National Aeronautics and Space Administration

# NASA Townhall
# AAS 223rd Meeting
# Washington, DC

**January 7, 2014**

# Astrophysics


## Paul Hertz

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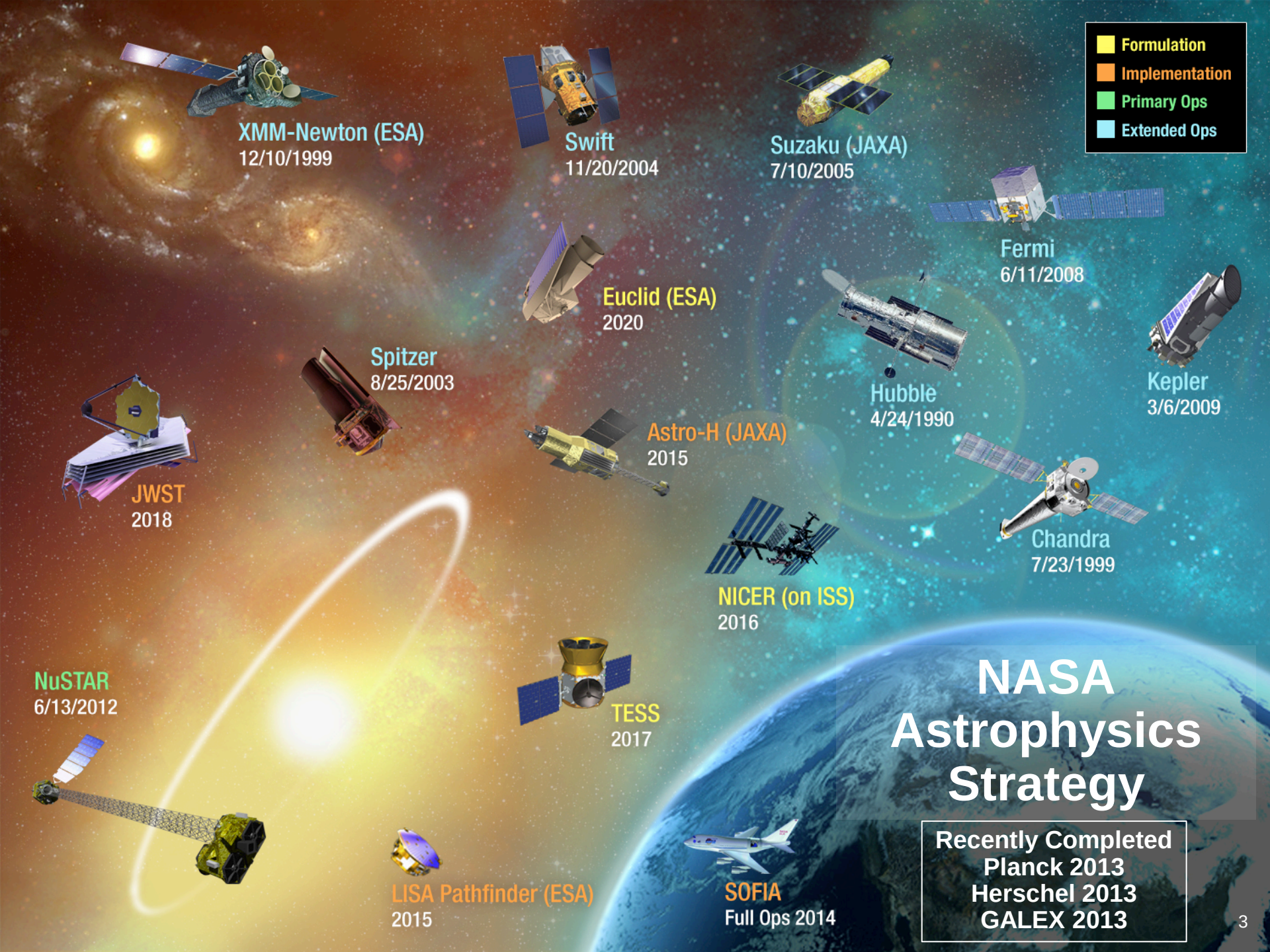
**Science Mission Directorate**


www.nasa.gov

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

# Outline

- NASA Astrophysics Strategy
  - The Big Picture
  - Science in 2013
  - Progress Toward the Decadal Survey
- NASA Astrophysics Budget
  - Budget Strategy
  - FY13 Budget
  - FY14 Budget
- NASA Astrophysics Programs
  - Impact of Government Shutdown
  - JWST & WFIRST-AFTA
  - Highlights for 2014
  - Research and Analysis Programs
- NASA Astrophysics Vision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6/13/2012
TESS
2017
LISA Pathfinder (ESA)
2015
SOFIA
Full Ops 2014
NASA Astrophysics Strategy
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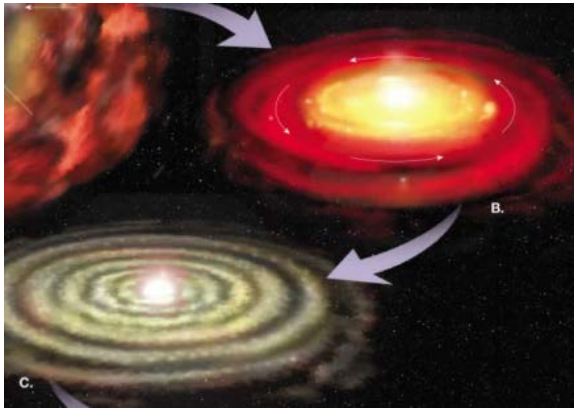
# Why Astrophysics?

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

1. How did our universe begin and evolve?

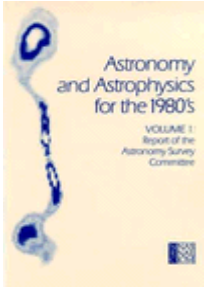



2. How did galaxies, stars, and planets come to be?

3. Are We Alone?

These national strategic drivers are enduring


1972

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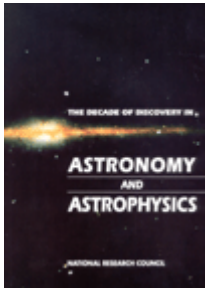



1991

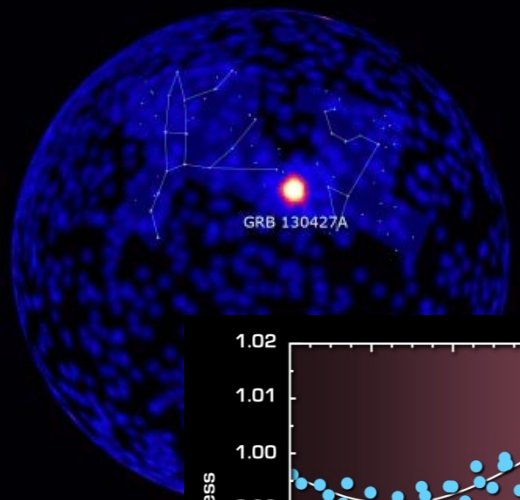

2001

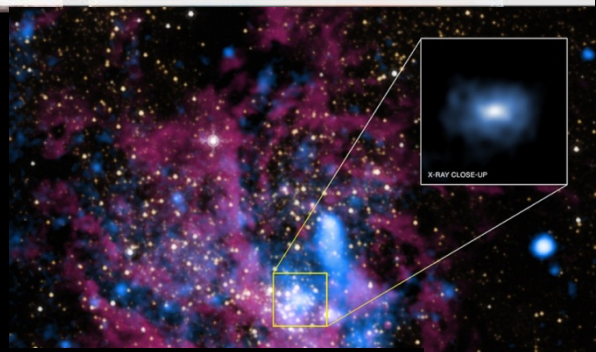

2010

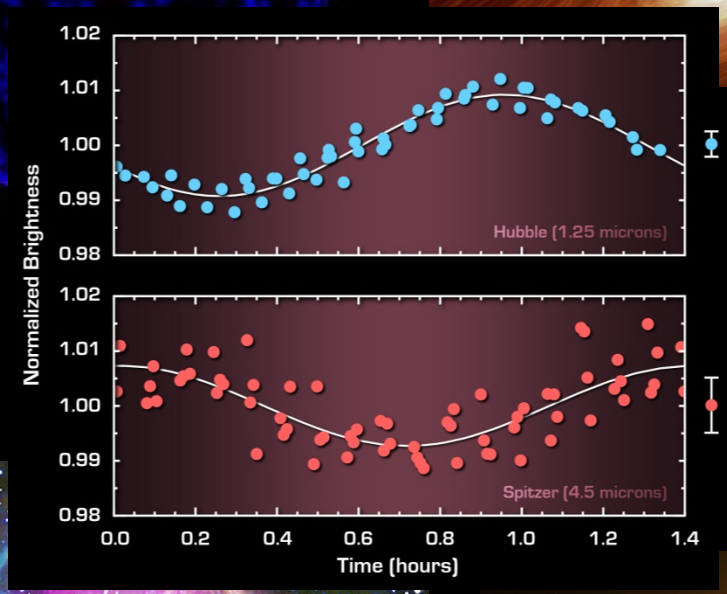
# The Big Picture

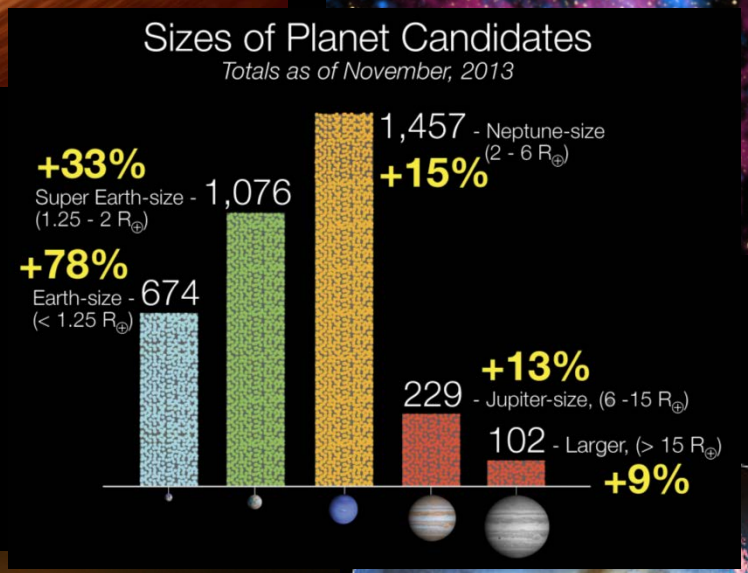
- This remains a time of scientific opportunity for NASA Astrophysics.
  - We are poised to answer the most compelling science questions.
  - The budget for NASA astrophysics, which includes JWST, is at ~$1.25B, a high level.
  - NASA continues to operate large and small space-based observatories spanning 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 contributions to international missions for launch this decade.
  - NASA has downselected two new Explorer projects to begin development for launch this decade, and an 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 reviewed processes.
  - NASA is preparing for the strategic mission that will follow JWST.
- The budgetary future remains uncertain.
  - Priorities must be used to guide difficult budget choices.

