

National Aeronautics and Space Administration



# Astrophysics

Exoplanet Exploration Program  
Analysis Group (ExoPAG)

[www.nasa.gov](http://www.nasa.gov)

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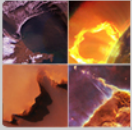
October 13, 2012



# 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.
  - NASA is considering whether the NRO 2.4m telescope assets can enable astrophysics priorities or other NASA objectives.
- 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.
  - A new strategic mission can be started as early as FY17 subject to available funding.

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 will be 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

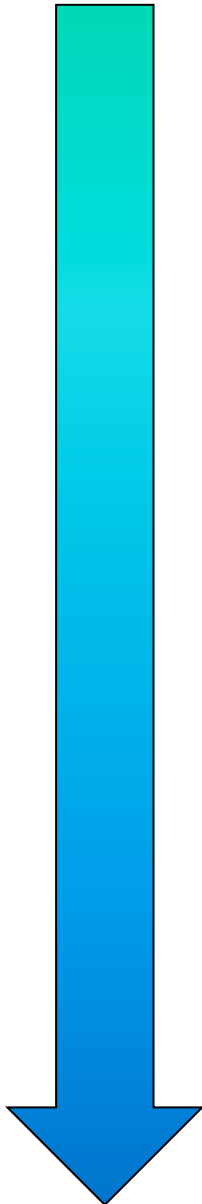
- Using community input, conduct prioritization and decision process for new formulation start.
- Start pre-formulation for new strategic mission.
- Start NRC mid-decade review.

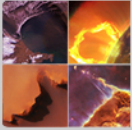
2016

- Complete mid-decade review. Revise plans as necessary in response to report.

2017

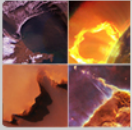
- New formulation start for strategic mission.





