



Astrophysics

NASA Headquarters Updates



ExoPAG #13

AAS 227th Meeting
Kissimmee, Florida
January 4, 2016

Martin Still

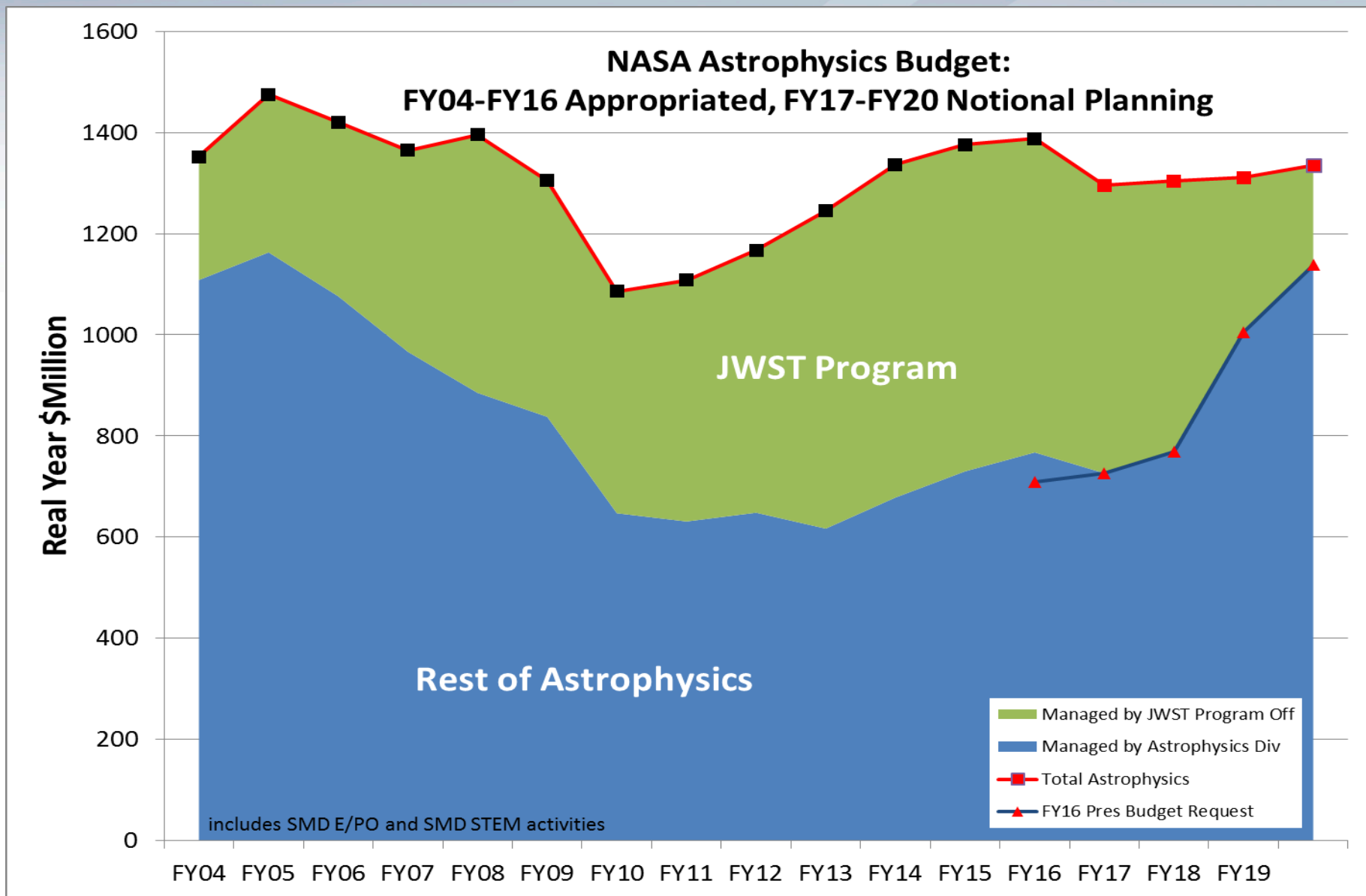
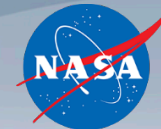
ExoPAG Executive Secretary
Astrophysics Division
Science Mission Directorate
Martin.Still@nasa.gov

Content



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4. Large Mission Concept Studies for 2020 Decadal Survey

1. Omnibus Appropriations Bill Signed



1. Omnibus Appropriations Bill Signed

FY16 Appropriation



Outyears are notional planning from FY16 President's budget request

(\$M)	2014	2015	2016	2017	2018	2019	2020
Astrophysics*	\$678	\$685	\$731	\$707	\$750	\$986	\$1118
JWST	\$658	\$645	\$620	\$569	\$535	\$305	\$198
Total	\$1336	\$1330	\$1351	\$1273	\$1285	\$1291	\$1316

