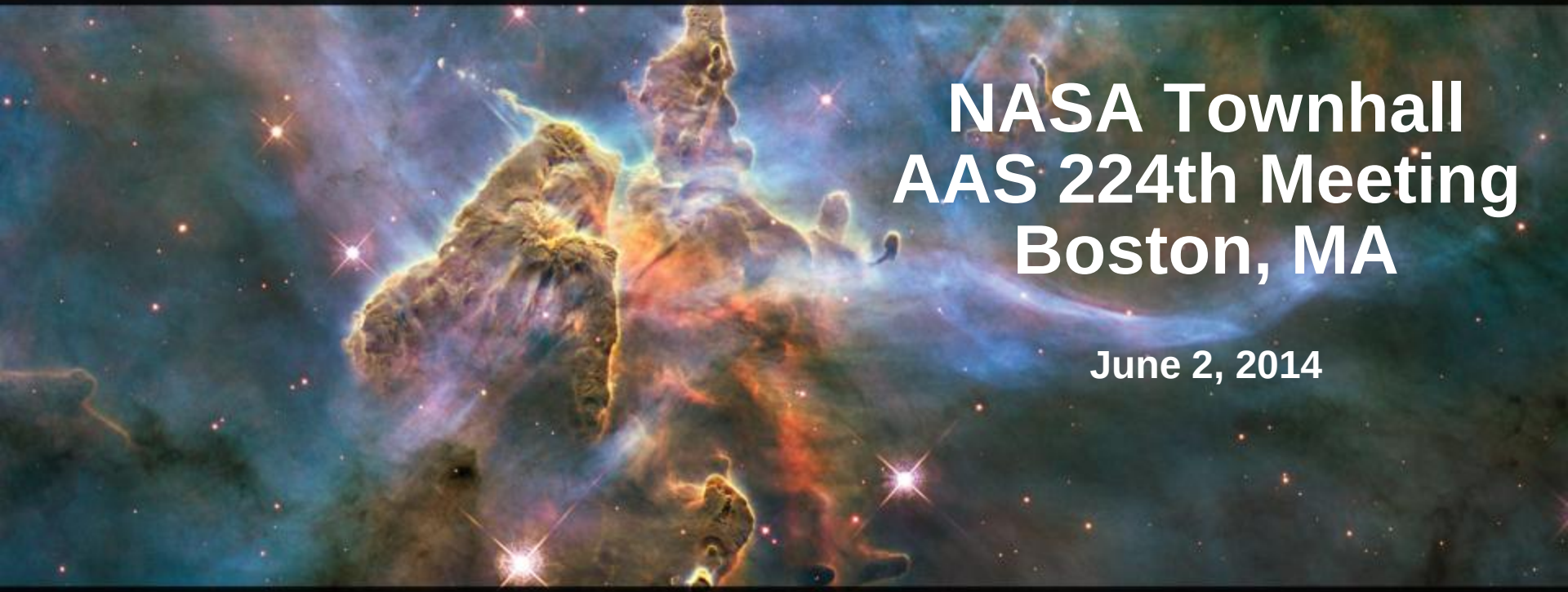
National Aeronautics and Space Administration



NASA Townhall
AAS 224th Meeting
Boston, MA

June 2, 2014

Astrophysics

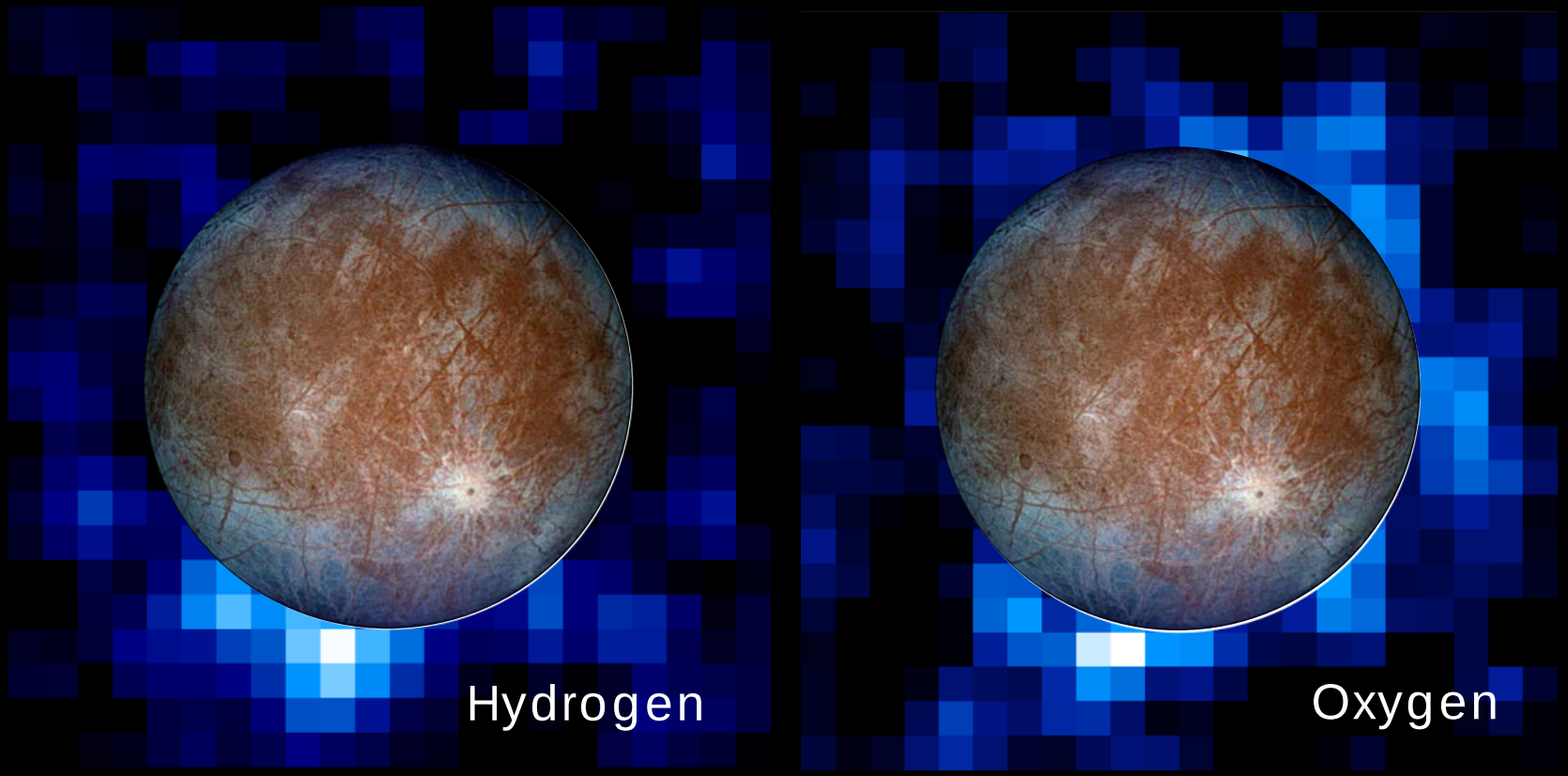
Paul Hertz

Director, Astrophysics Division
Science Mission Directorate
@PHertzNASA

www.nasa.gov

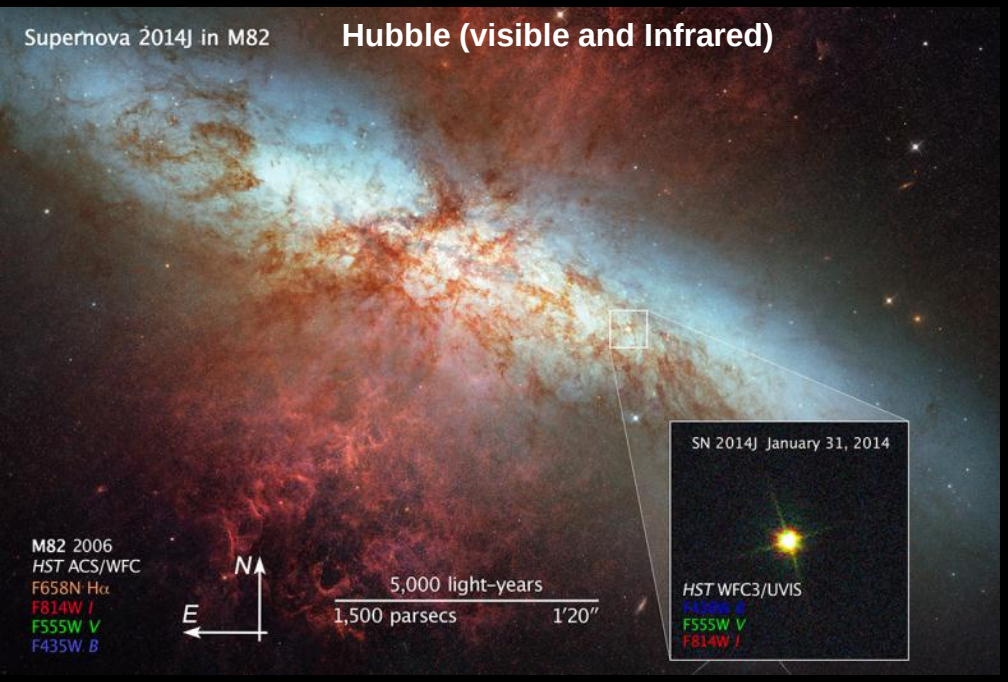
This presentation is posted at
http://science.nasa.gov/astrophysics/documents/

HST sees Water Vapor Plumes on Europa

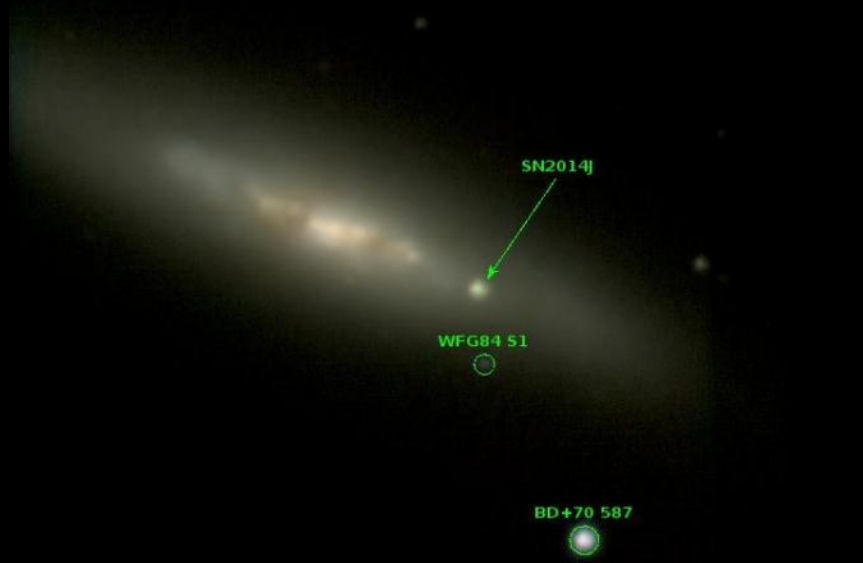


Hydrogen and oxygen emission lines from Hubble Space Telescope with superimposed Europa image from Galileo

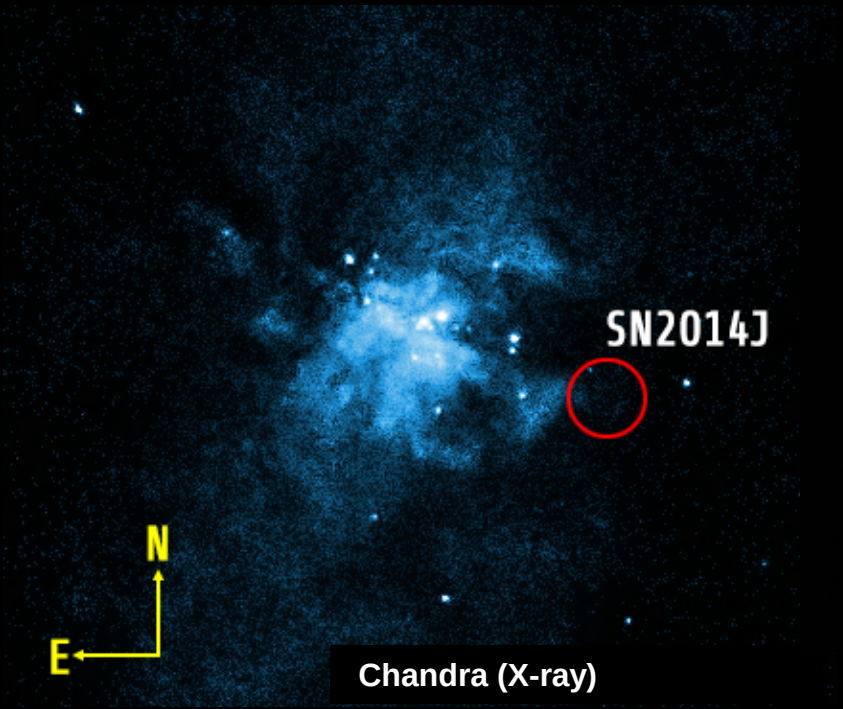
Roth et al. (2013). *Science.*



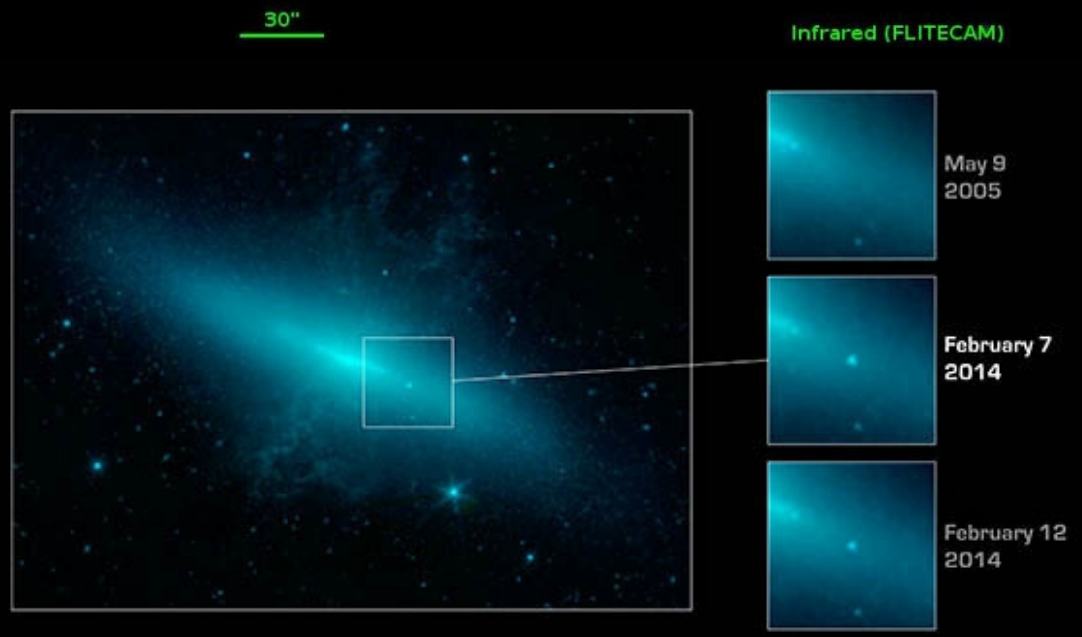
Hubble (visible and Infrared)



SOFIA (infrared)

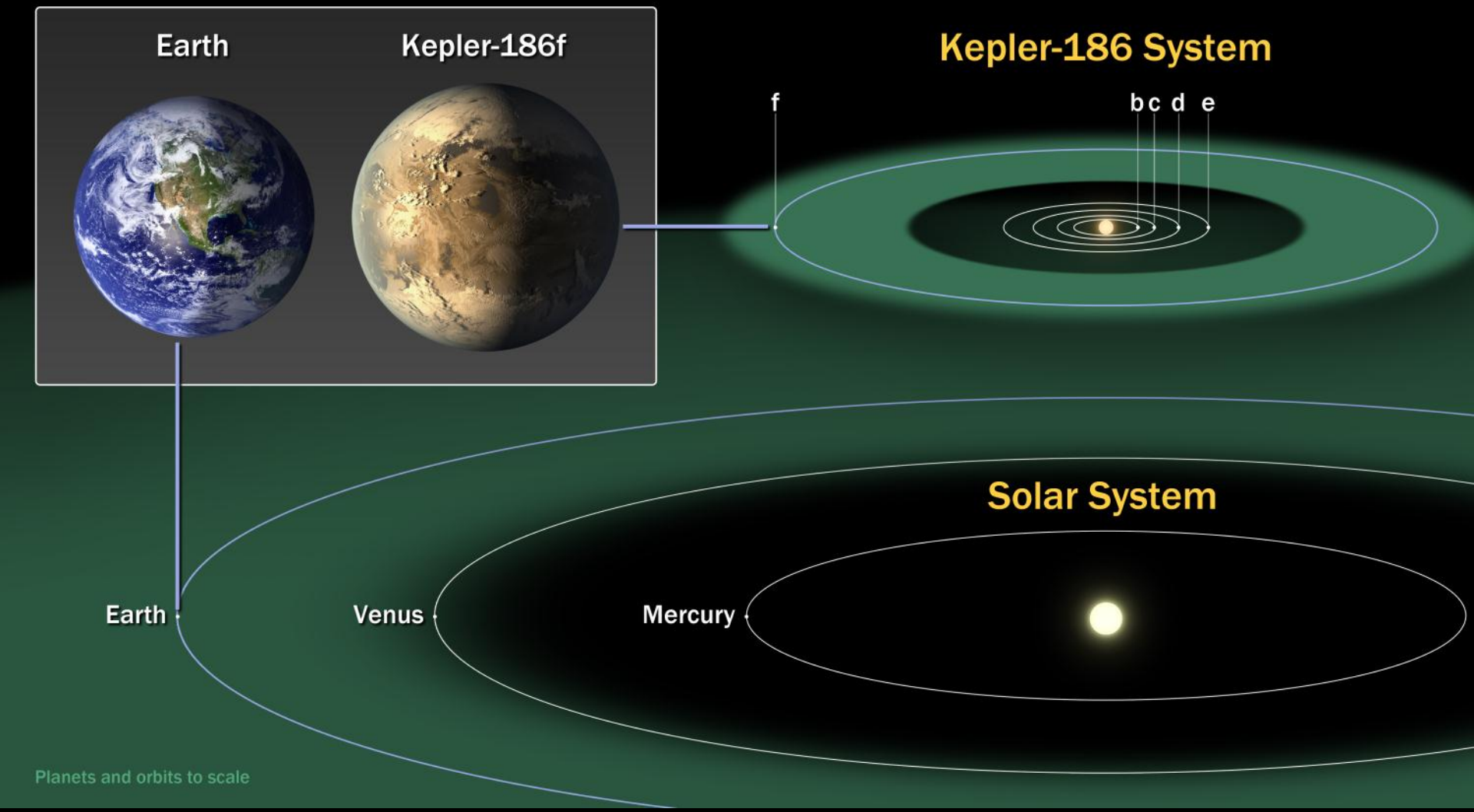


Chandra (X-ray)



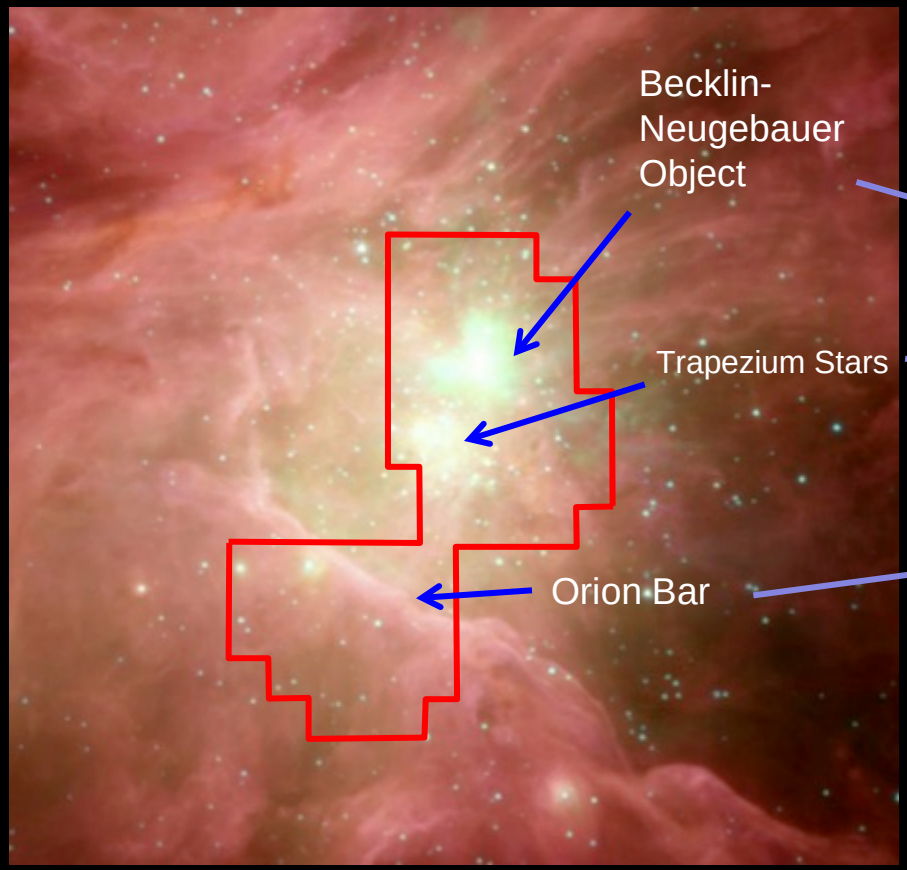
Spitzer (Infrared)

Kepler 186f:
First Earth-Size Planet in 'Habitable Zone'



