



Division Update to Astrophysics Subcommittee

August 11, 2014

Astrophysics

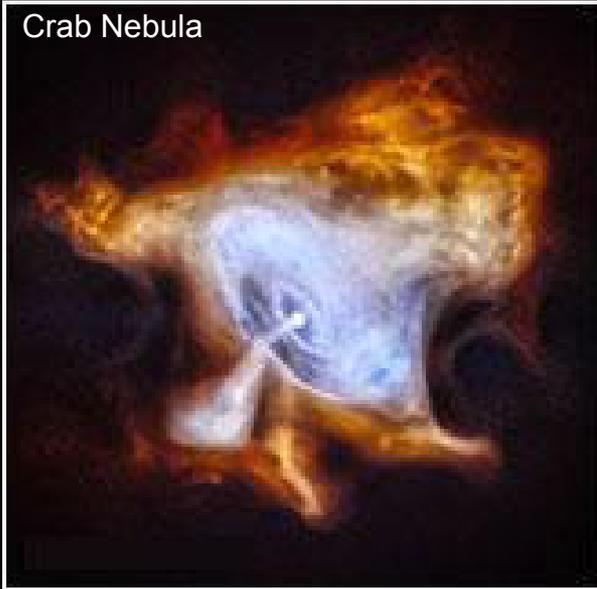
Paul Hertz

Director, Astrophysics Division
Science Mission Directorate

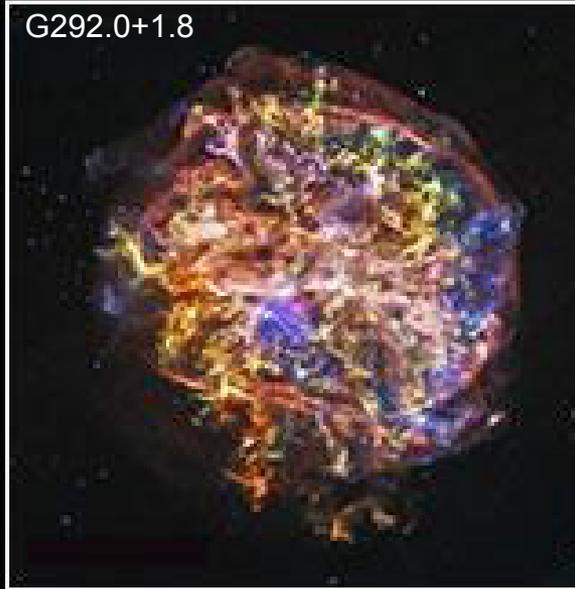
[@PHertzNASA](https://twitter.com/PHertzNASA)

Chandra Supernova Remnants - 15th Anniversary Images

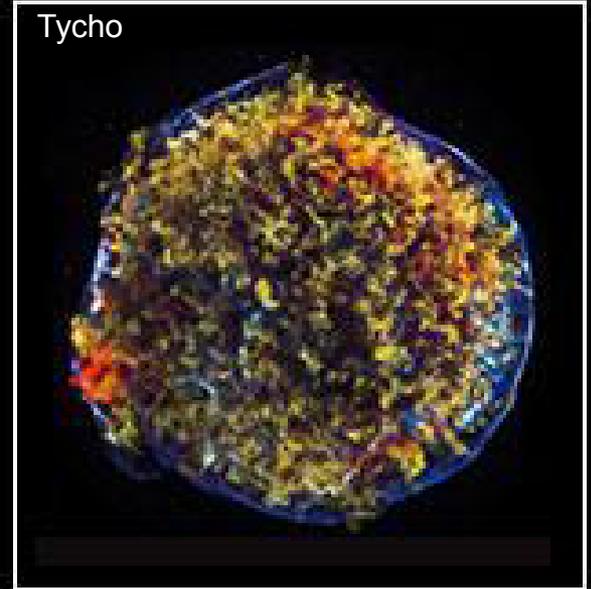
Crab Nebula



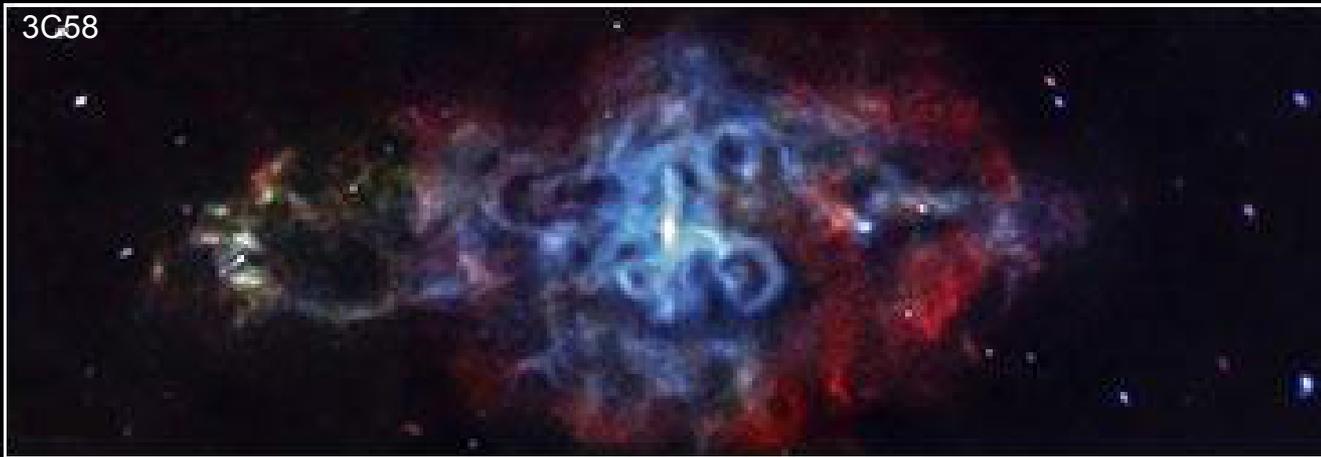
G292.0+1.8



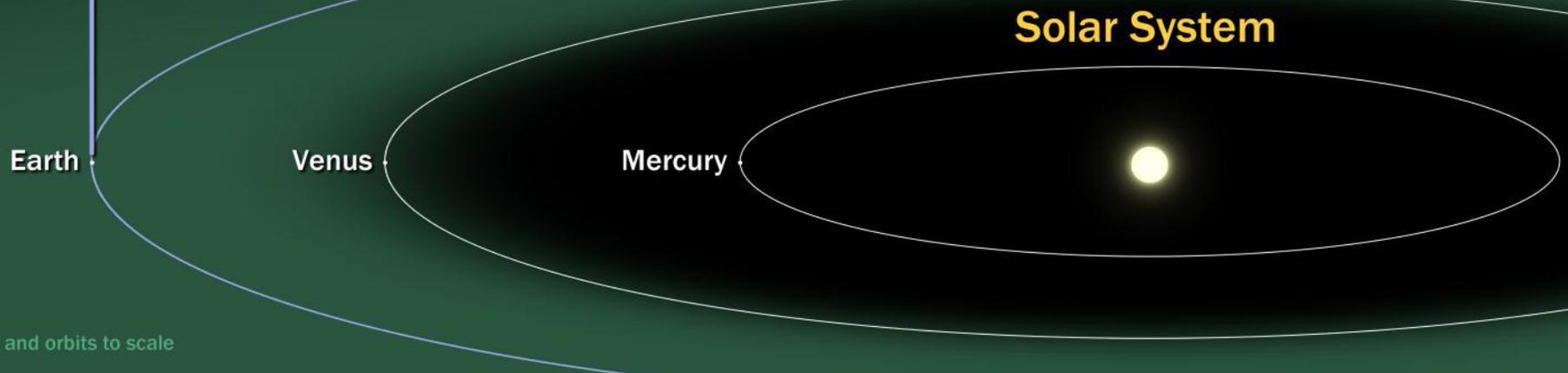
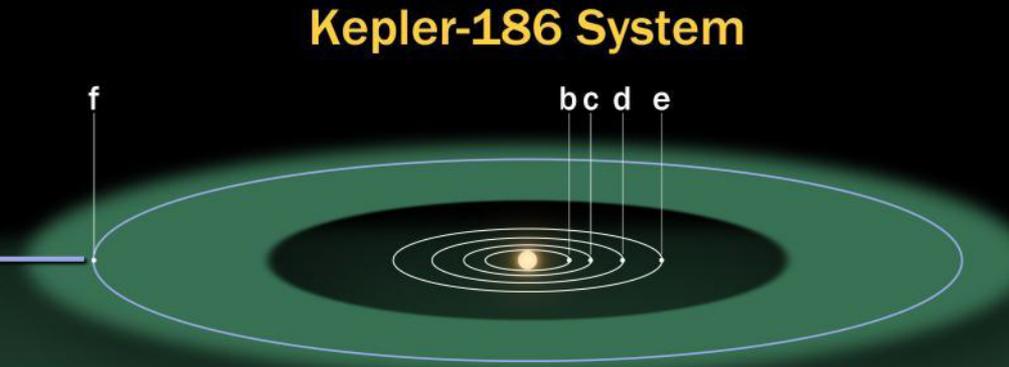
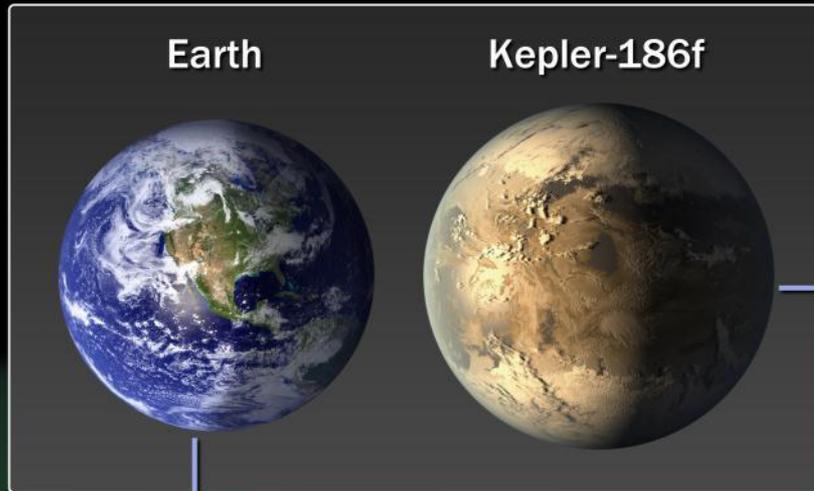
Tycho



