National Aeronautics and Space Administration

Astrophysics

STUC Meeting

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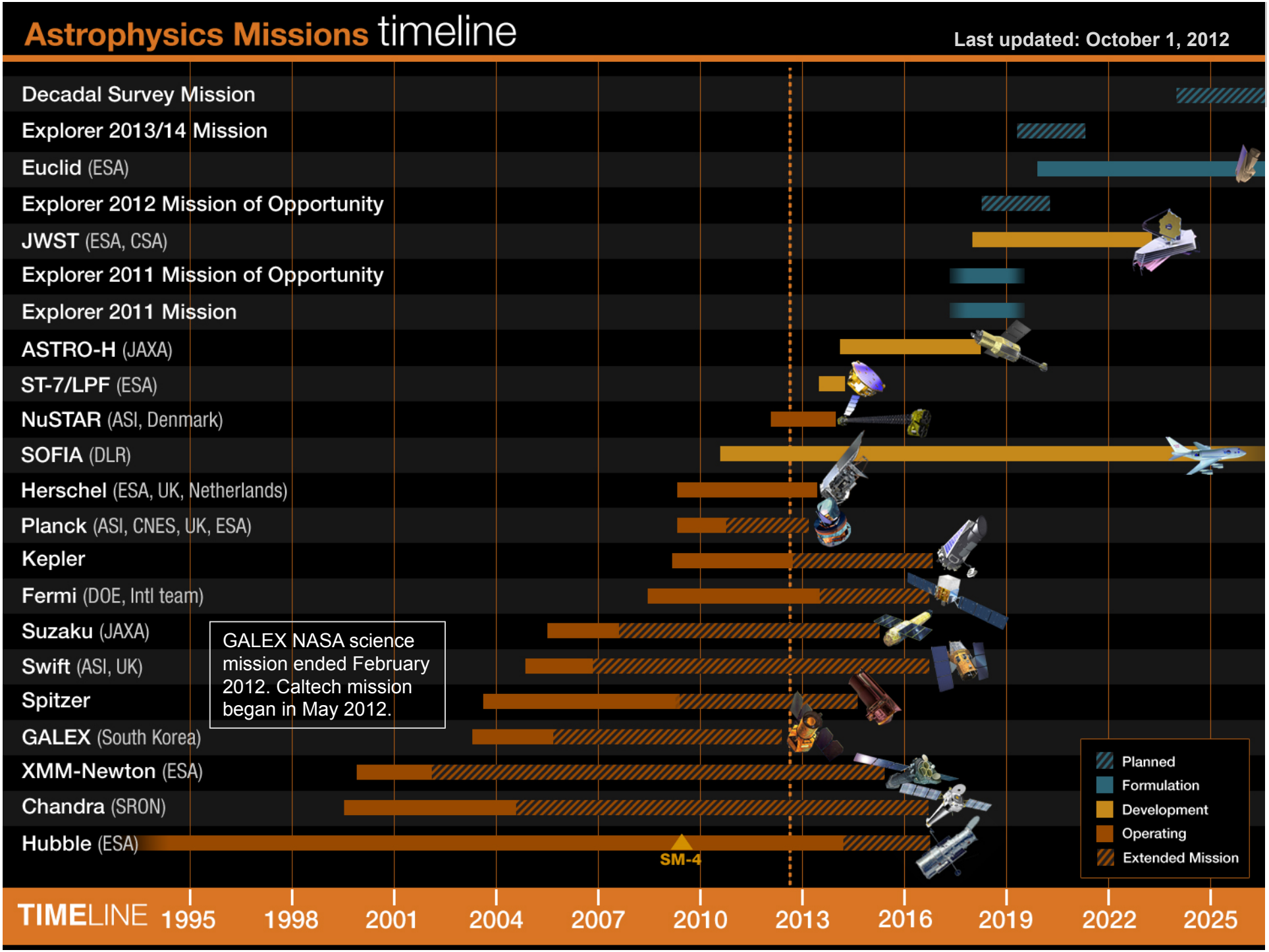
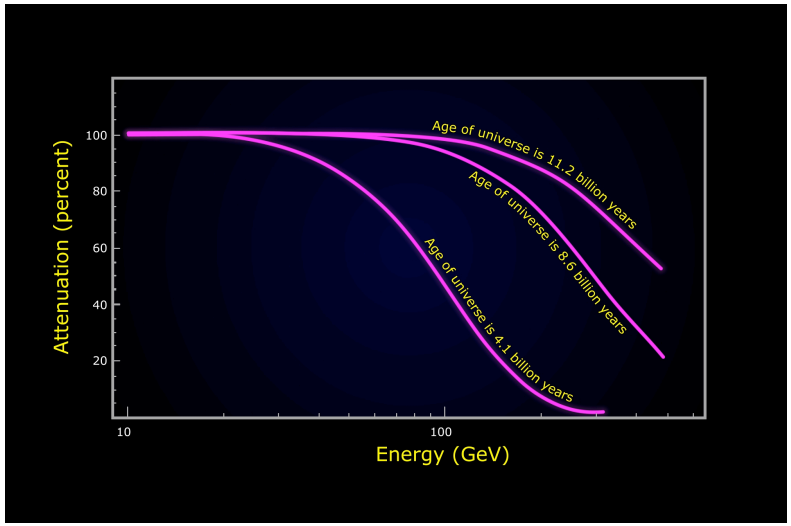
November 9 2012