Stratospheric Observatory for Infrared Astronomy

Orion Nebula

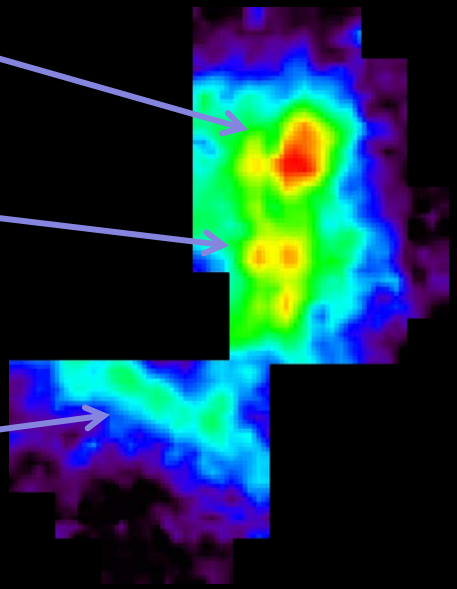


© Spitzer Observatory, Thomas Megeath

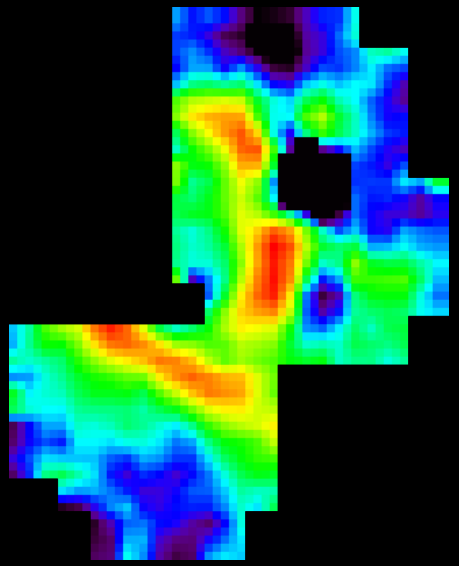
SOFIA / FIFI-LS

© FIFI-LS Team

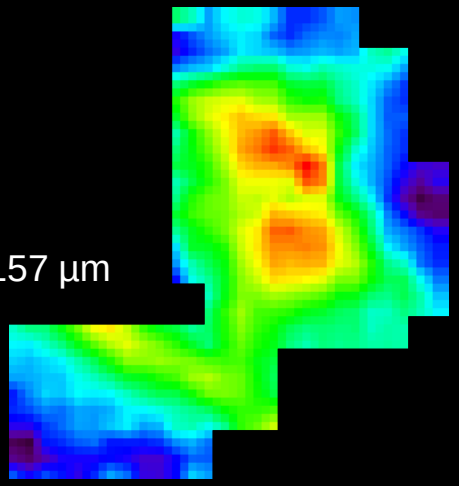
[OI] 63 µm



[OI] 145 µm



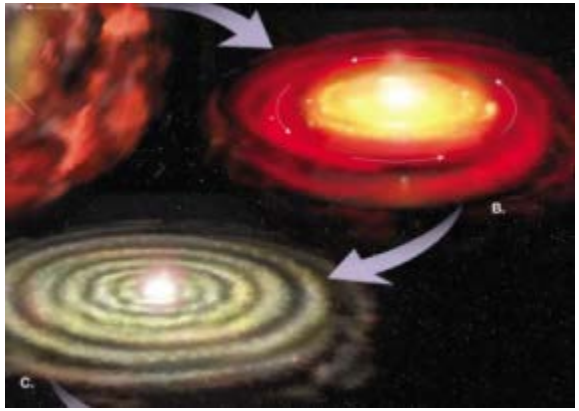
[CII] 157 µm



Why Astrophysics?

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

1. Discover how the universe works

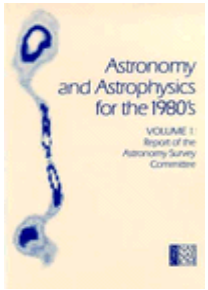


2. Explore how it began and evolved

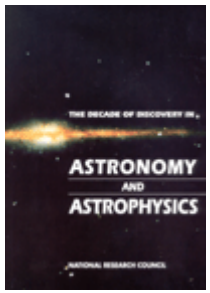
3. Search for life on planets around other stars

These national strategic drivers are enduring

1972



1982



1991

2001

2010

ASTROPHYSICS

Decadal Survey Missions

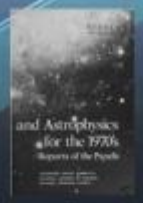
LRD: 2018

LRD: 2020s

2003

1999

1990



1972
Decadal Survey
Hubble

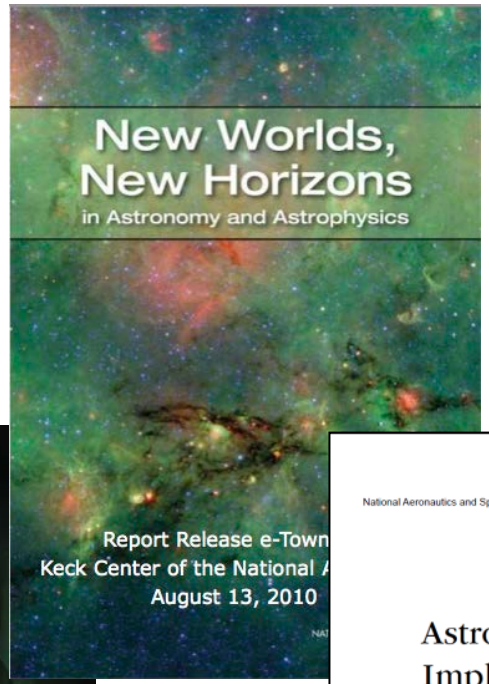
1982
Decadal Survey
Chandra

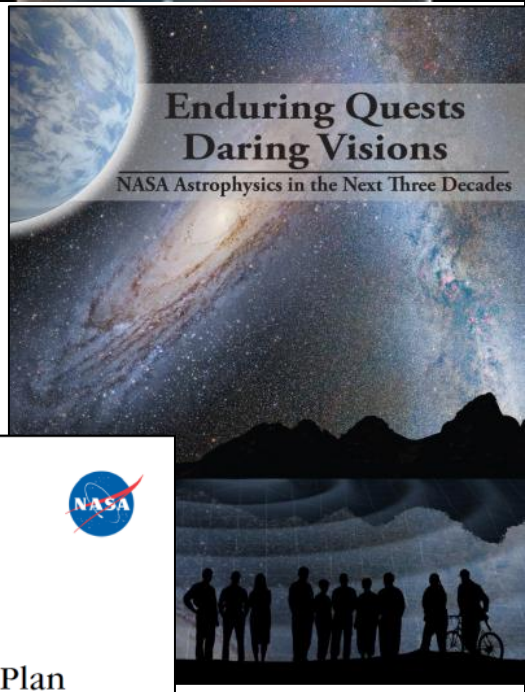
1991
Decadal Survey
Spitzer

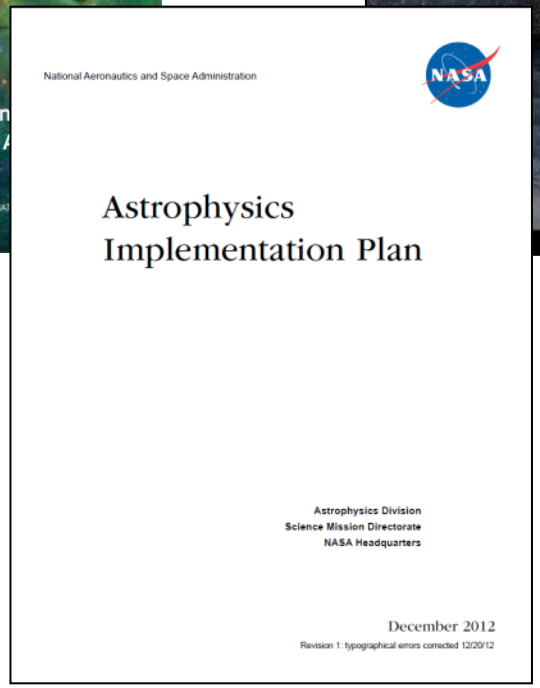
2001
Decadal Survey
JWST

2010
Decadal Survey
WFIRST

Astrophysics Driving Documents







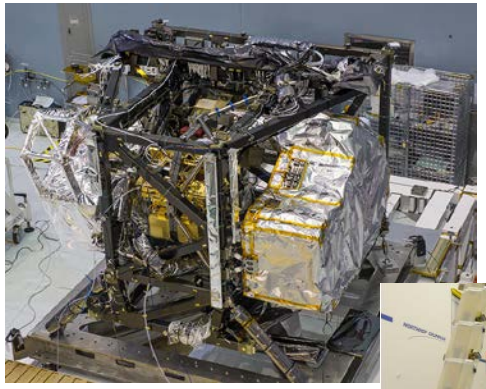
http://science.nasa.gov/astrophysics/documents

Progress Toward Decadal Survey Priorities

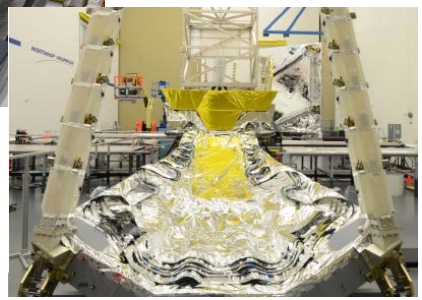
The NASA FY14 Appropriation, the President's FY15 Budget Request, and its notional out years support:	
L1. WFIRST	Preformulation and focused technology development for WFIRST/AFTA (a 2.4m version of WFIRST with a coronagraph) are underway to enable a new start NET FY17.
L2. Augmentation to Explorer Program	Increased to ~$140M/yr by FY16; supports decadal cadence of AOs including AO for SMEX in Fall 2014. MIDEX in approx 2017.
L3. LISA	Strategic astrophysics technology (SAT) investments including LISA Pathfinder plus discussing partnership on ESA's L3 gravitational wave observatory.
L4. IXO	Strategic astrophysics technology (SAT) investments plus discussing partnership on ESA's L2 X-ray observatory.
M1. New Worlds Technology Development Program	Focused technology development for a coronagraph on WFIRST; exoplanet probe mission concept studies and strategic astrophysics technology (SAT) investments
M2. Inflation Probe Technology Development Program	Three balloon-borne investigations plus strategic astrophysics technology (SAT) investments
Small. Research Program Augmentations	Increased from $65M (FY07) to $74M (FY10) to $82M (FY12 and beyond)

JWST Progress

- All science instruments installed into ISIM for cryo-vacuum testing this month
- First two of 5 flight sunshields being manufactured, 5 engineering sunshields being used for deployment testing
- Spacecraft bus under construction
- Good progress continues on telescope flight backplane testing and backplane pathfinder
- Program remains on track for October 2018 launch and within budget.



ISIM with all instruments



5 engineering sunshields folded for deployment testing

Flight telescope backplane & backplane support fixture

Pathfinder (backplane center section with secondary mirror structure)

JWST on Track for 2018 Launch

WFIRST / AFTA

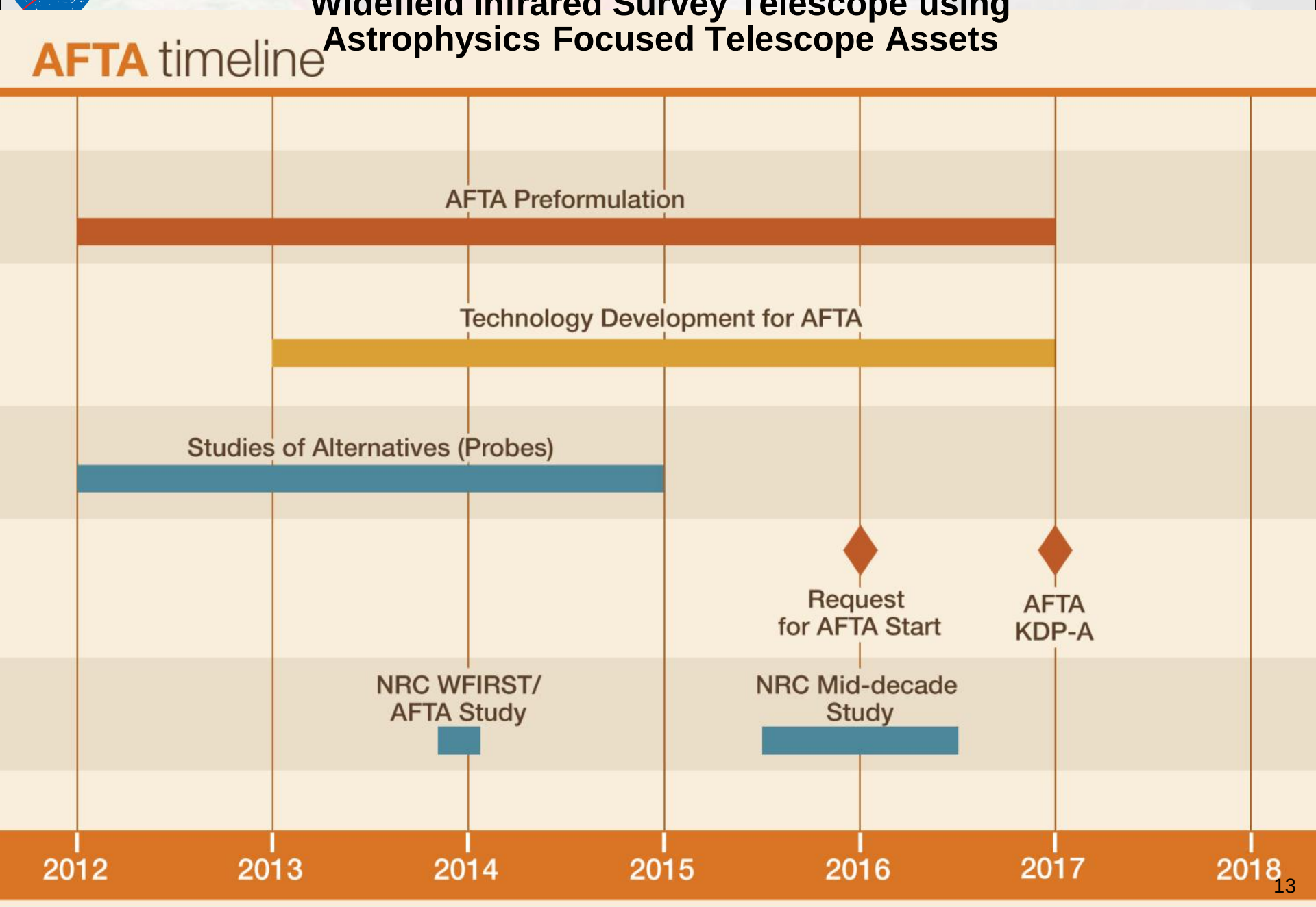
Widefield Infrared Survey Telescope with Astrophysics Focused Telescope Assets

- FY14 appropriation supports pre-formulation of WFIRST/AFTA, including technology development for detectors and coronagraph (with STMD).
- FY15 request supports Agency/Administration decision for formulation to begin NET FY 2017, should funding be available.

- Recent NRC study on WFIRST/AFTA offers positive view of WFIRST/AFTA with concerns about technology and cost risks.

Plan for WFIRST-AFTA Preformulation

Widefield Infrared Survey Telescope using Astrophysics Focused Telescope Assets



WFIRST Preparatory Science

- New ROSES Element, announced April 21.
- Proposals due July 11.
- Purpose: bridge from basic theory to observational modeling for WFIRST/AFTA.
- Proposals must be both:
  - Relevant to WFIRST's primary astrophysics goals.
  - Predominantly WFIRST-specific development of detailed simulations and models.
- Anticipate selecting ~12 proposals, total $1.8M in first year.
- Intend to select a range of scales (smaller and larger) and periods of performance (1,2,3 yr).
- Investigators selected will coordinate efforts with WFIRST Study Office and WFIRST/AFTA Science Definition Team.
  - Annual summary white paper on progress.

SOFIA
Stratospheric Observatory for Infrared Astronomy

- **World's Largest Airborne Observatory**
- 2.5-meter telescope
- Capable of observing from the visible to the far infrared
- 80/20 Partnership between NASA and the German Aerospace Center (DLR)
- Mission Ops based at NASA-Armstrong
- Science Ops based at NASA-Ames
- Six First-Generation instruments
  - Four U.S., two German
  - Imaging, Spectroscopy, and Photometry
- Limited Science Ops began in 2010
- Full Operational Capability in February 2014

CURRENT STATUS:

- Achieved Full Operational Capability (FOC) February 2014.
- Began Cycle 2 Science Observations February 2014.
- Completed commissioning flights for Field-Imaging Far-Infrared Line Spectrometer (FIFI-LS) April 2014 (5th instrument).
- Initiated commissioning of Echelon-Cross-Echelle Spectrograph (EXES) April 2014 (6th instrument).
- Demonstrating high cadence science operations in April/May 2014
- Formally entered Operational Phase May 2014.
- Second generation instruments under development (1 U.S., 1 German)
  - HAWC+: far infrared imager and polarimeter
  - upGREAT: multi-pixel heterodyne spectrometer
- President's FY15 budget request proposes to end funding and place SOFIA in storage.
  - NASA/DLR Working Group analyzed several scenarios to establish SOFIA's path forward.
  - Currently executing SOFIA's baseline schedule of operations and scheduled maintenance for FY14.
  - House proposed $70M for FY15 operations.

SOFIA Path Forward

- SOFIA's high operating costs cannot be accommodated within the reduced FY 2015 Astrophysics budget request.
- The Administration's FY 2015 budget request to Congress proposes to place SOFIA into storage by FY 2015.
- NASA and DLR are executing SOFIA's baseline schedule of operations for FY 2014, consistent with NASA's approved FY 2014 Operating Plan.
- A joint NASA/DLR Working Group analyzed several scenarios to establish SOFIA's path forward within the range of possible outcomes from the U.S. budget process.
- The U.S. budget process continues within the Appropriations Committees of the House and Senate.
  - The draft House NASA FY 2015 Authorization Bill directs NASA not to spend FY 2014 funding in terminating SOFIA.
  - The draft House FY 2015 Appropriations Bill, which includes NASA, proposes $70M in FY 2015 for operating SOFIA.
  - The Senate will work on a FY 2015 Appropriations Bill, which includes NASA, in early June.

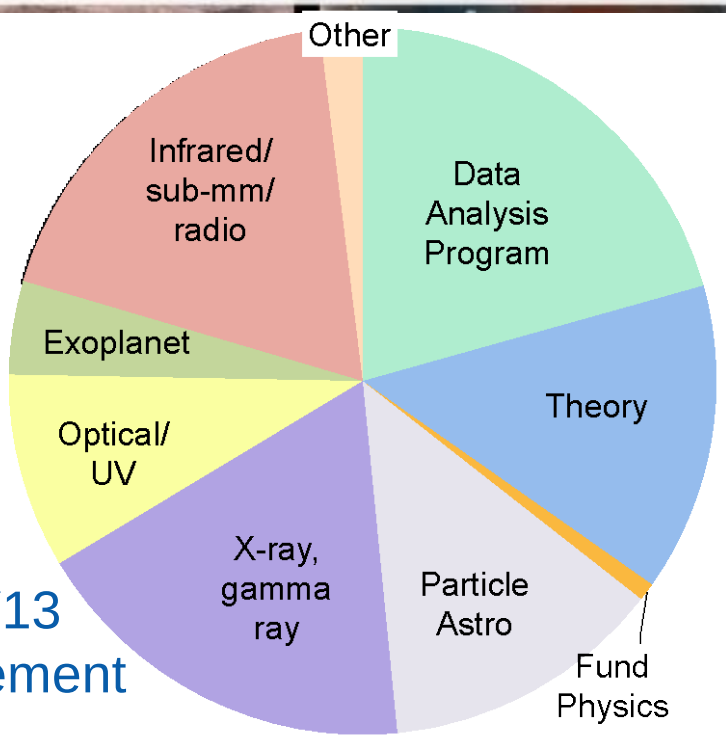
Other Project Highlights

- **NICER** confirmed (KDP-C) in February 2014.
- NASA delivered **ASTRO-H** Soft X-ray Spectrometer (SXS) calorimeter spectrometer insert to JAXA in March 2014.
- **TESS** on track for confirmation in Fall 2014.
- A SMEX + MO **Explorers AO** is planned for Fall 2014 (draft AO in early Summer 2014).
- NASA supporting **ESA's L2 X-ray observatory** mission concept studies during 2014.
- Astrophysics Division **consolidating limited FY14 E/PO** activities at the Program level.