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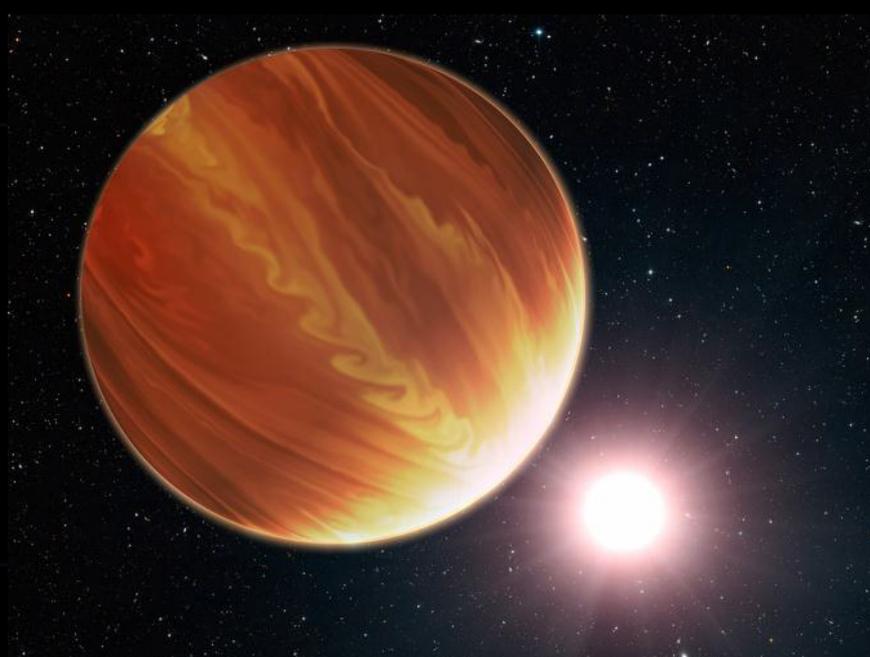
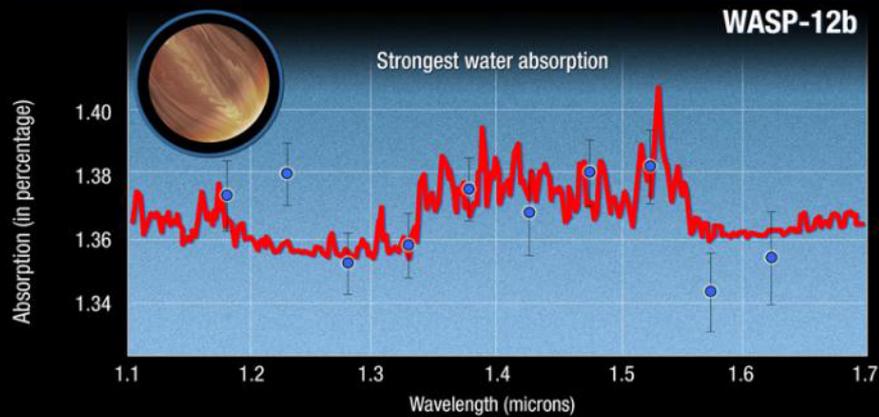
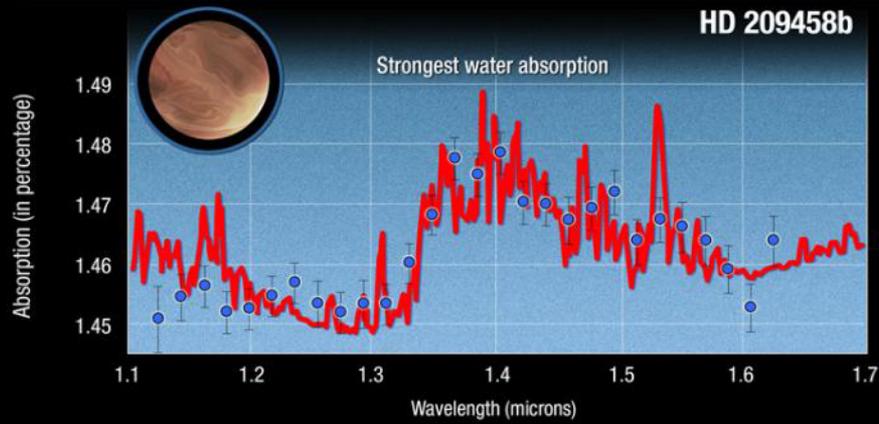
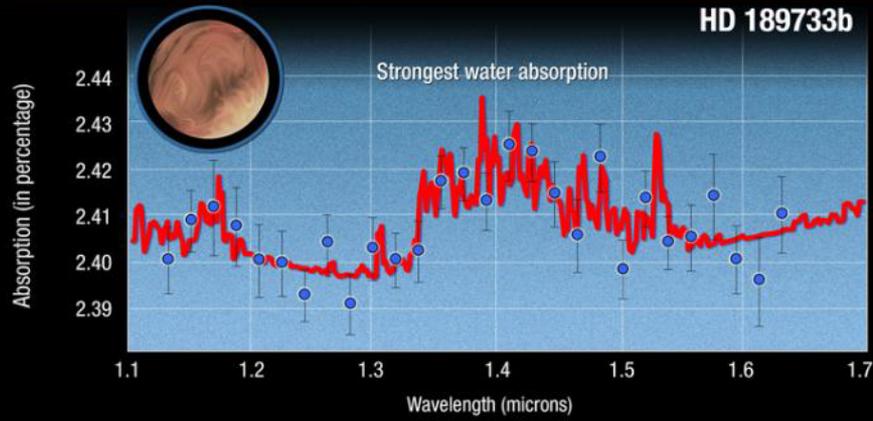


Kepler 186f: First Earth-Size Planet in 'Habitable Zone'



Planets and orbits to scale

Hubble measures water abundance on three exoplanets





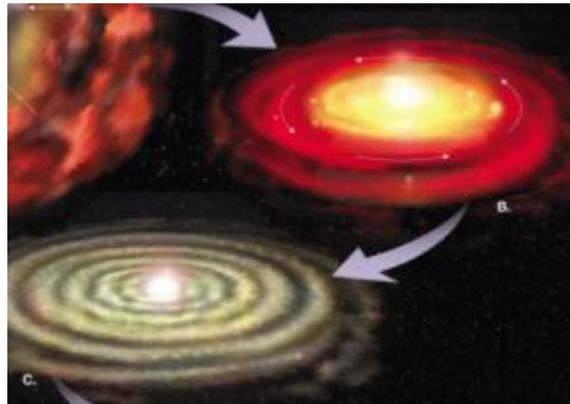
NASA Astrophysics Announcements

- NASA's Hubble Space Telescope Spots Mars-Bound Comet Sprout Multiple Jets (March 27)
- NASA Begins Search for Potential SOFIA Partners (April 1)
- NASA Hubble Team Finds Monster "El Gordo" Galaxy Cluster Bigger Than Thought (April 3)
- NASA's Hubble Extends Stellar Tape Measure 10 Times Farther Into Space (April 10)
- NASA's Kepler Telescope Discovers First Earth-Size Planet in 'Habitable Zone' (April 17)
- NASA Hubble Instruments Highlight New National Air and Space Museum Exhibit (April 23)
- Astronomical Forensics Uncover Planetary Disks in NASA's Hubble Archive (April 24)
- NASA's Spitzer and WISE Telescopes Find Close, Cold Neighbor of Sun (April 25)
- Hubble Astronomers Use Supernovae to Gauge Power of Cosmic Lenses (May 1)
- NASA's Chandra Observatory Delivers New Insight into Formation of Star Clusters (May 7)
- NASA's WISE Findings Poke Hole in Black Hole 'Doughnut' Theory (May 22)
- Hubble Team Unveils Most Colorful View of Universe Captured by Space Telescope (June 3)
- New Spectrograph Testing Begins on SOFIA Observatory (June 3)
- NASA Hubble to Begin Search Beyond Pluto for a New Horizons Mission Target (June 16)
- Swiftly Moving Gas Streamer Eclipses Supermassive Black Hole (June 19)
- Hubble Finds Dwarf Galaxies Formed More Than Their Fair Share of Universe's Stars (June 19)
- Testing Completed on NASA's James Webb Space Telescope Backplane (July 8)
- Hubble Spots Spiral Bridge of Young Stars Linking Two Ancient Galaxies (July 10)
- Leading Space Experts to Discuss the Search for Life Beyond Earth (July 10)
- NASA's Chandra X-ray Observatory Celebrates 15th Anniversary (July 22)
- Hubble Finds Three Surprisingly Dry Exoplanets (July 24)
- NASA's Fermi Space Telescope Reveals New Source of Gamma Rays (July 31)
- Hubble Shows Farthest Lensing Galaxy Yields Clues to Early Universe (July 31)
- NASA's Hubble Finds Supernova Star System Linked to Potential "Zombie Star" (August 6)



Why Astrophysics?

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

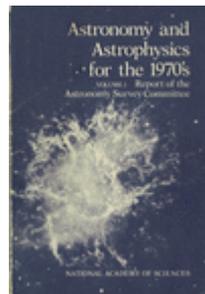


1. How did our universe begin and evolve?

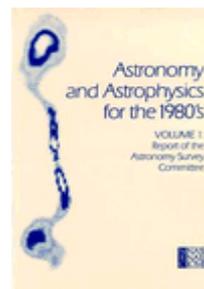
2. How did galaxies, stars, and planets come to be?

3. Are We Alone?

These national strategic drivers are enduring



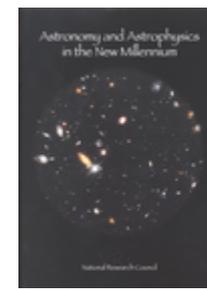
1972



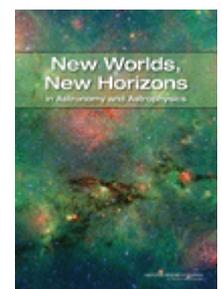
1982



1991



2001

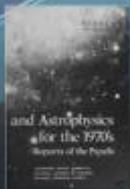


2010

ASTROPHYSICS

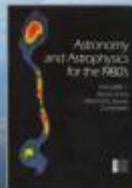
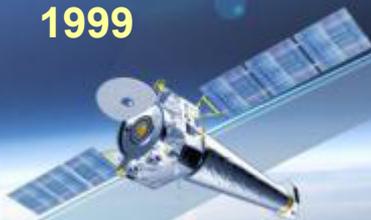
Decadal Survey Missions

1990



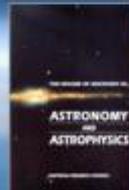
1972
Decadal
Survey
Hubble

1999



1982
Decadal
Survey
Chandra

2003



1991
Decadal
Survey
Spitzer

LRD: 2018



2001
Decadal
Survey
JWST

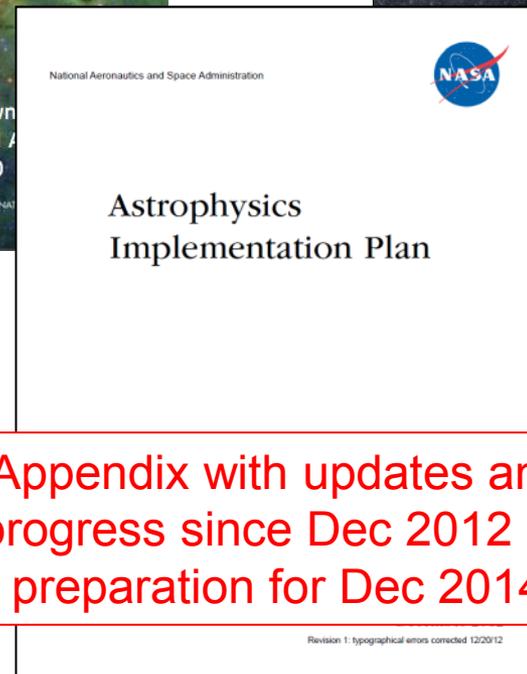
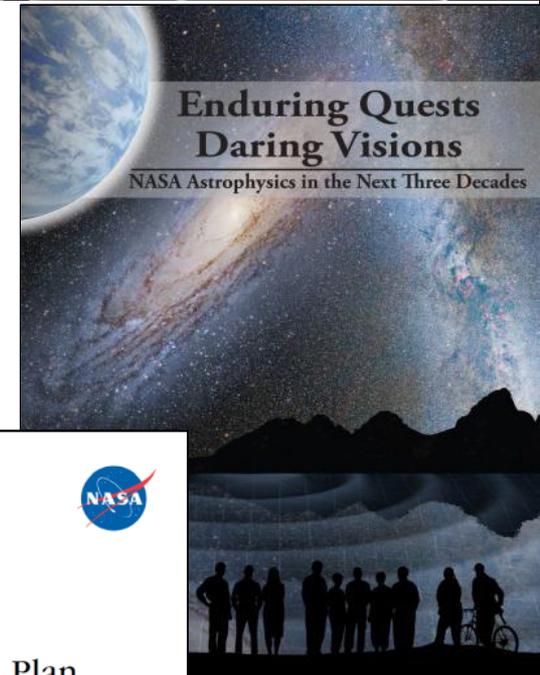
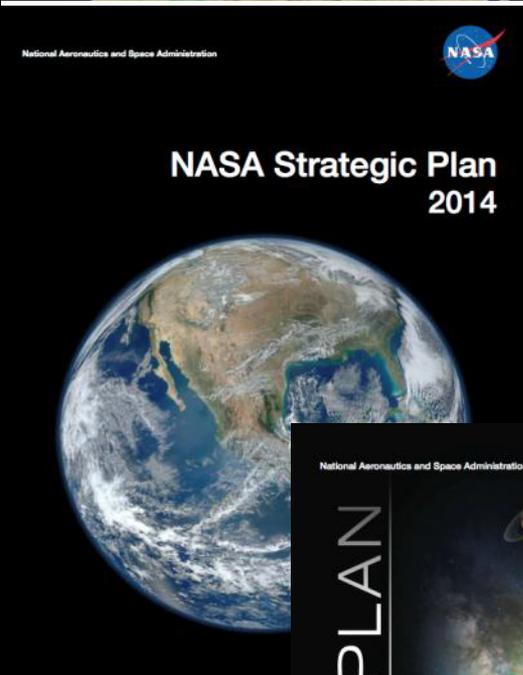
LRD: 2020s



