National Aeronautics and Space Administration

Astrophysics

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Astronomy and Astrophysics Advisory Committee

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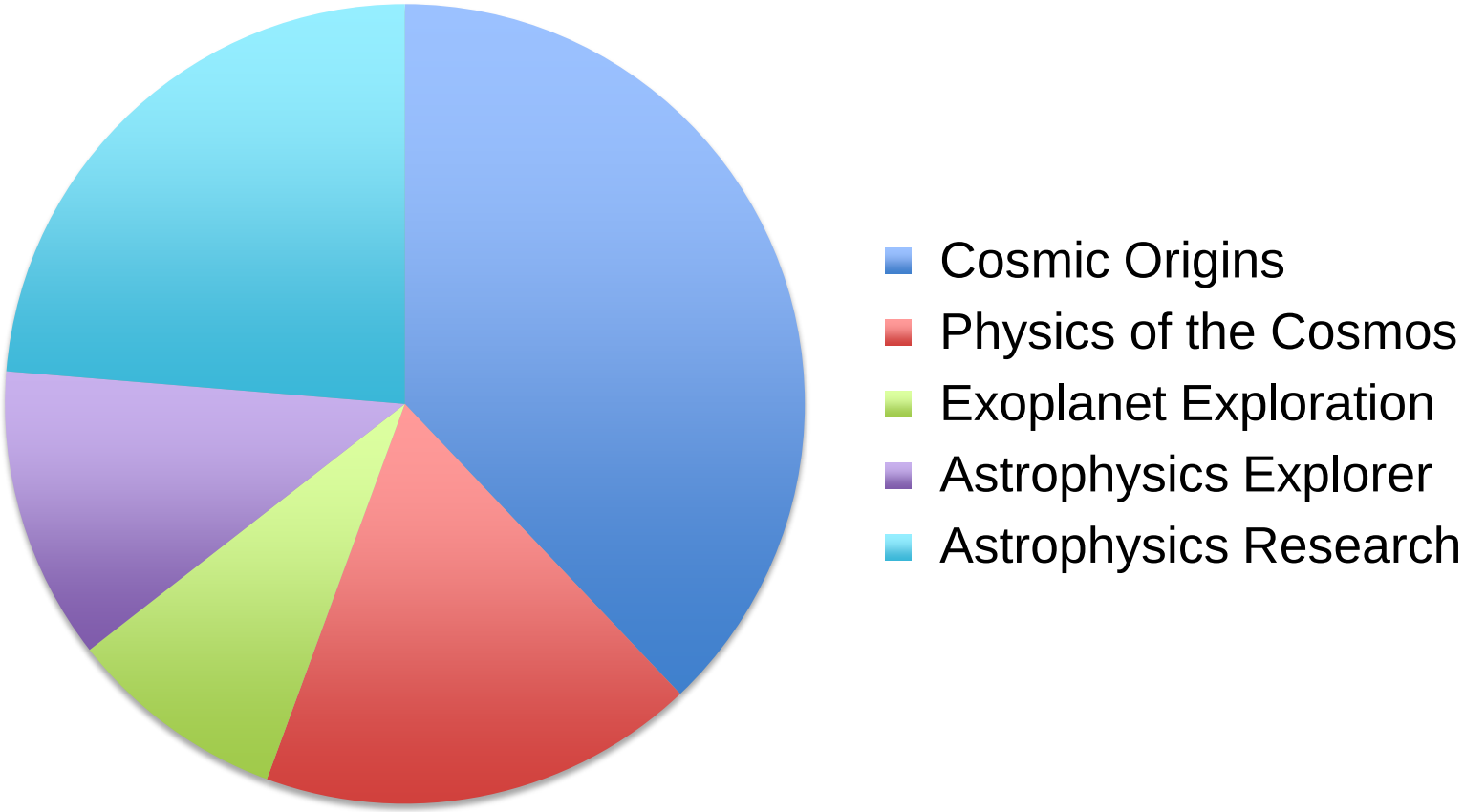
www.nasa.gov

SMD FY 2013 Program/Budget Strategy

- Continue to provide the most productive Earth & space science program for the available resources.
  - Guided by national priorities.
  - Informed by NRC Decadal Surveys recommendations.
- Continue to responsibly manage the national investment in robotic space missions.
  - Confirm new missions only after sufficient technology maturation and budgets at an appropriate confidence level.
  - Closely manage JWST to the new cost and schedule baseline.
- Plan and conduct a new Mars program with other NASA organizations to meet both human exploration and science goals.
- Adequately budget for launch services acquired for SMD by NASA's Launch Services Program (LSP):
  - Availability and reliability for medium class.
  - Encourage cost constraining measures for intermediate/large class.

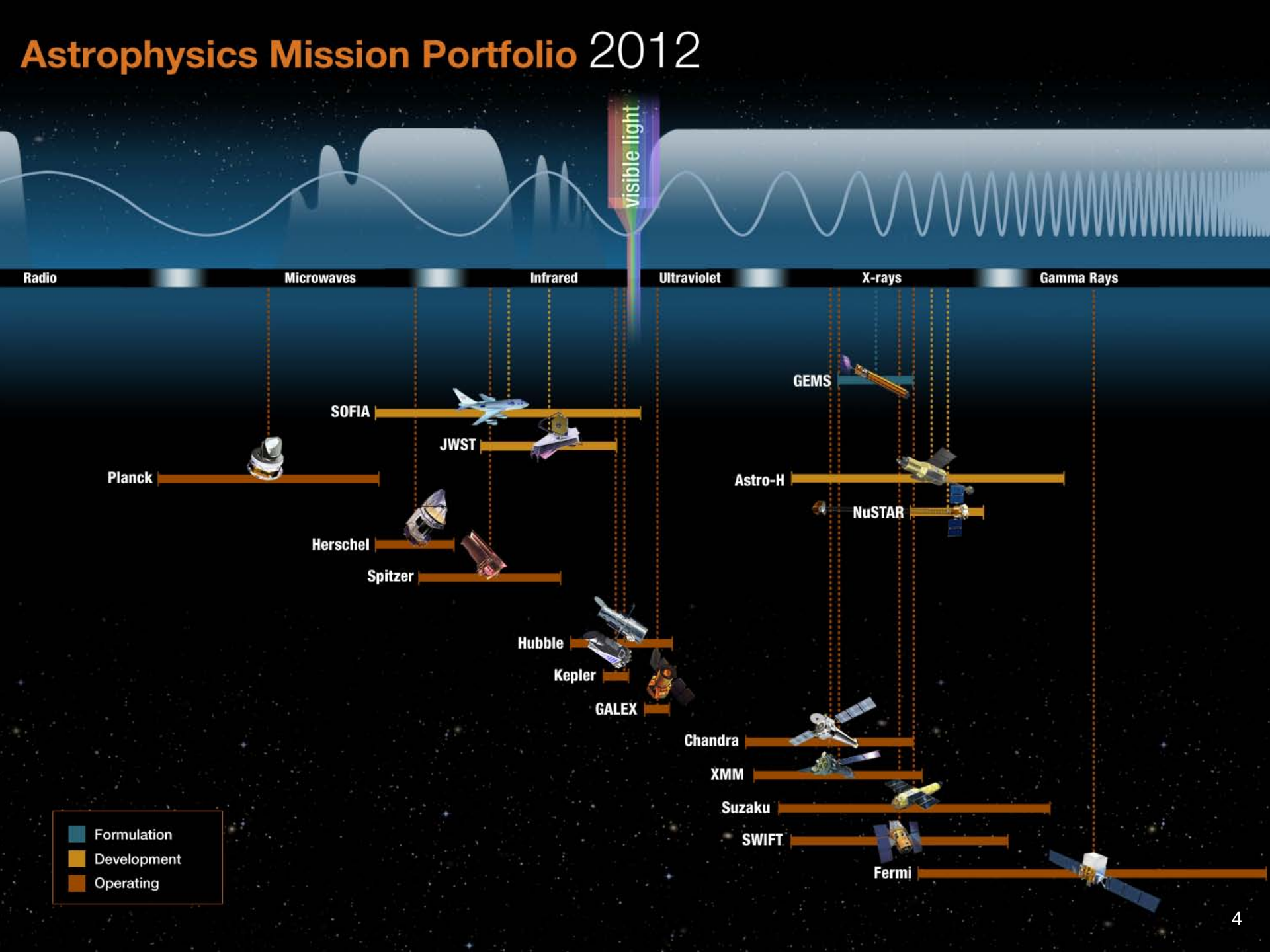
FY2013 President's Request for NASA Astrophysics