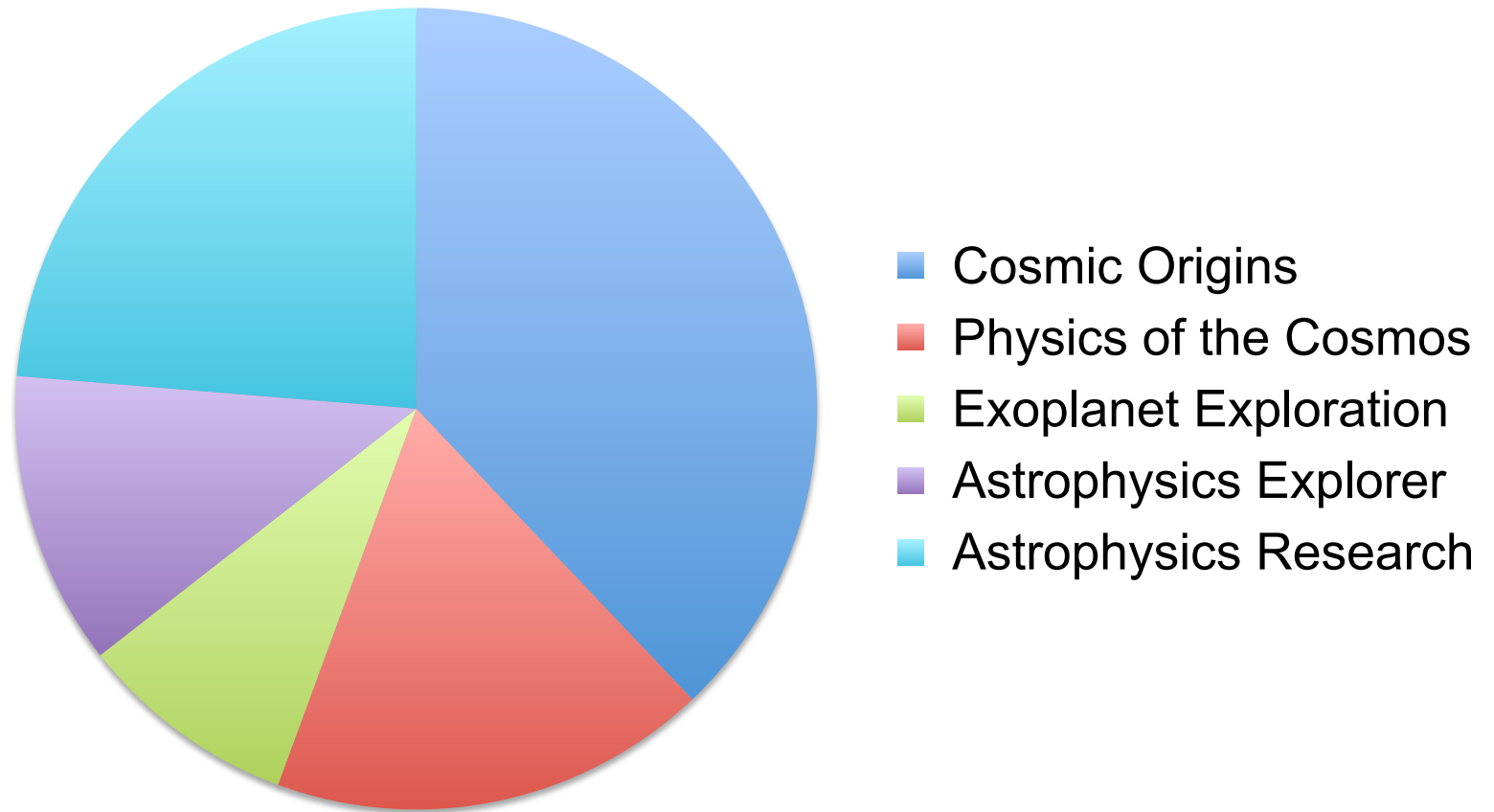
# Astrophysics Budget Strategy

- 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



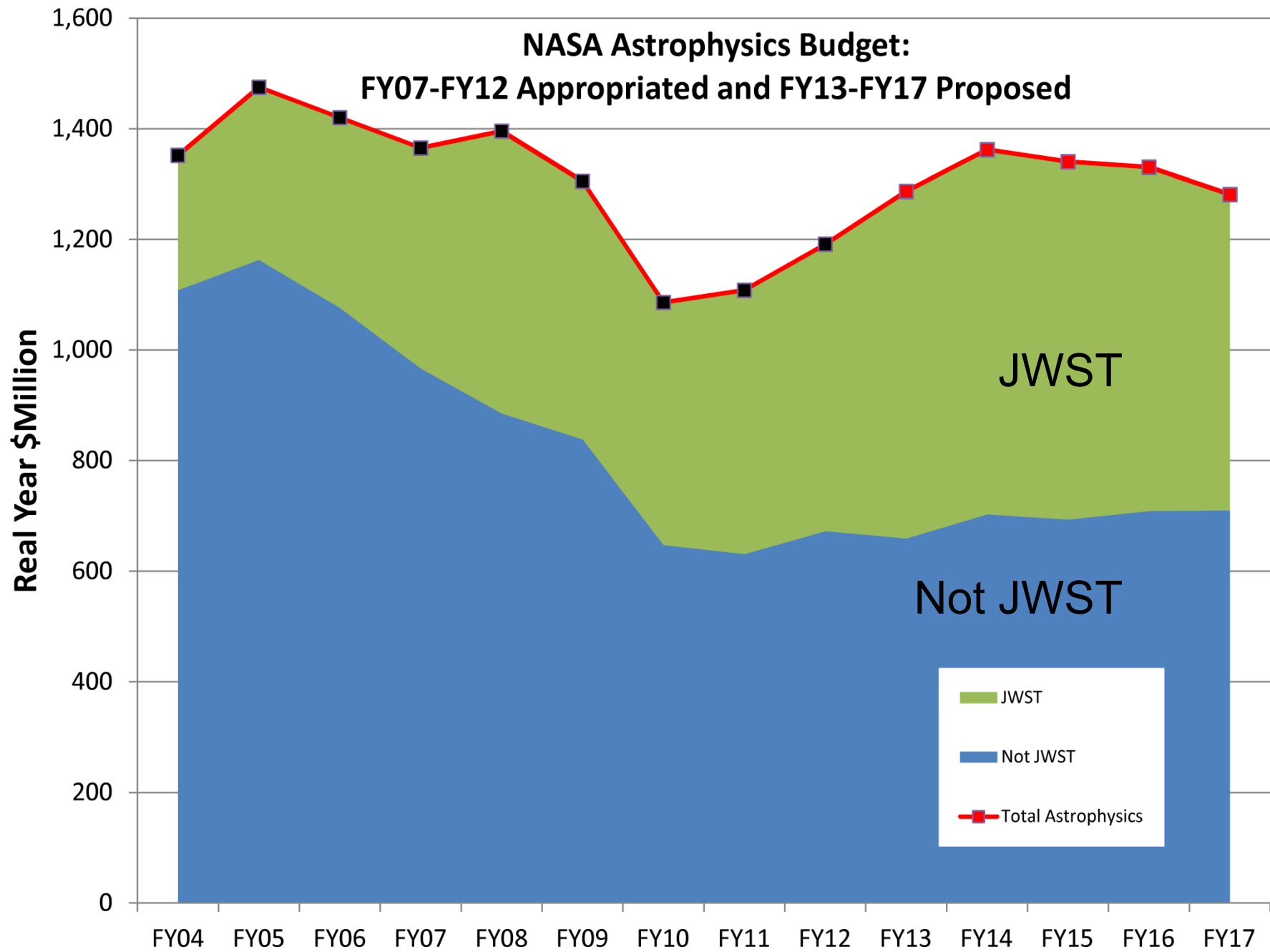
# FY2013 President's Request for NASA Astrophysics