2010
Decadal
Survey
WFIRST



Astrophysics Driving Documents

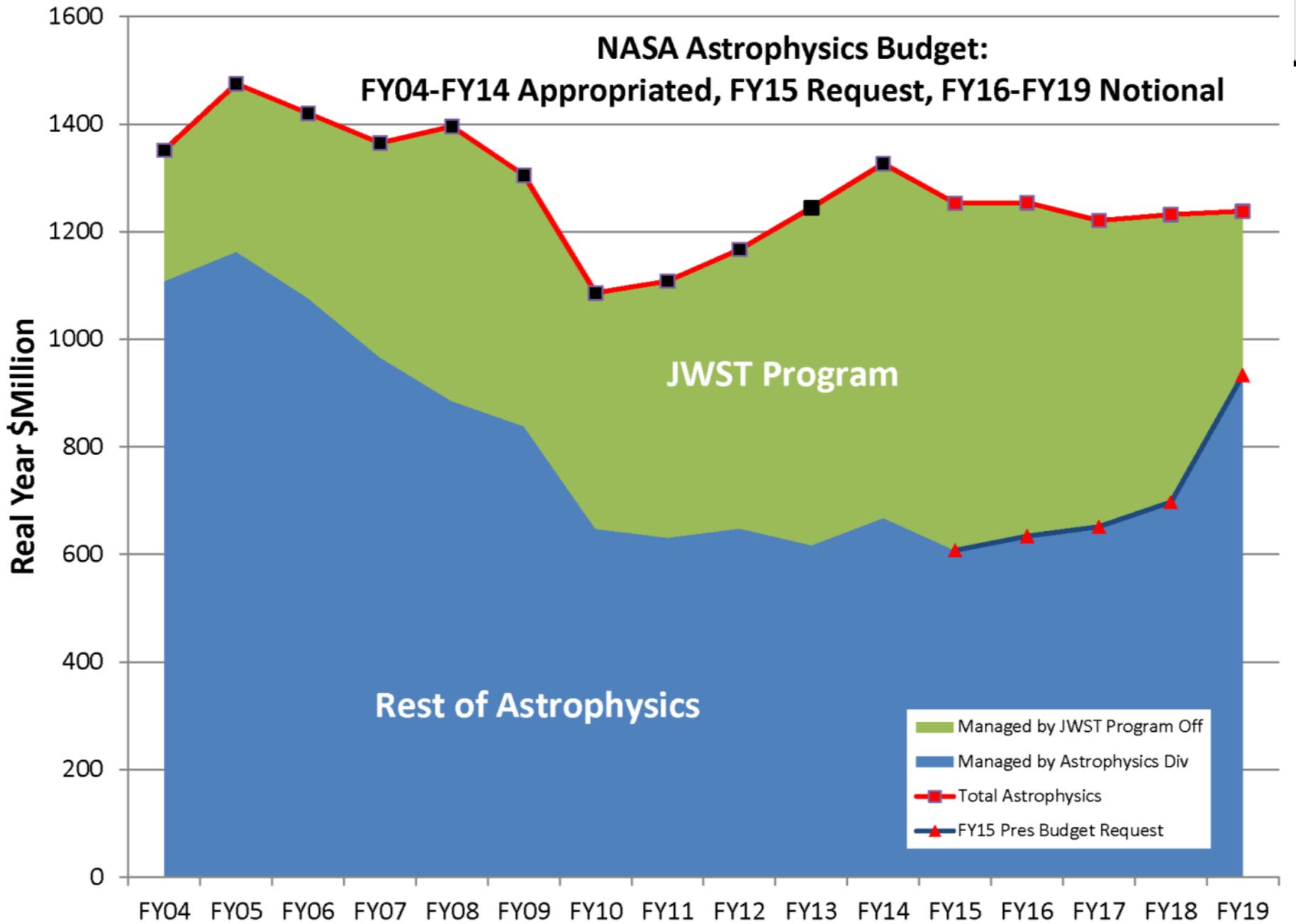


<http://science.nasa.gov/astrophysics/documents>



The Big Picture

- We are addressing decadal priorities within budget constraints.
 - The budget for NASA astrophysics, which includes JWST, continues at \$1.33B in FY14; the President has requested \$1.25B in FY15 (the difference is mostly due to deletion of SOFIA from FY15 budget request).
 - JWST, the highest priority of the community, is making progress, remains on schedule, and is fully funded for an October 2018 launch.
 - NASA is preparing for a strategic Astrophysics mission to follow JWST as soon as funding becomes available. Preformulation of WFIRST/AFTA was funded in FY14 appropriation and is included in FY15 budget request.
 - SOFIA has completed development and has entered its operations phase.
 - NASA is developing new Explorer missions (NICER, TESS) and contributions to our international partners (LPF, ASTRO-H, Euclid).
 - NASA is discussing contributions to ESA's Athena and L3 GW observatory.
 - NASA is planning a robust Astrophysics Explorers Program with a SMEX AO in late CY2014 and an EX AO in ~FY2017.
 - Following the 2014 Senior Review, NASA plans to continue operating all currently operating missions, including Spitzer.
 - NASA continues to support individual investigators for data analysis, theory, and technology investigations through open, competitive, peer reviews.
- The budgetary future remains uncertain.
 - Priorities must be used to guide difficult budget choices.
 - The FY2015 budget request represents a ~10% decrease for the Astrophysics Division in FY15; the cost of operating SOFIA can not be accommodated within this reduced budget.





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 successfully completed deployment testing.
- Spacecraft bus under construction.
- Good progress continues on telescope flight backplane testing and backplane pathfinder.
- Program remains on track and within budget for October 2018 launch.



ISIM with all instruments



5 engineering sunshields folded for deployment testing



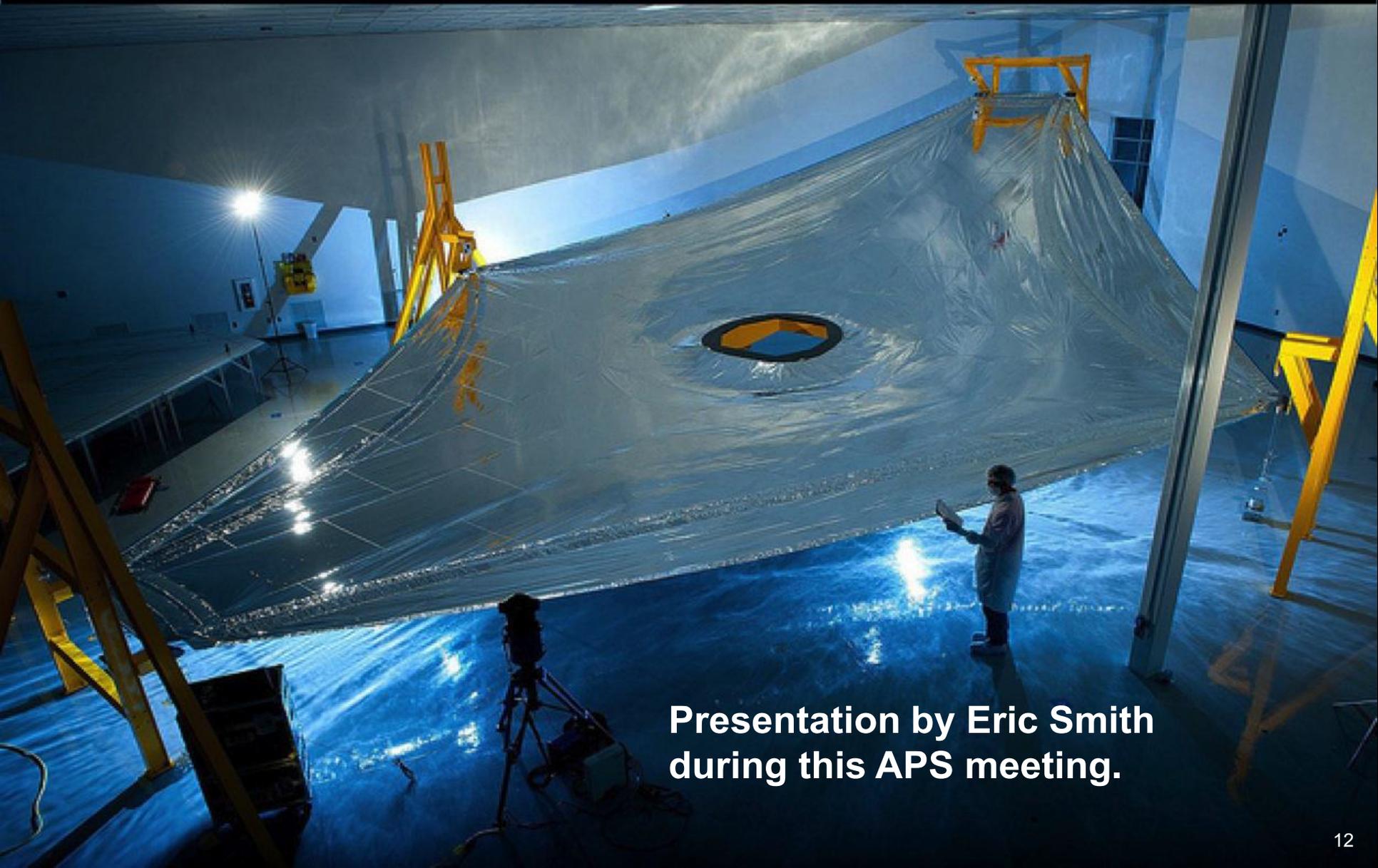
Flight telescope backplane & backplane support fixture



Pathfinder (backplane center section with secondary mirror structure)

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

JWST on Track for 2018 Launch



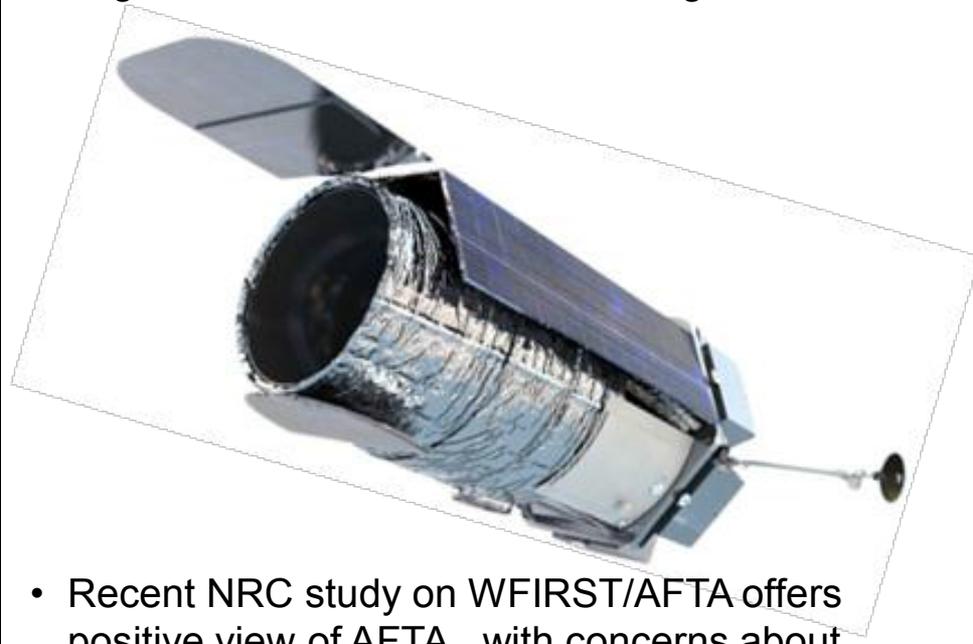
Presentation by Eric Smith
during this APS meeting.



WFIRST / AFTA

Widefield Infrared Survey Telescope with Astrophysics Focused Telescope Assets

- FY14 appropriation (\$56M) supports pre-formulation of WFIRST/AFTA, including technology development for detectors and coronagraph (with STMD).
- FY15 request (\$14M) 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:

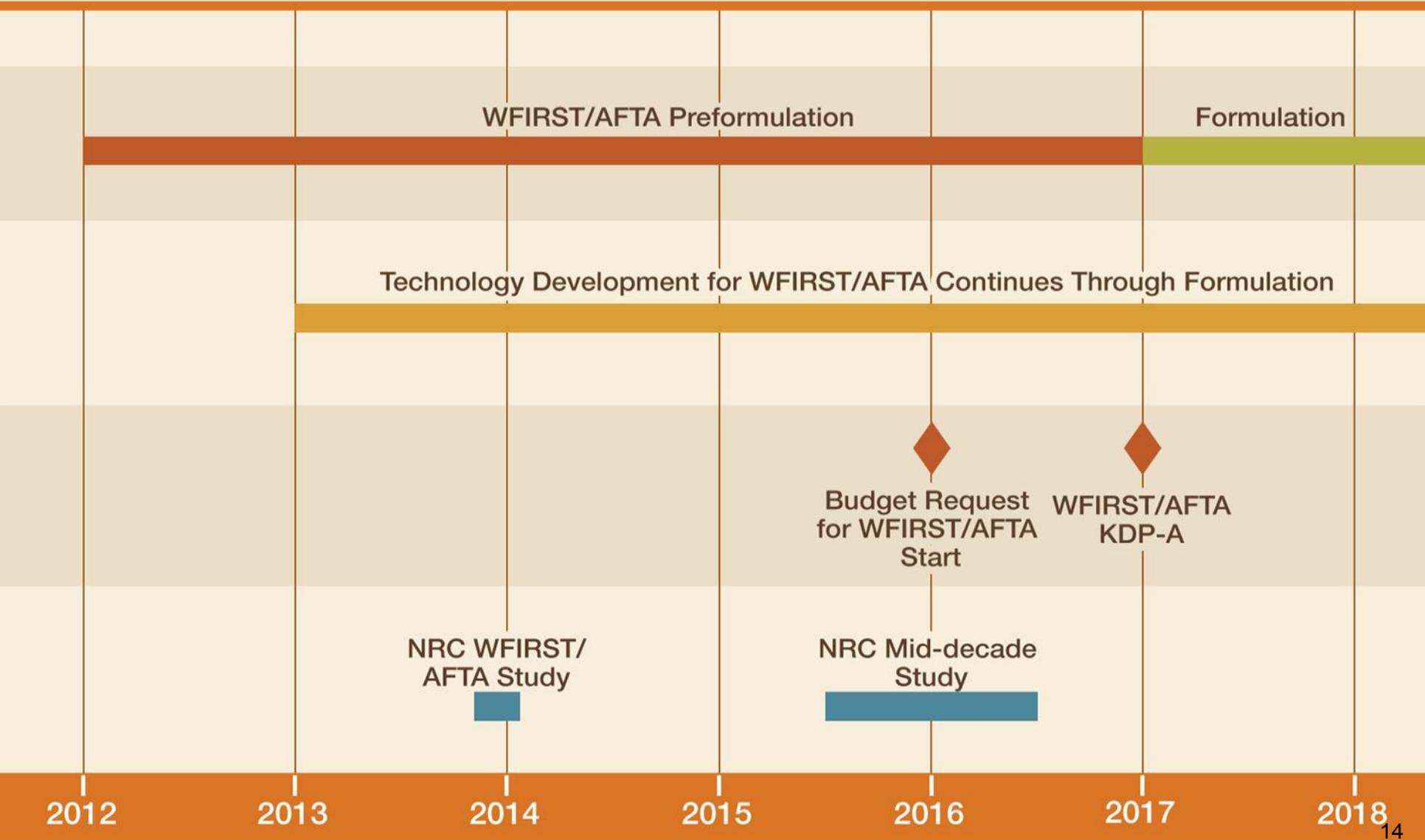
- May 2013, NASA Administrator Bolden directed study of WFIRST/AFTA and preserve option for FY17 new start if budget is available.
 - No decision expected before early 2016.
- Currently in pre-formulation phase.
 - AFTA endorsed by NRC study report released March 2014.
 - Interim SDT report posted April 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.