Astrophysics Missions timeline
Last updated: October 1, 2012
Decadal Survey Mission
Explorer 2013/14 Mission
Euclid (ESA)
Explorer 2012 Mission of Opportunity
JWST (ESA, CSA)
Explorer 2011 Mission of Opportunity
Explorer 2011 Mission
ASTRO-H (JAXA)
ST-7/LPF (ESA)
NuSTAR (ASI, Denmark)
SOFIA (DLR)
Herschel (ESA, UK, Netherlands)
Planck (ASI, CNES, UK, ESA)
Kepler
Fermi (DOE, Intl team)
Suzaku (JAXA)
Swift (ASI, UK)
Spitzer
GALEX (South Korea)
XMM-Newton (ESA)
Chandra (SRON)
Hubble (ESA)
GALEX NASA science mission ended February 2012. Caltech mission began in May 2012.
SM-4
Planned
Formulation
Development
Operating
Extended Mission
TIMELINE
1995
1998
2001
2004
2007
2010
2013
2016
2019
2022
2025

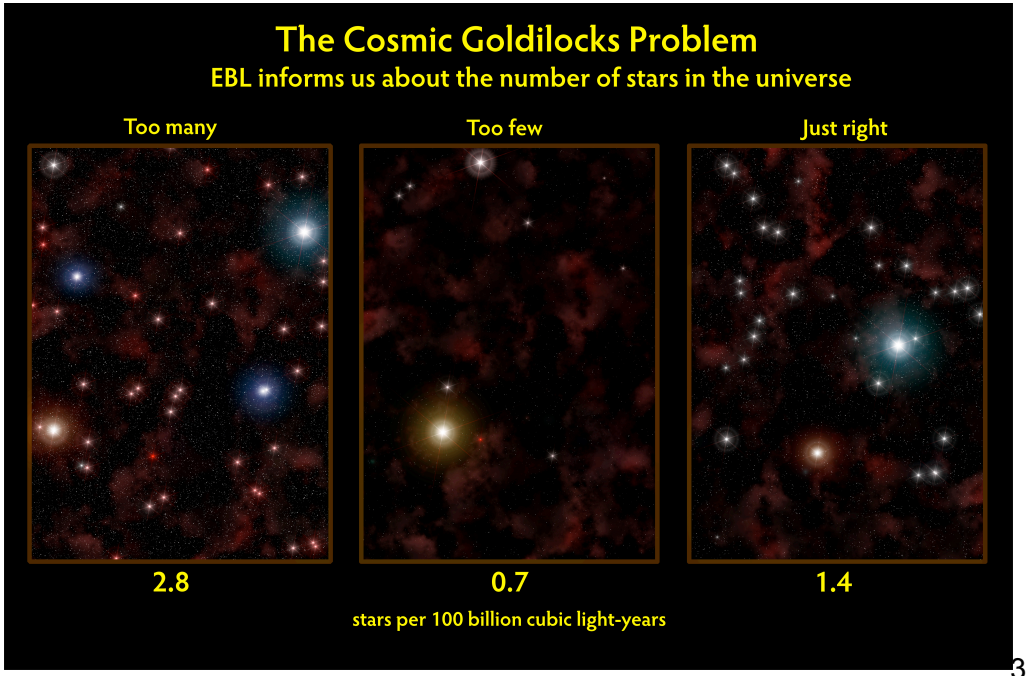
Cosmic ‘Fog” Produced by Ancient Starlight is Measured



