National Aeronautics and Space Administration

Astrophysics



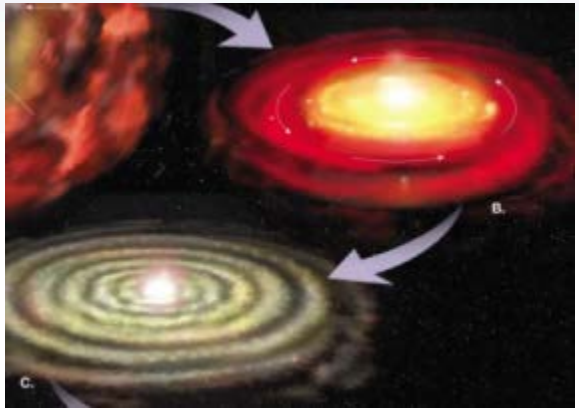

Astronomy and Astrophysics Advisory Committee
NASA Goddard Space Flight Center
January 28, 2016

Paul Hertz
Director, Astrophysics Division
Science Mission Directorate
@PHertzNASA

Why Astrophysics?

Astrophysics is humankind's scientific endeavor to understand the universe and our place in it.

1. How did our universe begin and evolve?

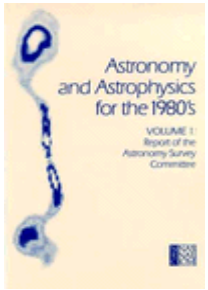


2. How did galaxies, stars, and planets come to be?

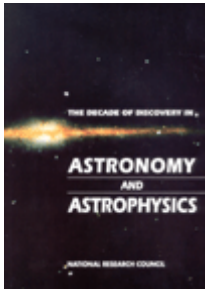
3. Are We Alone?