Plan for WFIRST/AFTA Preformulation

Widefield Infrared Survey Telescope using Astrophysics Focused Telescope Assets

WFIRST/AFTA timeline





WFIRST Preparatory Science

- New ROSES Element for WFIRST/AFTA, announced April 21.
- Purpose: bridge from basic theory to observational modeling.
- Proposals must be both:
 - Relevant to WFIRST's primary astrophysics goals.
 - Predominantly WFIRST-specific development of detailed simulations and models.
- 53 Proposals received on July 11. Covered all areas of WFIRST science including supernovae, galaxy redshift surveys, weak lensing, exoplanet microlensing, coronagraphy, and other surveys & GO science.
- 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



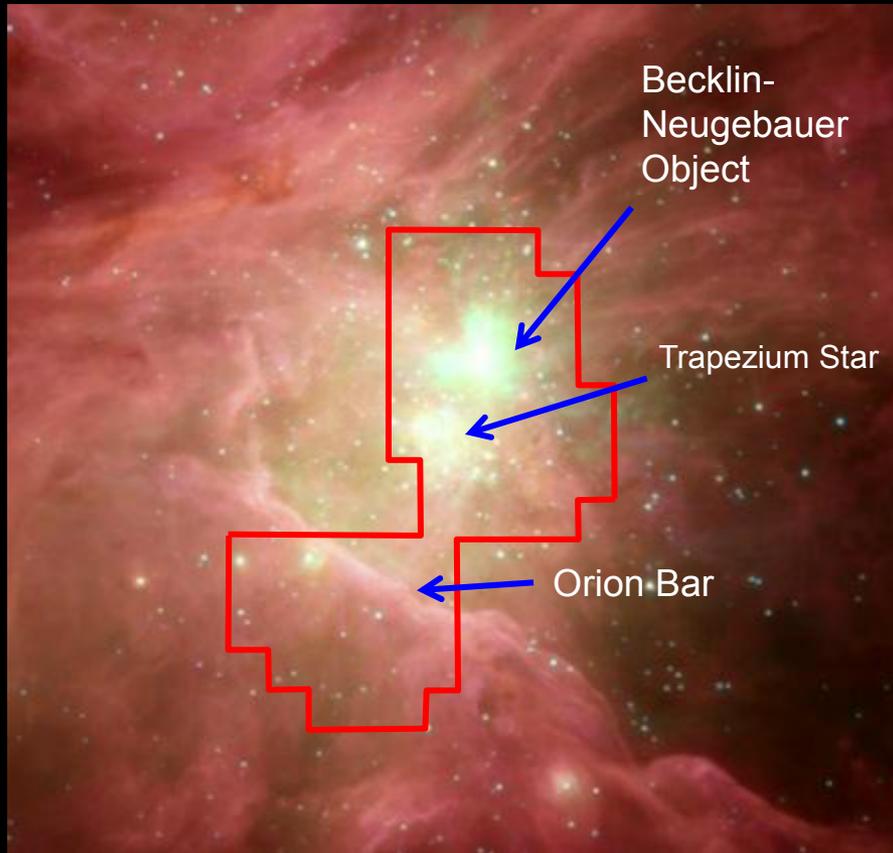
- **World's Largest Airborne Observatory**
- 2.5-meter telescope
- Capable of observing from the visible to the far infrared
- 80/20 Partnership between NASA and the German Aerospace Center (DLR)
- Mission Ops based at NASA-Armstrong
- Science Ops based at NASA-Ames
- Six First-Generation instruments
 - 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 Feb 2014.
- Began Cycle 2 Science Observations Feb 2014.
- Completed commissioning flights for Field-Imaging Far-Infrared Line Spectrometer (FIFI-LS) (5th instrument) and initiated commissioning of Echelon-Cross-Echelle Spectrograph (EXES) (6th instrument) April 2014.
- Demonstrated high cadence science operations in April/May 2014.
- Formally entered Operational Phase May 2014.
- Second generation instruments under development.
 - HAWC+: far infrared imager and polarimeter.
 - upGREAT: multi-pixel heterodyne spectrometer.
- IG report issued July 2014.
- Arrived in Germany July 2014 for Heavy Maintenance Visit; continues through Oct/Nov 2014.
- 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.
 - Senate proposed \$87M for FY15 operations.

Stratospheric Observatory for Infrared Astronomy

Orion Nebula



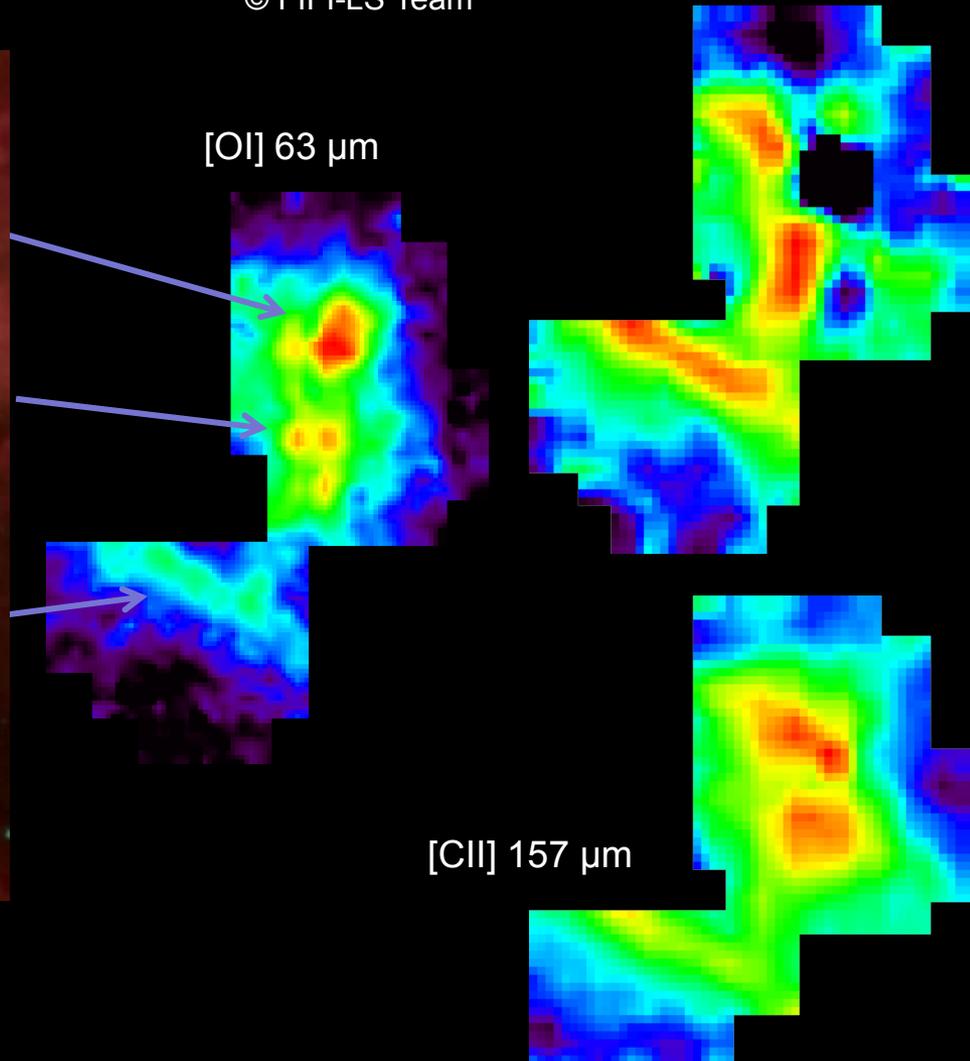
© Spitzer Observatory, Thomas Megeath

SOFIA / FIFI-LS

© FIFI-LS Team

[OI] 63 μm

[OI] 145 μm





SOFIA Docked at Lufthansa (1 of 2)





SOFIA Docked at Lufthansa (2 of 2)

SOFIA at maintenance station with engines removed (at right)



Aircraft interior with panels removed



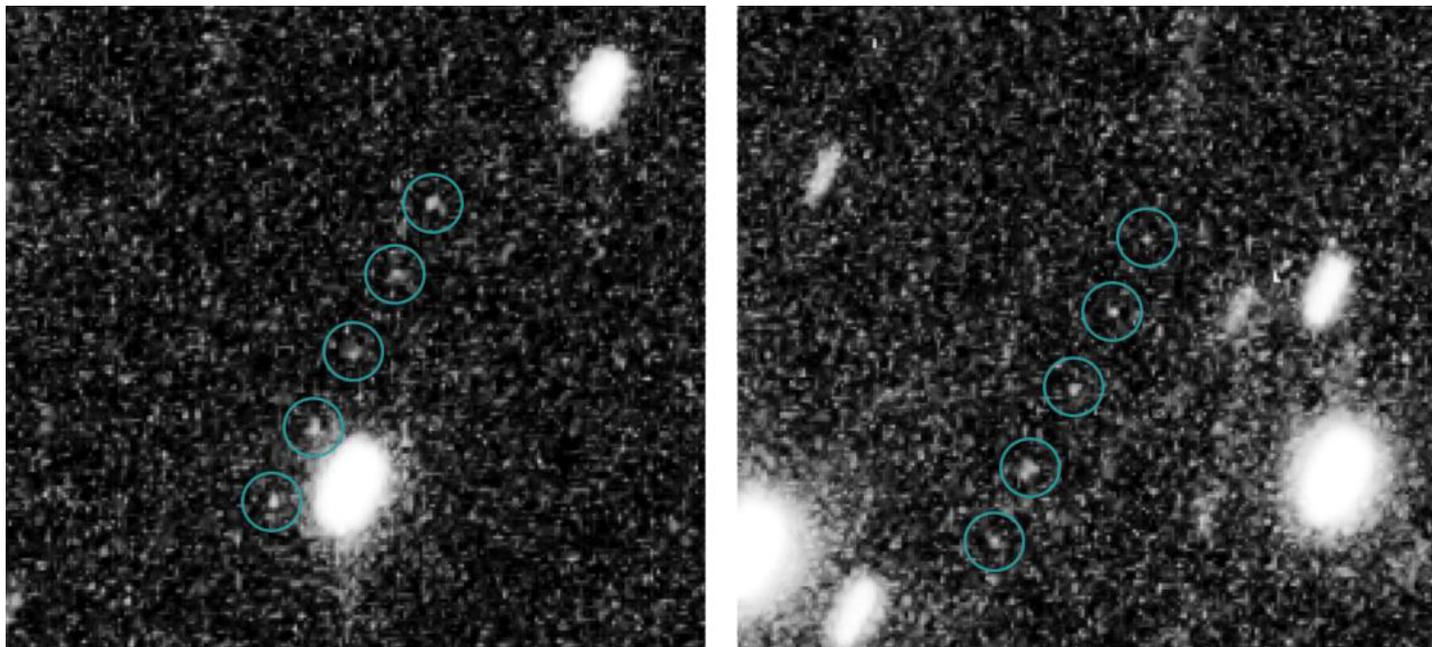
SOFIA

- FY 2014 Operational Science Flights have concluded.
 - FY 2014 science flights totaled 258 research hours.
 - 93% dispatch rate since start of CY 2014, with an average of 8.2 RH per 10-hr flight.
- Observatory arrived in Germany for Heavy Maintenance Visit (HMV) on June 28, 2014.
 - Current work continues on gaining access to hidden areas and conducting inspections.
 - Inspections underway: Stabilizers, pylons, engines, wing internal, fuselage, fuel tanks, cockpit, cabin walls.
- The Astrophysics Division Director consulted a senior group of experts in June 2014 to obtain thoughts on increasing the science output of SOFIA within any budget.
- OIG report on viability of SOFIA program and NASA response released on July 9, 2014.
- These reviews, as well the SRB, have suggested changes in the program to increase the scientific productivity of the mission.
 - Do not concentrate on successful flight hours as the sole metric by which the project is judged.
 - The requirement for a given number of flight hours at scientifically productive altitudes is hampering the formulation of a program that achieves the highest scientific productivity.
 - Development of new instruments increases science productivity.
 - Appropriate funding of science analysis by users should be revisited.
 - The pipeline is a bottleneck in the path toward publication of timely science results.
 - SOFIA's unique capabilities are the spectral region longer than 27 microns and very high spectral resolution.