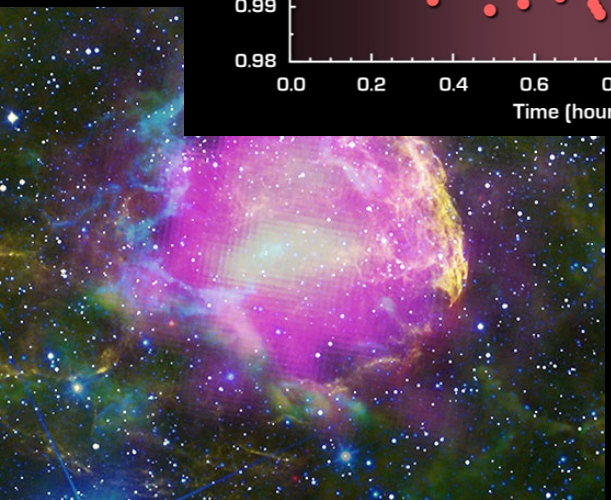
# Science in 2013

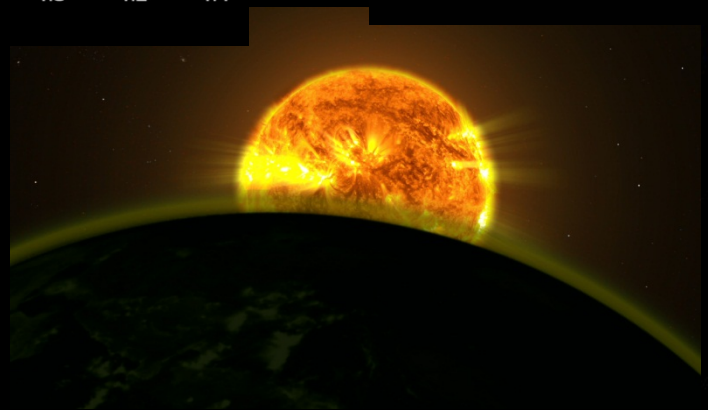


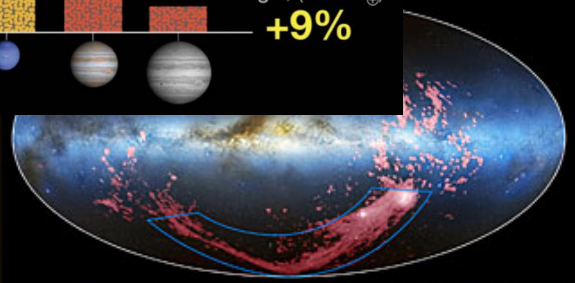



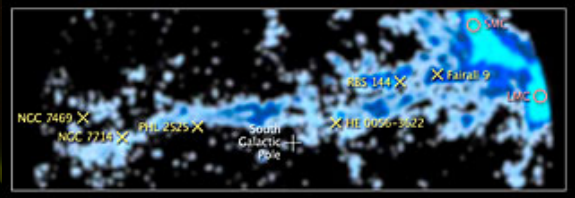









# ASTROPHYSICS

## Decadal Survey Missions

LRD: 2018

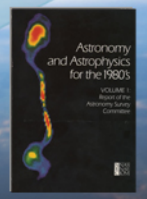
LRD: 2020s

2003

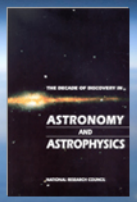
1999

1990

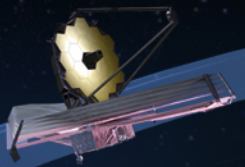

**1972** Decadal Survey *Hubble*




**1982** Decadal Survey *Chandra*




**1991** Decadal Survey *Spitzer*



**2001** Decadal Survey *JWST*




**2010** Decadal Survey *WFIRST*

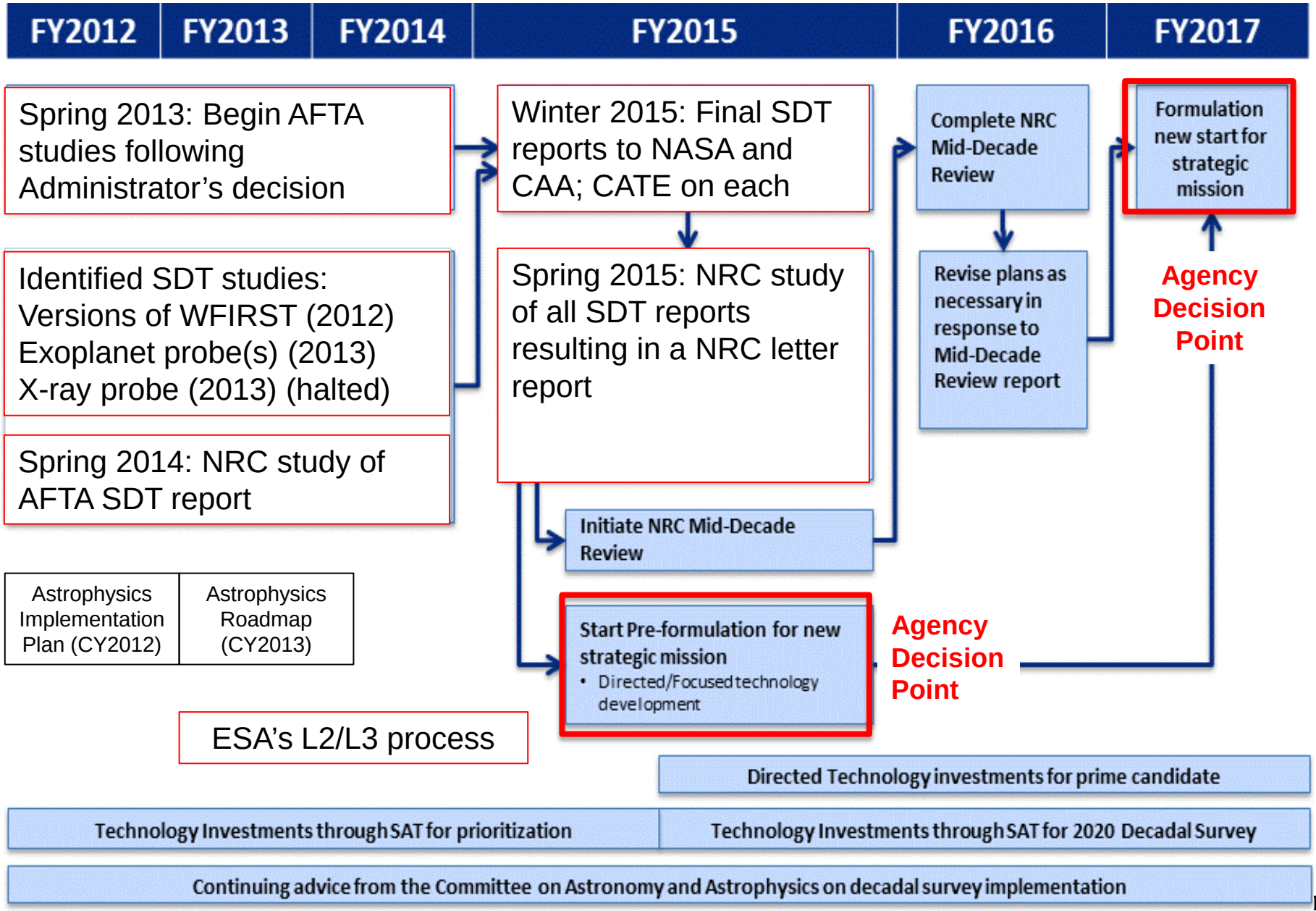
# Progress Toward Decadal Survey Priorities

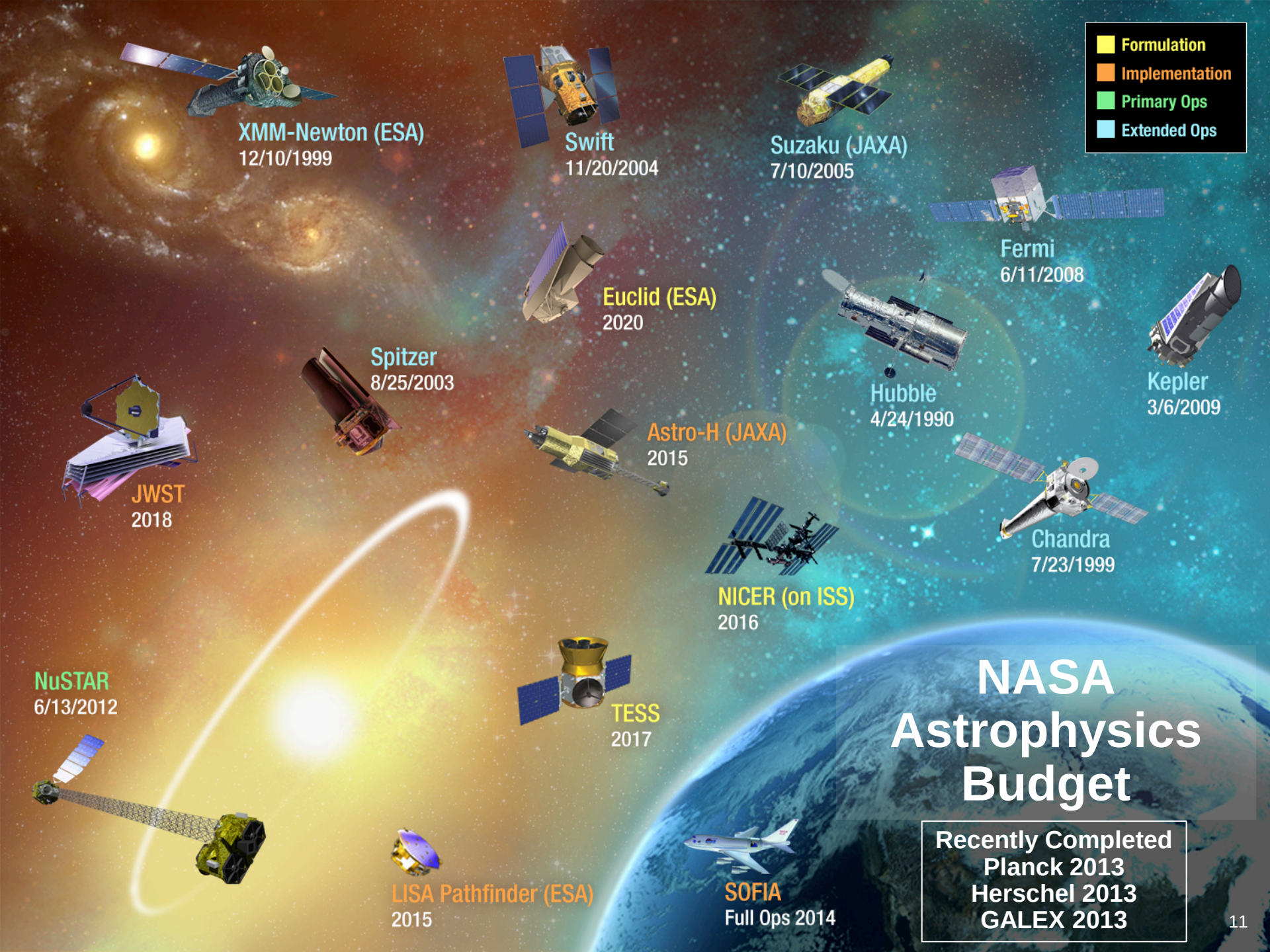
| The President's Budget Request for FY14 supports | |
|---|---|
| L1. WFIRST | Preformulation and focused technology development for AFTA (a 2.4m version of WFIRST) are underway to enable a new start NET FY17 |
| L2. Augmentation to Explorer Program | Increased from ~$90M in FY07 and ~$115M/yr in FY10 to ~$140M/yr in FY16 and beyond; supports AOs in 2014, 2017, … |
| L3. LISA | Strategic technology investments plus discussing partnership in ESA's L3 gravitational wave observatory |
| L4. IXO | Strategic technology investments plus discussing partnership in ESA's L2 X-ray observatory |
| M1. New Worlds Technology Development Program | Focused technology development for a coronagraph on WFIRST; mission concept studies and strategic technology investments |
| M2. Inflation Probe Technology Development Program | Three balloon-borne investigations plus strategic technology investments |

