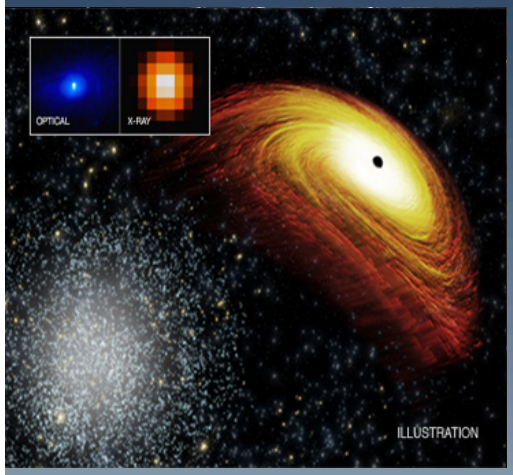
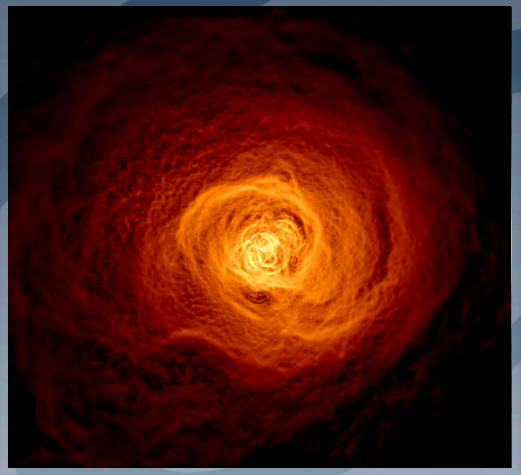
National Aeronautics and Space Administration

Astrophysics




Space Telescope Users Committee

November 13, 2017

Michael Garcia

NASA HQ Update

HST Program Scientist

APRA, Athena Program Scientist

LUVOIR, IXPE Deputy PS

Astrophysics CubeSat/SmallSat POC

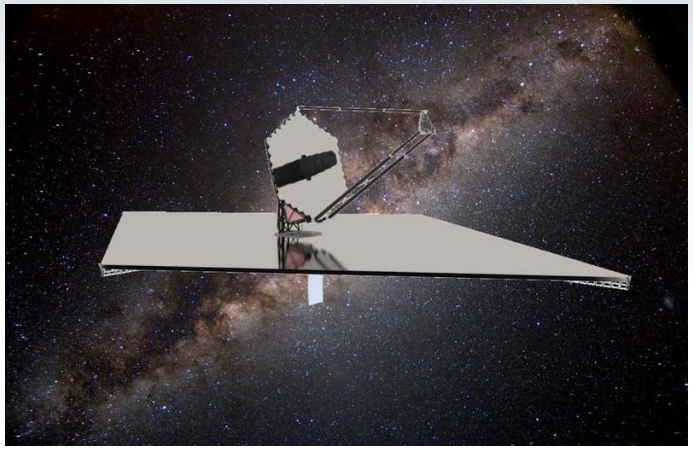
Current Program: an integrated strategic plan

We are executing a balanced strategic program for Astrophysics

- Operating missions, large and small, continue to deliver paradigm changing science
  - Cosmology, Dark Energy, Exoplanets, Origin of Structure, …
- Large strategic missions under development …
  - Are next generation great observatories
  - Will rewrite textbooks
  - Can only be done by NASA
- A high cadence of Explorers has been resumed
- Investing in the community has been prioritized
  - R&A, technology development, supporting capabilities, ….
- Planning for the future is underway

Planning for the Future

- Large Mission Concept Studies

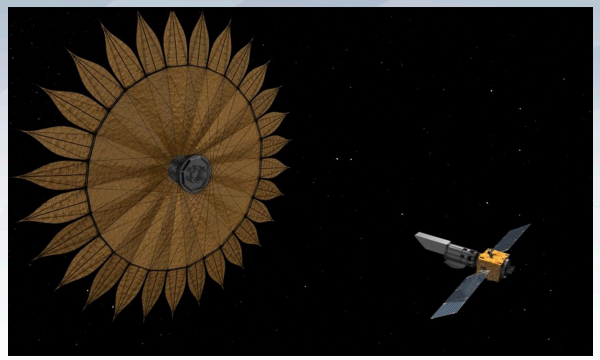


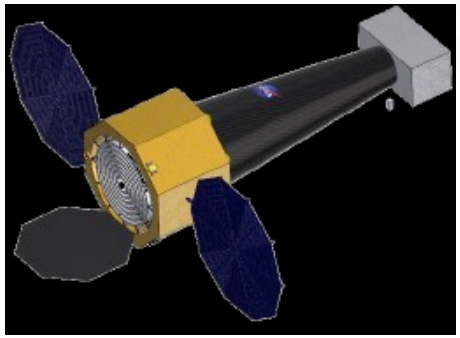
HabEx

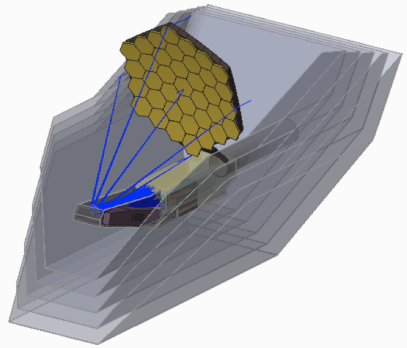
LUVOIR

Lynx

OST







- Medium (Probe) Concept Studies
  - Cosmic Dawn Intensity Mapper (A. Cooray)
  - Cosmic Evolution through UV Spectroscopy Probe (W. Danchi)
  - Galaxy Evolution Probe (J. Glenn)
  - High Spatial Resolution X-ray Probe (R. Mushotzky)
  - Inflation Probe (S. Hanany)
  - Multi-Messenger Astrophysics Probe (A. Olinto)
  - Precise Radial Velocity Observatory (P. Plavchan)
  - Starshade Rendezvous Mission (S. Seager)
  - Transient Astrophysics Probe (J. Camp)
  - X-ray Timing and Spectroscopy Probe (P. Ray)

Planning for the Future

Presentation on Technology by Thai Pham and Brendan Crill @ CAA Last Week

Mission Concept	TRL 2 Gaps	TRL 3 Gaps	TRL 4+ Gaps	Total # Gaps	Gaps Being Addressed
HabEx	0	6	6	12	12
LUVOIR	1	4	4	9	7
Lynx	1	3	1	5	4
OST	1	1	3	5	2

- **HabEx Gaps:** mirror coatings, starshade starlight suppression, starshade controlling scattered sunlight, starshade lateral formation sensing, starshade petal position accuracy, starshade petal shape and stability, *telescope vibration control*, deformable mirrors, **visible detectors**, *large aperture primary mirror*, **wavefront sensing and control**, ***coronagraph optics and architecture***
- **LUVOIR Gaps:** closed-loop segment phasing, *vibration isolation*, ***wavefront sensing and control***, *mirror segments*, ***high-contrast segmented-aperture coronagraphy***, deformable mirrors, near Infrared detectors, **visible detectors**, mirror coatings
- **Lynx Gaps:** high-resolution lightweight X-ray optics, non-deforming X-ray reflecting coatings, megapixel X-ray imaging detectors, **large-format, high resolution X-ray detectors**, X-ray grating arrays
- **OST Gaps:** far-IR (FIR) detectors, cryogenic readouts for large-format FIR detectors, warm readout electronics for large-format FIR detectors, sub-K Coolers, cryogenic FIR mirror segments

- Green: technologies being advanced through SAT or directed development,
- **Bold**: technologies being advanced by WFIRST or ATHENA
- *Italics*: technologies being worked on through the STDT's design studies

