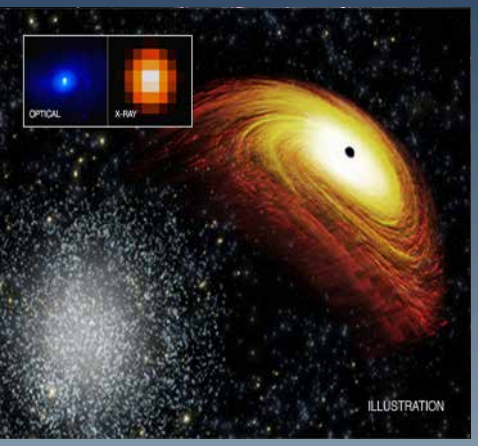
National Aeronautics and Space Administration

Astrophysics





NASA Astrophysics Update

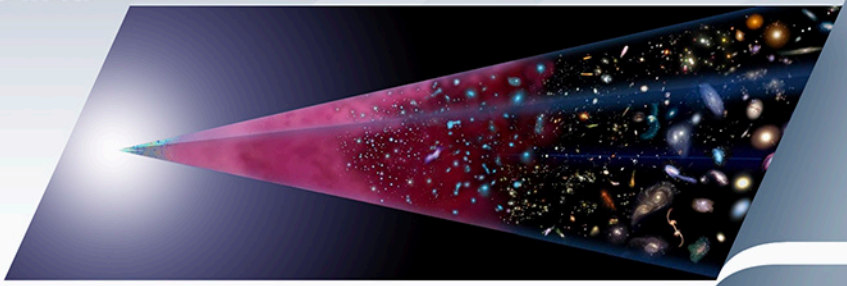
Committee on Astronomy and Astrophysics
October 24, 2017

Paul Hertz
Director, Astrophysics Division
Science Mission Directorate
@PHertzNASA

Why Astrophysics?

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

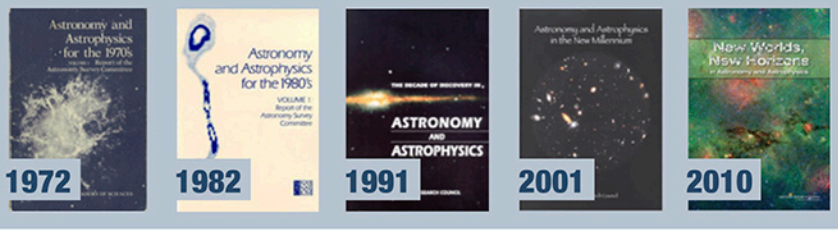
How did our universe begin and evolve?

