astrophysics Division

What's New

- **Exciting new capabilities to launch within two years:** GLAST, HST-SM4, Kepler, Herschel/Planck, WISE
- **New SMD focus on Strategic Investments in: Research and Analysis, Data Analysis, and Suborbital Opportunities.**
 - Re-instatement of NuSTAR mission
 - Next Small Explorer (SMEX) AO:
 - pre-proposal conference Nov. 6 in Washington DC (NOI Nov. 16)
 - Proposals due January 15, 2008
 - Mission cost cap of \$105M (FY08\$), not including launch vehicle
 - Mission of Opportunity allocation of \$70M (FY08\$)
 - Selections anticipated 4 months after proposals due
 - Approximately 6-8 Phase A concept studies
 - Anticipate selecting up to 3 for flight
 - New experience standards for PI, but only PI
 - Strategic Mission Concept Studies NRA (proposals due Nov 20)

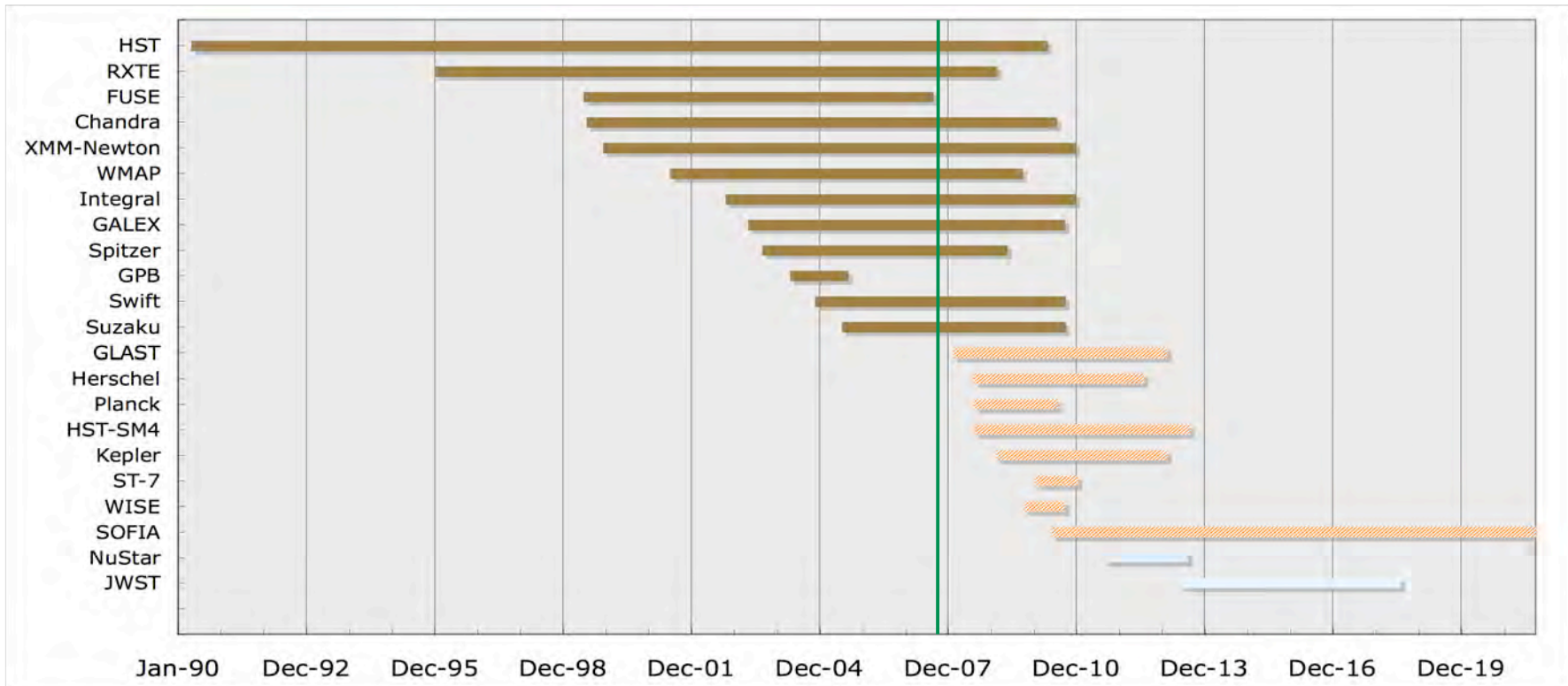


Looking Forward

- **BEPAC report recommendations**
 - JDEM first for development and launch
 - Technology investments in LISA and other missions
 - Cost estimates (70% confidence) for total portfolio >\$11B
- **ExoPTF recommendations imminent**
- **Assumptions for future planning**
 - Approximately flat Astrophysics Division Budget
 - Currently planned facilities operate at least as long as planned for (but most will likely last longer)
 - Complete current missions in development
 - Basic Research & Analysis (R&A) funding will go up, or at worst remain the same
 - Mission funding profile shapes will resemble those in the past



Astrophysics Timelines



Tan: mission in development, blue: mission in formulation



Astrophysics Missions

Mission	Launch	Launch Vehicle	FY07 Budget	Change	Phase
HST	Apr-90		same		Implementation - Extended Operations
RXTE	Dec-95		same		Implementation - Extended Operations
FUSE	Jun-99		same		Termination by 12/31/2007
Chandra	Jul-99		same		Implementation - Extended Operations
XMM	Dec-99		same		Implementation - Extended Operations
WMAP	Jun-01		same		Implementation - Extended Operations