# Astrophysics Decadal Survey - Summary

| Program Scale | Recommendation | Response supported by FY14 President's Budget Request |
|---|---|---|
| Large | **WFIRST** | DRM1 and DRM2 completed in FY12; AFTA "proof of concept" DRM completed in FY13; pre-formulation and technology development (detector and coronagraph) in FY14-FY19; prepared for decision regarding new start in FY15; participating in ESA's Euclid |
| Large | **Explorer** Augmentation | Impacted by sequestration and budget reductions including cancellation of selections from FY12 MO AO; EX AO in FY11; SMEX AO NET 2014; EX AO NET 2016; each AO has a mission and a MO |
| Large | **LISA** Technology | CST completed in FY12; technology supported through SAT; ST-7/LPF supported; will pursue partnership with ESA if a GW mission is selected for L2/L3 mission |
| Large | **IXO** Technology | CST completed in FY12; technology supported through SAT; X-ray probe STDT starting in FY14; will pursue partnership with ESA if an X-ray mission is selected for L2/L3 mission |
| Medium | **New Worlds Technology** | Technology supported through APRA and SAT(TDEM); exoplanet probe STDTs started in FY13; AFTA coronagraph study completed in FY13; AFTA coronagraph technology starting in FY14; will consider partnership with ESA if an exoplanet mission is selected for L2/L3 mission |
| Medium | **Inflation Probe Technology** | Technology supported through APRA and SAT including multiple suborbital payloads; will consider partnership with ESA if a CMB mission is selected for L2/L3 mission |
| Small | **Astrophysics Theory Program** Augmentation | Impacted by sequestration and budget reductions |
| Small | (Definition of) a **future UV-optical space capability** | RFI in FY12; follow-on workshops FY14-FY16; technology supported through APRA, SAT, and working with STMD |
| Small | **Intermediate Technology Development** Augmentation | SAT program initiated in FY11 and funded for prioritized investments; funding directed toward decadal survey priorities including AFTA, probes, New Worlds, and ESA L2/L3 technologies; impacted by sequestration and budget reductions |
| Small | **Laboratory Astrophysics** Augmentation | Augmentation started in FY12 including selection of large consortium; future selections impacted by sequestration and budget reductions |
| Small | **SPICA** mission (U.S. contributions to JAXA-led) | Candidate for future Explorer Mission of Opportunity |
| Small | **Suborbital Program** Augmentation | Technology augmentation for balloon program; continued development of ULDB balloon platforms; ISS payload selections; impacted by sequestration and budget reductions |
| Small | **Theory and Computation Networks** (NASA, NSF, DOE) | Six networks competitively selected in 2013 and funded by NSF and NASA in FY14-FY16 |
| N/A | **Additional core program augmentations** | Includes basic research and technology development, mission extensions, data analysis, N.G. Roman Technology Fellowships; impacted by sequestration and budget reductions |

# Implementing the Decadal Survey

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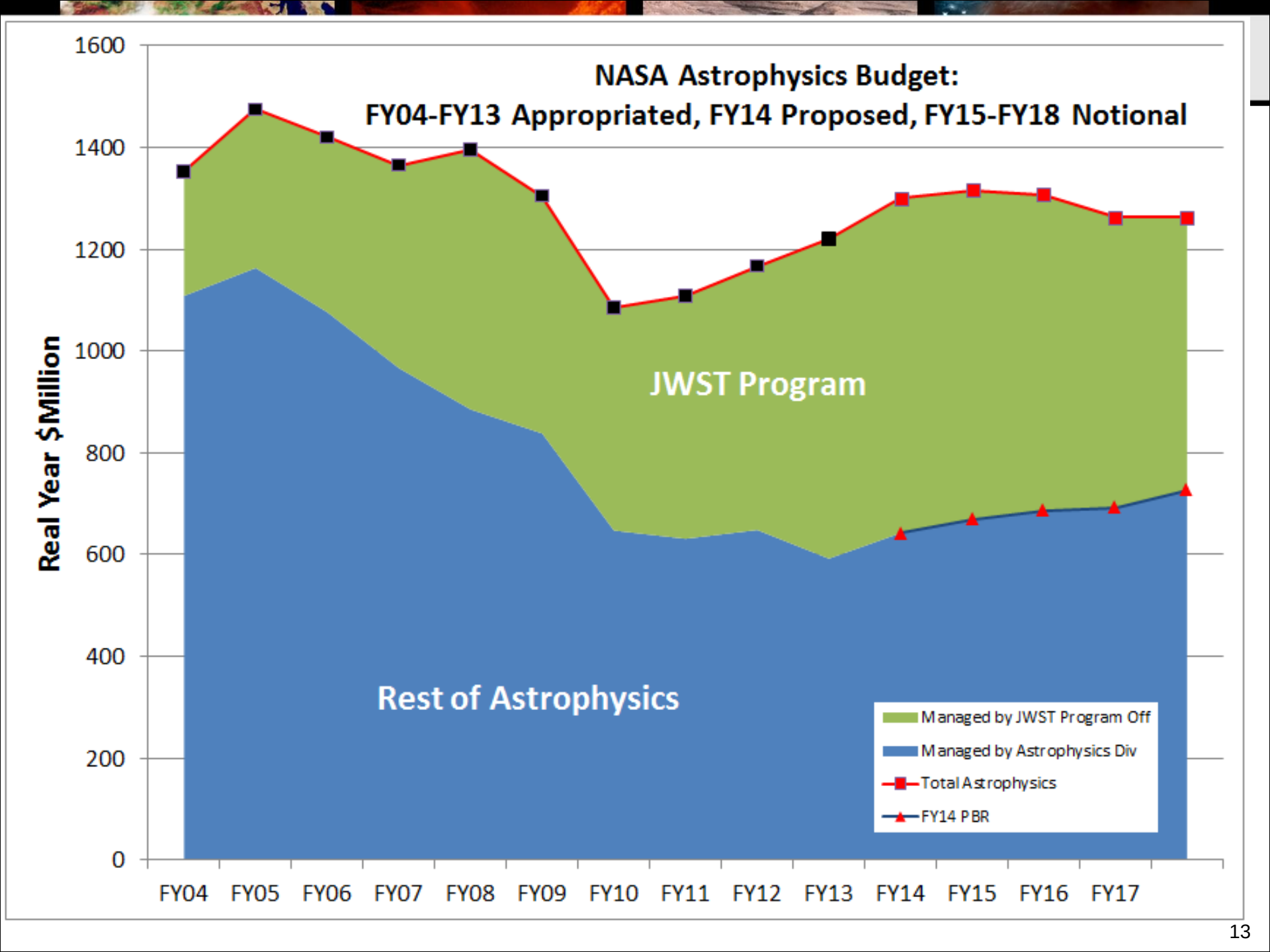
# Astrophysics Budget Strategy

- 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)


NASA Astrophysics Budget:
FY04-FY13 Appropriated, FY14 Proposed, FY15-FY18 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
FY14 PBR
FY04
FY05
FY06
FY07
FY08
FY09
FY10
FY11
FY12
FY13
FY14
FY15
FY16
FY17

# FY13 Budget Appropriation

- Congress appropriated $659M for Astrophysics & $628M for JWST.
  - Matched President's budget request before sequestration.
  - Rescission (~1.8%), Sequestration (~5%), and other budget adjustments resulted in an FY13 Astrophysics budget significantly lower.
  - Astrophysics ended at $617M ($42M reduction) & JWST ended at $628M for FY13.
- Astrophysics made reductions totaling $42M (6.4%) in the following areas.
  - Reduced carry-over for operating missions, includes rephasing of GO funds.
  - Rephased unneeded FY13 reserves for developing missions.
  - Rephased R&A funding until FY14 for some PIs, reduced selections.
  - Slowed down development of current and future Explorers.
  - Postponed needed upgrades in infrastructure programs.
  - Downstream impacts include.
    - Lowered R&A selection rates in 2013 (for FY14 funding).
    - Delays in future Explorer AOs.
    - Other reductions in FY14 where funding requirements were deferred.