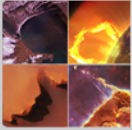
~\$633M Total \*



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

### NASA Astrophysics Budget: FY07-FY12 Appropriated and FY13-FY17 Proposed





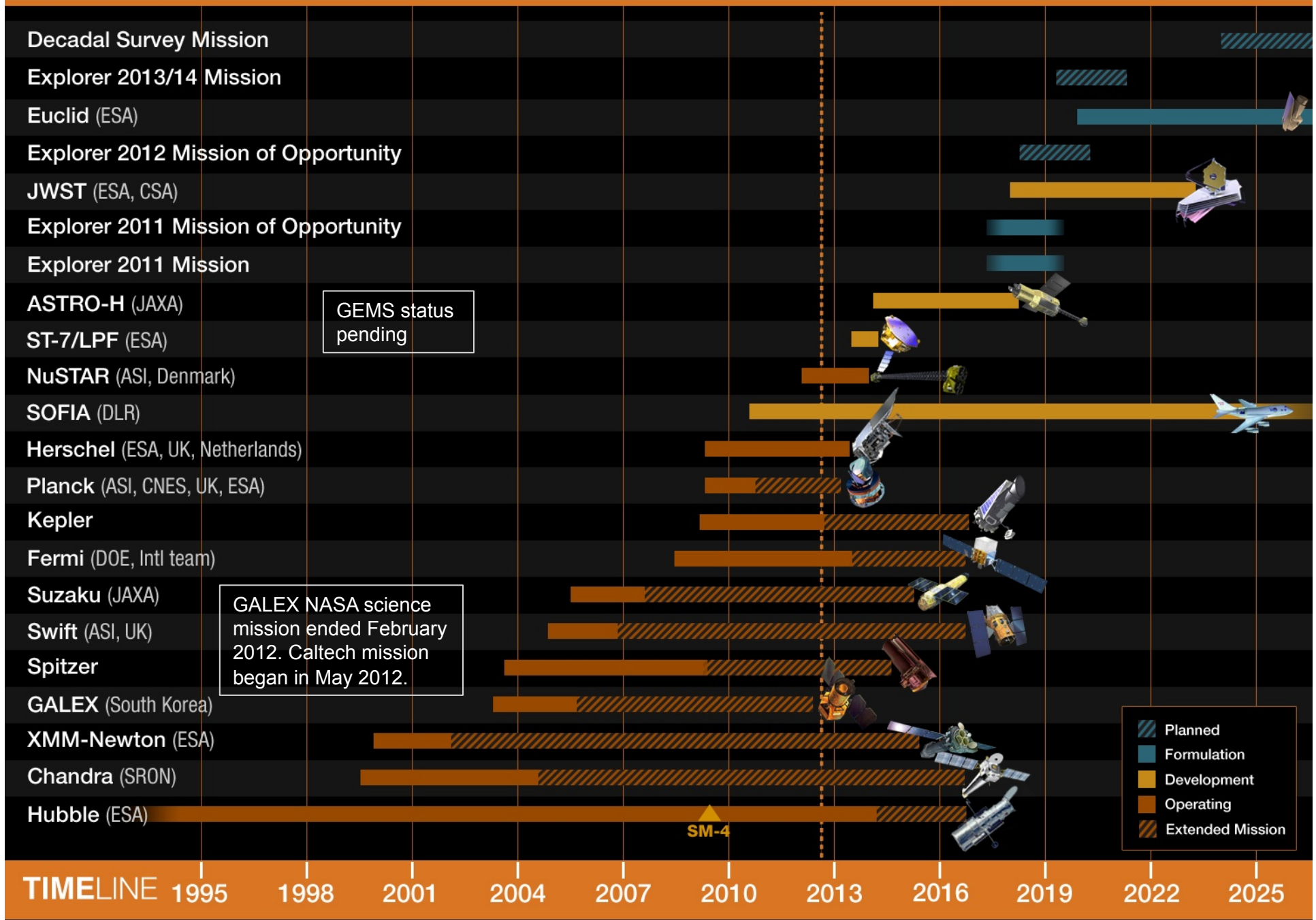
# Astrophysics Budget Strategy

- 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.