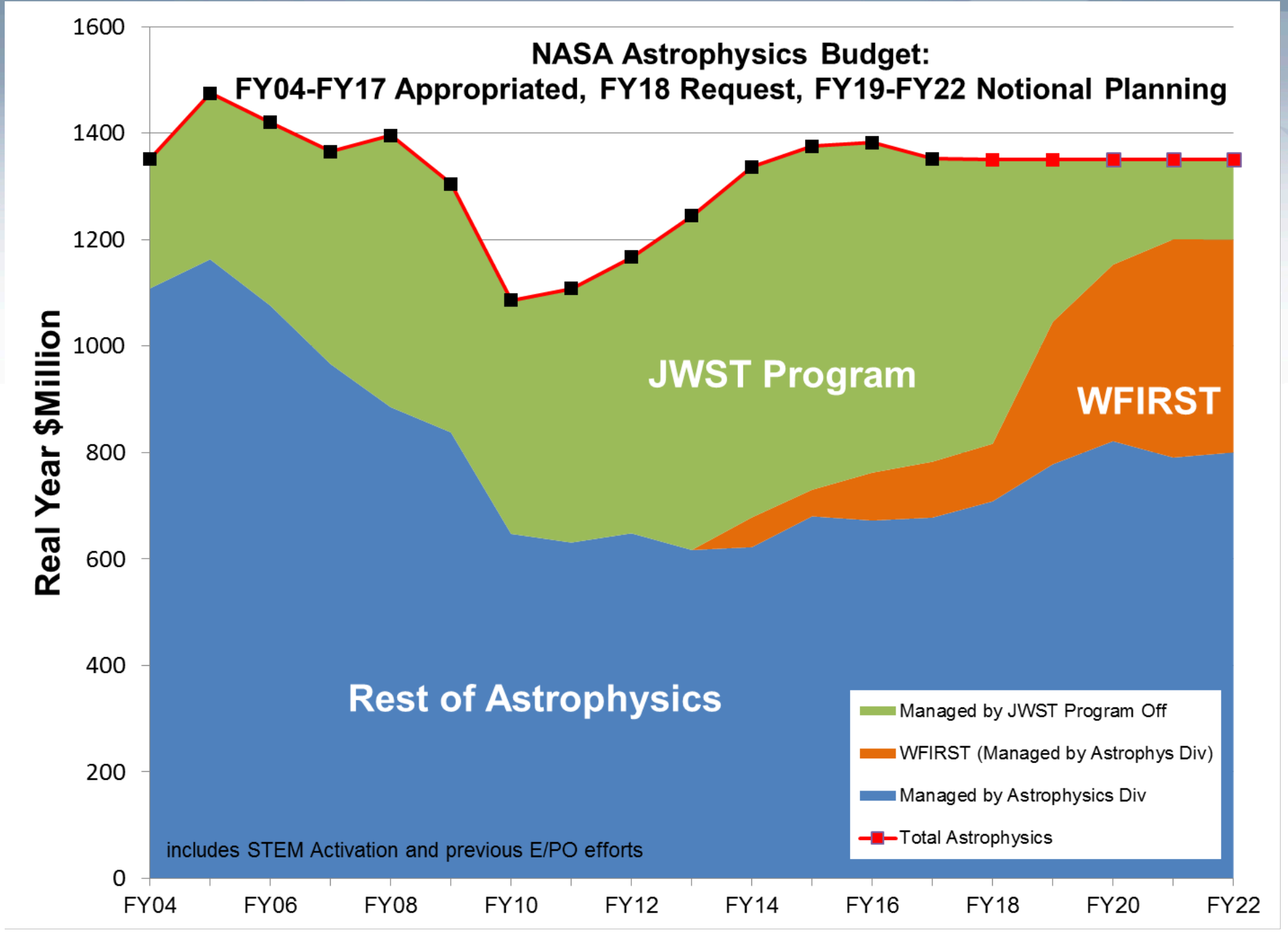


How did galaxies, stars, and planets come to be?

Are we alone?

Enduring National Strategic Drivers




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

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)
  - 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

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; adding 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

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.
- 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

- RFI is posted in Fed Biz Opportunities at

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

Seeking Private Sponsor for Spitzer Operations

- NASA is seeking information from parties who are interested in operating the Spitzer Space Telescope using non-NASA funding, including defining and executing a Spitzer science program, beyond the timeframe of the NASA-funded mission.
- The Astrophysics Division of SMD has committed support for Spitzer operations through March 2019. If no engineering impediments arise we expect that current Spitzer operations could continue through September 2019 and operations beyond September 2020 should be possible for the lowest data volume observing modes.
- The FY18 cost of Spitzer operations, without direct science data analysis funding for the Guest Observer (GO) program and Deep Space Network (DSN) support, is $14 million.
- Responses due December 1, 2017

- RFI is posted in Fed Biz Opportunities at

https://www.fbo.gov/notices/9bbeab044b505ed30c080b98a46ff622

Current Program: an integrated strategic plan

We are executing a balanced strategic program for Astrophysics

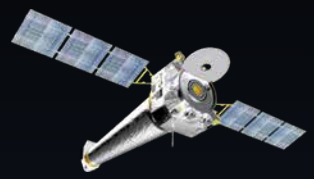
- Operating missions, large and small, continue to deliver paradigm changing science
  - Cosmology, Dark Energy, Exoplanets, Origin of Structure, Kilonovas, …
- Large strategic missions are under development …
  - Are next generation great observatories
  - Will rewrite textbooks
  - Can only be done 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
  - Preparing for the 2020 Decadal Survey
  - Investing in the future