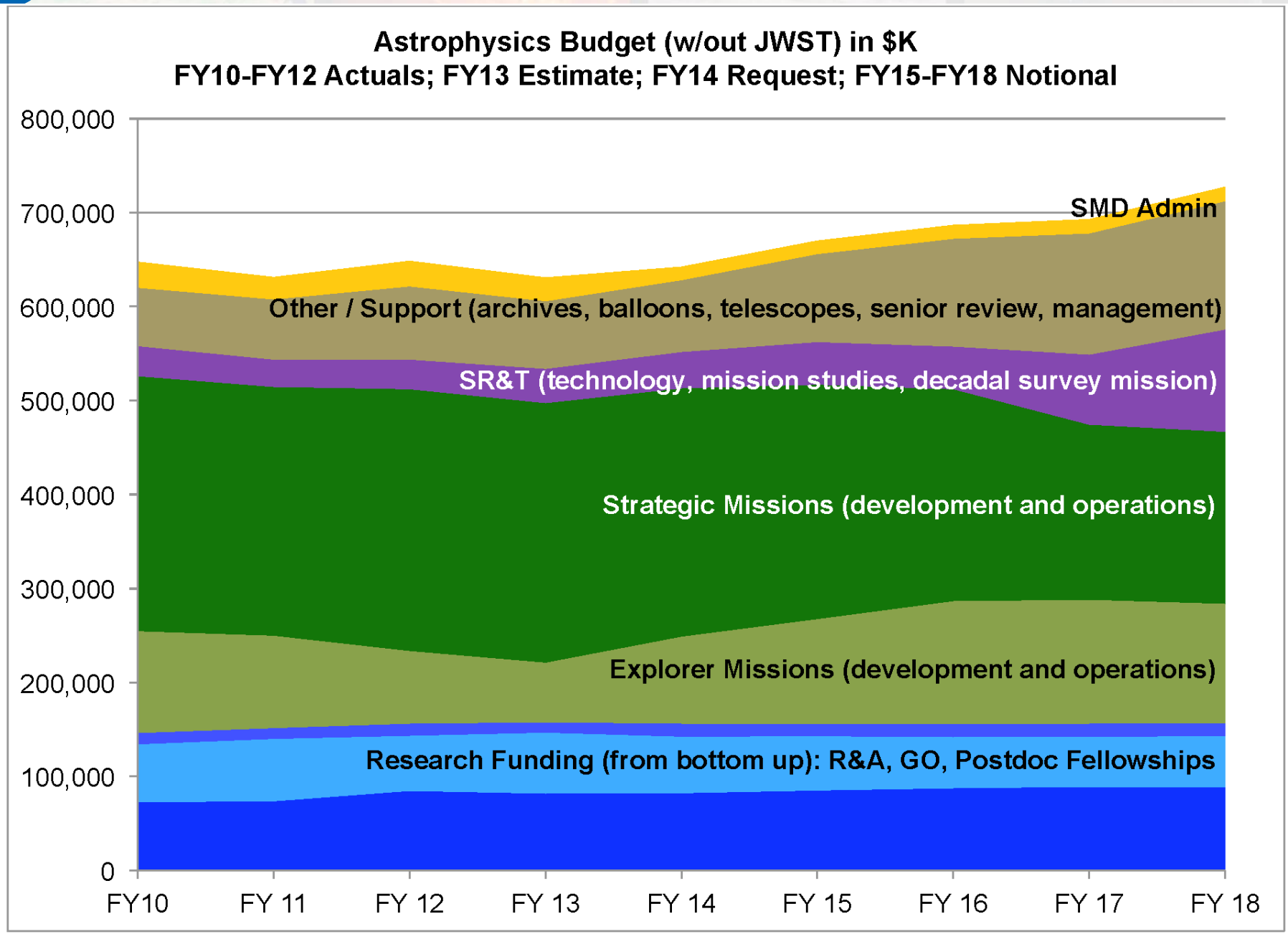
# FY14 Budget Appropriation

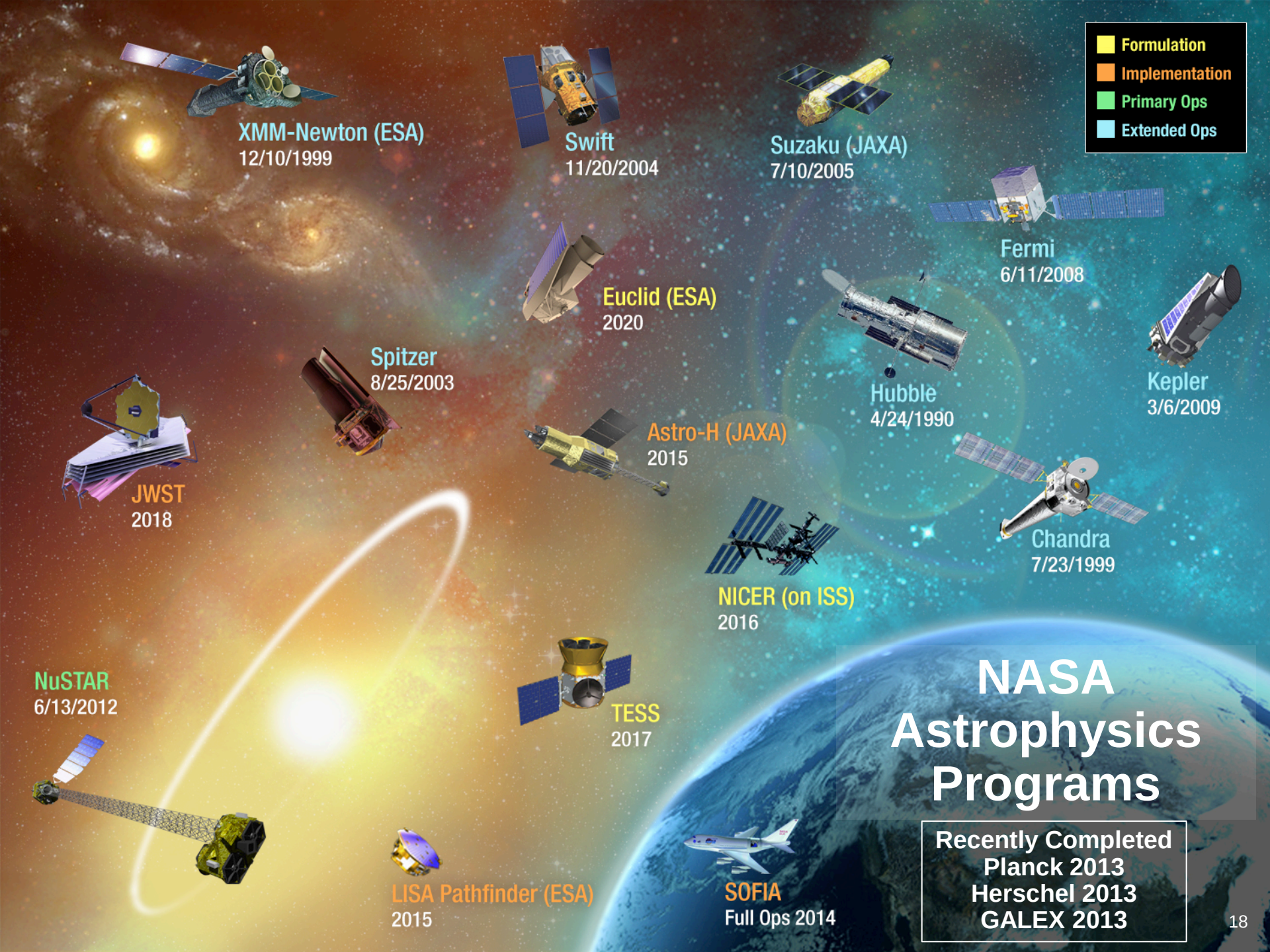
- President requested $642M for Astrophysics and $658M for JWST.
  - Request includes full funding required for JWST; new projects for TESS, NICER, Euclid; mission extensions per 2012 Senior Review; core funding for research and suborbital projects; planning budget wedge for strategic mission starting in FY17.
  - Request includes no funding for E/PO.
- Continuing resolution through January 15, 2014, is at FY13 post-sequestration level.
  - JWST is prioritized by NASA and will receive the funding required to maintain progress toward a 2018 LRD per the new baseline plan.
- Budget agreement sets FY14 and FY15 budget levels.
  - Astrophysics budget for FY14 is still TBD, but likely to be between President's Request ($642M) and FY13 post-sequestration ($617M).
  - Our current plans for missions and R&A follow the President's Request, so reductions and deferrals in some programs are expected.

# Distribution of FY14 Budget Request

| | % of FY14 PBR | Total $628.4M (excludes $13.9M SMD admin account) |
|---|---|---|
| R&A program elements | 13.2% | includes APRA, OSS, ATP, ADAP, RTF, TCAN |
| Research infrastructure | 10.2% | includes balloon program, Keck, LBTI, archives, astrobiology |
| Einstein, Hubble, Sagan Fellowships | 2.2% | |
| Operating missions (including GO programs) | Total 36.2%<br>Hubble 15.3%<br>Chandra 8.7%<br>Kepler 3.0%<br>Spitzer 2.6%<br>Fermi 2.3%<br>Others 4.4% | prioritized by Senior Review<br><br>“others” includes Herschel, NuSTAR, Planck, Swift, Suzaku, XMM-Newton<br><br>GO funding is 9.6% (of $628.4M FY14 PBR) |
| SOFIA | 13.9% | |
| Explorer missions in development | 12.8% | includes ASTRO-H, NICER, TESS |
| Strategic missions in development | 2.9% | includes Euclid, ST-7 |
| Future Explorer missions | 0.0% | no funding until next AO selection |
| Pre-formulation of WFIRST/AFTA | 2.1% | including technology development for detectors and coronagraph |
| Strategic Astrophysics Technology | 3.3% | directed, competed, and testbeds |
| Other strategic studies | 0.7% | includes exoplanet probes, X-ray probe |
| Program management | 2.6% | |

# Astrophysics Balance (w/out JWST)

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# Major Impacts of Government Shutdown

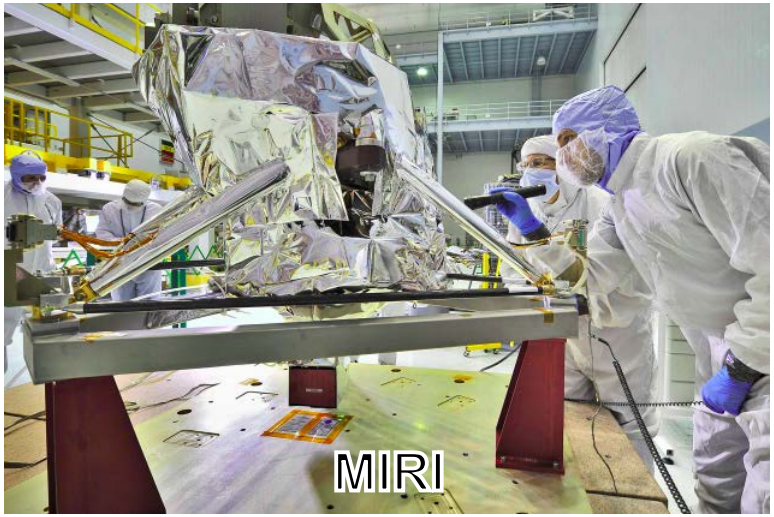
- The 2013-2014 Antarctic long duration balloon campaign is cancelled.
  - The shutdown came at a critical time, there were insufficient resources and time to prepare the McMurdo station and the payloads for launch.
  - Three astrophysics LDB flights have been cancelled for 2013-2014:
    - SPIDER (PI: W. Jones, Princeton) – CMB polarization
    - BACCUS (PI: A. Malinin, U. Maryland) – Cosmic-ray astrophysics
    - Super Pressure Balloon 100 day test flight (Balloon Program Office)
  - Will compete for a 2015 flight with other payloads planned for next year.
- SOFIA cancelled 9 science flights with U.S. instruments.
  - Rescheduling FLITECAM commissioning contributed to delay of FOC milestone.
- Stand down in ASTRO-H soft x-ray spectrometer (SXS) integration and test will result in a ~5 week delivery delay to JAXA.
  - SXS is near ASTRO-H critical path, so will have TBD impact on ASTRO-H integration and test schedule.
  - Delay increases U.S. cost to complete SXS.
- Other development projects took schedule hits including 1 month on ISS-CREAM payload.
- Operating missions continued most activities, some delay in science data processing.
- There will be delays in sending out research funding.

# Major Activities for CY 2014

- Confirm NICER Explorer Mission of Opportunity (launch in 2016) (January 2014)
- Begin Euclid detector flight build (launch in 2020) (Winter 2014)
- Senior Review for Operating Missions (March 2014)
- Deliver ASTRO-H soft X-ray spectrometer to JAXA (launch in 2015) (April 2014)
- Complete and test JWST instrument suite (launch in 2018) (Summer 2014)
- AO for Small Explorer (SMEX) and Mission of Opportunity (Fall 2014)
- Deliver ISS-CREAM for launch to Space Station (launch in 2014) (Fall 2014)
- Confirm TESS Explorer Mission (launch in 2017) (Fall 2014)
- Commission three more SOFIA instruments: FLITECAM, FIFI-LS, EXES (throughout 2014)
- Participate in ESA's L2 (X-ray observatory) Mission Study (launch in 2028) (throughout 2014)

# JWST
## James Webb Space Telescope

- JWST remains on schedule for its October 2018 launch
- JWST Town Hall: Wednesday 12:45 pm in Potomac Ballroom A



# WFIRST – AFTA

## Widefield Infrared Survey Telescope with Astrophysics Focused Telescope Assets

WFIRST Town Hall: Wednesday 6:30 pm in National Harbor 3

- **Top priority in 2010 Decadal Survey**
- **Study Baseline Payload:**
  - 2.4m existing telescope assets
  - Widefield imager
  - Coronagraph
- **Science objectives:**
  - Hubble-quality imaging over 200x the field
  - Comprehensive study of dark energy
  - Systematic census of outer planets
  - Coronagraphic imaging of exoplanets
  - 25% time for community competitive selected GO program
  - Enhancing JWST science

**CURRENT STATUS:**

- May 2013, NASA Administrator Bolden directed Astrophysics Division to study WFIRST-AFTA and preserve option for FY17 new start if budget is available
  - No decision expected before early 2016
- Currently in pre-formulation phase
  - NRC study in early 2014
  - SDT final report due Jan 2015
- Maturing key technologies to TRL 5 by FY 17 and TRL 6 by FY19
  - Infrared detectors
  - Internal coronagraph for exoplanet characterization

**Mission description**:

- #1 Large-Scale Priority: Widefield infrared survey telescope for Dark Energy, Exoplanets, IR Surveys
- #1 Medium-Scale Priority: Development and demonstration of technology for direct imaging and characterization of exoplanets

# AFTA Study: Strawman Payload & SDT Findings

## 2.4m Telescope with wide field-of-view

### Wide-Field Instrument

- *Imaging & spectroscopy over 1000s sq deg.*
- *Monitoring of SNe and microlensing fields*
- 0.7 – 2.0 micron bandpass
- 0.28 sq deg FoV (100x JWST FoV)
- 4 filter imaging, grism + IFU spectroscopy
- 18 H4RG detectors (288 Mpixels)

***Requires focused tech. development***

### Coronagraph (study option)

- *Imaging of ice & gas giant exoplanets*
- *Imaging of debris disks*
- 400 – 1000 nm bandpass
- $10^{-9}$ contrast
- 100 milliarcsec inner working angle at 400 nm

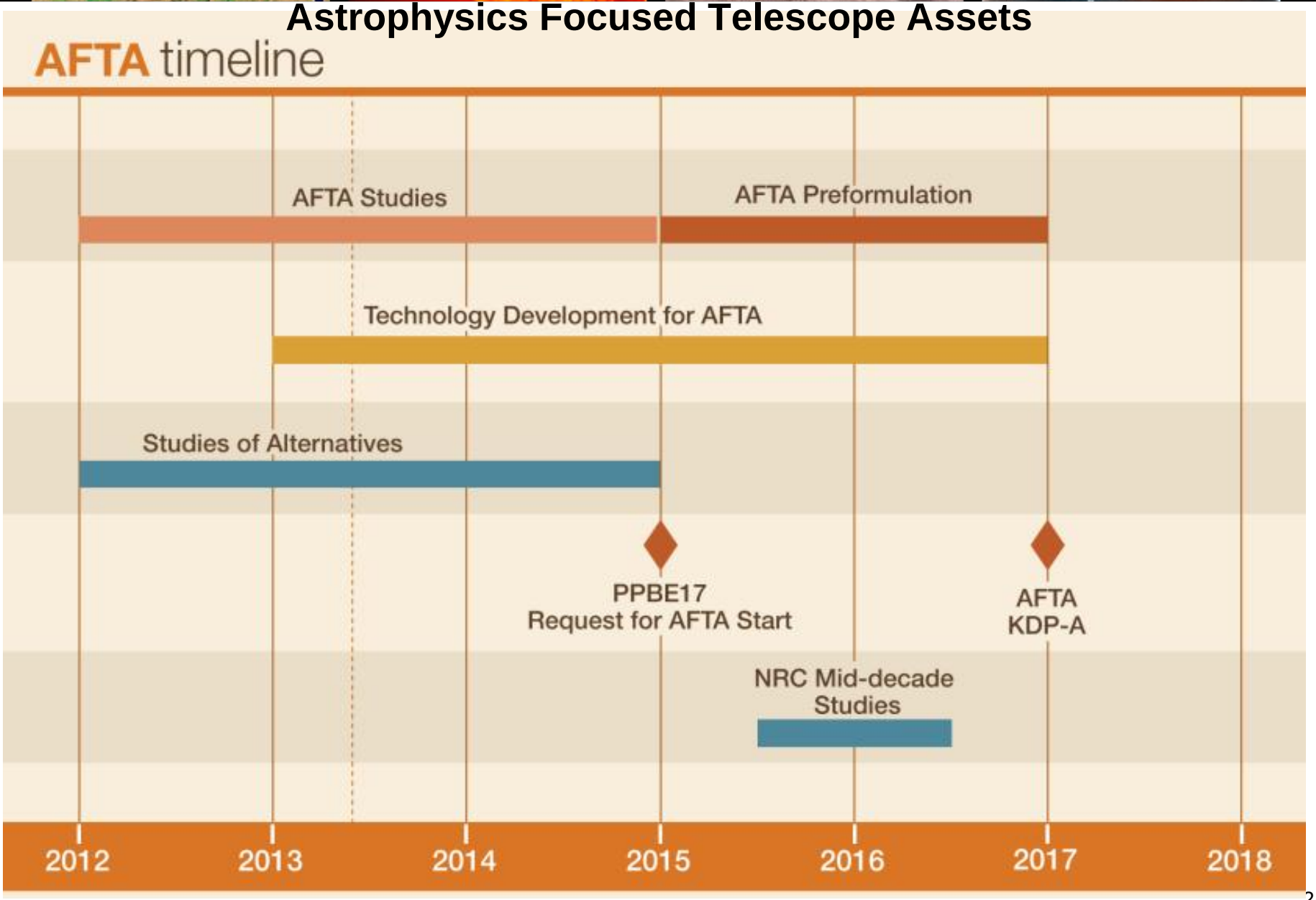
***Requires focused tech. development***