Hubble Space Telescope

- Hubble conducting search for Kuiper Belt Object suitable as New Horizons flyby destination following Pluto flyby.
- 154 orbit observing program recommended by TAC conditional on successful 40 orbit pilot program to validate predicted source counts and expected probability of success.
- June 2014 pilot successful; at least two KBOs detected.
- Full observing program completed early August 2014.



These two multiple-exposure images from NASA's Hubble Space Telescope show Kuiper Belt objects, or KBOs, against a background of stars in the constellation Sagittarius. The two KBOs are roughly 4 billion miles from Earth.

Image Credit: NASA, ESA, SwRI, JHU/APL, New Horizons KBO Search Team



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 began 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



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 and 3-stage modes.
- Completed early FM Dewar cryo performance testing in June with excellent results (>90% response efficiency).
- High Temperature Superconductor (HTS) leads were delivered to JAXA on July 16.
- Science Working group met July 9-11, 2014 (Paris) to discuss proposals from the ASTRO-H team for first observations.

UPCOMING EVENTS:

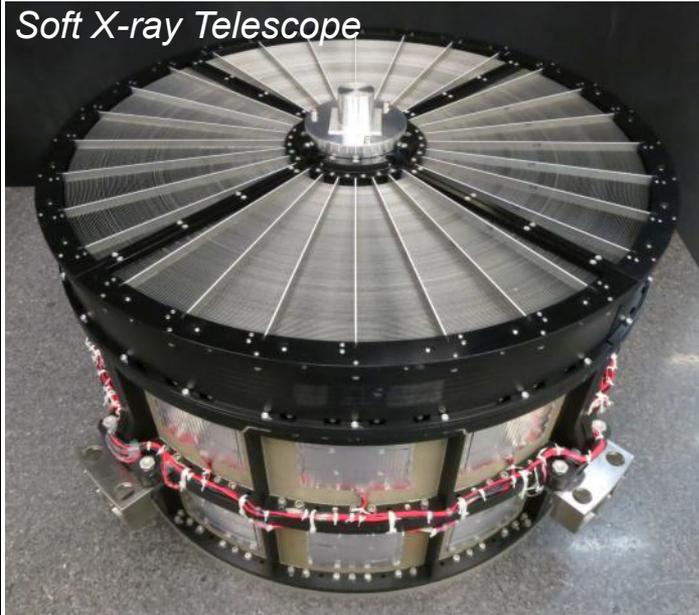
- August – JAXA CDR 2
- September - Final FM Dewar Performance Testing in Niihama, Japan (prior to integration with spacecraft).

- **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

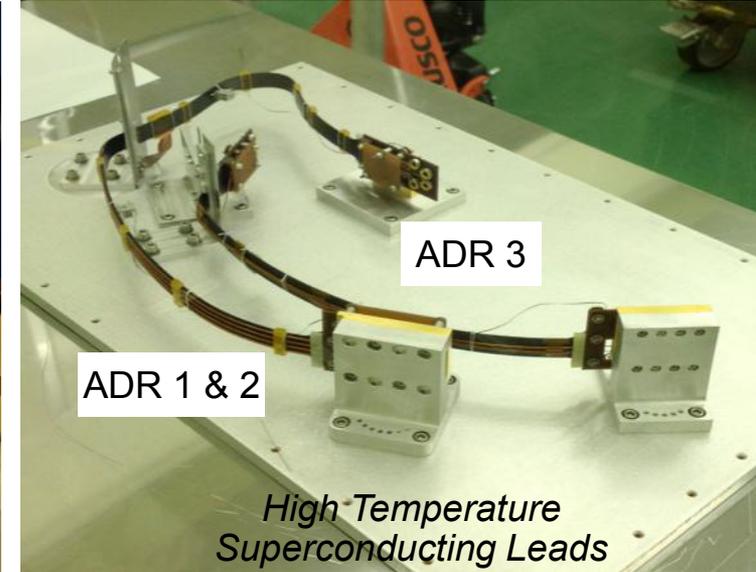


Program Update – ASTRO-H

Soft X-ray Telescope



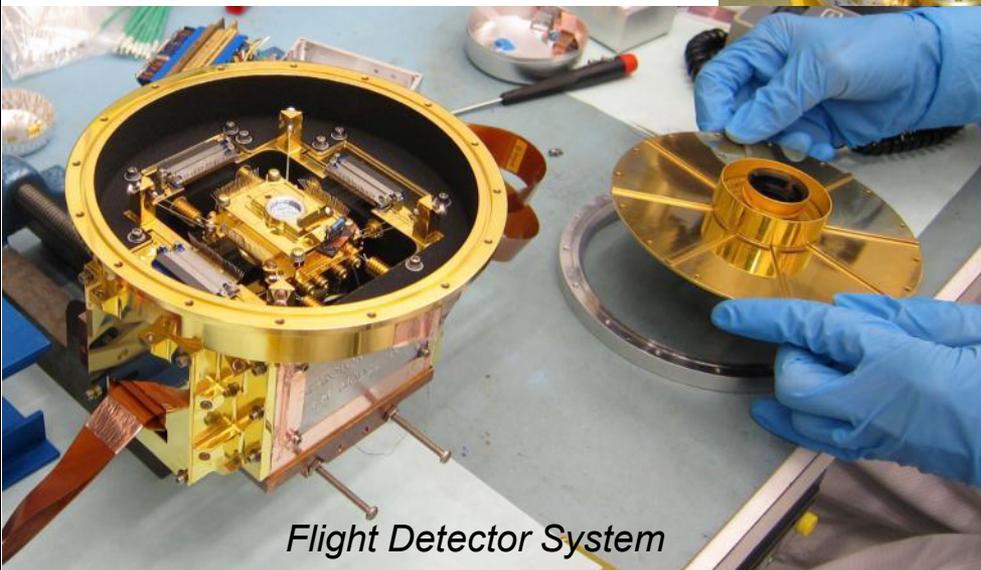
ADR Assembly



ADR 3

ADR 1 & 2

High Temperature Superconducting Leads



Flight Detector System



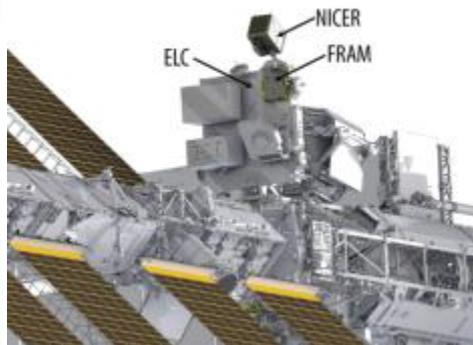
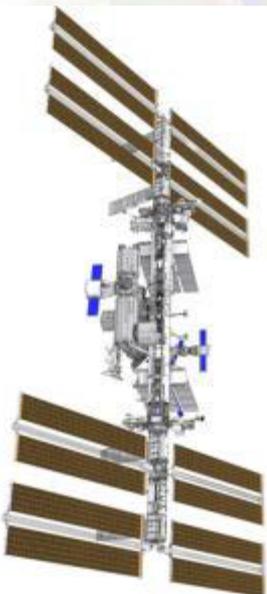
ADR Controller



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

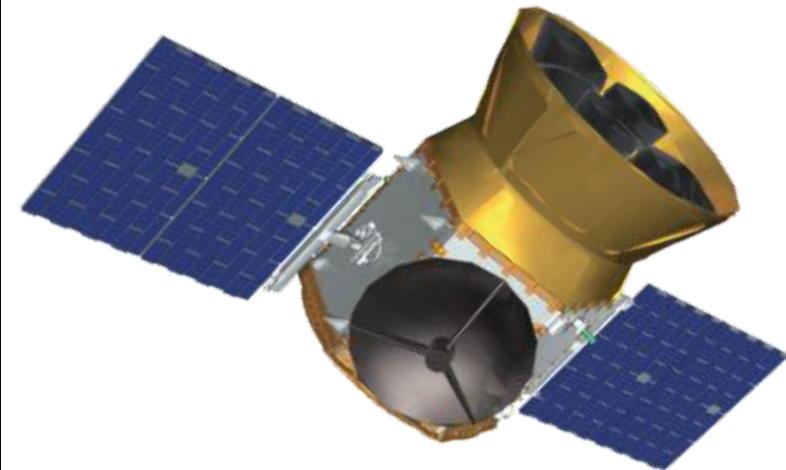
CURRENT STATUS:

- 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

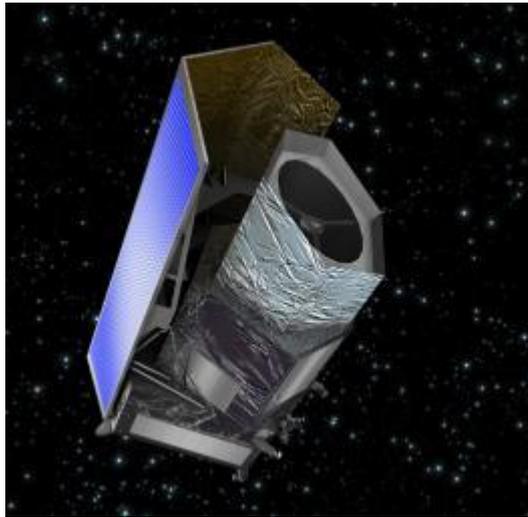
CURRENT STATUS:

- 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 (SRR) successfully completed on February 12-13, 2014.
 - Preliminary Design Review (PDR) scheduled for Sept 9-12, 2014.
 - Confirmation Review, for approval to enter implementation phase, is planned for October 2014.



Euclid

A visible and near-infrared telescope to explore cosmic evolution



CURRENT STATUS:

- **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.

- 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.