Integral	Oct-02		same		Implementation - Extended Operations
GALEX	Apr-03		same		Implementation - Extended Operations
Spitzer	Aug-03		same		Implementation - Prime Operations
Gravity Probe - B	Apr-04		same		Implementation - Post-Op Data Analysis
Swift	Nov-04		same		Implementation - Extended Operations
Astro-E2/Suzaku	Jul-05		same		Implementation - Prime Operations
GLAST	Nov-07	Delta II	Sep-07	+2 mos.	Implementation - Development
HST SM-4	Aug-07	STS-125/OV-104	Dec-07	+7 mos.	Implementation - Development
Herschel	Jul-08	Ariane 5	Jul-07	+12 mos.	Implementation - Development
Planck	Jul-08	Ariane 5	Jul-07	+12 mos.	Implementation - Development
Kepler	Nov-08	Delta II	Jun-08	+5 mos	Implementation - Development
WISE	Nov-09	Delta II	Jun-09	+5 mos.	Implementation - Development
JWST	Jun-13	Ariane 5	same		Formulation
SOFIA	2013	N/A	n/a	reinstated	Implementation - Development
SIM	TBD		2015-2016	delayed	Formulation
LISA	TBD		same		Pre-Formulation
Con-X	TBD		same		Pre-Formulation
JDEM	TBD		same		Pre-Formulation
TPF	TBD		same		Pre-Formulation



Astrophysics Re-organization

- **Requesting Astrophysics Subcommittee advice on re-establishing intellectual foundation for Astrophysics theme**
 - Science-based programs that contain projects
 - Conceptually like previous “Astronomical Search for Origins” and “Structure and Evolution of the Universe” themes
 - Astrophysics currently has 5 one-project programs and looks much different than all the other SMD Divisions



NASA Strategic Plan
February 2006

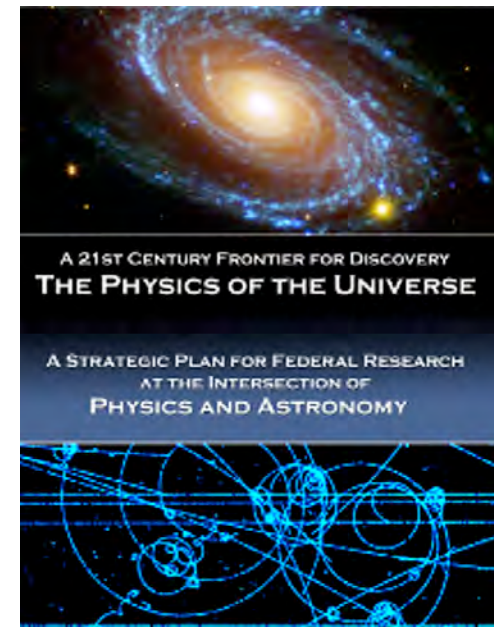
- Science-based grouping of missions is especially useful for forward planning
 - Intellectual framework helps to justify new initiatives and maintain a scientifically balanced portfolio
 - Upcoming strategic planning and NRC Decadal Survey
- Proposed scientific programs: Cosmic Origins, Physics of the Cosmos, Exoplanet Exploration
 - Plus Astrophysics Explorers and Astrophysics Research programs which already exist



Physics of the Cosmos*

Big Question: How does the Universe Work?