These national strategic drivers are enduring

1972



1982

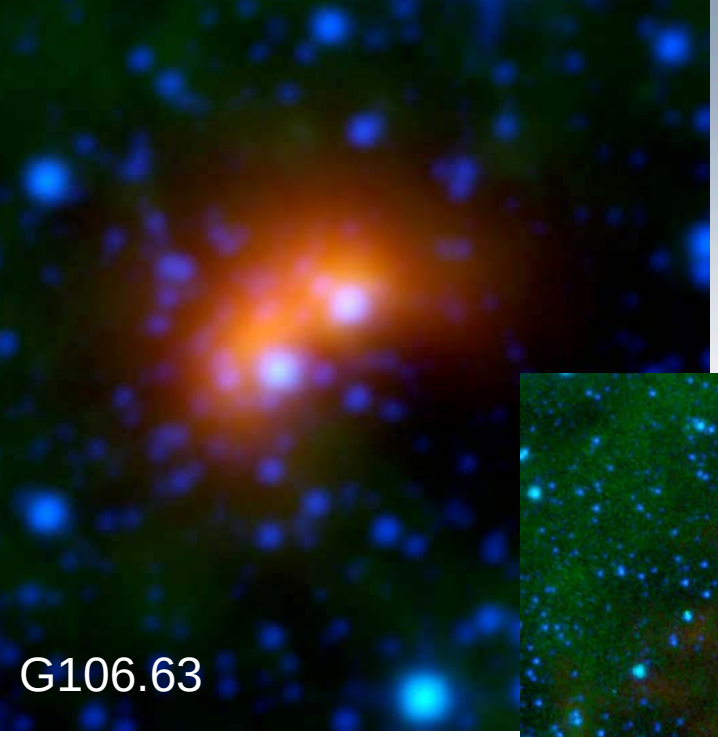


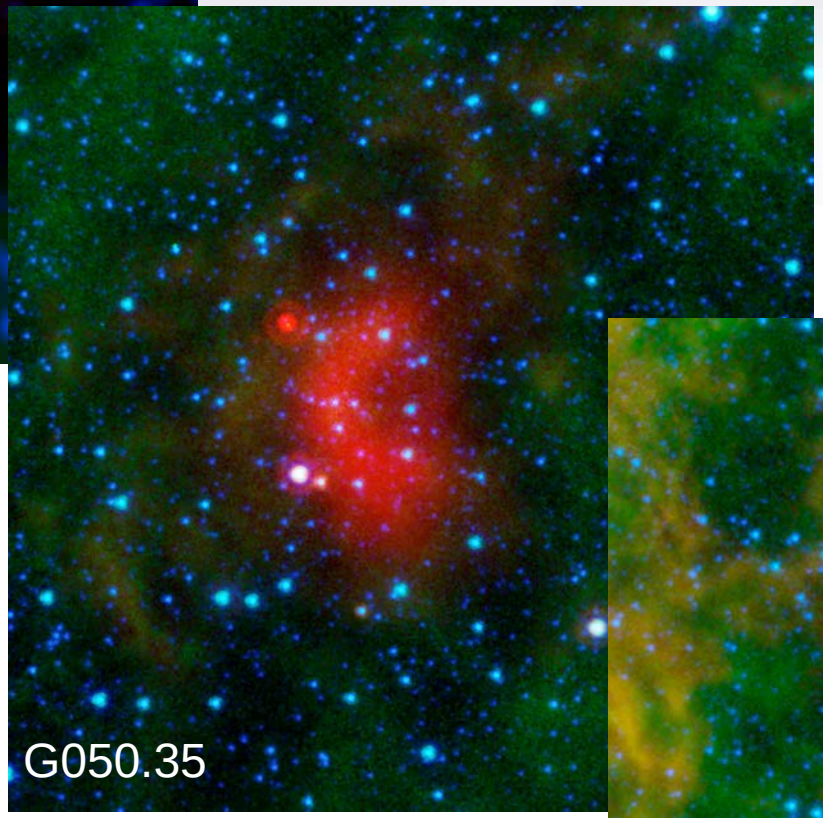
1991

2001

2010

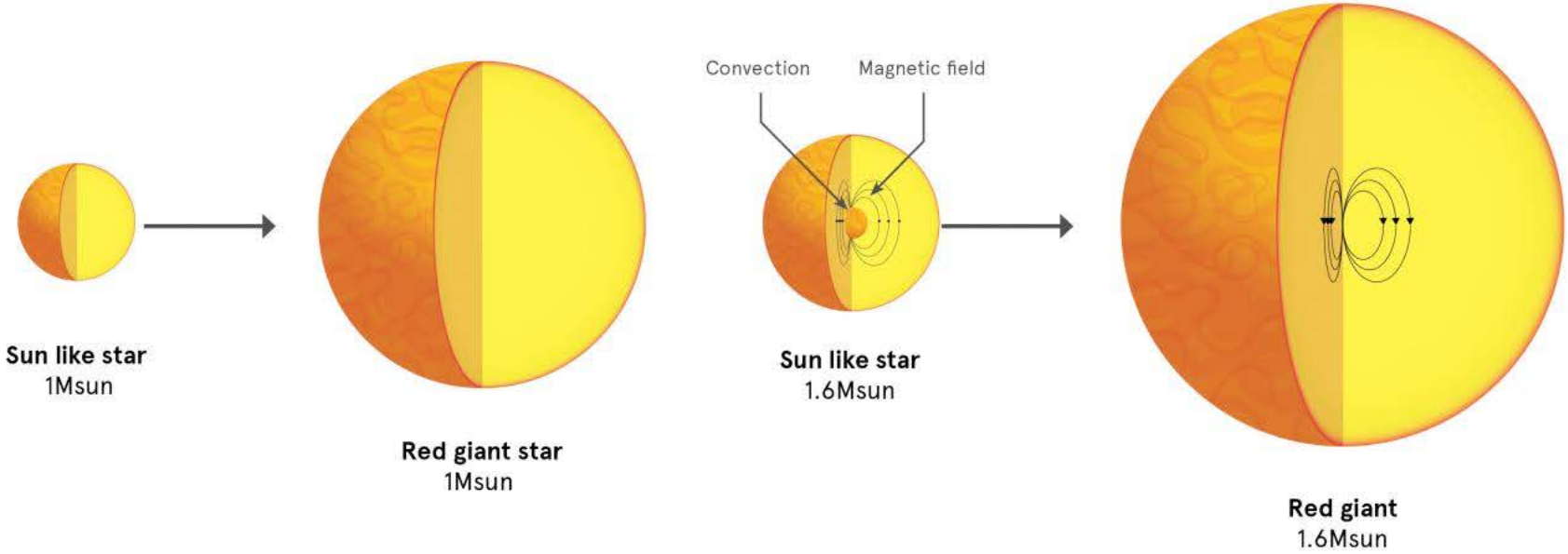
Bow Shocks in Space



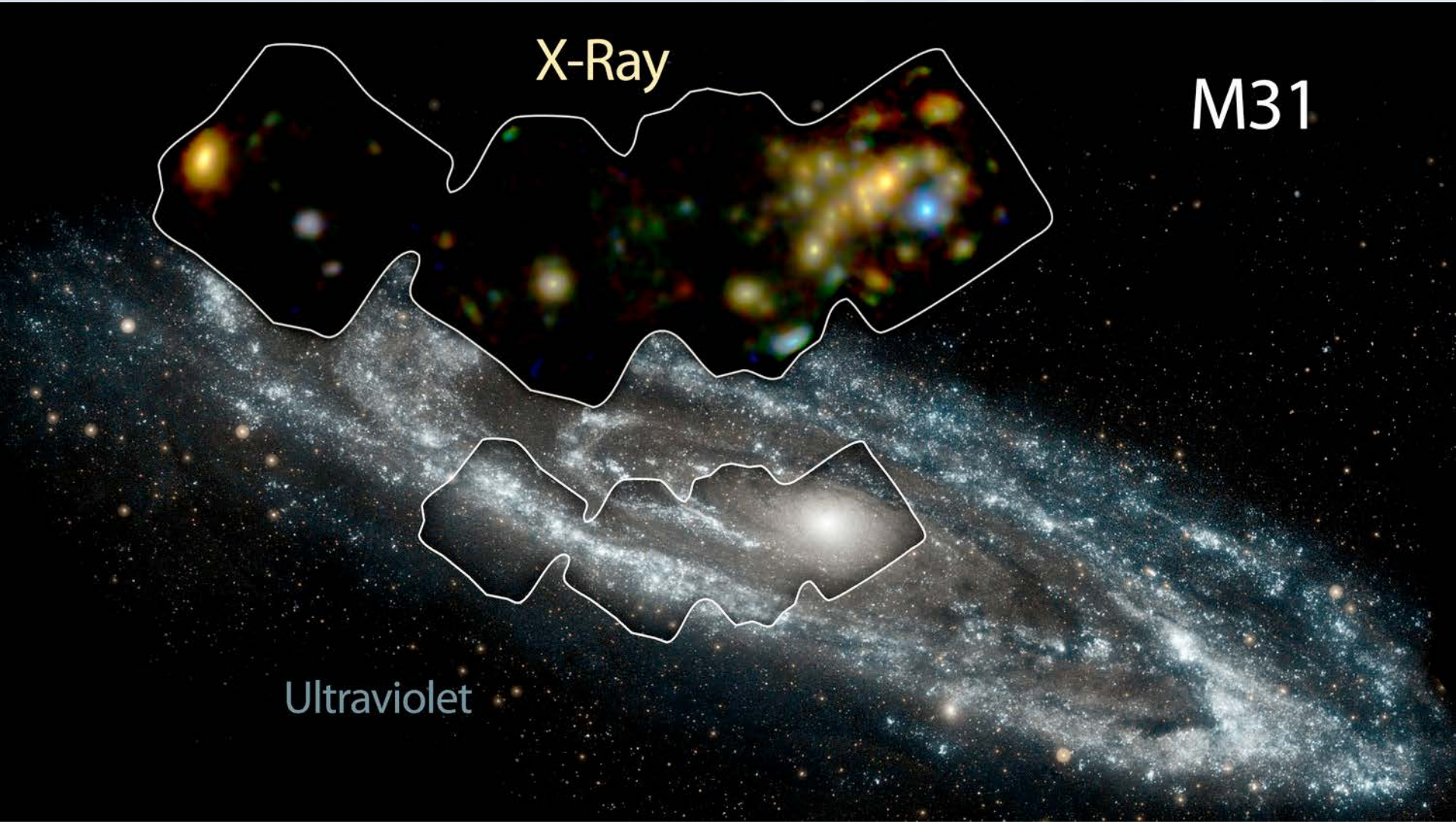


Strong Magnetic Fields Discovered in Majority of Stars

Convective core dynamo

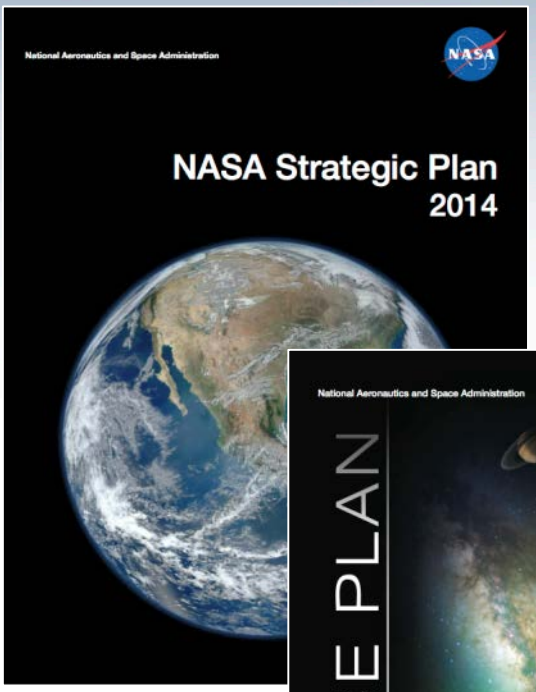


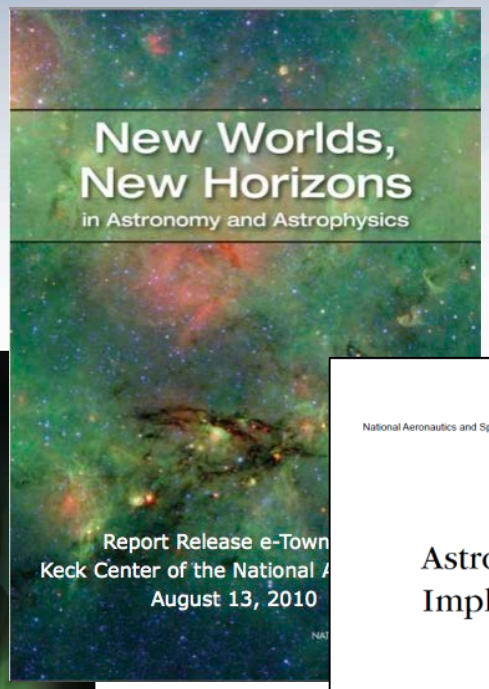
Andromeda Galaxy Scanned with High-Energy X-ray Vision