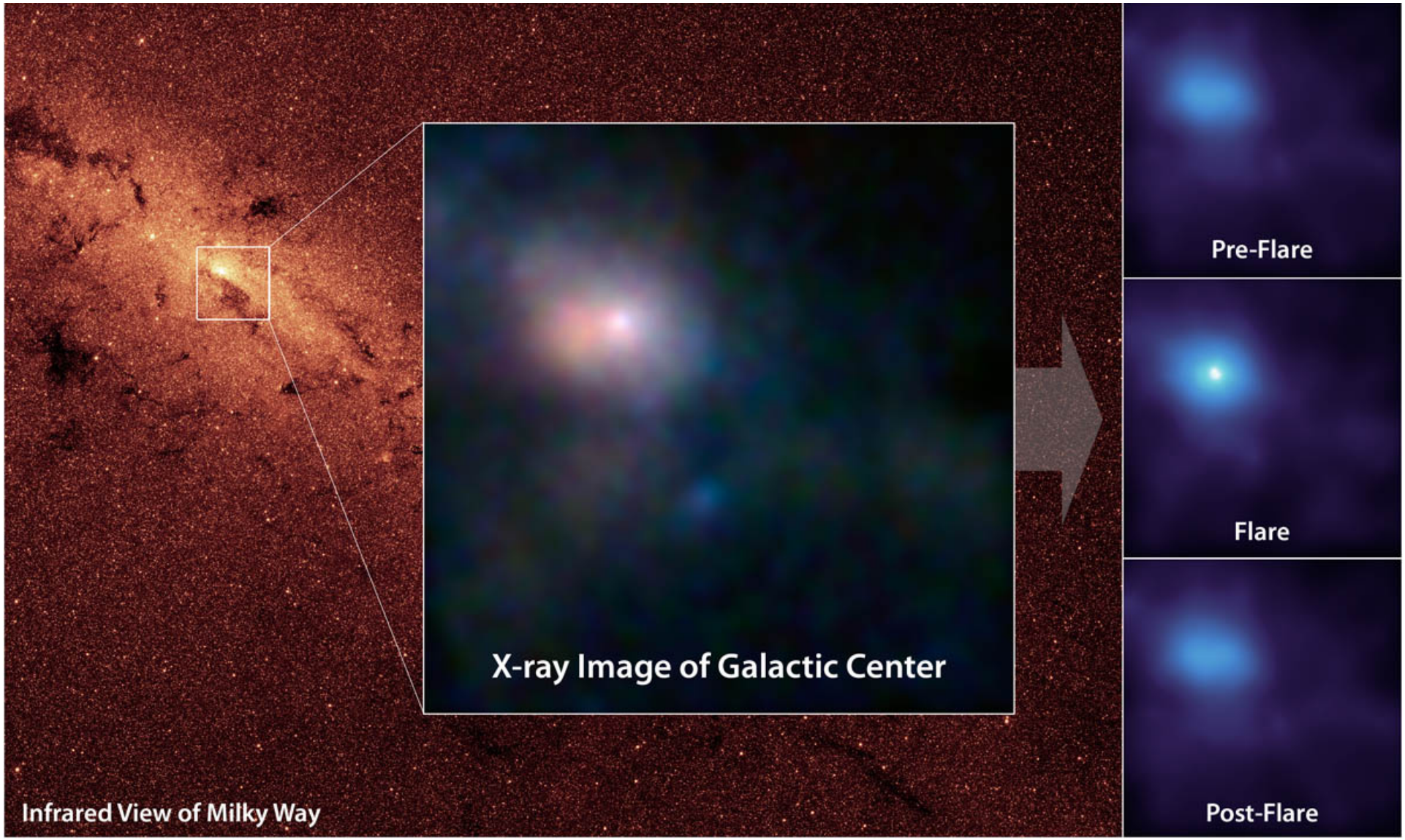
Fermi measured the amount of gamma-ray absorption in blazar spectra produced by ultraviolet and visible starlight at three different epochs in the history of the universe.