### Findings of SDT

- AFTA carries out the WFIRST science program (the top ranked decadal priority).
- AFTA's larger aperture enables astronomers to make important contributions towards many of the enduring questions listed in the decadal survey through both surveys and peer-reviewed observing programs.
- Equipped with a coronagraph, AFTA can image Jupiter and Saturn-like planets around the nearest stars. AFTA will be an essential stepping stone towards finding signs of life around nearby stars.

# Plan for WFIRST-AFTA Preformulation

## Widefield Infrared Survey Telescope using Astrophysics Focused Telescope Assets



# 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:

- Continuously monitored 100 sq. deg. field in constellations of Cygnus and Lyra for 4+ years
- Analysis of first 3 years of Kepler data has revealed:
  - 3538 exoplanet candidates orbiting 2658 unique stars
  - 167 candidates confirmed as planets to date
  - More than 100 planets discovered in their star's "habitable zone"—the region in the planetary system where liquid water might exist on the surface of a planet
  - 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
- Spacecraft suffered failure of 2 reaction wheels in July 2012 and May 2013:
  - Only 2 functional reaction wheels remain
  - Not sufficient to maintain precise pointing on the Kepler field
- Project has developed strategy for a new science mission that requires only 2 reaction wheels (see http://www.nasa.gov/kepler/a-sunny-outlook-for-nasa-keplers-second-light)
- New mission concept will be proposed to the 2014 Astrophysics Senior Review

# SOFIA
## Stratospheric Observatory for Infrared Astronomy

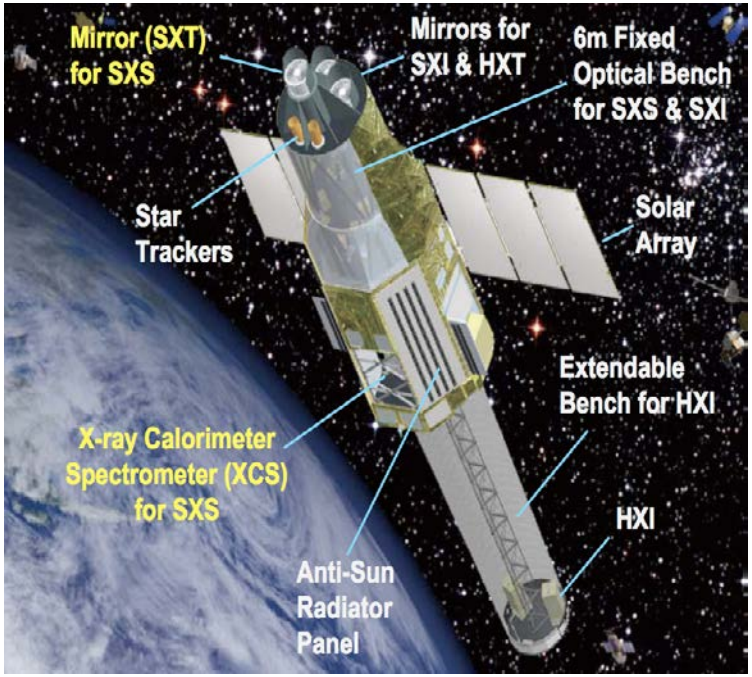

- **World's Largest Airborne Observatory**
- 2.5-meter telescope
- Capable of observing from the visible to the far infrared
- 80/20 Partnership between NASA and the German Aerospace Center (DLR)
- Mission Ops based at NASA-Dryden
- Science Ops based at NASA-Ames
- Six First-Generation instruments
 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

### CURRENT STATUS:

- Completed 46 successful flights during Calendar Year 2013
  - 25 science (153 research hours)
  - 10 instrument commissioning
  - 5 engineering/test
  - 6 ferry flights (to/from deployment)
- Completed Inaugural Southern Hemisphere Deployment, July 2013
  - Christchurch, New Zealand
  - 9 science flights in 14 nights
  - 100% of objectives achieved
- One remaining step to achievement of Full Operational Capability (FOC)
  - Completion of commissioning flights for 4$^{th}$ instrument
- Cycle 2 science investigations chosen
  - To be executed in 2014
- Second generation instruments under development (1 U.S., 1 German)
  - HAWC+: upgraded far infrared imager and polarimeter
  - upGREAT: multi-pixel heterodyne spectrometer

# ASTRO-H

## Soft X-ray Spectrometer and Soft X-ray Telescope Mirrors



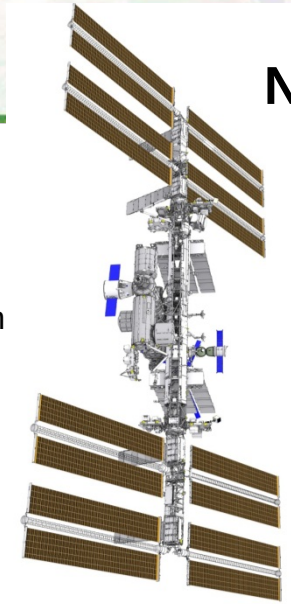

- **Explorer Mission of Opportunity**
- **PI**: R. Kelley, Goddard Space Flight Center
- **Launch Date**: Nov 2015 on JAXA H-IIA
- **Science Objectives**: Provides the high-resolution spectroscopy to detect abundant elements (heavier than He) that emit characteristic x-rays. Enables wide variety of physical measurements from black holes to clusters of galaxies
- **Operations**: Prime Mission is 3 years

### CURRENT STATUS

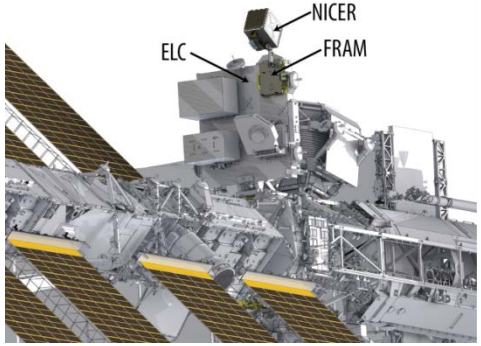
The U.S. is providing instrument contributions to the JAXA ASTRO-H mission.

- X-ray calorimeter spectrometer insert (CSI), including the 3 stage adiabatic demagnetization refrigerator and detectors, and Aperture Assembly - Delivery April 2014.
- ADR controller (ADRC) – Delivery Feb 2015
- X-ray Electronics Box – Delivery May 2014
- Soft X-ray telescope mirrors (SXT Mirror 1 and 2) – Both delivered.
- ASTRO-H project rebaselined in November 2013 to account for JAXA schedule changes and impact of U.S. government shutdown in Oct. of 2013.

# NICER
## Neutron Star Interior Composition Explorer



Intl Space Station (ISS)

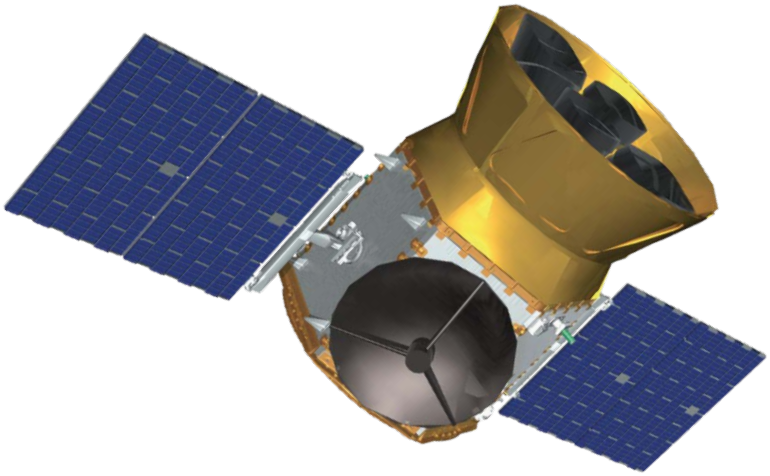



- **Explorer Mission of Opportunity**
- **PI:** Keith Gendreau, GSFC
- **Launch:** August 2016 on Space-X Falcon 9
- **Science Objectives:** Perform high-time-resolution and spectroscopic observations of neutron stars in the .2-12 keV energy range to study the physics of ultra-dense matter in the core 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.
  - Contracts for subsystems being put in place.
- The Preliminary Design Review successfully completed in December 2013.
- The Confirmation review, for approval to enter implementation phase, is scheduled for late January 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.

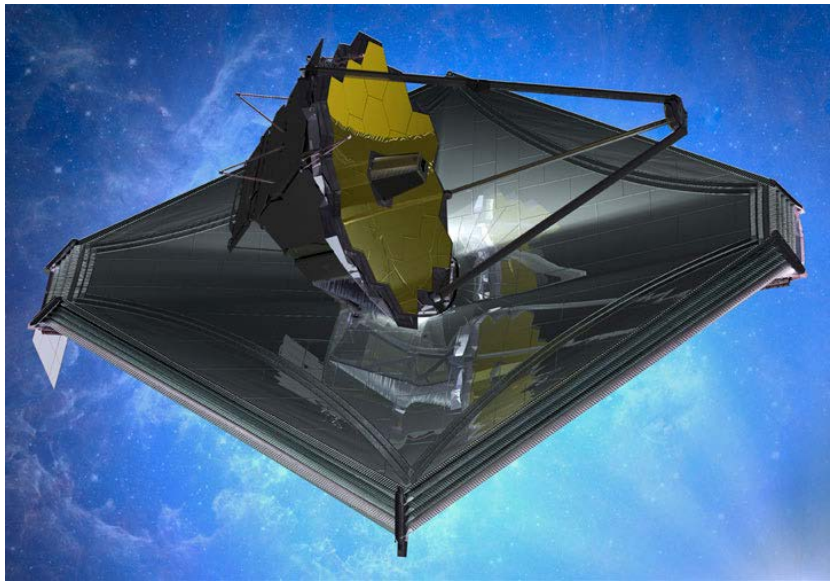
**Instruments**: Four wide field of view CCD cameras with overlapping field of view operating in the Visible-IR spectrum (0.6-1 micron).

**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 Labs
  - 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 planned for February 2014.
  - Confirmation Review, for approval to enter implementation phase, is planned for Fall 2014.