~$633M Total *



* Does not include SMD budgets that are bookkept in the Astrophysics budget line

Astrophysics Mission Portfolio 2012



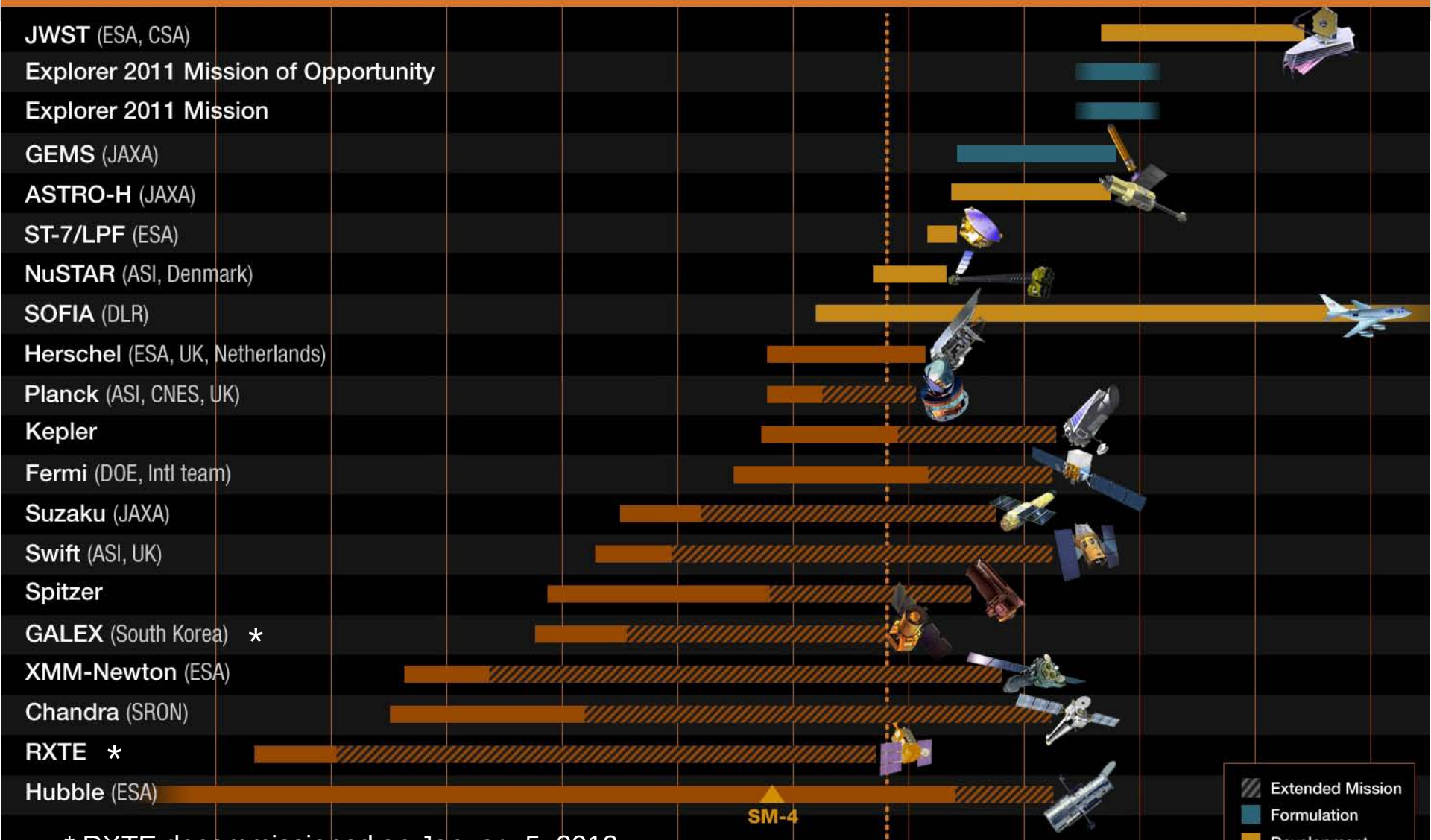
2012 Senior Review Results

Mission	Result
Chandra	- Fully fund as budgeted thru FY16 - Augment Guest Observer Program at ½ Project request
Fermi	- Mission extension thru FY16 - Reduced budget starting in FY14
Hubble	- Fully fund as budgeted
Kepler	- Extend mission operations thru FY16 - Augment Guest Observer and Participating Science Program at 1/2 Project request
Planck	- Fund US Support of 1-year extension of Low Frequency Instrument operations
Spitzer	- Extend ops thru FY14 - Closeout in FY15
Suzaku	- Extend US Science support through March 2015 (Astro-H launch +1 year)
Swift	- Extend mission operations thru FY16 - Augment Guest Observer Program per Project request
XMM-Newton	- Extend US support through March 2015

Note: All FY15 and FY16 decisions will be revisited in the 2014 Senior Review.

Astrophysics Missions timeline

Last updated: April 24, 2012



* RXTE decommissioned on January 5, 2012.
GALEX NASA science data acquisition ended on February 7, 2012.