From this measurement, scientists were able to estimate the fog's thickness. To account for the observations, the average stellar density in the cosmos is about 1.4 stars per 100 billion cubic light-years, which means the average distance between stars in the universe is about 4150 light-years.

- Scientists studied gamma-ray signals from 150 strongly detected blazars.
- Gamma rays produced in jets travel across billions of light-years to Earth, and some will interact via inverse-Compton on ambient visible and UV light emitted by stars that formed throughout the history of the universe.
- More distant blazars show fewer gamma rays at higher energies, especially above 25 GeV, thanks to absorption by the cosmic fog. The farthest blazars are missing most of their higher-energy gamma rays.



NuSTAR Galactic Center



Astrophysics Budget Reality

- There is inadequate available budget to implement the Astro2010 Decadal Survey recommendations as written; there is also changed external context.
  - Due to budget constraints, no new missions other than Explorers can enter formulation before FY17 (when JWST approaches launch).
  - ESA has ended the joint LISA and IXO studies.
- Currently there are no new starts for large missions.
  - NASA must earn back the privilege of starting large missions.
- Large strategic missions in the future are possible only with the Astrophysics budget that is freed up as JWST spending begins to decrease in FY17 and out.

The goal is to be prepared to start a new strategic Astrophysics mission to follow JWST as soon as funding becomes available while continuing to advance the science during the interim.

Astrophysics Budget Strategy

- Use the scientific priorities of the Astro2010 Decadal Survey to guide strategy and inform choices.
- In the absence of new missions, progress against decadal priorities is maintained through the core research program, through continued operation of existing missions and their GO programs, through the suborbital programs, and through frequent Explorer opportunities.
  - Support for all of these is maintained in the President's FY13 budget request.
- In order to prepare for a new mission, a near term program of mission concept studies and technology development is being undertaken, with the goal of informing a mid-decade decision on which mission(s) will begin formulation starting as early as FY17.
  - Currently there are no new starts for large missions. Moderate missions ("probes") will be studied, in addition to a large mission (e.g., WFIRST), to be prepared for a mid-decade decision.
  - Mission concepts studied must derive from the science of the missions and recommendations prioritized in the Decadal Survey.