# 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

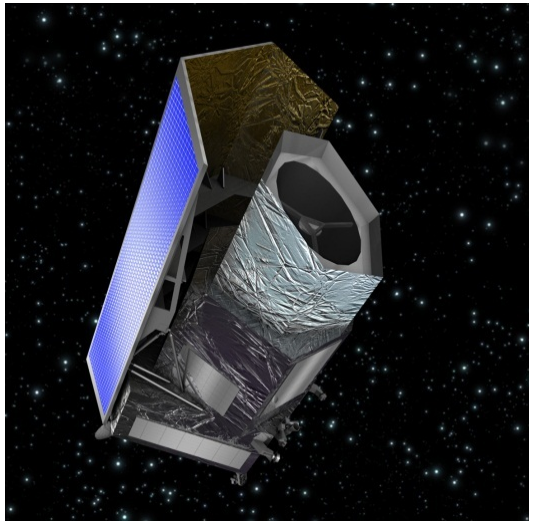
**Partners:** ESA, CSA

**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.
  - All optics are complete (primary segments, secondary, tertiary and fine steering mirrors) and delivered to GSFC.
  - Telescope wings are complete; backplane support fixture and center section are complete.
  - Spacecraft completing reviews leading to spacecraft Critical Design Review (Jan 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.

# 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, 5 year prime mission
- **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:**

- Currently in implementation phase.
- ~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 initiate the buy for the flight infrared detectors in FY 2014.
- NASA will test and characterize the near-IR flight detectors.

# ESA's New Vision to Study the Invisible Universe

- The hot energetic Universe and the search for elusive gravity waves will be the focus of ESA's next two large science missions.
- 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
- The L3 mission will study the gravitational Universe, searching for ripples in the very fabric of space-time created by celestial objects with very strong gravity, such as pairs of merging black holes.
  - Launch date ~2034
  - Will require development of a spaceborne gravitational wave observatory or extreme precision 'gravitometer'.
- NASA has expressed a strong interest to ESA in contributing to ESA's next large astrophysics missions if they are responsive to the U.S. Decadal Survey
  - The U.S. Decadal Survey recommended an international partnership for a gravitational wave observatory and an X-ray observatory.
- NASA and ESA are continuing to discuss a potential NASA contribution.

# 2013 Ft. Sumner Balloon Campaign

- **HASP student experiment platform flew September 2-3.**
  - Flight lasted ~12 hours with 9 of 10 student payloads being flown successfully.
- **HEROES (High Energy Replicated Optics to Explore the Sun) flew September 21-22.**
  - X-ray telescope that offers improved observations of solar flares and other astrophysical objects.
  - Flight lasted ~25 hours with nominal science operations.
- **BRRISON flew September 28.**
  - Observations of comet ISON and its emission rates of water and CO2.
  - Payload anomaly occurred shortly after launch; no science data obtained.
- **WASP/HySICS flew September 29.**
  - Tests high-accuracy pointing developed at WFF; HySICS improves accuracy of solar spectral irradiance observations for climate measurements.
  - Flight lasted ~8 hours with nominal science operations.
- **X-Calibur**
  - Measures energy of cosmic X-rays, providing insights into accretion disks of stellar mass black holes.
  - Due to reduced flight time and lingering technical issues decision made not to fly payload during this campaign.

HASP Launch

HySICS
(Credit: LASP)

# CY 2013 Astrophysics Sounding Rocket Launches

- April 2013, SLICE, PI: France, CU (UV spectra)
- May 2013, FORTIS, PI: McCandliss, JHU (UV spectra)
- **October 31, 2013, XQC** PI: Dan McCammon, Univ of Wisconsin - Madison (X-ray Spectroscopy, microcalorimeters)
- **November 19, 2013, FORTIS** PI: Steve McCandliss, John Hopkins Univ (UV Spectro-scopy, Comet ISON)

- **June 5, 2013, CIBER, PI: Bock, Caltech (IR imaging)**
  - **Launched on Black Brant XII rocket from Wallops**
  - **Studied when the first stars and galaxies formed in the universe and how brightly they burned their nuclear fuel.**
  - **Lofted to an altitude of ~358 miles above the Atlantic Ocean.**
  - **CIBER will not be recovered, as planned.**
- **Five astrophysics sounding rocket launches planned for CY2014**

*Photo by Toshiaki Arai*

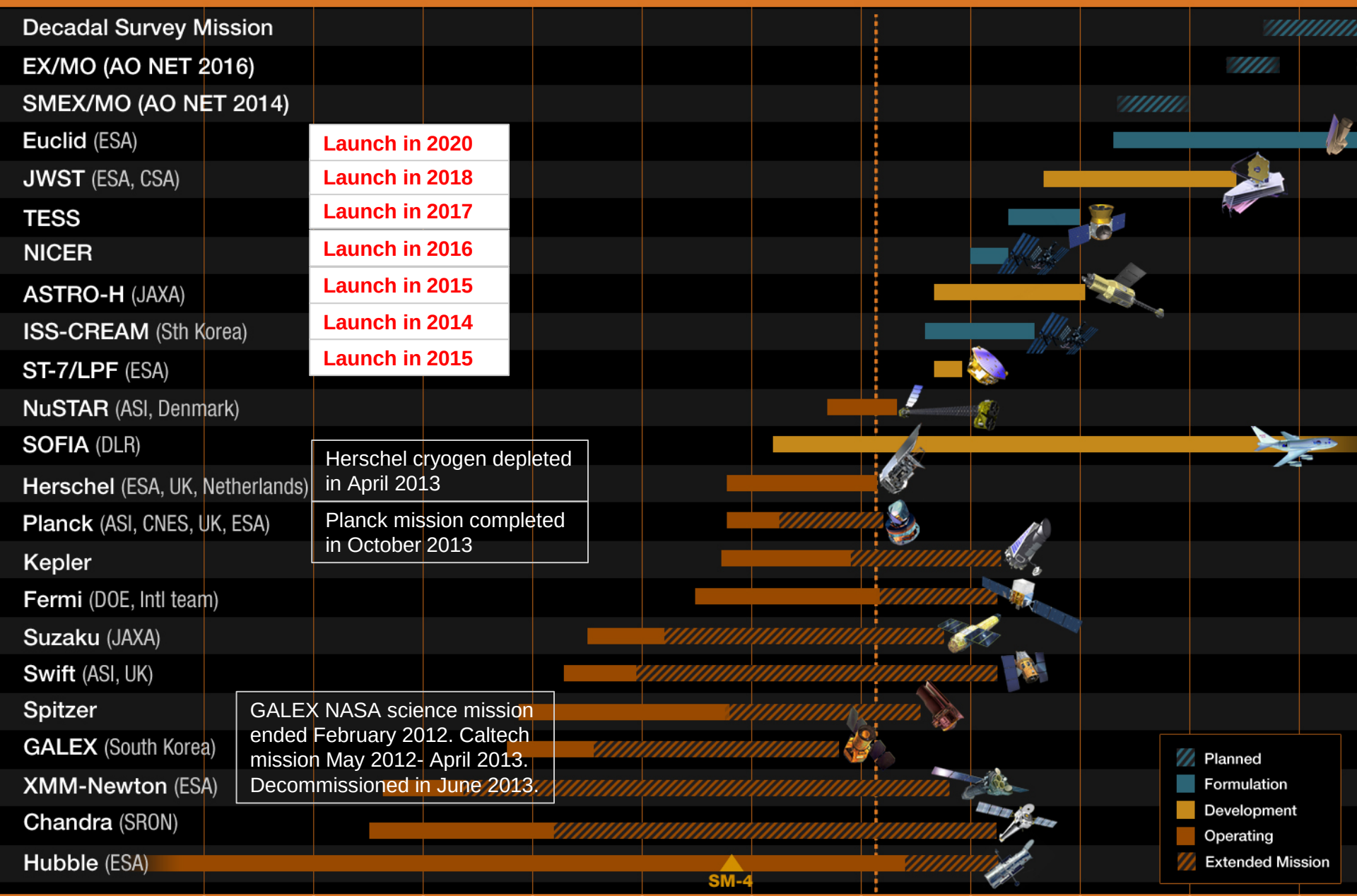
# Astrophysics Senior Review in 2014

- Astrophysics will conduct a Senior Review for Operating Missions (in conformity with PL 109-155, § 304(a)).
  - Coordinated reviews for Hubble, Chandra, and the remainder of the MO&DA portfolio to be held in the March 2014 timeframe.
  - Missions are required to submit self-identified mission objectives as well as budgets, FTE/WYE levels, and assessment against prior SR proposal.
  - All missions will be comparatively assessed by a single Senior Review Panel with the exception of the Hubble Space Telescope and the Chandra X-ray Observatory. The Hubble Space Telescope and the Chandra X-ray Observatory will be reviewed during this timeframe in self-contained separate, but similar reviews, by individualized Senior Review Panels.
- Senior Review Timeline.
  - Final Call for Proposals issued: November 15, 2013
  - Senior Review Proposals due: January 31, 2014
  - Senior Review panels meet: late March/ early April 2014
  - Panel's report & APD response: June 2014
- Missions invited.
  - Hubble, Chandra
  - Fermi, NuSTAR, Spitzer, Suzaku, Swift, XMM-Newton, Kepler (K2), Planck, WISE (MaxWISE)

# 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 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.
- PI-managed cost cap $125M (FY2015$) for SMEX, not including cost of ELV or transportation to the ISS.
- 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 1-2 MOs for 1-year Phase A concept studies, Step 2 down-selects 1 SMEX and 1 MO for Phase B and subsequent phases.

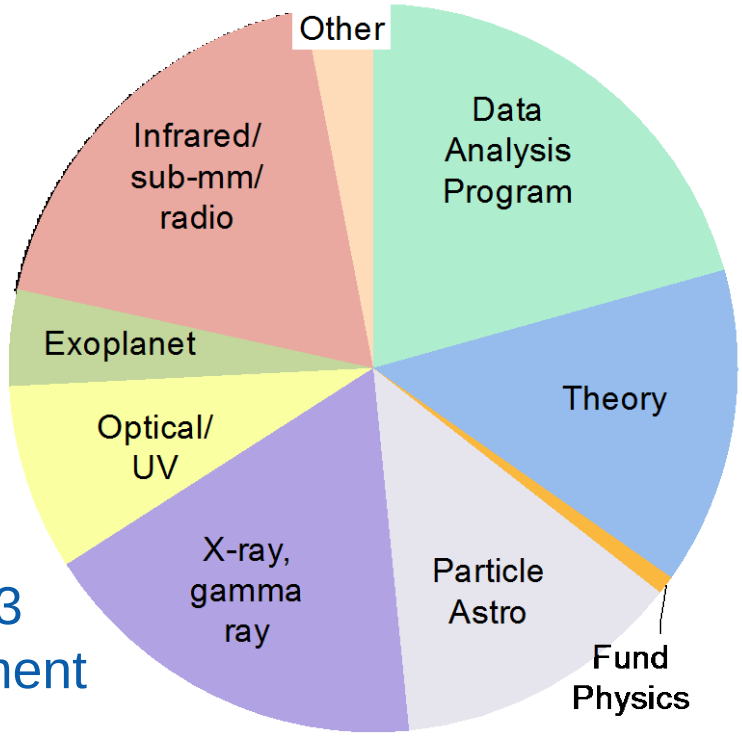
# Astrophysics Missions timeline



# Astrophysics Research Program Funding

Most recent year: some selections still pending

| | Proposals Rec'd | Year-1 $M | selected | Success Rate |
|---|---|---|---|---|
| RTF-12 | 12 | 0.6 | 2 | 17% |
| APRA-12 | 178 | 8.8 | 33 | 19% |
| SAT-12 | 38 | 2.8 | 5 | 13% |
| ADAP-13 | 276 | 3.6 | 33 | 12% |
| OSS-13 | 39 | 0.7 | 6 | 15% |
| ATP-13 | 181 | 3 | 23 | 13% |