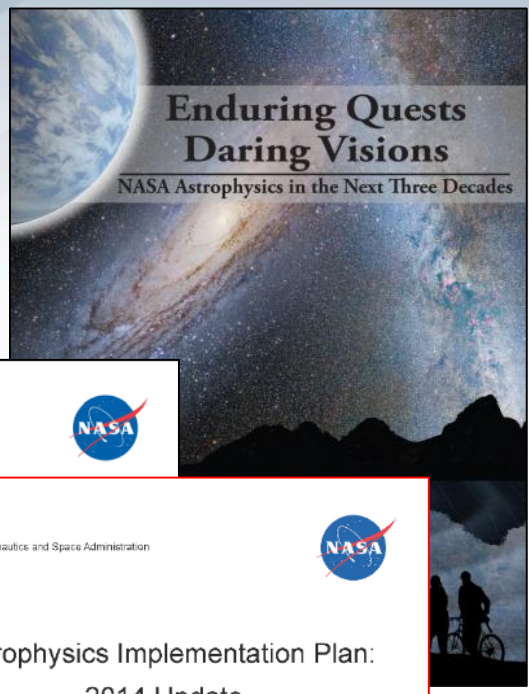


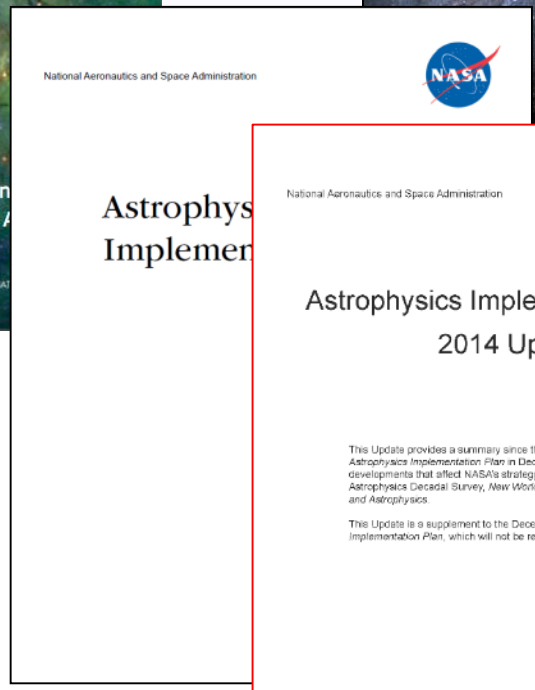
Credit: NASA/JPL-Caltech/GSFC

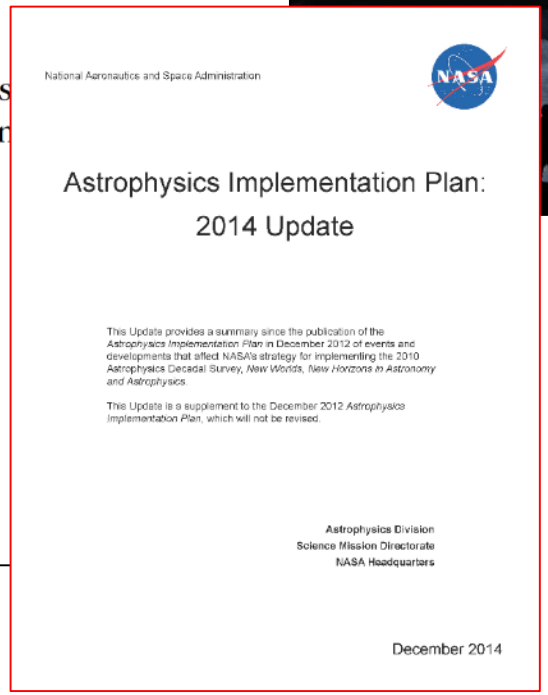
Astrophysics Driving Documents











http://science.nasa.gov/astrophysics/documents

Progress Toward Decadal Survey Priorities

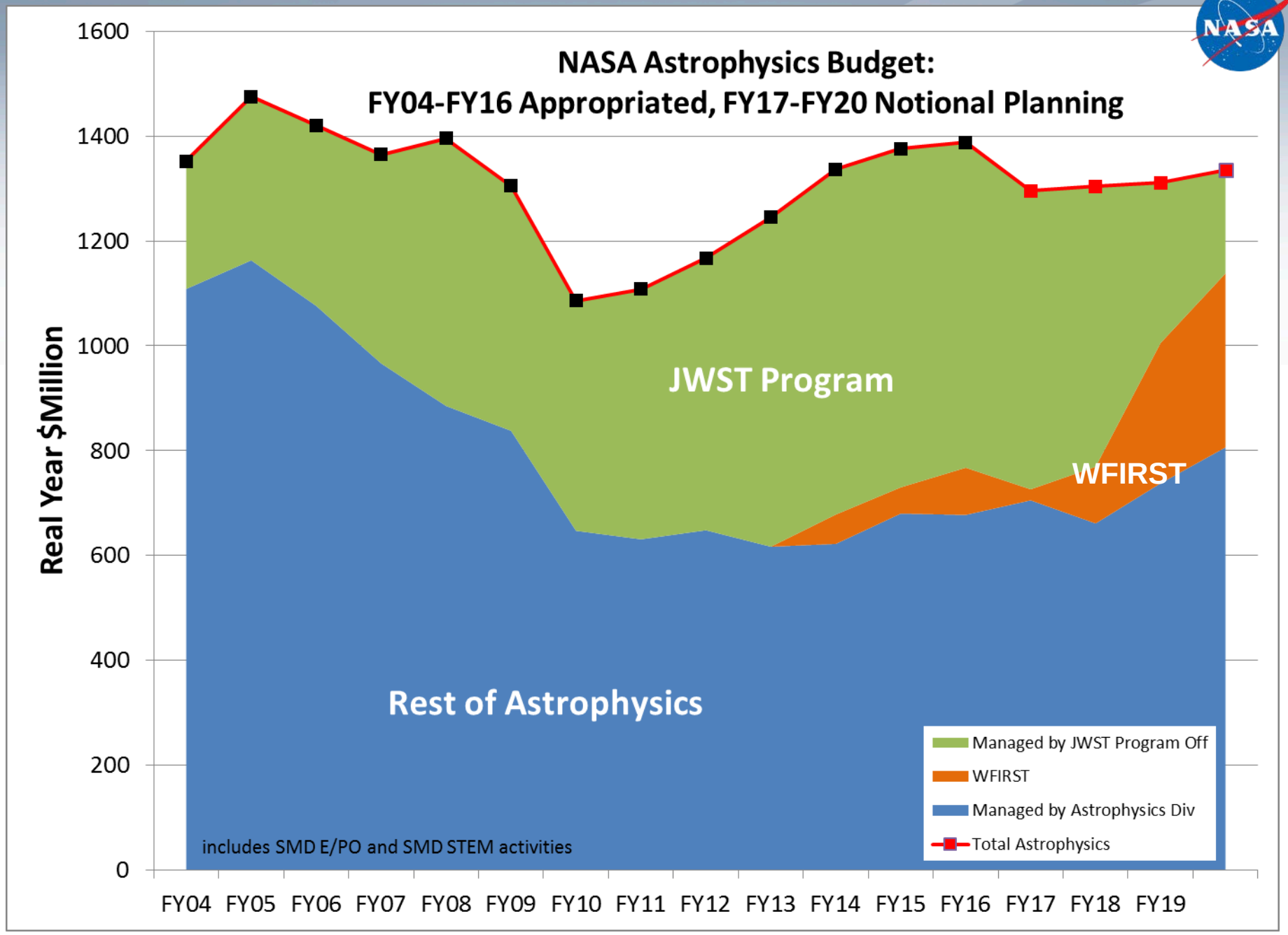
The NASA FY16 Appropriation and the notional out year budget planning guidance in the President's FY16 Budget Request support:	
Complete JWST	JWST remains within budget guidelines and on track for an October 2018 launch.
Large-scale 1. WFIRST	2 years of preformulation and focused technology development for WFIRST-AFTA (a 2.4m version of WFIRST with a coronagraph) are complete. Formulation (new start) planned to begin February 2016.
Large-scale 2. 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.
Large-scale 3. LISA	Planning partnership on ESA's L3 gravitational wave observatory and participating in ESA-led assessments in 2014-2015. Strategic astrophysics technology investments plus support of LISA Pathfinder.
Large-scale 4. IXO	Planning a partnership on ESA's L2 Athena X-ray observatory; the Athena study phase, with U.S. participation, is underway. Strategic astrophysics technology investments.
Medium-scale 1. New Worlds Technology Development Program	Focused technology development for coronagraph on WFIRST, strategic astrophysics technology investments, exoplanet probe mission concept studies. Partnership with NSF to develop precision Doppler spectrometer as facility instrument. Exozodi survey using LBTI.

Progress Toward Decadal Survey Priorities

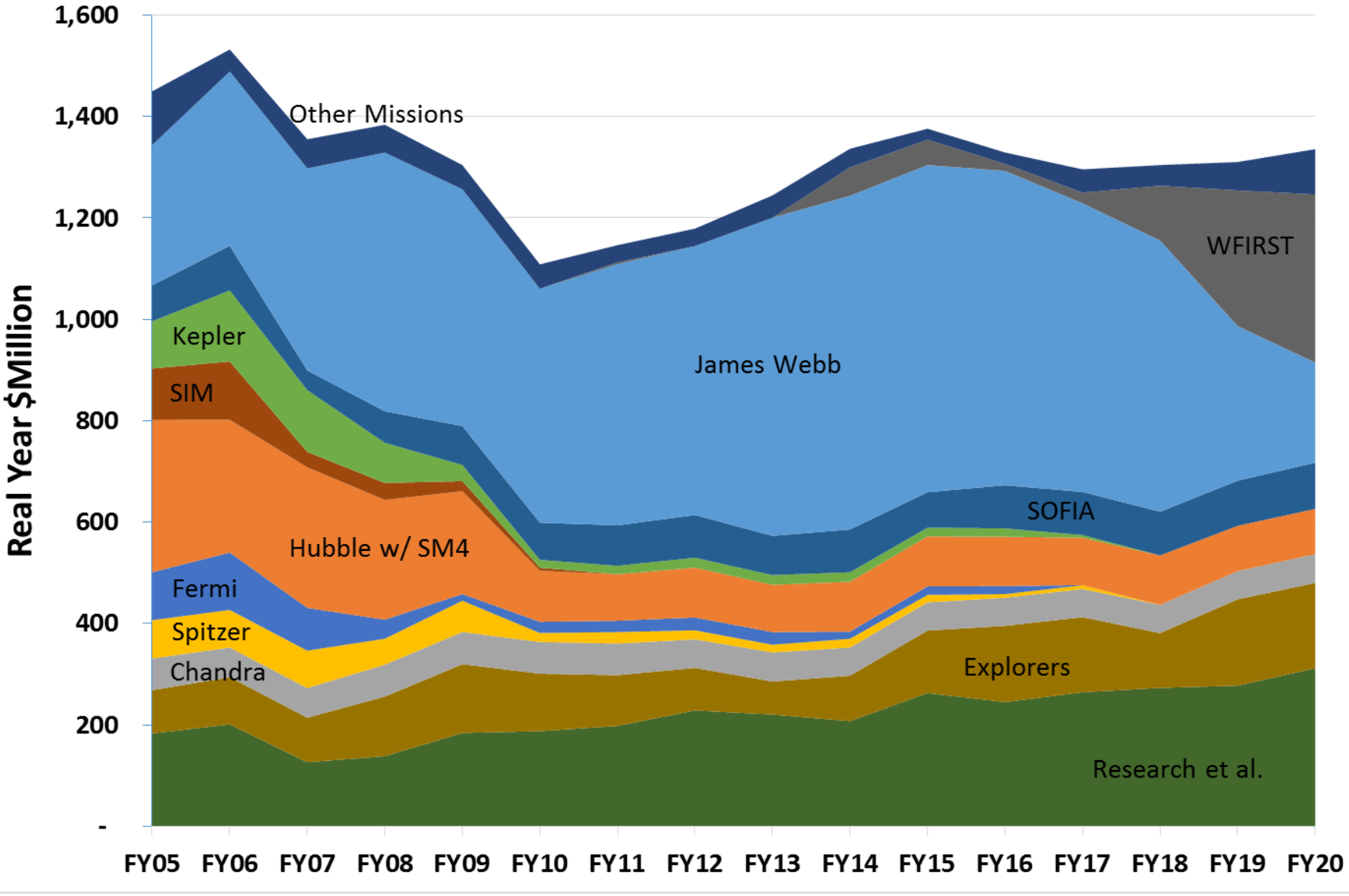
The NASA FY16 Appropriation and the notional out year budget planning guidance in the President's FY16 Budget Request support:	
Medium-scale 2. Inflation Probe Technology Development	Balloon-borne investigations plus strategic astrophysics technology investments. Studying partnership on JAXA's LiteBIRD.
Small-scale. Research Program Augmentations	Increased annual R&A budget by 10% from FY10 to FY12 and another 10% from FY14 to FY16. Within R&A: established Theoretical and Computational Astrophysics Networks program with NSF; funding available for astrophysics theory; funding available for lab astrophysics; funding available for suborbital payloads.
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 detectors).
Small-scale. Future Ultraviolet-Visible Space Capability	Strategic Astrophysics Technology and Astrophysics R&A investments; mission concept studies.
Small-scale. SPICA (U.S. contribution to JAXA-led)	Not supported as a strategic contribution; candidate for Explorer Mission of Opportunity.

Astrophysics - Big Picture

- **The FY16 appropriation provides funding for NASA astrophysics to continue its programs, missions, projects, and supporting research and technology.**
  - The total funding (Astrophysics including JWST) remains at ~$1.3B.
  - Fully funds JWST to remain on plan for an October 2018 launch.
  - Funds new start for WFIRST, start of formulation planned for February 2016.
  - Will require some adjustments to FY16 plans in response to appropriation levels.
- **The operating missions continue to generate important and compelling science results, and new missions are under development for the future.**
  - Chandra, Fermi, Hubble, Kepler/K2, NuSTAR, Spitzer, Swift, ESA's XMM-Newton all operating well; Senior Review is in Spring 2016 for FY17 and beyond.
  - SOFIA is in 5-year prime operations as of May 2014; HAWC+ 2nd generation instrument to begin commissioning in Spring 2016; 3rd generation instrument concept studies selected; Senior Review for SOFIA is in Spring 2018.
  - ESA's LISA Pathfinder successfully launched on December 3, 2015.
  - Missions on track for launch include JAXA's ASTRO-H (2016), NICER (2016), ISS-CREAM (2017), TESS (2017), JWST (2018), ESA's Euclid (2020).
  - WFIRST starting formulation in 2016; 5 SMEX and Mission of Opportunity concept studies selected in 2015 and MIDEX AO in 2016; NASA joining ESA's Athena X-ray observatory and ESA's L3 gravitational wave observatory.
- **Progress being made toward recommendations of the 2010 Decadal Survey.**
  - Update to the Astrophysics Implementation Plan released in December 2014.
  - NRC Mid Decade Review (with NSF, DOE) underway; Jackie Hewitt (MIT) is chair; NASA briefing at October 2015 meeting; NRC committee report expected in May 2016.
  - NASA initiating large mission concept studies as input for 2020 Decadal Survey.