Astrophysics – Operating Missions

Mission	Launch	End Date	Phase	-4	-3	-2	-1	This Month	Comments
Hubble	1990-04-24	2016-09-30	Prime	G	G	G	G	G	Extended
RXTE	1995-12-30	2012-01-05	Ext	G	G				Sci Ops ended Jan 3, spacecraft decommissioned on Jan 5 after 16 years of operations.
Chandra	1999-07-23	2016-09-30	Ext	G	G	G	G	G	Extended
XMM-Newton	1999-12-10	2015-03-31	Ext	G	G	G	G	G	Extended
GALEX	2003-04-28	2012-02-07	Ext	G	G	G			NASA'S mission ended Feb 7. In standby mode waiting Space Act Agreement with Caltech.
Spitzer	2003-08-25	2014-09-30	Ext	G	G	G	G	G	Extended
Swift	2004-11-20	2016-09-30	Ext	G	G	G	G	G	Extended
Suzaku	2005-07-10	2015-03-31	Ext	G	G	G	G	G	Extended
Fermi	2008-06-11	2016-09-30	Prime	G	G	G	G	G	Completed 1st maneuver using propulsion system to avoid another satellite. Extended
Kepler	2009-03-07	2016-09-30	Prime	G	G	G	G	G	Extended
Herschel	2009-05-14	2013-05-14	Prime	G	G	G	G	G	
Planck	2009-05-14	2013-01-31	Ext	G	G	G	G	G	Extended

G On plan, adequate margin

Y Problems, working to resolve within planned margin

R Problems, not enough margin to recover

Accomplishments & Significant Events

First generation HAWC instrument

NuSTAR in fairing

SOFIA

- Second Generation Instrument selection announced. The selected proposals were judged to have the best science value and feasible development plans.
  - **The High-resolution Airborne Wideband Camera Polarization (HAWC-Pol)**, Charles Dowell, JPL. Upgrades the HAWC instrument to include the capability to make polarimetric observations at far-infrared wavelengths. The investigation's main goals are to measure the magnetic field in the interstellar medium, star forming regions and the center of the Milky Way.
  - **HAWC++**, Johannes Staguhn, Johns Hopkins University. Provides a sensitive, large- format detector array to the HAWC-Pol investigation, increasing its observing efficiency and providing a broader range of targets.
- Next SOFIA instrument call for proposals in 2014

NuSTAR

- Launch readiness date is NET June 13, 2012, pending resolution of Pegasus flight S/W issues.
  - Flight Readiness Review ~May 30, 2012.
- Pegasus fairing removed to enable purging of the X-ray optics.

NuSTAR Schedule to Launch

Activity	Date	Status
SRR	July 9-10, 2008 (Caltech)	Complete
Program PDR	June 9-11, 2009 (Caltech)	Complete
MCR/KDP-C	August 6, 2009 (NASA HQs)	Complete
Phase C start	November 19, 2009	Complete
CDR	February 4, 2010	Complete
SIR	January 27-28, 2011	Complete
KDP-D	March 7, 2011	Complete
Observatory I&T complete	January 23, 2012	Complete
ORR	January 26, 2012	Complete
SMSR	March 5, 2012	Complete
MRB	March 7, 2012	Complete
FRR	~ May 30, 2012	
LRD	~ June 13, 2012 (Kwajalein)	
Phase E start	~ L+30-60 days	
Prime Mission complete	~ Summer/Fall 2014	

Accomplishments & Significant Events (cont.)

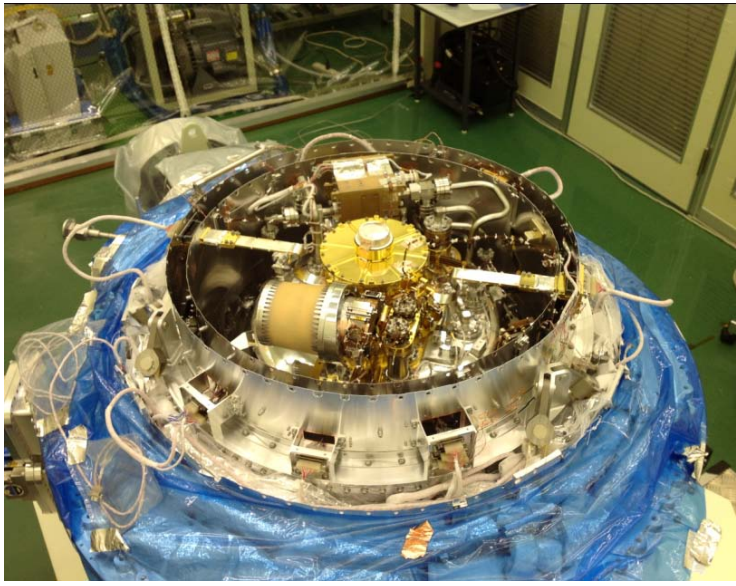
GEMS

- All flight mirror foils have been fabricated and flight spare foils are now being fabricated.
- Began fabrication of long lead flight polarimeter enclosures in house.
- SRB PDR delivered week of Apr 16, 2012.
- GSFC CMC - Apr 24, 2012.
- Confirmation /KDP-C - May 10, 2012.

GEMS flight mirror reflectors in storage

Astro-H

- The Engineering Model (EM) Calorimeter Spectrometer Insert (CSI) completed integration into the JAXA EM dewar on Apr 10, 2012.
- The EM CSI is scheduled to begin cryogenic functional testing Aug 7, 2012.
- All SXS EM hardware has completed fabrication.
- Flight model work proceeding as planned.



Astro-H CSI integrated into the JAXA EM dewar

JWST on track for 2018

Astrophysics - Missions in Formulation & Implementation

Project	Overall previous months				This Month					Comments
	-4	-3	-2	-1	O	T	C	S	P	
Physics of the Cosmos	G	G	G	G	G	G	G	G	G	
ST-7 (NET Apr 2014)	G	G	G	G	G	G	G	G	G	JPL team supporting testing of closed loop testbed. LPF S/C in storage.
Explorer Program										
NuSTAR (NET Jun 13, 2012)	Y	Y	Y	Y	Y	G	Y	Y	G	LRD TBD pending resolution of Pegasus S/W.
Astro-H (Aug 2014)	Y	Y	Y	Y	Y	G	Y	Y	G	Cost reserve status unclear until JAXA releases updated schedule.
GEMS (Nov 2014)	R	Y	G	G/Y	Y	G/Y	G	Y	G/Y	KDP-C delayed due to CMC date being rescheduled to Apr 24, 2012.
FINESSE, TESS, NICER, GUSSTO		G	G	G	G	G	G	G	G	Phase A reports due Sep 21, 2012.
Cosmic Origins	G	G	G	G	G	G	G	G	G	
SOFIA (ongoing)	G	G	G/Y	G/Y	Y	G/Y	G	Y	G/Y	Updated instrument commissioning timeline estimates will delay achieve-ment of full ops capability.
Exoplanet Exploration	G	G	G	G	G	G	G	G	G	
Balloon Prog (ongoing)	G	G	G	G	G	G	G	G	G	Palestine campaign followed by Sweden campaign in late June.