# Astrophysics Missions timeline

Last updated: September 5, 2012



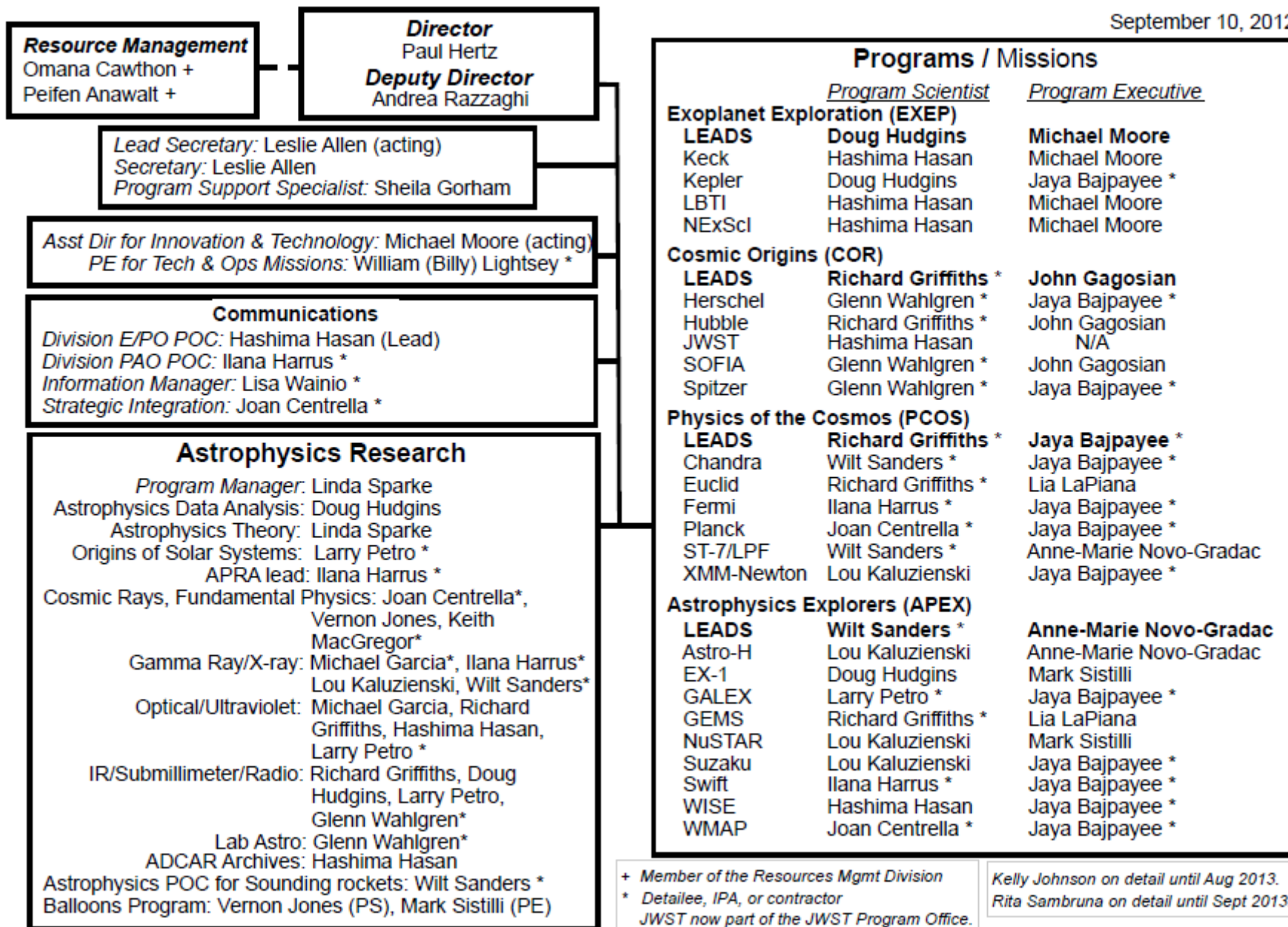