- **Rationale:** Our knowledge of fundamental physics underlies a substantial fraction of the US ~\$13T GDP. PCOS, along with related disciplines, will help define the new physics of the 21st Century, enabling very long-term competitiveness and innovation.
- **Links to 2004 NSTC/OSTP Interagency Working Group on the Physics of the Universe report: “A 21st Century Frontier for Discovery”**
- **Sample science questions:**
 - What powered the Big Bang?
 - What is Dark Matter?
 - What is Dark Energy?
 - What happens at the edge of a black hole?



* Program subsumes Beyond Einstein.



Cosmic Origins

Big Question: How did we get here?

- **Rationale: Scientific context for human exploration of the origins of life and existence. Cosmic Origins tells the story of the history of the Universe from the Big Bang to people.**

- Sample science questions:
 - How do stars and galaxies form and evolve?
 - How did large-scale structure form and evolve?
 - How were the elements in the periodic table formed?



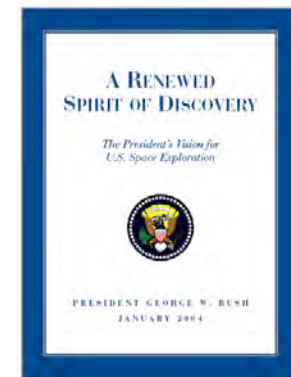
**NRC Astronomy
and Astrophysics
Decadal Survey**



Exoplanet Exploration*

Big Question: Are we alone?

- **Rationale: Seeks to determine whether Earth is the only abode for life in the Galaxy or whether we are part of a larger community. Either answer is profound in its implications for the future of human civilization.**
- **Sample science questions:**
 - How do planetary systems form and evolve?
 - How common are terrestrial class planets in the habitable zones around other stars?
 - Is there life elsewhere in the Universe?