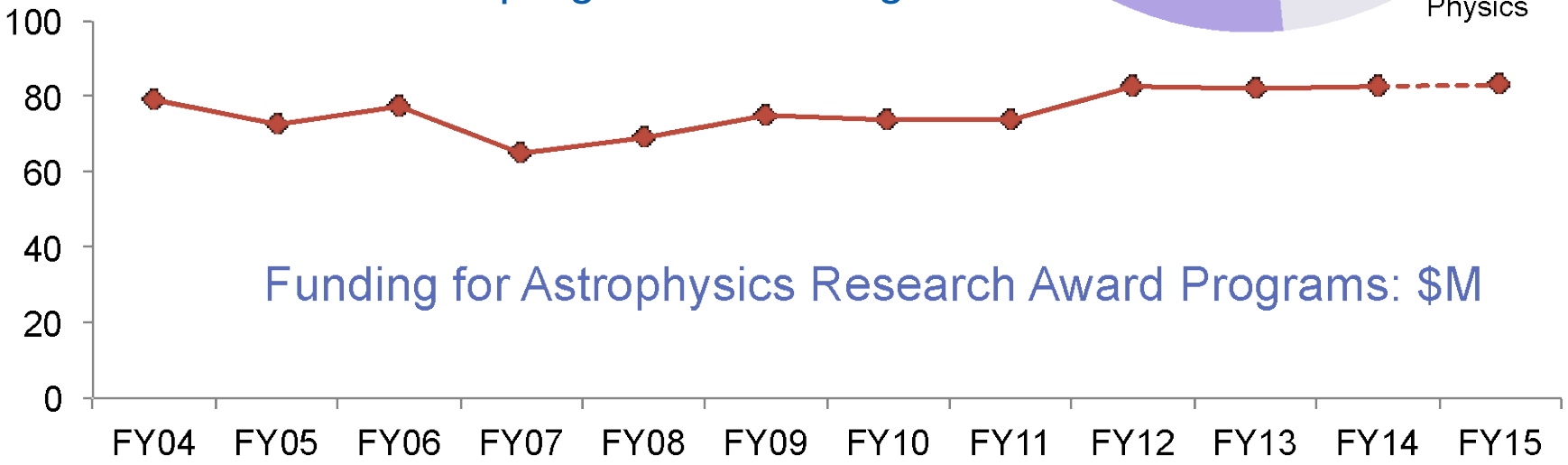
Astrophysics Research Program Funding

Most recent year:

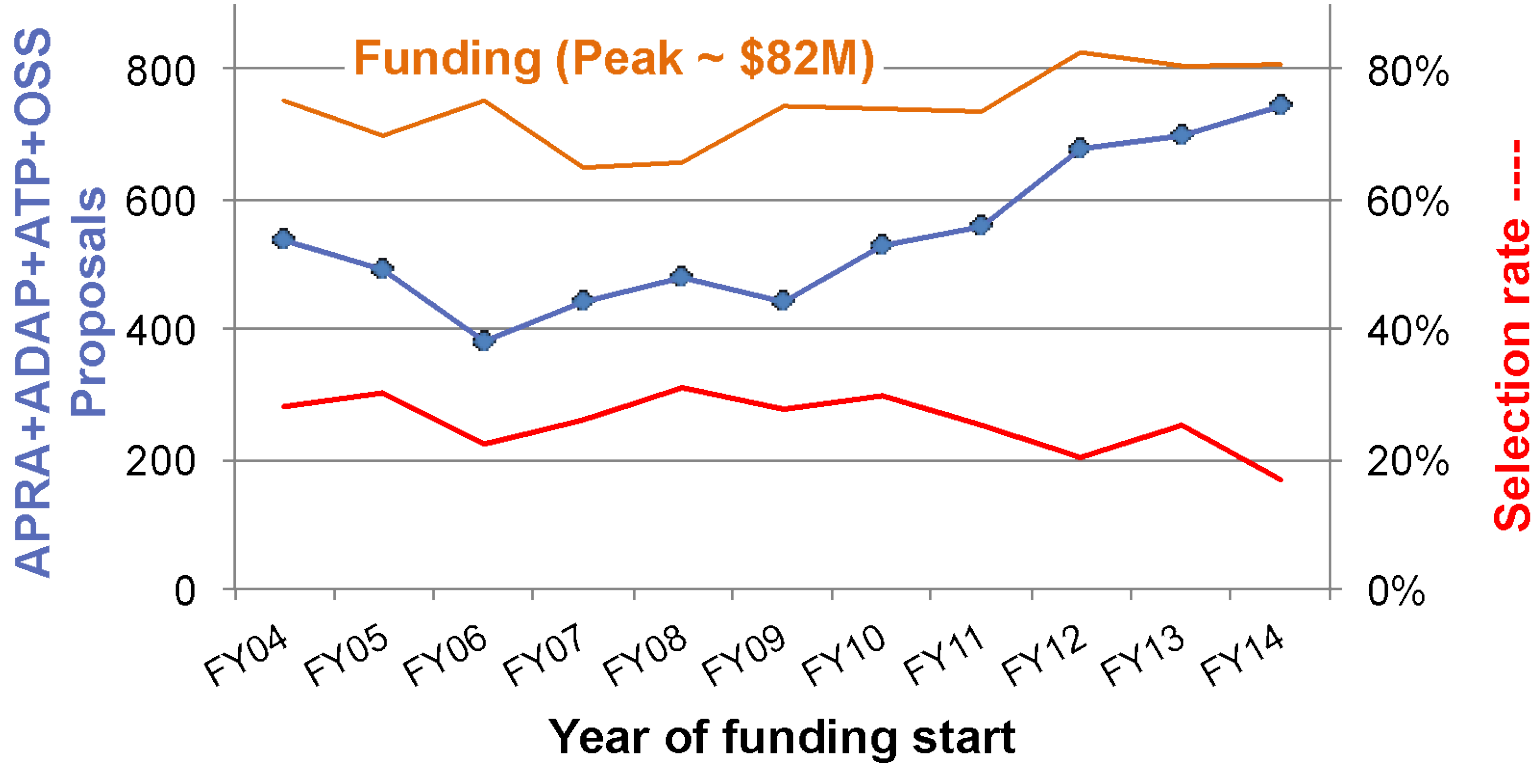
	Proposals Rec'd	Year-1 $M	selected	Success Rate
RTF-12	12	0.6	2	17%
APRA-12	178	13.6	37	21%
SAT-12	38	5.2	9	24%
ADAP-13	276	4.4	41	15%
OSS-13	39	0.9	7	18%
ATP-13	181	3.9	27	15%



Split of $81.967M spent in FY13
PI award programs + management



Astrophysics ROSES selection rates

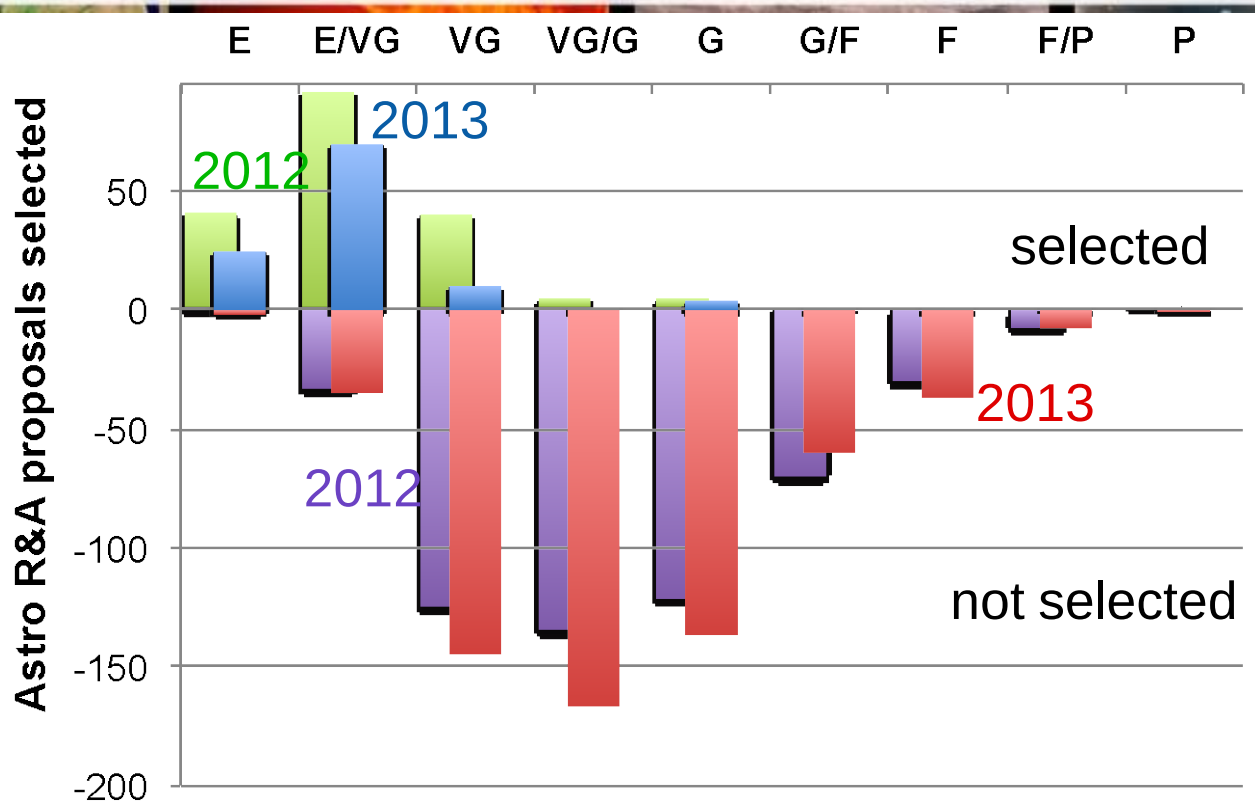


Last year, the Astrophysics Research Program received twice as many proposals as in 2006.

Funding for the program has risen 25% since 2006, but it has not doubled; so the success rate has fallen.

Total funding per successful proposal has been steady at $500k-$600k – this is an average over theory investigations, flight payloads, etc.

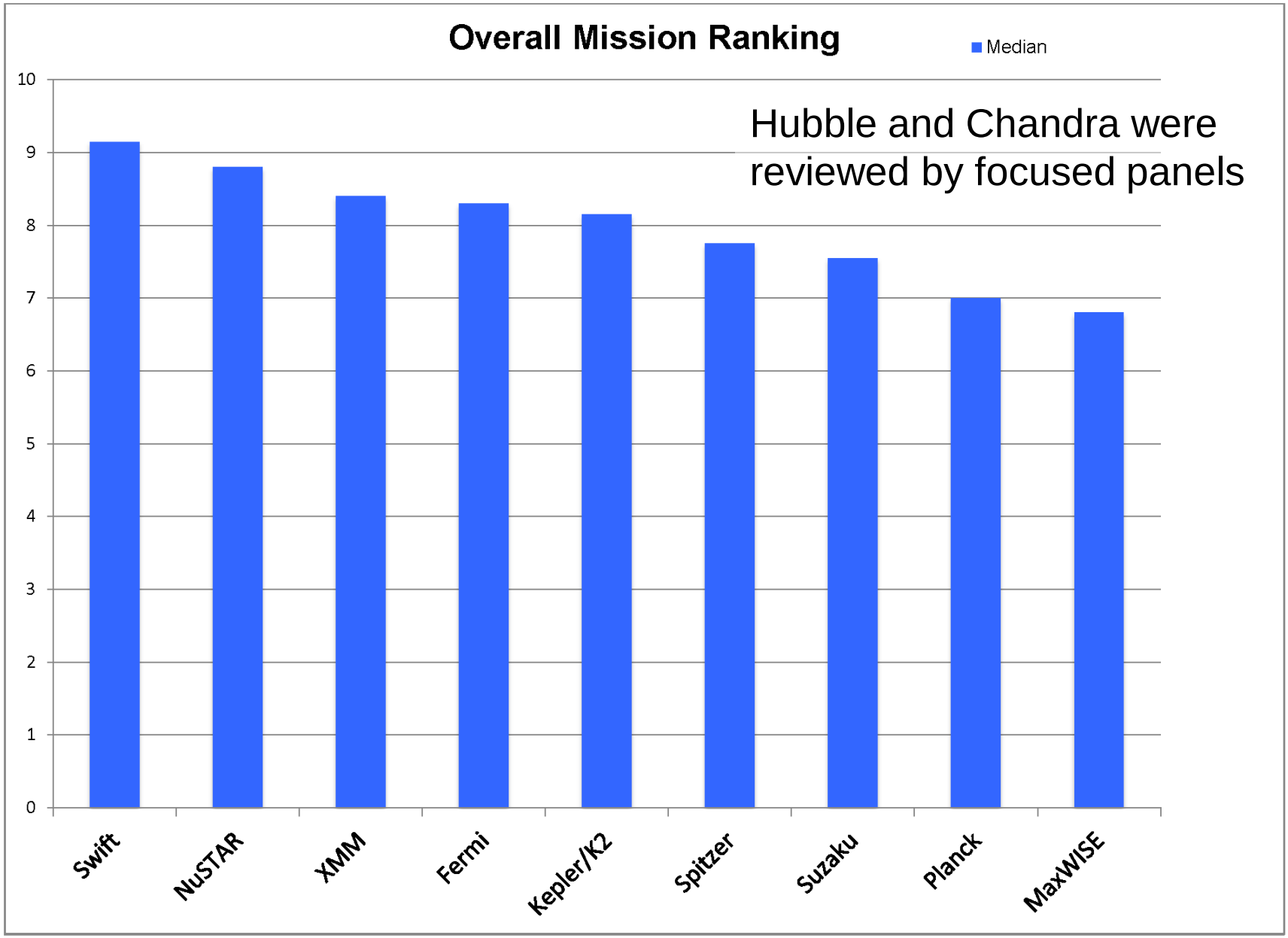
Astrophysics ROSES selections by rating



Of 726 proposals to the Astrophysics core R&A program (ADAP, APRA, SAT, ATP, OSS) in 2012, 25% were selected (green); 75% were declined (purple). Of 339 proposals rated VG or better, 51% were selected.

Of 713 proposals to these programs in 2013, 17% were selected (blue); 83% were declined (red). Of 299 proposals rated VG or better, 39% were selected.

Astrophysics 2014 Senior Review



Astrophysics 2014 Senior Review

- Hubble Space Telescope: extension approved
- Chandra X-ray Observatory: extension approved
- Swift Gamma-ray Burst Explorer: extension approved
- Nuclear Spectroscopic Telescope Array (NuSTAR): extension approved and new GO program
- X-ray Multi-Mirror Mission-Newton (XMM-Newton) (ESA mission): extension approved and augmented GO program
- Fermi Gamma-ray Space telescope: extension approved
- Kepler Space Telescope: K2 extension approved
- Spitzer Space Telescope: mission not extended
- Suzaku (JAXA mission): extension approved
- Planck (ESA mission): augmentation approved
- Widefield Infrared Survey Explorer (NEOWISE-R): data analysis proposal not approved

http://science.nasa.gov/astrophysics/2014-senior-review-operating-missions/

FY14 (this year) Budget Appropriation

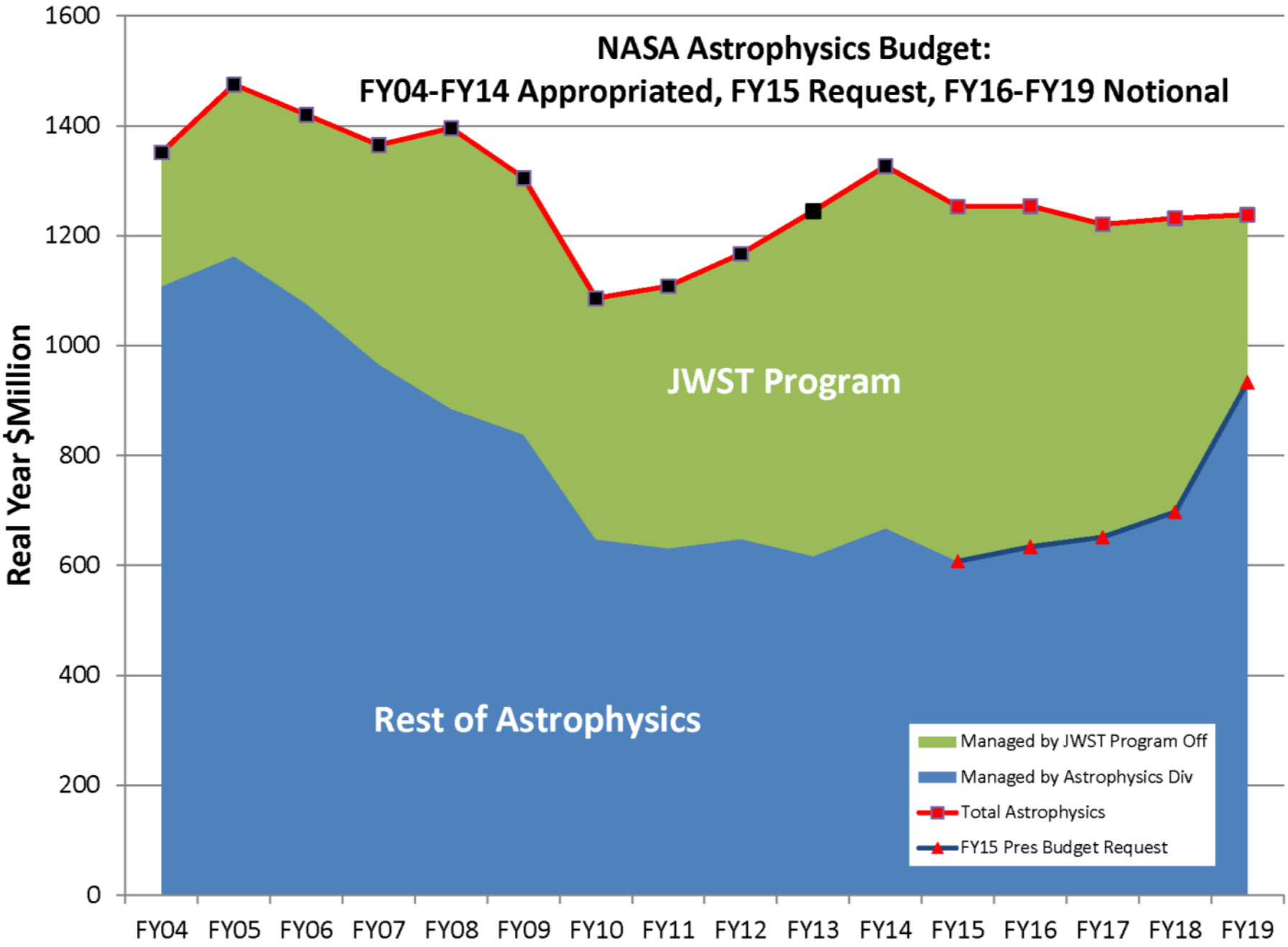
- Final FY14 Appropriation is $668M for Astrophysics and $658M for JWST.
  - **Appropriation includes new projects** for TESS, NICER, Euclid; augmentation for future Explorer AOs; core funding for research and suborbital projects; planning budget wedge for strategic mission starting NET FY17.
  - **JWST plan for 2018 launch is fully funded**.
  - **Budget is $26M higher for Astrophysics than requested**, including $56M directed funding for WFIRST/AFTA studies (compared with $13M planned).
  - Remainder of Astrophysics (other than JWST and WFIRST/AFTA) must be adjusted to accommodate the ~$20M difference; accommodated without impact by rephasing Explorers funding.
  - Appropriation includes no funding in Astrophysics for education; SMD to continue conducting education activities in FY14 and to consider consolidation at the Division level; **Astrophysics reprogrammed some funds for education activities in FY14**.
- FY15 President's budget request was released on March 4 (top level only) and March 10 (full details)

FY15 (next year) Budget Request

Outyears are notional

($M)	2013	2014	2015	2016	2017	2018	2019
Astrophysics	$617	$668	$607	$634	$651	$697	$993
JWST	$627	$658	$645	$620	$569	$535	$305

- **Supports pre-formulation of WFIRST/AFTA**, including technology development for detectors and coronagraph.
- Supports a growing Astrophysics Explorer program with continued development of ASTRO-H, NICER, and TESS, and initiation of the next Small Explorer mission.
- Supports operating missions: Hubble, Chandra, and other missions rated highly by the 2014 Senior Review.
- Continues a competed astrophysics research program and support of the balloon program.
- Seeks to work with current partner Germany and potential partners to identify a path forward for SOFIA with greatly reduced NASA funding. Unless partners are able to support the U.S. portion of SOFIA costs, **NASA will place the aircraft into storage by FY 2015**.
- **Supports the commitment to an October 2018 launch date for JWST**. Continues manufacturing of the flight sunshield structure and membranes. Completes and delivers the flight cryogenic cooler tower assembly. Delivers the Optical Telescope Element flight structure. Initiates integration of the 18 flight primary mirror segments. Conducts the final Integrated Science Instrument Module level cryo-vacuum test.


