

National Aeronautics and Space Administration

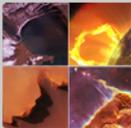


Astrophysics

Astrophysics Subcommittee

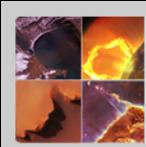
Paul Hertz
Director, Astrophysics Division

April 16, 2013



The Big Picture.....

- **This remains a time of opportunity for NASA Astrophysics**
 - The FY14 NASA astrophysics budget request remains at a high level.
 - Large and small space-based observatories spanning the electromagnetic spectrum are currently studying the universe.
 - The James Webb Space Telescope, the highest priority of the community, is on schedule and fully funded for an October 2018 launch.
 - Two new Explorer projects have been downselected and are beginning development for launch in this decade.
 - Individual investigators are leading data analysis, theory, and technology development projects selected through open, competitive, peer reviewed solicitations.
 - We are preparing for the strategic mission that will be developed following JWST.
- **The budgetary future remains uncertain**
 - FY13 rescission and sequester has an impact.
 - Constrained budget request for FY14 and planning for FY15-FY18 means priorities must be set and choices must be made.



Division Personnel Changes

Since January 2013

Departures

- Ilana Harrus completed her IPA on February 8. She has joined NSF AST as a program officer.

Arrivals

- Debra Wallace joined the Division on January 3 as an IPA from USC-Beaufort. She is the Fellowships Program Scientist.
- Tony Carro joined the Division on January 3 part time from the Planetary Science Division. He is the Exoplanet Exploration and Kepler Program Executive.
- Jeff Hayes started transitioning part time from the Heliophysics Division. He will be the Program Executive for selected operating missions and Senior Reviews.
- Janet Lawson joined the Division on April 15 to support Astrophysics Research.

Transitions

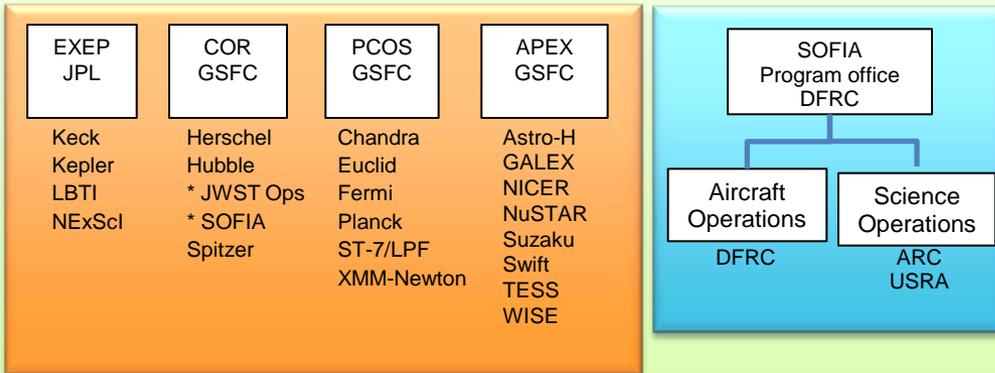
- Doug Hudgins is the new TESS PS; Mark Sistilli is the new TESS PE.
- Lou Kaluziński is the acting NICER PS; Mark Sistilli is the acting NICER PE.

Astrophysics Program Structure at a Glance

Division Director
Deputy Division Director

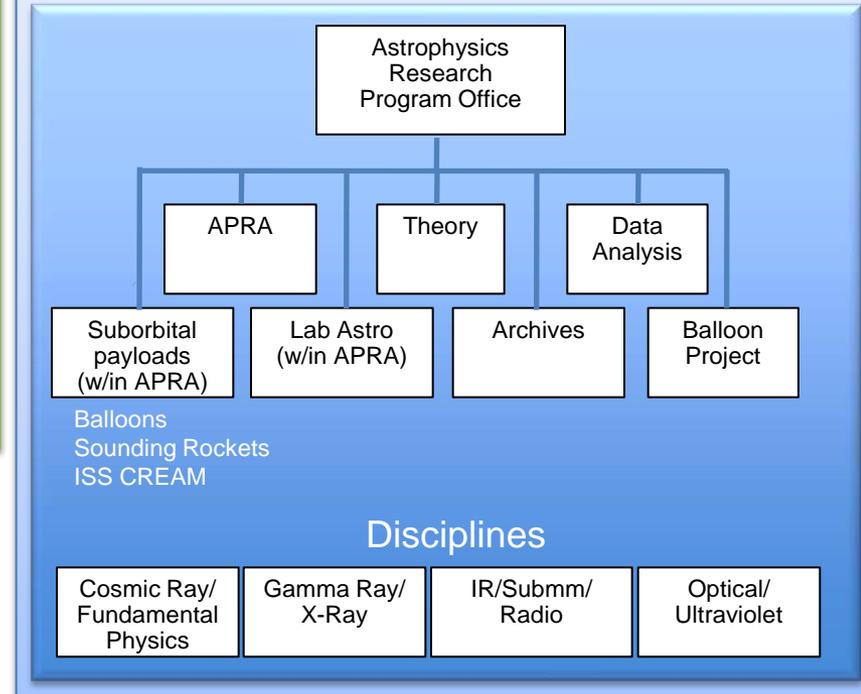
Program Director
Prog Executive/Prog Scientist

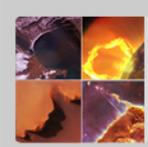
Program Offices at Centers



* Science only as it relates to the overall COR scientific mission

Program Office at Headquarters





ROSES Selections Since October 2012

Status: April 25, 2013

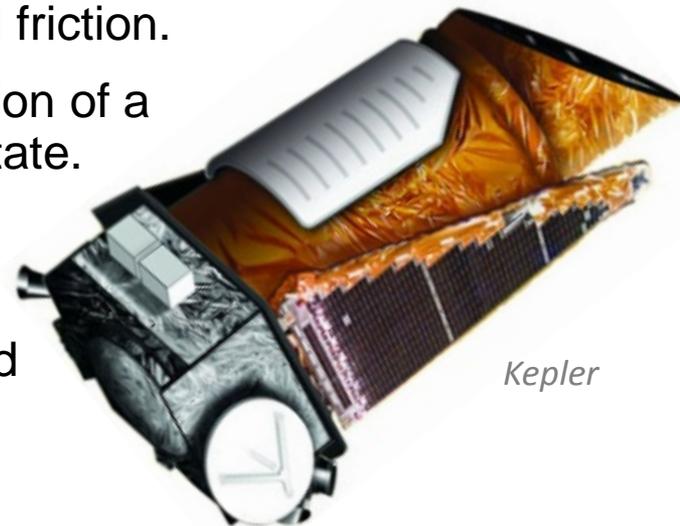
	Proposal Due Date	Notify Date	Days since received	Number received	Number selected	% selected
Astrophysics Theory Program	Jul 13	Dec 6	146	181	28	15%
Euclid Science Team	Aug 31	Nov 7	68	8	3	38%
Swift Guest Investigators	Sep 26	Dec 18	83	158	45	28%
Nancy Grace Roman Technology Fellowships	Nov 8	Mar 5	117	12	2	17%
Fermi Guest Observer	Jan 18	[1]	97	233	See separate presentation by Linda Sparke	
Kepler Guest Observer	Jan 18	[2]	97	62		
TCAN with NSF	Feb 14	[3]	70	101		
Kepler Participating Scientist	Mar 1	[3]	55	30		
APRA	Mar 22	[4]	34	182		
SAT	Mar 22	[4]	34	39		

See separate presentation by Linda Sparke

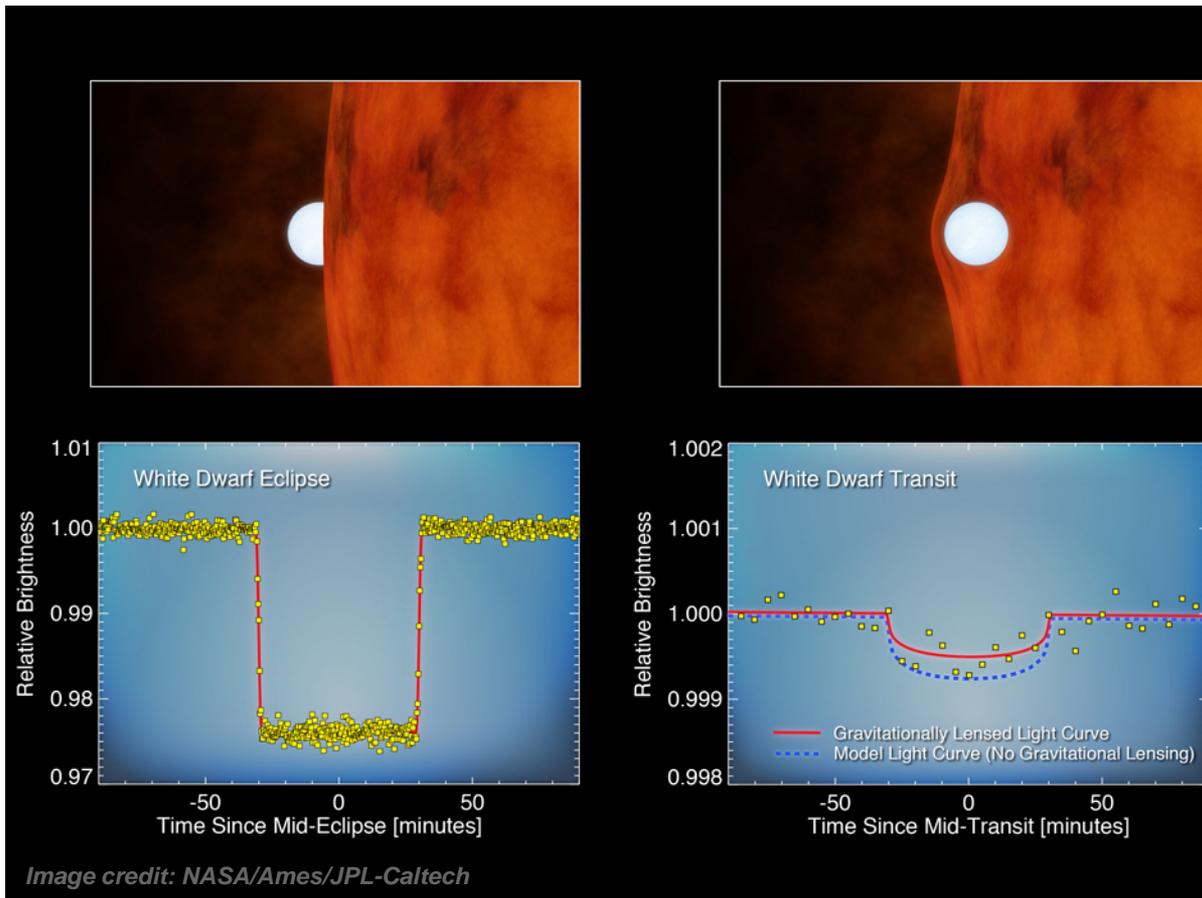
[1] Peer review in March; [2] Peer review in April; [3] Peer review in May; [4] Peer review in June.

Program Update - Kepler

- Announced additional 461 planet candidates (61 HZ candidates of all sizes, including one super-Earth around sun-like star) at AAS.
- Completed Quarter 15 Month 3 Science Data download.
- Elevated friction on wheel 4 seen in X-band on January 7.
- After observing persistence of elevated friction, wheel placed in rest position for 10 days starting January 17
- Reaction wheels restarted on January 27, less than 1 hour spent in low speed state.
- Returned to science mode on January 28.
- Wheel 4 exhibits erratic spikes on top of the elevated friction.
- Work continues with high priority on the implementation of a Thruster Controlled Safe Mode and the Point Rest State.
- Concepts for 2-RWA science operations under study.
- Using Kepler data, Dressing & Charbonneau reported that ~15% of cool stars have habitable zone planets.
- Kepler Press Conference on April 18.



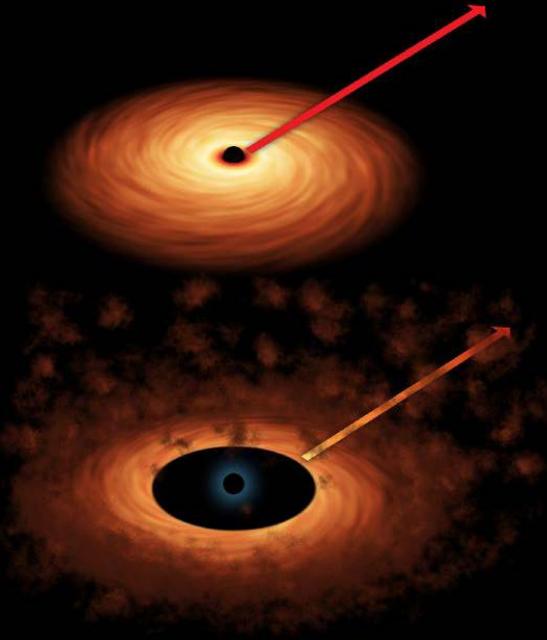
Kepler Detects Gravitational Lensing



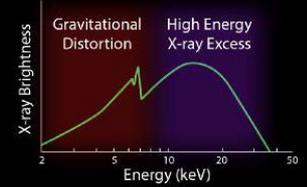
The plot on the left shows Kepler data collected for KOI-256, a small red dwarf. Astronomers first thought the dip in starlight was due to a large planet passing in front of the star. But clues, such as the sharpness of the dip, indicated it was a white dwarf. In the data shown at the left, the white dwarf is passing behind the red dwarf, an event referred to as a secondary eclipse. The change in brightness is a result of the total light of the system dropping.

The plot on the right shows what happens when the white dwarf passes in front of the star. The dip in brightness is subtle because the white dwarf, while just over half as massive as our sun, is only the size of Earth, much smaller than the red dwarf star. The blue line shows what would be expected given the size of the white dwarf. The red line reveals what was actually observed: the mass of the white dwarf is so great, that its gravity bent and magnified the light of the red star. Because the star's light was magnified, the transiting white dwarf blocked an even smaller fraction of the total starlight than it would have without the distortion.