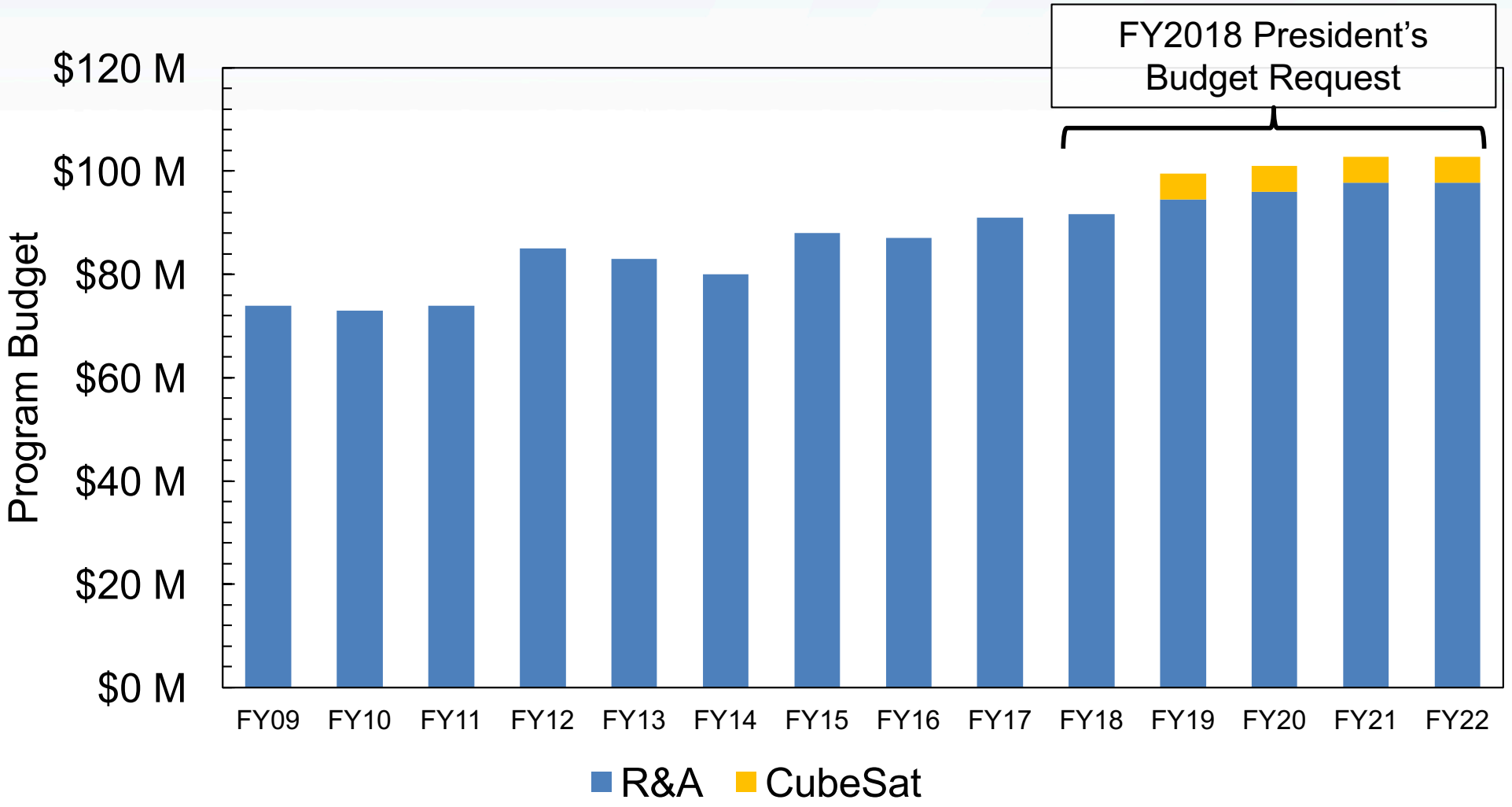
Implementing the Decadal Survey and the Midterm Assessment

Prioritized Recommendation	NASA plans
LARGE ACTIVITIES	
WFIRST	In Phase A, launch in mid-2020s; independent review
Explorers	Planning 4 AOs per decade: SMEX 2014, MIDEX 2016, SMEX 2019, MIDEX 2021; maintain cadence
LISA	Partnering on ESA's LISA gravitational wave observatory; increased US role
IXO	Partnering on ESA's Athena x-ray observatory; no increase to US role
MEDIUM ACTIVITIES	
Exoplanet technology	WFIRST coronagraph, Starshade and coronagraph technology development; lower priority than LISA technology
Inflation Probe technology	Balloon-borne technology experiments, detector investments
SMALL ACTIVITIES	
R&A augmentations	R&A increased by reducing Fellowships
Mid-TRL technology	Initiated SAT program, includes competed & directed technologies
Suborbital missions	Initiated ultra long duration balloon capability, CubeSats

"Despite a challenging budget environment, NASA-APD has maintained a balanced portfolio through the first half of the decade and, with the assumption of successful completion of an ambitious Explorer schedule, will do so during the second half of the decade as well. ..." NAS Midterm Assessment, Finding 4-14

Proposed R&A Future Budget

Program	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22
R&A	$74 M	$73 M	$74 M	$85 M	$82 M	$80 M	$88 M	$87 M	$91 M	$92 M	$95 M	$96 M	$98 M	$98 M
CubeSat											$5 M	$5 M	$5 M	$5 M
Total	**$74 M**	**$73 M**	**$74 M**	**$85 M**	**$82 M**	**$80 M**	**$88 M**	**$87 M**	**$91 M**	**$92 M**	**$100 M**	**$101 M**	**$103 M**	**$103 M**



Astrophysics CubeSat/SmallSat Approach

- Astrophysics CubeSats are solicited annually via ROSES/APRA (D.3).
- CubeSats are reviewed along with other sub-orbital proposals; they compete with balloons and sounding rockets (and potentially ISS attached payloads).
- The largest CubeSats that are eligible for CSLI (=launch at no cost to PI) are 6U.
- Astrophysics cubesats have been funded via the SMD wide congressional appropriation for CubeSats $5M/y, via APRA, and in future via $5M APD dedicated line.
- Over the past 5 years we have received ~10 CubeSat proposals/year; 4 have been selected.
- Overall selection rate within APRA is ~25%
- Are larger CubeSats possible in future?

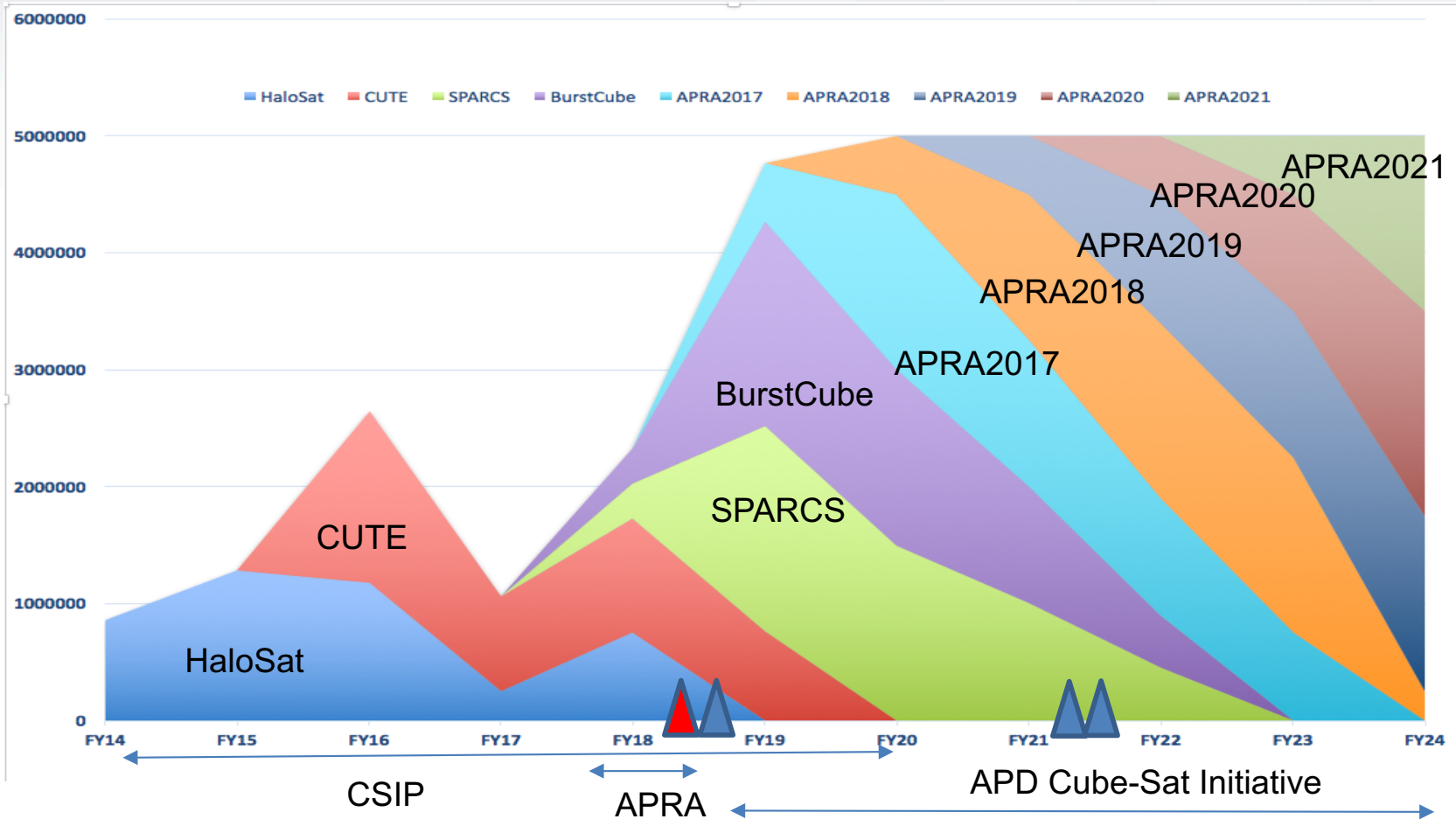
SmallSats for Astrophysics

- SMD released a Request for Information (RFI) on September 28, 2017, seeking information to inform decisions regarding Astrophysics SmallSats.
- Under Topic 1 ("Science Mission Concepts"), NASA is asking the astrophysics community to envision missions advancing compelling astrophysics science that can be realized involving SmallSats at a cost between that of Astrophysics CubeSats (APRA) and Astrophysics Explorers Missions of Opportunity. Between Sub-Orbital and MoO.
- Under Topic 2 ("Advanced Technology Concepts"), NASA solicits ideas for compelling astrophysics science involving SmallSats for which significant investments in instrument and/or spacecraft technologies would be required.
- Responses due November 30, 2017,POC Michael Garcia