NASA Astrophysics Budget:
FY04-FY16 Appropriated, FY17-FY20 Notional Planning
Real Year $Million
1600
1400
1200
1000
800
600
400
200
0
JWST Program
WFIRST
Rest of Astrophysics
includes SMD E/PO and SMD STEM activities
Managed by JWST Program Off
WFIRST
Managed by Astrophysics Div
Total Astrophysics
FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18 FY19

Astrophysics Budget by Project
FY05-FY14 Actual, FY15 Op Plan, FY16-FY20 Request



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.**

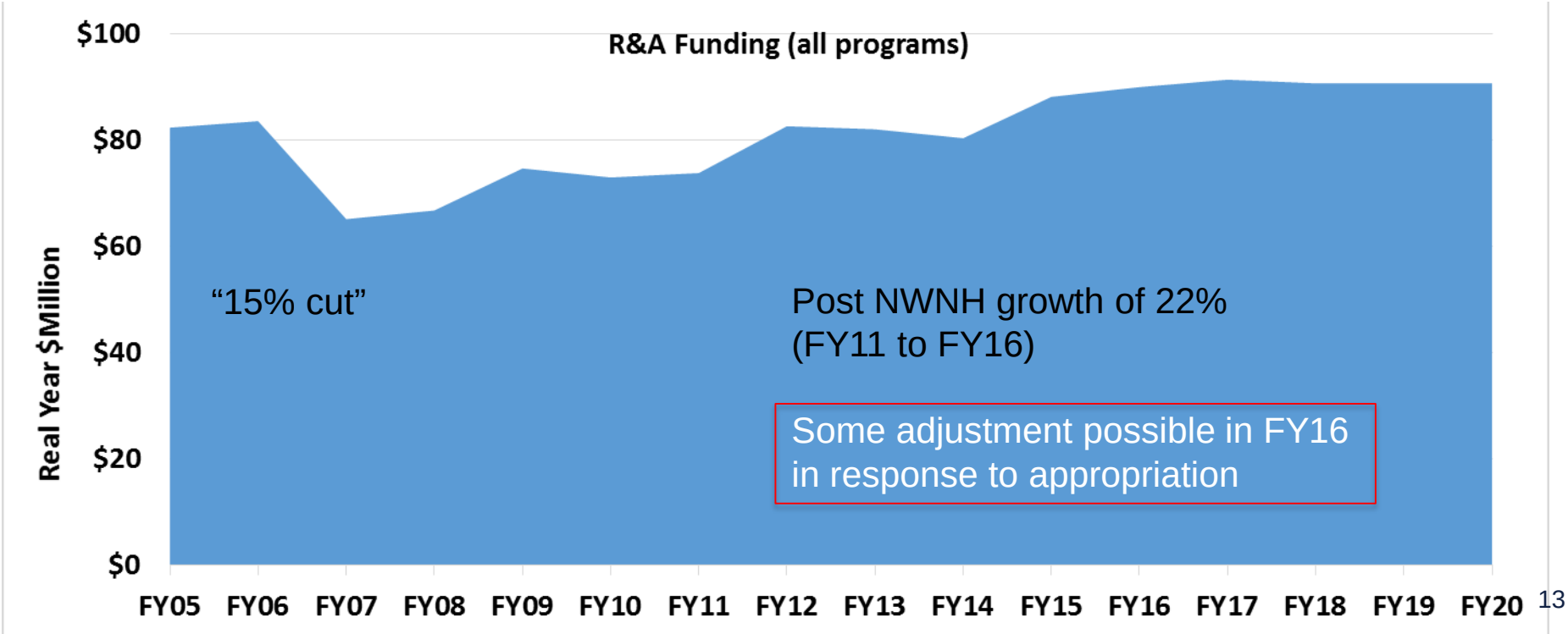
- Provides $90M for WFIRST and directs NASA to start Formulation.
- Provides full funding ($85M) for SOFIA operations and places SOFIA into the 2018 Astrophysics Senior Review.
- Provides full funding ($98M) for continued Hubble operations.
- Provides $37M for SMD STEM education activities.
- Requires 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 Astrophys*	$493	$457	-$36 (-7%)
Total	$1309	$1351	+$42

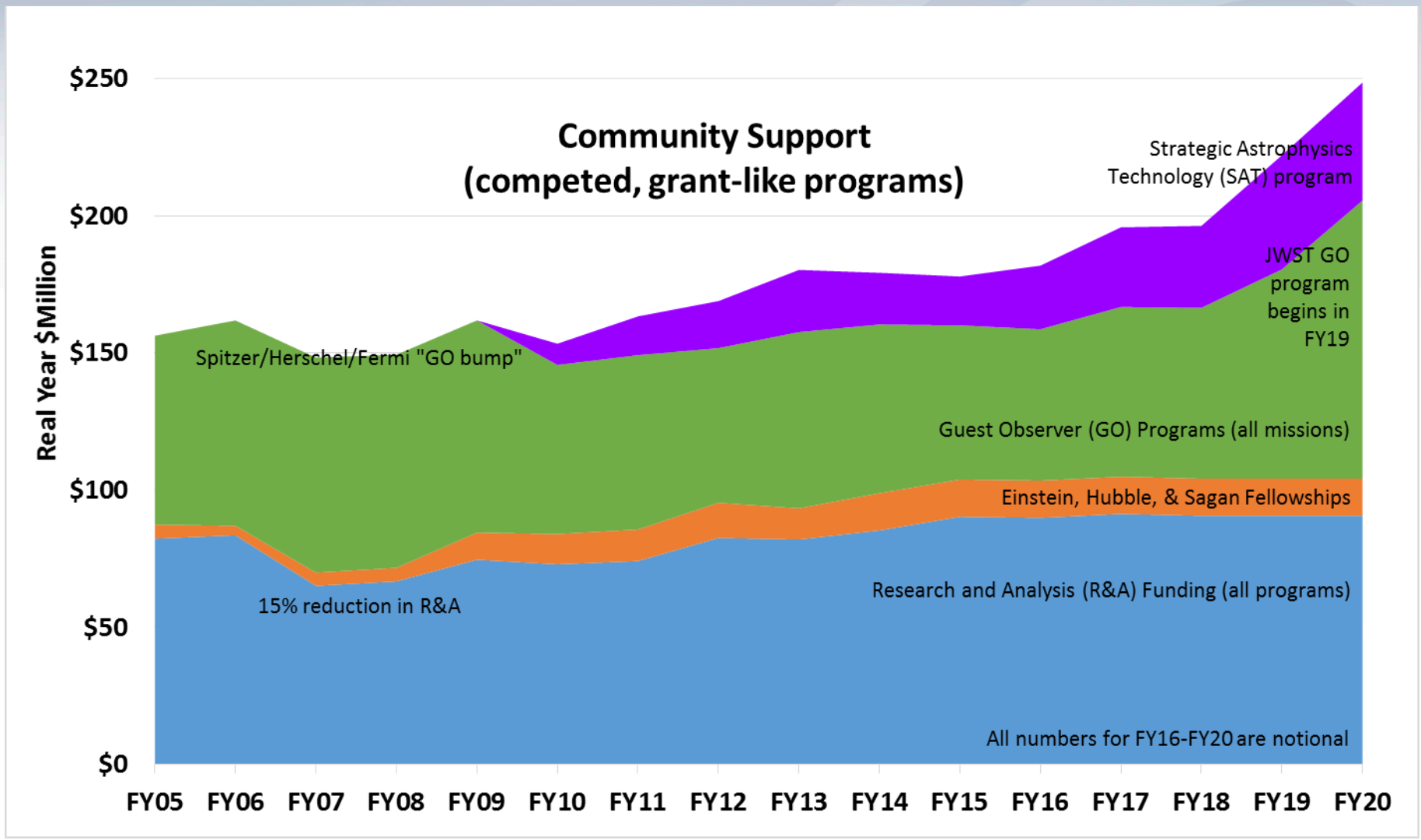
* Excludes "SMD STEM Activities."