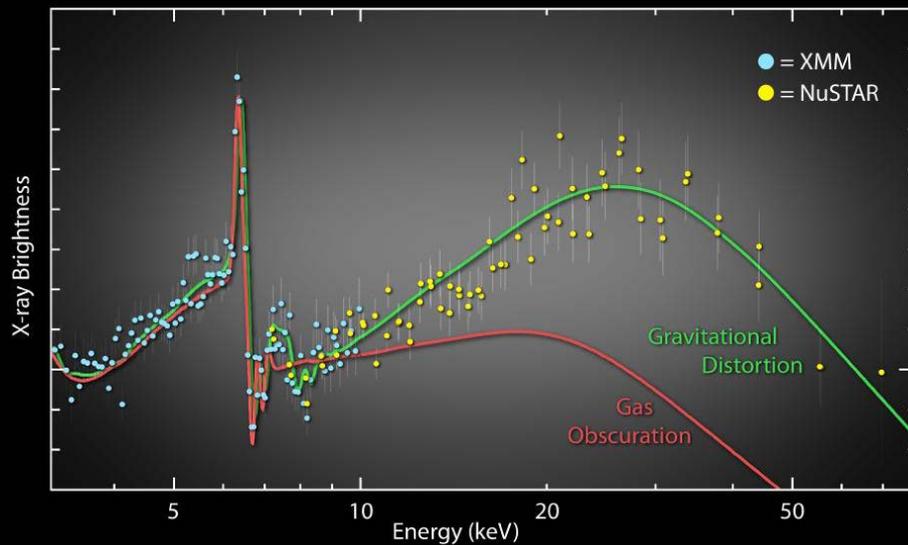
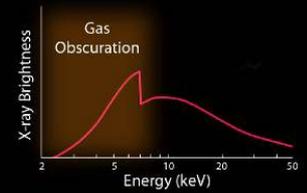
NuSTAR Helps Solve Riddle of Black Hole Spin



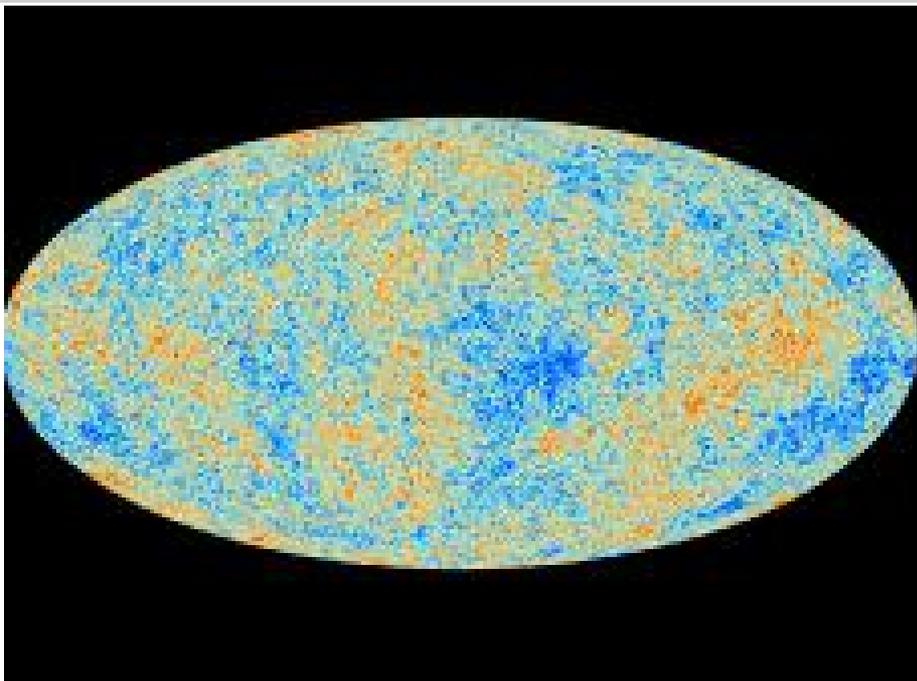
Prograde Rotation Model



Foreground Obscuration Model

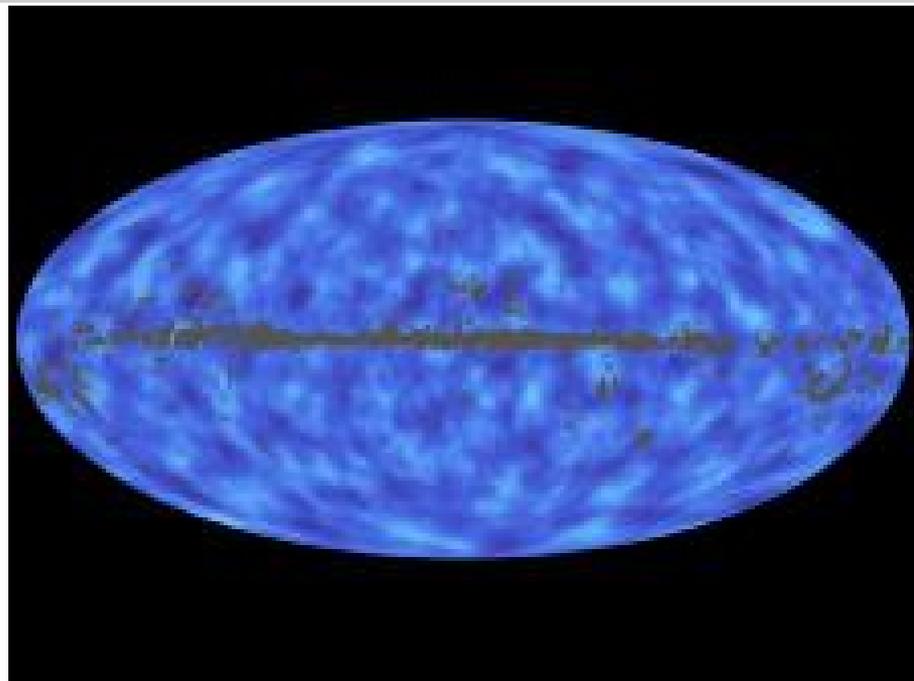


New Findings from the Planck Mission



This map shows the oldest light in our universe, as detected with the greatest precision yet. The ancient light was imprinted on the sky when the universe was 370,000 years old. It shows tiny temperature fluctuations that correspond to regions of slightly different densities, representing the seeds of all future structure: the stars and galaxies of today.

- **The universe is 13.8 billion years old, 100 million years older than previous estimates.**
- **Results suggest the universe is expanding more slowly than scientists thought.**
- **The universe is made up of:**
 - 26.8% dark matter**
 - 68.3% dark energy**
 - 4.9 % normal matter**
- **The newly estimated expansion rate of the universe, known as Hubble's constant, is 67.15 plus or minus 1.2 kilometers/second/megaparsec.**



This full-sky map shows matter between Earth and the edge of the observable universe. Regions with less mass show up as lighter areas while regions with more mass are darker. The grayed-out areas are where light from our own galaxy was too bright, blocking Planck's ability to map the more distant matter.

Program Update – JWST

Hardware Progress: Telescope



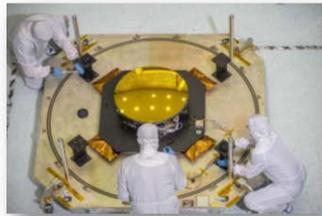
Primary Mirror Segment Deliveries Commence



Aft Optics System



Backplane Wings



Secondary Mirror Delivered



Backplane Center Section Completed

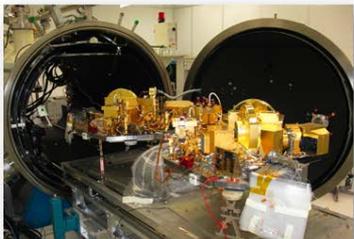
See separate presentation by Geoff Yoder/ Eric Smith

Hardware Progress: Science Instruments

Mid Infrared instrument JPL/EC



Near Infrared Camera UA



Fine Guidance Sensor CSA



Near Infrared Spectrograph ESA



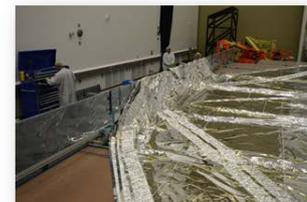
Hardware Progress: Spacecraft & Facilities



Sunshield Hole Punching



Chamber A



Sunshield Folding



Sunshield Deployment Testing



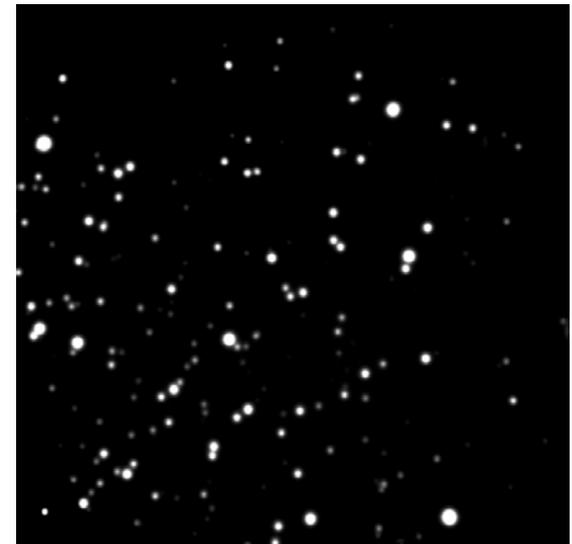
Primary Mirror Segment Assembly (PSMA) Installation Fixture (PAIF)

Program Update – SOFIA

- Completion of observatory V&V flights delayed until May due to Mission Communication and Control System S/W bug.
 - Does not prevent instrument commissioning and science flights from proceeding.
- First four Cycle 1 Airborne Astronomy Ambassadors flew on board during commissioning/ V&V flights in February; next Airborne Astronomy Ambassadors scheduled to fly in June.
- SSPC met March 14-15 at Ames; stated general support for maintaining high rate of new instrument calls.
- **FORCAST instrument commissioning phase 1 completed April 4.**
- **Cycle 1 Science began April 11 with GREAT instrument.**
 - Successful GREAT commissioning and science flights on both April 11 (Flight #100) and April 12 (Flight #101).
 - On Flight #101, combined science instrument/observatory performance was good with 60% on source efficiency, 3 times better than during the Early Science phase. Preliminary performance data indicates pointing/tracking well within 1 arc-seconds.
- SRB Review: Program Implementation Review (PIR) scheduled for June 17-20.
- **Southern Hemisphere deployment to New Zealand to occur in July 2013.**
- **Baseline plan established for 3rd-generation instrument call**
 - Release AO July 2014; select instrument by April 2015



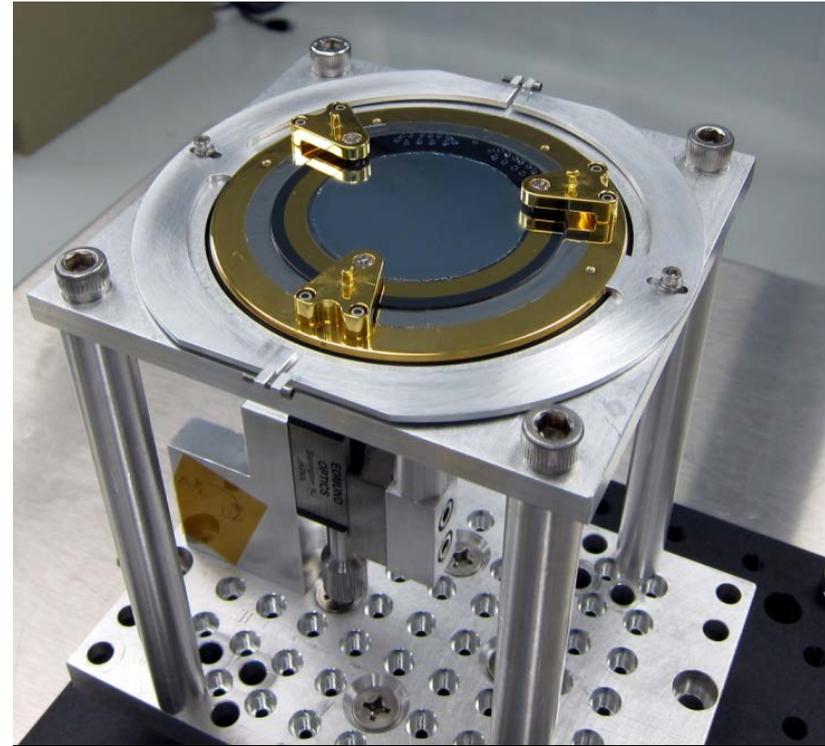
Star field image taken with original Focal Plane Imager



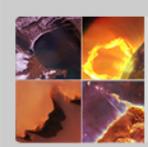
Similar Star field with upgraded detector

Program Update – Astro-H

- New official Launch Readiness Date of 2015 was announced by JAXA (was Feb 2014).
- Flight mirror #1 completed Acceptance Review and was shipped to JAXA on March 21.
- SXS instrument-to-spacecraft micro-vibration testing was conducted in Japan (March 18-23). NASA team provided support.
- Vibrations must be reduced to acceptable levels for the mission to meet minimum science requirements.
 - JAXA has formally requested assistance from NASA to address vibration issue. The Project is working to identify best path to accommodate JAXA request within ITAR restrictions.
- Instrument Manager (IM) Cynthia Simmons has been reassigned to another project as of March 18, 2013. Deputy IM Jim Pontius has taken over as IM.
- SMD Program Management Council released remaining UFE to project in response to changing JAXA schedule.
- Later this calendar year, the SMD Program Management Council will review the overall cost impacts of the new JAXA schedule.



*FM Dewar Main Shield X-ray Filter
Installed in Carrier Mount*



Program Update – Euclid

- First ESA engineering-phase detectors completed March 22.
 - First Test results reported out April 17.
- Yield from recent JWST detectors produced by Teledyne has been very high.
 - Mitigates concerns about yield for Euclid detectors.
- Program Level Requirements Appendix (PLRA) in review.
- ESA/JPL Technical Assistance Agreement (TAA) signed.

Upcoming key dates:

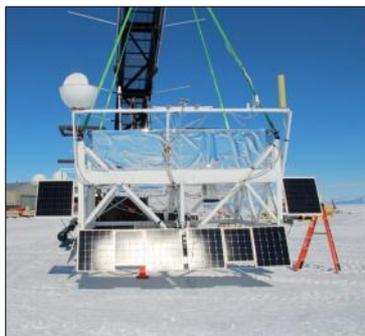
- Systems Requirements Review at JPL for NASA contribution April 10.
- ESA engineering-phase Test Readiness Review at Teledyne April 17.
- Consortium Meeting in Leiden - May 13-15.
- PDR at JPL June 12-13.
- KDP-C at SMD July 23.