- RFI is posted in Fed Biz Opportunities at

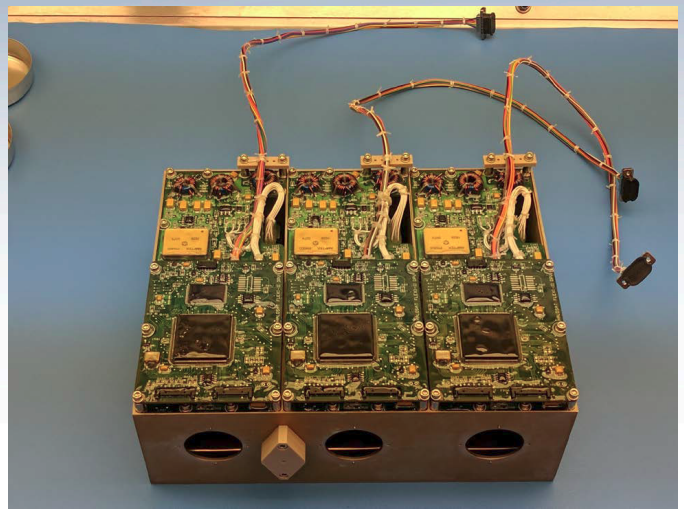
https://www.fbo.gov/notices/2f68a3d8a7a55cf1f165ebeefdc29890

Astrophysics CubeSats



HaloSat

A CubeSat to study the hot Galactic Halo



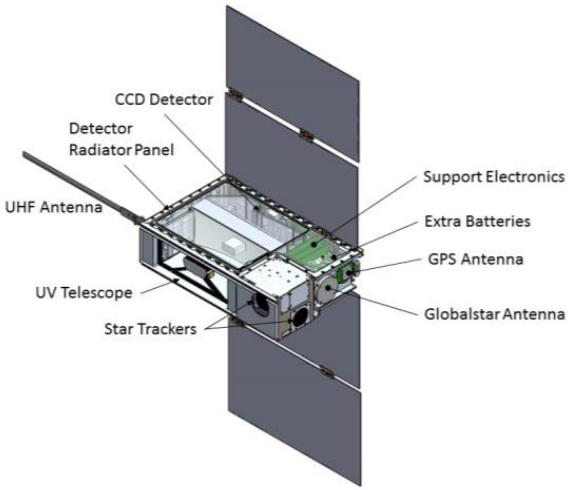
- **PI**: Phil Kaaret, U Iowa, Co-I WFF, GSFC, JHU, CNRS
- **LRD**: 3 years from initiation, ~$3.9M
- **Science Objectives:** HaloSat will map the distribution of hot gas in the Milky Way and determine whether it fills an extended, and thus massive halo, or whether the halo is compact, and thus does not contribute significantly to the total mass of the Milky Way.
- **Operations**: 2 month minimum, 1 year goal

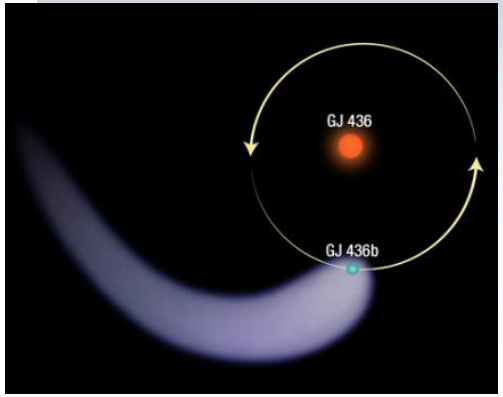
Key Facts:

- **Science**: Constrain the mass and spatial distribution of hot gas associated with the Milky Way by mapping the emission in the O VII and O VIII lines. This goal can be achieved by mapping the summed intensity of the O VII and O VIII lines to derive a total emission measure for each field. Limit background from SWCX via observing only at night.
- **Technologies:** 6U CubeSat advancing science, using COTS technologies. Blue Canyon Technologies bus, WFF design and assembly, Amptex commercial detectors, 100 square degree FOV.
- **Timeline:** APRA-2014 selection, Manifested for **May 1 2018 launch from WFF,** ISS re-supply.
- **Orbit**: ISS like.

CUTE

A CubeSat to study atmospheres and B-fields in ExoPlanets





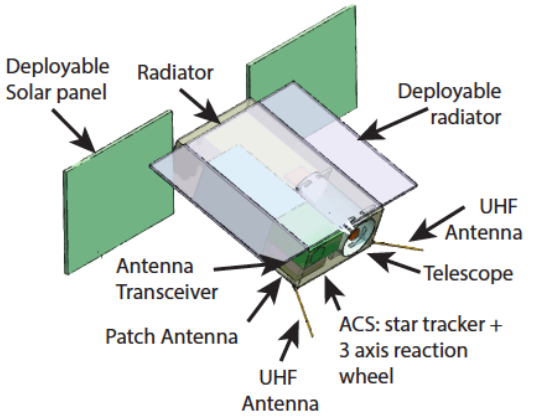
- **PI**: Kevin France, CU, multiple s/r programs, two Helio cubesats at CU.
- **LRD**: 3 years from initiation, ~$3.4M
- **Science Objectives:** The Colorado Ultraviolet Transit Experiment (CUTE) will take multiple medium resolution UV spectra of hot Jupiters during transit, in order to measure the composition of the atmosphere being ablated away. Magnetic fields may be detected via the presence of tori or bow shocks. 14 targets.
- **Operations**: 1 month minimum, 6 month full survey of 14 exoplanets (2 done to date)

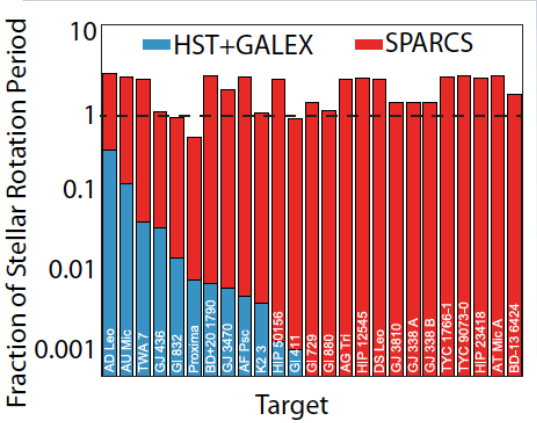
Key Facts:

- **Science**: The atmosphere on two hot Jupiters is observed to be ablating away due to early ingress/late egress in the UV or X-ray. The UV has multiple diagnostic lines which can determine the structure and geometry of the atmospheres. This would be the first UV survey of hot Jupiter atmospheres. This would compliment the sole existing APD cubesat, which is X-ray.
- **Technologies:** 6U CubeSat advancing science, using COTS technologies. Blue Canyon Technologies bus, e2v UV-CCD, exiting cubesat downlink station.
- **Timeline:** APRA-2015 proposal, Selected Feb 2017. LRD mid 2019.
- **Orbit**: ISS like okay, sun synchronous better

SPARCS

Star-Planet Activity Research CubeSat





- **PI**: Eygenya Shkolnik, AZ State U.
- **LRD**: 2 years from initiation
- **Science Objectives:** Determine rate, strength and color of bright UV flares from a select 25 M dwarfs, with an eye towards how these flares effect the habitability of planets within their habitable zones.
- **Operations**: 2 years to complete full survey, which will cover 1 to 3 complete rotations of each star (periods 4-45 days); 6 months to do threshold mission.

Key Facts:

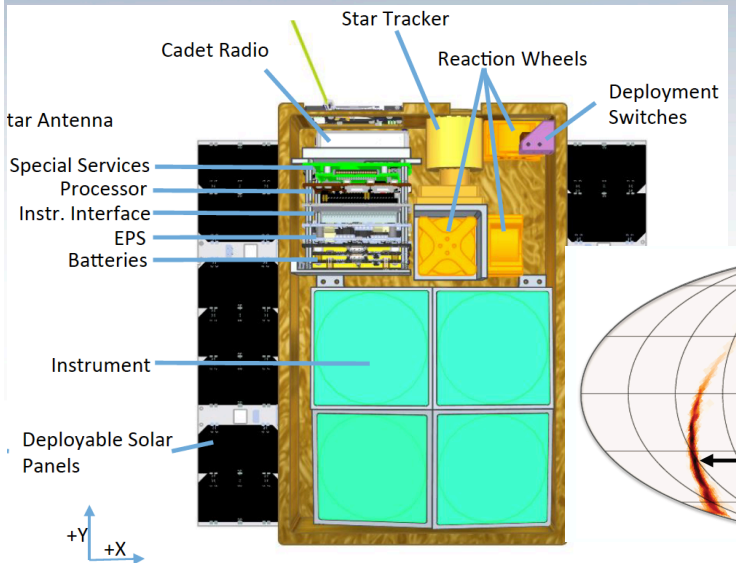
- **Science**: First mission dedicated to provide the time-dependent spectral slope, intensity and evolution of M dwarf stellar FUV and NUV radiation. These measurements are crucial to interpreting observations of planetary atmospheres around low-mass stars. Target list includes young, old, (in)-active, (non)-planet hosting M stars. 1.8 degree FOV allows much ancillary science.