O: Overall, C: Cost, S: Schedule, T: Technical, P: Programmatic

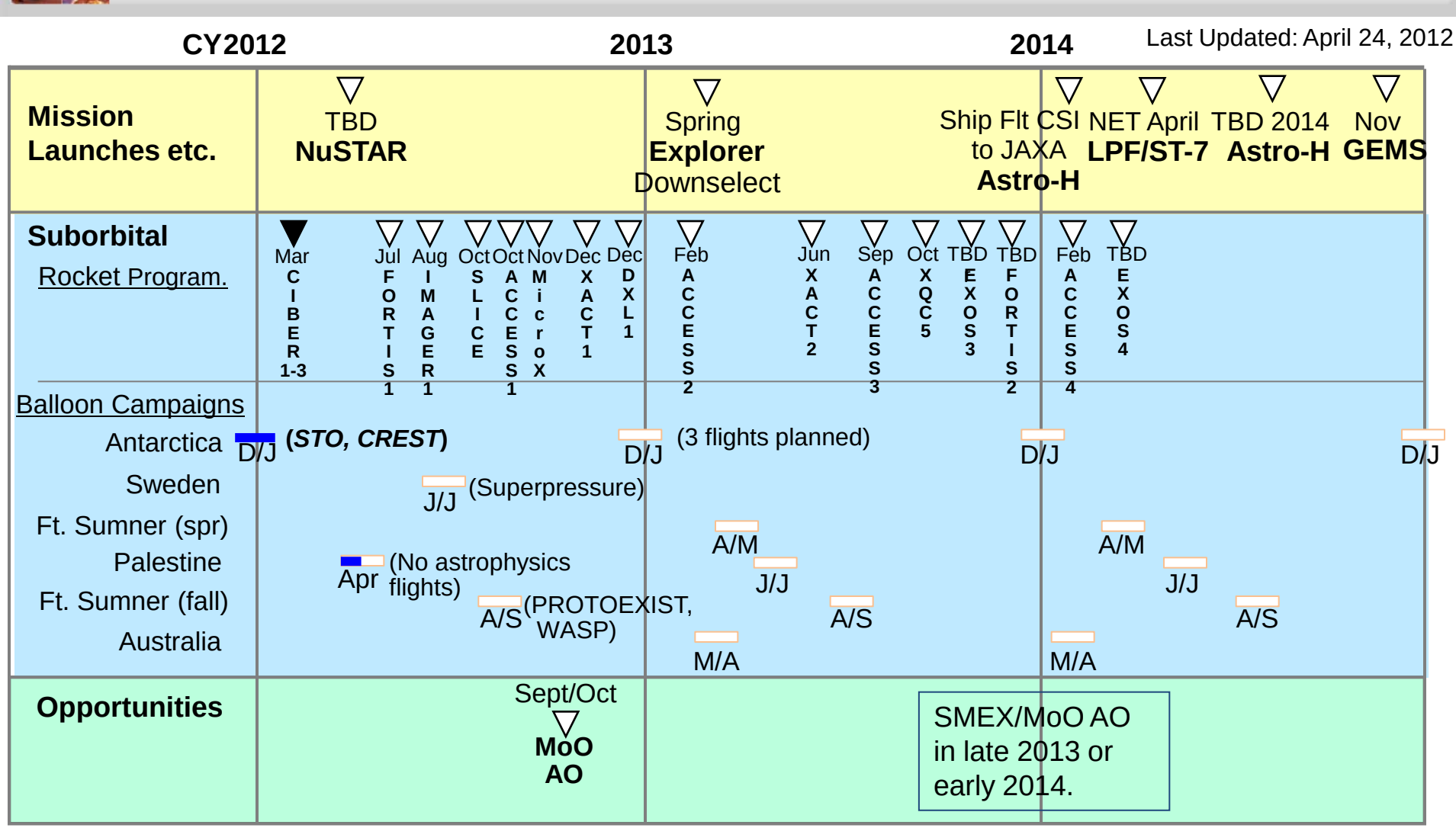
G — On plan, adequate margin

Y — Problems, working to resolve within planned margin

R — Problems, not enough margin to recover

Astrophysics Mission Events

Last Updated: April 24, 2012



Explorer Options

- FY13 budget request does not support an AO for both missions and missions of opportunity (MOs) in late CY12.
  - First priority in the Explorer program is to complete Explorers in development: NuSTAR, SXS/Astro-H, GEMS.
  - Second priority is to downselect and fund the development of one mission and one MO from the projects currently conducting Phase A studies.
  - Third priority is to issue new AOs leading to the development of new missions.
- Identifying Explorer AO options is straightforward: (i) identify total mission budget (including Launch Vehicle and required HQ reserves, neither of which is included in the PI cost cap); (ii) see when Phase B and a reasonable profile can be accommodated within the future mission line; (iii) back up 2 years from Phase B start for a 2-step AO release date (a little less for a 1-step AO for MOs).
- The Astro2010 Decadal Survey said to “Enable rapid response to science opportunities; augments current plan by 2 MIDEXs, 2 SMEXs, and 4 MoOs.”
  - “This survey recommends that the annual budget of the astrophysics component of the Explorer program be increased from $40 million to $100 million by 2015.”
  - The Astrophysics Explorer budget is $134M in FY15 and $166M in FY17.
- Astrophysics Division is planning a series of AOs (subject to budget):
  - An AO for a MO with a $50-60M cost cap in Sep/Oct 2012.
  - An AO for a SMEX and a MO late CY2013 or early CY2014 with the cost caps and actual dates TBD by summer 2012.

WFIRST (Wide-Field Infrared Survey Telescope)

- Science Definition Team delivered its interim report in July 2011.
  - The report is at: *http://wfirst.gsfc.nasa.gov/science/WFIRST_Interim_Report.pdf*
  - The Interim Design Reference Mission (IDRM) is a proof of concept that a mission can be constructed that is compliant with the Astro2010 recommendation for groundbreaking observations in Dark Energy, Exoplanet and NIR sky surveys.
- Updated guidance given to Science Definition Team Dec 8, 2011.
  - Second DRM will not duplicate capabilities of Euclid, LSST, and JWST in advancing science objectives of WFIRST. Hope for cost savings.
  - Final report due June 2012.
- Astro2010 recommended WFIRST as the highest priority large mission.
  - The President's FY13 NASA budget request includes no new large missions; Astrophysics expects none before we successfully complete JWST.
  - WFIRST will not launch in this decade (2018 + 7 yrs = 2025).
  - Astrophysics does not anticipate budget growth in the foreseeable future.
  - FY13 budget request does not support originally planned WFIRST technology development.
- NASA is proceeding as follows:
  - Through the Science Definition Team and Design Reference Missions, establish a basis for WFIRST planning.
  - Partner on ESA's Euclid to advance some of the science of Astro2010 and WFIRST.
  - Advance the technology required for WFIRST as the budget allows.