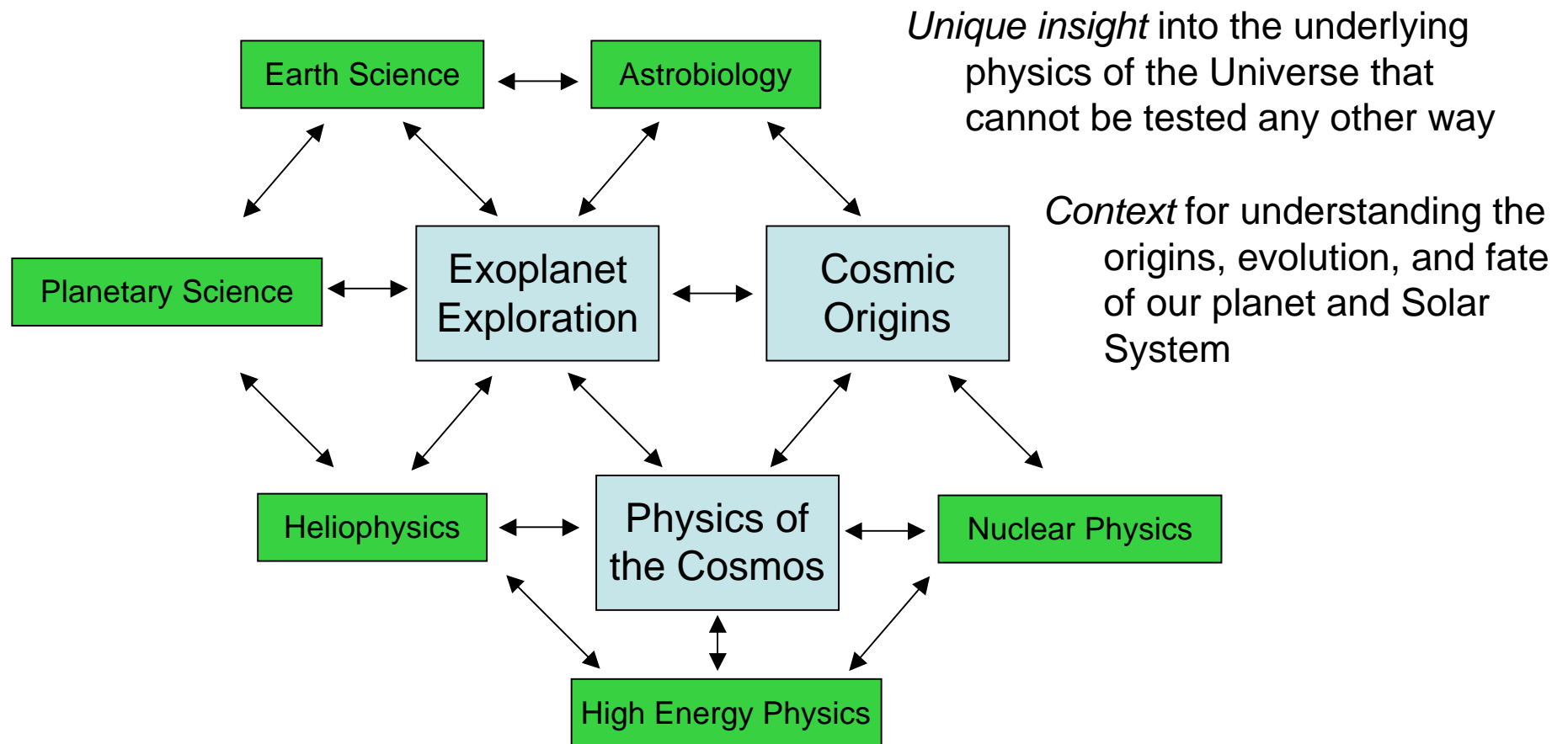


**Presidential Policy Directive
Vision for Space Exploration
February 2004**

* An explicit objective of the Vision for Space Exploration: “Conduct advanced telescope searches for Earth-like planets and habitable environments around other stars”