Astrophysics Budget Strategy

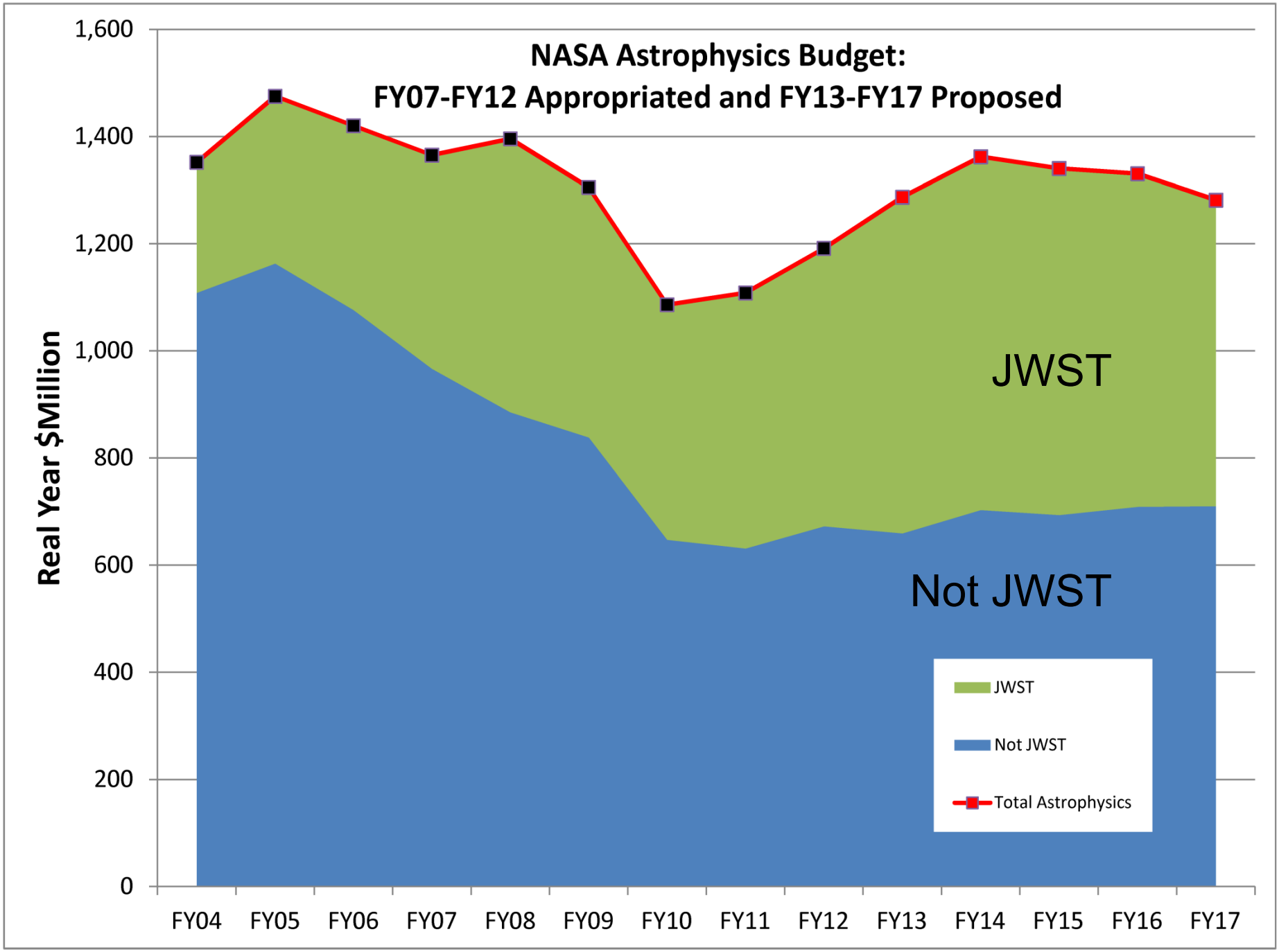
2012	• Study WFIRST options.
	• Solicit ideas from the community for studies of moderate missions that address DS priorities.
	• Establish community study teams for mission concepts.
	• Initiate mission concept studies within the programs.
	• Use community analysis groups to inform process.
2013	• Use competed and directed technology programs to develop enabling technology and mission concepts.
2014	• Continue from 2013.
2015	• Using community input, conduct prioritization and decision process for new formulation start.
	• Start pre-formulation for new strategic mission.
	• Start NRC mid-decade review.
2016	• Complete mid-decade review. Revise plans as necessary in response to report.
2017	• New formulation start for strategic mission.

Astrophysics Budget Strategy

- Mission concept studies generate candidates for future strategic missions
  - A new formulation start as early as FY17 and an efficient development toward an early launch date requires mature technology
  - Mission concept studies identify technology requirements, and this guides technology investment
- Mission concepts studied must derive from the science of the missions and recommendations prioritized in the Decadal Survey.
  - WFIRST DRM1 and DRM2 (done)
  - Gravity wave concepts to advance the LISA science and X-ray concept studies to advance the IXO science (done)
  - UV/Vis science objectives to drive concept studies (probes?) and technology that advances the science of a future UV telescope (underway)
  - Use of NRO telescopes to advance science of a Widefield Infrared Survey Telescope (underway)
  - Exoplanet probe concept studies to advance science of a planet characterization and imaging mission (planned for FY13)
  - Additional concept studies , including use of NRO telescopes to advance other science objectives may be undertaken