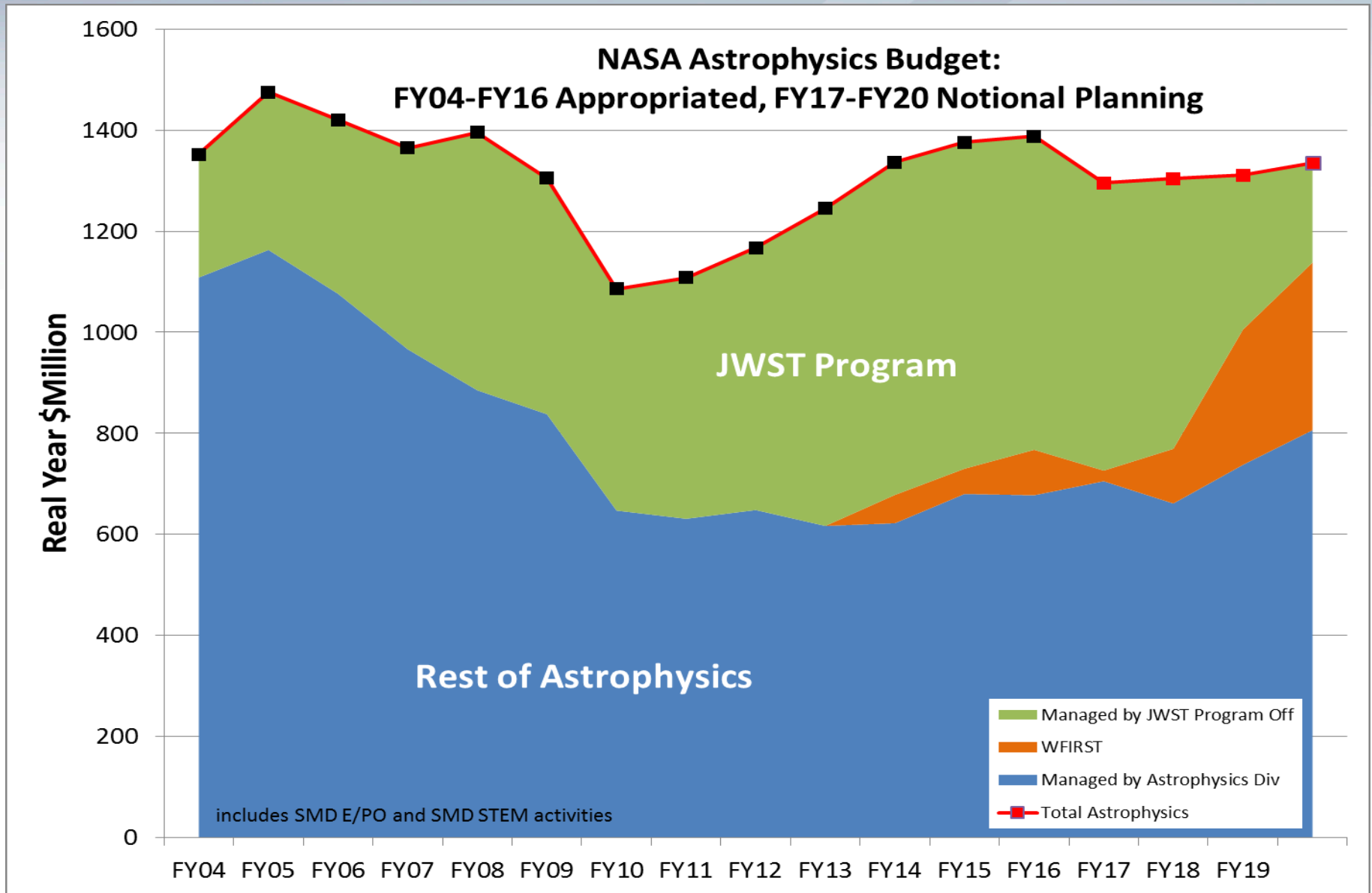
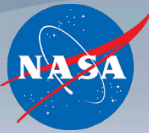
* Excludes "SMD STEM Activities" in all years.

- Provides \$90M for WFIRST and directs NASA to start Formulation
- Provides full funding (\$85M) for SOFIA operations and places SOFIA into the 2018 Astrophysics Senior Review
- Provides full funding (\$98M) for continued Hubble operations
- Provides \$37M for SMD STEM education activities
- Requires reduction of \$36M in rest of Astrophysics portfolio

(\$M)	FY16 Request	FY16 Approps	Delta
JWST	\$620	\$620	--
WFIRST	\$14	\$90	+\$76
SOFIA	\$85	\$85	--
Hubble	\$97	\$98	+\$1
Rest of Astrophysics	\$493	\$457	-\$36 (-7%)
Total	\$1309	\$1351	+\$42

1. Omnibus Appropriations Bill Signed

WFIRST-AFTA Formulation is Accelerated



2. Astrophysics Division Status

a. Progress Toward Decadal Survey Priorities



The NASA FY16 Appropriation and the notional out year budget planning guidance in the President's FY16 Budget Request support:

Complete JWST	JWST remains within budget guidelines and on track for an October 2018 launch.
Large-scale: WFIRST	2 years of preformulation and focused technology development for WFIRST-AFTA (a 2.4m version of WFIRST with a coronagraph) are complete. Formulation (new start) planned to begin February 2016.
Large-scale: Augmentation to Explorer Program	Astrophysics Explorers planned budget increased to support cadence of four AOs per decade including a SMEX AO in Fall 2014 and a MIDEX AO in Fall 2016.
Medium-scale: New Worlds Technology Development Program	Technology development for WFIRST coronagraph, exoplanet probe mission concept studies. Partnership with NSF to develop precision Doppler spectrometer as facility instrument. Exozodi survey using LBTI.
Small-scale: Research Program Augmentations	Increased annual R&A budget by 10% from FY10 to FY12 and another 10% from FY14 to FY16.
Small-scale: Intermediate Technology development Augmentation	Established competed Strategic Astrophysics Technology program element; directed technology funding for WFIRST and other large-scale decadal priorities (e.g., WFIRST coronagraph, Athena).

2. Astrophysics Division Status

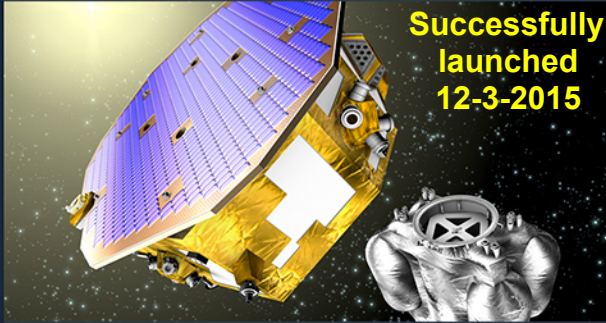
b. Missions in Development



LISA Pathfinder 12/2015

ESA-led Mission

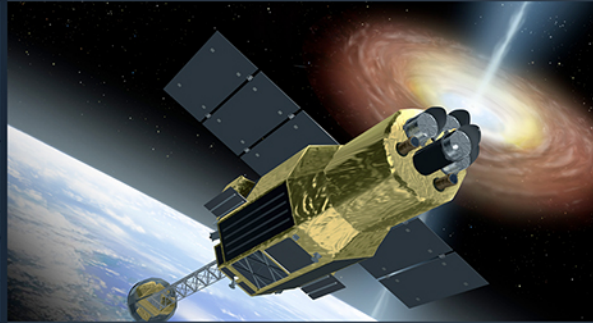
Successfully
launched
12-3-2015



NASA supplied the ST7/Disturbance Reduction System (DRS)