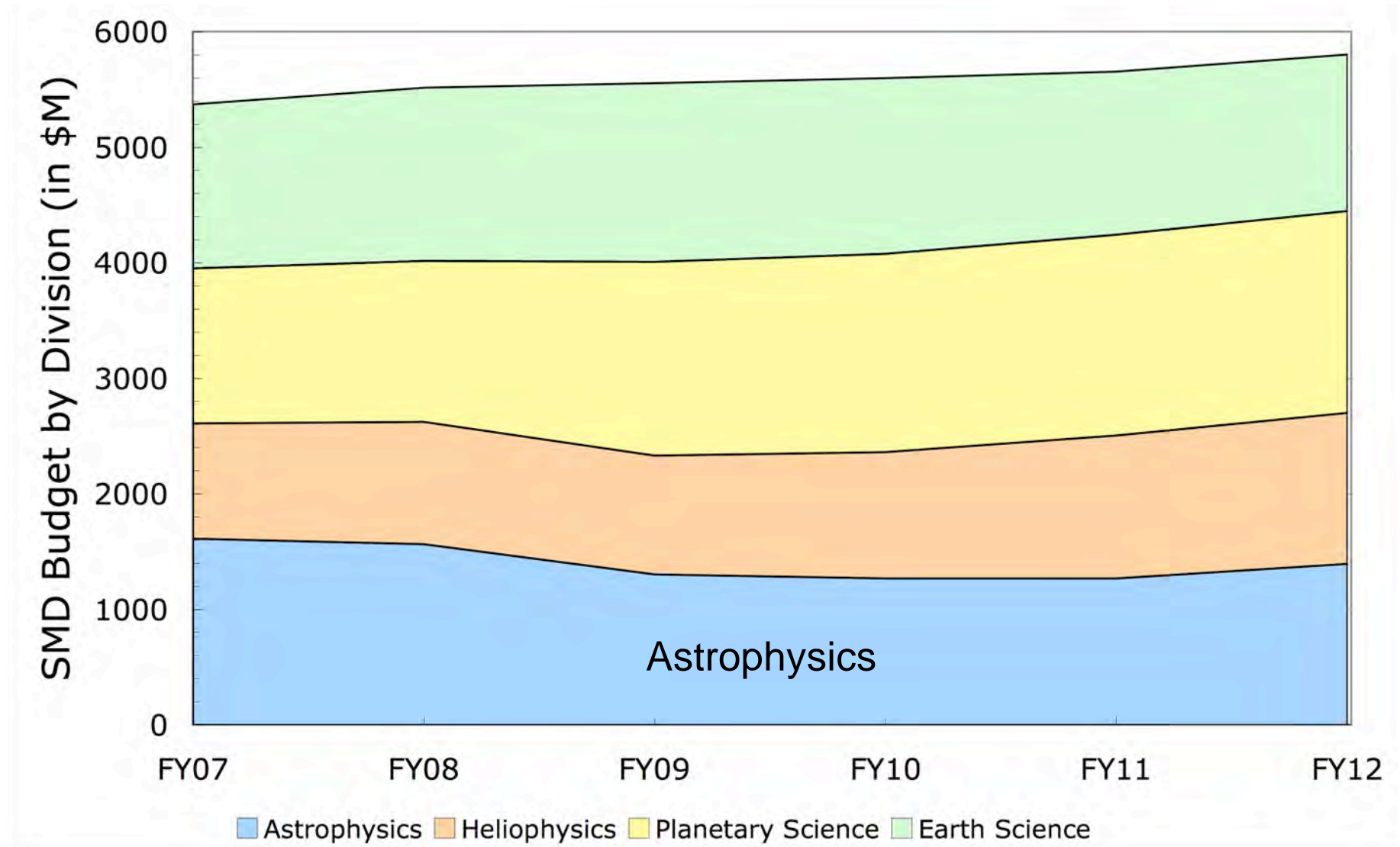


Observing the cosmos complements, augments and bridges other disciplines by providing:





FY2008 SMD Budget by Division (\$M)





FY2008 NASA Budget (\$M)

	FY2006	* FY2007	FY2008	FY2009	FY2010	FY2011	FY2012
<u>Total NASA</u>	<u>\$16,658.0</u>	<u>\$16,792.3</u>	<u>\$17,309.4</u>	<u>\$17,614.2</u>	<u>\$18,026.3</u>	<u>\$18,460.4</u>	<u>\$18,905.0</u>
<u>Science</u>	<u>\$5,244.6</u>	<u>\$5,466.8</u>	<u>\$5,516.1</u>	<u>\$5,555.3</u>	<u>\$5,600.6</u>	<u>\$5,656.9</u>	<u>\$5,802.7</u>
Planetary Science	\$1,298.9	\$1,411.2	\$1,395.8	\$1,676.9	\$1,720.3	\$1,738.3	\$1,748.2
Heliophysics	\$1,067.3	\$1,028.1	\$1,057.2	\$1,028.4	\$1,091.3	\$1,241.2	\$1,307.5
Astrophysics	\$1,552.8	\$1,563.0	\$1,565.8	\$1,304.2	\$1,268.9	\$1,266.2	\$1,393.8
Earth Science	\$1,325.6	\$1,464.5	\$1,497.3	\$1,545.8	\$1,520.1	\$1,411.2	\$1,353.2
<u>Exploration Systems</u>	<u>\$3,050.1</u>	<u>\$4,152.5</u>	<u>\$3,923.8</u>	<u>\$4,312.8</u>	<u>\$4,757.8</u>	<u>\$8,725.2</u>	<u>\$9,076.8</u>
Constellation Systems	\$1,733.5	\$3,232.5	\$3,068.0	\$3,451.2	\$3,784.9	\$7,666.0	\$7,993.0
Advanced Capabilities	\$1,316.6	\$920.0	\$855.8	\$861.6	\$973.0	\$1,059.1	\$1,083.9
Aeronautics Research	\$893.2	\$529.3	\$554.0	\$546.7	\$545.3	\$549.8	\$554.7
<u>Space Operations</u>	<u>\$6,904.7</u>	<u>\$6,108.3</u>	<u>\$6,791.7</u>	<u>\$6,710.3</u>	<u>\$6,625.7</u>	<u>\$3,036.6</u>	<u>\$2,978.0</u>
Space Shuttle	\$4,812.5	\$4,017.6	\$4,007.5	\$3,650.9	\$3,634.4	\$116.2	\$0.0
International Space Station	\$1,753.4	\$1,762.6	\$2,238.6	\$2,515.1	\$2,609.2	\$2,547.5	\$2,600.8
Space and Flight Support (SFS)	\$338.8	\$328.1	\$545.7	\$544.3	\$382.0	\$372.9	\$377.2
Inspector General	\$32.0	\$33.5	\$34.6	\$35.5	\$36.4	\$37.3	\$38.3
<u>Cross-Agency Support Programs</u>	<u>\$533.4</u>	<u>\$502.0</u>	<u>\$489.2</u>	<u>\$453.5</u>	<u>\$460.4</u>	<u>\$454.7</u>	<u>\$454.4</u>
Education Theme	\$162.4	\$167.4	\$153.7	\$152.8	\$152.7	\$149.8	\$149.6
Advanced Business Systems (IEMP)	\$156.3	\$97.4	\$103.1	\$69.4	\$71.6	\$67.6	\$67.5
Innovative Partnerships Program	\$214.8	\$215.1	\$198.1	\$197.2	\$199.8	\$200.0	\$200.0
Shared Capability Assets Program	\$0.0	\$22.1	\$34.3	\$34.2	\$36.2	\$37.3	\$37.2