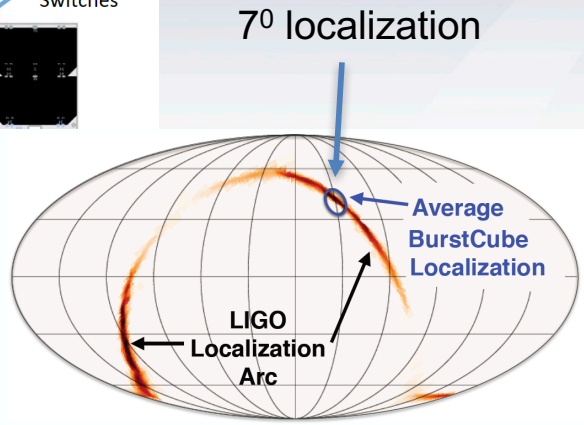
- **Technologies:** 6U CubeSat advancing science, JPL delta-doped e2V CCD, red-leak suppressing filters, 9 cm R-C telescope, ASU downlink station to be completed in 2017 for AOSat CubeSat.

- **Orbit**: sun synchronous to ensure 2 year life-time.

BurstCube

6U CubeSat with four CsI detectors sensitive to gamma-rays from 10 keV to 1 MeV





- **PI:** Jeremy Perkins (GSFC)
- **Science Objectives:**

1) Rapid localizations for high-significance LIGO/Virgo detections coincident with short GRBs
2) Correlate short GRBs with LIGO/Virgo sub-threshold signals, increasing volume
3) Search of gamma-ray transients

- **Operations**: 3 year development, 1 year operation

Key Facts:

- **Science**: BurstCube autonomously detects GRBs onboard, rapidly downlinking data for timing and localizations that are disseminated to ground-based observers to maximize the chances of detecting afterglows. BurstCube will increase the rate of concurrently detected sGRBs and GWs by enhancing the sky coverage beyond current sensitive instruments.
- **Technology:** 6U divided into a 4U instrument package and 2U spacecraft subsystems. Spacecraft highly leverages Dellingr, developed at GSFC. Instrument is similar to Fermi-GBM, except BurstCube uses CsI for 10 keV – 1 MeV.
- **Orbit**: Low earth orbit with no major orbital or observational constraints

Big Picture

- **The FY17 appropriation and FY18 budget request provide funding for NASA astrophysics to continue its planned programs, missions, projects, research, and technology.**
  - Total funding (Astrophysics including Webb) remains at ~$1.35B.
  - The NASA Astrophysics budget funds Webb for a **Spring 2019 launch**, WFIRST formulation, Explorers mission development, increased funding for R&A, operating missions, suborbital missions and new capabilities, continued technology development and mission studies.
  - FY17 Consolidated Appropriation was less than planning budget; reductions to plans required.
  - FY18 President's Budget Request balances current science and future missions; *Congressional markups, if enacted, would put that balance at risk.*
- **NASA continues to prioritize implementation of the recommendations of the 2010 Decadal Survey.**
  - National Academies' 2016 Midterm Assessment Report validates NASA's progress.
  - NASA is conducting large and medium mission concept studies for 2020 Decadal Survey.

FY17 Final Budget

$M	FY17 Request	FY17 Actual	Delta	
Total	1,350.9	1,352.3	+1.4	Reduction of $31.5M in total offset by cost sharing of STEM Activation
Webb	569.4	569.4	---	Set by Appropriation
WFIRST	90.0	105.0	+15.0	Set by Appropriation; Appropriation caps WFIRST LCC at $3.5B through prime mission
SOFIA	83.8	85.2	+1.4	Set by Appropriation
Hubble	97.3	97.3	---	
STEM Activation	25.0	37.0	+12.0	Set by Appropriation but costs shared across Divisions
TESS	89.0	74.0	-15.0	Deferred launch vehicle payment until FY18; reduction in HQ-held reserves in FY18 to accommodate
Balloon Project	37.0	34.0	-3.0	Defer upgrades in Antarctica for efficient three payload operations
Rest of Astrophysics			-9.0	Rephasing and reduction in many programs and projects

FY18 President's Budget Request

$M	FY16 Actual	FY17 Actual	FY18 Request	Change from FY16	Change from FY17
NASA	19,285	19,653	19,092	-1.0 %	-2.9%
SMD	5,584	5,765	5,712	+2.3 %	-0.9 %
Earth Science	1,927	1,908	1,754	-9.0 %	-8.1 %
Heliophysics	647	675	678	+4.8 %	+0.4 %
Planetary Science	1,628	1,828	1,930	+18.6 %	+5.6 %
Astrophysics (including Webb)	1,382	1,352	1,350	-2.3%	-0.1 %

- Supports an SMD-wide CubeSat/SmallSat initiative that uses smaller, less expensive satellites to advance science in a cost-effective manner.
- Reflects more efficient operations of the Hubble Space Telescope, without impact to science.
- Reflects efficiencies realized by the SOFIA in the past few years. SOFIA will participate in the 2019 Astrophysics Senior Review.
- Does not include WFIRST review recommendations.

FY17 OmniBus and Astrophysic (Slide from May STUC)

- HST continues to operate at the top of its scientific productivity.
- HST has strong support inside and outside NASA.
- NASA will continue to operate HST as a Great Observatory as long as it is technically capable.
- NASA expects HST to continue producing great science until 2020 and beyond, enabling overlap with JWST.

- BUDGET Realities:
- FYxx budget are ~flat for Astrophysics.
- HST has a large 'un-costed' amount of funding: a standout in APD.
- Our new administration is focused on cost savings.
- *Lean Forward!* HQ has challenged the Project (GSFC) to find ways to spend down this large un-costed, while maintaining the current level of operations, GSFC and STScI have instituted changes ☺

FY18 Presidents Budget Request (PBR)

Science: Astrophysics

COSMIC ORIGINS

FY 2018 Budget

Budget Authority (in $ millions)	Actual FY 2016	Enacted FY 2017	Request FY 2018	Notional FY 2019	Notional FY 2020	Notional FY 2021	Notional FY 2022
Hubble Space Telescope (HST)	98.3	--	**83.3**	83.3	83.3	98.3	98.3
Stratospheric Observatory for Infrared Astronomy (SOFIA)	83.6	--	**79.9**	79.8	39.8	16.6	0.0
Other Missions and Data Analysis	13.7	--	**28.4**	26.9	18.9	42.9	58.1
Total Budget	**195.6**	**--**	**191.6**	**190.0**	**142.0**	**157.8**	**156.4**

"The budget reflects more efficient operations of the Hubble Space telescope through the rephasing of grant funds, without impact to science."

	FY18 PBR	FY18 Markups	
Total Astrophysics	$ 1,350.5 M	$ 1,350.5 M	
Line Item Projects	$ 941.6 M	$ 995.3 M	Webb, WFIRST, Hubble, SOFIA, R&A, STEM *
Rest of Astrophysics	$ 408.9 M	$ 365.2 M	$43.7M (13%) reduction