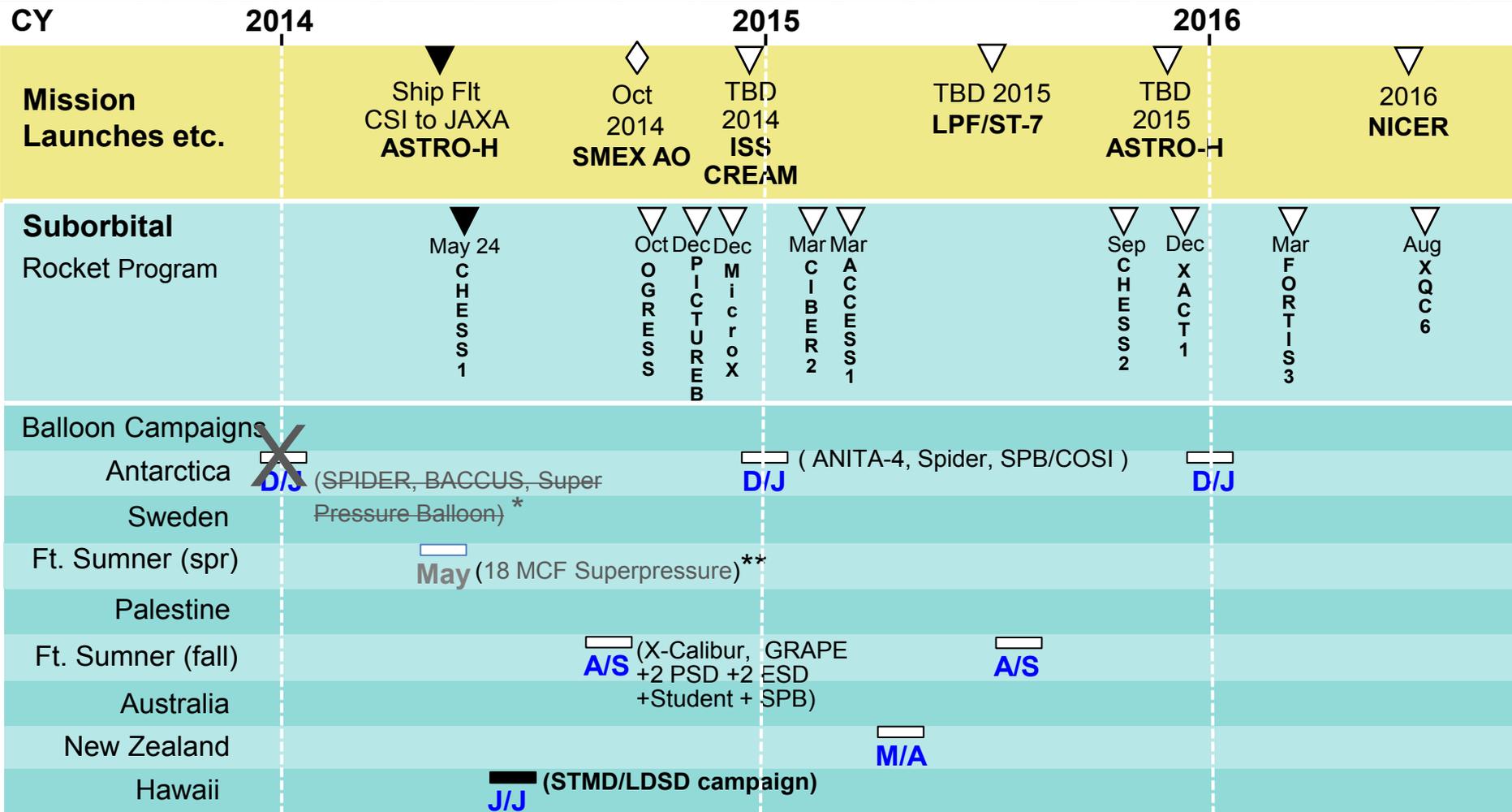


ESA's L2 Advanced X-ray Observatory: Athena

- The Advanced Telescope for High Energy Astrophysics (Athena) has been selected for the ESA L2 slot. Launch date ~2028.
- NASA and ESA are discussing a potential NASA contribution.
 - The Decadal Survey recommended an international partnership for an advanced X-ray observatory.
 - NASA solicited applications for a U.S. representative on the ESA Athena Science Study Team. Randall Smith (CfA) is U.S. member. Robert Petre (GSFC) and Michael Garcia (HQ) are ex officio. First meeting July 2014.
 - An ESA instrument AO will be released in early 2015.
- NASA's FY15 budget request supports a potential Athena partnership.
 - NASA will continue investing in technologies likely to be appropriate for an Athena contribution; investments include both directed and competed SAT investigations.
 - NASA is budgeting for development of contributed flight hardware, U.S. participation in the Athena science team, and a U.S. data center and GO program.
- NASA has suggested the following types of contributions, limited to \$100-150M for contributed flight hardware.
 - Portions of the calorimeter instrument
 - Inner mirror shells
 - Portions of the wide field imager
 - Contribution to science data center (U.S. node)



Astrophysics Mission Events



Last Update: July 28, 2014

* 2014 Antarctica campaign cancelled due to government shutdown.

** Campaign cancelled due to issues with weather, personnel, and programmatic considerations.



2014 Astrophysics Explorer AO

- Community Announcement released on November 12, 2013, indicating NASA will solicit proposals for SMEX missions and Missions of Opportunity.
- Draft AO July 14, 2014, comments received August 4, 2014.
 - NASA received ~70 comments.
 - Responses will be posted at <http://explorers.larc.nasa.gov/APSMEX/>.
- Final AO targeted early fall 2014, with Pre-Proposal Conference ~ 3 weeks after final AO release. Proposals due 90 days after AO release.



Other Project Highlights

- **CREAM** Termination Review held June 27, 2014 - additional funding approved. Proceeding to KDP-D in September.
- **Spitzer** directed to plan for 2 years of continued operations.
- NASA is participating in ESA's planned assessments for its L3 gravitational wave observatory.
- Astrophysics Division **consolidating limited FY14 E/PO** activities at the Program level.

**Presentation by Kristin Erickson
during this APS meeting.**



Progress Toward Decadal Survey Priorities

The NASA FY14 Appropriation, the President's FY15 Budget Request, and its notional out years support:

Large-scale 1. 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 FY2017. Planning budget proposed for an Astrophysics Decadal Strategic Mission.
Large-scale 2. Augmentation to Explorer Program	Astrophysics Explorers planned budget increased to ~\$150M/yr by FY16; supports decadal cadence of AOs including AO for SMEX AO in Fall 2014 (FY2015) and EX AO in ~FY2017.
Large-scale 3. LISA	Strategic astrophysics technology (SAT) investments including LISA Pathfinder plus discussing partnership on ESA's L3 gravitational wave observatory – participating in ESA-led assessments in 2014-2015.
Large-scale 4. IXO	Strategic astrophysics technology (SAT) investments plus pursuing partnership on ESA's L2 Athena X-ray observatory. Athena study phase, with U.S. participation, is underway.
Medium-scale 1. New Worlds Technology Development Program	Focused technology development for a coronagraph on WFIRST, strategic astrophysics technology (SAT) investments, and exoplanet probe mission concept studies.



Progress Toward Decadal Survey Priorities

The NASA FY14 Appropriation, the President's FY15 Budget Request, and its notional out years support:

Medium-scale 2. Inflation Probe Technology Development Program	Three balloon-borne investigations plus strategic astrophysics technology (SAT) investments.
Small-scale. Research Program Augmentations	Increased annual R&A budget from \$74M (FY10) to \$82M (FY12 and beyond). Within R&A: established Theoretical and Computational Astrophysics Networks (TCAN) 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 (SAT) program element; directed technology funding for WFIRST and other large-scale decadal priorities.
Small-scale. Future Ultraviolet-Visible Space Capability	Strategic Astrophysics Technology (SAT) investments.
Small-scale. SPICA (U.S. contribution to JAXA-led)	Not supported as a strategic contribution; candidate for Explorer Mission of Opportunity.



Proposal Selections Since May 2013

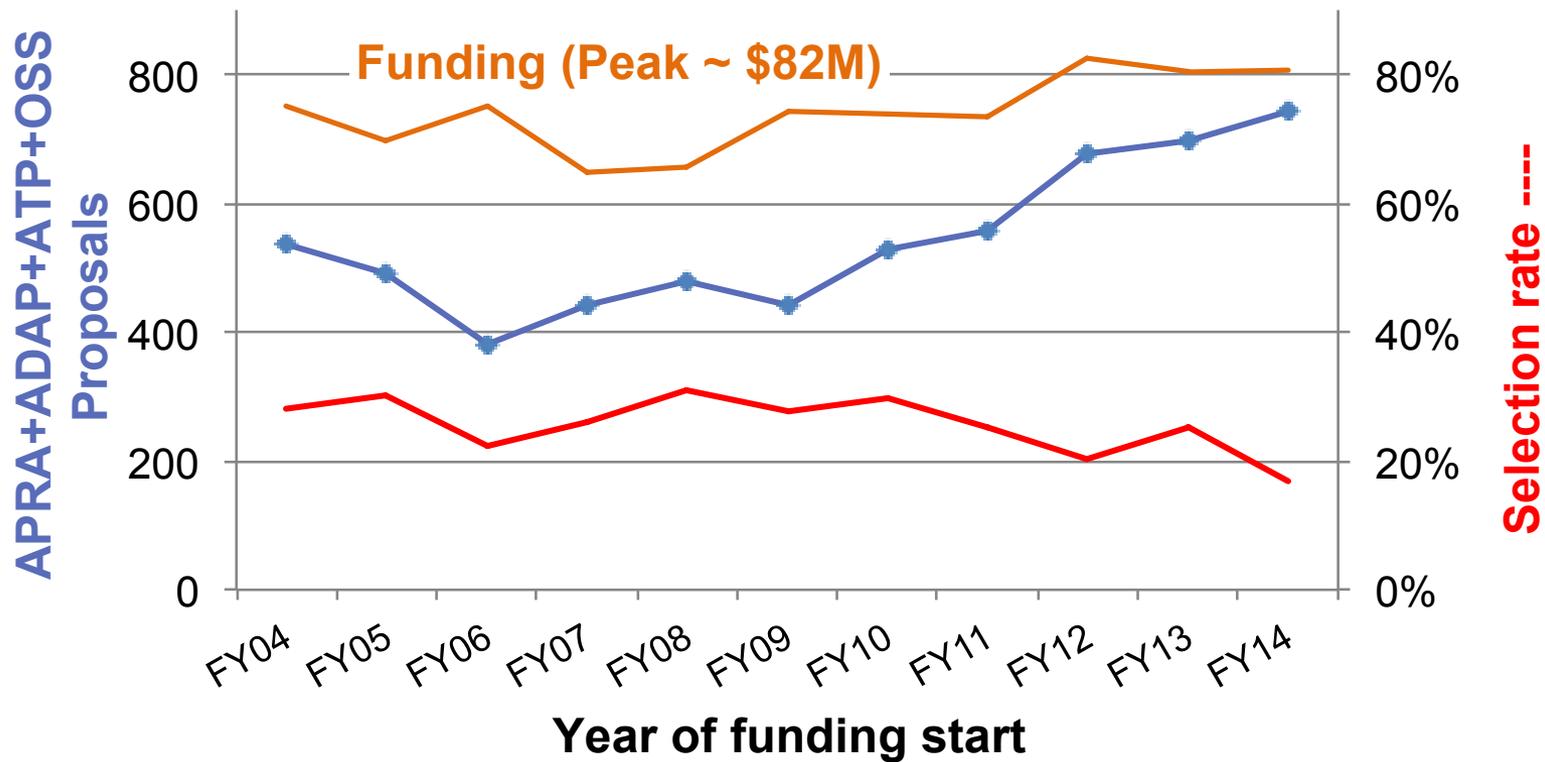
Status: July 31, 2014

	Proposal Due Date	Notify Date	Days since received	Number received	Number selected	% selected
ADAP (data analysis)	May 17	Oct 30	166	276	41	15%
Origins of Solar Sys.	May 23	Nov 7	168	39	7	18%
SOFIA GO Cycle 2 ⁺	Jun 28	Oct 31	125	112	35	31%
ATP (theory)	Jul 12	Dec 9	150	181	27	15%
Spitzer GO Cycle 10 ⁺	Aug 2	Oct 22	81	137	38	28%
Swift GI Cycle 10	Sep 26	Dec 18	83	175	45	26%
Fermi Cycle 6	Jan 31, 2014	Jun 23	143	224	44	20%
Roman Tech Stage 2	Feb 1	Apr 21	79	2	1	50%
Chandra GO Cycle 16	Mar 13	July 17	140	636	192	30%
APRA / SAT	Mar 21		132	177/18		
Hubble GO Cycle 22	Apr 11	Jun 23	111	1135	254	22%
ADAP (data analysis)	May 16		76	306	up 11%	
Exoplanet Research	May 23		69	64	up 64%	
ATP (theory)	July 11		20	216	} up 49%	
WFIRST Prep Science	July 11		20	53		

+ Priority 1 proposals only



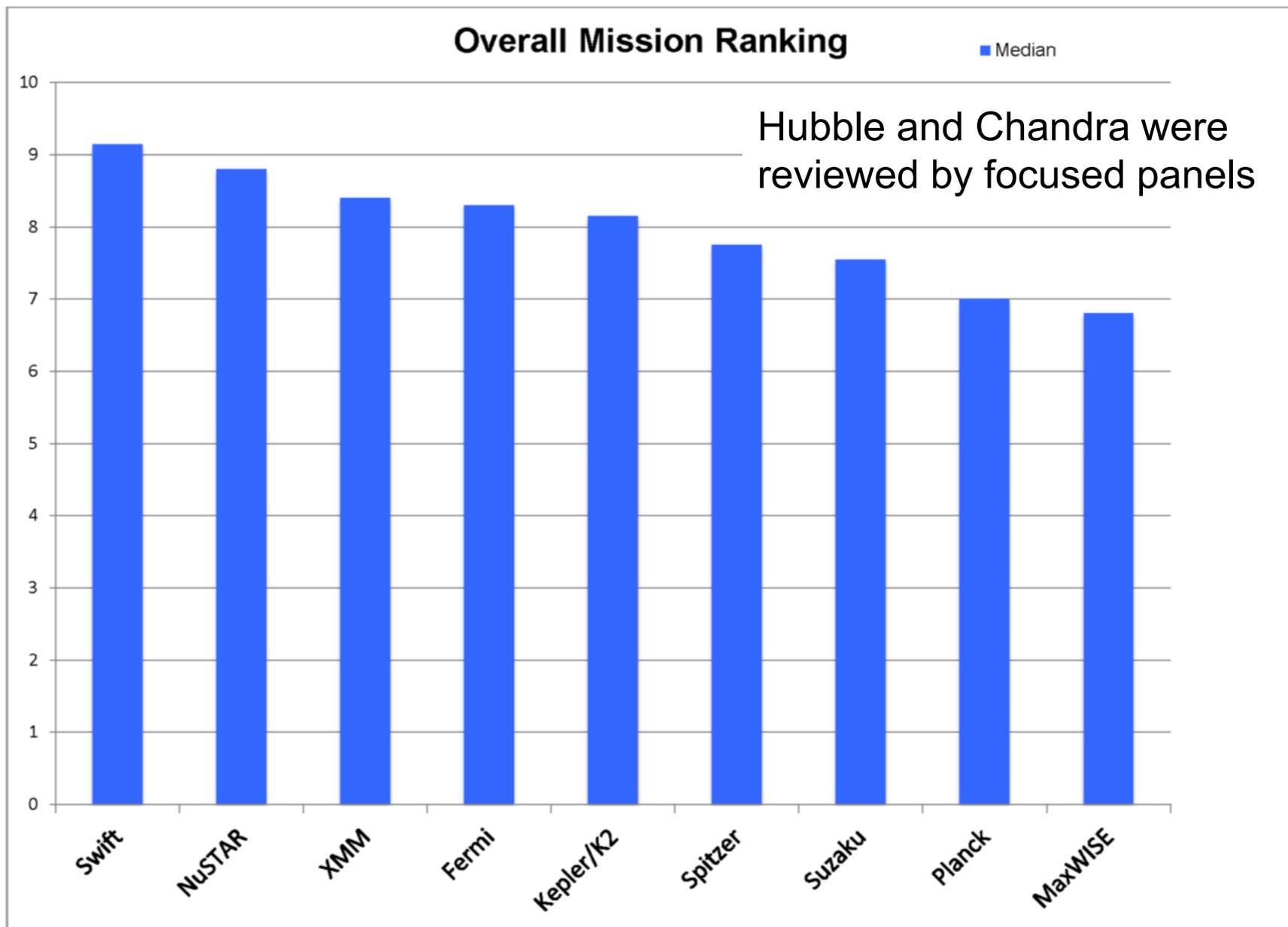
Astrophysics ROSES selection rates



Presentation by Linda Sparke during this APS meeting.