Antarctic Campaign 2012-2013

See separate presentation by Vernon Jones

Super-TIGER (R. Binns, WUStL)

Trans-Iron Galactic Element Recorder, measure ultra-heavy cosmic rays. Launched Dec 8, 2012; landed Feb 1, 2013.



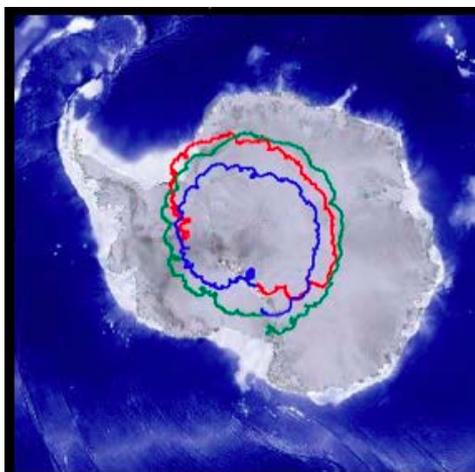
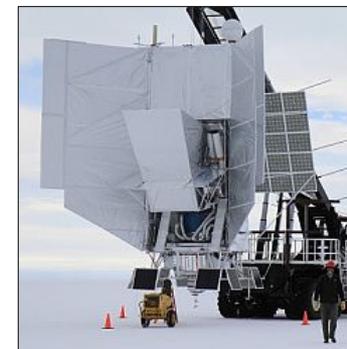
BLAST (M. Devlin, U Penn)

Balloon-borne Large-Aperture Submillimeter Telescope, map large-scale magnetic fields of star forming molecular clouds. Launched Dec 25, 2012; landed Jan 10, 2013.

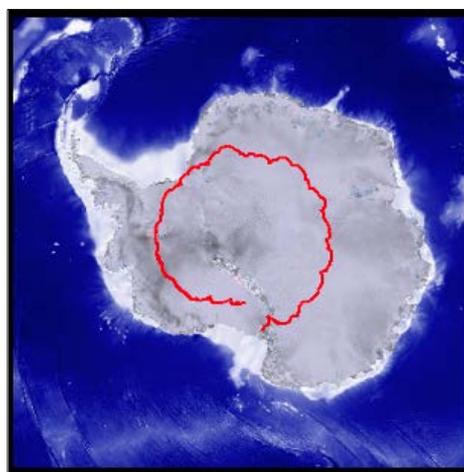


EBEX (S. Hanany, U Minn)

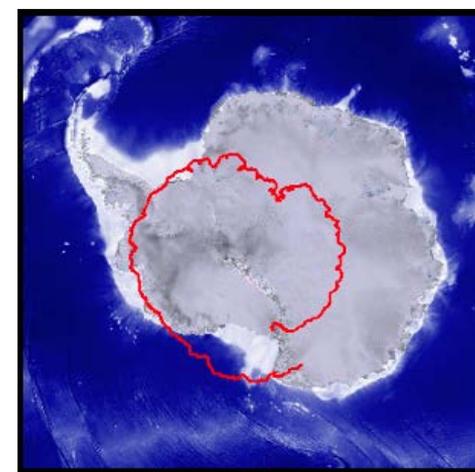
The E and B Experiment, measure the intensity and polarization of the cosmic microwave background. Launched Dec 28, 2012; landed Jan 23, 2013.



Flight Complete
Total Flight Time
55 days, 1 hour, 34 minutes



Flight Complete
Total Flight Time
16 days, 3 hours, 17 minutes



Flight Complete
Total Flight Time
25 days, 11 hours, 39 minutes

Sounding Rocket/Range Status

Sounding Rocket Program: Wallops Flight Facility and White Sands Missile Range (WSMR) safety organizations have agreed to new flight rules to maximize range safety should a Black Brant combustion instability occur. SMD launches back on WSMR manifest for April.

- Sequestration impacts at DOD reduce launch opportunities at WSMR (1 day/week closure & no weekends).

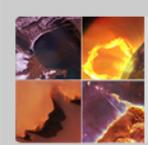


Research Range:

-- Antares Support

- Next milestones are the A-ONE test launch (April 17 @ 5 pm) and the first ORB-D1 demonstration with CYGNUS (June).

Activity	2012			2013									2014																		
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb		
Antares Project Milestones	Site Development			5K Test	5K-2 Test	7K Test	AONE Launch	RRR, FRR & LRR	ORB-D1 Launch	RRR, FRR & LRR	ORB-1 Launch	RRR, FRR & LRR				ORB-2 Launch	RRR, FRR & LRR														



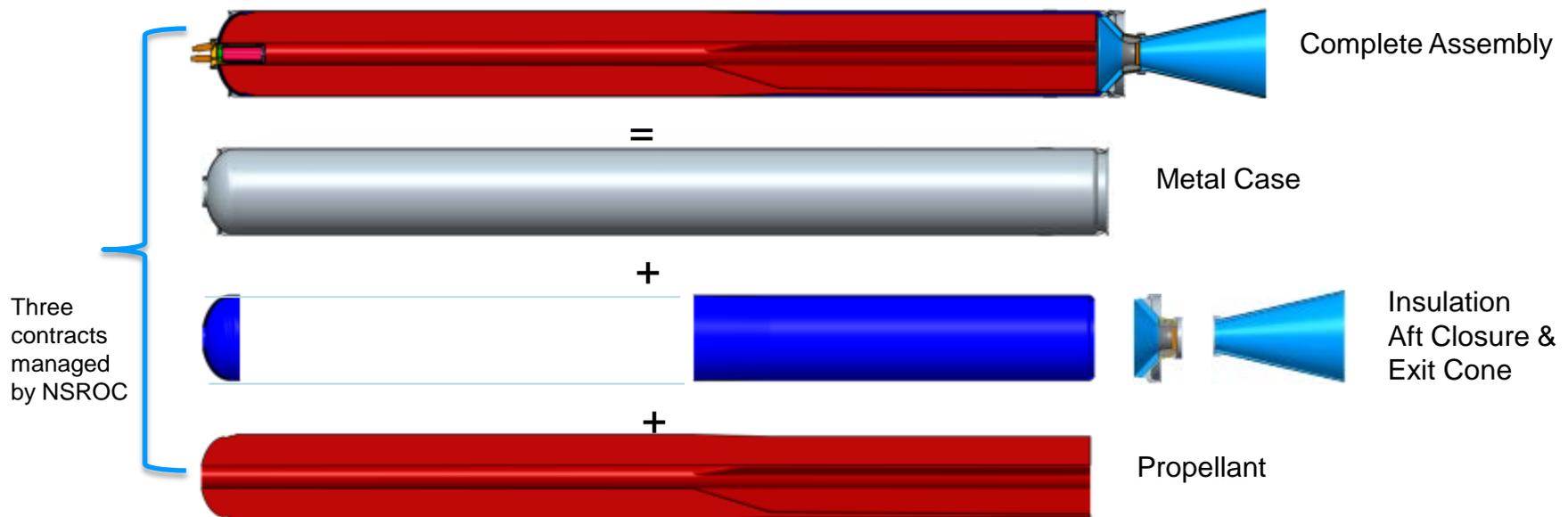
FY 2013 Sounding Rocket Schedule

#	Vehicle Type	Veh. No.	Experimenter	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
				FY 2013											
				Approx. 45 missions are in progress											
				PI readiness slip Range Safety slip											
				Where: Green indicates Astrophysics launches and Blue indicates Heliophysics launches											
WALLOPS ISLAND															
1	Terrier Orion	41.107 GT	Lithium Test-WEST/NASA-GSFC-WFF				▲								
2	Black Brant XII	40.030 UG	CIBER-BOCK/CAL TECH												
3	Terrier Orion	41.106 UO	RockOn-KOEHLER/UNIV. OF COLORADO										△		
4	Black Brant V	21.140 GE	Daytime Dynamo-PFAFF/NASA-GSFC										△		
5	Terrier Orion	41.090 GE	Daytime Dynamo-PFAFF/NASA-GSFC										△		
6	Terrier Imp. Malemute	46.006 GT	Test-ROSANOVA/NASA/GSFC-WFF												△
7	Terrier Imp. Malemute	46.005 UO	RockSat-KOEHLER/UNIV. OF COLORADO												△
WSMR															
8	Black Brant IX	36.255 US	FOXSI-KRUCKER/U OF CA @ BERKELEY		▲										
9	Black Brant IX	36.260 UG	IMAGER-COOK/BOSTON UNIVERSITY		▲										
10	Black Brant IX	36.283 UH	DXL-GALLEAZZI/UNIVERSITY OF MIAMI			▲									
11	Black Brant IX	36.268 UG	FORTISS-MCCANDLISS/JHU												
12	Black Brant IX	36.271 UG	SLICE-FRANCE/UNIV OF COLORADO												
13	Terrier Orion	41.104 GT	Test-ROSANOVA/NASA/GSFC-WFF						▲						
14	Black Brant IX	36.253 US	RAISE-HASSLER/SWRI												
15	Black Brant IX	36.235 US	HYPE-HARRIS/UNIV OF CALIFORNIA/DAVIS												
16	Black Brant IX	36.269 GS	EUNIS-RABIN/NASA-GSFC												
17	Black Brant IX	36.245 UH	MicroX-FIGUERO/MIT												
18	Black Brant IX	36.239 DS	VERIS-KORENDYKE/NRL												
BACK UP WSMR MISSIONS															
19	Black Brant IX	36.289 US	DFS-JUDGE/USC												
20	Black Brant IX	36.262 UG	ACCESS-KAISER/JHU												
21	Black Brant IX	36.282 US	MOSES-KANKELBORG/MONTANA ST. UNIV												
PFRR															
22	Talos Terrier Oriole Nihka	49.001UE	VISIONS-ROWLAND/NASA-GSFC												
KWAJALEIN															
23	Terrier Malemute	46.001 UE	EVEX-KUDEKI/UNIVERSITY OF ILLINOIS												
24	Terrier Oriole	45.005 UE	EVEX-KUDEKI/UNIVERSITY OF ILLINOIS												
REIMBURSABLE MISSIONS															
25	Terrier Orion	41.100 DR	MOSC-CATON/USAF												
26	Terrier Orion	41.102 DR	MOSC-CATON/USAF												

Sounding Rockets/Peregrine

- All three subcontracts have now been signed (motor case, insulation/closure/exit cone, and propellant casting)
 - The cast vendor has begun ordering propellant materials
 - The Preliminary Manufacturing Review has been completed with the insulation vendor
 - The case vendor has procured the mandrel material and is beginning the machining process
- The Marshall Safety and Quality Assurance Group has drafted a Quality Plan for the Peregrine program
- *Kick-off meetings with the PI's for the first & second Peregrine secondary experiments (funded by partner Space Technology Program) were conducted last week. The three experiment groups are from GRC, ARC, and JPL.*
- Fin and tail-can designs nearing completion and preparation of manufacturing drawings is underway.

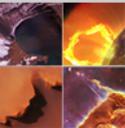
Project remains on schedule and within budget



Astrophysics Mission Events

CY	2013	2014	2015	Last Update: 04-10-2013
Mission Launches etc.	Apr 5 Explorer11 Downselect	Ship Flt CSI to JAXA Astro-H	TBD 2014 ISS CREAM	TBD 2015 LPF/ST-7
Suborbital <i>Rocket Program</i>	Apr S L I C E	May F O R T I S 1	Jun C I B E R 1-4	Sep X Q C 5
		Dec X A C T 1	Jan M i c r o X	Feb A C C E S S 1
		Mar O G R E S S	Apr C H E S S 1	Jun P I C T U R E B
		Jul X A C T 2	Aug A C C E S S 2	Oct C I B E R 2
				Feb F O R T I S 2
				Aug X Q C 6
				Aug C H E S S 2
<i>Balloon Campaigns</i>				
Antarctica	D/J (<i>Supertiger, BLAST, EBEX</i>)	D/J (ANITA, SPIDER, BACCUS)	D/J	D/J
Sweden			Jun	
Ft. Sumner (spr)				
Palestine				
Ft. Sumner (fall)		A/S (X-Caliber, HEROES)	A/S	A/S
Australia				
New Zealand				M/A

Astrophysics - Missions in Formulation & Implementation



Project	Overall previous months				March 2013					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 (2015)	G	G	G	G	G	G	G	G	G	LRD moved to 2015.
Euclid (2020)	G	G	G	G	G	G	G	G	G	ESA/JPL TAA approved.
Astrophysics Explorer	G	G	G	G	G	G	G	G	G	
Astro-H (2015)	Y	Y	Y	Y	Y	G	Y	Y	Y	JAXA working vibration/microphonics issue and schedule.
TESS, NICER	G	G	G	G	G	G	G	G	G	Downselection announced April 5.
Cosmic Origins	G	G	G	G	G	G	G	G	G	
SOFIA (ongoing)	Y/ G	Y/ G	Y/ G	Y/ G	Y	Y/ G	G	Y/ G	Y	Resumption of science flights in April 2013.
Exoplanet Exploration	G	G	Y	Y	G	R	G	G	G	Kepler wheel friction persists with elevated friction spikes.
Balloon Prog (ongoing)	G	G	G	G	G	G	G	G	G	Sweden campaign to begin in late May with Superpressure balloon test flight.

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 – Operating Missions

Mission	Launch	End Date	Phase	-4	-3	-2	-1	this mon	Comments
Hubble	1990-04-24	2016-09-30	Prime	G	G	G	G	G	Cycle 21 GO Call had a 6:1 oversubscription rate.
Chandra	1999-07-23	2016-09-30	Ext	G	G	G	G	G	Cycle 15 GO Call had a 5.2:1 oversubscription rate.
XMM-Newton	1999-12-10	2015-03-31	Ext	G	G	G	G	G	
GALEX	2003-04-28	2012-02-07	Ext	S	S	S	S	S	GALEX on loan to Caltech since May 2012 and returned to NASA in mid-April. Decommissioning to take place NLT April 30.
Spitzer	2003-08-25	2014-09-30	Ext	G	G	G	G	G	
Swift	2004-11-20	2016-09-30	Ext	G	G	Y	G	G	U of Rome antenna at Malindi providing support since Feb 8, 2013. No nighttime passes.
Suzaku	2005-07-10	2015-03-31	Ext	G	G	G	G	G	
Fermi	2008-06-11	2016-09-30	Prime	G	G	G	G	G	
Kepler	2009-03-07	2016-09-30	Ext	Y	Y	R	Y	Y	Science collection continues, but elevated friction persists with elevated friction spikes.
Herschel	2009-05-14	2013-05-14	Prime	G	G	G	G	G	Helium is projected to run out in early April 2013.
Planck	2009-05-14	2013-08	Ext	G	G	G	G	G	ESA & NASA Press event March 21 - CMB data.
NuSTAR	2012-06-13	2014-08-01	Prime	G	G	G	G	G	Malindi ground station now being backed up by KSAT Singapore ground station. No nighttime Malindi passes.