R&A Funding continues to Grow

- 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



Core Research



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 3rd 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	Dec 30, 2015	106	165	39	24%
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NuSTAR GO – Cycle 2	Dec 11, 2015					

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Chandra GO –			17		75	30%
APRA (Basic R			12		40	27%
SAT (Technolo			12		9	32%
Hubble GO – C			e 24		61	23%
EPDS (Doppler			y 2,		2	33%
ADAP (Data Analysis)	May 15, 2015	Sep 29, 2015	137	250	51	20%
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NuSTAR GO – Cycle 2	Dec 11, 2015					

100% of 2015 selections announced within 155 days

R&A Selection Rate: 24%
GO Selection Rate: 28%

Proposal Opportunities Expected in 2016

ROSES research opportunities

- APRA/SAT, Exoplanet Research in March
- ADAP in May
- Astrophysics Theory in July
- Habitable Worlds in November

ROSES Guest Observer/Guest Investigator opportunities

- Fermi GI Cycle 10 in January
- Kepler K2 GO Cycle 4 in February
- ASTRO-H GO Cycle 1 in July
- Swift GI Cycle 13 in September
- Kepler K2 GO Cycle 5 in October
- NuSTAR GO Cycle 3 in January 2017

Other Astrophysics Guest Observer opportunities

- Chandra Cycle 18 in March
- Hubble Cycle 23 in April
- SOFIA Cycle 5 and Spitzer Cycle 13 in June
- XMM-Newton in October

Explorer MIDEX proposals: target date in late summer 2016

Astrophysics in 2016




Astrophysics Missions in Development

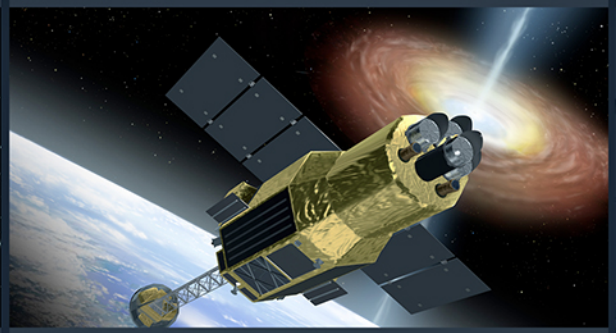
LISA Pathfinder
12/2015

ESA-led Mission

NASA supplied the ST7/Disturbance Reduction System (DRS)

ASTRO-H
02/2016

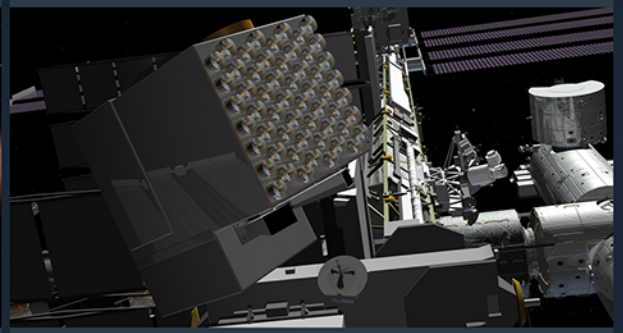
JAXA-led Mission



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

NICER
8/2016

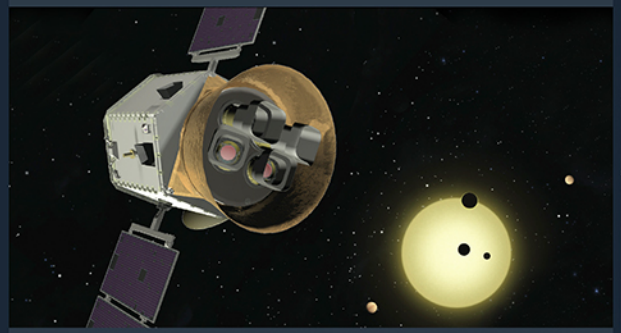
NASA Mission



Neutron Star Interior Composition Explorer

TESS
8/2017

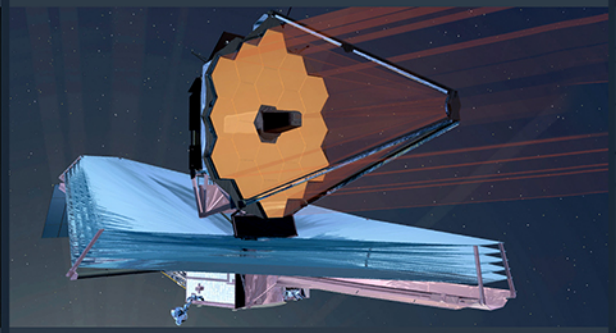
NASA Mission



Transiting Exoplanet Survey Satellite

JWST
10/2018

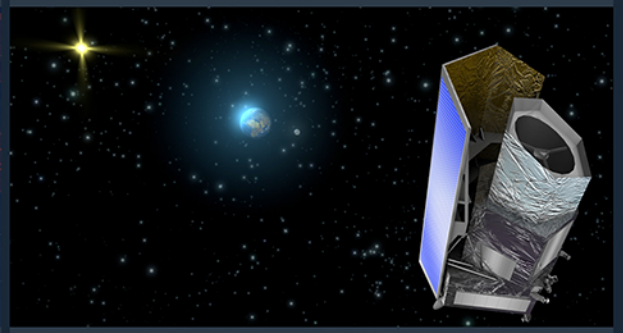
NASA Mission



James Webb Space Telescope

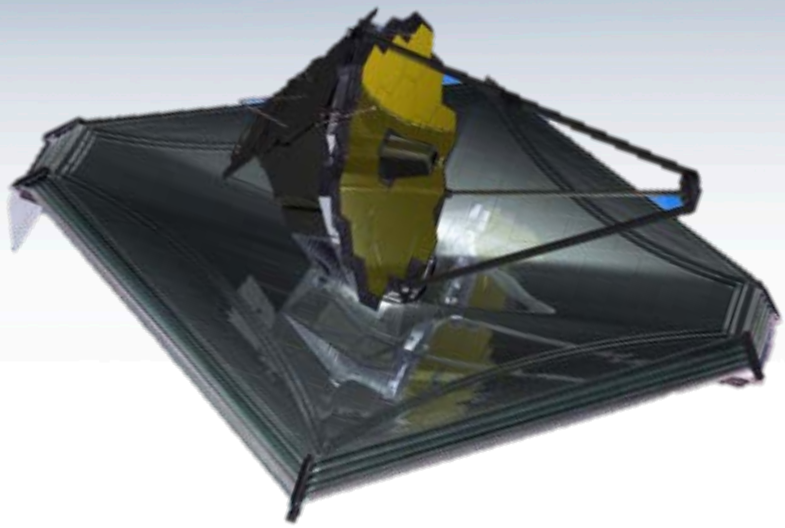
Euclid
2020

ESA-led Mission



NASA is supplying the NISP Sensor Chip System (SCS)

JWST
James Webb Space Telescope



Large Infrared Space Observatory

Top priority of 2000 Decadal Survey

Science themes: First Light; Assembly of Galaxies; Birth of Stars and Planetary Systems; Planetary Systems and the Origins of Life

Mission: 6.5m deployable, segmented telescope at L2, passively cooled to <50K behind a large, deployable sunshield

Instruments: Near IR Camera, Near IR Spectrograph, Mid IR Instrument, Near IR Imager and Slitless Spectrograph

Operations: 2018 launch for a 5-year prime mission

Partners: ESA, CSA

2015 Accomplishments

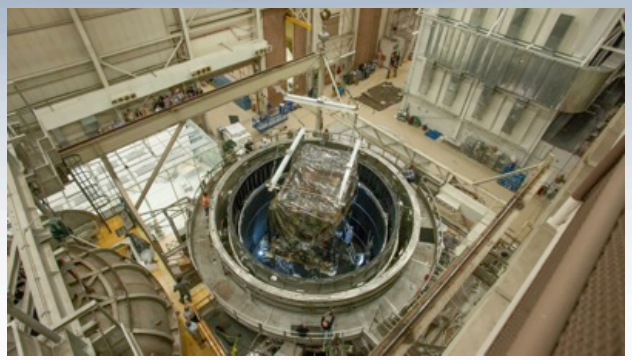
- Completed Telescope Structure
- Completed second Telescope Pathfinder test at JSC
- All updates/fixes made to ISIM following 2nd cryovacuum test
- Spacecraft Bus Structure delivered to I&T
- Final ISIM cryovacuum test started
- Mirror installation onto Telescope Structure started

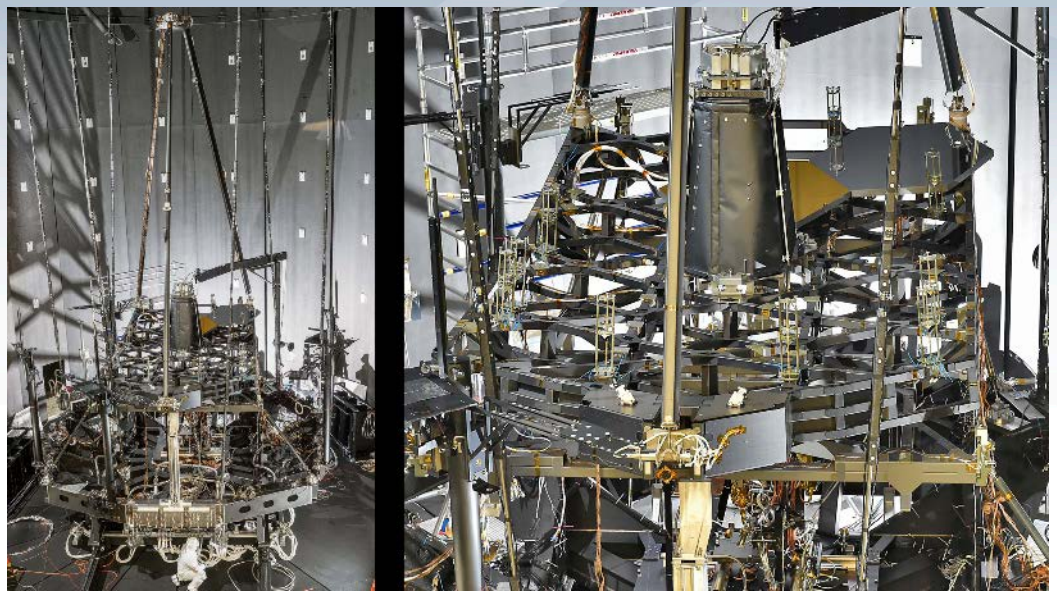
2016 Plans

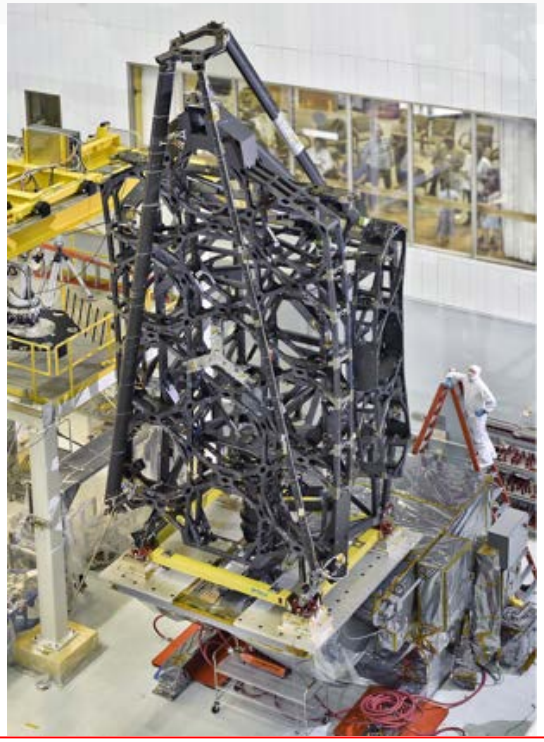
- Complete ISIM cryovacuum testing
- Complete mirror installation
- Install ISIM into Telescope Structure
- Complete Flight Sunshield Membranes
- Conduct final GSE test at JSC before test of Flight telescope and instruments