Astrophysics Missions in Operation

Hubble
4/1990
NASA Mission

Hubble Space Telescope

Chandra
7/1999
NASA Mission



Chandra X-ray Observatory

XMM-Newton
12/1999
ESA-led Mission

X-ray Multi Mirror - Newton

Spitzer
8/2003
NASA Mission

Spitzer Space Telescope

Swift
11/2004
NASA Mission

Swift Gamma-ray Burst Explorer

Fermi
6/2008
NASA Mission

Fermi Gamma-ray Space Telescope

Kepler
3/2009
NASA Mission

Kepler Space Telescope

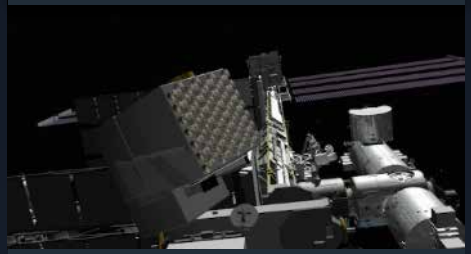
NuSTAR
6/2012
NASA Mission

Nuclear Spectroscopic Telescope Array

SOFIA
5/2014
NASA Mission

Stratospheric Observatory for Infrared Astronomy

ISS-NICER
6/2017
NASA Mission



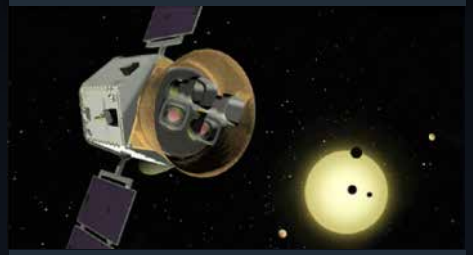
Neutron Star Interior Composition Explorer

ISS-CREAM
8/2017
NASA Mission

Cosmic Ray Energetics And Mass

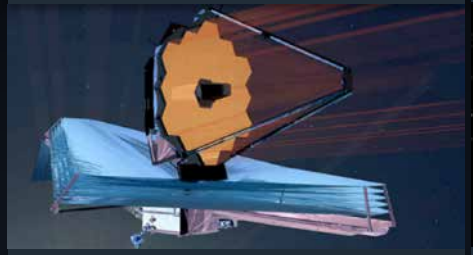
Astrophysics Missions in Development

TESS — 3/2018
NASA Mission



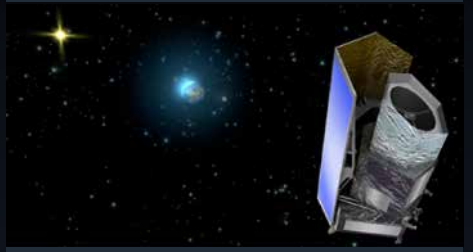
Transiting Exoplanet Survey Satellite

Webb — 2019
NASA Mission



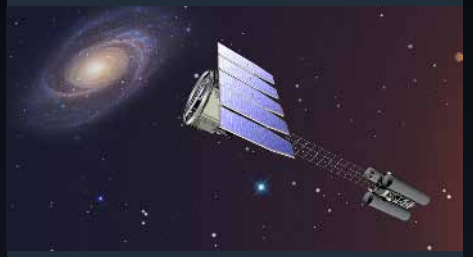
James Webb Space Telescope

Euclid — 2020
ESA-led Mission



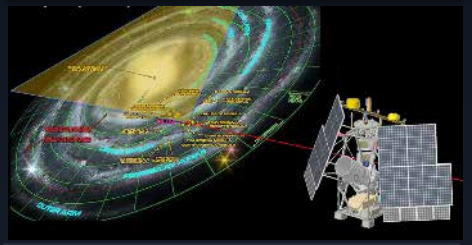
NASA is supplying the NISP Sensor Chip System (SCS)