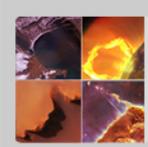
Note: End dates beyond 2014 are pending approval in the 2014 Senior Review process.

G On plan, adequate margin

Y Problems, working to resolve within planned margin

R Problems, not enough margin to recover

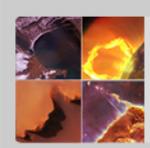
S Space Act Agreement. GALEX on loan to Caltech. 21



AFTA WFIRST DRM Status



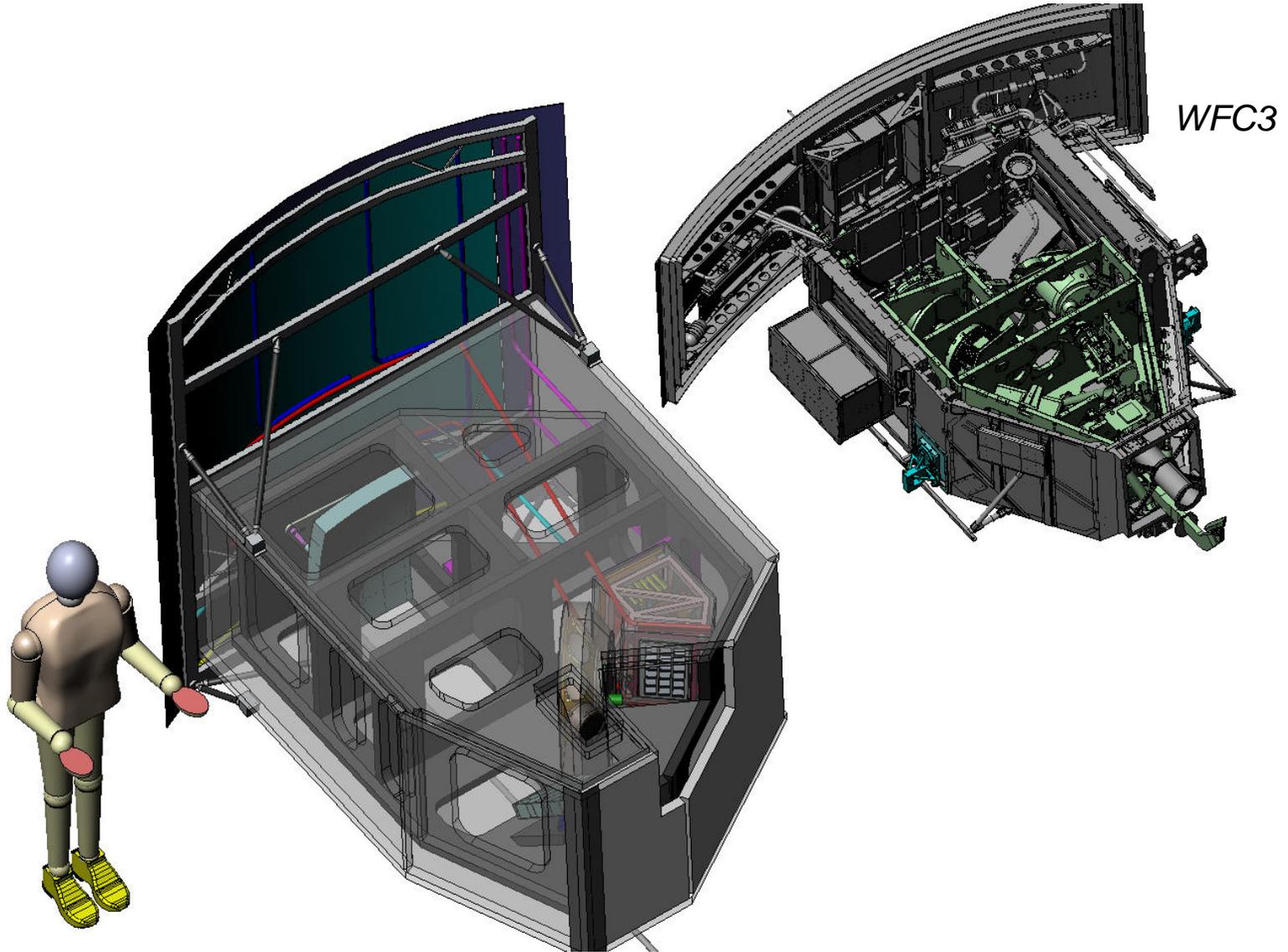
- SDT Report due Apr 30, HQ presentation Apr 19.
- SIP presentation May 30.
- CATE due May 31.
 - If AFTA study is continued following SIP decision, SDT will continue leading up to CAA and mid-decadal reviews.
- Master Equipment Lists (MELs) as well as development schedules are being updated in preparation for submission.
 - Spacecraft MEL is completed.
 - The Payload and Wide field Instrument MELs are near completion.
- Spacecraft modeling and design continues.
- Wide Field Instrument tasks are on track.
 - Design near completion.
 - Working requirements flowdown, packaging and detailed design parameters.
 - The IFU optical design is complete and has been folded into the overall design.
- The JPL Telescope team working tasks.
 - Developed study configuration and I&T flow.
 - Schedule, cost, and master equipment lists remain in work.
- The JPL Coronagraph team tasks are on track.
 - The final study configuration has been wrapped up and an associated cost estimate is in work.
 - A technology development plan, in response to the HQ Programmatic guidance, is currently in process.



AFTA WFIRST Wide Field Instrument



1.8m
(72")





Explorer Proposal

Transiting Exoplanet Survey Satellite

Dr. George R. Ricker, PI, MIT

Authorizing Official: Michael P. Corcoran, MIT
Assistant Director, Office of Sponsored Programs

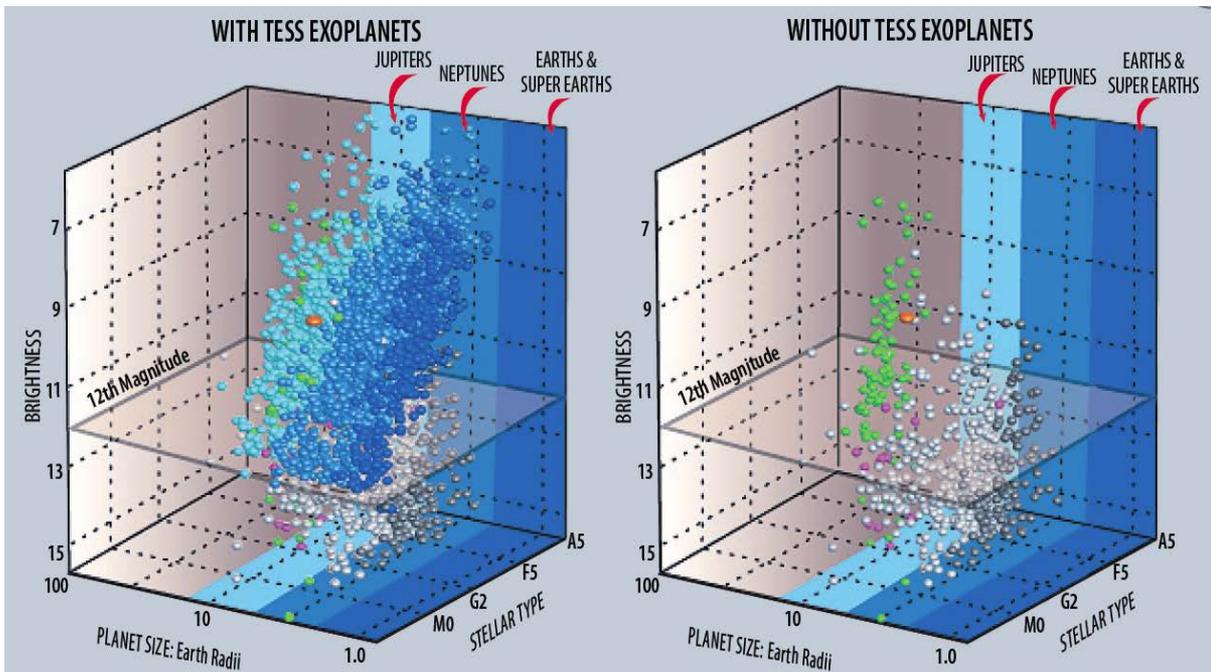


Transiting Exoplanet Survey Satellite

All-Sky, Two-Year Photometric Exoplanet Mapping Mission

Discover new worlds transiting the nearest and brightest stars

- **All-sky survey** of transiting extrasolar planets
- **Monitor >500,000 main-sequence stars**, focus on dwarfs of types F5 to M5.
- **Discover more than 2,000 new planets**, approximately 300 of which are expected to fall in Earth ($R_p \leq 1.25 R_E$) and super-Earth ($R_p \leq 2.0 R_E$) categories.
- **Provide the target list for JWST** future follow-up observations and future exoplanet characterization missions



Instrument: Four WFOV CCD cameras with overlapping FOV of 23x90deg mounted in a common lens hood. Passively-cooled 600-1000nm 4096x4096 pixel FPA

See separate presentation by George Ricker

NICER

Neutron star Interior Composition Explorer



An Explorer Mission of Opportunity
Proposal Submitted in Response to
SALMON AO: NNH08ZDA0090
Program Element Appendix:
NNH08ZDA0090-EXPM011

Principal Investigator:
Dr. Keith Gendreau
NASA's Goddard Space Flight Center

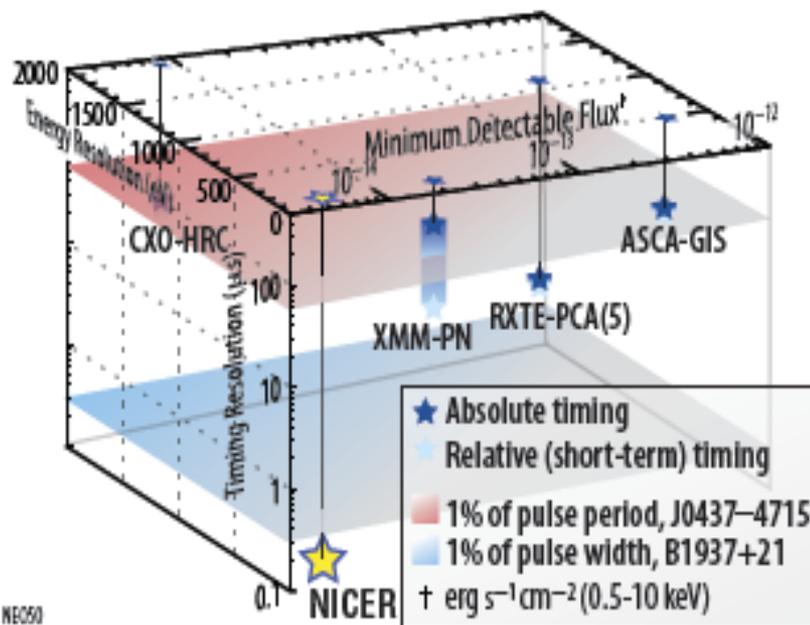
February 16, 2011

NASA's Goddard Space Flight Center
Massachusetts Institute of Technology

Neutron Star Interior Composition ExploreR

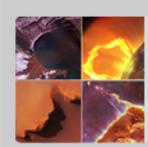
Resolving the nature of matter at the threshold of
collapse to a black hole

- Answer fundamental questions about **extremes in gravity, material density, and electromagnetism.**
- High resolution (5%-10%) mass and radius measurements will **resolve competing models of neutron star interiors.**
- ISS enables rapid response to Target of Opportunity triggers to **uncover the origins of the dynamic X-ray sky.**



NICER plumbs unexplored depths in time resolution, spectral resolution, and sensitivity.

See separate presentation by Keith Gendreau



Astrophysics Roadmap

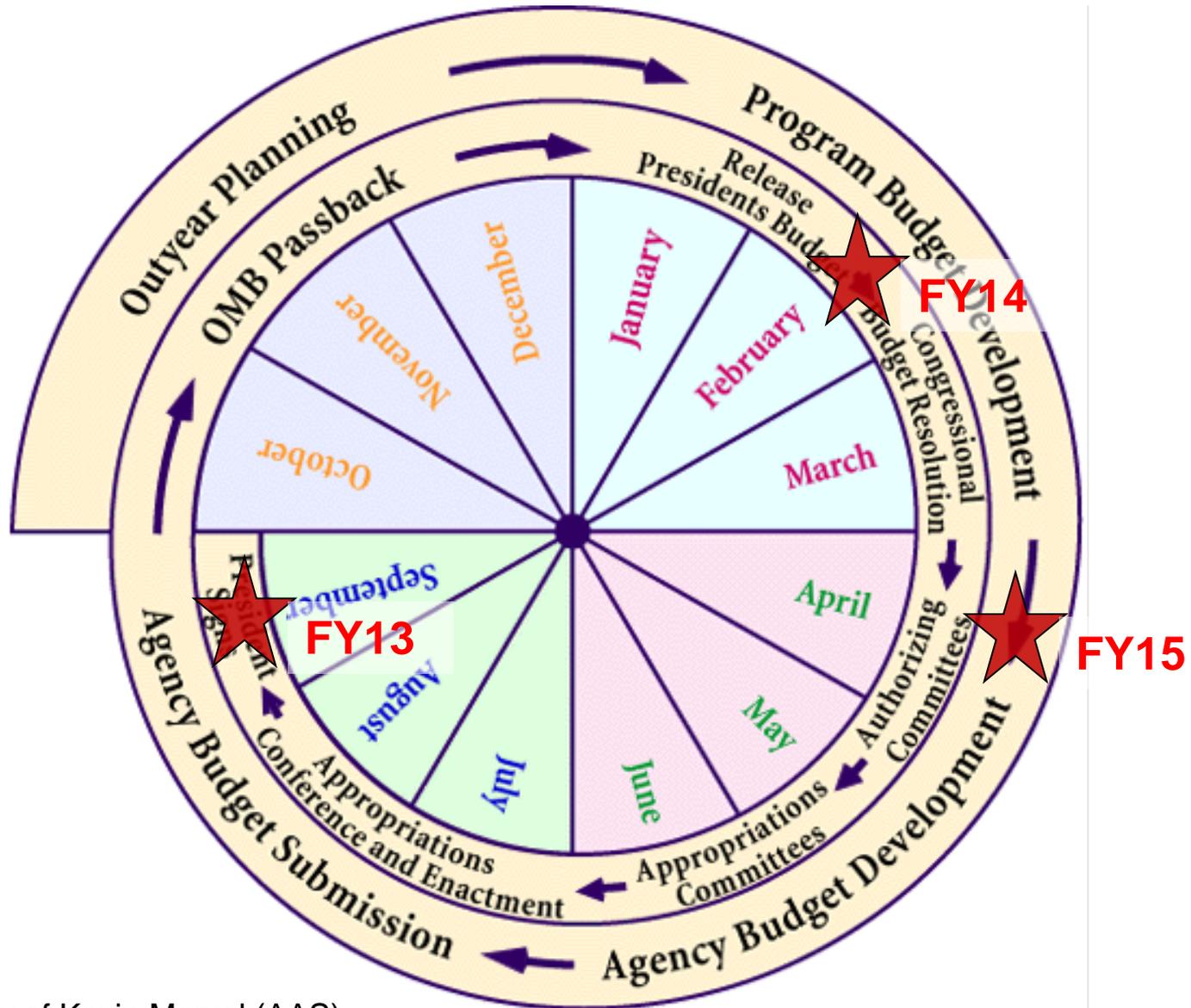
- **The NASA Astrophysics Roadmap is under development by a task force of the APS during 2013**
- **23 member Team with broad expertise and visionary thinkers**
- **Schedule:**
 - Virtual Town Hall workshop: Planned for May 6-7
 - One more face-to-face meeting planned in June
 - High-level themes ready for approval by APS by August 30, 2013
 - Final report ready for approval by APS with public release by December 16, 2013
- **Roadmap team is inviting the astrophysics community to submit ideas for science & technology challenges**
 - Abstracts received March 25, 2013.
 - 106 abstracts with 80 Science Challenges and 26 Technology Challenges.