http://www.jwst.nasa.gov/

JWST Hardware Progress





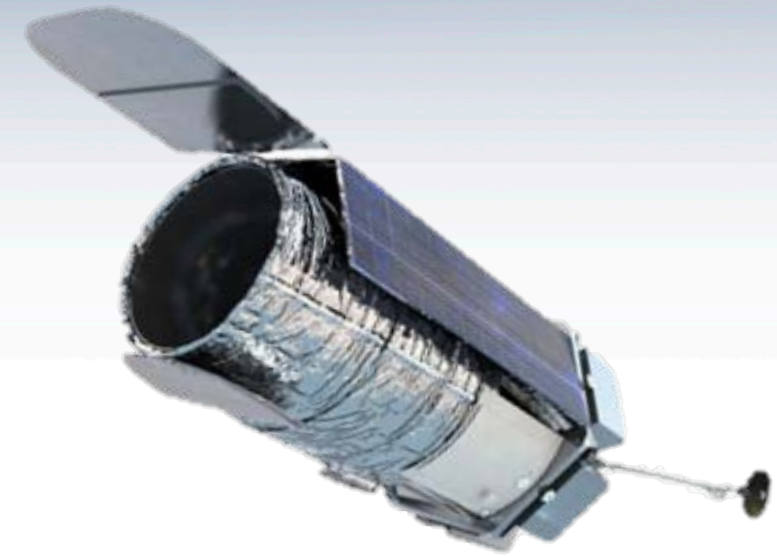


JWST remains on track for an October 2018 launch within its replan budget guidelines

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

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 0.8-2μm

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 in December 2015
- 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; RFP for industry studies released in January 2016
- 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

http://wfirst.gsfc.nasa.gov/

WFIRST – AFTA

Wide-Field Infrared Survey Telescope with Astrophysics Focused Telescope Assets

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 Adjutant Scientist
Jason Kalirai	STScI	Resolving the Milky Way with WFIRST	GI/GO
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 Adjutant Scientist
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

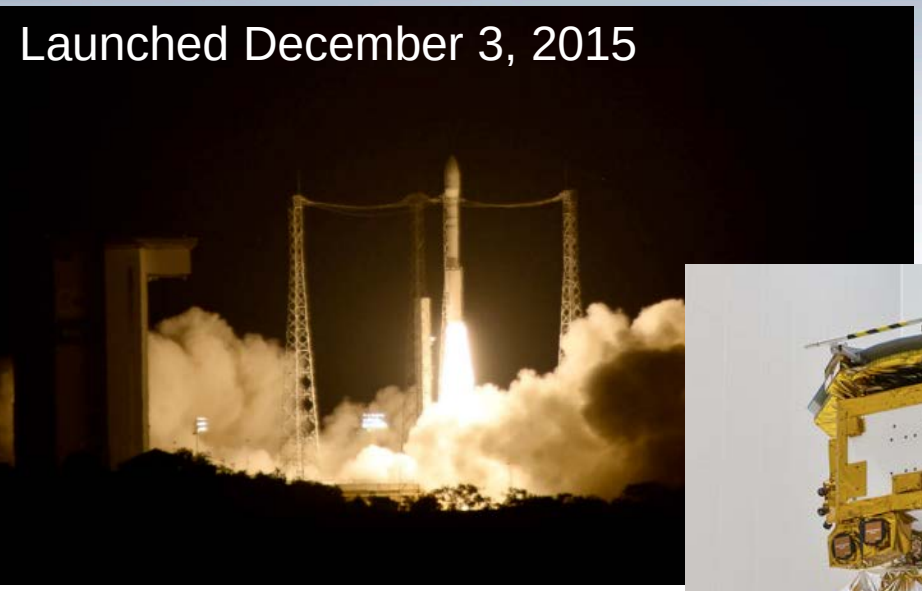
WFIRST – AFTA

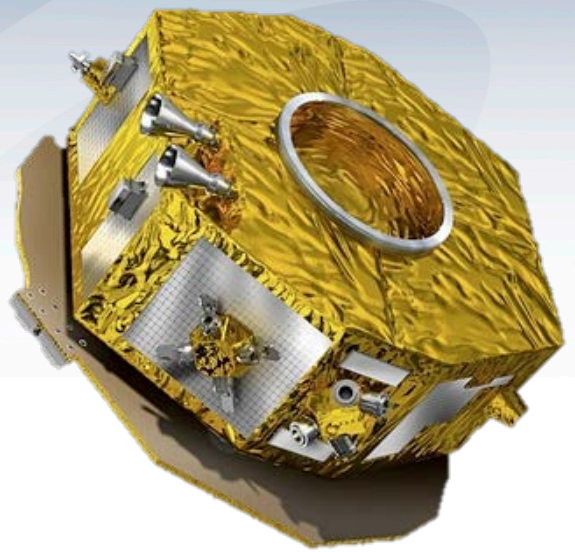
Wide-Field Infrared Survey Telescope with Astrophysics Focused Telescope Assets

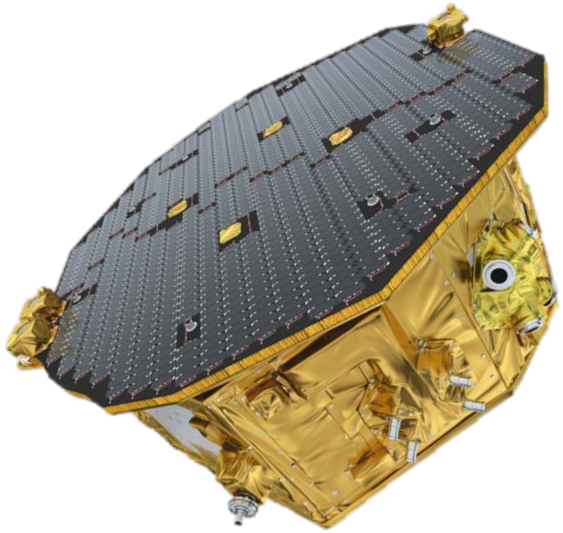
Coronagraph Technology Milestones		
1	Shaped Pupil mask fabricated with reflectivity of 10^{-4} and 20 μm pixel size.	7/21/14 ✓
2	Shaped Pupil Coronagraph demos 10^{-8} raw contrast with narrowband light.	9/30/14 ✓
3	PIAACMC mask fabricated with 10^{-8} raw contrast with 10% broadband light.	12/15/14 ✓
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

LISA Pathfinder
ST-7/Disturbance Reduction System (DRS)







Dec 3 Launch
Dec 11 On way to L1
Feb 17 Release test masses
Mar 4 Commissioning
June/July DRS ops

https://lisapathfinder.org/

NASA's L3 Study

- NASA intends to partner with ESA on the ESA-led Large 3 (L3) gravitational wave mission with launch in 2034. This responds to the recommendations of the 2010 Astrophysics Decadal for a space-based gravitational wave observatory.
- Following the successful launch of the LISA Path Finder, NASA is forming an L3 Study Team (L3ST) drawing membership from members of the US astrophysics community.
- The goals of the L3ST are:
  1. Analyze the options for NASA participation in the L3 mission and work with the European L3 consortium on proposals to ESA; and
  2. Prepare a report to the 2020 Decadal Survey on NASA's participation, including possible options, in the L3 mission as a minority partner.
- Dear Colleague Letter on December 7, 2015; applications due December 21, 2015; members to be announced NLT January 31, 2016.
- The L3ST Charter, a list of FAQs, and list of selected members (after January 15) can be found at **http://pcos.gsfc.nasa.gov/studies**.

ASTRO-H
Soft X-ray Spectrometer and Soft X-ray Telescope Mirrors

CURRENT STATUS

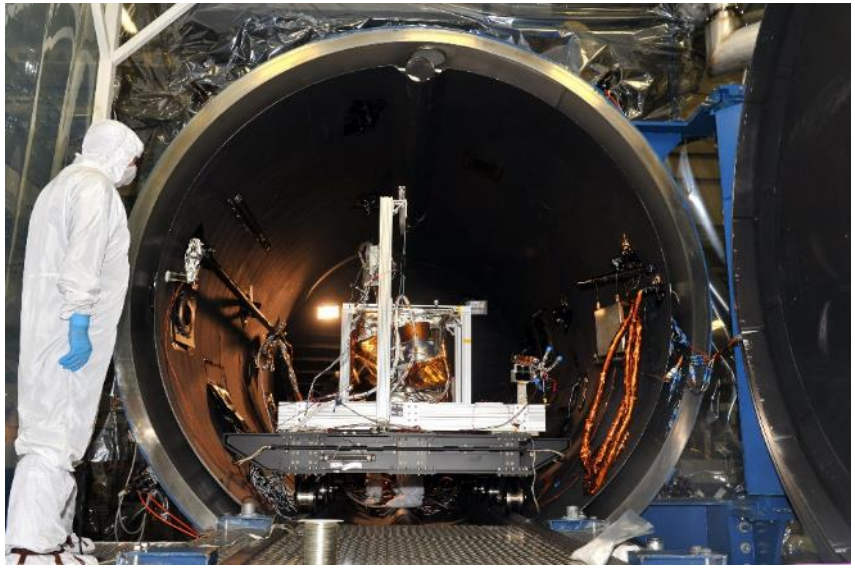
- All U.S. hardware integrated onto the spacecraft.
- Spacecraft-level environmental testing completed
- Spacecraft arrived at launch site on December 6
- Spacecraft undergoing final preparations and check-out at Tanegashima launch site

UPCOMING EVENTS:

- Launch – February 12, 2016
- Cycle 1 GO call – April 2016 (TBC)

https://heasarc.gsfc.nasa.gov/docs/astroh/

NICER
Neutron star Interior and Composition Explorer



- All subsystems/sub-assemblies have completed fabrication and environmental testing.
- The NICER project has now started final payload integration.