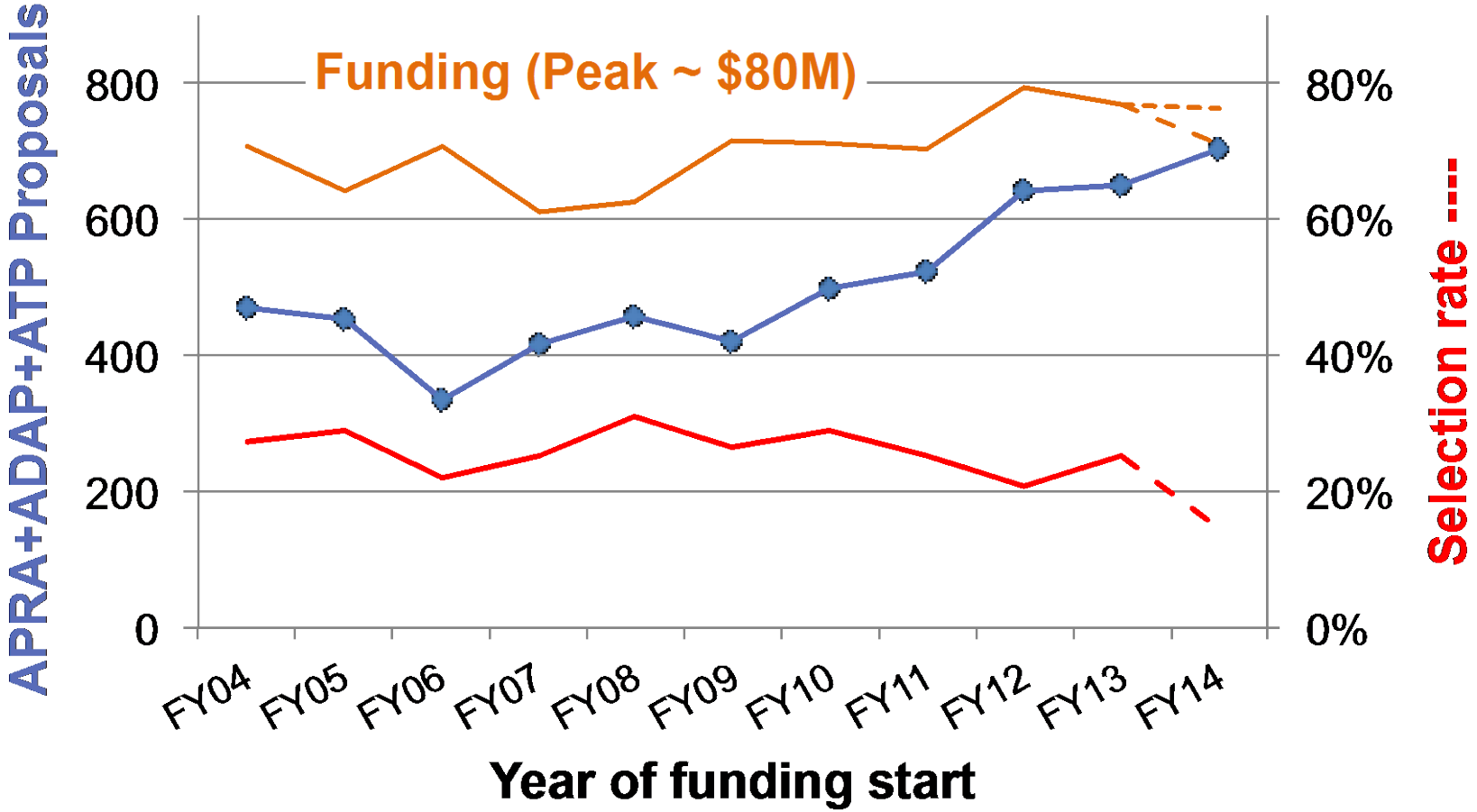



Split of $81.967M spent in FY13
PI award programs + management


Growth from $65M (FY07) to $74M (FY10) to $82M (FY13)

Funding for Research Award Programs: $M

# Proposal numbers grow faster than funding




To develop metrics for the Research Program, the Astrophysics Division is undertaking a pilot study with ADS. This will track published papers from research awards, using the (required) acknowledgement of grant numbers (or proposal numbers) in the text.

# R&A Proposal Selections During 2013

Status: January 7, 2014

| | Proposal Due Date | Notify Date | Days since received | Number received | Number selected | % selected |
|---|---|---|---|---|---|---|
| Roman Tech Fellowships | Nov 8 | Mar 5 | 117 | 12 | 2 | 17% |
| Fermi GI Cycle 6 | Jan 18 | May 16 | 118 | 233 | 50 | 21% |
| Kepler GO Cycle 5 | Jan 18 | April 15 | 87 | 63 | 25 | 40% |
| TCAN with NSF | Feb 14 | June 20 | 126 | 106 | 20* | 19% |
| Kepler Participating Sci. | Mar 1 | July 5 | 126 | 30 | 11 | 37% |
| Hubble GO Cycle 21 | Mar 1 | May 30 | 90 | 1094 | 249 | 23% |
| Chandra GO Cycle 15 | Mar 14 | July 12 | 120 | 636 | 179 | 30% |
| APRA (basic research) | Mar 22 | Sep 11 | 173 | 178 | 33 ** | 19% |
| SAT (technology) | Mar 22 | Sep 13 | 175 | 38 | 5 ** | 13% |
| ADAP (data analysis) | May 17 | Oct 30 | 166 | 276 | 33 ** | 12% |
| Origins of Solar Sys. | May 23 | Nov 7 | 168 | 41 | 6 ** | 15% |
| SOFIA GO Cycle 2 | Jun 28 | Oct 31 | 125 | 112 | 35 | 31% |
| ATP (theory) | Jul 12 | Dec 9 | 150 | 181 | 23 ** | 13% |
| Spitzer GO Cycle 10 | Aug 2 | Oct 22 | 81 | 137 | 38 | 28% |
| Swift GI Cycle 10 | Sep 26 | Dec 16 | 78 | 174 | 45 | 26% |

* Includes 10 NSF TCAN proposal selections.

** Does not include “maybes.”

# Upcoming Proposal Due Dates

| Research Announcement | Notice of Intent Due Date | Proposal Due Date |
|---|---|---|
| Fermi Guest Investigator – Cycle 7 | N/A | Jan. 31, 2014 |
| Chandra General Observer – Cycle 16 | N/A | March 13, 2014 |
| Astrophysics Research and Analysis (APRA) | Jan 24, 2014 | March 21, 2014 |
| Strategic Astrophysics Technology (SAT) | Jan 24, 2014 | March 21, 2014 |
| Hubble General Observer – Cycle 22 | N/A | Apr. 11, 2014 |

# Space Technology Mission Directorate Contributes to Astrophysics

Space Technology Mission Directorate

Innovative Adv Concepts
Center Innovation Fund
Space Tech Res Grants
~$45M

Small Business Innovative Research (SBIR)/
Small Business Technology Transfer (STTR)
~$135M

Game Changing Development
~$145M

Small Spacecraft
~$20M

Tech Demo
Missions
~$150M

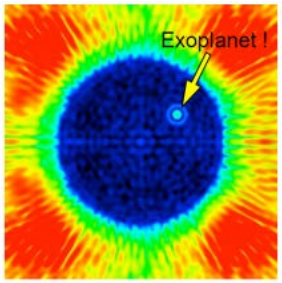
SMD Astrophysics Division

APRA

SAT

1 2 3 4 5 6 7

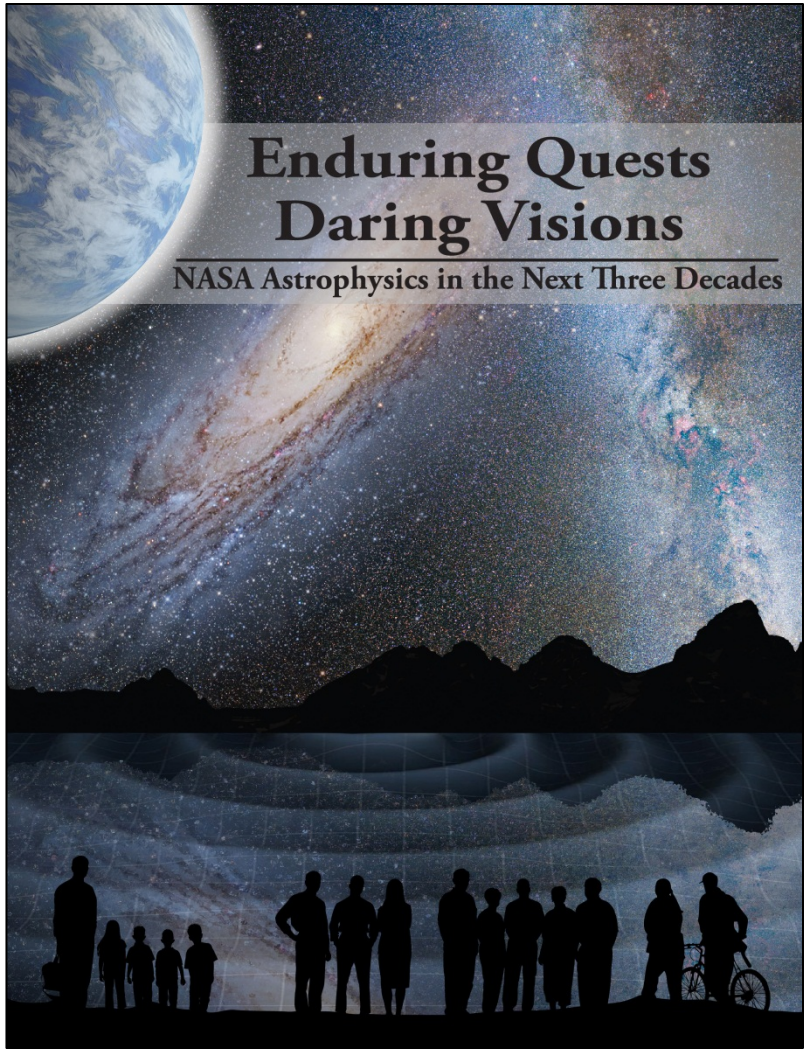
Technology Readiness Level (TRL)

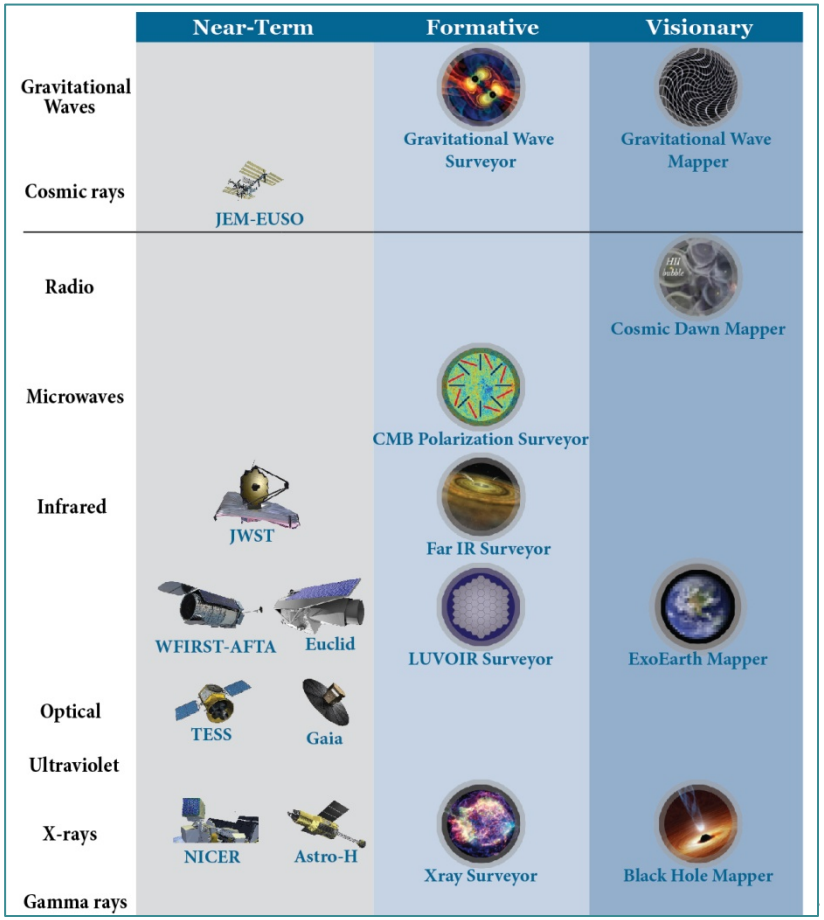

# Education and Public Outreach

- NASA will conduct E/PO in FY14.
  - During the period of the continuing resolution (CR) through January 15, 2014, SMD projects are directed to continue planned E/PO activities at the same level of effort and budget as during FY13, except where decreases were already planned.
- SMD is awaiting policy direction from NASA's Office of Education on E/PO beyond the period of the CR.