IXPE — 2021
NASA Mission



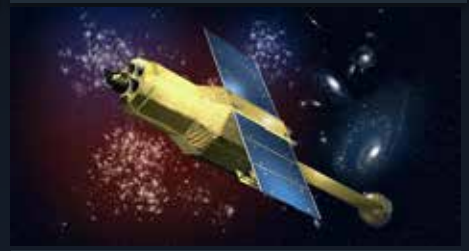
Imaging X-ray Polarimetry Explorer

GUSTO — 2021
NASA Mission



Galactic/ Extragalactic ULDB Spectroscopic Terahertz Observatory

XARM — 2021
JAXA-led Mission

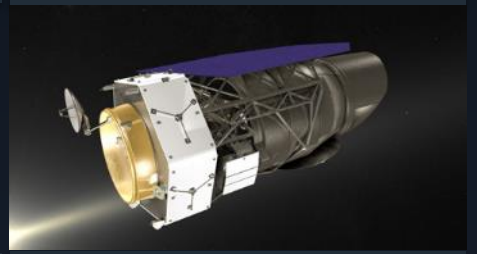


NASA is supplying the SXS Detectors, ADRs, and SXTs

MIDEX/MO — 2022/ 2023
NASA Mission

Arcus, FINESSE, or SPHEREx CASE, COSI-X, or ISS-TAO

WFIRST — Mid 2020s
NASA Mission

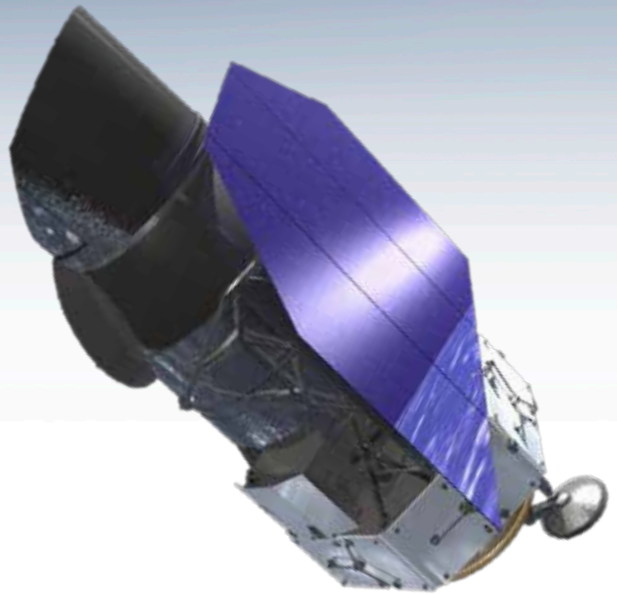


Wide-Field Infrared Survey Telescope

James Webb Space Telescope

Presentation by Eric Smith Tuesday afternoon

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

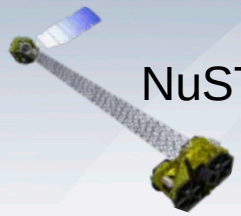
WFIRST

Presentation of WIETR by Peter Michelson and Orlando Figueroa on Wednesday morning

- 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?