See separate presentation by Chryssa Kouveliotou

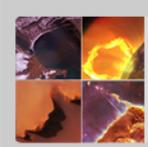
- Formulation
- Implementation
- Primary Ops
- Extended Ops



Current Location on the Budget Cycle

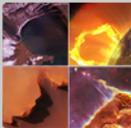


Graphic courtesy of Kevin Marvel (AAS)



Current Location on the Budget Cycle

- FY12 Reporting
- FY13 Planning and executing simultaneously
 - A full year budget has been passed by Congress and signed by the President
 - The budget includes a 1.8% rescission and a 5% sequester to be applied to the appropriated funds
 - An operating plan must be submitted to Congress outlining how NASA will apply the reductions within FY13
- FY14 Planning
 - A FY14 budget request has been submitted by the President to Congress
 - NASA is adjusting its plans to execute the president's budget request
- FY15 Formulating
 - The FY15 NASA budget formulation process leads to the President's FY15 budget request to Congress in February 2014
 - Early May: Projects, programs, Centers report to HQ
 - June: Astrophysics Division reports to SMD
 - Summer: SMD reports to Agency
 - Fall: Agency reports to OMB
 - February: President submits request to Congress



FY13 Appropriation

- Congress appropriated \$659M for Astrophysics and \$628M for JWST
 - Astrophysics appropriation is \$10M over FY13 PBR, earmarked for WFIRST
 - JWST appropriation is what was requested
- Rescission (~1.8%), Sequester (~5%), and other budget adjustments will result in an FY13 Astrophysics budget significantly lower
 - Exact amounts applied to Astrophysics are not public until the operating plan has been submitted to Congress and agreed upon
 - Estimating the reduction at 6.8% is a ROM estimate to astrophysical accuracy
- Astrophysics will take reductions in the following areas first
 - Reduce carry-over for operating missions, includes rephasing of GO funds
 - Rephase unneeded FY13 reserves for developing missions
 - Rephase R&A funding until FY14 for some PIs, reduced selections
 - Slow down development of future Explorers
- Impacts will include
 - Lowered R&A selection rates in 2013 (for FY14 funding)
 - Delays in future Explorer AOs
 - Other reductions in FY14 where funding requirements were deferred

FY 2014 SMD Program/Budget Strategy

- Provide the most productive Earth & space science program for the available resources
 - Guided by national priorities
 - Informed by NRC Decadal Surveys recommendations
 - Incorporating new ideas and partnerships
 - Increase cross-directorate collaboration on strategic projects (Mars 2020, NEOs)
- Responsibly manage the national investment in robotic space missions, with adherence to NPD 7120
 - Confirm new missions only after sufficient technology maturation and budgets at an appropriate confidence level
 - Take aggressive steps with missions that do not stay within budget
 - Aggressively manage JWST to the cost and schedule baseline
- Increase efforts to detect and study NEOs in support of future agency initiatives
- Begin Mars 2020 mission to build on Curiosity's discoveries
- Plan for land imaging capability beyond LDCM, Climate Sensors (previously on JPSS-2), and DSCOV Earth observing instruments
- Implement the Administration's proposed STEM initiative

Science Budget Request Summary

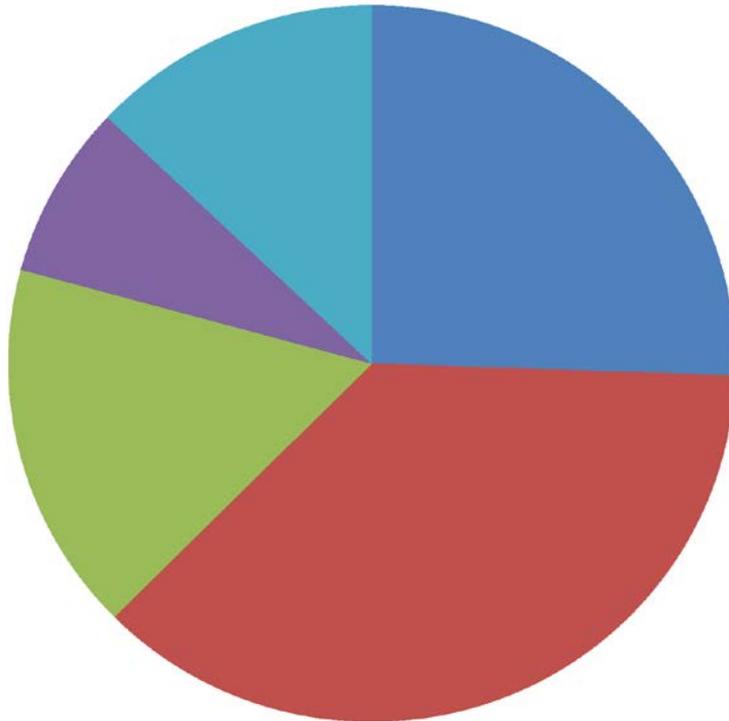
	FY2012	* FY2013	FY2014	FY2015	FY2016	FY2017	FY2018
Science Total	5073.7	5115.9	5017.8	5017.8	5017.8	5017.8	5017.8
<u>Earth Science</u>	<u>1760.5</u>		<u>1846.1</u>	<u>1854.6</u>	<u>1848.9</u>	<u>1836.9</u>	<u>1838.1</u>
Earth Science Research	441.1		443.3	483.1	483.4	485.1	476.5
Earth Systematic Missions	879.9		787.5	811.2	861.9	839.1	833.3
Earth System Science Pathfinder	183.3		353.6	293.1	232.2	237.4	250.0
Earth Science Multi-Mission Operations	168.6		171.7	174.3	177.9	179.0	182.0
Earth Science Technology	51.2		55.1	56.2	55.1	56.1	56.1
Applied Sciences	36.4		35.0	36.7	38.4	40.1	40.1
<u>Planetary Science</u>	<u>1501.4</u>		<u>1217.5</u>	<u>1214.8</u>	<u>1225.3</u>	<u>1254.5</u>	<u>1253.0</u>
Planetary Science Research	174.1		220.6	233.3	229.1	230.4	232.2
Lunar Quest Program	139.9		17.7				
Discovery	172.6		257.9	268.2	242.3	187.5	215.0
New Frontiers	143.7		257.5	297.2	266.5	151.0	126.2
Mars Exploration	587.0		234.0	227.7	318.4	504.7	513.2
Outer Planets	122.1		79.0	45.6	24.4	26.4	26.4
Technology	161.9		150.9	142.8	144.7	154.4	140.0
<u>Astrophysics</u>	<u>648.4</u>		<u>642.3</u>	<u>670.0</u>	<u>686.8</u>	<u>692.7</u>	<u>727.1</u>
Astrophysics Research	165.5		147.6	170.6	192.3	207.2	218.5
Cosmic Origins	239.9		228.0	216.5	193.1	196.7	194.1
Physics of the Cosmos	108.3		110.4	107.5	100.0	82.8	86.4
Exoplanet Exploration	50.8		55.4	59.4	57.7	60.7	90.7
Astrophysics Explorer	83.9		100.9	116.0	143.8	145.3	137.4
<u>James Webb Space Telescope</u>	<u>518.6</u>		<u>658.2</u>	<u>645.4</u>	<u>620.0</u>	<u>569.4</u>	<u>534.9</u>
<u>Heliophysics</u>	<u>644.8</u>		<u>653.7</u>	<u>633.1</u>	<u>636.8</u>	<u>664.3</u>	<u>664.6</u>
Heliophysics Research	166.7		195.7	163.0	167.5	172.1	174.1
Living with a Star	196.3		216.2	277.7	332.6	353.9	374.4
Solar Terrestrial Probes	216.0		146.6	68.7	48.9	50.1	27.9
Heliophysics Explorer Program	65.8		95.2	123.7	87.9	88.2	88.2

FY 2015-FY 2018 estimates are notional

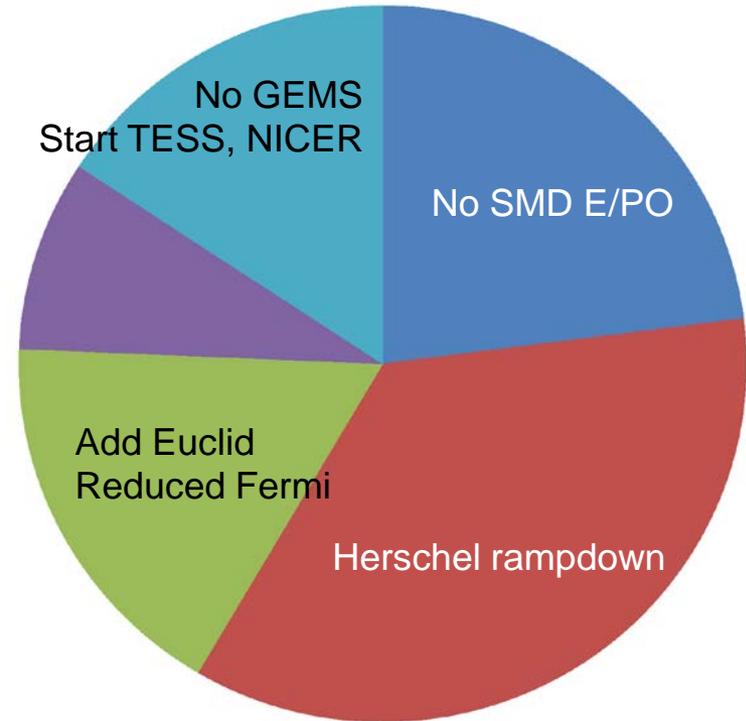
* FY2013 reflects pre-appropriation “annualized CR” rate; pending Operating Plan will be less than \$4.8B after rescissions and sequestration

FY12 and FY14 Budgets (excluding JWST)

FY12 \$648.4M



FY14 \$642.3M



Astrophysics Research
Cosmic Origins
Physics of the Cosmos
Exoplanet Exploration
Astrophysics Explorer



Astrophysics Budget Features

What's changed (since the President's FY13 budget request)

- A new Explorer mission (TESS) and a new Explorer Mission of Opportunity (NICER) downselected for development leading to flight
- New Euclid project created in PCOS program to fund hardware procurement and US science team
- Spitzer, Planck, Chandra, Fermi, XMM, Kepler, Swift, and Suzaku extended per the recommendation of the 2012 Senior Review
- Efficiencies in Fermi mission operations implemented in FY14, ahead of schedule and resulting in a significant reduction of operating costs, and the Fermi GO program canceled for one year (FY14)
- Budget does not support selections for the 2012 Astrophysics Explorer Mission of Opportunity AO
- 30% reduction to COR/PCOS program office budget (commensurate with reduced scope and content)
- Rebalancing of SR&T in all programs to implement Decadal Survey recommendations

What's the same

- JWST funded to maintain progress toward 2018 launch
- Hubble, SOFIA, NuSTAR, Astro-H, ST-7, Balloons, R&A, Archives
- Budget for large decadal survey mission begins to grow in FY17



FY14 Budget Request for Astrophysics

- **Reduction in Fermi Budget**

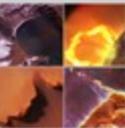
- In response to the recommendations of the 2012 Senior Review, reductions were planned for the Fermi Gamma-ray Space Telescope to take advantage of operational efficiencies. These reductions were planned to be phased in over three years.
- The FY14 PBR requests less funding for Fermi than planned. The savings from operational efficiencies will need to be realized immediately (in FY14).
- In addition, due to a need to realize additional savings in FY14 that exceed those attainable through operational efficiencies alone, the Fermi Guest Observers program will be eliminated for one year (FY14).
- NASA is working with DOE and its international partners on Fermi to make the necessary changes in Fermi operations.



FY14 Budget Request for Astrophysics

- **Reduction in Astrophysics Explorer Budget**

- The Astrophysics Explorer Program continues to support missions in development and missions in operation. We continue to implement a science rich program including the recent selections of TESS and NICER.
- The pace of how we implement the program, however, will have to be adjusted to stay within the funding profile requested for the Astrophysics Explorer Program in the President's FY14 budget request.
- The President's FY14 budget request for the Astrophysics Explorer Program does not support the selection of an astrophysics mission of opportunity from the 2012 Astrophysics Explorer Mission of Opportunity AO.
- We will complete the evaluation of the proposals, but will not make a selection. Once the evaluation of proposals is completed, we will put on hold any further selection activities for this AO.