UPCOMING EVENTS:

- December 10-11, 2015: Pre-environmental Review
- January 28, 2016: Start Phase D
- February 2016: Start of payload environmental testing
- August 2016 (TBC): Launch on SpaceX-11 commercial resupply service (CRS) flight to ISS (Switched with CREAM)

https://heasarc.gsfc.nasa.gov/docs/nicer/

DAPS (Deployment & Pointing System) TVAC integration & testing

ISS-CREAM
Cosmic Ray Energetics and Mass for the ISS

ISS-CREAM at KSC

- August 2015: Delivered to KSC, in storage until 60 days before launch to International Space Station (ISS)
- December 2016 (TBC): Launch on SpaceX-12 commercial resupply service (CRS) flight to ISS (Switched with NICER)

2015-2016 Antarctic LDB Campaign

Gamma-Ray Imager/ Polarimeter for Solar flares (GRIPS)

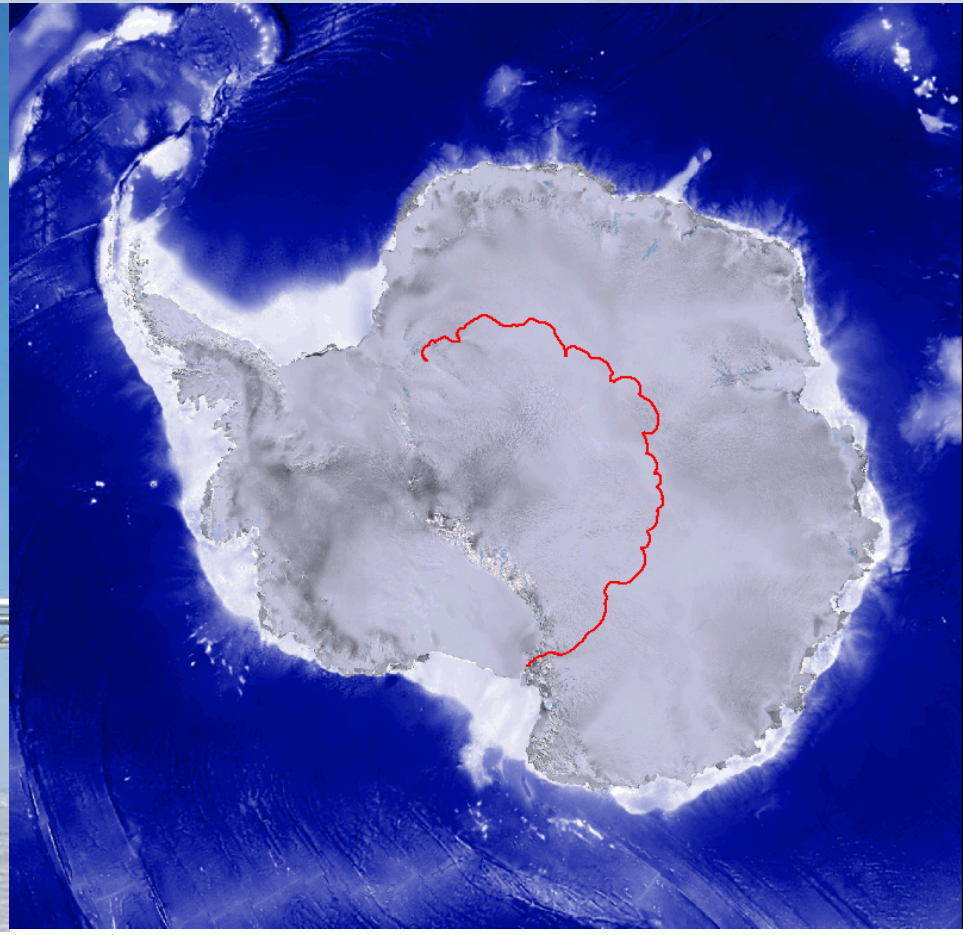
Stratospheric Terahertz Observatory (STO-II)

http://www.nsbf.nasa.gov/

http://www.csbf.nasa.gov/antarctica/ice.htm

2015-2016 Antarctic LDB Campaign

Gamma-Ray Imager/ Polarimeter for Solar flares (GRIPS)

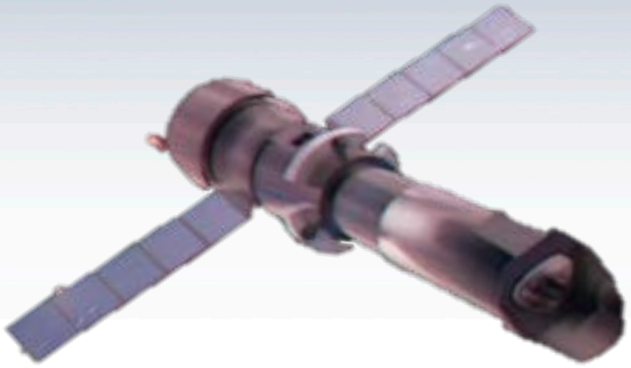


Launched January 19, 2016
Track as of January 27, 2016

http://www.nsbf.nasa.gov/
http://www.csbf.nasa.gov/antarctica/ice.htm

Athena

Advanced **T**elescope for **H**igh **En**ergy **A**strophysics



- **Second ESA Cosmic Vision Large mission**
  - L-class with NASA/JAXA participation
  - Decadal Survey recommendation
  - Large X-ray mirror, X-IFU and WFI instruments
- **Launch Date:** 2028
- **Breakthrough Technologies**:
  - High Throughput, Wide FOV, High spectral resolution X-ray Astronomy
  - 10x Chandra area, 100x improved non-dispersive spectral resolution, 5x FOV.
- **Science Objectives**: The Hot and Energetic Universe: How does ordinary matter assemble into the large scale structures that we see today? How do black holes grow and shape the Universe?

CURRENT STATUS:

- Selected as 2nd Large mission in ESA Cosmic Visions Program.
- Currently in 2 year Study Phase.
- NASA and US community involved in Study Phase via membership on ESA-chartered Athena Science Study Team and Science Working Groups.
- NASA budgeting for a $100M-$150M hardware contribution, plus a U.S. GO program and a U.S. data center.
- NASA will provide the sensor array for the X-ray Integral Field Unit (calorimeter).
- NASA and ESA are discussing other possible NASA contributions, such as:
  - A contribution to the Wide Field Imager
  - Use of the NASA XRCF for Calibration
  - Contribution to ESA science data center (U.S. node)
- NASA continues to invest in Athena technologies via SAT and directed investigations.

Explorers MIDEX and MO AO in 2016

- The target schedule for the solicitation:
  - 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.
  - Partner Mission of Opportunity endorsement need date before January 2022.
- Astrophysics Explorer Program planning budget is sufficient to select and execute one MIDEX mission and one MO.

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


Formulation
Implementation
Primary Ops
Extended Ops
XMM-Newton (ESA)
12/10/1999
Swift
11/20/2004
CREAM (on ISS)
12/2016
Euclid (ESA)
2020
Fermi
6/11/2008
JWST
2018
Spitzer
8/25/2003
ASTRO-H (JAXA)
2016
Hubble
4/24/1990
Kepler
3/7/2009
Chandra
7/23/1999
NICER (on ISS)
8/2016
NuSTAR
6/13/2012
TESS
2017
Senior Review 2016
LISA Pathfinder (ESA)
12/3/2015
SOFIA
Full Ops 2014

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/

Astrophysics

Preparing for the 2020 Decadal Survey in Astronomy and Astrophysics




ASTROPHYSICS

Decadal Survey Missions

Preparing for the 2020 Decadal Survey
Large Mission Concepts

- NASA will study large mission concepts as input to the 2020 Decadal Survey
  - Science case
  - Technology assessment
  - Design reference mission with strawman payload
  - Cost assessment
- Charge to the Astrophysics Program Analysis Groups (PAGs): COPAG, ExoPAG, PhysPAG (December 2014)
  - "I am charging the Astrophysics PAGs to solicit community input for the purpose of commenting on the small set [of large mission concepts to study], including adding or subtracting large mission concepts."
- PAGs reported to the Astrophysics Subcommittee in October 2015
  - PAGs unanimously endorsed a common set of four mission concepts to study
  - Astrophysics Subcommittee reported to the NAC Science Committee that NASA should study these four mission concepts
  - All three PAG reports posted at **http://cor.gsfc.nasa.gov/copag/rfi/**

Preparing for the 2020 Decadal Survey
Large Mission Concepts

NASA is initiating community-led studies of the following four large mission concepts.