NASA Astrophysics Budget:
FY04-FY14 Appropriated, FY15 Request, FY16-FY19 Notional
Real Year $Million
1600
1400
1200
1000
800
600
400
200
0
JWST Program
Rest of Astrophysics
Managed by JWST Program Off
Managed by Astrophysics Div
Total Astrophysics
FY15 Pres Budget Request
FY04
FY05
FY06
FY07
FY08
FY09
FY10
FY11
FY12
FY13
FY14
FY15
FY16
FY17
FY18
FY19

FY15 (next year) Budget Appropriation

- Administration request is $607M for Astrophysics and $645M for JWST.
- Progress to date: markup by House subcommittee and committee; considered on House floor on May 28-29. House drafted appropriations bill and report includes:
  - Recommendation is $680M for Astrophysics and $645M for JWST
  - Restores $5M reduction in Hubble operations
  - Rejects SOFIA termination; appropriates $70M (an increase of $58M) to “support the aircraft’s fixed costs (flight crews, required maintenance, etc.) as well as a base level of scientific observations. NASA shall continue seeking third-party partners whose additional funding support would restore SOFIA’s budget to its full operational level.”
  - Provides $30M (an increase of $15M) to “proportionally reallocate these funds among the SMD divisions, resulting in a dedicated budget line for each division’s own EPO activities.”
- Next steps:
  - Markup by Senate appropriations subcommittee and committee scheduled for this week; draft appropriations bill and report to be reconciled with House version.
  - Votes by House and Senate then signed into law by the President

FY15 Planned Accomplishments

- The **TESS** Explorer Mission will be confirmed to begin implementation (KDP-C) in FY15
- The **ISS-CREAM** experiment will be launched to the International Space Station (KDP-E) in FY15
- The Step 1 selection (KDP-A) will be made for the next Small Astrophysics **Explorer** and Explorer Mission of Opportunity in FY15
- ESA's **LISA Pathfinder** with NASA's ST-7 experiment will launch (KDP-E) in FY15
- The **WFIRST/AFTA** science definition team report will be completed in FY15
- Manufacture, assembly, and test of the **Euclid** flight detectors will continue in FY15
- JAXA's **ASTRO-H** mission spacecraft system level test will take place in FY15
- The Astrophysics **Archives Senior Review** will be held in FY15
- **Hubble** will achieve 25 years of operation in FY15
- The NRC **Mid-Decade Review** will begin in FY15
- Four **Balloon** campaigns in FY15
- Five **Sounding Rocket** launches in FY15

Monday

12:45-1:45	Session 109: NASA Town Hall (America Ballroom North/Central)
12:45-3:30	Cosmic Origins SAGs (Great Republic & Defender – 7th floor)

Tuesday

12:30-2:00	K2 Mission Town Hall (America Ballroom South)
6:30 – 7:30	SOFIA Town Hall (Staffordshire)

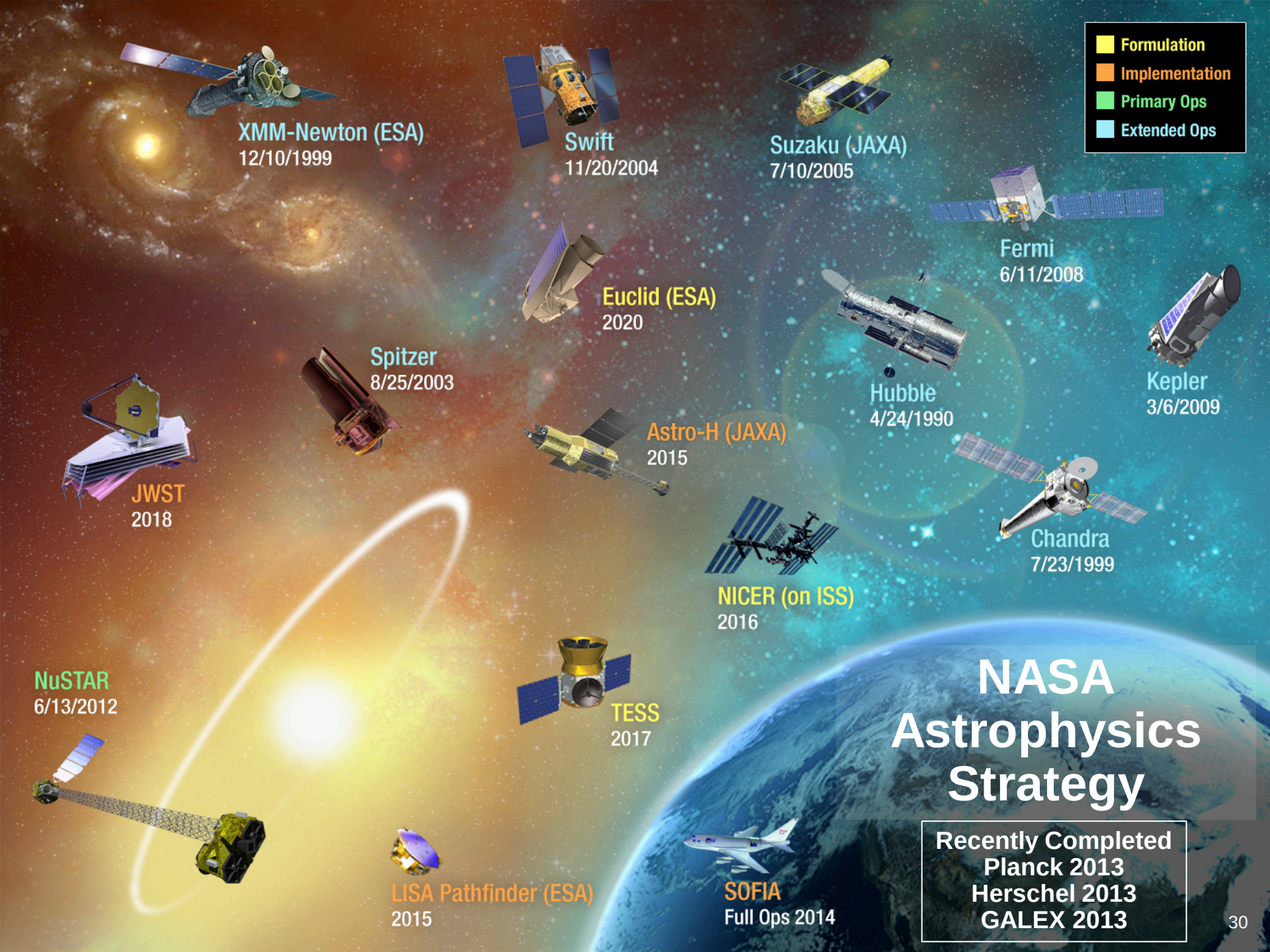
Wednesday

2:00-3:30	Session 311: On the Shoulders of Giants: Planets Beyond the Reach of Kepler IV: The Near Future including WFIRST & JWST (America Ballroom North/Central)

Thursday

9:30-11:30	Joint Cosmic Origins & Exoplanet PAGs (Parliament/Adams – 7th floor)

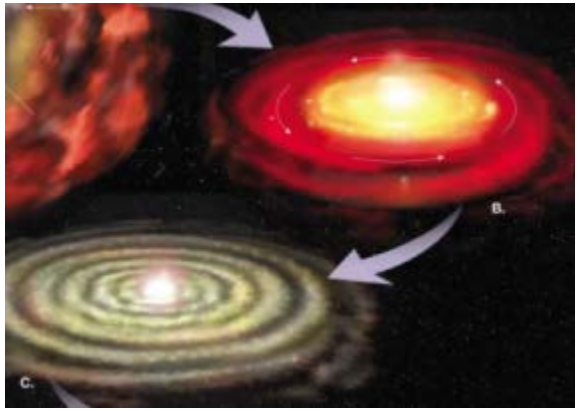
Longer Report including backup slides


Formulation
Implementation
Primary Ops
Extended Ops
XMM-Newton (ESA)
12/10/1999
Swift
11/20/2004
Suzaku (JAXA)
7/10/2005
Fermi
6/11/2008
Euclid (ESA)
2020
Spitzer
8/25/2003
Hubble
4/24/1990
Kepler
3/6/2009
JWST
2018
Astro-H (JAXA)
2015
Chandra
7/23/1999
NICER (on ISS)
2016
NuSTAR
6/13/2012
TESS
2017
LISA Pathfinder (ESA)
2015
SOFIA
Full Ops 2014
NASA Astrophysics Strategy
Recently Completed
Planck 2013
Herschel 2013
GALEX 2013

Why Astrophysics?

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

1. Discover how the universe works

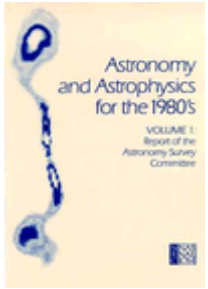


2. Explore how it began and evolved

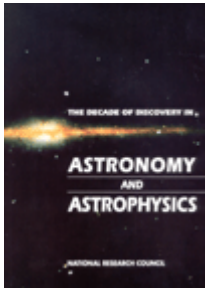
3. Search for life on planets around other stars

These national strategic drivers are enduring

1972

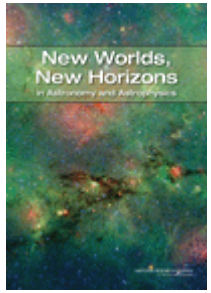


1982

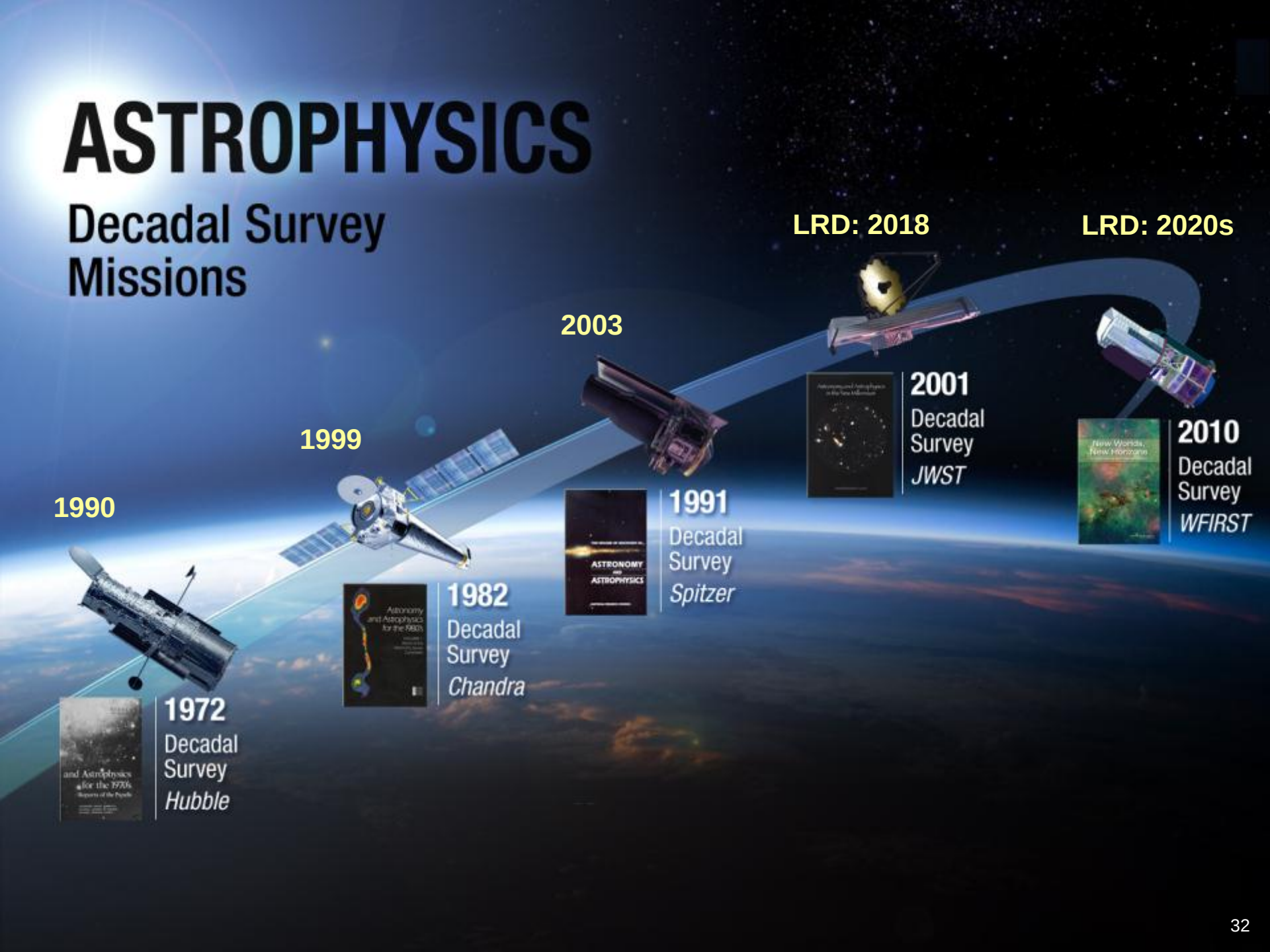


1991

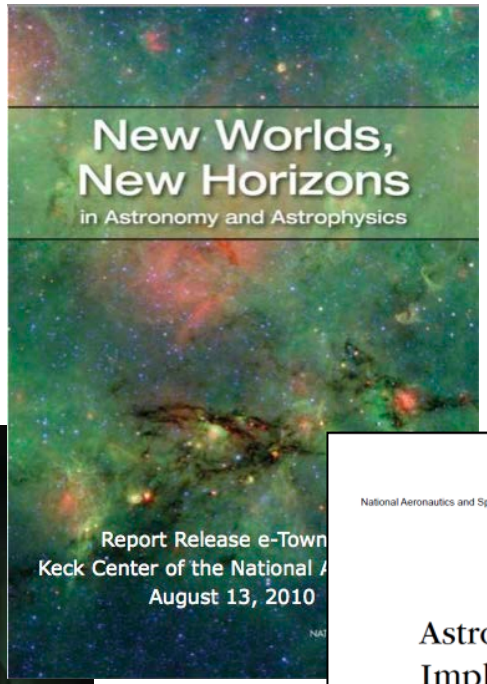
2001

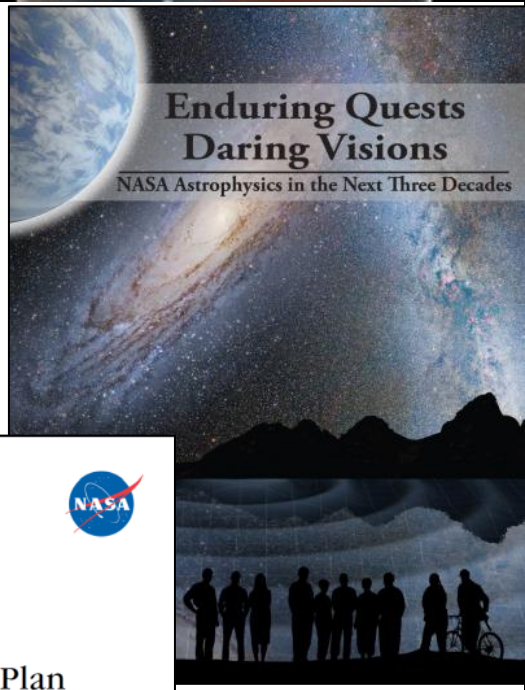


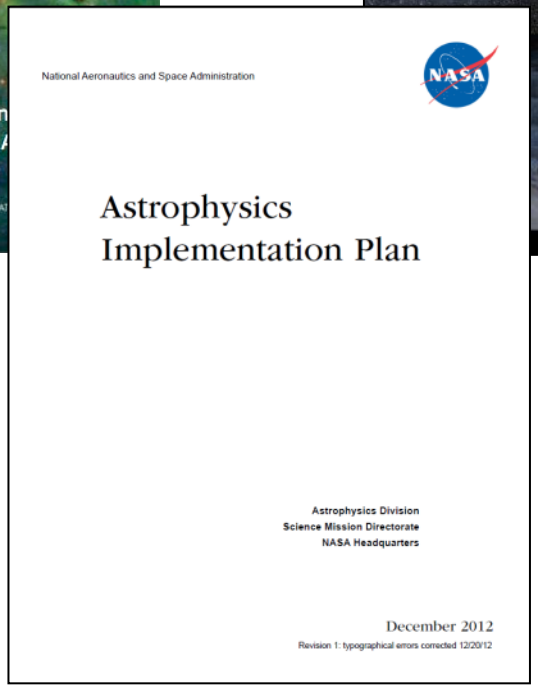
2010


ASTROPHYSICS
Decadal Survey
Missions
LRD: 2018
LRD: 2020s
2003
1999
1990
2001
Decadal
Survey
JWST
2010
Decadal
Survey
WFIRST
1991
Decadal
Survey
Spitzer
1982
Decadal
Survey
Chandra
1972
Decadal
Survey
Hubble

Astrophysics Driving Documents







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

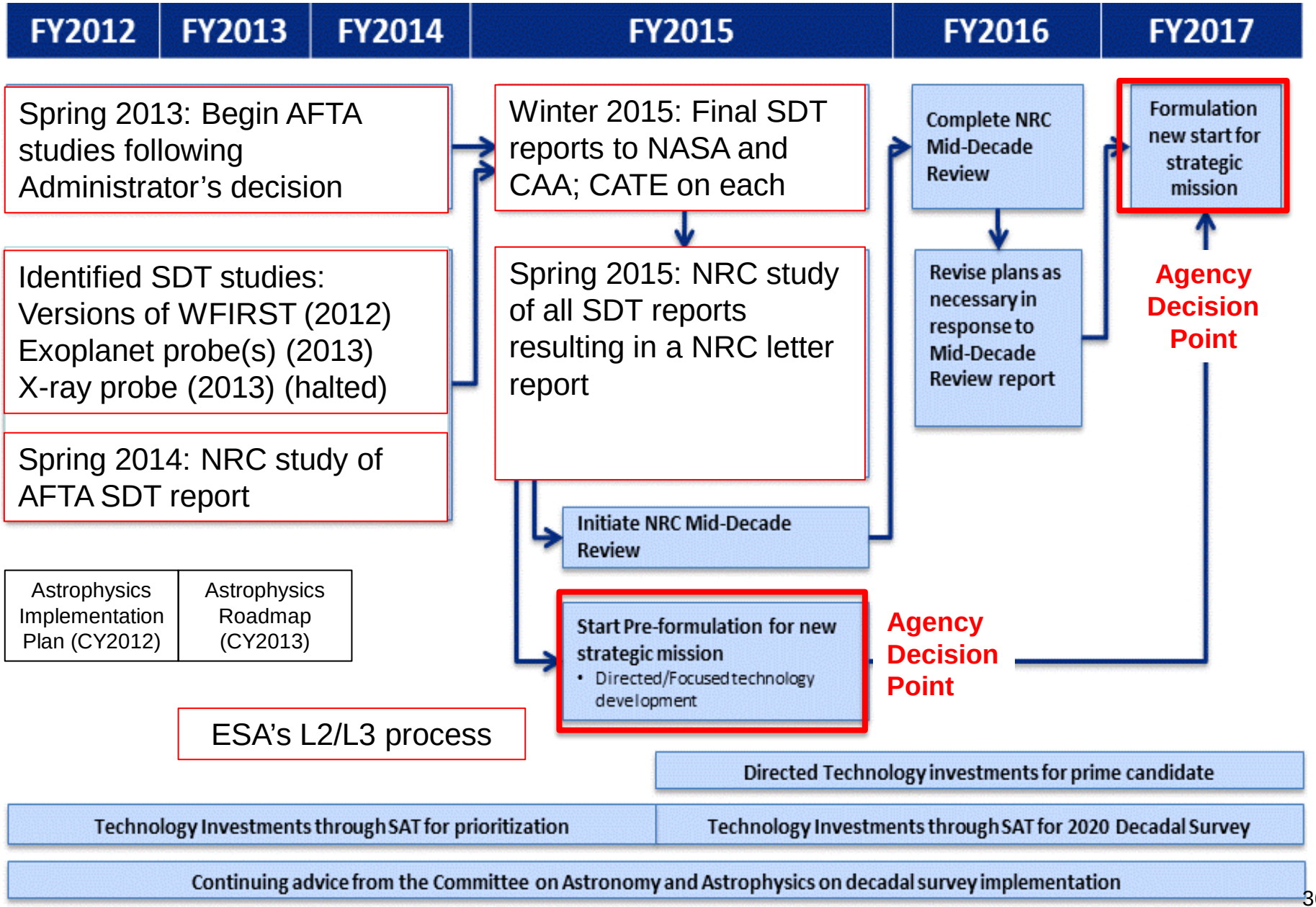
The Big Picture

- This remains a time of scientific opportunity for NASA Astrophysics.
  - We are poised to answer the most compelling science questions.
  - The budget for NASA astrophysics, which includes JWST, continues at $1.33B in FY14; the President has requested $1.25B in FY15.
  - NASA continues to operate large and small space-based observatories spanning the electromagnetic spectrum, including multiple Great Observatories.
  - The James Webb Space Telescope, the highest priority of the community, is on schedule and fully funded for an October 2018 launch.
  - NASA continues to develop Explorer missions and contributions to international missions for launch this decade, and a Small Explorer AO is planned for late 2014 to select two more Explorer projects.
  - NASA continues to support individual investigators for data analysis, theory, and technology investigations through open, competitive, peer reviews.
  - NASA is preparing for a new strategic Astrophysics mission to follow JWST as soon as funding becomes available; the preparation includes preformulation studies of WFIRST-AFTA.
- The budgetary future remains uncertain.
  - Priorities must be used to guide difficult budget choices.
  - The President has requested a ~10% decrease for the Astrophysics Division in FY15; the cost of operating SOFIA can not be accommodated within this reduced budget.