Euclid Status

- The Division is in the process of working out the details of the planned collaboration with ESA on the Euclid Project
  - Held multiple conversations with ESA (Fabio Favatta) to determine the NASA hardware contribution to Euclid.
  - Informed stakeholders (including NRC) on plan to spend $40-50M on the U.S. hardware contribution to Euclid.
  - Sent a letter to ESA outlining the details of our contribution and expected elements of the MOU.
  - MOU now in process with State.
- The Euclid Project was assigned to JPL who is working with the instrument developers in Europe and the PCOS office at GSFC on the technical details of the project. NASA will provide:
  - Detectors
  - Cables
  - ASICS
- Solicitation for NASA appointed science team members in preparation for release in May 2012.

Astrophysics Research Program

	FY04 Final $k	FY05 Final $k	FY06 Final $k	FY07 Final $k	FY08 Final $k	FY09 Final $k	FY10 Final $k	FY11 Final $k	FY12 Projected
Particle Astro	$ 8,248	$ 7,671	$ 8,544	$ 7,631	$ 6,672	$ 8,201	$ 8,260	$ 8,243	$ 8,585
High Energy	$ 14,548	$ 13,693	$ 14,779	$ 12,782	$ 12,406	$ 13,886	$ 14,110	$ 13,911	$ 14,548
UV/Opt/IR/ Sub-mm	$ 20,409	$ 18,742	$ 21,851	$ 17,442	$ 19,094	$ 22,353	$ 21,534	$ 21,295	$ 23,032
Other	$ 1,019	$ 854	$ 338	$ 394	$ 594	$ 670	$ 673	$ 641	$ 1,627
APRA Total	$ 44,224	$ 40,960	$ 45,511	$ 38,250	$ 38,765	$ 45,110	$ 44,577	$ 44,090	$ 47,791
Orig Solar Systems	$ 4,209	$ 3,872	$ 4,150	$ 3,673	$ 2,965	$ 3,000	$ 2,807	$ 2,944	$ 2,978
Astro Theory Program	$ 7,860	$ 7,363	$ 10,245	$ 10,227	$ 11,696	$ 11,890	$ 12,262	$ 12,577	$ 13,226
R&A (399131)	$ 56,293	$ 52,195	$ 59,906	$ 52,150	$ 53,426	$ 60,000	$ 59,646	$ 59,611	$ 63,995
ADAP/LTSA	$ 16,986	$ 15,700	$ 15,189	$ 12,641	$ 12,013	$ 14,384	$ 13,258	$ 14,132	$ 16,320
Core Research	$ 73,279	$ 67,895	$ 75,095	$ 64,791	$ 65,439	$ 74,384	$ 72,904	$ 73,743	$ 80,315
TPF/FS	$ 2,000	$ 2,000		(Foundation Science; now in ATP)					
Beyond Einstein FS	$ 4,000	$ 3,000	$ 2,000						
ASMCS (399131)	Mission concept studies				$ 3,452	$ 442			
PCOS SR&T				(Fundamental Physics; now in APRA)			$ 968	$ 184	
Technology Fellows									$ 600
TOTAL	$ 79.3M	$ 72.9M	$ 77.1M	$ 64.8M	$ 68.9M	$ 74.8M	$ 73.9M	$ 73.9M	$ 80.9M
		$7M cut	smaller cut	15% cut	partial recovery	more recovery	flat	flat	growth!

In response to the Astro2010 Decadal Survey recommendations:
-- The budget for research awards increased by 10% in FY12
-- Theory and Computation Networks: AAAC studying NASA-NSF program
-- Suborbital program (payloads, balloons) growth deferred

	Due Date	Notification	Days from due date	Weeks past review	Rec'd		Selected	Success
ROSES-2011								
Strategic Astrophysics Technology	23-Mar-12		34	-6.1	49			
Astrophysics Research and Analysis	23-Mar-12		34	-6.1	162	→		
Fermi Guest Investigator -- Cycle 5	20-Jan-12		97	4.1	221	→		
Kepler Guest Observer - Cycle 4	20-Jan-12		97	3.0	64	↑		
Roman Technology Fellowships	18-Nov-11	7-Mar-12	110	7.5	16		3	19%
Swift Guest Investigator -- Cycle 8	28-Sep-11	21-Dec-11	84	1.6	152	→	32	21%
Astrophysics Theory	3-Jun-11	28-Oct-11	147	6.2	197	→	33	17%
Origins of Solar Systems	27-May-11	7-Oct-11	133	7.1	36	→	5	14%
Astrophysics Data Analysis	20-May-11	29-Sep-11	132	6.1	278	↑↑	60	22%
ROSES-2010								
Strategic Astrophysics Technology	25-Mar-11	31-Aug-11	159	9.0	56	↑↑	14	25%
Astrophysics Research and Analysis	25-Mar-11	31-Aug-11	159	9.0	166	↑↑	40	24%
Elements with NEW STARTS IN FY12		weighted mean =	133	6.2	901		187	**21%**
Kepler Participating Scientists	11-Feb-11	17-Jun-11	126	4.4	30		12	40%
Fermi Guest Investigator -- Cycle 4	21-Jan-11	28-Apr-11	97	3.2	210		87	41%
Euclid Science Teams	20-Dec-10	15-Feb-11	57	3.5	2		0	
Kepler Guest Observer - Cycle 3	17-Dec-10	25-Mar-11	98	1.0	40		22	55%
Suzaku Guest Observer -- Cycle 6	19-Nov-10	28-Feb-11	101	4.6	91		40	44%
Swift Guest Investigator -- Cycle 7	29-Sep-10	21-Dec-10	83	1.6	182		61	34%
Astrophysics Theory	4-Jun-10	21-Oct-10	139	7.1	193		33	17%
Origins of Solar Systems	28-May-10	19-Oct-10	144	8.5	36		6	17%
Astrophysics Data Analysis	14-May-10	2-Sep-10	111	6.3	186		63	34%
ROSES-2009								
Astrophysics Research and Analysis	26-Mar-10	5-Aug-10	132	6.6	143		37	26%
Elements with NEW STARTS IN FY11		weighted mean =	111	4.7	1113		361	**32%**

2012 Astrophysics Fellows

Sagan Fellows

Name	Host Institution
Sarah Ballard	Univ. of WA, Seattle
Jean-Michel Desert	Caltech
Catherine Espaillat	Harvard Smithsonian Ctr.
Nikole Lewis	MIT
Rebecca Martin	Univ of Colorado, Boulder
Christian Schwab	Yale Univ.