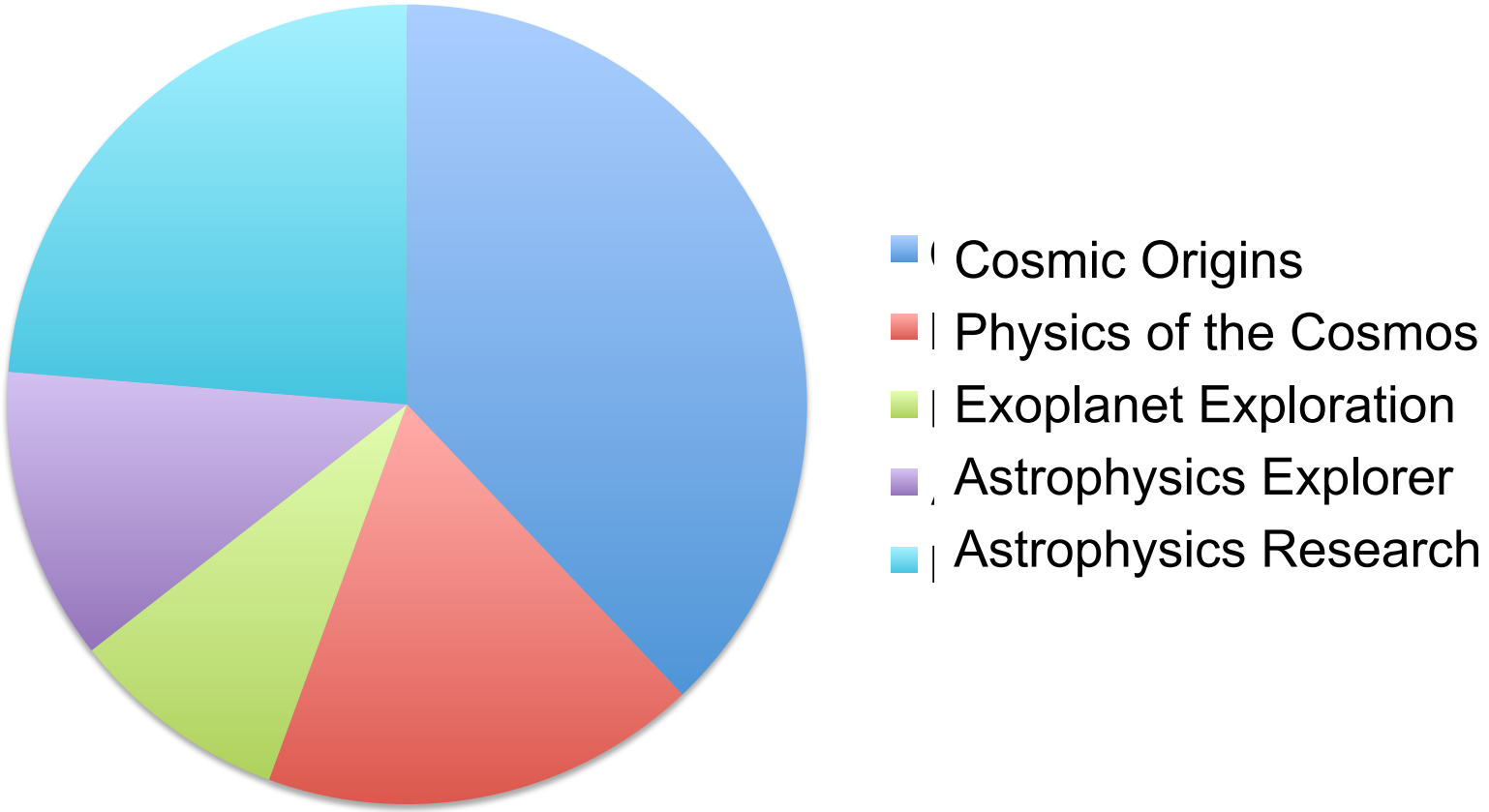
Astrophysics Budget Strategy

- A white paper describing the Astrophysics Division strategy in response to the Decadal Survey recommendations, consistent with current budget guidance, is under development.
  - Will review with Committee on Astronomy and Astrophysics and Astrophysics Subcommittee in the Fall.
  - Will release to the community before Long Beach AAS meeting.
- Will outline calls and studies planned to prepare for:
  - Mid-decade decision to start a new strategic mission after JWST (and possibly a second mission, depending on out-year budget guidance).
  - Mid-decade review.
  - Next decadal survey.
- Basic content is already known.
  - Competed and directed technology development in response to technology prioritizations.
  - RFIs and study teams for missions and probes (e.g., X-ray, Gravitational wave, UV/Visible, …)
  - Studies of potential missions leading to concept studies, e.g., WFIRST (DRM1), WFIRST probe (DRM2), Use of NRO telescopes, Exoplanet probes, X-ray mission concepts, GW mission concepts, other probes, etc.