* FY2007 is President's Budget, adjusted for Full Cost Simplification. Does not reflect full-year CR or current planning.



Astrophysics: Content of FY08 Budget

	FY07	FY08	FY09	FY10	FY11	FY12
FY 08 President's Budget	1,563.0	1,565.8	1,304.2	1,268.9	1,266.2	1,393.8
Navigator	124.7	57.1	58.4	59.5	61.0	62.5
SIM	94.2	20.2	20.7	22.0	22.3	22.6
Keck Interferometer / Single Aperture / Ops	10.0	13.0	11.8	10.5	10.3	10.7
TPF	0.0	6.1	6.2	6.3	6.4	6.5
Other Navigator	12.4	13.6	15.4	16.4	17.7	18.3
Institutional	8.0	4.3	4.3	4.3	4.3	4.5
JWST	468.5	545.4	452.1	376.9	321.1	285.9
Direct	391.0	447.5	372.0	311.1	265.1	236.2
Institutional	77.5	98.0	80.1	65.7	55.9	49.7
Hubble Space Telescope	343.0	277.7	165.2	152.8	151.4	151.3
Development	188.9	136.6	45.8	37.6	35.9	35.0
Operations and Data Analysis	95.6	90.0	89.5	88.1	88.9	89.8
Institutional	58.5	51.1	29.9	27.1	26.7	26.5
SOFIA	0.0	77.3	89.1	88.6	89.9	92.1
Direct	0.0	63.1	72.9	72.9	74.1	75.9
Institutional	0.0	14.2	16.1	15.7	15.8	16.2
GLAST	90.7	42.2	28.3	28.3	29.3	30.2
Direct	75.2	34.4	23.2	23.3	24.1	24.9
Institutional	15.5	7.8	5.1	5.0	5.2	5.3
Discovery	105.0	93.0	25.7	16.3	16.2	17.6
Kepler	89.2	79.5	21.4	13.4	13.3	14.5
Institutional	15.7	13.5	4.4	2.9	2.9	3.1
*Astrophysics Explorer	69.4	99.1	88.8	28.2	11.7	5.7
WISE	52.7	72.7	65.2	13.0	5.2	1.6
Swift, Suzaku	9.1	13.1	11.4	11.7	5.1	3.2
Institutional	7.6	13.2	12.2	3.5	1.4	0.8
Astrophysics Research	319.8	315.2	306.1	331.9	378.5	491.4
Research and Analysis	50.0	47.5	48.9	46.2	48.1	49.8
Chandra	61.1	62.9	65.0	67.8	68.5	70.2
Spitzer	76.3	75.4	71.7	48.9	44.3	43.2
Astrophysics Future Missions			0.2	42.7	78.1	164.6
Other Operating Missions / D A / Archives	67.8	60.0	50.9	50.7	55.5	58.6
Balloons	19.8	22.0	24.1	23.9	23.8	25.1
Institutional	44.8	47.4	45.3	51.8	60.1	79.7
ISSC	19.8	26.5	39.1	38.7	36.5	35.2
Herschel & Planck	18.5	24.8	36.6	36.3	34.2	33.0
Institutional	1.3	1.7	2.5	2.4	2.3	2.2
Beyond Einstein	22.1	32.3	51.5	147.6	170.6	222.1
Direct	18.3	26.5	42.3	121.5	140.7	183.2
Institutional	3.8	5.8	9.2	26.1	29.9	38.8
*Future Explorer (non-add; in Heliophysics)	9.1	11.6	47.8	110.4	154.3	172.5