FY14 Budget Request for Astrophysics

- **Future Explorer AOs**

- The future Astrophysics Explorer schedule must be revisited following the selections of TESS and NICER, the FY13 reductions due to the rescission and sequester, the FY14 budget request, and the elimination of selections from the 2012 MO AO.
- There will be no Astrophysics Explorer SMEX AO in CY 2013.
- The next Astrophysics Explorer AO will be for a SMEX and a MO. It will be in the 2014/2015 time period (NET 2014).
- The following Astrophysics Explorer AO will be for a EX and a MO. It may be in the 2016/2017 time period (NET 2016).



FY14 Budget Request for Astrophysics

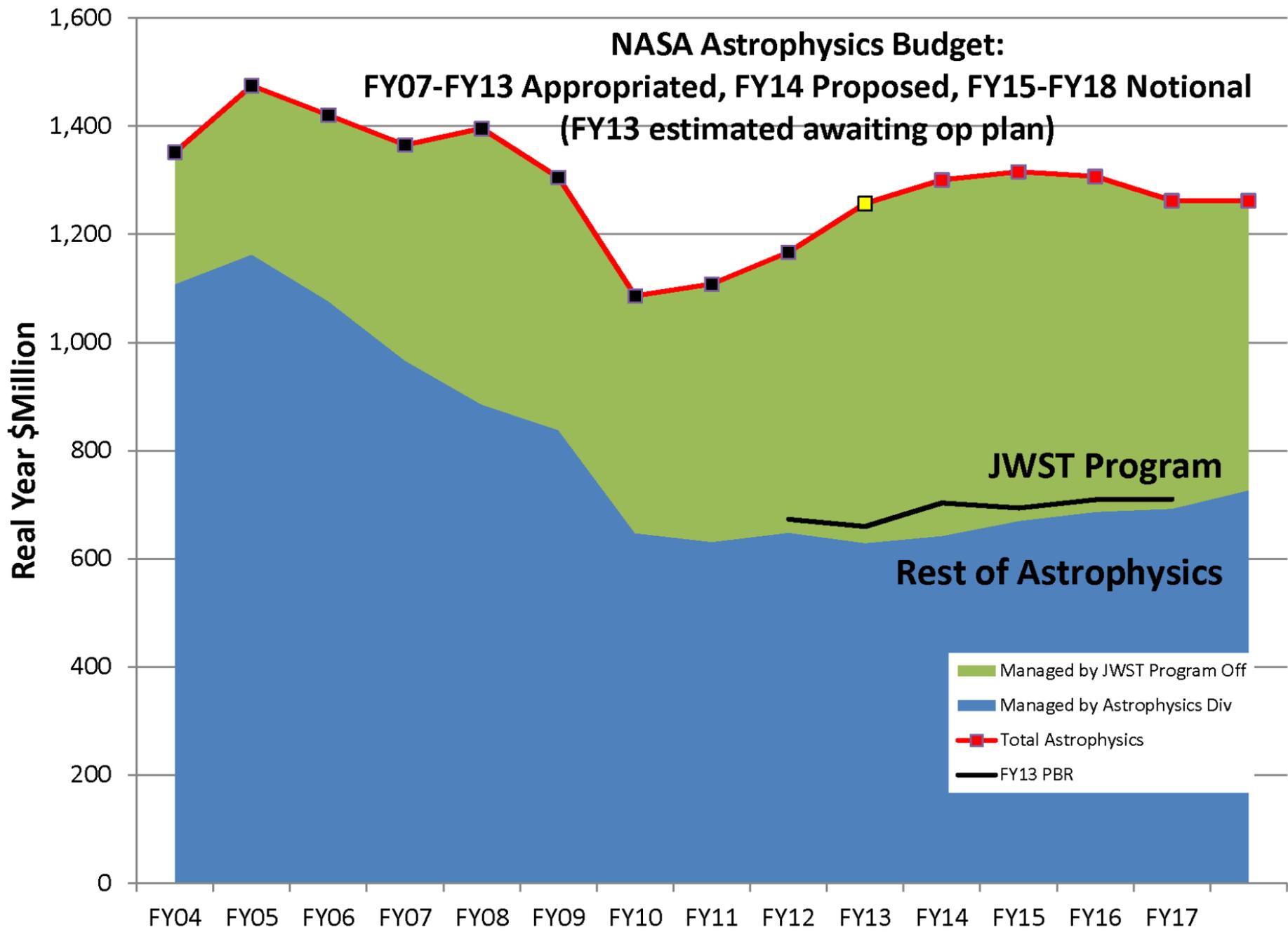
- **Impacts to R&A**

- Unable to realize additional planned growth plus new requirements (e.g. TCAN) within existing budget
- Reduced selection rates in ATP 2012 for FY13 funding
- Reduced overall selection rates in 2013 for FY14 funding

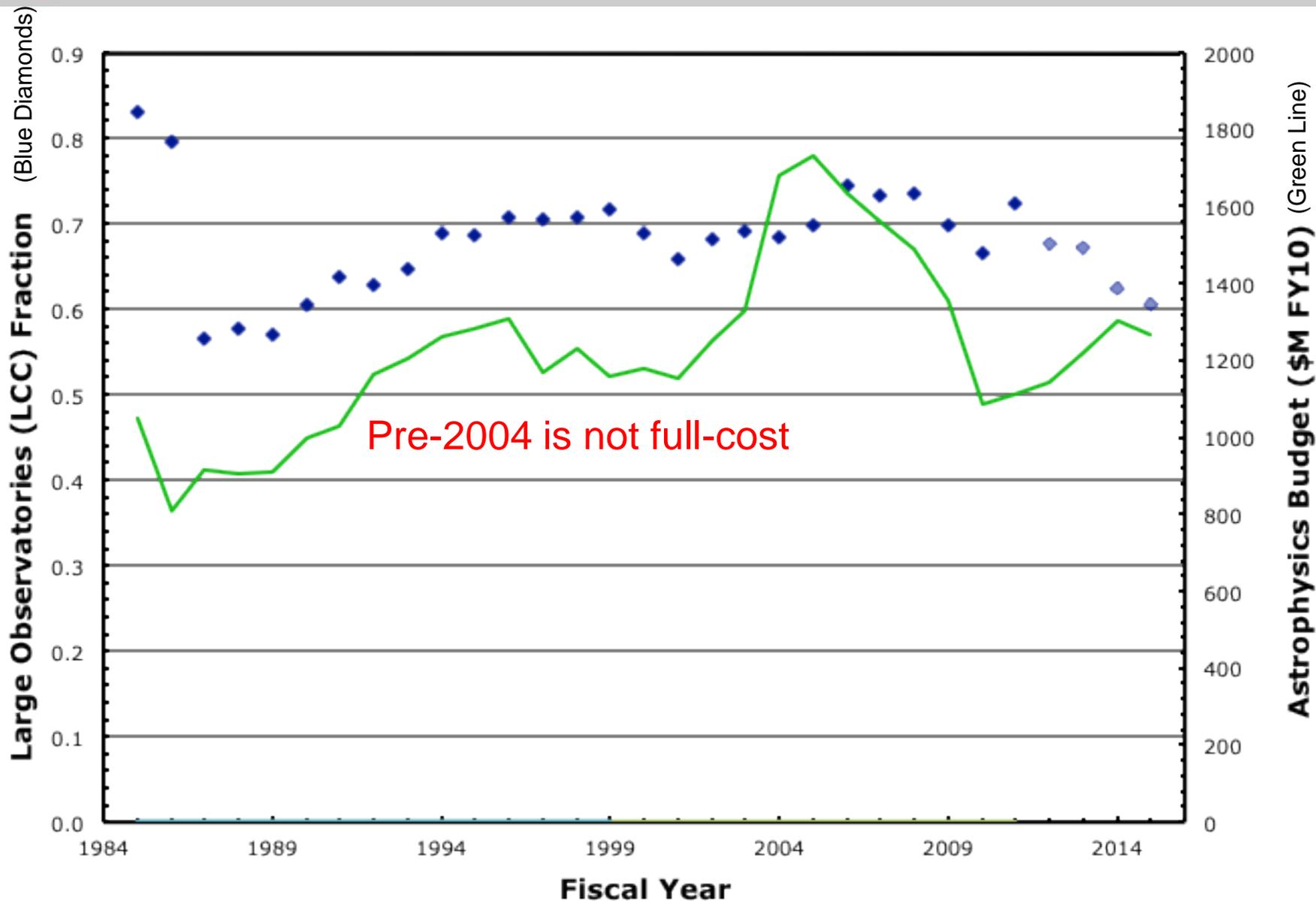
See separate presentation by Linda Sparke

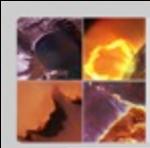
NASA Astrophysics Budget:

FY07-FY13 Appropriated, FY14 Proposed, FY15-FY18 Notional
(FY13 estimated awaiting op plan)



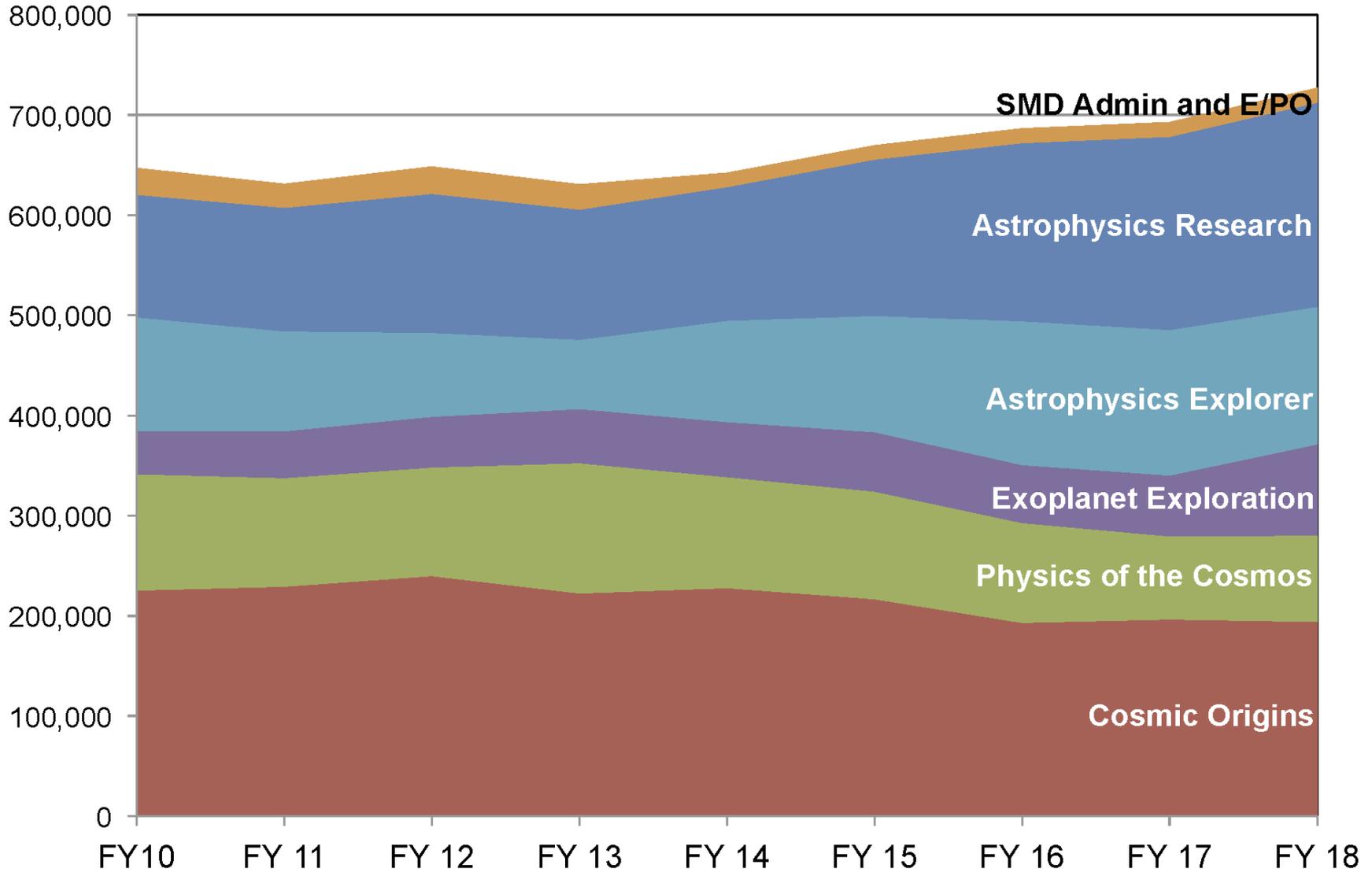
Flagship Missions vs Astrophysics Budget