Astrophysics 2014 Senior Review





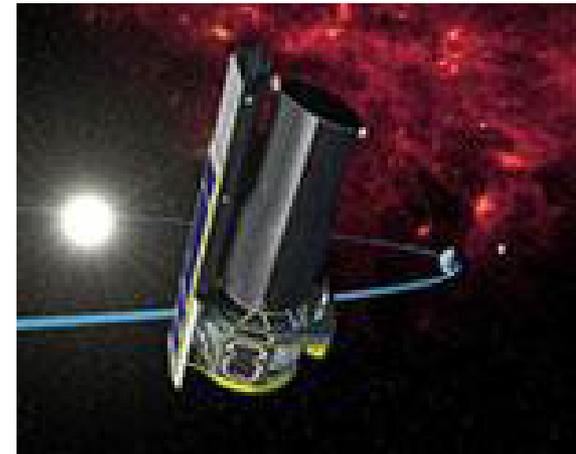
Astrophysics 2014 Senior Review

- 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 extended after original decision**
 - SMD determined that Spitzer infrared observations are an important resources for research programs across SMD. Both Astrophysics and Planetary Science Divisions identified observing time requirements for FY15 and both Divisions have committed funding to support their observations
- Suzaku (JAXA mission): extension approved; no GO augmentation
- Planck (ESA mission): reduced augmentation approved
- Widefield Infrared Survey Explorer (NEOWISE-R): data analysis proposal not approved



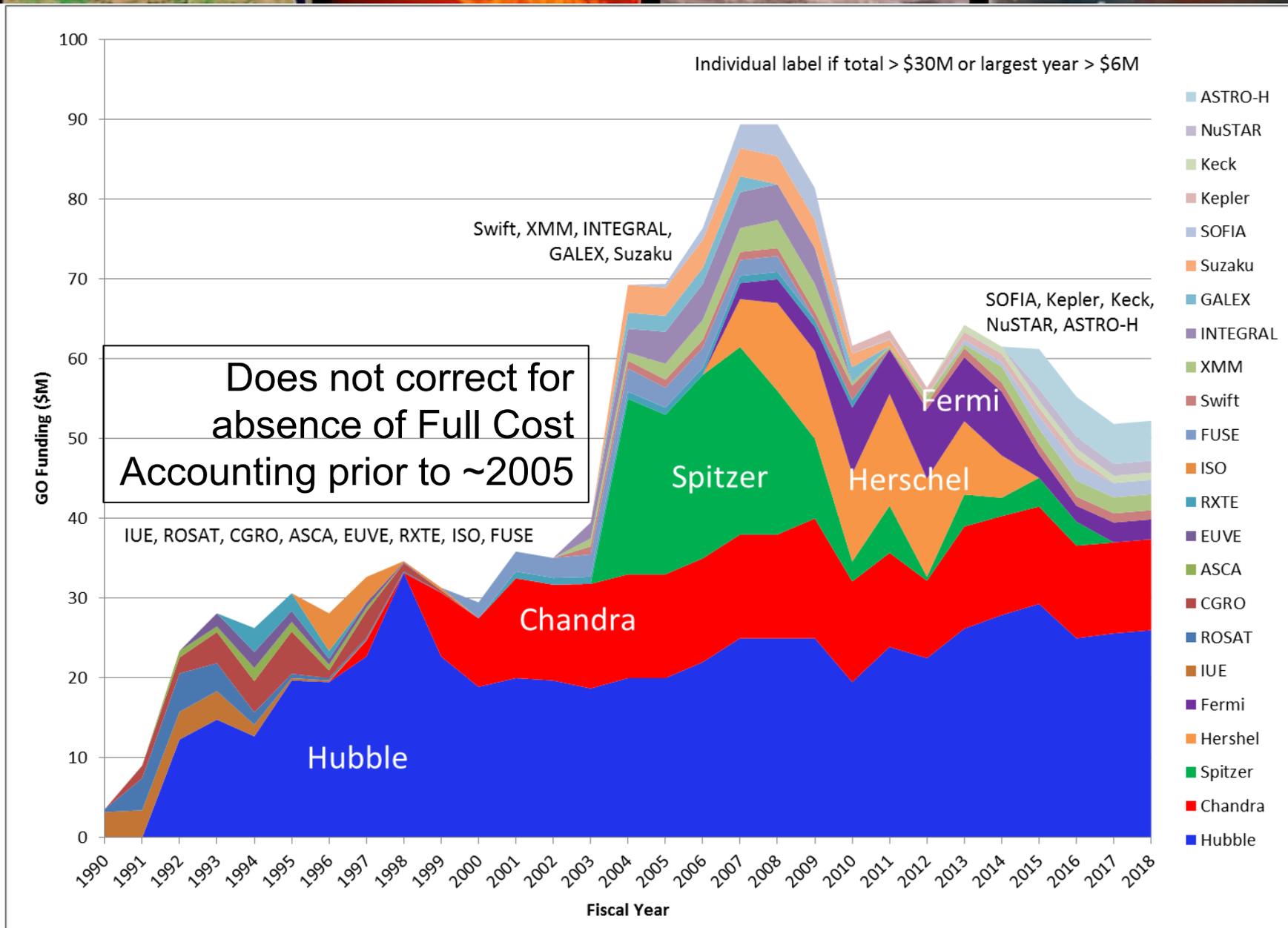
Spitzer

- The Science Mission Directorate has made the decision to extend Spitzer operations for the next two years.
- The Spitzer observatory is an important resource for on-going infrared observations for research programs across the Science Mission Directorate, and, subject to the availability of Congressional appropriations in FY 2015, it will be continued.
- Both the Astrophysics and the Planetary Science Divisions have requested observing time commitments for FY 2015, and both Divisions have committed funding to support their observations.
- The Spitzer project is directed to continue planning for operations beyond FY14.



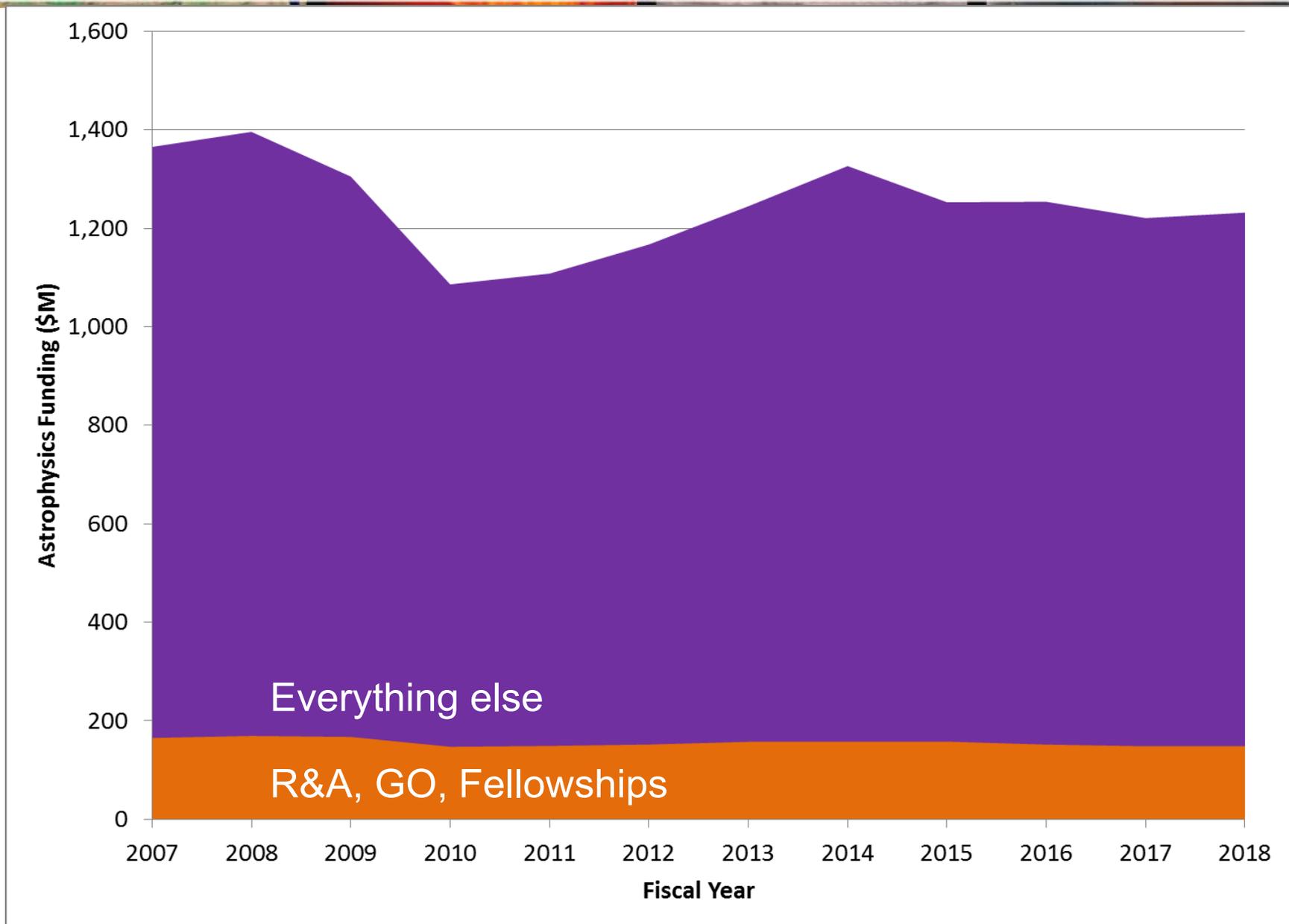


GO Funding: 1990-2018 (projected)





Community Funding vs Total Budget





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).

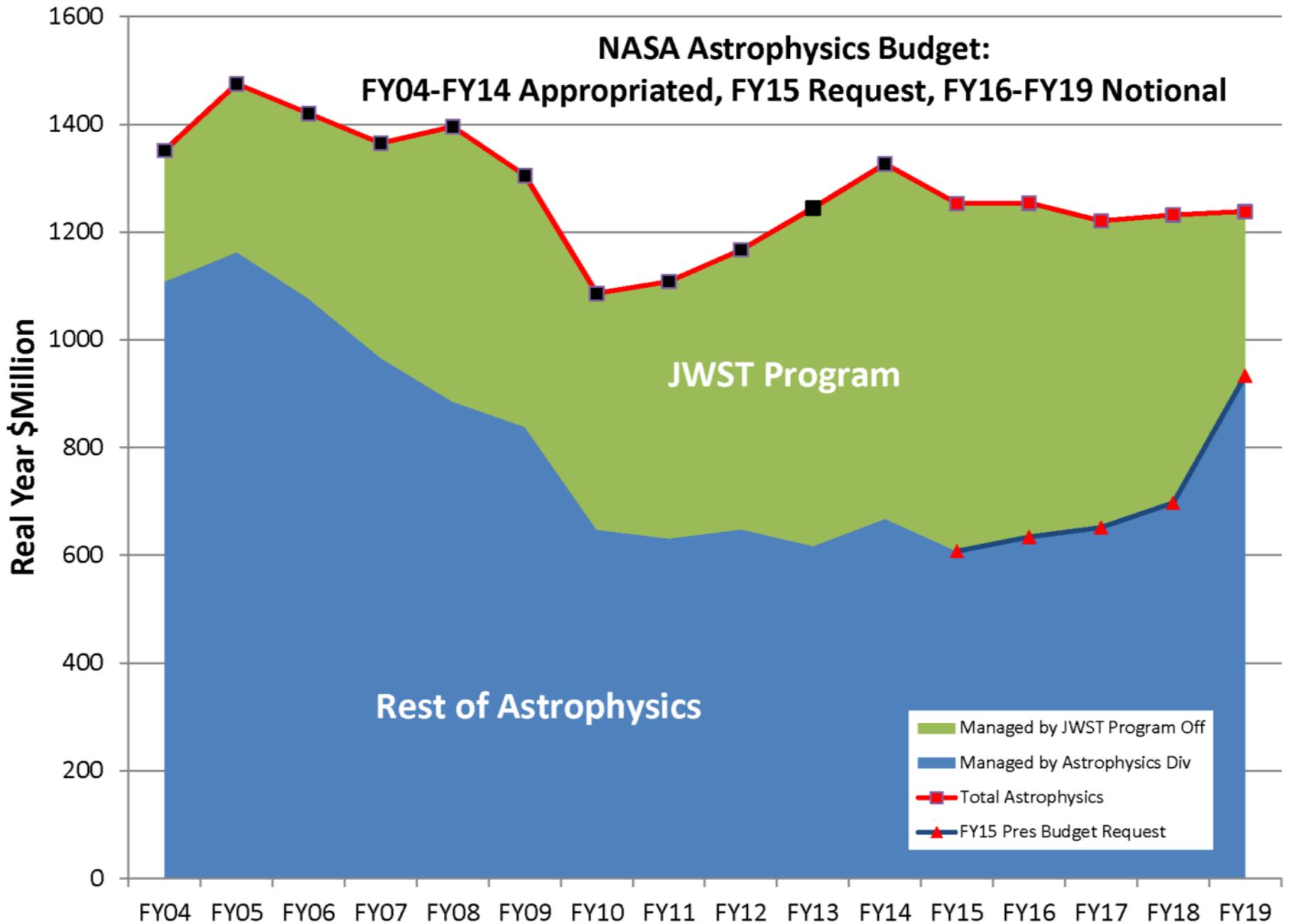


FY15 (next year) President's Budget Request

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.