Astrophysics Research Budget

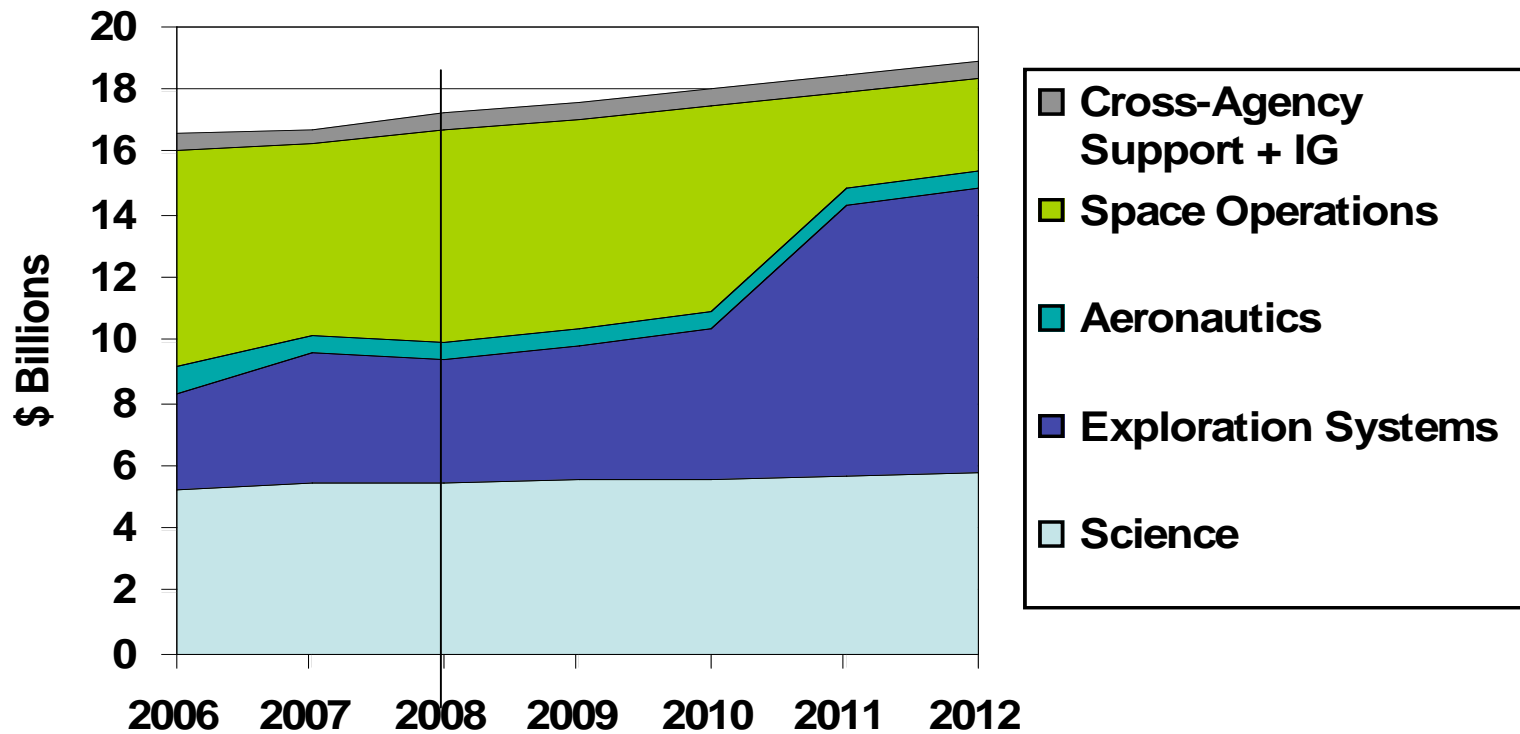
For *FY2007*, the following aggregates the competed Astrophysics research budget excluding flight hardware development

- **“Astrophysics R&A” (really ST&T)\$50M**
 - **Data analysis (other than “Astrophysics R&A”).....\$88M**
 - Mission specific General Observer/Guest Investigator programs
 - Archival data analysis programs
 - **Mission Science Teams (other than “Astrophysics R&A”)\$75M**
 - PI teams for missions and instruments selected through AO
 - Additional team members selected through competition
 - Participating scientists, interdisciplinary scientists, science working group members, etc.
 - **Total Astrophysics research and data analysis funding~ \$213M**
-