	Community STDT Chair	Center Study Scientist	Study Lead Center	HQ Program Scientist
Far IR Surveyor	TBD	David Leisawitz	GSFC	Kartik Sheth
Habitable Exoplanet Imaging Mission	TBD	Bertrand Mennesson	JPL	Martin Still
Large UV/Optical/IR Surveyor	TBD	Aki Roberge	GSFC	Mario Perez
X-ray Surveyor	TBD	Jessica Gaskin	MSFC	Dan Evans

Preparing for the 2020 Decadal Survey
Large Mission Concepts

NASA is asking for applications for membership on the four large mission concept Science and Technology Definition Teams (STDTs)

- STDTs have a significant role and responsibility
  - Develop science case
  - Flow science case into mission parameters
  - Vet technology gap list
  - Direct trades of science vs cost/capability

- STDT members will be appointed by NASA HQ
  - Community call for applications will be released via NSPIRES and Astrophysics Programs mailing lists on the day after the AAS Town Hall
  - Responses requested by February 1, 2016

- STDTs will be chartered and managed by HQ
  - Charter and management plan available at:

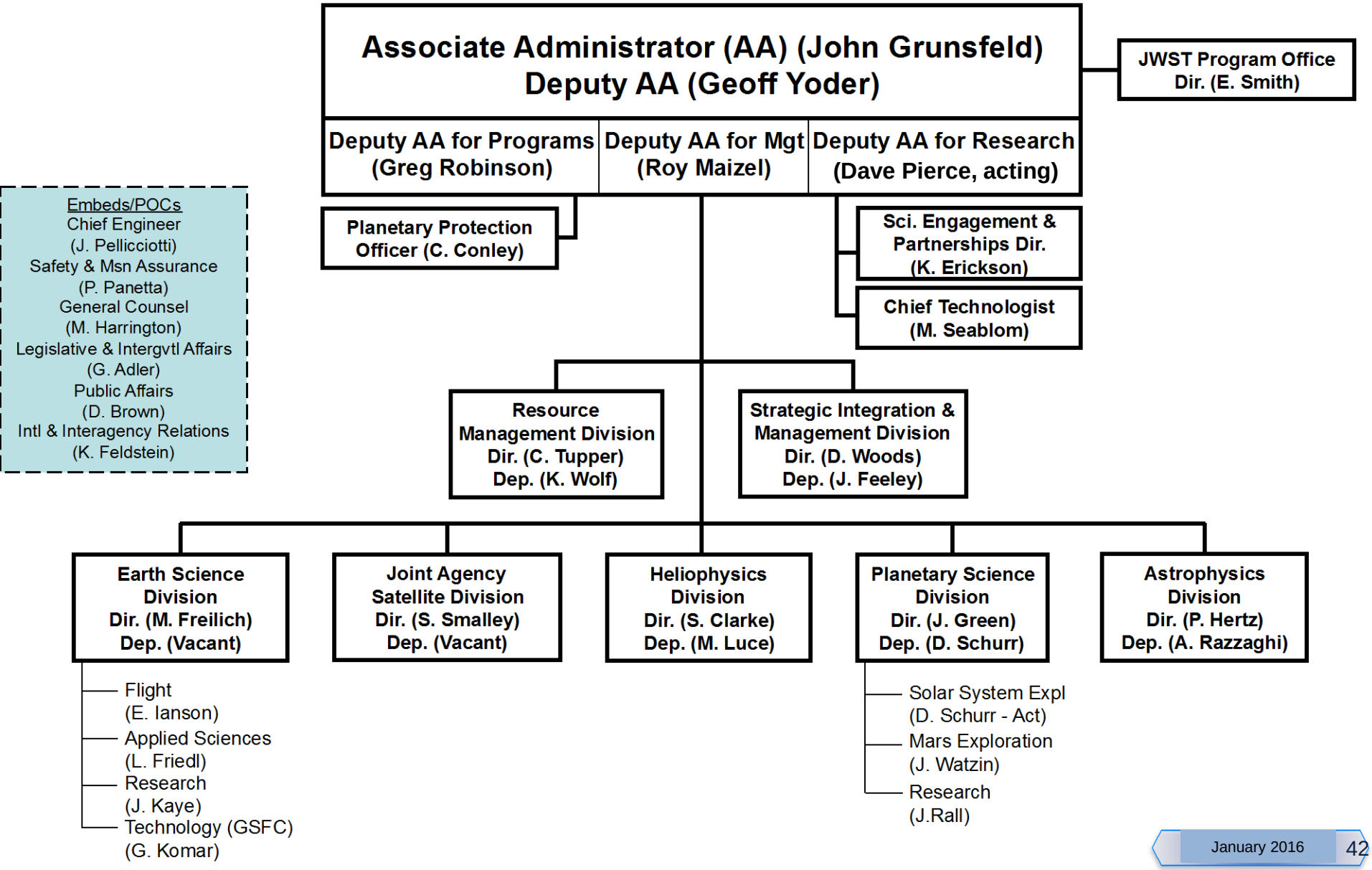
http://science.nasa.gov/astrophysics/2020-decadal-survey-planning/

Astrophysics

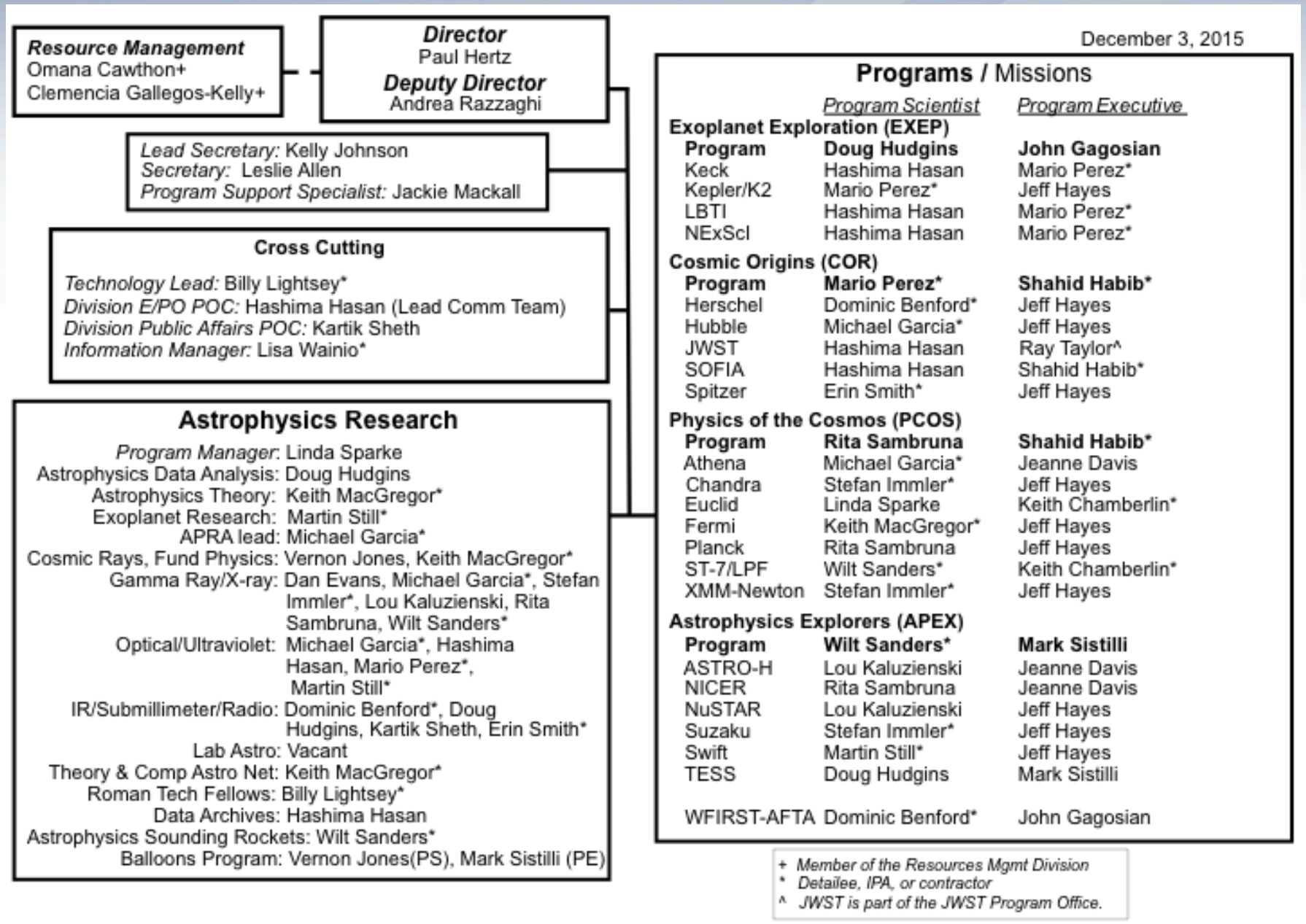



BACKUP

SMD Organization Chart



Astrophysics Division - SMD



SMD Science Education Restructuring

- Background – FY16 Budget provides $37M for NASA Science Education
- Why Restructure? To further enable NASA scientists and engineers to engage more effectively with learners of all ages. SMD will no longer have minimum of 1 percent set-asides through our missions, or issue disparate 3-year grants. But we are taking a strategic approach, building on our science discipline-based legacy and looking for new approaches given Stakeholder priorities.
- Objectives?
  - Enable STEM Education
  - Improve US Scientific Literacy
  - Advance National Educational Goals
  - Leverage Through Partnerships

- How? Through the competitive selection of organizations that utilize NASA data, products, or processes to meet education objectives; and by enabling our scientists and engineers with education professionals, tools, and processes to better meet user needs. SME's continue to be funded within the Divisions, where appropriate.
- What? Selected 27 Science Education Cooperative Agreements - announced Sept 25, 2015. Awards scheduled for January 2016.

SMD Science Education Restructuring

- Selections posted at: **http://www.nasa.gov/press-release/nasa-selects-science-education-partners-for-stem-agreements**
- 27 Selections build upon legacy of excellence, balanced across diverse audiences, and fit within annual budget of $42M/year towards meeting NASA Science Mission Directorate's desired Outcome and Objectives.
  - 27 of 73 compliant proposals selected (37%) for negotiations leading to cooperative agreement awards
  - 15 are from "Legacy" institutions (56%)
  - 3 selections support the 2017 Total Solar Eclipse, allowing for one full academic year of preparation
  - 15 include Astrophysics content
  - 16 include Earth Science content
  - 17 include Planetary Science content
  - 15 include Heliophysics content
- Scheduled start date for awards – January 4, 2016.