ASTRO-H 02/2016

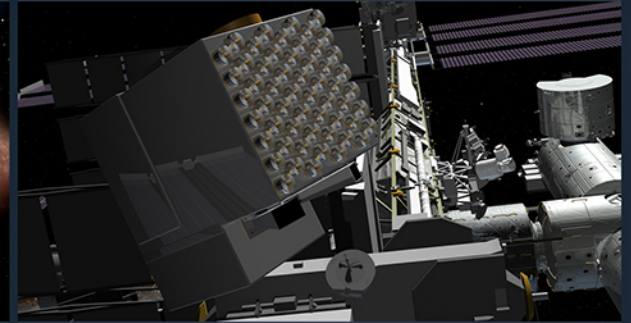
JAXA-led Mission



NASA supplied the Soft X-ray Spectrometer (SXS) instrument

NICER 8/2016

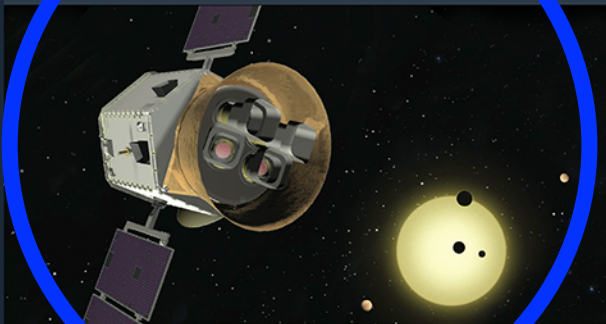
NASA Mission



Neutron Star Interior Composition Explorer

TESS 8/2017

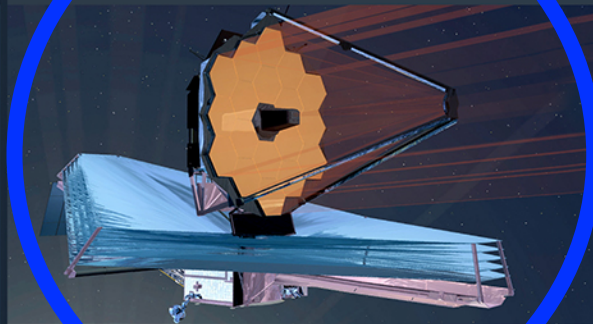
NASA Mission



Transiting Exoplanet Survey Satellite

JWST 10/2018

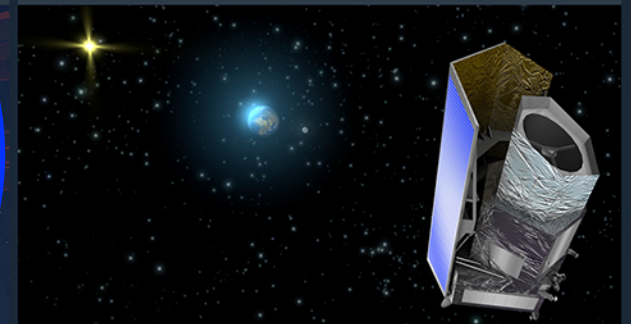
NASA Mission



James Webb Space Telescope

Euclid 2020

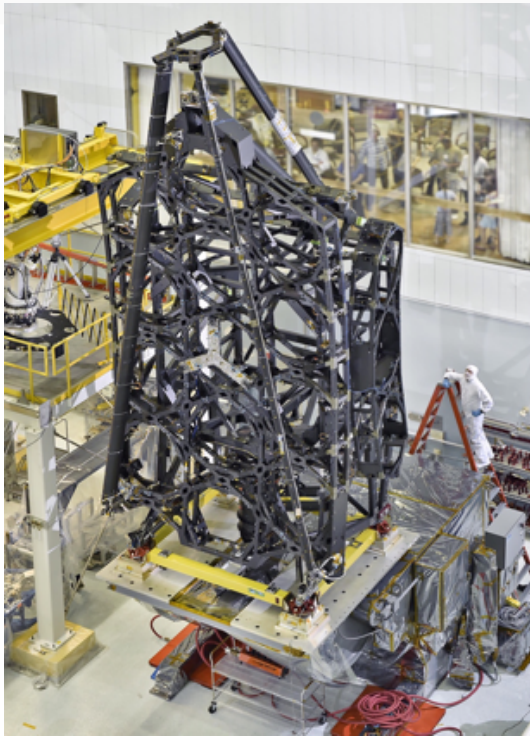
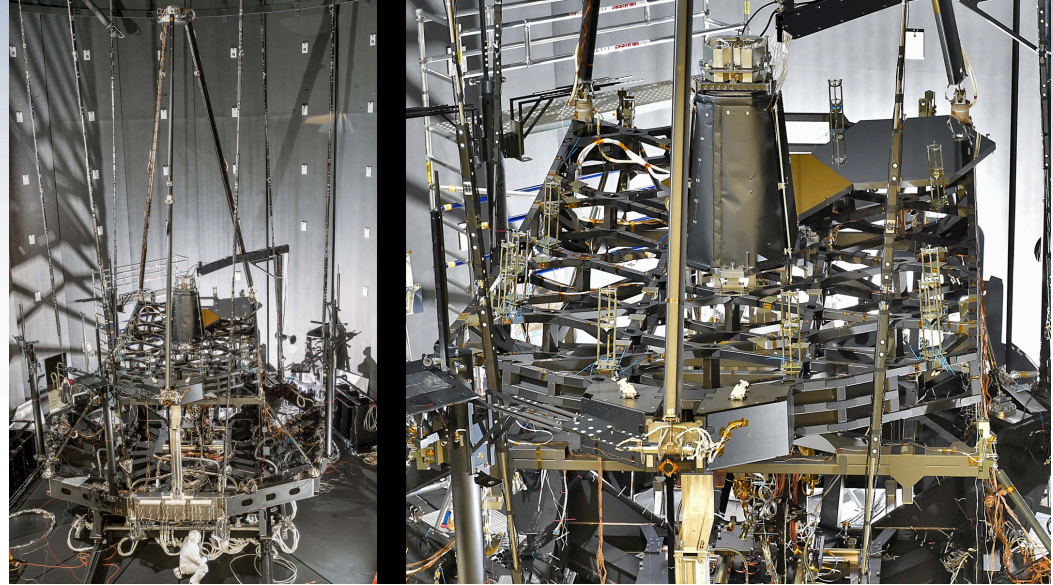
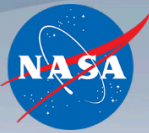
ESA-led Mission



NASA is supplying the NISP Sensor Chip System (SCS)

2. Astrophysics Division Status

b. Missions in Development: JWST Hardware Development



JWST remains on track for an October 2018 launch within its replan budget guidelines

<http://jwst.nasa.gov/webcam.html>

2. Astrophysics Division Status

b. Missions in Development: WFIRST-AFTA Pre-formulation

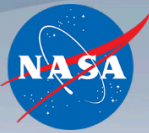


Coronagraph Technology Milestones		
1	Shaped Pupil mask fabricated with reflectivity of 10^{-4} and 20 μm pixel size.	7/21/14 ✓
2	Shaped Pupil Coronagraph demos 10^{-8} raw contrast with narrowband light.	9/30/14 ✓
3	PIAACMC mask fabricated with 10^{-8} raw contrast with 10% broadband light.	12/15/14 ✓
4	Hybrid Lyot Coronagraph demos 10^{-8} raw contrast with narrowband light.	2/28/15 ✓
5	Occulting Mask Coronagraph demos 10^{-8} raw contrast with 10% broadband light.	9/15/15 ✓
6	Low Order Wavefront Sensing provides jitter sensing better than 0.4 mas rms.	9/30/15 ✓
7	Spectrograph read-out demo to have low dark current and read noise.	8/25/16
8	PIAACMC coronagraph demos 10^{-8} raw contrast with 10% broadband light.	9/30/16
9	Occulting Mask Coronagraph demos 10^{-8} raw contrast with 10% broadband light.	9/30/16