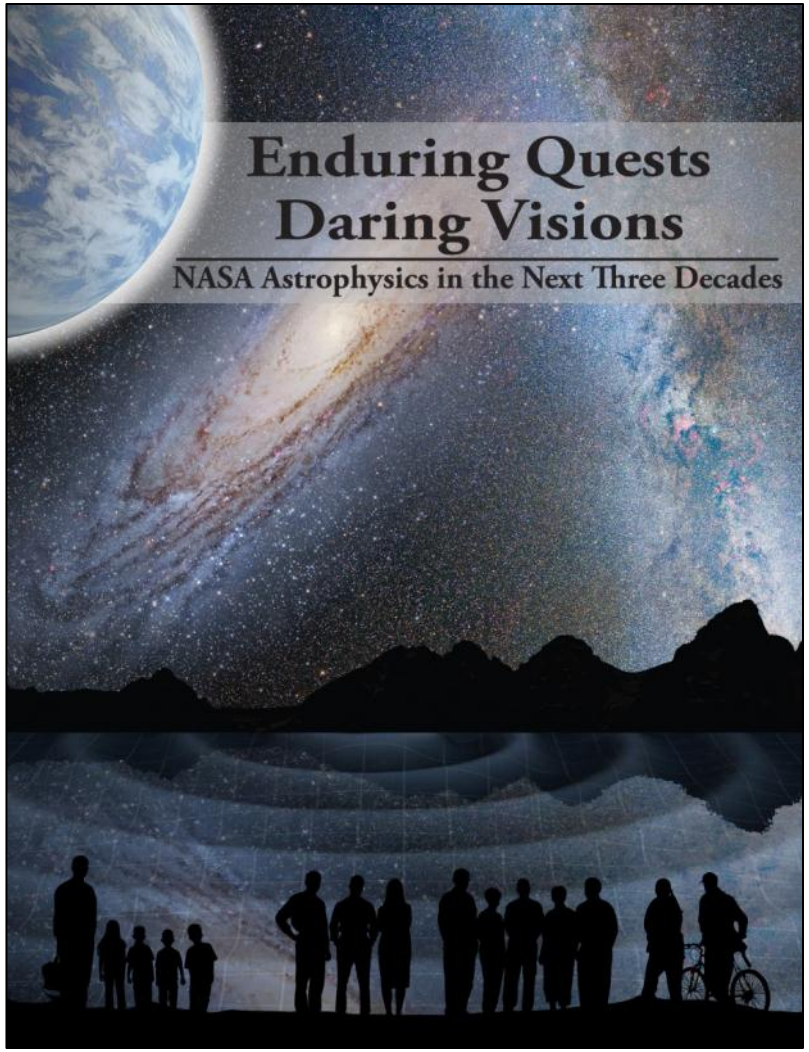
Progress Toward Decadal Survey Priorities

The NASA FY14 Appropriation, the President's FY15 Budget Request, and its notional out years support:	
L1. WFIRST	Preformulation and focused technology development for WFIRST/AFTA (a 2.4m version of WFIRST with a coronagraph) are underway to enable a new start NET FY17.
L2. Augmentation to Explorer Program	Increased to ~$140M/yr by FY16; supports decadal cadence of AOs including AO for SMEX in Fall 2014. MIDEX in approx 2017.
L3. LISA	Strategic astrophysics technology (SAT) investments including LISA Pathfinder plus discussing partnership on ESA's L3 gravitational wave observatory.
L4. IXO	Strategic astrophysics technology (SAT) investments plus discussing partnership on ESA's L2 X-ray observatory.
M1. New Worlds Technology Development Program	Focused technology development for a coronagraph on WFIRST; exoplanet probe mission concept studies and strategic astrophysics technology (SAT) investments
M2. Inflation Probe Technology Development Program	Three balloon-borne investigations plus strategic astrophysics technology (SAT) investments
Small. Research Program Augmentations	Increased from $65M (FY07) to $74M (FY10) to $82M (FY12 and beyond)

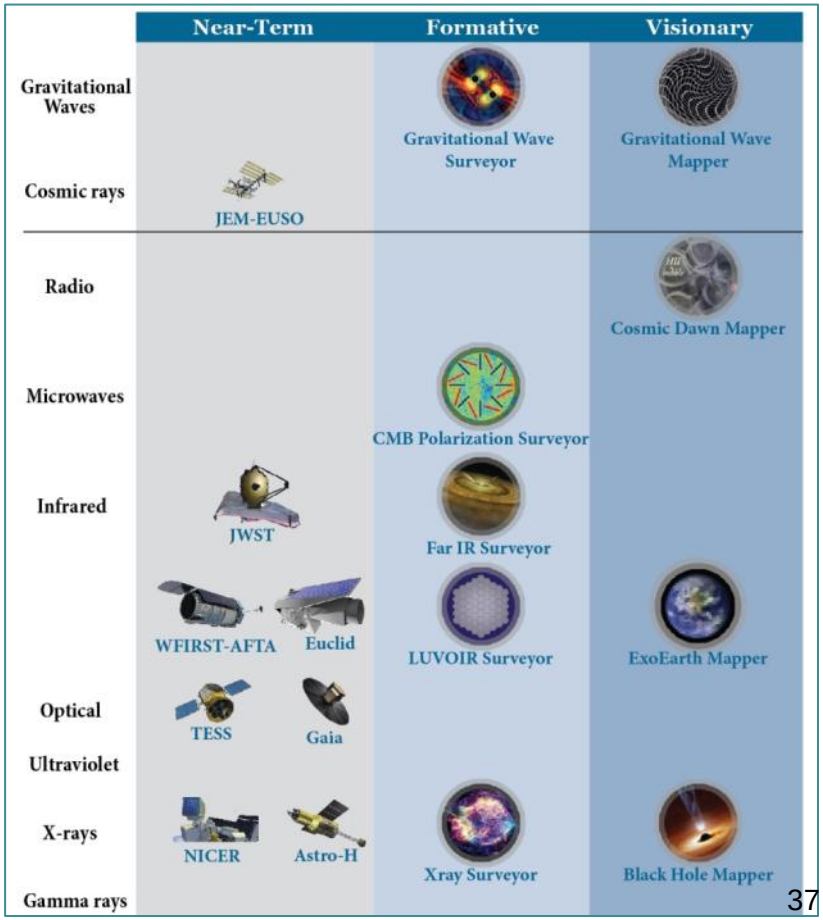
Implementing the Decadal Survey



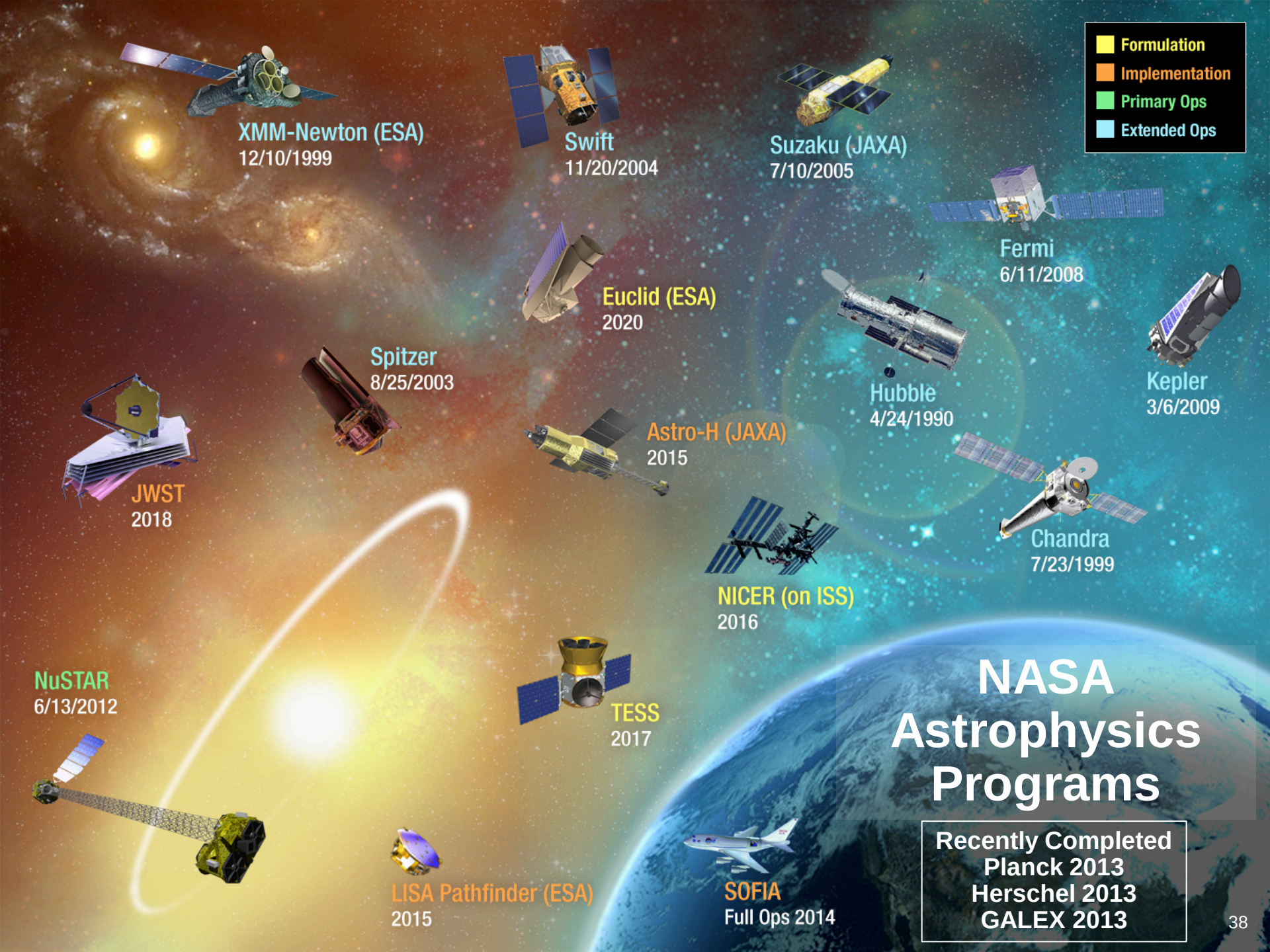
Enduring Quests, Daring Visions



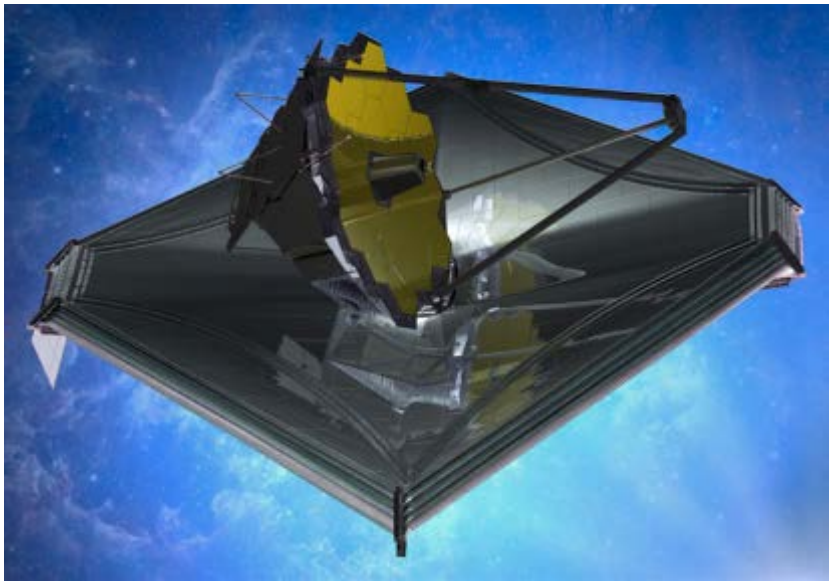
- A 30 year vision to address the enduring questions:
  - Are we alone?
  - How did we get here?
  - How does the universe work?



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


Formulation
Implementation
Primary Ops
Extended Ops
XMM-Newton (ESA)
12/10/1999
Swift
11/20/2004
Suzaku (JAXA)
7/10/2005
Fermi
6/11/2008
Euclid (ESA)
2020
Spitzer
8/25/2003
Hubble
4/24/1990
Kepler
3/6/2009
JWST
2018
Astro-H (JAXA)
2015
Chandra
7/23/1999
NICER (on ISS)
2016
NuSTAR
6/13/2012
TESS
2017
LISA Pathfinder (ESA)
2015
SOFIA
Full Ops 2014
NASA Astrophysics Programs
Recently Completed
Planck 2013
Herschel 2013
GALEX 2013

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

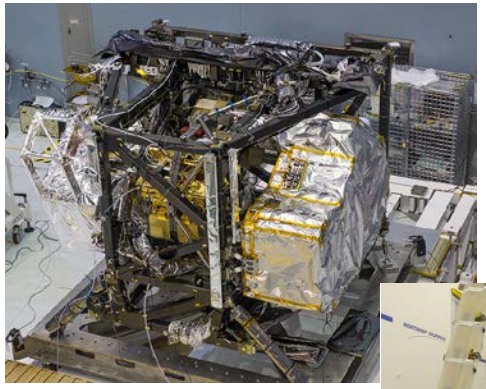
Partners: ESA, CSA

CURRENT STATUS:

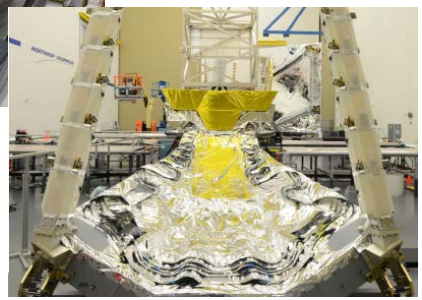
- Project has entered its long and challenging Integration and Test activities.
- Technical progress continues to be significant.
  - Instruments are delivered and in integration & test phase. ISIM cryo-vac test #2 starts mid-June 2014.
  - All optics are complete (primary segments, secondary, tertiary and fine steering mirrors) and delivered to GSFC.
  - Telescope wings and backplane support fixture and center section are in final acceptance testing.
  - Project passed system Look-back review (May 2014).
- Project is performing within the budget, to schedule.
  - Government shutdown did not impact October 2018 launch date.
- FY14 is the peak funding year with many critical activities.

JWST Progress

- All science instruments installed into ISIM for cryo-vacuum testing this month
- First two of 5 flight sunshields being manufactured, 5 engineering sunshields being used for deployment testing
- Spacecraft bus under construction
- Good progress continues on telescope flight backplane testing and backplane pathfinder
- Program remains on track for October 2018 launch and within budget.



ISIM with all instruments



5 engineering sunshields folded for deployment testing

Flight telescope backplane & backplane support fixture

Pathfinder (backplane center section with secondary mirror structure)

JWST on Track for 2018 Launch

WFIRST / AFTA

Widefield Infrared Survey Telescope with Astrophysics Focused Telescope Assets

- FY14 appropriation supports pre-formulation of WFIRST/AFTA, including technology development for detectors and coronagraph (with STMD).

- FY15 request supports Agency/Administration decision for formulation to begin NET FY 2017, should funding be available.

- Recent NRC study on WFIRST/AFTA offers positive view of AFTA, with concerns about technology and cost risks

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

CURRENT STATUS:

- May 2013, NASA Administrator Bolden directed study of WFIRST/AFTA and preserve option for FY17 new start if budget is available.
  - No decision expected before early 2016.
- Currently in pre-formulation phase.
  - AFTA endorsed by NRC study report released March 2014.
  - Interim SDT report posted April 30, 2014
  - SDT final report due Jan 2015.
- Maturing key technologies to TRL 5 by FY17 and TRL 6 by FY19.
  - H4RG infrared detectors for widefield imager.
  - Internal coronagraph for exoplanet characterization (two architectures identified December 2013; occulting mask coronagraph and phased induced amplitude apodization complex mask coronagraph).
- FY14 Appropriation and FY15 Request support
  - Assessment of the 2.4m telescopes, mission design trades, payload accommodation studies, and observatory performance simulations.

WFIRST / AFTA

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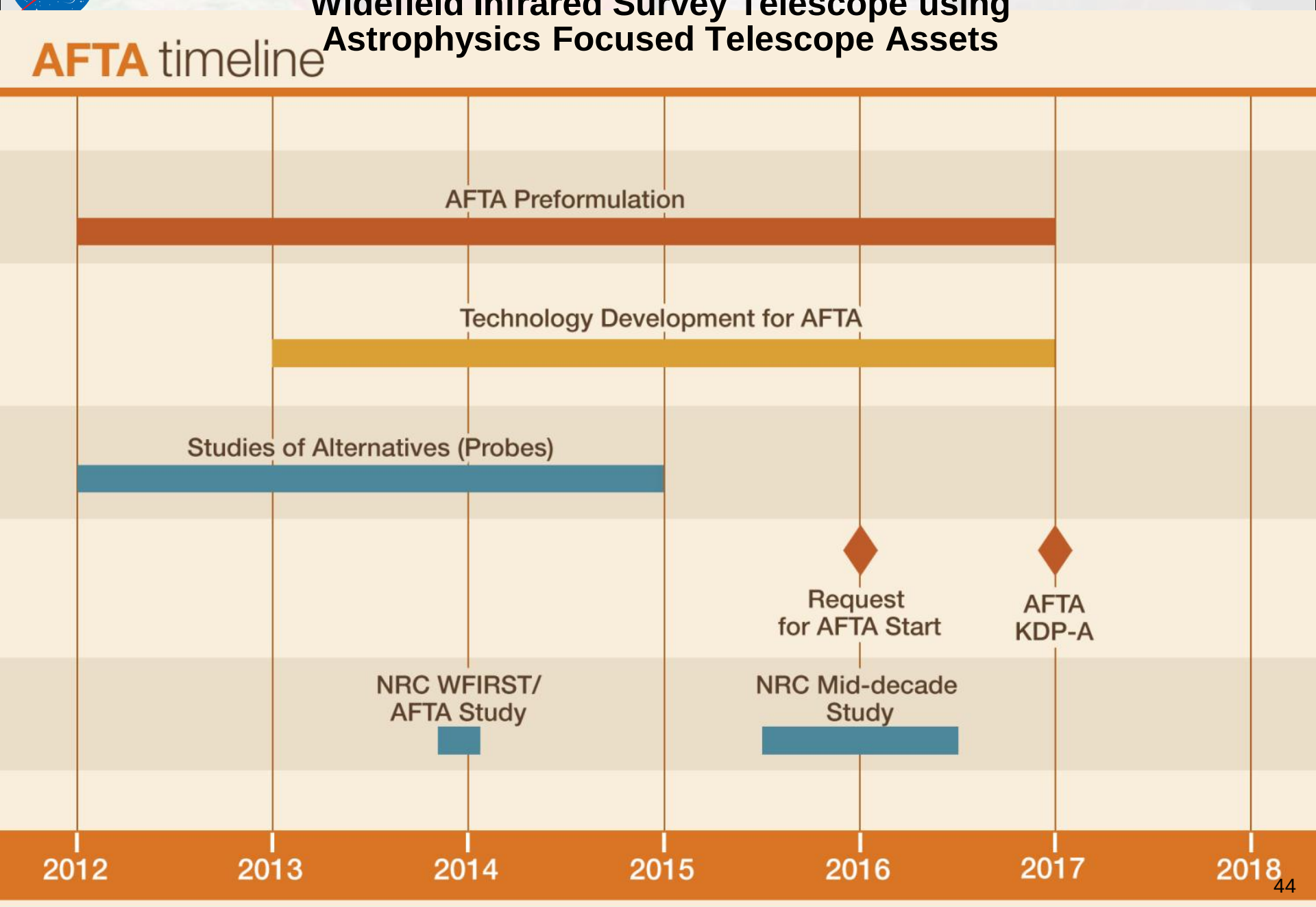
- FY15 request supports Agency/Administration decision for formulation to begin NET FY 2017, should funding be available.

- Recent NRC study on WFIRST/AFTA offers positive view of WFIRST/AFTA with concerns about technology and cost risks.

Plan for WFIRST-AFTA Preformulation

Widefield Infrared Survey Telescope using Astrophysics Focused Telescope Assets



WFIRST/AFTA to continue Pre-Formulation

- Supports pre-formulation of WFIRST/AFTA, including technology development for detectors and coronagraph.
- Continues efforts from FY14 such as:
  - The WFIRST/AFTA Science Definition Team (SDT) interim report released April 30, 2014 and final report in early 2015 including a design reference mission and draft science requirements.
  - The WFIRST/AFTA Study Office including continued assessment of the 2.4m telescopes, mission design trades, payload accommodation studies, and observatory performance simulations.
  - Technology development for H4RG detectors for the wide field camera.
  - Technology development for the primary coronagraph architecture (occulting mask coronagraph) and the backup coronagraph architecture (phased induced amplitude apodization complex mask coronagraph).
- Supports Agency/Administration decision for formulation to begin NET FY 2017, should funding be available.

WFIRST Preparatory Science

- New ROSES Element, announced April 21.
- Proposals due July 11.
- Purpose: bridge from basic theory to observational modeling for WFIRST/AFTA.
- Proposals must be both:
  - Relevant to WFIRST's primary astrophysics goals.
  - Predominantly WFIRST-specific development of detailed simulations and models.
- Anticipate selecting ~12 proposals, total $1.8M in first year.
- Intend to select a range of scales (smaller and larger) and periods of performance (1,2,3 yr).
- Investigators selected will coordinate efforts with WFIRST Study Office and WFIRST/AFTA Science Definition Team.
  - Annual summary white paper on progress.

SOFIA
Stratospheric Observatory for Infrared Astronomy

- **World's Largest Airborne Observatory**
- 2.5-meter telescope
- Capable of observing from the visible to the far infrared
- 80/20 Partnership between NASA and the German Aerospace Center (DLR)
- Mission Ops based at NASA-Armstrong
- Science Ops based at NASA-Ames
- Six First-Generation instruments
  - Four U.S., two German
  - Imaging, Spectroscopy, and Photometry
- Limited Science Ops began in 2010
- Full Operational Capability in February 2014

CURRENT STATUS:

- Achieved Full Operational Capability (FOC) February 2014.
- Began Cycle 2 Science Observations February 2014.
- Completed commissioning flights for Field-Imaging Far-Infrared Line Spectrometer (FIFI-LS) April 2014 (5th instrument).
- Initiated commissioning of Echelon-Cross-Echelle Spectrograph (EXES) April 2014 (6th instrument).
- Demonstrating high cadence science operations in April/May 2014
- Formally entered Operational Phase May 2014.
- Second generation instruments under development (1 U.S., 1 German)
  - HAWC+: far infrared imager and polarimeter
  - upGREAT: multi-pixel heterodyne spectrometer
- President's FY15 budget request proposes to end funding and place SOFIA in storage.
  - NASA/DLR Working Group analyzed several scenarios to establish SOFIA's path forward.
  - Currently executing SOFIA's baseline schedule of operations and scheduled maintenance for FY14.
  - House proposed $70M for FY15 operations.

SOFIA Working Group

- NASA and DLR formed a working group (WG) to develop a go forward plan for SOFIA.
- Overall objectives included maximizing scientific return within U.S. budget constraints; supporting critical near-term decisions; and identification of long-term options for continued operations or for storage until such time that additional funds are made available for resumption of SOFIA operations.
- The WG presented its final report to the NASA and DLR Astrophysics Directors on April 29.
- One dozen scenarios were studied, with three chosen for the most detailed analysis:
  - Decommissioning the Observatory *(compliant with intent of FY 2015 budget request).*
  - Continued Operations with Heavy Maintenance as scheduled in 2014 *(contingency scenario if appropriation does not match budget request).*
  - Continued Operations with Heavy Maintenance deferred to late 2015.
- Complete decommissioning cannot be accomplished within the FY 2015 budget request.
- NASA and DLR are working to preserve the option to conduct Heavy Maintenance in 2014.

SOFIA Path Forward

- SOFIA's high operating costs cannot be accommodated within the reduced FY 2015 Astrophysics budget request.
- The Administration's FY 2015 budget request to Congress proposes to place SOFIA into storage by FY 2015.
- NASA and DLR are executing SOFIA's baseline schedule of operations for FY 2014, consistent with NASA's approved FY 2014 Operating Plan.
- A joint NASA/DLR Working Group analyzed several scenarios to establish SOFIA's path forward within the range of possible outcomes from the U.S. budget process.
- The U.S. budget process continues within the Appropriations Committees of the House and Senate.
  - The draft House NASA FY 2015 Authorization Bill directs NASA not to spend FY 2014 funding in terminating SOFIA.
  - The draft House FY 2015 Appropriations Bill, which includes NASA, proposes $70M in FY 2015 for operating SOFIA.
  - The Senate will work on a FY 2015 Appropriations Bill, which includes NASA, in early June.