* Combined House and Senate markups

FY18 Appropriation Markups

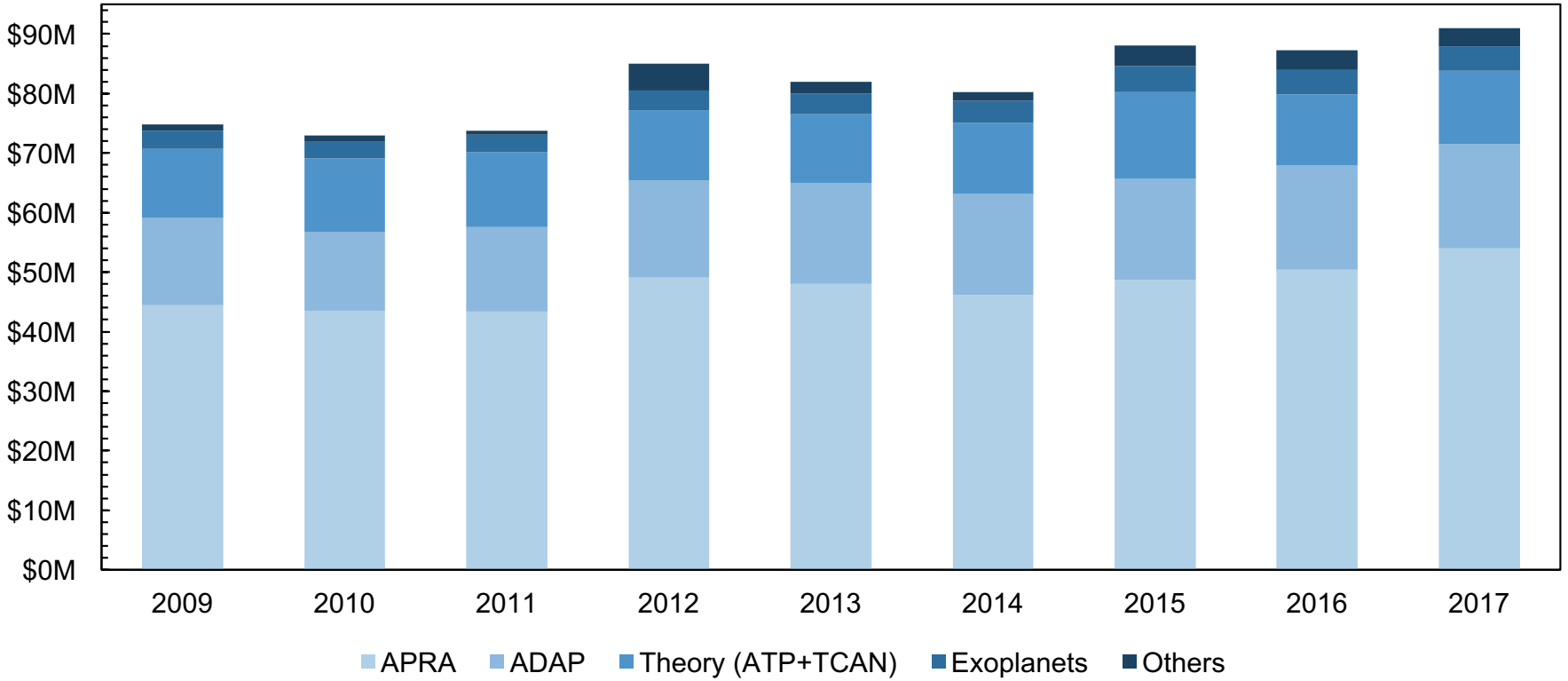
- Both Markups
  - Follow the Decadal Survey
  - Webb must be $533.7M (= requested) but do not overrun
  - STEM Activation must be $44.0M (= request); other language
- House Markup
  - Core R&A must be $74.1M (= request), does not include ADAP
  - SOFIA must be $85.2M (+$5.3M over request, = FY17 level); other language
  - WFIRST must be $126.6M (= request) but spend $20M on starshade technology
  - Language on high energy observatories, astrophysics probes, finding target(s) for interstellar probe
- Senate Markup
  - WFIRST must be $150.0M (+23.4M over request); review; data w/ Hubble, Webb
  - Hubble must be $98.3M (+$15M over request)
  - At least $10M on “life detection technology”; consistent with request (maybe)

	FY18 PBR	FY18 Markups	
Total Astrophysics	$ 1,350.5 M	$ 1,350.5 M	
Line Item Projects	$ 941.6 M	$ 995.3 M	Webb, WFIRST, Hubble, SOFIA, R&A, STEM *
Rest of Astrophysics	$ 408.9 M	$ 365.2 M	$43.7M (13%) reduction