Widefield Detector Technology Milestones		
1	Produce, test, and analyze 2 candidate passivation techniques in banded arrays.	7/31/14 ✓
2	Produce, test, and analyze 1 additional candidate passivation techniques in banded arrays.	12/30/14 ✓
3	Produce, test, and analyze full arrays with operability > 95%.	9/15/15 ✓
4	Produce, test, and analyze final selected recipe in full arrays demonstrating a yield > 20% with operability > 95%.	9/15/16
5	Complete environmental testing of one sensor chip assembly, as per NASA test standards.	12/1/16

2. Astrophysics Division Status

b. Missions in Development: WFIRST-AFTA



WFIRST Science Investigation Teams

PI	PI Institution	Title	Topic
Olivier Dore	JPL	Cosmology with the WFIRST High Latitude Survey	Galaxy Redshift Survey, Weak Lensing Survey
Ryan Foley	Illinois	Optimizing the WFIRST Type Ia Supernova Survey	Supernovae Survey
Scott Gaudi	Ohio State	Preparing for the WFIRST Microlensing Survey	Microlensing Survey
Jeremy Kasdin	Princeton	WFIRST Coronagraph Instrument Adjutant Scientist	Coronagraph Instrument
Bruce Macintosh	Stanford	Optimizing WFIRST Coronagraph Science	Coronagraphy
Saul Perlmutter	LBNL	Investigating the Nature of Dark Energy using Type Ia Supernovae	Supernovae Survey
James Rhoads	Arizona State	Cosmic Dawn with WFIRST	GI/GO
Brant Robertson	UC Santa Cruz	WFIRST Extragalactic Potential Observations	GI/GO
David Spergel	Princeton	WFIRST Wide Field Instrument Adjutant Scientist	Widefield Instrument
Alexander Szalay	Johns Hopkins	Archival Research Capabilities of the WFIRST Data Set	GI/GO
Margaret Turnbull	SETI Institute	Harnessing the Power of the WFIRST-Coronagraph	Coronagraphy
Benjamin Williams	Washington	WFIRST Infrared Nearby Galaxy Survey	GI/GO

- Formulation
- Implementation
- Primary Ops
- Extended Ops

XMM-Newton (ESA)
12/10/1999

Swift
11/20/2004

CREAM (on ISS)
12/2016

Fermi
6/11/2008

Euclid (ESA)
2020

Hubble
4/24/1990

Kepler
3/7/2009

JWST
2018

Spitzer
8/25/2003

ASTRO-H (JAXA)
2016

Chandra
7/23/1999

NICER (on ISS)
8/2016

NuSTAR
6/13/2012

TESS
2017

2. Astrophysics Division Status

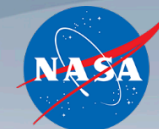
c. Mission Operations: Senior Review 2016

LISA Pathfinder (ESA)
12/3/2015

SOFIA
Full Ops 2014

2. Astrophysics Division Status

c. Operating Missions: 2016 Senior Review Timeline



Action	Date	Done
Draft Call for Proposals issued	August 20, 2015	✓
Deadline to send comments on draft to NASA	September 10, 2015	✓
Final Call for Proposals issued	September 25, 2015	✓
Senior Review Proposals due	January 22, 2016	
Main panel meets in Washington, DC	February 22-25, 2016	
HST review and site visit in Baltimore, MD	March 8-10, 2016	
CXO review and site visit in Cambridge, MA	March 22-24, 2016	
Delivery of panel reports to NASA HQ	April 2016	
NASA Response/direction to projects. Reports released on APD website.	May-June 2016	

For more information:

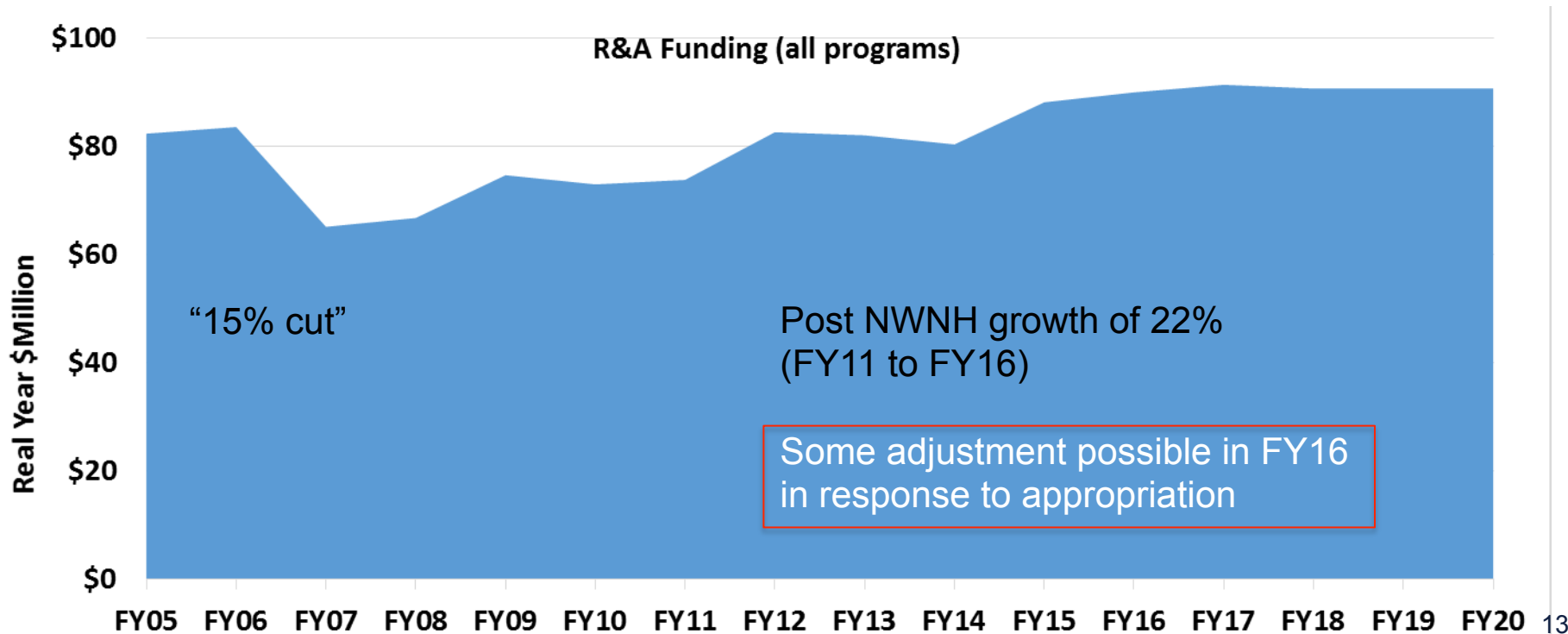
<http://science.nasa.gov/astrophysics/2016-senior-review-operating-missions/>