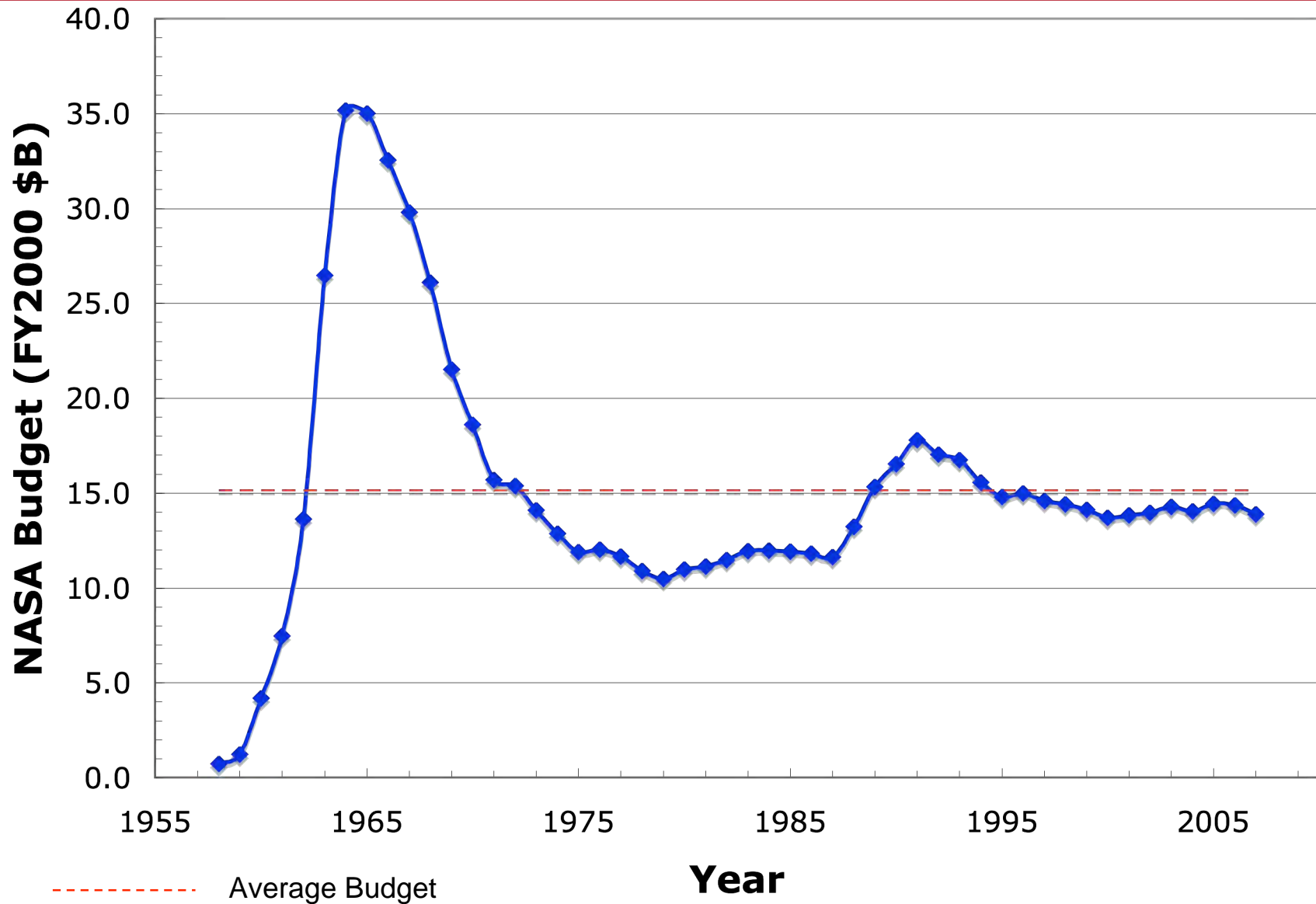
OSTP-OMB FY08 budget overview for SSB, March 2007

Total NASA Budget (\$17.3 billion requested for FY08)





NASA Funding History (\$B FY2000)





We Are Successful !