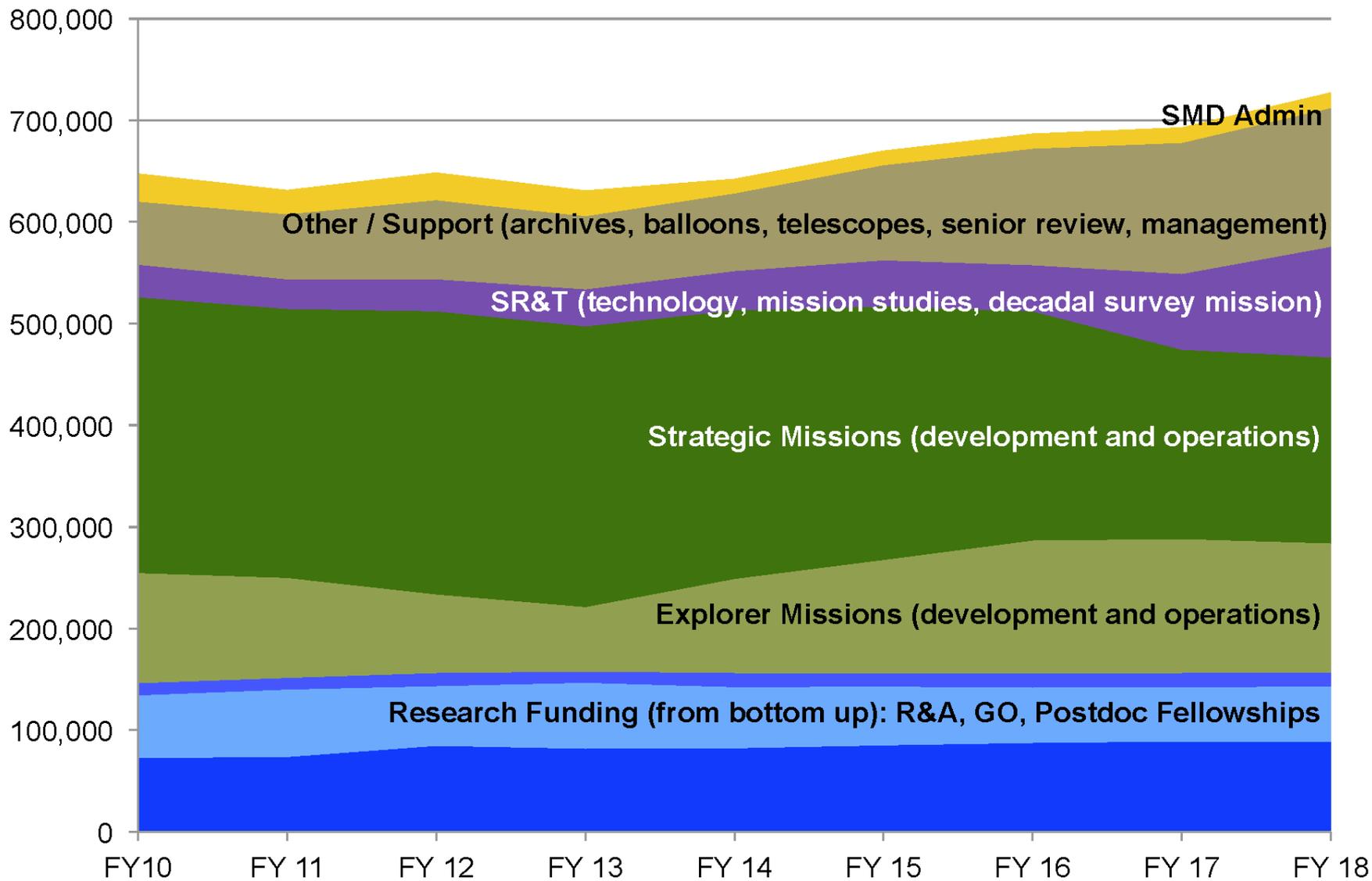
Astrophysics Programs (w/out JWST)

Astrophysics Budget (w/out JWST) in \$K
FY10-FY12 Actuals; FY13 Estimate; FY14 Request; FY15-FY18 Notional



Astrophysics Balance (w/out JWST)

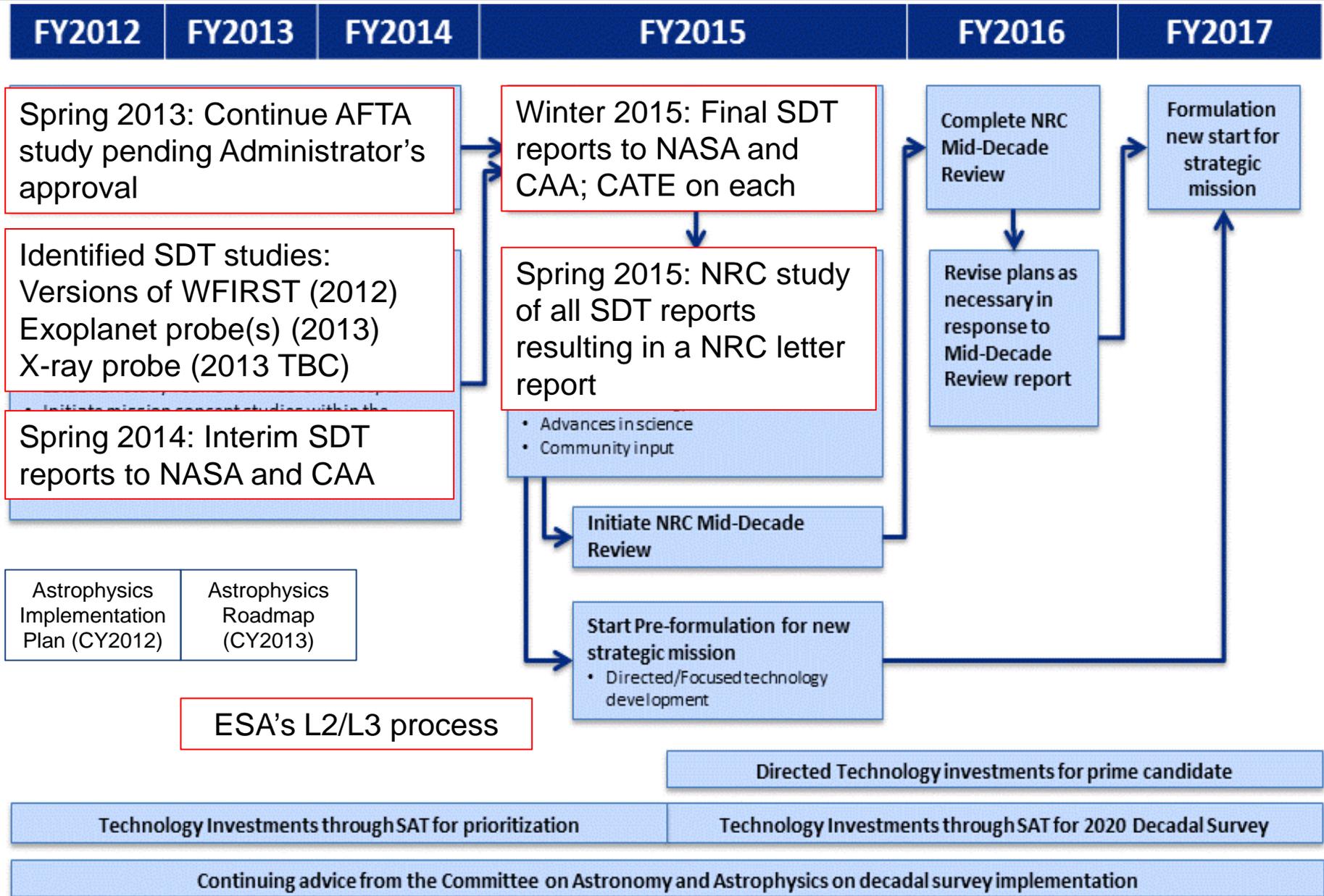
Astrophysics Budget (w/out JWST) in \$K
FY10-FY12 Actuals; FY13 Estimate; FY14 Request; FY15-FY18 Notional



Astro2010 Decadal Report Status - Response

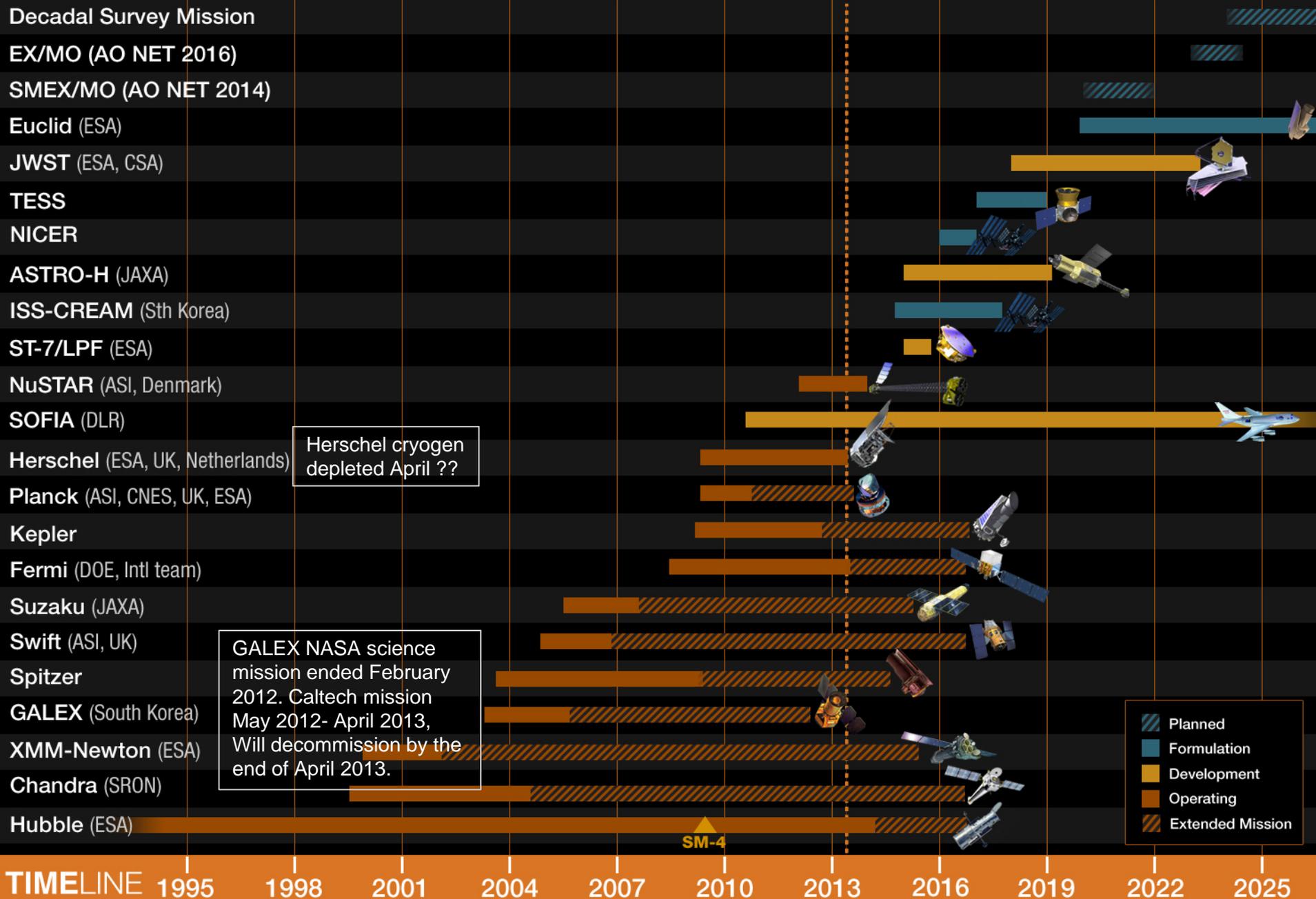
Program Scale	Recommendation	Current Response FY14
Large	WFIRST	DRM1 and DRM2 completed in FY12; AFTA DRM completed in FY13; detector technology development begun in FY13; continued pre-formulation and technology development in FY14; decision regarding new start in FY15
Large	Explorer Augmentation	Impacted by sequester and budget reductions; EX AO in 2010; SMEX AO in 2014/2015; EX AO in 2016/2017; each AO has a mission and a MO
Large	LISA Technology	CST completed in FY12; technology supported through SAT; ST-7/LPF supported; will pursue partnership with ESA if a GW mission is selected for L2/L3 mission
Large	IXO Technology	CST completed in FY12; technology supported through SAT; X-ray probe SDT planned for 2013; will pursue partnership with ESA if an X-ray mission is selected for L2/L3 mission
Medium	New Worlds Technology	Technology supported through TDEM/SAT; SDTs started in FY13; AFTA coronagraph study in FY13; will consider partnership with ESA if an exoplanet mission is selected for L2/L3 mission; working with STMD on early-stage technology
Medium	Inflation Probe Technology	Technology supported through APRA including multiple suborbital payloads; will consider partnership with ESA if a CMB mission is selected for L2/L3 mission
Small	Astrophysics Theory Program Augmentation	Impacted by budget reductions
Small	(Definition of) a future UV-optical space capability	RFI in FY12; technology supported through APRA, SAT, and working with STMD
Small	Intermediate Technology Development Augmentation	SAT program initiated and funded for prioritized investments
Small	Laboratory Astrophysics Augmentation	Augmentation started in FY12 including selection of large consortium; impacted by budget reductions
Small	SPICA mission (U.S. contributions to JAXA-led)	Candidate for future Explorer Mission of Opportunity
Small	Suborbital Program Augmentation	Technology augmentation for balloon program; continued development of ULDB balloon platforms; ISS payload selections; future is impacted by budget reductions
Small	Theory and Computation Networks (NASA, NSF, DOE)	First NASA-NSF call in 2013 for FY14 funding
N/A	Additional core program augmentations	Impacted by budget reductions

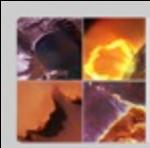
Astrophysics Near-term Strategy



Astrophysics Missions timeline

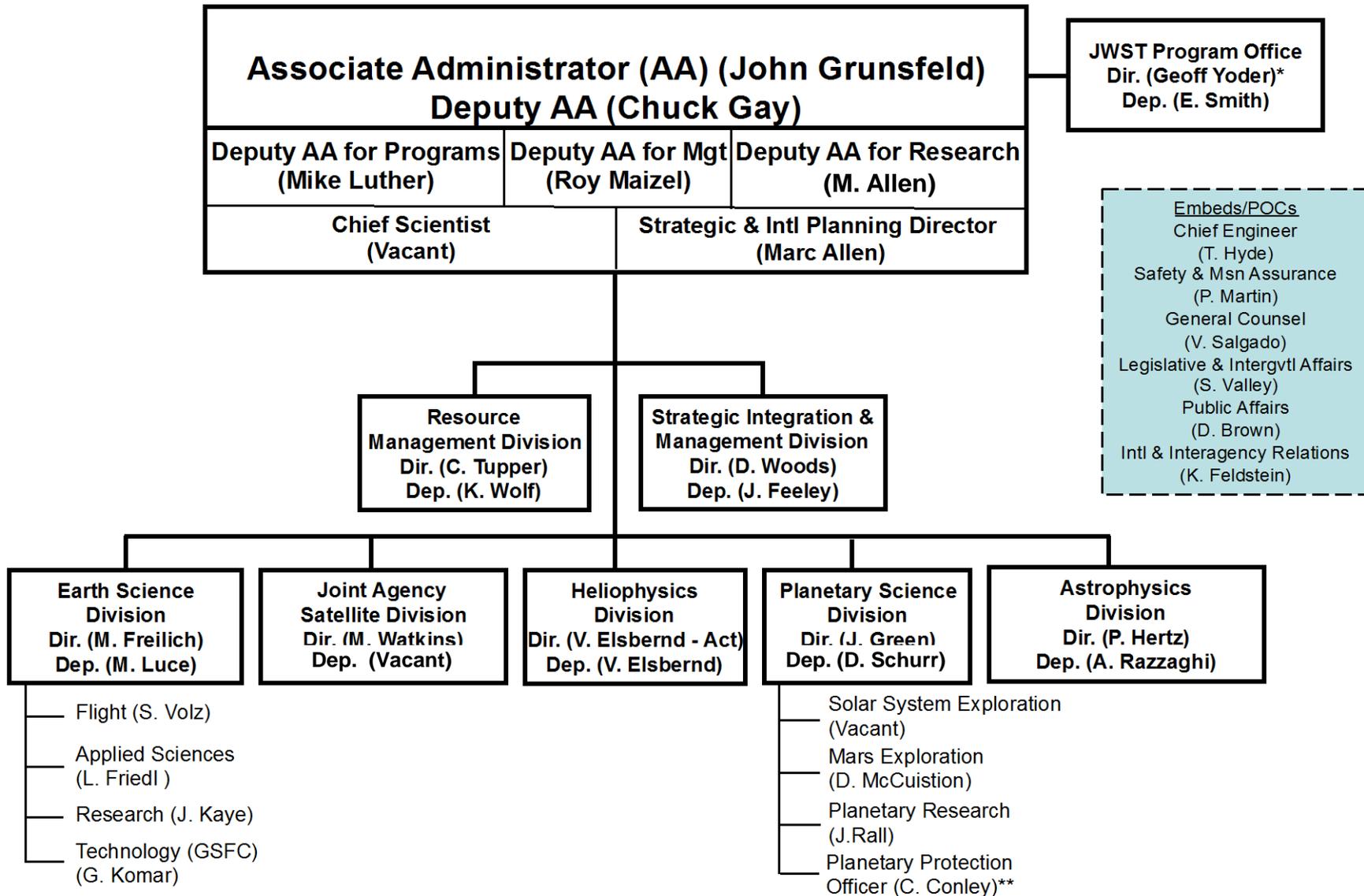
Last updated: April 15, 2013





Backup

SMD Organization



* Direct report to NASA Associate Administrator

** Co-located from the Front Office

Astrophysics Division Organization Chart

February 11, 2013

Resource Management

Omana Cawthon +
Peifen Anawalt +

Director

Paul Hertz

Deputy Director

Andrea Razzaghi

Lead Secretary: Leslie Allen (acting)