2. Astrophysics Division Status



d. Research and Analysis: R&A funding has grown 22% since 2010

- Core R&A Funding includes
 - Astrophysics Research and Analysis (APRA): all years
 - Astrophysics Data Analysis Program (ADAP): all years
 - Astrophysics Theory Program (ATP): all years
 - Exoplanet Research Program (XRP), was Origins of Solar Systems (OSS): all years
 - Theoretical and Computational Astrophysics Networks (TCAN): FY14+
 - Nancy G. Roman Technology Fellowships (RTF): FY12+
 - Long Term Space Astrophysics (LTSA): through FY09, then into ADAP
 - Beyond Einstein Foundation Science (BEFS): through FY06, then into ATP
 - Does not include WFIRST Preparatory Science (WPS) or mission-funded theory



2. Astrophysics Division Status

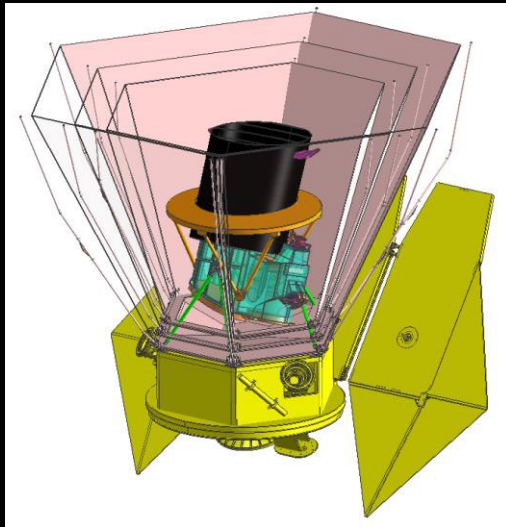
d. Research and Analysis: Proposal calls expected in 2016



- **ROSES research opportunities**
 - APRA/SAT in March
 - Exoplanet Research in March
 - ADAP in May
 - Astrophysics Theory in July
 - Habitable Worlds in November
- **ROSES Guest Observer/Investigator opportunities**
 - Kepler K2 GO Cycle 4 in February
 - Kepler K2 GO Cycle 5 in October
- **Other Astrophysics Guest Observer opportunities**
 - HST Cycle 23 in April
 - SOFIA Cycle 5 in June
 - Spitzer Cycle 13 in June

2. Astrophysics Division Status

e. Missions Opportunities: SMEX/MO Missions in Formulation



SPHEREx

PI: J. Bock, Caltech
An All-Sky Near-IR
Spectral Survey



PRAXyS

PI: K. Jahoda, GSFC
Polarimeter for Relativistic
Astrophysical X-ray
Sources



Investigator:
Dr. C. Weisskopf, MSFC
Project Official:
Dr. R. Bruemmer, Director MSFC

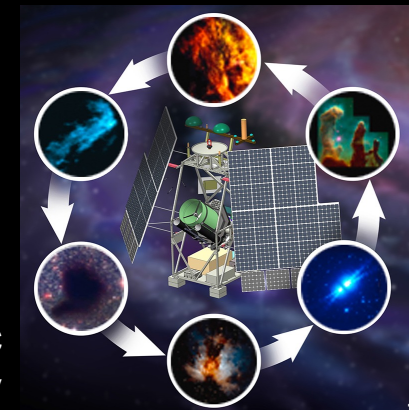
IXPE

PI: M. Weisskopf, MSFC
Imaging X-ray Polarimetry
Explorer



PI: A. Lee, UC Berkeley
US Participation in JAXA's
LiteBIRD CMB Polarization Survey

PI: C. Walker, U. Arizona
GUSTO: Gal/Xgal U/LDB Spectroscopic
- Stratospheric Terahertz Observatory



2. Astrophysics Division Status



e. Missions Opportunities: MIDEX/MO Call for 2016

- Astrophysics Explorer Program planning budget is sufficient to select and execute one MIDEX mission and one MO.
- The schedule for the solicitation is intended to be:
 - Release of draft AO: Spring 2016 (target);
 - Release of final AO: Late summer 2016 (target);
 - Proposals due: 90 days after AO release;
 - Selection for 9-month competitive Phase A studies: Summer 2017 (target);
 - Down-selection: Late 2018 (target).
- MIDEX Parameters
 - PI-managed mission cost cap is \$250M (FY17\$), not including the cost of the Expendable Launch Vehicle (ELV) or any contributions.
 - Standard launch services on an ELV will be provided for MIDEX missions at no charge against the mission cost cap; no MIDEX ISS-attached payloads.
 - MIDEX launch readiness date no later than December 2023.
- Mission of Opportunity Parameters
 - PI-managed mission cost cap is \$70M (FY17\$) for Partner MOs and Small Complete Mission MOs, including ISS-attached payloads.
 - PI-managed mission cost cap is \$35M (FY17\$) for suborbital-class MO.
 - Small Complete Mission launch readiness date no later than December 2022.