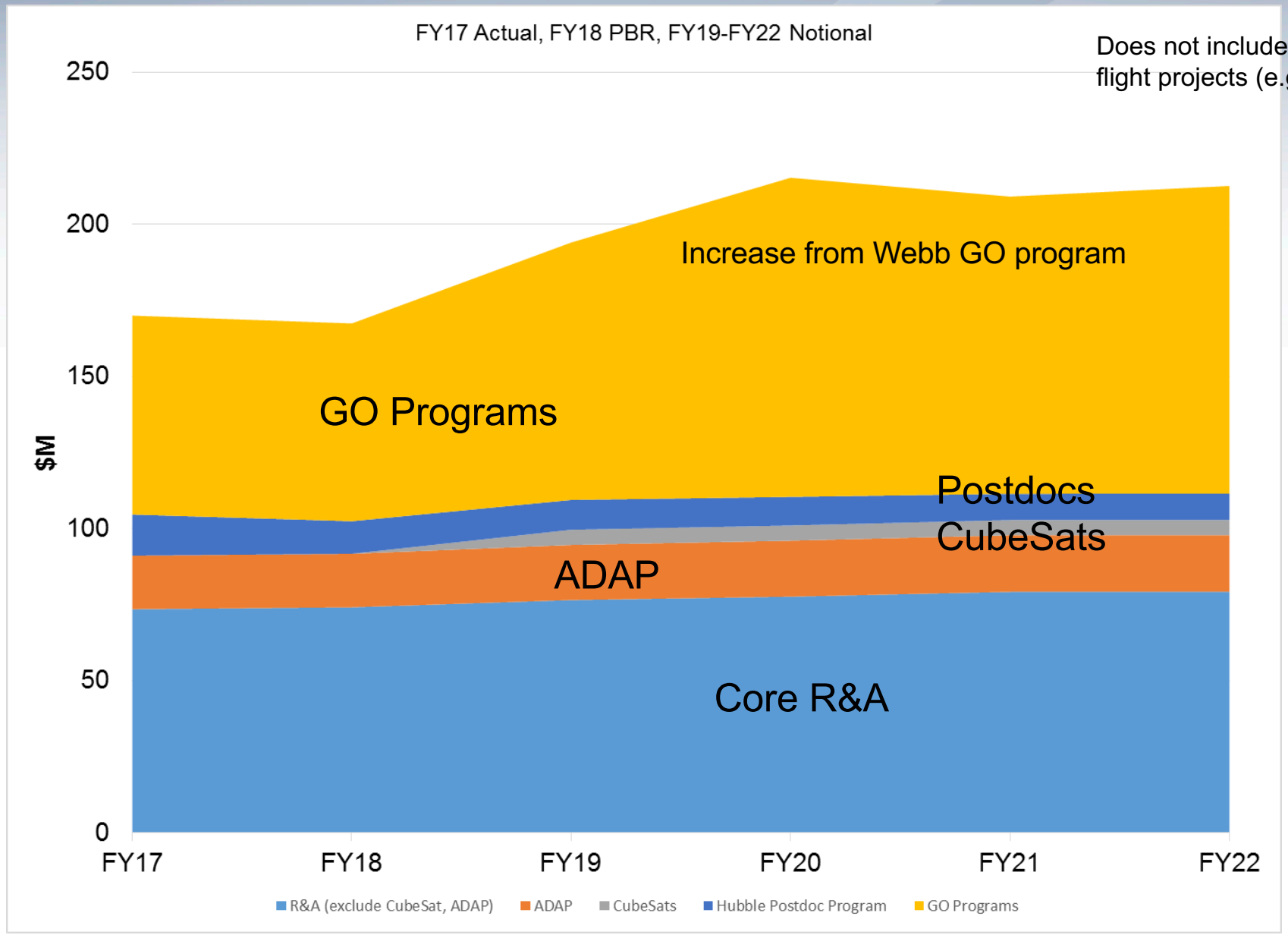
* Combined House and Senate markups

Historical R&A Budget Trends

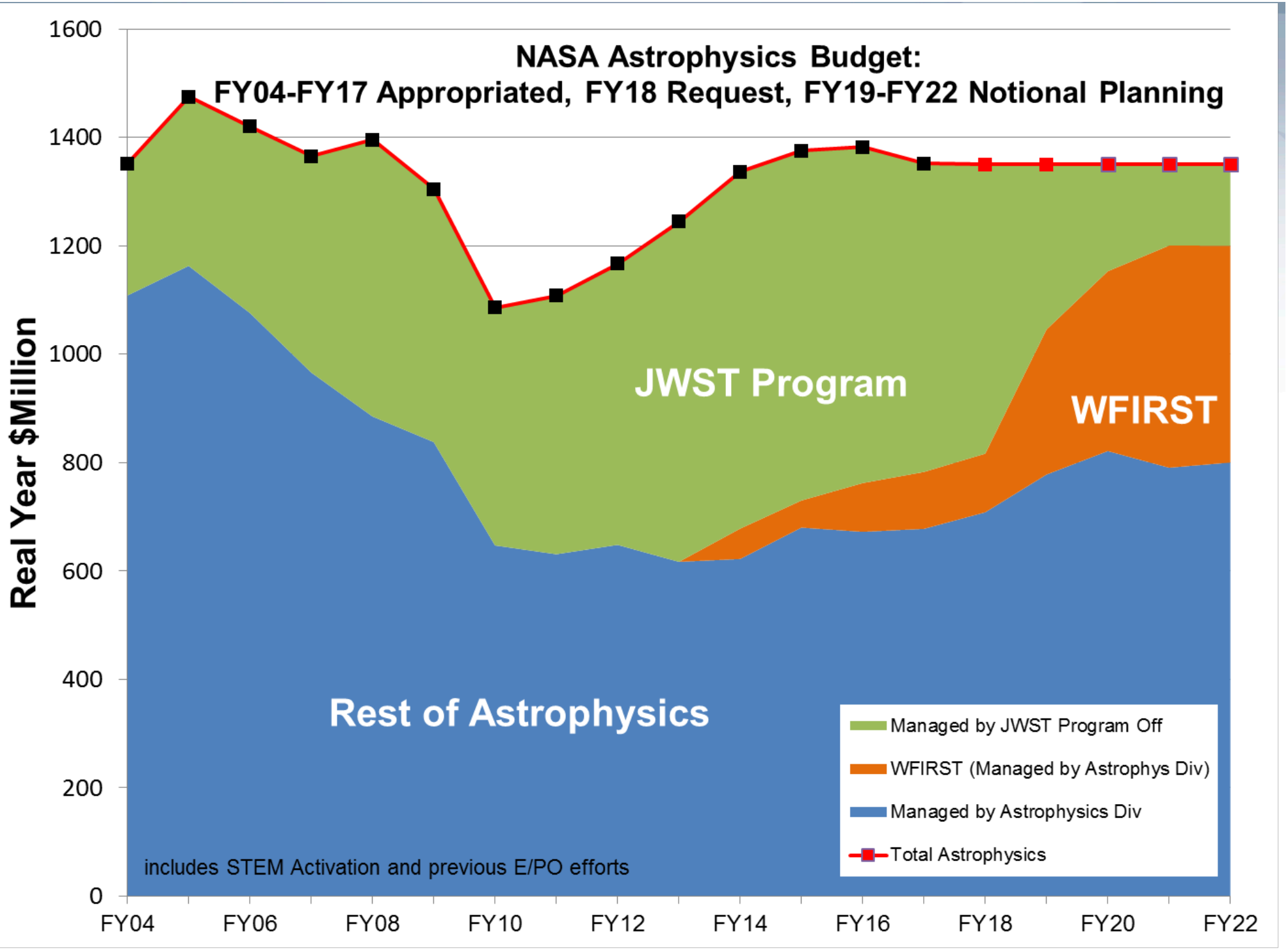
Program	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16	FY17
APRA	$44 M	$44 M	$43 M	$49 M	$48 M	$46 M	$49 M	$50 M	$54 M
ADAP	$15 M	$13 M	$14 M	$16 M	$17 M	$17 M	$17 M	$18 M	$18 M
Theory (ATP+TCAN)	$11 M	$12 M	$13 M	$12 M	$12 M	$12 M	$15 M	$12 M	$12 M
Exoplanets	$3 M	$3 M	$3 M	$3 M	$4 M	$4 M	$4 M	$4 M	$4 M
Others	$1 M	$1 M	$1 M	$5 M	$2 M	$1 M	$3 M	$3 M	$3 M
Total	**$75 M**	**$73 M**	**$74 M**	**$85 M**	**$82 M**	**$80 M**	**$88 M**	**$87 M**	**$91 M**



Total Community Support



GO programs funded from Chandra, Fermi, Hubble, Kepler/K2, NuSTAR, SOFIA, Spitzer, Swift, TESS, Webb, XARM, XMM; does not include possible extensions following the 2019 Senior Review.


NASA Astrophysics Budget:
FY04-FY17 Appropriated, FY18 Request, FY19-FY22 Notional Planning
Real Year $Million
1600
1400
1200
1000
800
600
400
200
0
FY04
FY06
FY08
FY10
FY12
FY14
FY16
FY18
FY20
FY22
JWST Program
WFIRST
Rest of Astrophysics
includes STEM Activation and previous E/PO efforts
Managed by JWST Program Off
WFIRST (Managed by Astrophys Div)
Managed by Astrophysics Div
Total Astrophysics

NASA Astrophysics Diversity and Inclusion

- The NASA Astrophysics Division is actively taking steps to advance diversity, inclusion, and equal opportunity in the NASA workforce and among NASA grantee institutions.
- NASA Astrophysics is committed to:
  - Setting the expectancy of diversity and inclusion in the composition of: proposal teams, peer review panels, science and technology definition teams, and mission and instrument teams.
  - Working with the Office of the Chief Scientist to produce a short video on unconscious bias in peer reviews for future distribution to panelists.
  - Discussing best practices in peer reviews with other agencies.
  - Recruiting a diverse Astrophysics Division staff.
  - Observing the demographics of R&A proposers and awardees.
  - Promoting diversity on HQ-selected groups (e.g., APAC, PAGs, etc.)
- The Spring 2018 APAC meeting should expect a detailed report on these aspects.

New Process for Nancy Grace Roman Technology Fellowship

1 For early-career applicants:

- Submit APRA proposal
- Tick RTF box, include one-page application
- Undergo successful review, APRA proposal selected
- Receive the title "Roman Technology Fellow"

2 When a previously selected RTF gains a permanent or permanent-track position:

- Submit proposal for up to $300k in Fellowship Funds
- Undergo successful review
- Use Fellowship Funds to start lab or research group

Omid Noroozian (NRAO)

Abigail Vieregg (Chicago)

Administrator Nominee

- Jim Bridenstine (R-OK)
  - Representative of Oklahoma's First Congressional District
  - Sponsor of the American Space Renaissance Act (H.R. 4945)
  - Serves on the House Armed Services Committee and the Science, Space and Technology Committee
  - Nine years active duty in the United States Navy
  - Lieutenant Commander in the U.S. Navy Reserve
  - Active member of the Oklahoma Air National Guard
  - Executive Director of the Tulsa Air and Space Museum & Planetarium
  - Business/Economics/Psychology major at Rice University
  - MBA from Cornell University
  - Business experience in real estate, ranching, aerospace, and defense contracting

Source: https://bridenstine.house.gov

Astrophysics Division R&A Staff

- *Nasser Barghouty* (MSFC, RTF from MG, Technologies, +)
- *William Latter* (Ames, CubeSats, Lab Astro, +)
- *Valerie Connaughton* (MSFC, NuStar, XARM, +)
- Dominic Benford
- Dan Evans
- Ingrid Farrell
- Mike Garcia
- Thomas Hams
- Hashima Hasan
- Doug Hudgins
- Stefan Immler
- Vernon Jones
- Mario Perez
- Rita Sambruna
- Kartik Sheth
- Linda Sparke
- Martin Still
- Eric Tollestrup