Einstein Fellows

Name	Host Institution
Laura Blecha	Univ of MD, College Park
Julie Hlavacek-Larrando	Stanford Univ.
Ann-Marie Madigan	UC Berkeley
Smadar Naoz	Harvard Univ.
Joey Neilsen	Boston Univ.
Chris Nixon	Univ of Colorado, Boulder
Christian Reisswig	Caltech
Fabian Schmidt	Princeton Univ.
Leo Stein	Cornell Univ.
Meng Su	MIT
Reinout van Weeren	SAO
Justin Vandenbroucke	SLAC

Hubble Fellows

Name	Host Institution
Xuening Bai	SAO
Alis Deason	UC Santa Cruz
Jennifer Donley	LANL
Robert Feldmann	UC Berkeley
Michele Fumagalli	Obs. of the Carnegie Inst. of WA
Kaitlin Kratter	Univ. of Colorado, Denver
Xin Liu	UCLA
Michael McDonald	MIT
Matthew McQuinn	UC Berkeley
Kohta Murase	Inst. for Advanced Study
Stella Offner	Yale Univ.
Steven Rodney	JHU
Leslie Rogers	Caltech
Yue Shen	Obs. of the Carnegie Inst. of WA
James Steiner	SAO
Erik Tollerud	Yale Univ.
Mark Vogelsberger	Harvard College Observatory

Roman Technology Fellows

Name	Institution
Judd Bowman	Arizona State Univ.
Michael McElwain	NASA GSFC
Randall McEntaffer	University of Iowa

Astro2010 Decadal Report Status - Response

Program Scale	Recommendation	Recommended Funding	Current Response FY13
Large	**WFIRST**	$1.6B	SDT and DRMs in FY12
Large	**Explorer** Augmentation	$463M	$20M/yr augmentation in FY14 growing to a $70M/yr augmentation in FY16
Large	**LISA** (Technology)	$852M	$3.4M in FY12; only PCOS SAT in FY13 and beyond
Large	**IXO** Technology	$200M	$6M in FY12 (including PCOS SAT); only PCOS SAT in FY13 and beyond
Medium	**New Worlds Technology**	$100-200M	$9M in FY12 (including EXEP SAT); funding increases by $12M/yr in FY15 growing to an increase of $15M/yr in FY17
Medium	**Inflation Probe Technology**	$60-200M	$0.3M in FY12 (SAT only); only PCOS SAT in FY13 and beyond; several APRA investigations are relevant
Small	**Astrophysics Theory Program** Augmentation	$35M additional	$0.3M/yr augmentation starting in FY12
Small	(Definition of) a **future UV-optical space capability**	$40M	$6M in FY12 (including SAT); included in COR SR&T growing by an additional $6M by FY15
Small	**Intermediate Technology Development** Augmentation	$2M/yr additional, increasing to $15M/yr additional by 2021	Included in 3 Program SAT augmentations toward 5 prioritized areas
Small	**Laboratory Astrophysics** Augmentation	$2M/yr additional	$0.5M/yr augmentation over $3M/yr baseline starting in FY12; includes one large investigation
Small	**SPICA** mission (U.S. contributions to JAXA-led)	$150M	Candidate for Explorer Mission of Opportunity
Small	**Suborbital Program** Augmentation	$15M/yr additional	$1M/yr augmentation for payloads over $22M/yr baseline; zero augmentation for Balloon Project
Small	**Theory and Computation Networks** (NASA, NSF, DOE)	$5M/yr NASA	$1.5M/yr for 3 years; to be reviewed after 3 years
N/A	**Additional core program augmentations**	N/A	Roman Technology fellows: $1M/yr; in FY13 new program; Astrophysics Data Program: $2M/yr augmentation over $14M baseline; APRA SR&T: $1M/yr augmentation over $20M baseline

Astrophysics Subcommittee Report Card

N = will not be achieved **P**= partially achieved **Y** = likely achieved **TBD** = to be decided

Status	***Large-scale Space Activities:***
N	Wide-Field Infrared Survey Telescope (WFIRST) with DOE
Y	Explorer Program Augmentation
N	Laser Interferometer Space Antenna (LISA) with ESA
N	International X-ray Observatory (IXO) with ESA
Status	***Medium-scale Space Activities:***
Y	New Worlds Technology Development Program (deferred in ROSES11)
N	Inflation Probe Technology Development Program
Status	***Small-scale Space Activities:***
N	Astrophysics Theory Program Augmentation (10% of requested increase)
Y	Definition of Future UV/Optical Space Capability
TBD	Intermediate Technology Development Augmentation (competitive selection)
P	Laboratory Astrophysics Program Augmentation (25% of requested increase)
TBD	JAXA-led SPICA Mission (future MOO announcement)
N	Suborbital Program Augmentation (4% to 7% of requested increase)
P	Theory and Computation Networks (with NSF, DOE; 30% of requested new start)

Backup Slides

Astrophysics Program Content

	FY 11	FY 12	FY 13	FY 14	FY 15	FY 16	FY 17
				(FY14-17 estimates are notional)			
Astrophysics	**631.1**	**672.7**	**659.4**	**703.0**	**693.7**	**708.9**	**710.2**
Astrophysics Research	146.9	164.1	176.2	189.1	205.1	211.5	218.7
Astrophysics Research and Analysis	59.6	64.6	64.2	65.5	66.8	68.2	69.5
Balloon Project	26.8	31.6	31.3	31.2	32.8	34.2	34.3
Other Missions and Data Analysis	60.5	67.9	80.6	92.3	105.4	109.2	114.8
Keck Single Aperture	2.2	2.3	2.4	2.4	2.5	2.5	2.5
Astrophysics Data Analysis Program	14.1	16.3	18.3	18.5	18.5	19.1	19.1
Astrophysics Data Curation and Archival	20.8	20.1	20.0	19.6	21.7	22.1	22.2
Astrophysics Senior Review			16.3	24.5	33.5	35.2	40.0
Education and Public Outreach	13.2	15.4	10.1	10.1	10.1	10.1	10.1
Directorate Support - Space Science	10.1	13.7	13.5	13.9	14.0	14.5	14.5
Directed Research and Technology				3.3	5.2	5.6	6.4
Cosmic Origins	229.1	237.3	240.4	228.5	215.1	205.3	205.7
Hubble Space Telescope (HST)	91.7	95.7	98.3	98.3	94.3	90.2	90.5
SOFIA	79.9	84.2	85.5	88.0	88.0	86.0	85.9
Other Missions And Data Analysis	57.6	57.4	56.6	42.2	32.8	29.1	29.3
Spitzer Space Telescope	22.7	17.8	9.8				
Herschel	24.6	24.0	20.8	15.8	5.8		
Cosmic Origins SR&T	7.9	10.6	19.4	19.5	20.7	21.7	21.8
Cosmic Origins Future Missions	0.7	1.0	1.7	1.7	1.0	2.0	2.0
Cosmic Origins Program Management	1.7	4.0	4.9	5.2	5.3	5.4	5.5