<http://explorers.larc.nasa.gov/APMIDEX2016/>

3. Changes in ROSES-2016

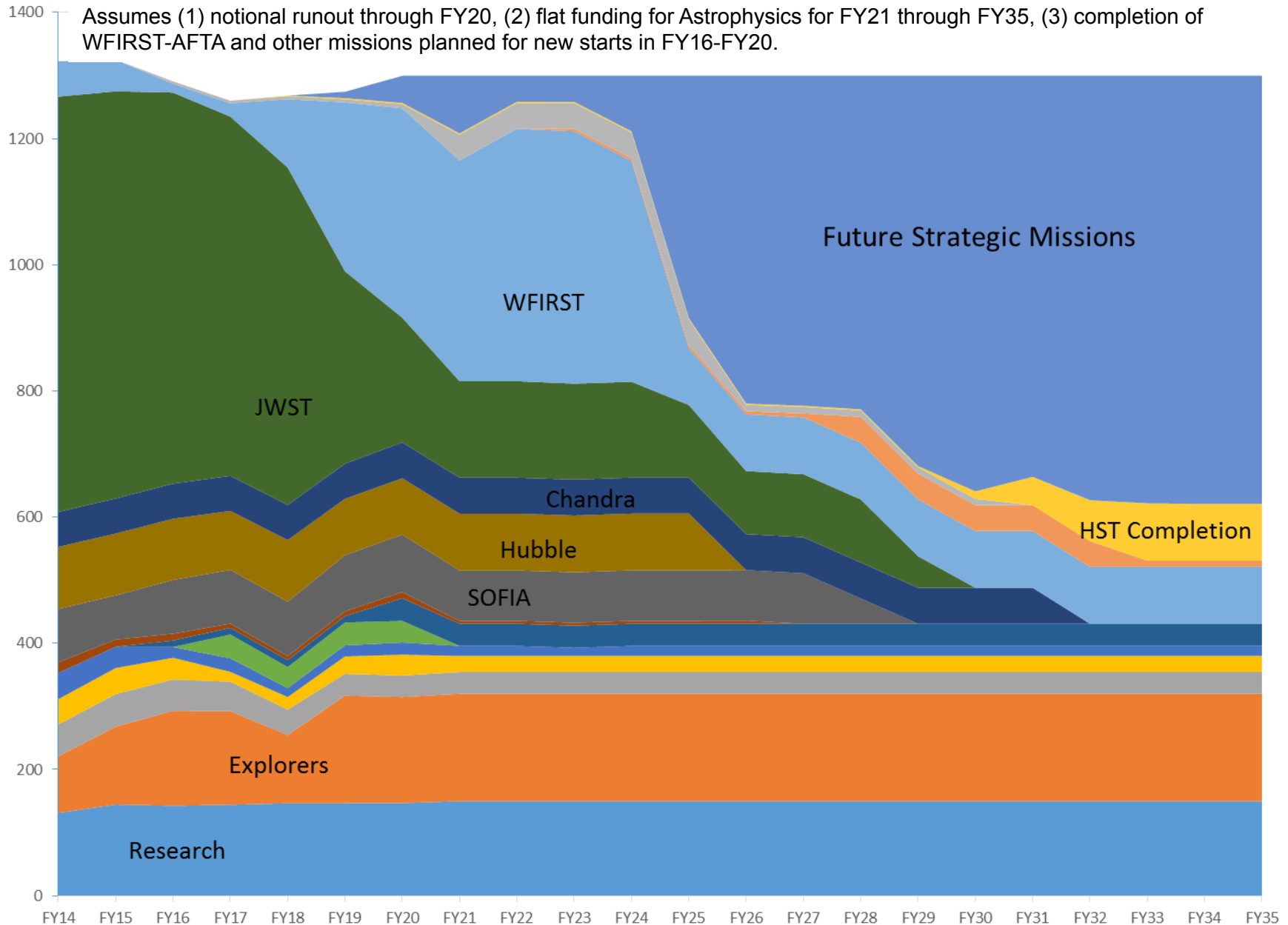
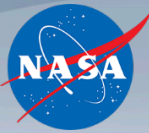
Astrophysics/Planetary Science cross-divisional programs



- The Exoplanet Research Program
 - Programmatic duplication with GO programs, the ADAP, ATP and NSF AAG will be avoided
 - Investigations are expected to directly support the goal of understanding exoplanetary systems, by doing one or more of the following:
 - Astrophysics Division**
 - detect exoplanets and/or confirm exoplanet candidates in order to provide high-value targets for current and future NASA observatories
 - observationally characterize exoplanets and their atmospheres in order to inform target and operational choices for current NASA missions, and/or targeting, operational, and formulation data for future NASA observatories
 - Planetary Sci. Division**
 - understand the chemical and physical processes of exoplanets, including the state and evolution of their surfaces, interiors, and atmospheres
 - improve understanding of the origins of exoplanetary systems
 - Programs that combine two or more divisional disciplines to investigate exoplanet properties (Astrophysics, Planetary Sci, Heliophysics, and Earth Science) are encouraged
- The Habitable Worlds element is moving from Appendix C (Planetary Science Division) to Appendix E (cross-divisional programs)
 - The Astrophysics Division will potentially fund high-value Habitable Worlds proposals of strategic interest to current and future Astrophysics mission goals

4. Large Mission Concept Studies

Notional 20-year Sandchart





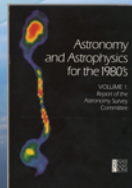
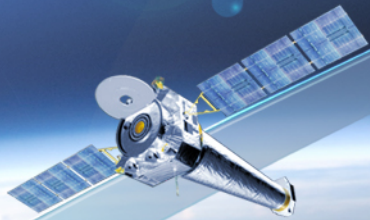
4. Large Mission Concept Studies

ASTROPHYSICS

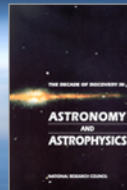
Decadal Survey Missions



1972
Decadal Survey
Hubble



1982
Decadal Survey
Chandra



1991
Decadal Survey
Spitzer, SOFIA



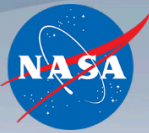
2001
Decadal Survey
JWST



2010
Decadal Survey
WFIRST

4. Large Mission Concept Studies

Large Mission Concepts



NASA is initiating studies of the following four large mission concepts:

- **FAR IR Surveyor** – The Astrophysics Visionary Roadmap identifies a Far IR Surveyor as contributing through improvements in sensitivity, spectroscopy, and angular resolution.
- **Habitable-Exoplanet Imaging Mission** – The 2010 Decadal Survey recommends that a habitable-exoplanet imaging mission be studied in time for consideration by the 2020 Decadal Survey.
- **Large UV/Optical/IR Surveyor** – The Astrophysics Visionary Roadmap identifies a Large UV/Optical/IR Surveyor as contributing through improvements in sensitivity, spectroscopy, high contrast imaging, astrometry, angular resolution and/or wavelength coverage. The 2010 Decadal Survey recommends that NASA prepare for a UV mission to be considered by the 2020 Decadal Survey.
- **X-ray Surveyor** – The Astrophysics Visionary Roadmap identifies an X-ray Surveyor as contributing through improvements in sensitivity, spectroscopy, and angular resolution.