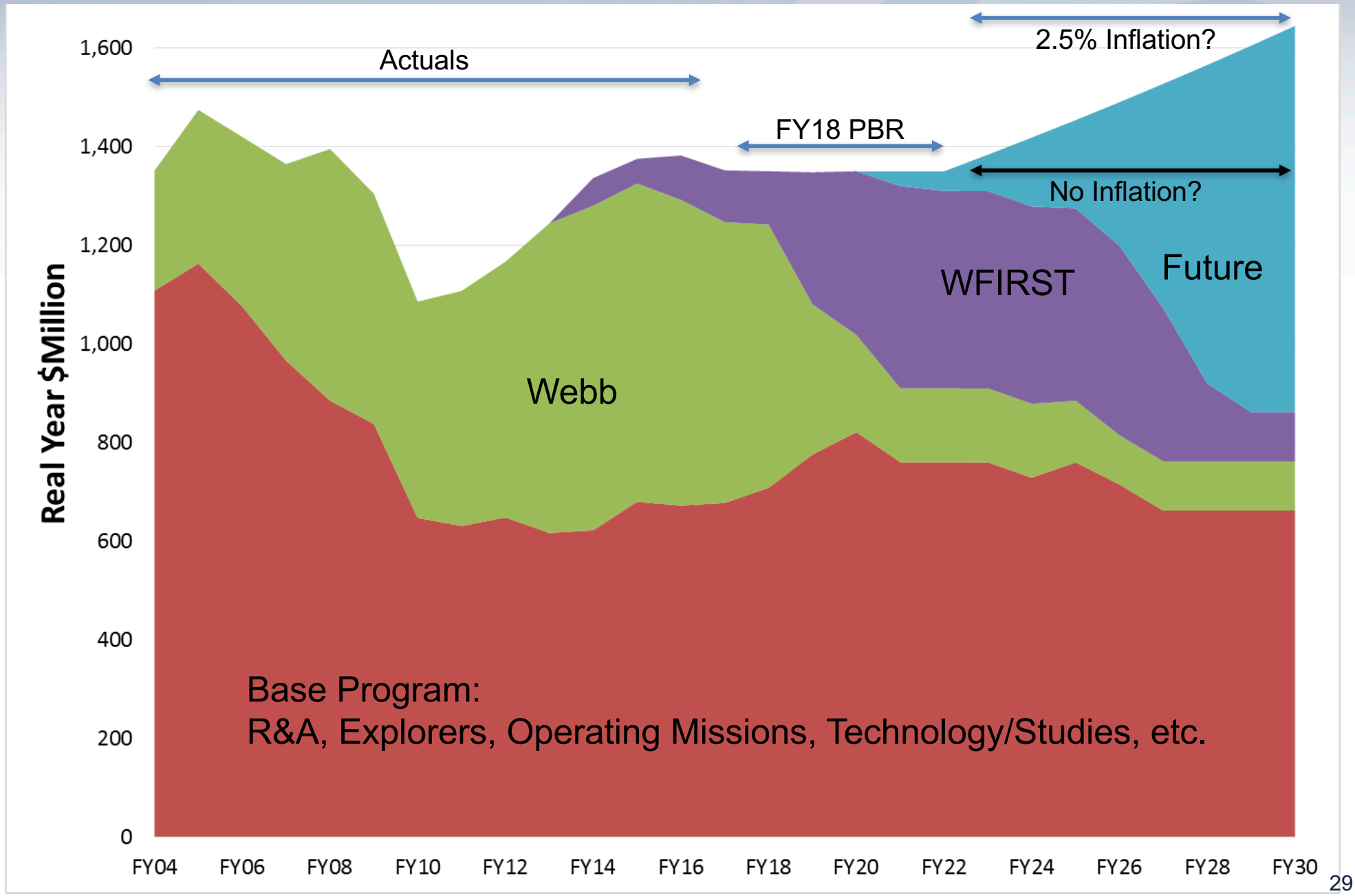
NASA Astrophysics

Backup

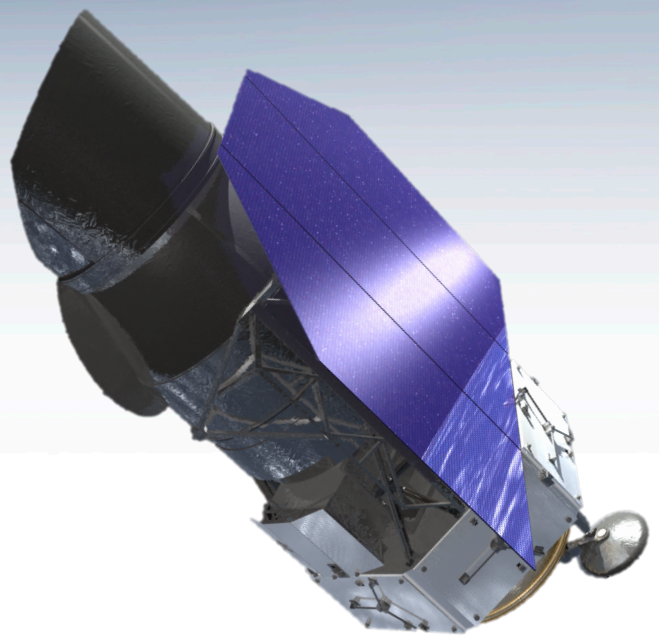
NASA Astrophysics

A Balanced Plan
A Strategic Vision

Planning for the Future



WFIRST
Wide-Field Infrared Survey Telescope



Wide-Field Infrared Survey Telescope

Top priority of 2010 Decadal Survey

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

Mission: 2.4m widefield telescope at L2; using existing hardware, images 0.28deg^2 at 0.8-2μm

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

Phase: Currently in Formulation (Phase A)

https://wfirst.gsfc.nasa.gov/

CURRENT STATUS:

- Successfully completed three-year technology demonstration activities on WFIRST's two critical mission technologies (near infrared detectors and coronagraph technologies)
- Completed industry formulation studies on Wide Field Instrument Optomechanical Assembly
- Conducting WFIRST Independent External Technical/Cost/Management Review (WIETR) in response to findings and recommendations in National Academies' Midterm Assessment
  - NASA is managing WFIRST with major emphasis on cost control
  - WFIRST will proceed to SRR/MDR and KDP-B after responding to WIETR recommendations
- WFIRST does not have a starshade; but NASA is studying a starshade for the next Decadal Survey's consideration.
  - Starshade compatibility is being studied during Phase A; mandated minimum impact on WFIRST.
  - NASA will decide by fall 2017 whether to maintain starshade compatibility.
- Jeff Kruk is new Project Scientist following loss of Neil Gehrels

WFIRST

- NASA commissioned a WFIRST Independent External TMC Review (WIETR)
- An independent review of WFIRST before Phase B was recommended by two National Academies studies: the 2013 Harrison Report and the 2016 Midterm
- In direct response to these National Academies recommendations, the WIETR was commissioned by the SMD AA on April 27, 2017
- The WIETR Terms of Reference contain these questions:
  - Are the technical requirements understood and reasonable?
  - Are the scope and cost/schedule understood and aligned?
  - Are the management processes in place adequate for a project of this scope and complexity?
  - Are the benefits of the coronagraph to NASA objectives commensurate with the cost and cost risk of development?

WFIRST

Presentation of WIETR by Peter Michelson and Orlando Figueroa
At November CAA meeting

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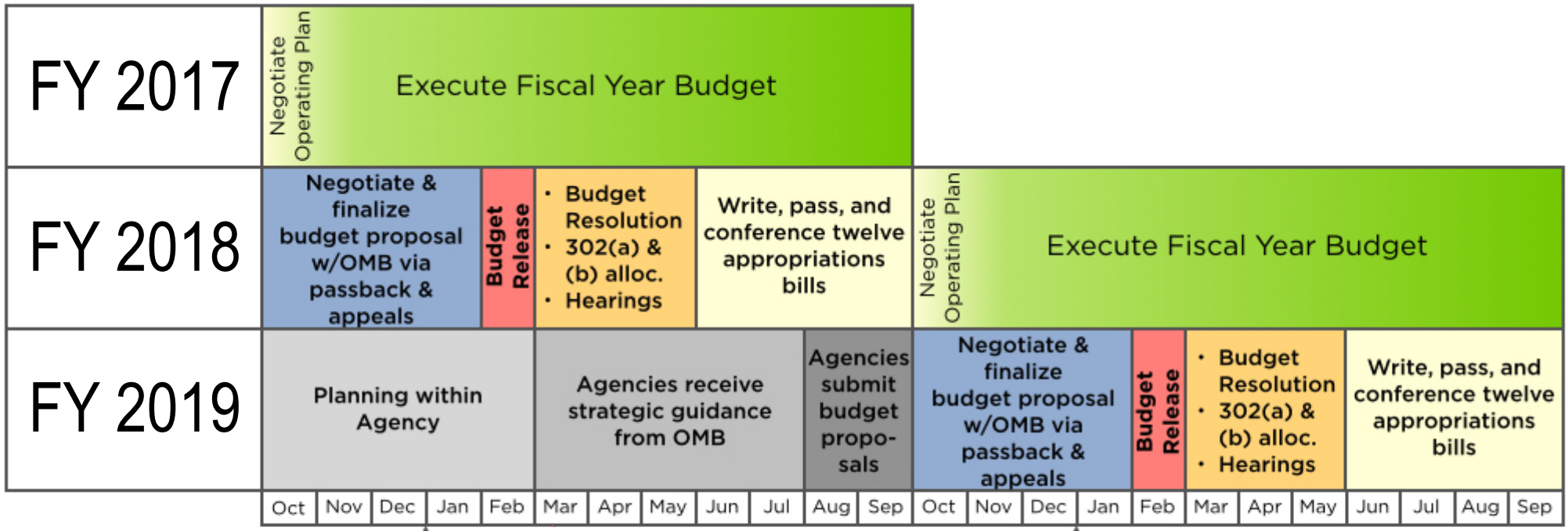
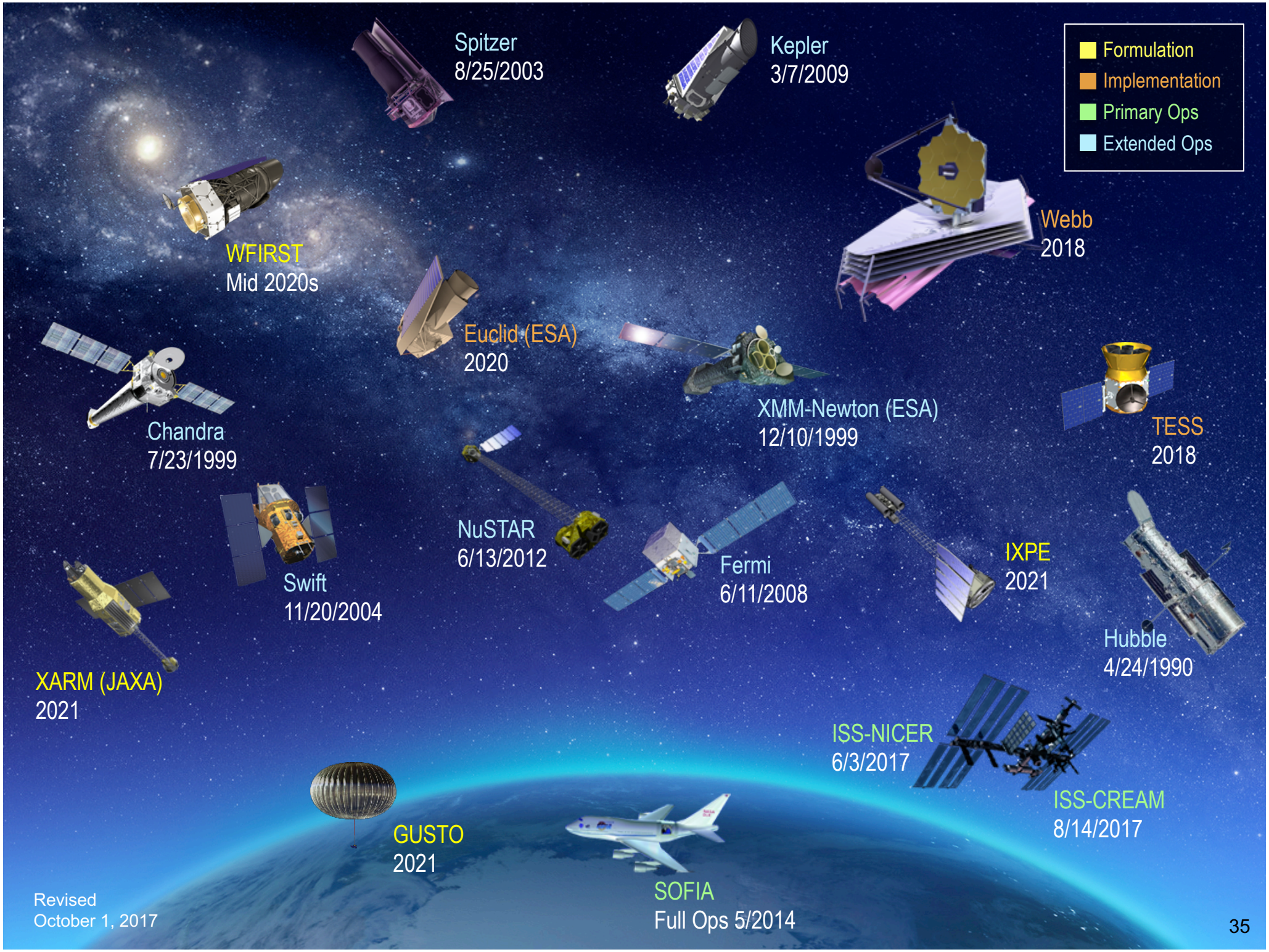
NASA Astrophysics