Secretary: Christie Ashley *

Program Support Specialist: Sheila Gorham

Cross Cutting

Technology Lead: William (Billy) Lightsey *

Strategic Integration: Joan Centrella *

Division E/PO POC: Hashima Hasan (Lead Comm Team)

Division PAO POC: Lisa Wainio *

Information Manager: Lisa Wainio *

Astrophysics Research

Program Manager: Linda Sparke

Astrophysics Data Analysis: Doug Hudgins, Debra Wallace

Astrophysics Theory: Linda Sparke

Origins of Solar Systems: Larry Petro *

APRA lead: Michael Garcia *

Cosmic Rays, Fundamental Physics: Joan Centrella*,
Vernon Jones, Keith
MacGregor*

Gamma Ray/X-ray: Michael Garcia*,
Lou Kaluzienski, Wilt Sanders*

Optical/Ultraviolet: Michael Garcia, Richard
Griffiths, Hashima Hasan,
Mario Perez *, Larry Petro *

IR/Submillimeter/Radio: Richard Griffiths, Doug
Hudgins, Larry Petro,
Glenn Wahlgren*

Lab Astro: Glenn Wahlgren*

Data Archives: Hashima Hasan

Astrophysics POC for Sounding Rockets: Wilt Sanders *

Balloons Program: Vernon Jones (PS), Mark Sistilli (PE)

Programs / Missions

	<u>Program Scientist</u>	<u>Program Executive</u>
Exoplanet Exploration (EXEP)		
LEADS	Doug Hudgins	Tony Carro *
Keck	Hashima Hasan	Mario Perez *
Kepler	Doug Hudgins	Tony Carro *
LBTI	Hashima Hasan	Mario Perez *
NExScI	Hashima Hasan	Mario Perez *
Cosmic Origins (COR)		
LEADS	Michael Garcia *	John Gagosian
Herschel	Glenn Wahlgren *	John Gagosian
Hubble	Richard Griffiths *	John Gagosian
JWST	Hashima Hasan	N/A
SOFIA	Glenn Wahlgren *	John Gagosian
Spitzer	Glenn Wahlgren *	John Gagosian
Physics of the Cosmos (PCOS)		
LEADS	Richard Griffiths *	Lia LaPiana
Chandra	Wilt Sanders *	Lia LaPiana
Euclid	Richard Griffiths *	Lia LaPiana
Fermi	Lou Kaluzienski	Lia LaPiana
Planck	Joan Centrella *	Lia LaPiana
ST-7/LPF	Wilt Sanders *	Anne-Marie Novo-Gradac
XMM-Newton	Lou Kaluzienski	Lia LaPiana
Astrophysics Explorers (APEX)		
LEADS	Wilt Sanders *	Anne-Marie Novo-Gradac
Astro-H	Lou Kaluzienski	Anne-Marie Novo-Gradac
GALEX	Larry Petro *	Anne-Marie Novo-Gradac
NuSTAR	Lou Kaluzienski	Mark Sistilli
Suzaku	Lou Kaluzienski	Anne-Marie Novo-Gradac
Swift	Michael Garcia *	Anne-Marie Novo-Gradac
WISE	Hashima Hasan	Anne-Marie Novo-Gradac

+ Member of the Resources Mgmt Division

* Detailee, IPA, or contractor

JWST now part of the JWST Program Office.

Kelly Johnson on detail until Aug. 2013.

Rita Sambruna on detail until Sept. 2013

Astrophysics Program Content

	FY2012	FY2013	FY2014	FY2015	FY2016	FY2017	FY2018
				<i>(FY15-18 estimates are notional)</i>			
Astrophysics	648.4		642.3	670.0	686.8	692.7	727.1
<u>Astrophysics Research</u>	<u>165.5</u>		<u>147.6</u>	<u>170.6</u>	<u>192.3</u>	<u>207.2</u>	<u>218.5</u>
Astrophysics Research and Analysis	68.6		65.7	68.3	70.2	71.5	71.5
Balloon Project	31.6		32.9	32.8	34.2	34.3	34.3
<u>Other Missions and Data Analysis</u>	<u>65.3</u>		<u>49.1</u>	<u>69.4</u>	<u>87.9</u>	<u>101.3</u>	<u>112.7</u>
Keck Single Aperture	2.3						
Astrophysics Data Analysis Program	16.4		17.0	17.0	17.6	17.6	17.6
Astrophysics Data Curation and Archival	20.0		18.2	19.1	19.1	19.1	19.1
Astrophysics Senior Review				13.9	24.5	35.8	41.0
Education and Public Outreach	12.9						
Contract Administration, Audit & QA Svcs	13.7		13.9	14.0	14.5	14.5	14.5
Astrophysics Directed R&T				5.4	12.3	14.3	20.5
<u>Cosmic Origins</u>	<u>239.9</u>		<u>228.0</u>	<u>216.5</u>	<u>193.1</u>	<u>196.7</u>	<u>194.1</u>
Hubble Space Telescope (HST)	98.3		96.3	92.3	88.2	88.2	83.9
SOFIA	84.2		87.4	87.3	85.2	85.1	86.2
<u>Other Missions And Data Analysis</u>	<u>57.4</u>		<u>44.3</u>	<u>36.9</u>	<u>19.7</u>	<u>23.4</u>	<u>24.0</u>
Spitzer	17.8		16.3	14.2			
Herschel	24.3		12.2	5.5	2.7	1.0	
Cosmic Origins SR&T	10.2		12.8	13.1	13.3	18.6	19.2
Cosmic Origins Future Missions	1.0		0.4	1.6	1.0	1.0	2.0
Cosmic Origins Program Management	4.1		2.6	2.6	2.7	2.8	2.9

Astrophysics Program Content (cont'd)

	FY2012	FY2013	FY2014	FY2015	FY2016	FY2017	FY2018
				<i>(FY15-18 estimates are notional)</i>			
<u>Physics of the Cosmos</u>	<u>108.3</u>		<u>110.4</u>	<u>107.5</u>	<u>100.0</u>	<u>82.8</u>	<u>86.4</u>
Euclid	1.0		15.1	9.3	3.7	4.0	5.0
Chandra X-Ray Observatory	56.4		55.0	55.8	55.4	55.6	55.6
Fermi Gamma-ray Space Telescope	25.3		14.3	18.6	20.7		
Planck	7.1		6.2	4.1			
XMM-Newton	2.1		1.9	1.0			
Physics of the Cosmos SR&T	13.3		15.3	14.9	16.4	19.3	20.8
Physics of the Cosmos Program Mgmt	3.0		2.7	2.8	2.8	2.9	3.0
Physics of the Cosmos Future Missions	0.3			1.0	1.0	1.0	2.0
<u>Exoplanet Exploration</u>	<u>50.8</u>		<u>55.4</u>	<u>59.4</u>	<u>57.7</u>	<u>60.7</u>	<u>90.7</u>
Kepler	19.6		18.7	18.0	18.3		
Large Binocular Telescope Interferometer	2.0		2.9	2.0	0.5	0.5	
Keck Operations	3.2		5.8	6.0	6.1	6.1	6.2
Keck Interferometer	0.4						
Exoplanet Exploration SR&T	18.4		22.2	26.0	26.1	34.3	34.3
Exoplanet Exploration Program Mgmt	5.6		4.6	5.4	5.5	5.6	5.7
Exoplanet Exploration Future Missions	1.5		1.2	2.0	1.2	14.2	44.4

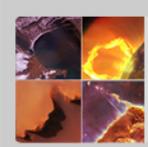
Astrophysics Program Content (cont'd)

	FY2012	FY2013	FY2014	FY2015	FY2016	FY2017	FY2018
				<i>(FY15-18 estimates are notional)</i>			
<u>Astrophysics Explorer</u>	<u>83.9</u>		<u>100.9</u>	<u>116.0</u>	<u>143.8</u>	<u>145.3</u>	<u>137.4</u>
Astro-H (SXS)	16.2		1.3	0.9	0.9		
Swift	4.3		4.8	5.0	5.1		
Wide-Field Infrared Survey Explorer	4.5		0.2				
Suzaku (ASTRO-E II)	0.3		0.3	0.3			
Nuclear Spectroscopic Telescope Array	15.6		1.3	0.4			
GALEX	0.5						
Wilkinson Microwave Anisotropy Probe	1.0						
Gravity and Extreme Magnetism SMEX	33.2						
Astrophysics Explorer Future Missions	2.7		86.0	105.8	130.9	137.9	133.4
Astrophysics Explorer Program Mgmt	5.6		7.0	3.5	6.8	7.4	4.0

Astrophysics PAGs

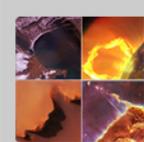
NASA Advisory Council (NAC)			→ NASA / Charlie Bolden
Science Committee			→ SMD / John Grunsfeld
Astrophysics Subcommittee			→ Astrophysics / Paul Hertz
COPAG	ExoPAG	PhysPAG	
<p>COPAG SAGs include:</p> <ul style="list-style-type: none"> → Science objectives for a 4m–8m UV/Optical mission J. Gagosian, M. Garcia, M. Ahmed, D. Benford Technology for a 4m-class monolithic telescope UV/Optical mission with internal coronagraph Technologies for an 8m-class segmented telescope UV/Optical mission with external occulter Technologies for a future far-IR mission Science objectives and technology requirements for a series of Cosmic Origins Probes 	<p>ExoPAG SAGs include:</p> <ul style="list-style-type: none"> → Precision measurements from solar system probes T. Carro, D. Hudgins, G. Blackwood, W. Traub Planetary measurements needed for exoplanet characterization Exoplanet flagship requirements and characteristics State of precision RV measurements for planetary census Exoplanet probe requirements and characteristics 	<p>PhysPAG SAGs include:</p> <ul style="list-style-type: none"> → Cosmic Origins Study Analysis Group L. LaPiana, R. Griffiths, M. Ahmed, A. Hornschemeier Gamma-ray Study Analysis Group Gravitational Wave Study Analysis Group Inflation Probe Study Analysis Group X-ray Study Analysis Group 	

Table 2—Analysis Groups. Structure of Program Analysis Groups (PAGs) and Study Analysis Groups (SAGs) reporting to the Astrophysics Subcommittee.



NASA Advisory Council (NAC)		
Science Committee		
Astrophysics Subcommittee		
COPAG	ExoPAG	PhysPAG
<p>COPAG SAGs include:</p> <ul style="list-style-type: none"> • Science objectives for a 4m–8m UV/Optical mission • Technologies for a 4m-class monolithic telescope UV/Optical mission with internal coronagraph • Technologies for an 8m-class segmented telescope UV/Optical mission with external occulter • Technologies for a future far-IR mission • Science objectives and technology requirements for a series of Cosmic Origins Probes 	<p>ExoPAG SAGs include:</p> <ul style="list-style-type: none"> • Potential for exoplanet science measurements from solar system probes • Planetary measurements needed for exoplanet characterization • Exoplanet flagship requirements and characteristics • State of precision RV measurements for planetary census • Exoplanet probe requirements and characteristics 	<p>PhysPAG SAGs include:</p> <ul style="list-style-type: none"> • Cosmic Ray Study Analysis Group • Gamma-ray Study Analysis Group • Gravitational Wave Study Analysis Group • Inflation Probe Study Analysis Group • X-ray Study Analysis Group

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Study on Applications of Large Space Optics (SALSO)

- In June 2012, NASA announced that it had acquired the use of two sets of 2.4m space-qualified telescope optics systems and supporting components.
- Although their most obvious applications are in astrophysics, **NASA is interested in identifying possible uses for these systems to address a broader range of its science, exploration, and technology goals.**
 - In November 2012, NASA released an RFI soliciting broad community inputs focused on utilization of the telescope assets for Agency goals in space technology, human exploration and operations, heliophysics, planetary science, and astrophysics (excluding a wide field infrared survey).
 - A workshop was held February 5-6, 2013, in Huntsville AL to provide a forum for concept presentation and discussion of innovative ideas.
 - Astrophysics concepts included UV/Visible observatories, exoplanet observatories, solar system observatories, time domain observatory, deep imaging observatories, exo-ecliptic observatory, binocular observatory, balloon borne observatory, etc.
- **NASA will use all of the information gathered to formulate and evaluate future strategies for utilizing the assets to advance Agency goals.**
 - A final study report will contain the workshop briefings and the results of follow-on analyses. This report will be completed about May 2013 and publicly released thereafter.

<http://science.nasa.gov/salso/>