PAG reports are posted at <http://cor.gsfc.nasa.gov/copag/rfi>

4. Large Mission Concept Studies

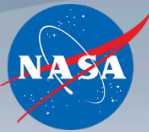
Science and Technology Definition Teams Required



- The four Large Mission Concept Studies will inform the 2020 NRC Decadal Survey
 - NASA anticipates that the Decadal Survey Committee will use these studies in formulating their recommendation for the priorities for NASA's large strategic missions following JWST and WFIRST
- Assessment and prioritization within an astrophysics portfolio is the job of the 2020 Decadal Survey Committee
- The role of the study teams is to make the best case for the concepts
- Study Teams are not in competition with each other
- NASA defines "full success" as delivery to the Decadal Survey Committee of four compelling and executable concepts so that the science of all four large missions can be adequately prioritized by the Committee
 - By executable we mean feasible with respect to technical, cost, and risk resources outlined in the Study Report

4. Large Mission Concept Studies

Short-term timeline



Activity / Milestones	Schedule
Invitation at AAS conference for STDT nominations. Release STDT charter and brief mgmt. approach	Jan 6, 2016 (ref charter and mgmt. approach)
STDT nominations due	Feb 1, 2016
Study Team finalization, set first meetings and telecons	March 10, 2016
Studies kick off	Early April, 2016
Delivery of detailed study execution plan	Aug 1, 2016

- Where to hear the detailed plan:
 - Jan 5, 1.00pm: Joint PAG meeting, **Osceola A Ballroom**, Paul Hertz
 - Jan 6, 12.45pm: 216 - NASA Town Hall, Sun A, Paul Hertz
 - Jan 6: 2.00pm: NASA Decadal Mission Studies and STDTs, St George 112, Paul Hertz + Study Scientists

Seeking Visiting Scientists for NASA HQ Detail



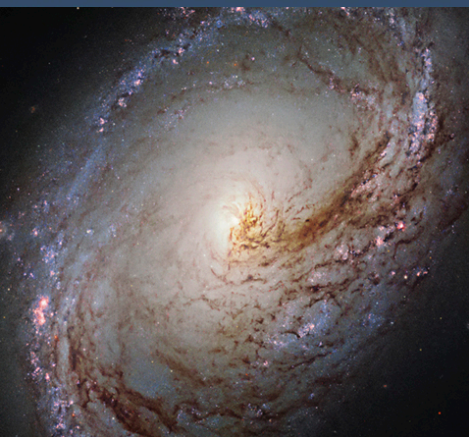
Looking for a few good astrophysicists....

- Seeking one or more experienced scientists
 - to take leave from their U.S. home institution
 - for a 2-year visiting position (can extend up to 6 years)
 - to work in Astrophysics at NASA Headquarters
- Duties include:
 - Management of the Astrophysics grants programs
 - Planning, development, and management of NASA missions
 - Strategic planning for the future of NASA astrophysics
- Requires Ph.D., research experience, familiarity with NASA award programs and/or missions, and the ability to communicate effectively
- For additional info, talk with any of the Astrophysics HQ staff.

Applications welcome until position is filled

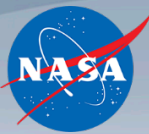
https://jobregister.aas.org/job_view?JobID=51984