# Backup Slides



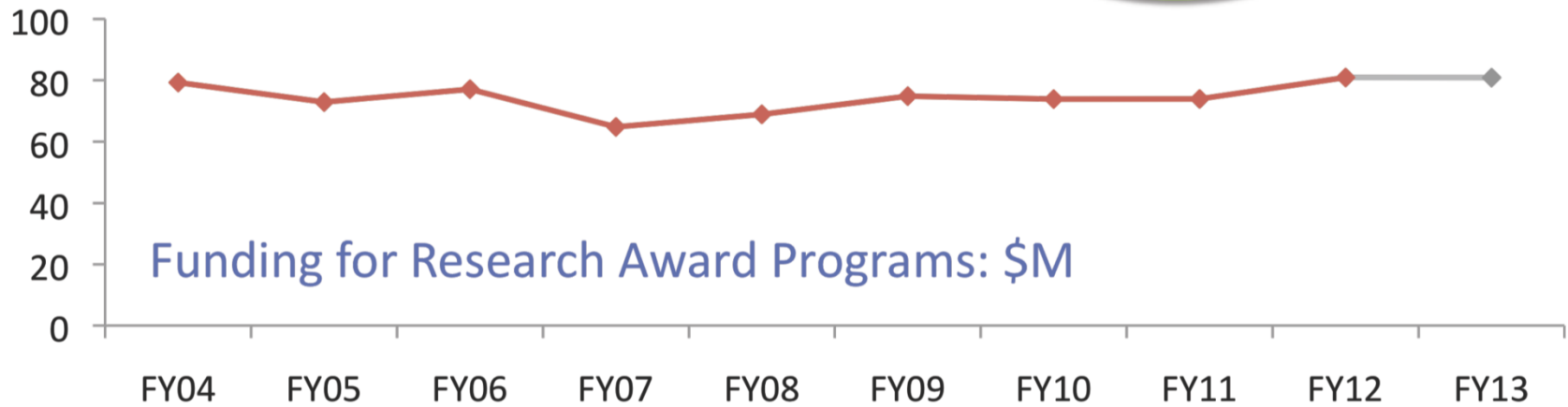
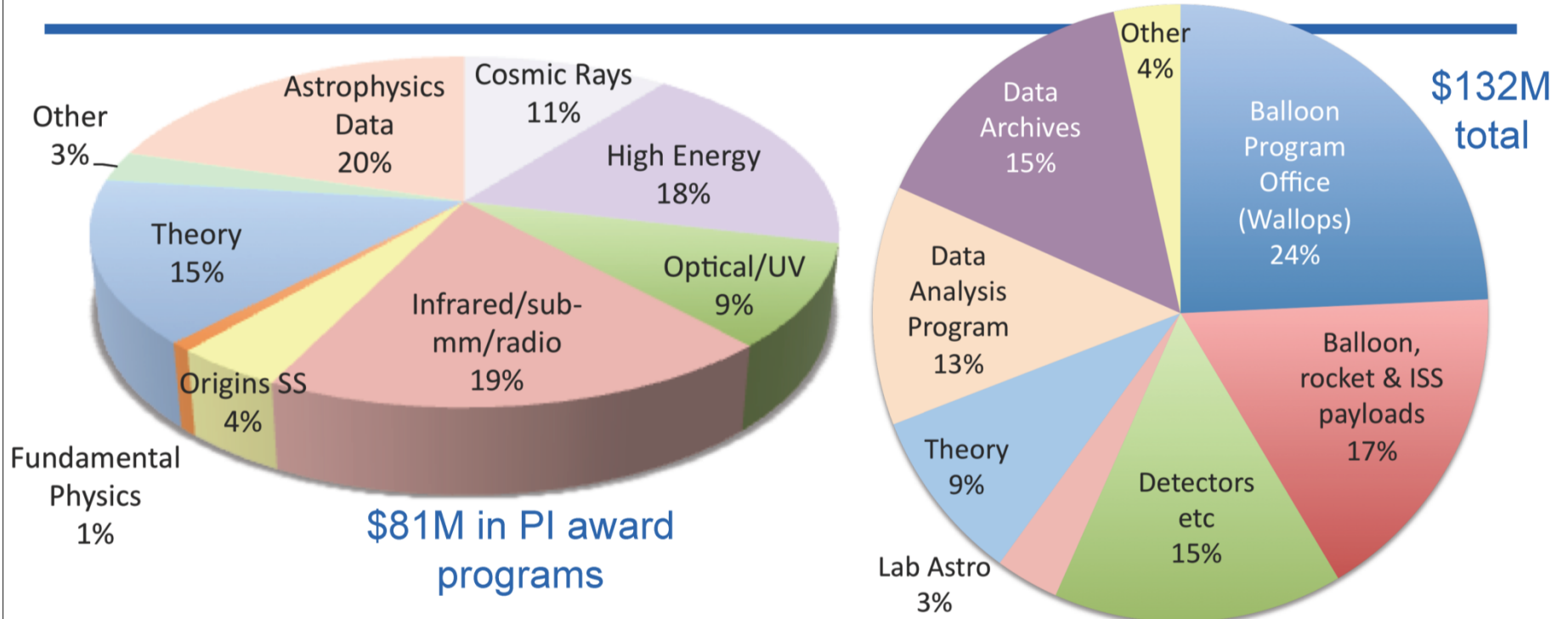
# Astrophysics Division Organization Chart