NASA Astrophysics Budget:
FY07-FY12 Appropriated and FY13-FY17 Proposed
Real Year $Million
1,600
1,400
1,200
1,000
800
600
400
200
0
FY04
FY05
FY06
FY07
FY08
FY09
FY10
FY11
FY12
FY13
FY14
FY15
FY16
FY17
JWST
Not JWST
JWST
Not JWST
Total Astrophysics

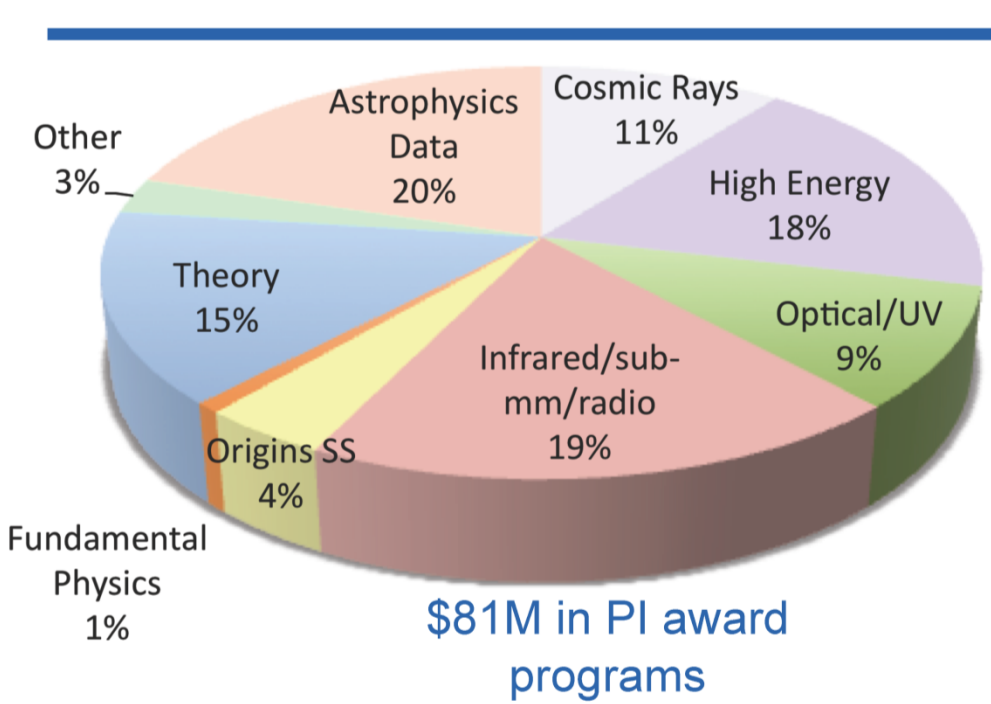
FY2013 President's Request for NASA Astrophysics