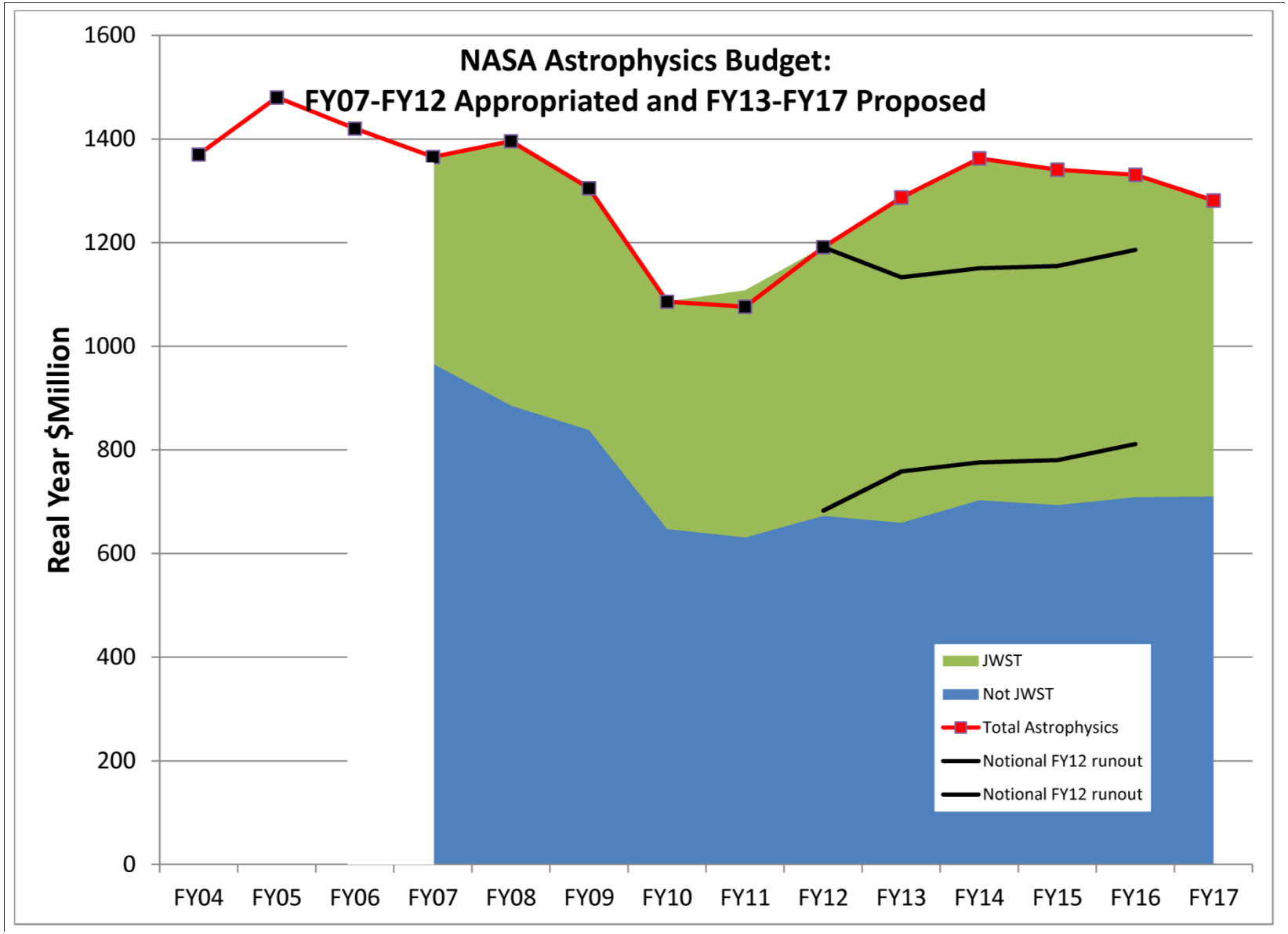
Astrophysics Program Content (cont'd)

	FY 11	FY 12	FY 13	FY 14	FY 15	FY 16	FY 17
				(FY14-17 estimates are notional)			
Physics of the Cosmos	108.7	108.3	111.8	109.6	96.3	92.7	74.6
Chandra X-Ray Observatory	60.6	54.7	56.6	56.6	56.6	56.7	51.2
Fermi Gamma-ray Space Telescope	22.3	25.3	25.0	24.5	17.5	12.9	
Planck	8.1	7.2	6.8	4.6	0.8		
XMM-Newton	1.2	2.1	1.9	1.9			
Physics of the Cosmos SR&T	13.9	15.0	14.9	15.3	15.3	16.0	16.2
Physics of the Cosmos Program Management	2.3	3.1	4.7	5.0	5.1	5.2	5.3
Physics of the Cosmos Future Missions	0.3	1.0	1.8	1.7	1.0	2.0	2.0
Exoplanet Exploration	46.4	50.8	56.0	41.6	43.3	42.4	45.6
Kepler	16.8	19.6	13.6	0.2			
Large Binocular Telescope Interferometer	1.5	2.0	3.8	2.9	2.0	0.5	0.5
Keck Operations	3.6	3.2	3.3	3.4	3.5	3.5	3.5
Keck Interferometer	0.1	0.4					
Wide Field Infrared Space Telescope	3.6						
Exoplanet Exploration SR&T	14.9	18.1	28.0	28.2	30.8	31.1	34.3
Exoplanet Exploration Program Management	4.8	6.0	6.1	5.7	5.9	6.0	6.0
Exoplanet Exploration Future Missions	1.2	1.5	1.2	1.2	1.2	1.2	1.2