# Enduring Quests, Daring Visions

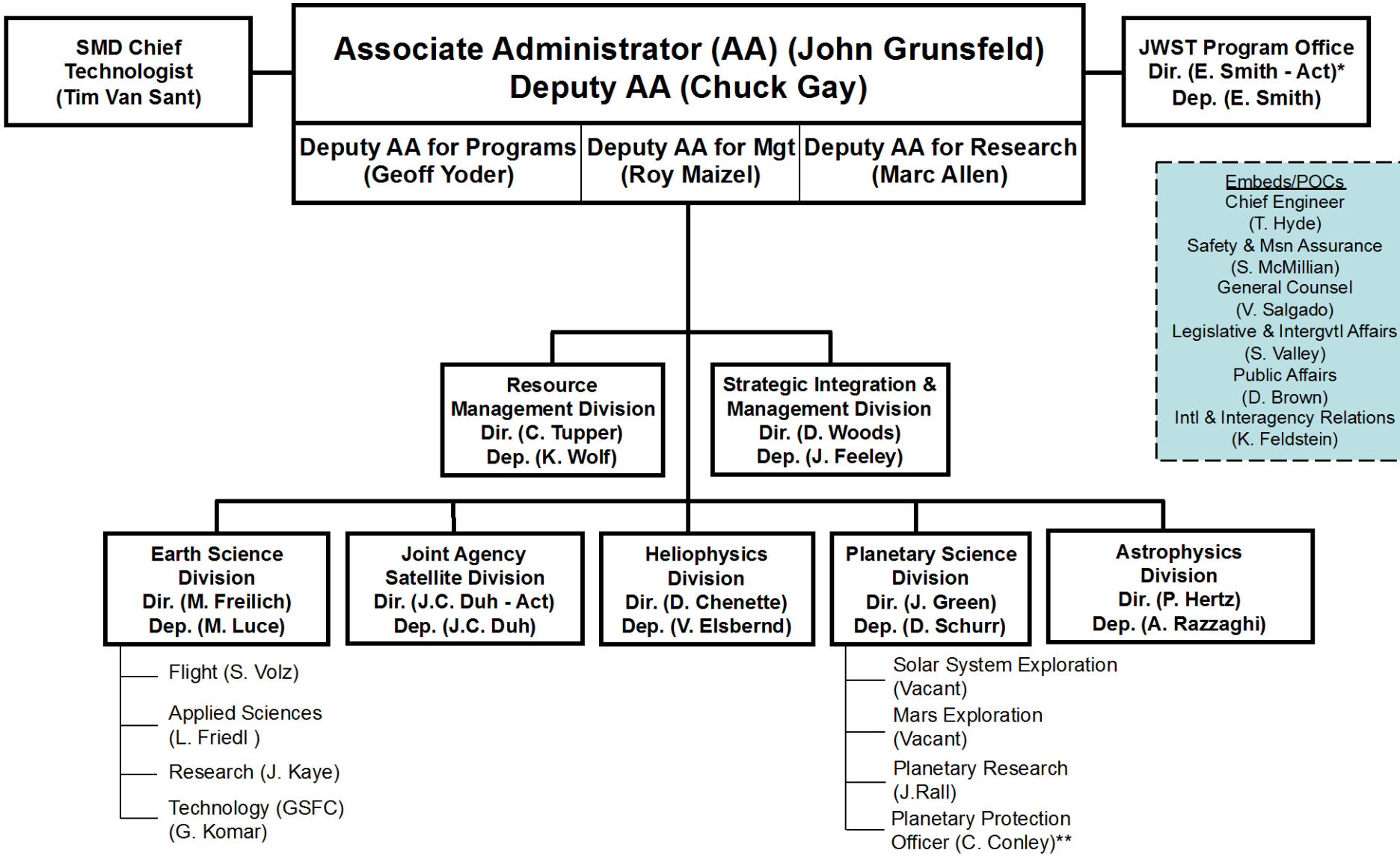



- A 30 year vision to address the enduring questions:
  - Are we alone?
  - How did we get here?
  - How does the universe work?




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

# SMD Organization




* Direct report to NASA Associate Administrator
** Co-located from the Front Office

October 2013

# Astrophysics Division

**Resource Management**
Omana Cawthon +
Clemencia Gallegos-Kelly +

***Director***
Paul Hertz
***Deputy Director***
Andrea Razzaghi

*Lead Secretary:* Kelly Johnson
*Secretary:* Leslie Allen
*Program Support Specialist:* TBD

**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)

January 2, 2014

## Programs / Missions

| | *Program Scientist* | *Program Executive* |
|---|---|---|
| **Exoplanet Exploration (EXEP)** | | |
| **Program** | **Doug Hudgins** | **Tony Carro *** |
| Keck | Hashima Hasan | Mario Perez * |
| Kepler | Doug Hudgins | Tony Carro * |
| LBTI | Hashima Hasan | Mario Perez * |
| NExScI | Hashima Hasan | Mario Perez * |
| **Cosmic Origins (COR)** | | |
| **Program** | **Mario Perez *** | **John Gagosian** |
| Herschel | Glenn Wahlgren * | John Gagosian |
| 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 * | Lia LaPiana |
| Euclid | Linda Sparke | Lia LaPiana |
| Fermi | Keith MacGregor * | Lia LaPiana |
| Planck | Rita Sambruna | Lia LaPiana |
| ST-7/LPF | Wilt Sanders * | Lia LaPiana |
| XMM-Newton | Lou Kaluzienski | Lia LaPiana |
| **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 |
| WISE | Hashima Hasan | Jeff Hayes * |
| AFTA Study | 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.*

# Astrophysics Division Personnel Changes

Personnel who have left in 2013:

- Joan Centrella
- Richard Griffiths
- Ilana Harrus
- Anne-Marie Novo-Gradac

Personnel who have arrived in 2013:

- Dominic Benford
- Tony Carro
- Jeanne Davis
- Jeff Hayes
- Stefan Immler
- Rita Sambruna
- Eric Tollestrup
- Debra Wallace

# Community Participation

## COPAG

- Chair: Ken Sembach
- Executive Cmte: 10 members
- SAGs: 6 Active
- Website: http://cor.gsfc.nasa.gov/copag

## ExoPAG

- Chair: Scott Gaudi
- Executive Cmte: 11 members
- SAGs: 3 Active
- Website: http://exep.jpl.nasa.gov/exopag

## PhysPAG

- Chair: John Nousek
- Executive Cmte: 13 members
- SAGs: 5 Active
- Website: http://pcos.gsfc.nasa.gov/physpag

**Science and Technology Definition Teams (STDTs):**

- AFTA use of telescope assets: 20 members
- Exoplanet Probe with Internal Coronagraph: 10 members
- Exoplanet Probe with External Occulter: 10 members
- X-ray Astrophysics Probe: 14 members [disbanded 12/12/13]

Preliminary reports from the studies are due Spring 2014.
Final reports from the studies are due in January 2015.

**Advisory Committees:**

- NRC Space Studies Board (SSB)
- NRC Committee on Astronomy and Astrophysics (CAA)
- Astronomy and Astrophysics Advisory Committee (AAAC)
- NASA Advisory Council's Science Committee (NAC SC)
- NASA Advisory Council's Astrophysics Subcommittee (APS)

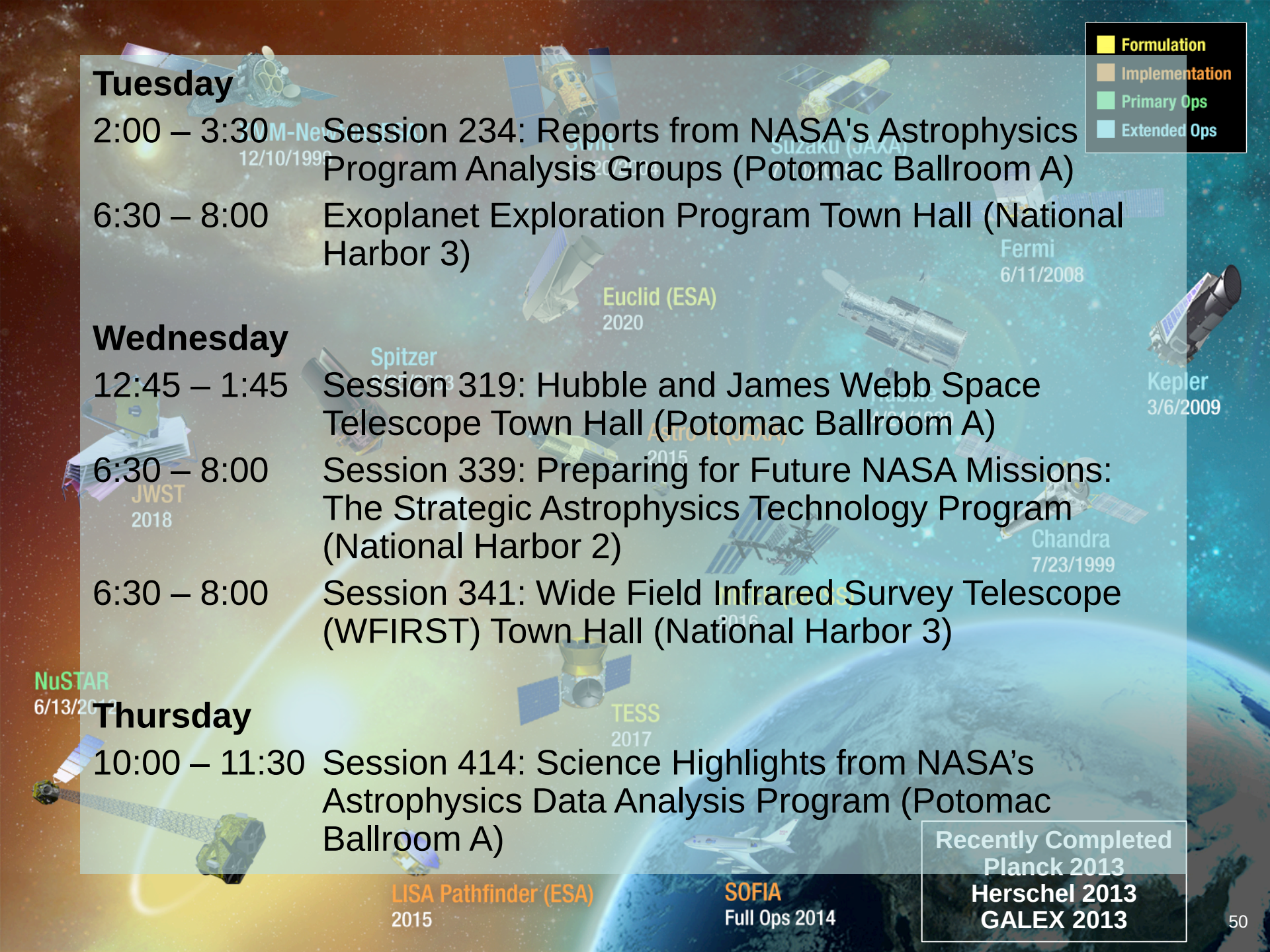
# Visiting Scientists at NASA HQ

**Looking for a few good astrophysicists….**

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

**Apply by January 31, 2014**

http://jobregister.aas.org/job_view?JobID=46612




**Tuesday**

2:00 – 3:30 Session 234: Reports from NASA's Astrophysics Program Analysis Groups (Potomac Ballroom A)

6:30 – 8:00 Exoplanet Exploration Program Town Hall (National Harbor 3)

**Wednesday**

12:45 – 1:45 Session 319: Hubble and James Webb Space Telescope Town Hall (Potomac Ballroom A)

6:30 – 8:00 Session 339: Preparing for Future NASA Missions: The Strategic Astrophysics Technology Program (National Harbor 2)

6:30 – 8:00 Session 341: Wide Field Infrared Survey Telescope (WFIRST) Town Hall (National Harbor 3)

**Thursday**

10:00 – 11:30 Session 414: Science Highlights from NASA's Astrophysics Data Analysis Program (Potomac Ballroom A)