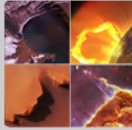
September 10, 2012





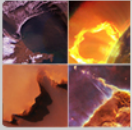
# Research Program Spending in FY12





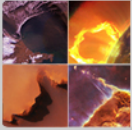
# Astrophysics Program Content

	FY 11	FY 12	FY 13	FY 14	FY 15	FY 16	FY 17
				<i>(FY14-17 estimates are notional)</i>			
<b>Astrophysics</b>	<b>631.1</b>	<b>672.7</b>	<b>659.4</b>	<b>703.0</b>	<b>693.7</b>	<b>708.9</b>	<b>710.2</b>
<u>Astrophysics Research</u>	<u>146.9</u>	<u>164.1</u>	<u>176.2</u>	<u>189.1</u>	<u>205.1</u>	<u>211.5</u>	<u>218.7</u>
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
<u>Other Missions and Data Analysis</u>	<u>60.5</u>	<u>67.9</u>	<u>80.6</u>	<u>92.3</u>	<u>105.4</u>	<u>109.2</u>	<u>114.8</u>
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
<u>Cosmic Origins</u>	<u>229.1</u>	<u>237.3</u>	<u>240.4</u>	<u>228.5</u>	<u>215.1</u>	<u>205.3</u>	<u>205.7</u>
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
<u>Other Missions And Data Analysis</u>	<u>57.6</u>	<u>57.4</u>	<u>56.6</u>	<u>42.2</u>	<u>32.8</u>	<u>29.1</u>	<u>29.3</u>
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
				<b>(FY14-17 estimates are notional)</b>			
<u>Physics of the Cosmos</u>	<u>108.7</u>	<u>108.3</u>	<u>111.8</u>	<u>109.6</u>	<u>96.3</u>	<u>92.7</u>	<u>74.6</u>
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
<u>Exoplanet Exploration</u>	<u>46.4</u>	<u>50.8</u>	<u>56.0</u>	<u>41.6</u>	<u>43.3</u>	<u>42.4</u>	<u>45.6</u>
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
				<i>(FY14-17 estimates are notional)</i>			
<u>Astrophysics Explorer</u>	<u>100.0</u>	<u>112.2</u>	<u>75.1</u>	<u>134.3</u>	<u>133.9</u>	<u>157.0</u>	<u>165.6</u>
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	
<u>Other Missions and Data Analysis</u>	<u>41.0</u>	<u>37.2</u>	<u>24.1</u>	<u>97.1</u>	<u>131.2</u>	<u>156.8</u>	<u>165.6</u>
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 Anisotropy 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