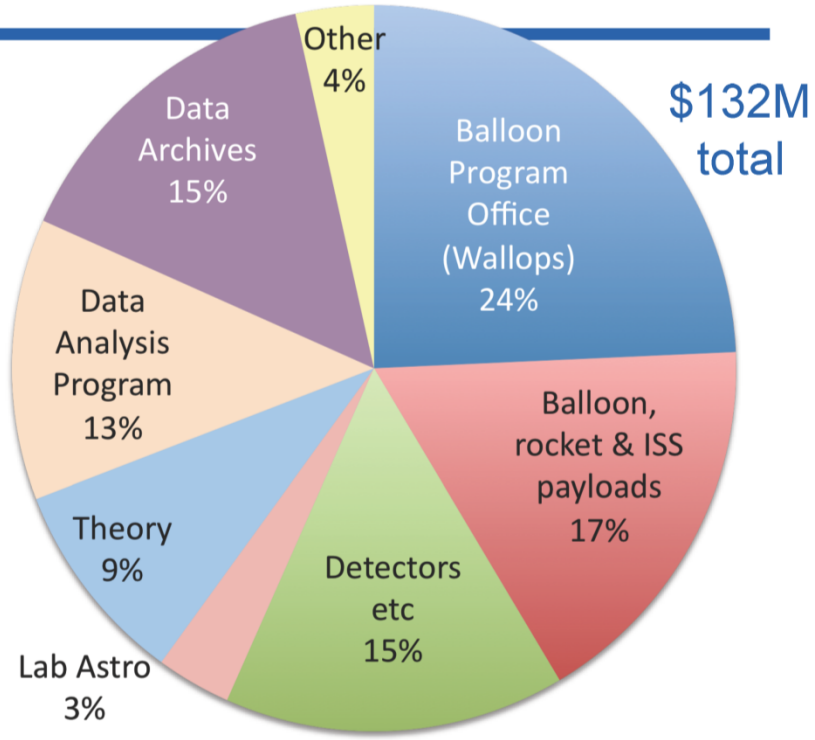
~$633M Total *

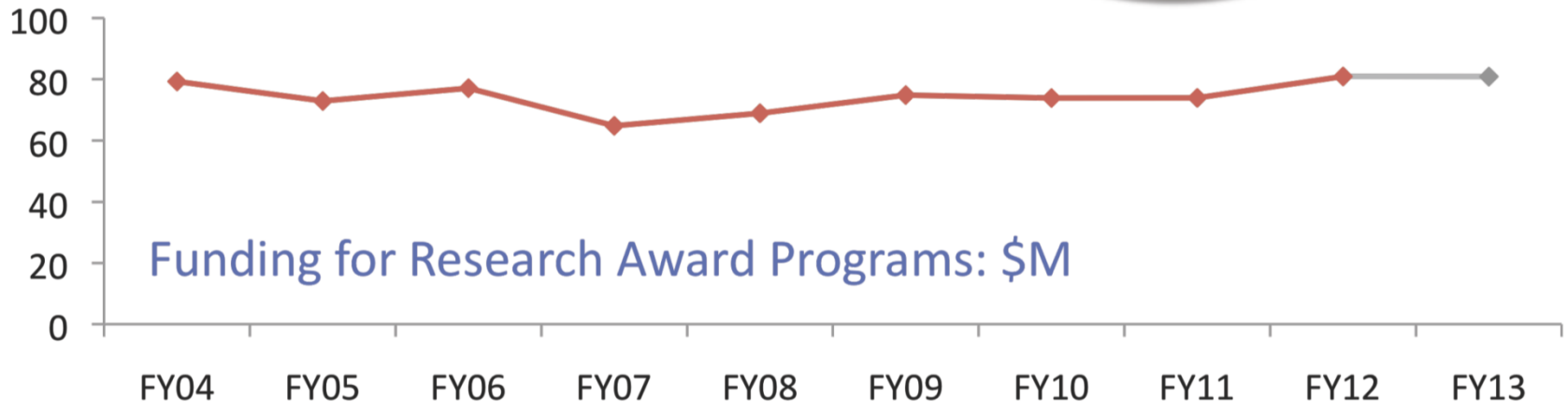


* Does not include SMD budgets that are bookkept in the Astrophysics budget line

Research Program Spending in FY12







Mission Proposal Selection Rates

Mission	Number of Proposals	Number of Proposals Selected	Oversubscription Rate (time available)
Hubble (Cycle 20)	1090	230	6
Chandra (Cycle 14)	672 (452 GO, 78 Large, 17 X-ray Vision, 72 Archive, 53 Theory)	185 (144 GO, 12 Large, 4 X-ray Vision, 17 Archive, 8 Theory)	5.3
Spitzer (Cycle 9)	61 (>100 hrs) 139 (<100 hrs)	14 TBD	5.6 5.9
SOFIA (Cycle 1)	172 (133 U.S. + 32 German)	49	5
Suzaku (Cycle 7)	83 (U.S. only) 227 (Total)	46 (U.S. only) 125 (Total)	3.5
XMM-Newton (AO-11)	175 (U.S. PI-only) 501 (Total)	63 (U.S. PI-only) 179 (Total)	6.7

Explorer Program

- 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.
  - Second priority is to downselect and fund the development of one mission and one Mission of Opportunity (MO) from the projects currently conducting Phase A studies (FINESSE/TESS, GUSSTO/NICER).
  - Third priority is to issue new AOs leading to the development of additional missions.
- Funding planned for GEMS will remain in the Explorer Program.
  - Immediately begin the new projects when they are downselected in Spring 2013.
  - Advance the next mission AO.
- The Astro2010 Decadal Survey that "NASA should support the selection of two new astrophysics MIDEX missions, two new astrophysics SMEX missions, and at least four astrophysics MoOs over the coming decade." Astrophysics Division is planning a series of AOs (subject to budget approval):
  - An AO for an MO with a $50-60M cost cap in Sept 2012; proposals due Dec 14, 2012.
  - An AO for a SMEX in late-2013/early 2014 with the cost caps and dates TBD.
  - An AO for an EX and MO in 2015.

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

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