FY15 (next year) Budget Appropriation

- Administration request is \$607M for Astrophysics and \$645M for JWST.
- House appropriations bill and report includes:
 - Recommendation is \$680M for Astrophysics (an increase of \$73M) and \$645M for JWST
 - Restores \$5M reduction in Hubble operations
 - Rejects SOFIA termination; appropriates \$70M (an increase of \$58M) for SOFIA operations
 - Provides \$30M (an increase of \$15M) for EPO
- Senate appropriations committee markup and report includes:
 - Recommendation is \$750M for Astrophysics (an increase of \$143M) and \$645M for JWST
 - Restores \$23M reduction in Hubble operations
 - Provides \$56M for WFIRST (an increase of \$42M)
 - Rejects SOFIA termination; appropriates \$87M (an increase of \$75M) for SOFIA operations
 - Provides \$42M (an increase of \$27M) for EPO
- Continuing Resolution highly likely to start FY15.



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 will be conducted in FY15.
- Five **Sounding Rockets** with Astrophysics payloads will launch in FY15.



Astrophysics Timeline

Decadal Survey Mission

EX/MO (AO NET 2016)

Euclid (ESA)

SMEX/MO (AO 2014)

JWST (ESA, CSA)

TESS

NICER

ASTRO-H (JAXA)

ST-7/LPF (ESA)

ISS-CREAM (South Korea)

NuSTAR (ASI, Denmark)

SOFIA (DLR)

Kepler

Fermi (DOE, Intl team)

Suzaku (JAXA)

Swift (ASI, UK)

Spitzer

XMM-Newton (ESA)

Chandra (SRON)

Hubble (ESA)

■ Prime Mission

▨ Extended Mission

▤ Depends on Congressional Direction

TIMELINE CY

2000

2003

2006

2009

2012

2015

2018

2021

2024

- Formulation
- Implementation
- Primary Ops
- Extended Ops



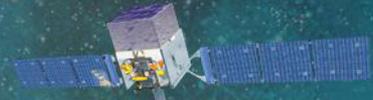
XMM-Newton (ESA)



Swift



Suzaku (JAXA)



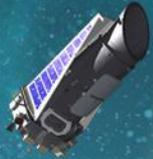
Fermi



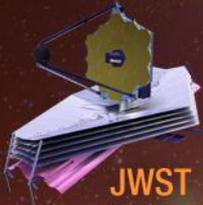
Euclid (ESA)



Hubble



Kepler



JWST



Spitzer



STRIP-H (JAXA)

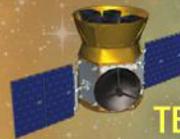
BACK-UP



NICER (on ISS)



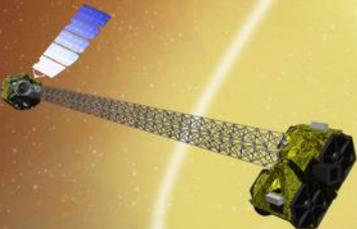
Chandra



TESS

NASA Astrophysics

NuSTAR

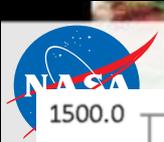


LISA Pathfinder (ESA)

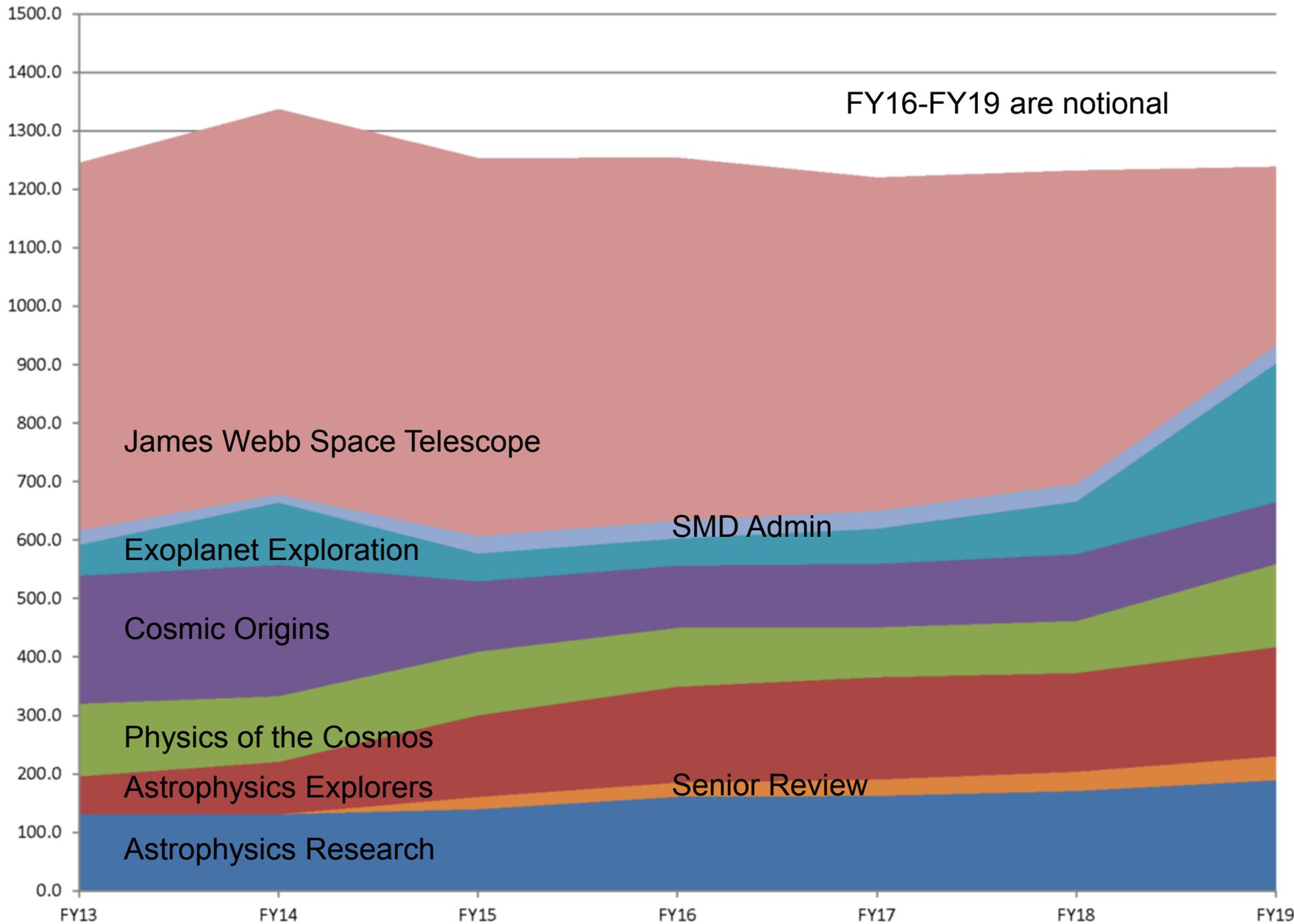


SOFIA

Recently Completed
 Planck 2013
 Herschel 2013
 GALEX 2013



President's FY15 Budget Request



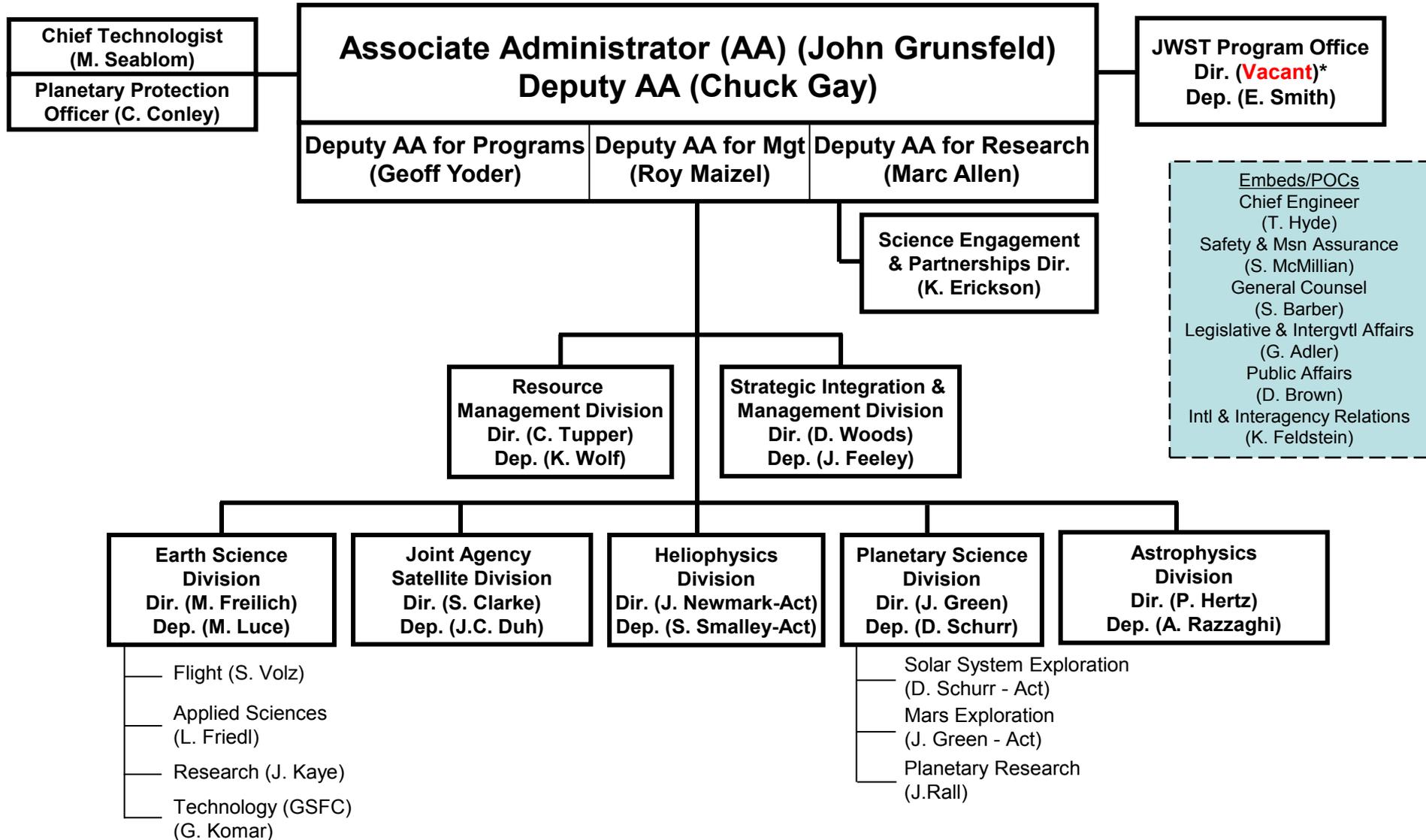


Astrophysics FY 2015 Budget Request

	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



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 Kaluziński, 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 Kaluziński

Jeff Hayes

Astrophysics Explorers (APEX)

Program

Wilt Sanders *

Mark Sistilli

ASTRO-H

Lou Kaluziński

Jeanne Davis

NICER

Rita Sambruna

Jeanne Davis

NuSTAR

Lou Kaluziński

Jeff Hayes

Suzaku

Lou Kaluziński

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.