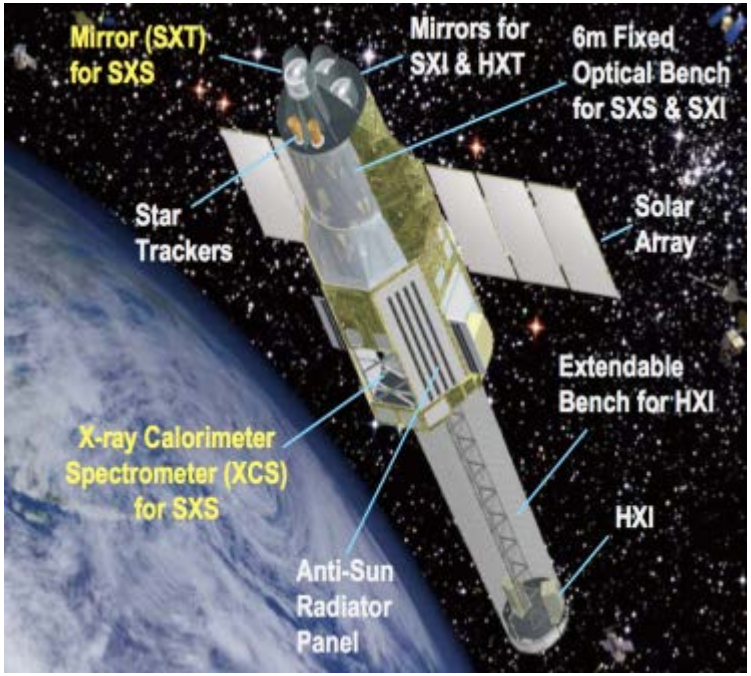
Kepler
Kepler Space Telescope

- **NASA's first space mission dedicated to the search for extrasolar planets, or exoplanets**
- **PI:** W. Borucki, NASA Ames Research Center
- **Launch Date:** March 6, 2009
- **Payload:** 0.95-meter diameter telescope designed to measure the tiny dimming that occurs when an orbiting planet passes in front of ('transits') a star
- **Scientific objectives:**
  - conduct census of exoplanet systems
  - explore the structure and diversity of extrasolar planetary systems
  - determine the frequency of habitable, Earth-sized planets in our galaxy

CURRENT STATUS:

- Kepler "K2" mission concept approved for operations through Fiscal Year 2016 after completion of 2014 Senior Review.
  - Kepler will conduct observations along the ecliptic, changing its orientation four times per year.
  - First 75-day Campaign to begin in June.
  - Targets selected via proposals from community.
- From 2009-13, Kepler continuously monitored 100 sq. deg. field in constellations of Cygnus and Lyra for 4+ years.
  - These observations ended after failure of 2nd reaction wheel
- Analysis of first 3 years of Kepler data has revealed:
  - 3845 exoplanet candidates orbiting 2658 unique stars
  - 962 candidates confirmed as planets to date
  - More than 100 planets discovered in their star's "habitable zone"
  - two dozen of the habitable zone planet candidates are less than twice the size of the Earth
- Analysis of the full (4+ year) Kepler data set ongoing.

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



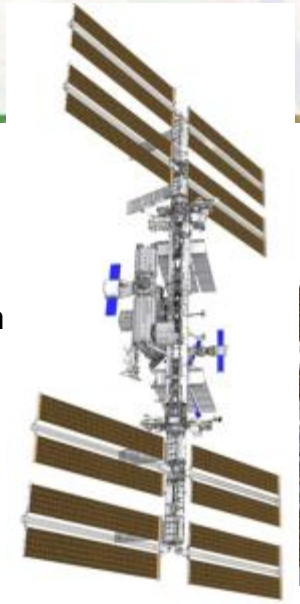
- **Explorer Mission of Opportunity**
- **PI**: R. Kelley, Goddard Space Flight Center
- **Launch Date**: Nov 2015 on JAXA H-IIA
- **Science Objectives**: Study the physics of cosmic sources via high-resolution X-ray spectroscopy. The SXS will enable a wide range of physical measurements of sources ranging from stellar coronae to clusters of galaxies.
- **Operations**: Prime Mission is 3 years

CURRENT STATUS

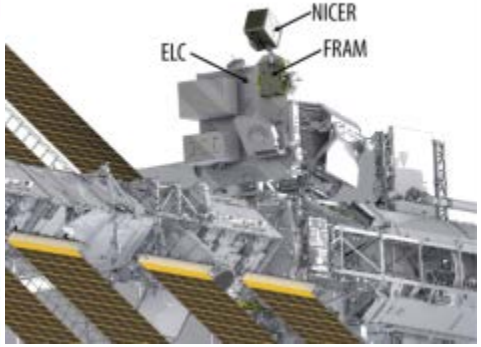
The U.S. is providing instrument contributions to the JAXA ASTRO-H mission.

- Soft X-ray telescope mirrors (SXT-S and SXT-I) – Both delivered.
- Calorimeter Spectrometer Insert (CSI) – delivered and integrated on to the FM Dewar and has successfully been tested at the 2-stage mode. Currently undergoing 3-stage mode testing and is progressing well.
- SXS Electronics Box – Delivery June 2014
- June 2014 Update: Early FM Dewar performance testing is progressing well and meeting test goals

NICER
Neutron Star Interior Composition Explorer



Intl Space Station (ISS)

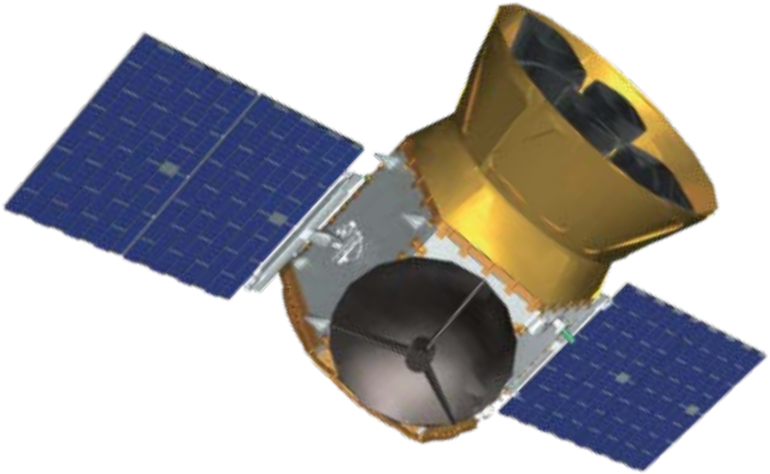


- **Explorer Mission of Opportunity**
- **PI:** Keith Gendreau, GSFC
- **Launch:** August 2016 on Space-X Falcon 9
- **Science Objectives:** Perform high-time-resolution and spectroscopic observations of neutron stars in the .2-12 keV energy range to study the physics of ultra-dense matter in the core of neutron stars.
- **Instrument:** X-ray Timing Instrument uses X-ray concentrators and detectors to detect X-ray photons and return energy and time of arrival.
- **Platform:** Located externally on the ISS, ExPRESS Logistics Carrier 2, Starboard 3 site
- **Operations:** Operated on a non-interference basis for 18 months
- **SEXTANT** for Pulsar navigation demo funded by NASA's Space Technology Mission Directorate

CURRENT STATUS:

- Downselected April 2013.
- Science team and project management both led by NASA GSFC.
- Development progressing on plan.
- The Preliminary Design Review successfully completed in December 2013.
- NICER passed Confirmation (KDP-C), for approval to enter implementation phase, on February 24, 2014.
- All major contracts have been awarded for optics, pointing system and star tracker
- Design is maturing quickly; engineering test units of the optics have been manufactured and tested
- Critical design review (CDR) planned for September 2014

TESS
Transiting Exoplanet Survey Satellite



Standard Explorer (EX) Mission

PI: G. Ricker (MIT)

Mission: All-Sky photometric exoplanet mapping mission.

Science goal: Search for transiting exoplanets around the closest and brightest stars in the sky.

Instruments: Four wide field of view (24x24 degrees) CCD cameras with overlapping field of view–operating in the Visible-IR spectrum (0.6-1 micron).

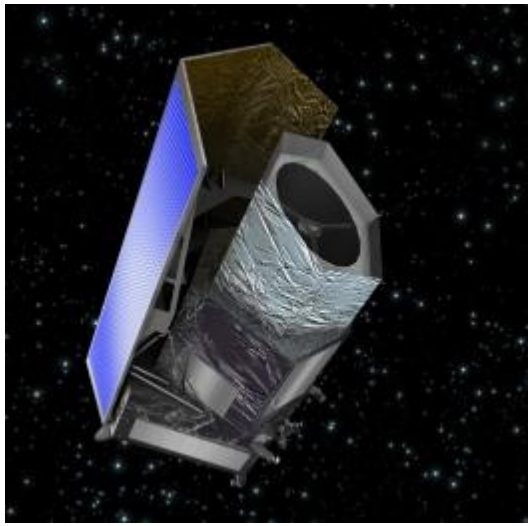
Operations: 2017 launch with a 2-year prime mission

CURRENT STATUS:

- Downselected April 2013.
- Major partners:
  - PI and science lead: MIT
  - Project management: NASA GSFC
  - Instrument: Lincoln Lab
  - Spacecraft: Orbital Science Corp
- Tentative launch readiness date August 2017.
- High-Earth elliptical orbit (17 x 58.7 Earth radii).
- Development progressing on plan.
  - Systems Requirement Review successfully completed on February 12-13, 2014.
  - Confirmation Review, for approval to enter implementation phase, is planned for Fall 2014.

Euclid

A visible and near-infrared telescope to explore cosmic evolution



- **ESA Cosmic Vision 2015-2025 Mission**, M-Class with NASA participation.
- 1.2-m mirror, visible & near-IR images, spectra
- **Launch Date**: Mar 2020
- **Science Objectives**:
  - Euclid will look back 10 billion years into cosmic history.
  - Probe the history of cosmic expansion (influenced by dark energy and dark matter) and how gravity pulls galaxies together to form the largest structures.
  - The shapes of distant galaxies appear distorted because the gravity of dark matter bends their light (gravitational lensing). Measuring this distortion tells us how the largest structures were built up over cosmic time.
  - Measuring how strongly galaxies are clumped together tells us how gravity influences their motions, and how dark energy has affected the cosmic expansion.

CURRENT STATUS:

- NASA Euclid Project passed Confirmation (KDP-C), for approval to enter implementation phase, on September 13, 2013.
- ~50 U.S. scientists are members of the Euclid Science Team that will analyze the data, and make maps of the sky.
- First experimental manufacturing run for the Euclid near-infrared detectors to complete in FY 2014 (ESA).
- NASA will test and characterize the near-IR experimental and flight detectors.
- NASA developing ground system node and U.S. science center.

ESA's L2 Advanced X-ray Observatory

- The science theme "the hot and energetic Universe" was selected for L2, and expected to be pursued with an advanced X-ray observatory.
  - Launch date ~2028
- NASA and ESA are discussing a potential NASA contribution.
  - NASA is interested in contributing to this mission because it is responsive to the U.S. Decadal Survey. The U.S. Decadal Survey recommended an international partnership for an advanced X-ray observatory.
  - NASA announced on May 2, 2014 the upcoming release of a Dear Colleague Letter to solicit applications and nominations for U.S. participants in the ESA L2 Science Study Team.
- NASA's FY15 budget request supports a potential L2 partnership.
  - U.S. scientists are participating in proposal(s) in response to the ESA mission concept call for proposals; proposals were due April 15, 2014.
  - NASA will provide input to ESA on appropriate U.S. members of the L2 Science Study Team.
  - NASA will continue investing in technologies likely to be appropriate for an L2 contribution; investments include both directed and competed SAT investigations.
  - NASA is budgeting for development of contributed flight hardware, U.S. participation in the L2 science team, and a U.S. data center and GO program.

2014 Astrophysics Explorer AO (1 of 2)

- Community Announcement released on November 12, 2013, indicating NASA will solicit proposals for SMEX missions and Missions of Opportunity.
- Draft AO targeted for spring 2014, with Explorer Workshop ~ 2 weeks later.
- Final AO targeted for late summer/early fall 2014, with Pre-Proposal Conference ~ 3 weeks after final AO release. Proposals due 90 days after AO release.
- Missions of Opportunity allowed in all three categories: Partner Mission of Opportunity, New Missions using Existing Spacecraft, or Small Complete Mission, including those requiring flight on the ISS.
- PI-managed cost cap $35M for sub-orbital class MOs, which include ultra-long duration balloons, suborbital reusable launch vehicles, and CubeSats. Other MOs (not suborbital-class) have a $65M PI-managed cost cap.
- Two-step process. Step 1 selects 2-3 SMEX missions and 1-3 MOs for 1-year Phase A concept studies, Step 2 down-selects 1 SMEX and 1 MO for Phase B and subsequent phases.

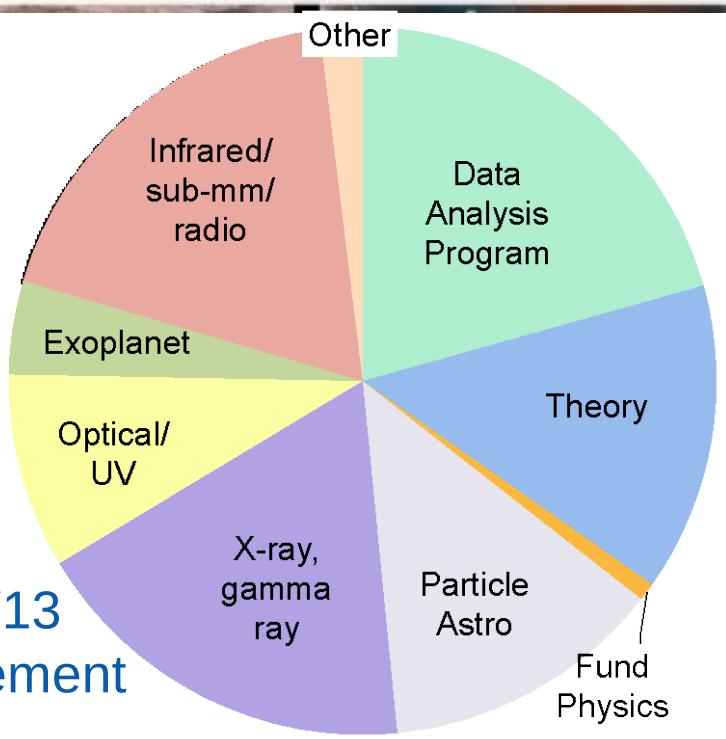
2014 Astrophysics Explorer AO (2 of 2)

- Although NASA-provided launch services are offered and may be proposed, proposers may also propose alternative access to space, including contributed launch services.
- The PI-Managed Mission Cost for proposed SMEX missions will be $175M, including the launch services.
- NASA-provided launch services may be proposed at a charge of $50M in FY 2015 dollars against the PI-Managed Mission Cost.
- For alternative access to space, which must be arranged by the proposer and funded within the $175M PI-Managed Mission Cost, a charge to the PI-Managed Mission Cost of $2M will be levied for the expected NASA launch vehicle monitoring functions and advisory services.

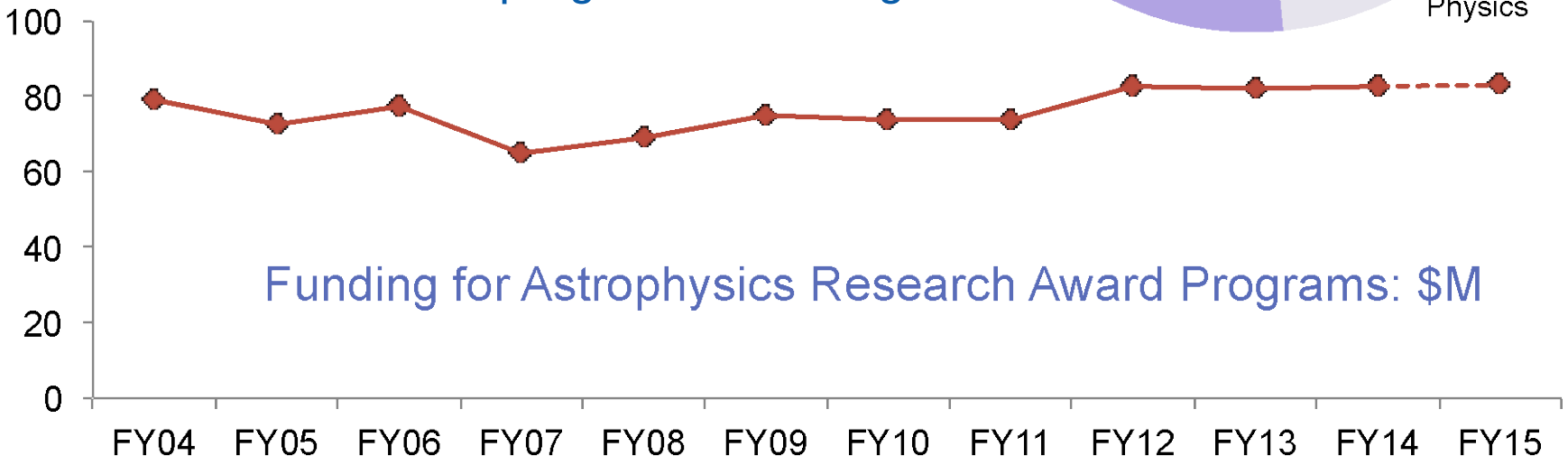
Astrophysics Research Program Funding

Most recent year:

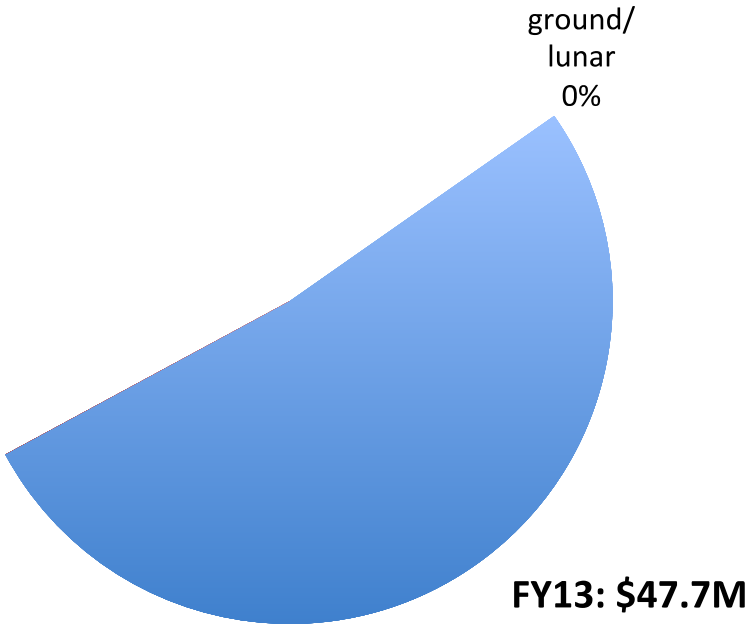
	Proposals Rec'd	Year-1 $M	selected	Success Rate
RTF-12	12	0.6	2	17%
APRA-12	178	13.6	37	21%
SAT-12	38	5.2	9	24%
ADAP-13	276	4.4	41	15%
OSS-13	39	0.9	7	18%
ATP-13	181	3.9	27	15%

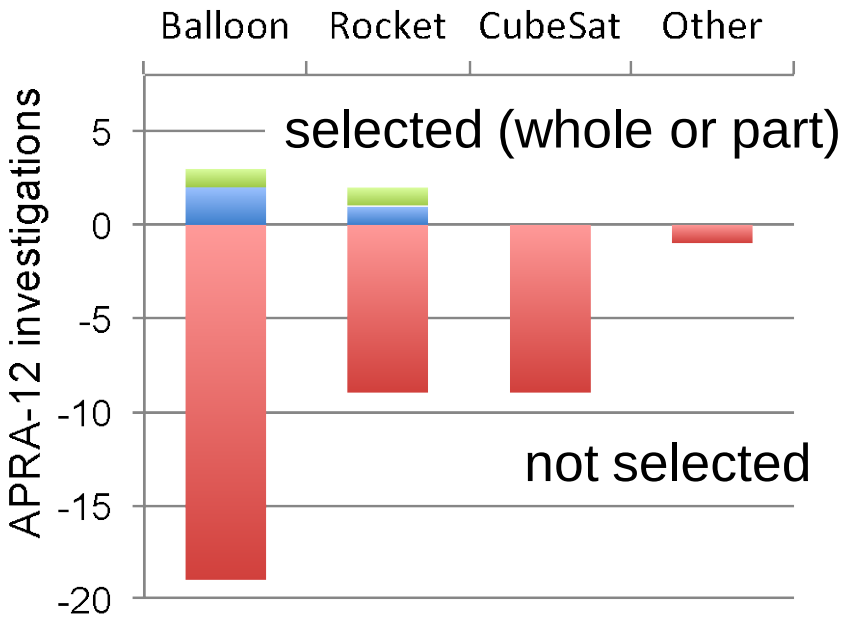


Split of $81.967M spent in FY13
PI award programs + management



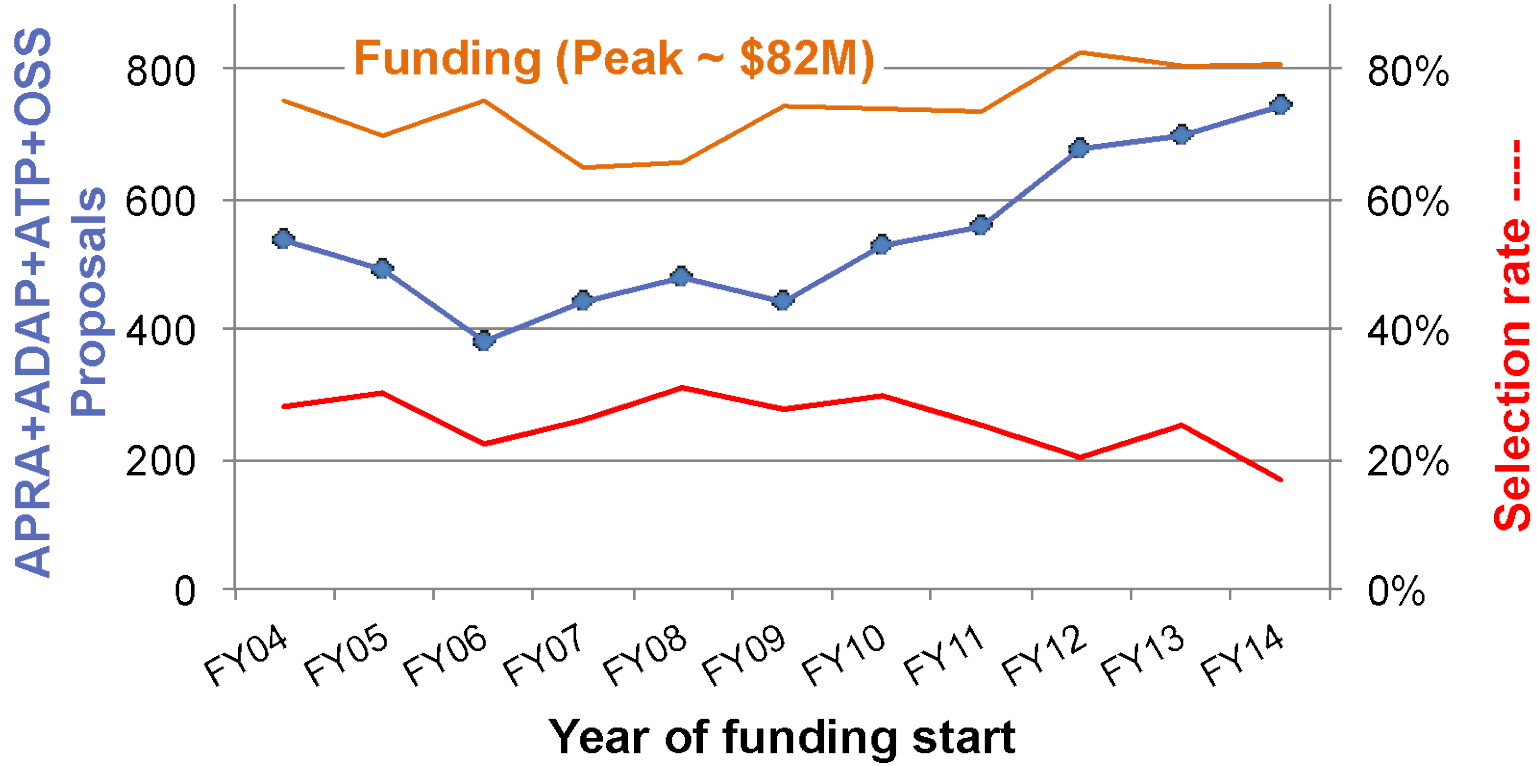
APRA (sub)orbital payloads





Roughly half of APRA funding is spent on suborbital-class payloads.