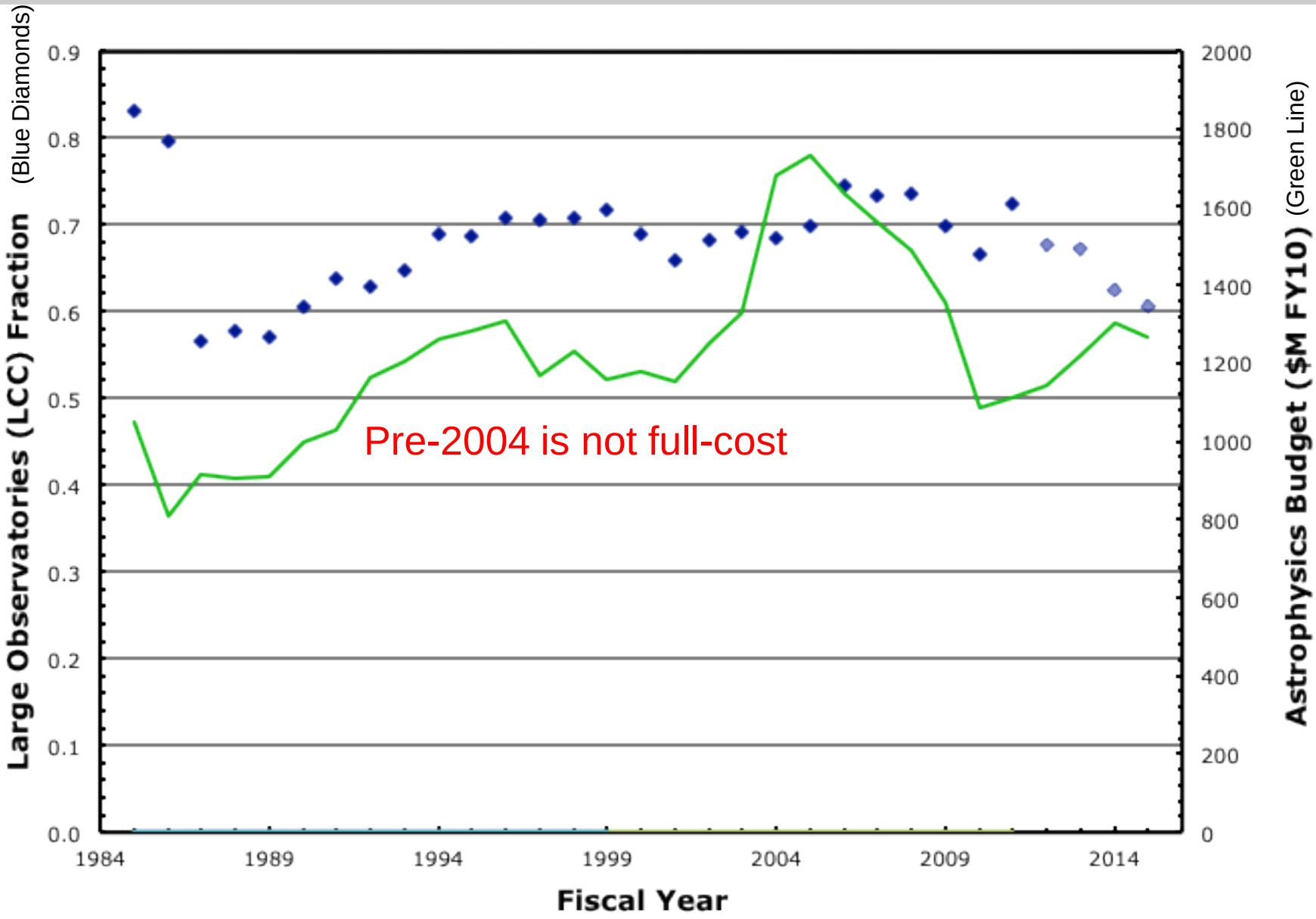
Astrophysics Program Content (cont'd)

	FY 11	FY 12	FY 13	FY 14	FY 15	FY 16	FY 17
				(FY14-17 estimates are notional)			
Astrophysics Explorer	100.0	112.2	75.1	134.3	133.9	157.0	165.6
Nuclear Spectroscopic Telescope Array (NuSTAR)	36.1	11.8	4.7	4.4			
Gravity and Extreme Magnetism	23.0	63.2	46.4	32.9	2.7	0.2	
Other Missions and Data Analysis	41.0	37.2	24.1	97.1	131.2	156.8	165.6
Astro-H (SXS)	16.9	16.2	4.4	1.8	1.0	0.9	
SWIFT	6.3	4.3	4.4	4.4			
Wide-Field Infrared Survey Explorer	7.3	4.5	0.2				
Suzaku (ASTRO-E II)	1.8	0.3	0.3				
GALEX	6.2	0.6					
Wilkinson Microwave Anistropy Pro (WMAP)	1.6	1.0					
Rossi X-Ray Timing Explorer (RXTE)	0.9						
Astrophysics Explorer Future Missions		3.1	10.6	85.6	124.0	149.6	159.3
Astrophysics Explorer Program Management		7.3	4.1	5.3	6.2	6.3	6.4

President's FY13 Budget Request for Astrophysics



Flagship Missions vs Astrophysics Budget



JWST FY12 Milestones

Note: Milestones assume the budget approved in APMC Decision Memo of 9/23/11, profile in quarterly template of 9/23/2011, and timely availability of FY12 funding.

As of 3/31/12

Month	Milestone	Comments
Oct '11	Initiate Delivery of Ambient Alignment Optical Stand (AOAS) to GSFC	Completed 10/4
Nov '11	ISIM Electronics Simulator Engineering Model Test Bed Complete Software Development & Verification Simulator Delivery to Software Development Lab	Completed 11/15 Completed 10/27
Dec '11	JSC Helium (GHe) floor shroud installed ESA NIRSpec preliminary root cause and corrective action assessment	Completed 10/26 Completed 12/15
Jan '12	Spacecraft-Optical Telescope Element (OTE) Vibration Isolation IDR 3/4 (CDR) Center of Curvature Optical Assembly (COCOA) Assembly complete S/C equipment panel Mechanical Ground Support Equipment (MGSE) Preliminary Req Review Complete Aft Optic System Integration & alignment Update Program Plan and Program Commitment Agreement to reflect replan	Completed 12/15 Completed 1/13 Completed 12/1 Completed 12/22 Completed 1/28
Feb '12	Complete assembly & verification testing (MSFC testing) of Primary Mirror Segment Assemblies (PMSAs) JSC GHe wall shrouds installed	Completed 12/19 Completed 12/29, all other panels installed 2/2
Mar '12	Complete System Engineering Team thermal margin assessment Optical Ground Support Equipment (OGSE) -1 Test Concept assessment complete	Completed 3/19 Completed 3/1
Apr '12	ICDH Flt #2 delivered to ISIM I&T Flight MIRI delivery Sunshield Support Structure IDR 3/4 (CDR) Deployable Tower Assembly (DTA) Composite flight components fabrication complete	SDRAM part failure in T/V. Part replaced, delivery in early May Delayed to May - no impact Completed 3/21 Completed 2/28

JWST FY12 Milestones

Note: Milestones assume the budget approved in APMC Decision Memo of 9/23/11, profile in quarterly template of 9/23/2011, and timely availability of FY12 funding.

As of 3/31/12

Month	Milestone	Comments
May '12	Complete COCOA assessment at ITT Complete Sunshield template layer 5 shape verification Conduct review of initial implementation of replan	Completed 3/9
Jun '12	JSC Chamber mods complete Communications support structure IDR 3/4 (CDR) complete Hardpoint Offloader Support System (HOSS) & Upper Suspension Frame Design Audit Complete Sunshield deployment MGSE PDR	
Jul '12	Program Office agreement on FY13 spending plan Flight FGS delivered ISIM Flt S/W Integrated Construction 12.6("Build" 12.6) to ISIM I&T Solar array Preliminary Design Audit Cryo Cooler Cold Head Assembly delivered to ISIM I&T Complete flight Secondary Mirror Support Structure End Fitting Fabrication	Flight CHA to be delivered in June 2013. No impact, work around in place.
Aug '12	Order remaining Chamber A isolators from Minus K	
Sept '12	Flight NIRCam Delivered OTE Simulator delivered to ISIM I&T Start Photogrammatry (PG) canister cryo test Complete Primary Mirror Backplane Support Structure center section Flight NIRSpec delivered	Delivery date moved to 4/13. No impact to, work around in place.