Budget Update

Federal Budget Cycle



Adapted by Kevin Marvel (AAS)
https://aas.org/files/budgetprocess_adaptedfromaaas.jpg
from budget presentation by Matt Hourihan (AAAS)
http://www.aaas.org/page/presentations



Revised
October 1, 2017

Astrophysics Division, NASA Science Mission Directorate

Resource Management
Omana Cawthon+
Clemencia Gallegos-Kelly+
Debra Mcneill+

Director
Paul Hertz
Deputy Director
Andrea Razzaghi

Lead Secretary: Kelly Johnson
Secretary: Kyle Nero
Program Support Specialist: Jackie Mackall

Cross Cutting

Technology Lead: Nasser Barghouty*
Education POC: Hashima Hasan (Lead Comm Team)
Public Affairs Lead: Kartik Sheth
Information Manager: Lisa Wainio*
Strategic Planning: Rita Sambruna

Astrophysics Research

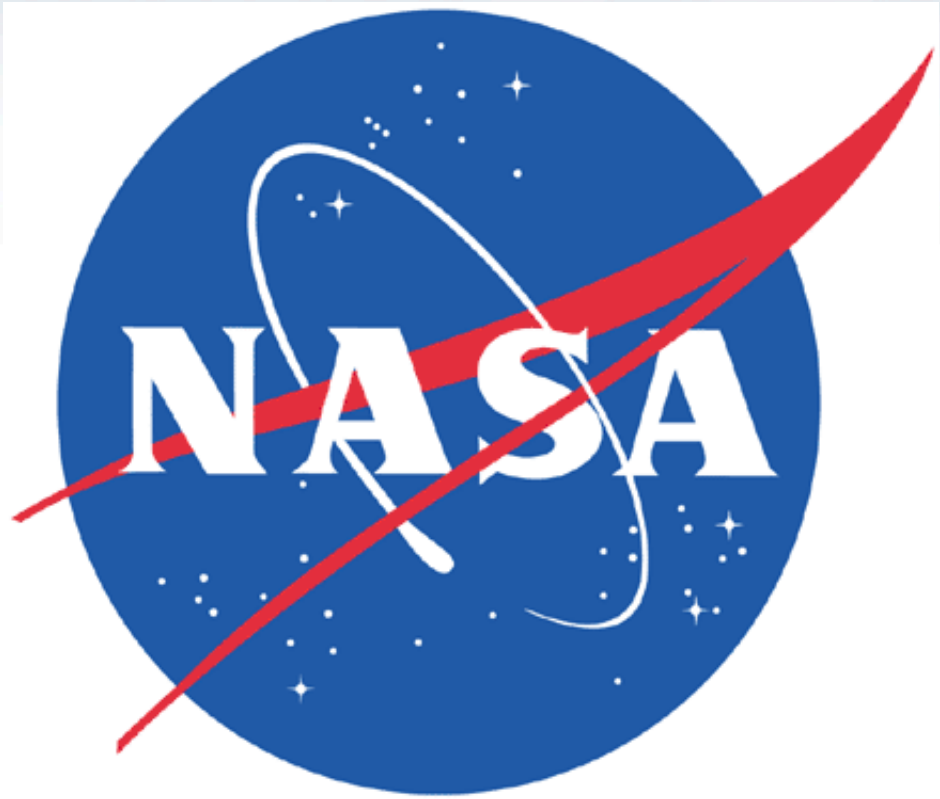
***Program Manager*:**	**Dan Evans**
Program Support:	Ingrid Farrell*
Astrophysics Data Analysis:	Doug Hudgins
Astrophysics Theory:	Keith MacGregor*
Exoplanet Research:	Martin Still*
APRA lead:	Michael Garcia*
Cosmic Ray, Fund Physics:	Thomas Hams*, Vernon Jones, Keith MacGregor*, Rita Sambruna
Gamma Ray/X-ray:	Dan Evans, Michael Garcia*, Stefan Immler*, Rita Sambruna
Optical/Ultraviolet:	Michael Garcia*, Hashima Hasan, Mario Perez*, Martin Still*
IR/Submillimeter/Radio:	Dominic Benford*, Doug Hudgins, Kartik Sheth, Eric Tollestrup*
Lab Astro:	Doug Hudgins
Theory & Comp Astro Net:	Keith MacGregor*
Roman Tech Fellows:	Michael Garcia
Data Archives:	Hashima Hasan
Astrophysics Sounding Rockets:	Thomas Hams*
Balloons Program:	Vernon Jones(PS), Mark Sistilli (PE)
CREAM:	Vernon Jones(PS), Jeff Hayes (PE)

Programs / Missions & Projects

	Program Scientist	*Program Executive*
Exoplanet Exploration (EXEP)		
Program	**Doug Hudgins**	**John Gagosian**
Keck	Hashima Hasan	Mario Perez*
Kepler/K2	Mario Perez*	Jeff Hayes
LBTI	Doug Hudgins	Mario Perez*
NN-EXPLORE	Doug Hudgins	Mario Perez*
WFIRST	Dominic Benford*	John Gagosian
Cosmic Origins (COR)		
Program	**Mario Perez***	**Shahid Habib**
Herschel	Dominic Benford*	Jeff Hayes
Hubble	Michael Garcia*	Jeff Hayes
SOFIA	Kartik Sheth	Lucien Cox*
Spitzer	Kartik Sheth	Jeff Hayes
Webb^	Hashima Hasan	N/A
Physics of the Cosmos (PCOS)		
Program	**Rita Sambruna**	**Shahid Habib**
Athena	Michael Garcia*	Shahib Habib
Chandra	Stefan Immler*	Jeff Hayes
Euclid	Eric Tollestrup*	Shahid Habib
Fermi	Stefan Immler*	Jeff Hayes
LISA	Rita Sambruna	Shahid Habib
Planck	Rita Sambruna	Jeff Hayes
ST-7/LPF	Rita Sambruna	Jeff Hayes
XMM-Newton	Stefan Immler*	Jeff Hayes
Astrophysics Explorers (APEX)		
Program	**Linda Sparke**	**Mark Sistilli**
GUSTO	Thomas Hams*	Lucien Cox*
IXPE	Eric Tollestrup*	Mark Sistilli
NICER	Rita Sambruna	Jeff Hayes
NuSTAR	Stefan Immler*	Jeff Hayes
Swift	Martin Still*	Jeff Hayes
TESS	Martin Still*	Mark Sistilli
XARM	Dan Evans	Shahid Habib

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

Oct 10, 2017



Astrophysics Division
Science Mission Directorate
National Aeronautics and Space Administration