Astrophysics ROSES selection rates

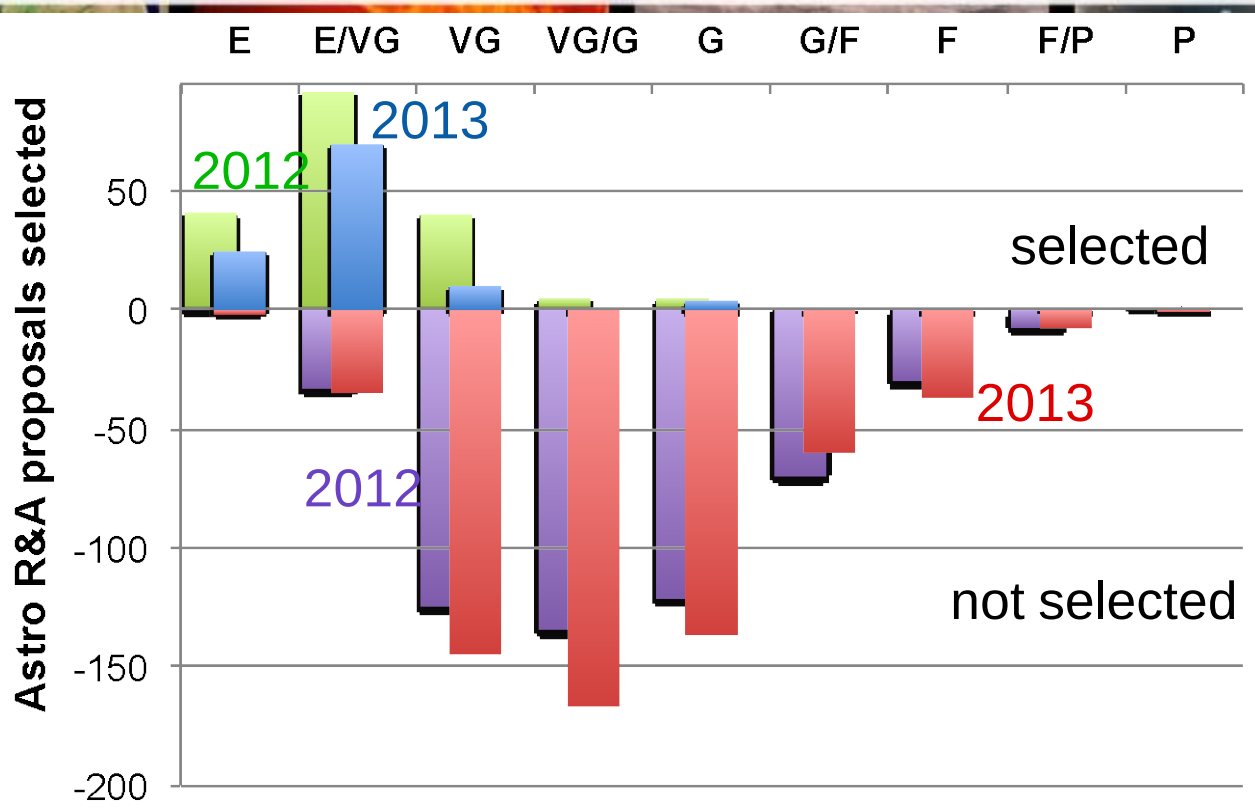


Last year, the Astrophysics Research Program received twice as many proposals as in 2006.

Funding for the program has risen 25% since 2006, but it has not doubled; so the success rate has fallen.

Total funding per successful proposal has been steady at $500k-$600k – this is an average over theory investigations, flight payloads, etc.

Astrophysics ROSES selections by rating



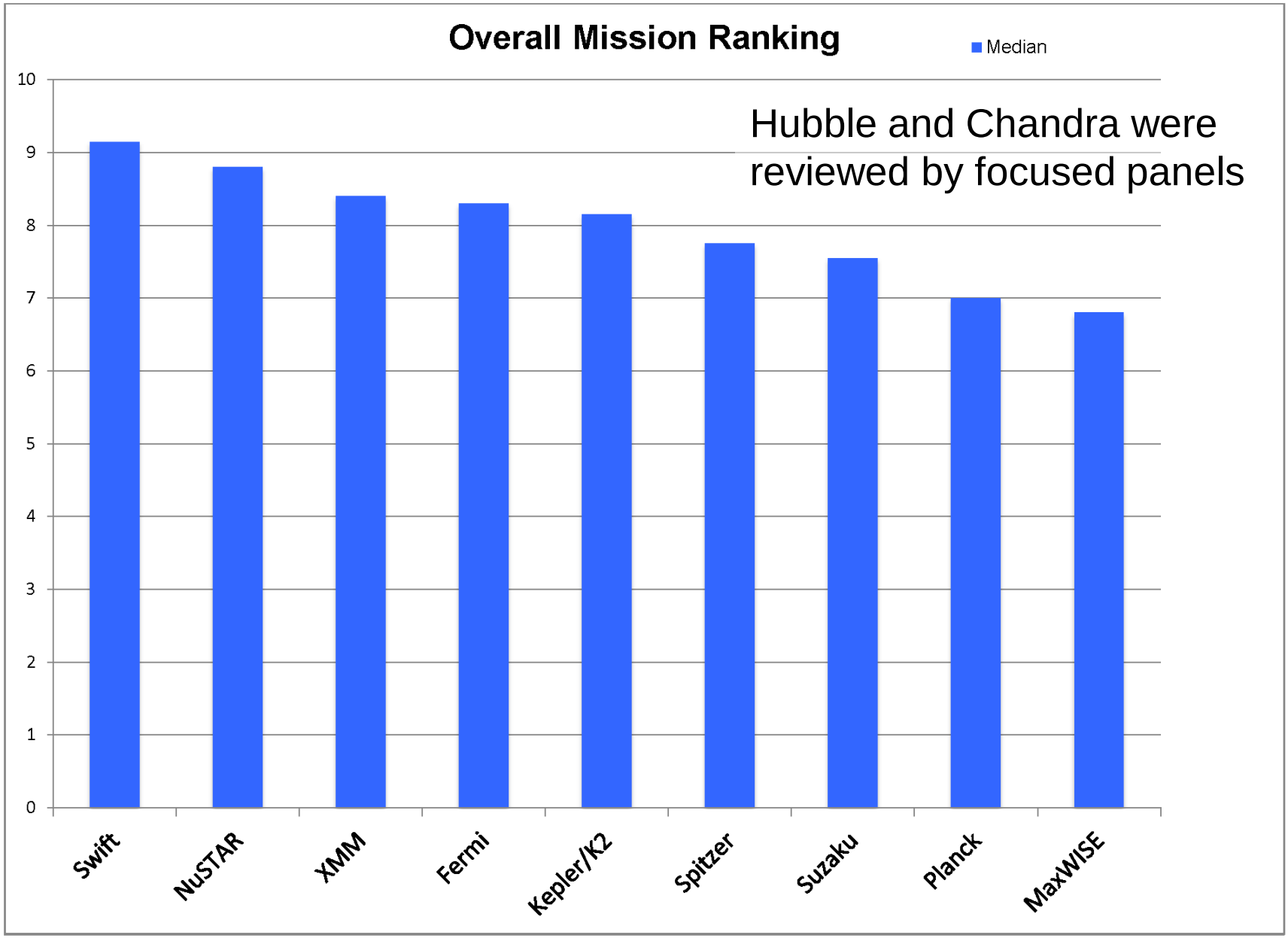
Of 726 proposals to the Astrophysics core R&A program (ADAP, APRA, SAT, ATP, OSS) in 2012, 25% were selected (green); 75% were declined (purple). Of 339 proposals rated VG or better, 51% were selected.

Of 713 proposals to these programs in 2013, 17% were selected (blue); 83% were declined (red). Of 299 proposals rated VG or better, 39% were selected.

Astrophysics R&A budget keeps FY12 gains…

Amounts in $k	FY07 Final	FY08 Final	FY09 Final	FY10 Final	FY11 Final	FY12 Final	FY13 Final	FY14 Op Plan	FY15 Request
Particle Astro	$ 7,631	$ 6,672	$ 8,201	$ 8,260	$ 8,243	$ 9,375	$ 10,545	$ 8,265	
High Energy	$ 12,782	$ 12,406	$ 13,886	$ 14,110	$ 13,911	$ 14,943	$ 14,345	$ 13,846	
UV/Opt/IR/ Sub-mm	$ 17,442	$ 19,094	$ 22,353	$ 21,534	$ 21,295	$ 23,378	$ 21,939	$ 21,781	
Other	$ 394	$ 594	$ 670	$ 673	$ 641	$ 2,018	$ 1,591	$ 2,123	
APRA Total	$ 38,250	$ 38,765	$ 45,110	$ 44,577	$ 44,090	$ 50,573	$ 47,495	$ 44,752	
Orig Solar Systems	$ 3,673	$ 2,965	$ 3,000	$ 2,807	$ 2,944	$ 3,244	$ 3,500	$ 3,700	
Astro Theory Program	$ 10,227	$ 11,696	$ 11,890	$ 12,262	$ 12,148	$ 11,816	$ 11,557	$ 12,500	
TCAN with NSF								$ 1,500	
Tech Fellows						$ 538	$ 895	$ 1,200	
R&A (399131)	$ 52,150	$ 53,426	$ 60,000	$ 59,646	$ 59,611	$ 66,172	$ 65,038	$ 63,275	$ 66,030
ADAP/LTSA	$ 12,641	$ 12,013	$ 14,384	$ 13,258	$ 14,132	$ 16,365	$ 16,929	$ 17,008	$ 16,983
Core R&A	$ 64,791	$ 65,439	$ 74,384	$ 72,904	$ 73,743	$ 82,537	$ 81,967	$ 82,783	$ 83,013
ASMCS (399131)		$ 3,452	$ 442	Fund Phys in PCOS SR&T in FY10-11; now APRA			WFIRST support	$ 2,500	
Fundamental Physics				$ 968	$ 613	$ 860	$ 666	$ 859	
TOTAL ($M)	**$ 64.79**	**$ 68.89**	**$ 74.83**	**$ 73.87**	**$ 73.93**	**$ 82.54**	**$ 81.97**	**$ 82.78**	**$ 83.01**
	15% cut from FY06	partial recovery	more R&A recovery	flat	flat	growth!		growth	retained!

Astrophysics 2014 Senior Review



Astrophysics 2014 Senior Review

- Hubble Space Telescope: extension approved
- Chandra X-ray Observatory: extension approved
- Swift Gamma-ray Burst Explorer: extension approved
- Nuclear Spectroscopic Telescope Array (NuSTAR): extension approved and new GO program
- X-ray Multi-Mirror Mission-Newton (XMM-Newton) (ESA mission): extension approved and augmented GO program
- Fermi Gamma-ray Space telescope: extension approved
- Kepler Space Telescope: K2 extension approved
- Spitzer Space Telescope: mission not extended
- Suzaku (JAXA mission): extension approved
- Planck (ESA mission): augmentation approved
- Widefield Infrared Survey Explorer (NEOWISE-R): data analysis proposal not approved

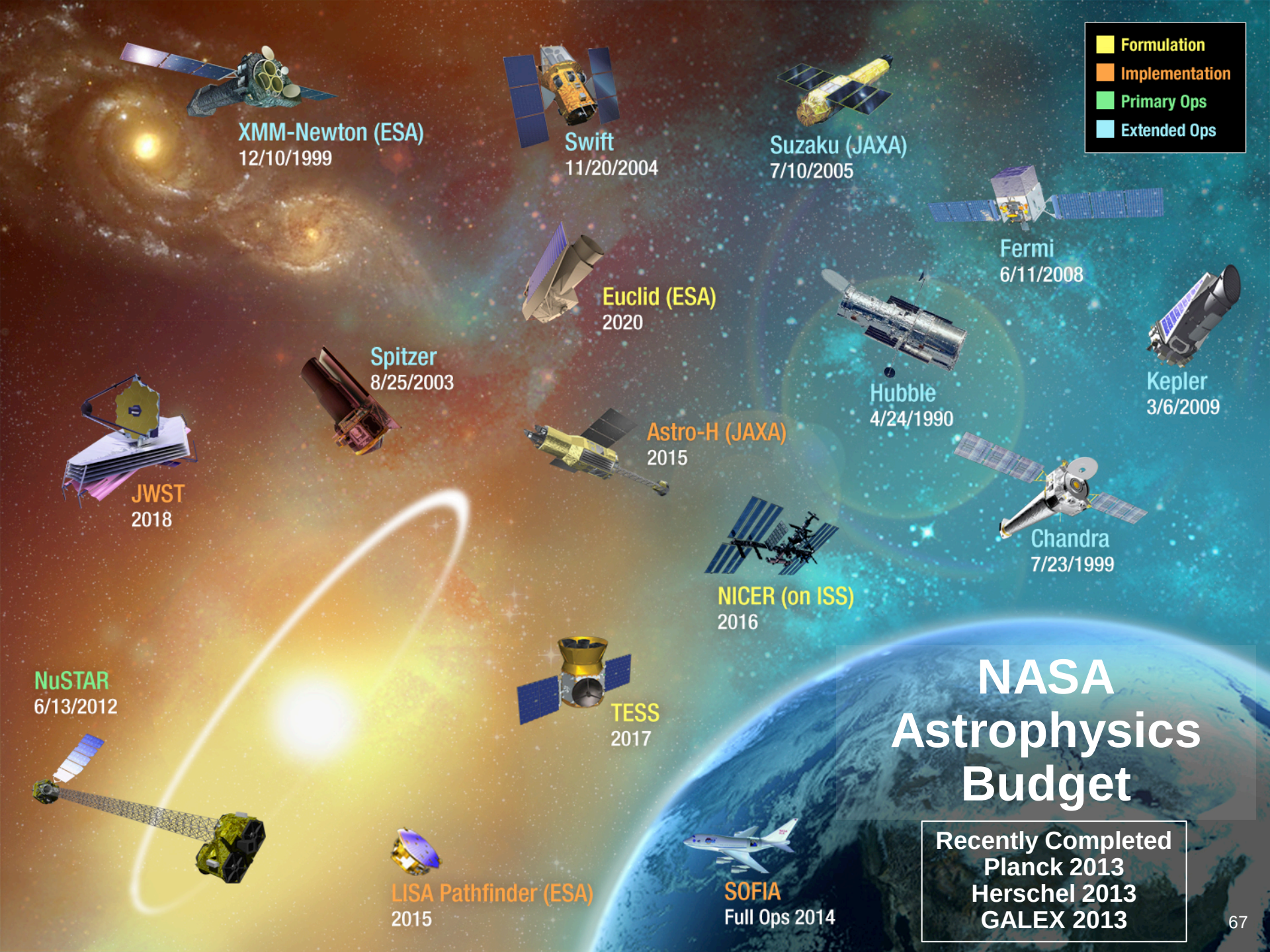
http://science.nasa.gov/astrophysics/2014-senior-review-operating-missions/

Education and Public Outreach

- The FY14 appropriated budget does not included any restoration of funding for education, but it does direct SMD to continue conducting education activities and to consider consolidation at the Division level.
- For FY15 SMD will assess its portfolio of education activities and competitively allocate funding to the highest priority education projects within NASA Science.
- FY14 is a bridge year between old and new education practices. SMD has adopted some unifying principles.
  - Each Division would preserve its mission education funding at an appropriate level
  - Investments would be focused on content
  - Education funding can be consolidated, with one mission supporting other missions
  - Education would no longer “be part of everything we do,” and some missions, projects, and programs might have no education activities
- For FY14, Astrophysics is consolidating as follows.
  - STScI will consolidate education activities for COR missions including Hubble, JWST, and other COR activities, but excluding SOFIA and JPL/IPAC missions.
  - Chandra will consolidate education activities for PCOS missions including Chandra, Fermi, and other PCOS activities, but excluding JPL/IPAC missions.
  - ExEP Program Office at JPL will consolidate education activities for ExEP missions including Kepler, NExScI, other ExEP activities, as well as JPL/IPAC missions.
  - SOFIA –SOFIA will continue the Airborne Astronomy Ambassadors program for FY14 that was previously approved.