Astrophysics

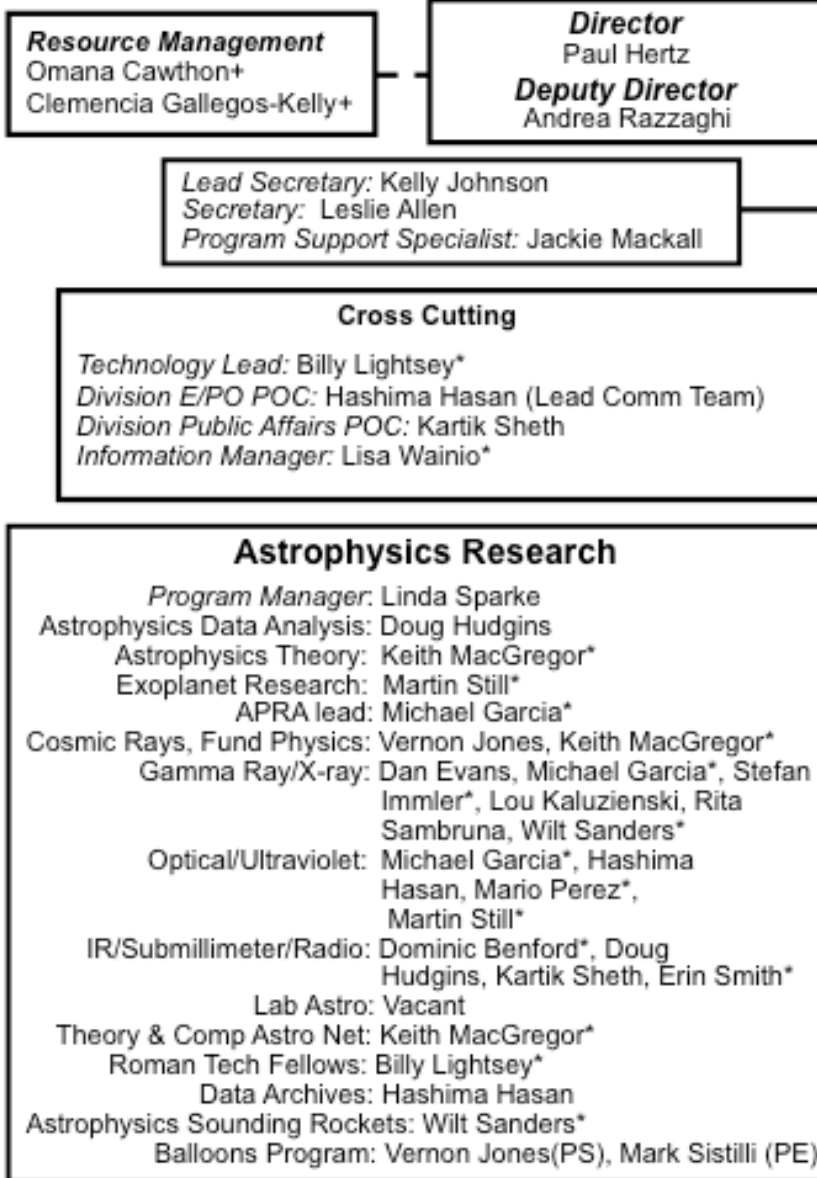


BACKUP

Astrophysics Division - SMD



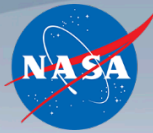
December 3, 2015



Programs / Missions		
	<u>Program Scientist</u>	<u>Program Executive</u>
Exoplanet Exploration (EXEP)		
Program	Doug Hudgins	John Gagosian
Keck	Hashima Hasan	Mario Perez*
Kepler/K2	Mario Perez*	Jeff Hayes
LBTI	Hashima Hasan	Mario Perez*
NExSci	Hashima Hasan	Mario Perez*
Cosmic Origins (COR)		
Program	Mario Perez*	Shahid Habib*
Herschel	Dominic Benford*	Jeff Hayes
Hubble	Michael Garcia*	Jeff Hayes
JWST	Hashima Hasan	Ray Taylor^
SOFIA	Hashima Hasan	Shahid Habib*
Spitzer	Erin Smith*	Jeff Hayes
Physics of the Cosmos (PCOS)		
Program	Rita Sambruna	Shahid Habib*
Athena	Michael Garcia*	Jeanne Davis
Chandra	Stefan Immler*	Jeff Hayes
Euclid	Linda Sparke	Keith Chamberlin*
Fermi	Keith MacGregor*	Jeff Hayes
Planck	Rita Sambruna	Jeff Hayes
ST-7/LPF	Wilt Sanders*	Keith Chamberlin*
XMM-Newton	Stefan Immler*	Jeff Hayes
Astrophysics Explorers (APEX)		
Program	Wilt Sanders*	Mark Sistilli
ASTRO-H	Lou Kaluzienski	Jeanne Davis
NICER	Rita Sambruna	Jeanne Davis
NuSTAR	Lou Kaluzienski	Jeff Hayes
Suzaku	Stefan Immler*	Jeff Hayes
Swift	Martin Still*	Jeff Hayes
TESS	Doug Hudgins	Mark Sistilli
WFIRST-AFTA	Dominic Benford*	John Gagosian

+ Member of the Resources Mgmt Division
 * Detailee, IPA, or contractor
 ^ JWST is part of the JWST Program Office.

Proposal Selections in 2015



Status: January 1, 2016

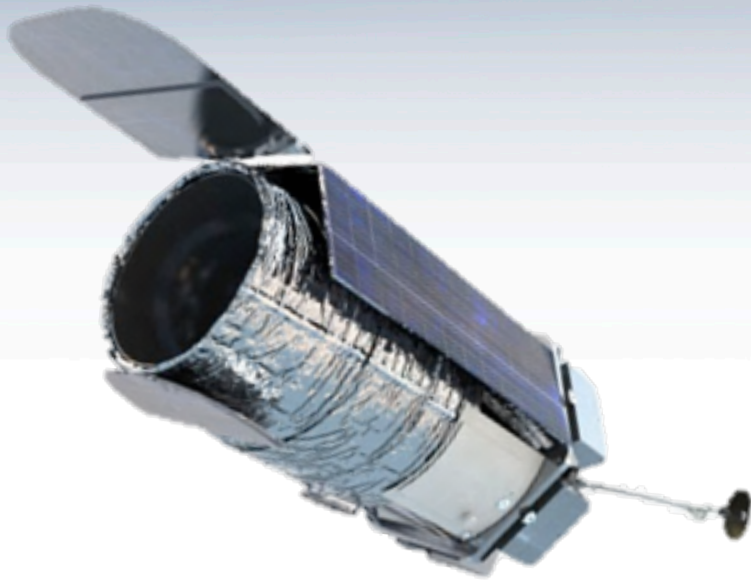
	Proposal Due Date	Notify Date	Days past received	Number received	Number selected	% selected
Kepler K2 GO – Cycle 1	Sep 23, 2014	Jan 16, 2015	115	92	36	39%
Swift GI – Cycle 11	Sep 25, 2014	Jan 6, 2015	123	165	39	24%
Roman Tech Fellows	Nov 6, 2014	Feb 3, 2015	89	8	3	38%
NuSTAR GO – Cycle 1	Nov 25, 2014	Apr 17, 2015	143	193	35	18%
Fermi GI – Cycle 8	Jan 22, 2015	June 26, 2015	155	190	36	19%
NESSF-15	Feb 6, 2015	June 2, 2015	116	134	10	7%
Kepler K2 GO – Cycle 2	Feb 27, 2015	June 12, 2015	105	76	35	46%
Chandra GO – Cycle 17	Mar 17, 2015	July 17, 2015	122	582	175	30%
APRA (Basic Research)	Mar 20, 2015	Aug 12, 2015	145	149	40	27%
SAT (Technology)	Mar 20, 2015	Aug 12, 2015	145	28	9	32%
Hubble GO – Cycle 23	Apr 10, 2015	June 24, 2015	75	1114	261	23%
EPDS (Doppler Spectr)	Apr 24, 2015	July 2, 2015	69	6	2	33%
ADAP (Data Analysis)	May 15, 2015	Sep 29, 2015	137	250	51	20%
Exoplanet Research	May 22, 2015	Oct 15, 2015	146	43	7	16%
Kepler K2 GO – Cycle 3	Jul 1, 2015	Oct 14, 2015	105	72	32	44%
SOFIA GI – Cycle 4	Jul 10, 2015	Oct 22, 2015	104	155	82	53%
Spitzer GO – Cycle 12	Sep 11, 2015	Oct 26, 2015	45	104	31	30%
SOFIA 3 rd Gen Instrument	Oct 7, 2015	Dec 10, 2015	64	3	2	67%
WFIRST Sci. Inv. Teams	Oct 15, 2015	Dec 18, 2015	64	38	12	32%
Swift GI – Cycle 12	Sep 25, 2015					
Roman Tech Fellows	Nov 6, 2015					
NuSTAR GO – Cycle 2	Dec 11, 2015					

**100% of 2015
selections announced
within 155 days**

**R&A Selection Rate: 23%
GO Selection Rate: 28%**

WFIRST – AFTA

Wide-Field Infrared Survey Telescope with Astrophysics Focused Telescope Assets



Wide-Field Infrared Survey Telescope

Top priority of 2010 Decadal Survey

Science themes: Dark Energy, Exoplanets, Large Area Near Infrared Surveys

Mission: 2.4m widefield telescope at L2; using existing hardware, images 0.28deg^2 at $0.8\text{-}2\mu\text{m}$

Instruments (design reference mission): Wide Field Instrument (camera plus IFU), Coronagraph Instrument (imaging/IFS)

Phase: Currently in pre-formulation

CURRENT STATUS:

- Completed Mission Concept Review (MCR) held in December 2015
- Formulation Science Investigation Teams Selected
- Planning for Key Decision Point A (KDP-A) in Feb 2016
 - Official start of formulation phase
 - Supported by FY16 appropriations
- Industry RFI released July 2015; call for industry studies anticipated soon.
- Other activities include:
 - Technology development for detectors and coronagraph (with STMD); prototyping key parts
 - Assessment of telescopes + risk mitigation
 - Mission design trades; performance simulations
- Maturing key technologies by FY19.
 - H4RG infrared detectors for widefield imager.
 - Internal coronagraph for exoplanet characterization.
 - Milestones on road to achieve TRL-5 by end of CY16, TRL-6 by end of CY18; reports made public.

WFIRST starts Formulation in February 2016