FY15 Planned Accomplishments

- The **TESS** Explorer Mission will be confirmed to begin implementation (KDP-C) in FY15
- The **ISS-CREAM** experiment will be launched to the International Space Station (KDP-E) in FY15
- The Step 1 selection (KDP-A) will be made for the next Small Astrophysics **Explorer** and Explorer Mission of Opportunity in FY15
- ESA's **LISA Pathfinder** with NASA's ST-7 experiment will launch (KDP-E) in FY15
- The **WFIRST/AFTA** science definition team report will be completed in FY15
- Manufacture, assembly, and test of the **Euclid** flight detectors will continue in FY15
- JAXA's **ASTRO-H** mission spacecraft system level test will take place in FY15
- The Astrophysics **Archives Senior Review** will be held in FY15
- **Hubble** will achieve 25 years of operation in FY15
- The NRC **Mid-Decade Review** will begin in FY15
- Four **Balloon** campaigns in FY15
- Five **Sounding Rocket** launches in FY15


Formulation
Implementation
Primary Ops
Extended Ops
XMM-Newton (ESA)
12/10/1999
Swift
11/20/2004
Suzaku (JAXA)
7/10/2005
Fermi
6/11/2008
Euclid (ESA)
2020
Spitzer
8/25/2003
Hubble
4/24/1990
Kepler
3/6/2009
JWST
2018
Astro-H (JAXA)
2015
Chandra
7/23/1999
NICER (on ISS)
2016
NuSTAR
6/13/2012
TESS
2017
NASA
Astrophysics
Budget
LISA Pathfinder (ESA)
2015
SOFIA
Full Ops 2014
Recently Completed
Planck 2013
Herschel 2013
GALEX 2013

Astrophysics Budget Strategy

- Use the scientific priorities of the 2010 Decadal Survey to guide strategy and inform choices.
- There is inadequate available budget to implement the 2010 Decadal Survey recommendations as written.
- A goal is to be prepared to start a new strategic NASA Astrophysics mission to follow JWST as soon as funding becomes available, while continuing to advance Decadal Survey science during the interim.
  - WFIRST-AFTA (WFIRST using existing 2.4 m telescopes)
  - Moderate missions ("probes") derived from the science objectives of the prioritized missions and recommendations in the 2010 Decadal Survey are are being studied, in addition to a large mission (WFIRST), to be prepared for a mid-decade decision.
- As appropriate, collaborate with international partners to realize Decadal Survey priorities and recommendations.
  - Partner on ESA's Euclid mission (complements WFIRST commitment)
  - Partner on ESA's L2 x-ray observatory (responds to IXO recommendation)
  - Partner on ESA's L3 gravitational wave observatory (responds to LISA recommendation)

FY14 (this year) Budget Appropriation

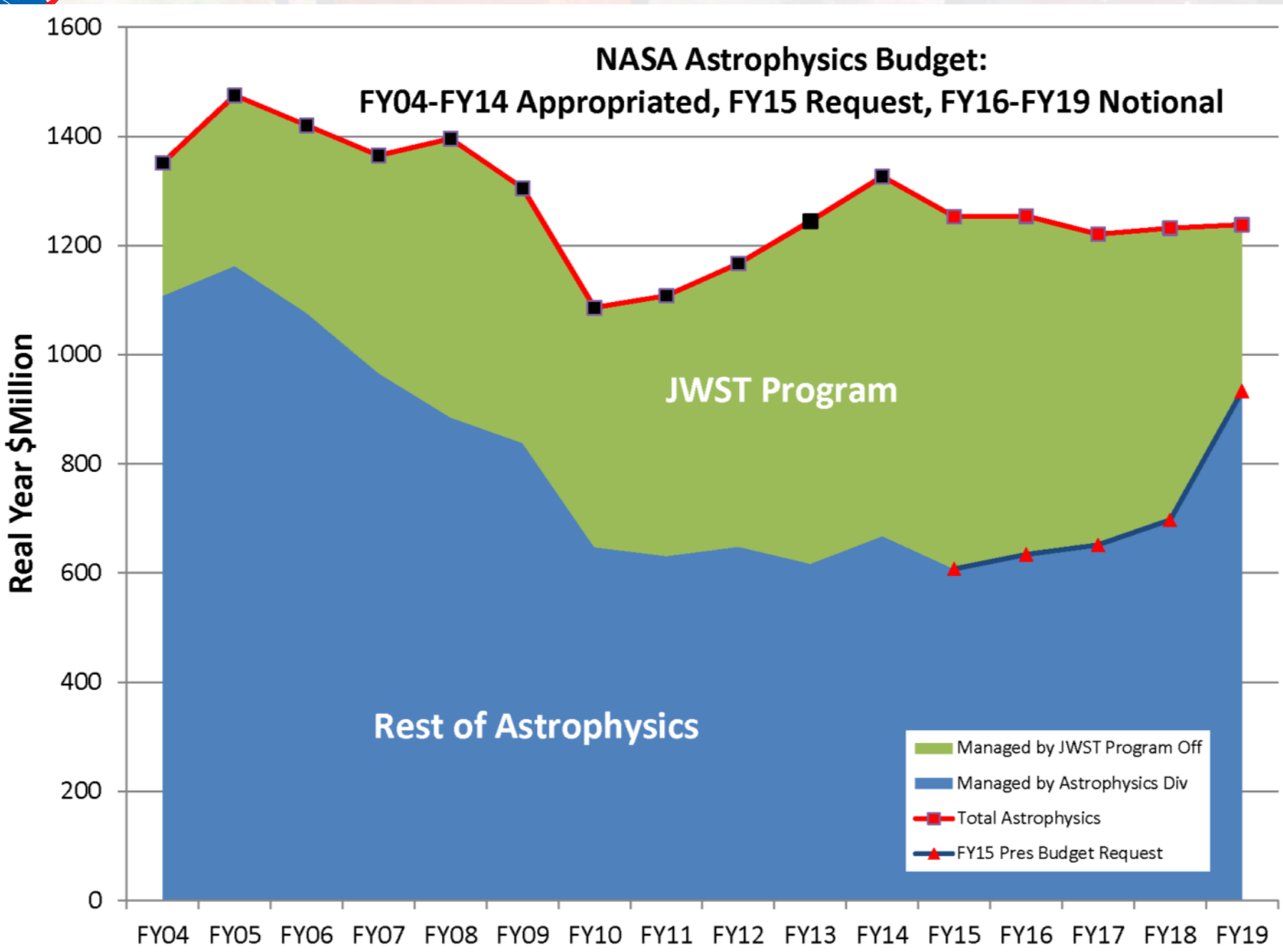
- Final FY14 Appropriation is $668M for Astrophysics and $658M for JWST.
  - **Appropriation includes new projects** for TESS, NICER, Euclid; augmentation for future Explorer AOs; core funding for research and suborbital projects; planning budget wedge for strategic mission starting NET FY17.
  - **JWST plan for 2018 launch is fully funded**.
  - **Budget is $26M higher for Astrophysics than requested**, including $56M directed funding for WFIRST/AFTA studies (compared with $13M planned).
  - Remainder of Astrophysics (other than JWST and WFIRST/AFTA) must be adjusted to accommodate the ~$20M difference; accommodated without impact by rephasing Explorers funding.
  - Appropriation includes no funding in Astrophysics for education; SMD to continue conducting education activities in FY14 and to consider consolidation at the Division level; **Astrophysics reprogrammed some funds for education activities in FY14**.
- FY15 President's budget request was released on March 4 (top level only) and March 10 (full details)

FY15 (next year) Budget Request

Outyears are notional

($M)	2013	2014	2015	2016	2017	2018	2019
Astrophysics	$617	$668	$607	$634	$651	$697	$993
JWST	$627	$658	$645	$620	$569	$535	$305

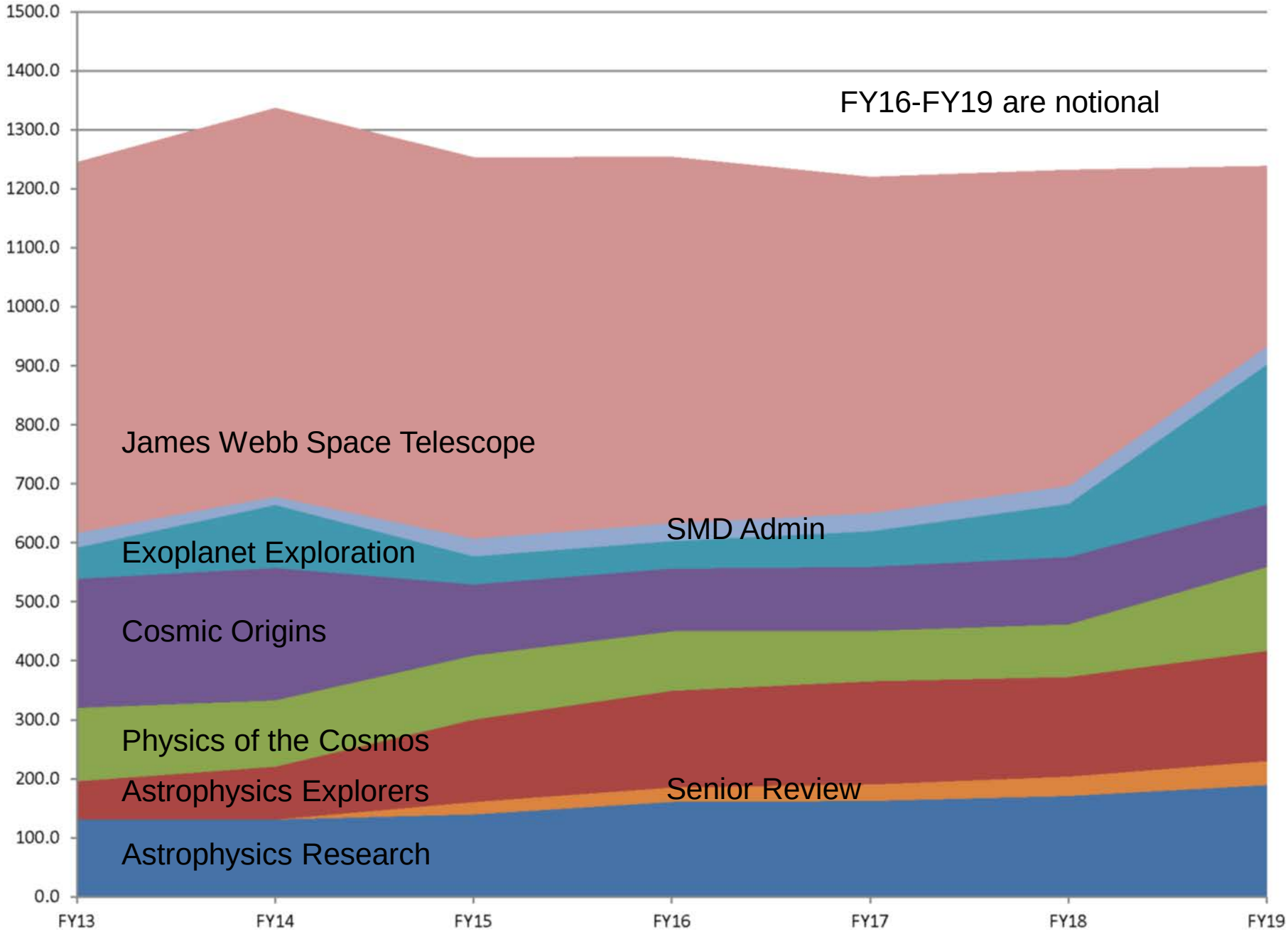
- **Supports pre-formulation of WFIRST/AFTA**, including technology development for detectors and coronagraph.
- Supports a growing Astrophysics Explorer program with continued development of ASTRO-H, NICER, and TESS, and initiation of the next Small Explorer mission.
- Supports operating missions: Hubble, Chandra, and other missions rated highly by the 2014 Senior Review.
- Continues a competed astrophysics research program and support of the balloon program.
- Seeks to work with current partner Germany and potential partners to identify a path forward for SOFIA with greatly reduced NASA funding. Unless partners are able to support the U.S. portion of SOFIA costs, **NASA will place the aircraft into storage by FY 2015**.
- **Supports the commitment to an October 2018 launch date for JWST**. Continues manufacturing of the flight sunshield structure and membranes. Completes and delivers the flight cryogenic cooler tower assembly. Delivers the Optical Telescope Element flight structure. Initiates integration of the 18 flight primary mirror segments. Conducts the final Integrated Science Instrument Module level cryo-vacuum test.


NASA Astrophysics Budget:
FY04-FY14 Appropriated, FY15 Request, FY16-FY19 Notional
Real Year $Million
1600
1400
1200
1000
800
600
400
200
0
JWST Program
Rest of Astrophysics
Managed by JWST Program Off
Managed by Astrophysics Div
Total Astrophysics
FY15 Pres Budget Request
FY04
FY05
FY06
FY07
FY08
FY09
FY10
FY11
FY12
FY13
FY14
FY15
FY16
FY17
FY18
FY19

FY15 (next year) Budget Appropriation

- Administration request is $607M for Astrophysics and $645M for JWST.
- Progress to date: markup by House subcommittee and committee; considered on House floor on May 28-29. House drafted appropriations bill and report includes:
  - Recommendation is $680M for Astrophysics and $645M for JWST
  - Restores $5M reduction in Hubble operations
  - Rejects SOFIA termination; appropriates $70M (an increase of $58M) to “support the aircraft’s fixed costs (flight crews, required maintenance, etc.) as well as a base level of scientific observations. NASA shall continue seeking third-party partners whose additional funding support would restore SOFIA’s budget to its full operational level.”
  - Provides $30M (an increase of $15M) to “proportionally reallocate these funds among the SMD divisions, resulting in a dedicated budget line for each division’s own EPO activities.”
- Next steps:
  - Markup by Senate appropriations subcommittee and committee scheduled for this week; draft appropriations bill and report to be reconciled with House version.
  - Votes by House and Senate then signed into law by the President

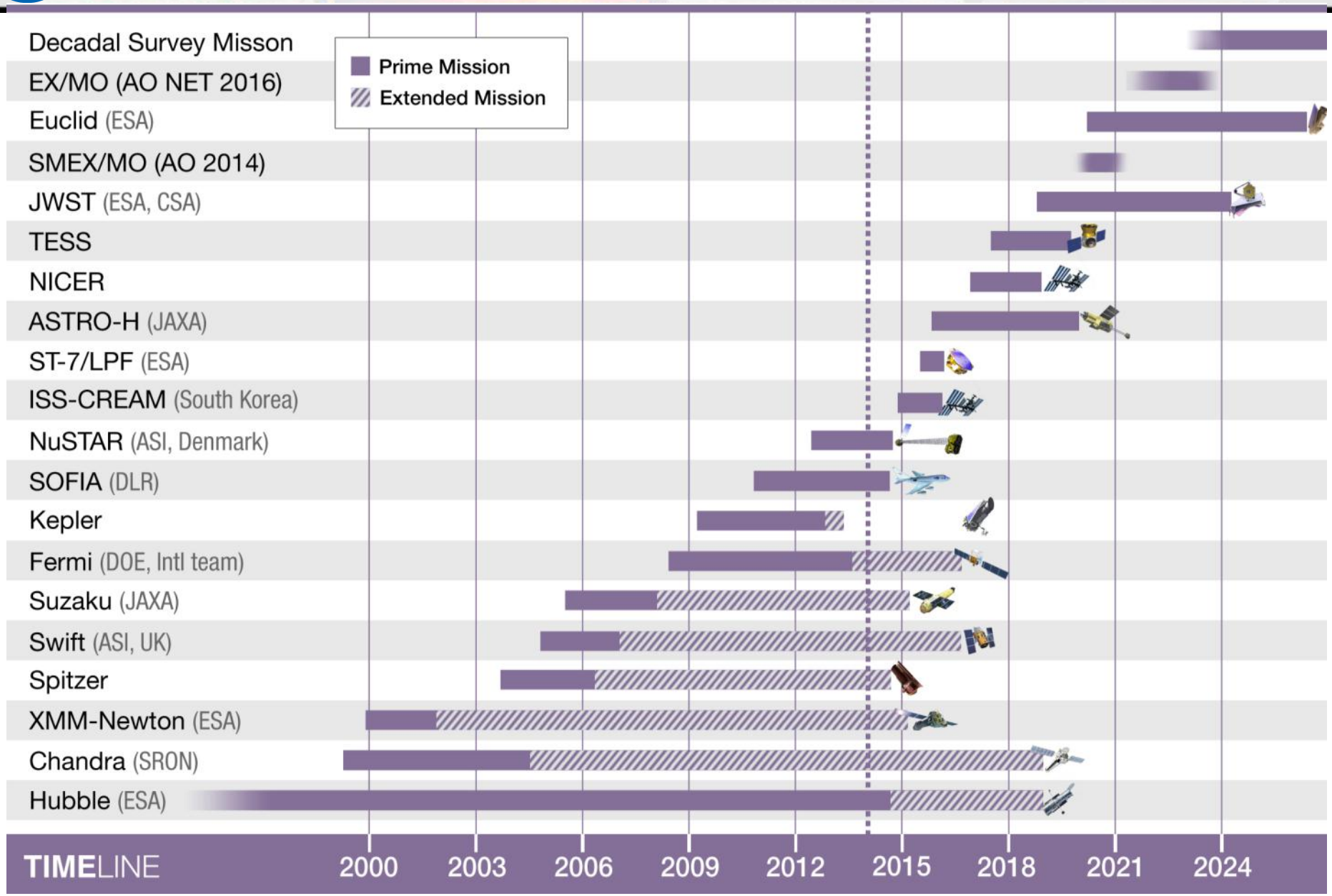
President's FY15 Budget Request



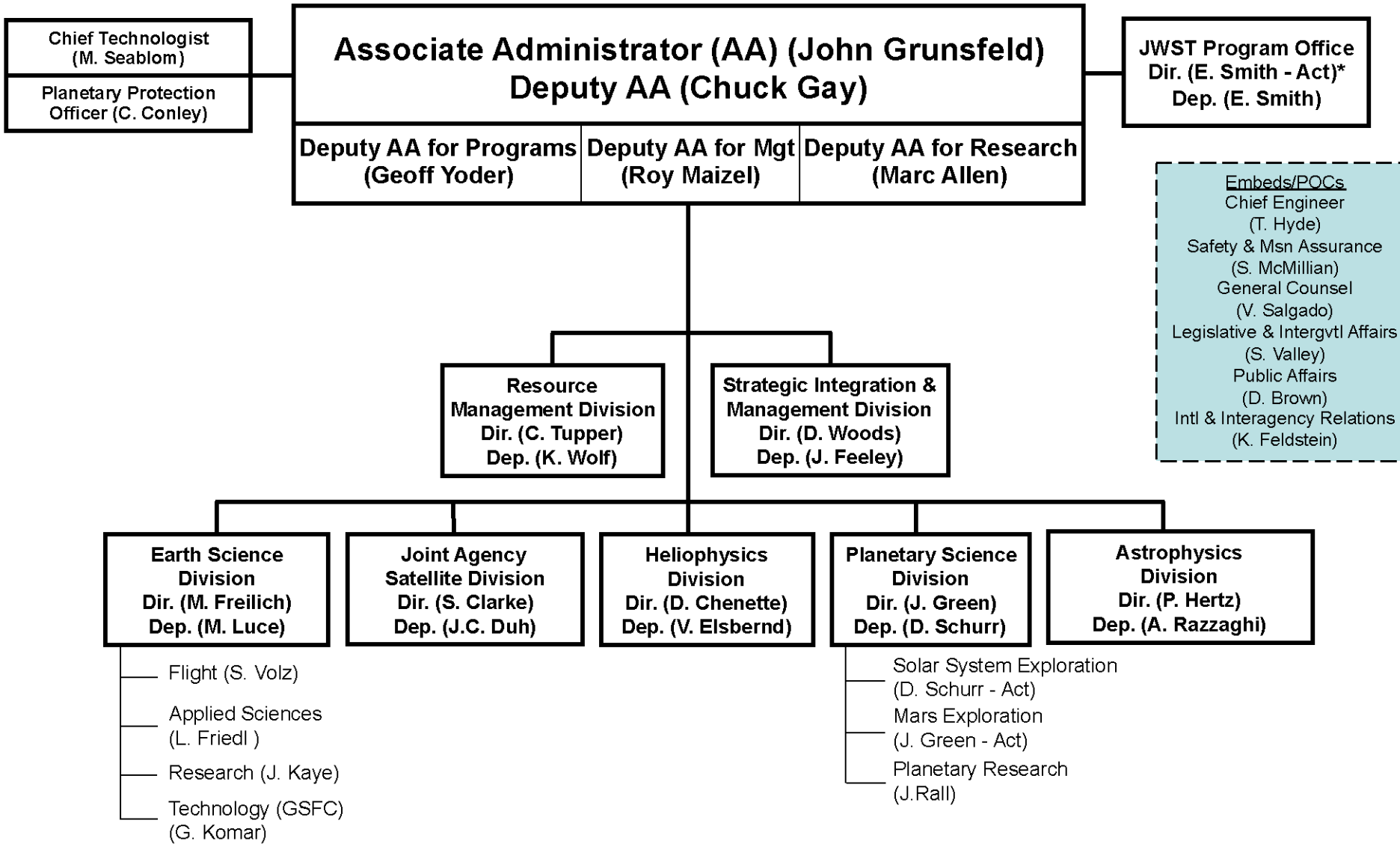
Astrophysics FY 2015 Budget Request

				Notional			
	FY 2013 Op Plan	FY 2014 Op Plan	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
Astrophysics	617.0	668.0	607.3	633.7	651.2	696.8	993.0
Astrophysics Research	155.8	134.9	191.0	216.2	221.2	234.6	261.2
Cosmic Origins	218.9	224.2	120.3	106.4	108.2	114.2	105.8
Physics of the Cosmos	124.5	112.6	108.8	100.9	86.6	89.4	142.4
Exoplanet Exploration	52.8	106.7	47.5	46.4	60.4	89.8	237.3
Astrophysics Explorers	65.1	89.6	139.7	163.7	174.9	168.7	186.4
James Webb Space Telescope	627.6	658.2	645.4	620.0	569.4	534.9	305.0
Astrophysics + JWST	1,244.6	1,326.2	1,252.7	1,253.7	1,220.6	1,231.7	1,298.0

Astrophysics Timeline



SMD Organization



* Direct report to NASA Associate Administrator

Astrophysics Division - Science Mission Directorate

May 22, 2014

Resource Management
Omana Cawthon +
Clemencia Gallegos-Kelly +

Director
Paul Hertz
Deputy Director
Andrea Razzaghi

Lead Secretary: Kelly Johnson
Secretary: Leslie Allen
Program Support Specialist: Jackie Mackall

Cross Cutting

Technology Lead: William (Billy) Lightsey *
Division E/PO POC: Hashima Hasan (Lead Comm Team)
Division Public Affairs POC: Lisa Wainio *
Information Manager: Lisa Wainio *

Astrophysics Research

Program Manager: Linda Sparke
Program Support: Janet Larson *
Astrophysics Data Analysis: Debra Wallace *
Astrophysics Theory: Keith MacGregor *
Origins of Solar Systems: Larry Petro *
APRA lead: Michael Garcia *
Cosmic Rays, Fundamental Physics: Vernon Jones, Keith MacGregor *
Gamma Ray/X-ray: Michael Garcia*, Stefan Immler* Lou Kaluzienski, Rita Sambruna, Wilt Sanders*
Optical/Ultraviolet: Michael Garcia *, Hashima Hasan, Mario Perez *
IR/Submillimeter/Radio: Dominic Benford *, Doug Hudgins, Larry Petro *, Eric Tollestrup *, 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

	Program Scientist	*Program Executive*
Exoplanet Exploration (EXEP)		
Program	**Doug Hudgins**	**John Gagosian**
Keck	Hashima Hasan	Mario Perez *
Kepler	Doug Hudgins	Jeff Hayes
LBTI	Hashima Hasan	Mario Perez *
NExScI	Hashima Hasan	Mario Perez *
Cosmic Origins (COR)		
Program	**Mario Perez ***	**Lia Lapiana**
Herschel	Glenn Wahlgren *	Jeff Hayes
Hubble	Michael Garcia *	John Gagosian
JWST	Hashima Hasan	N/A
SOFIA	Glenn Wahlgren *	John Gagosian
Spitzer	Glenn Wahlgren *	Jeff Hayes
Physics of the Cosmos (PCOS)		
Program	**Rita Sambruna**	**Lia LaPiana**
Chandra	Wilt Sanders *	Jeff Hayes
Euclid	Linda Sparke	Jeff Hayes
Fermi	Keith MacGregor *	Jeff Hayes
L2/X-ray	Michael Garcia *	Lia LaPiana
Planck	Rita Sambruna	Jeff Hayes
ST-7/LPF	Wilt Sanders *	Jeff Hayes
XMM-Newton	Lou Kaluzienski	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	Lou Kaluzienski	Jeff Hayes
Swift	Michael Garcia *	Jeff Hayes
TESS	Doug Hudgins	Mark Sistilli
WFIRST/AFTA	Dominic Benford *	Lia LaPiana

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

Anne-Marie Novo-Gradac on detail to the SMD Front Office.