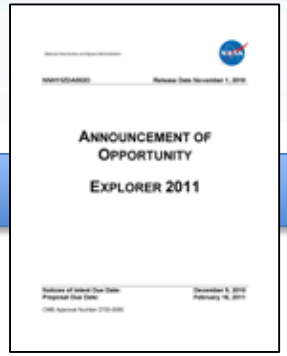
Astrophysics Explorers Program

Swift

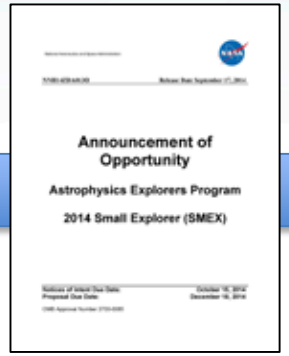


NuSTAR

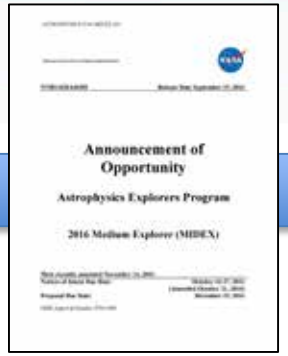
NICER



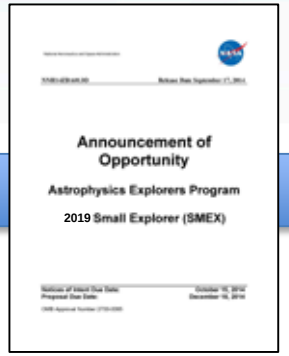
MIDEX 2011



SMEX 2014



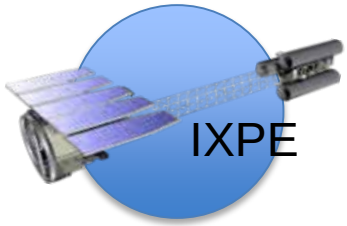
MIDEX 2016



SMEX 2019 (planned)

Small and Mid-Size Missions

TESS



IXPE

Arcus
FINESSE
SPHEREx

Missions of Opportunity

NICER

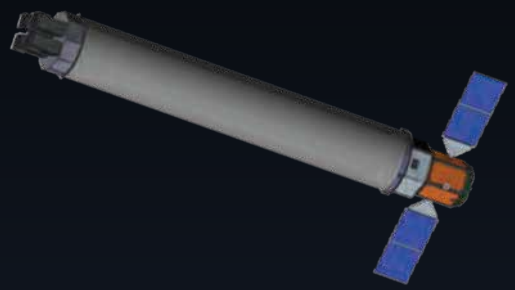
GUSTO

CASE
COSI-X
ISS-TAO

XARM

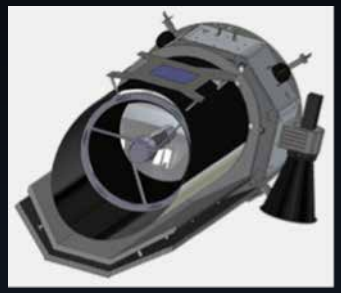
Astrophysics Explorers in Competitive Phase A

Arcus
PI: R. Smith/SAO



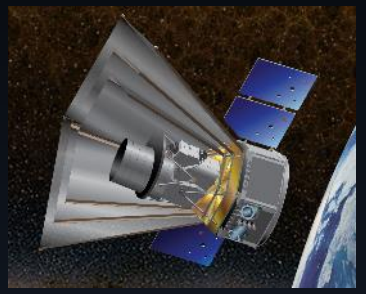
High resolution x-ray spectroscopy to explore the origin of galaxies

FINESSE
PI: M. Swain/JPL



NIR transit spectroscopy to explore exoplanet atmospheres

SPHEREx
PI: J. Bock/Caltech



NIR spectral survey addressing cosmology, galaxy evolution, and origin of ices

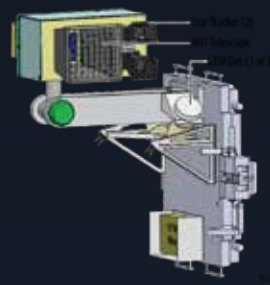
CASE
PI: M. Swain/JPL

Contribution of detectors to ESA's ARIEL

COSI-X
PI: S. Boggs/UCB

ULDB balloon mission to study origin of elements in the galaxy

ISS-TAO
PI: J. Camp/GSFC



All-sky x-ray survey to study transients and search for GW sources

Astrophysics Missions in Pre-Formulation

Athena

Late 2020s

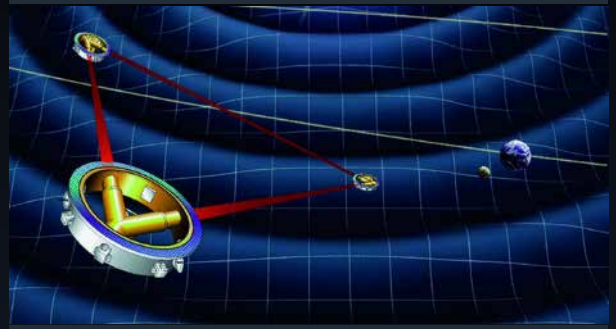
ESA-led Mission

NASA is supplying elements for both instruments

LISA

Mid 2030s

ESA-led Mission



NASA is developing technology for both the payload and the mission

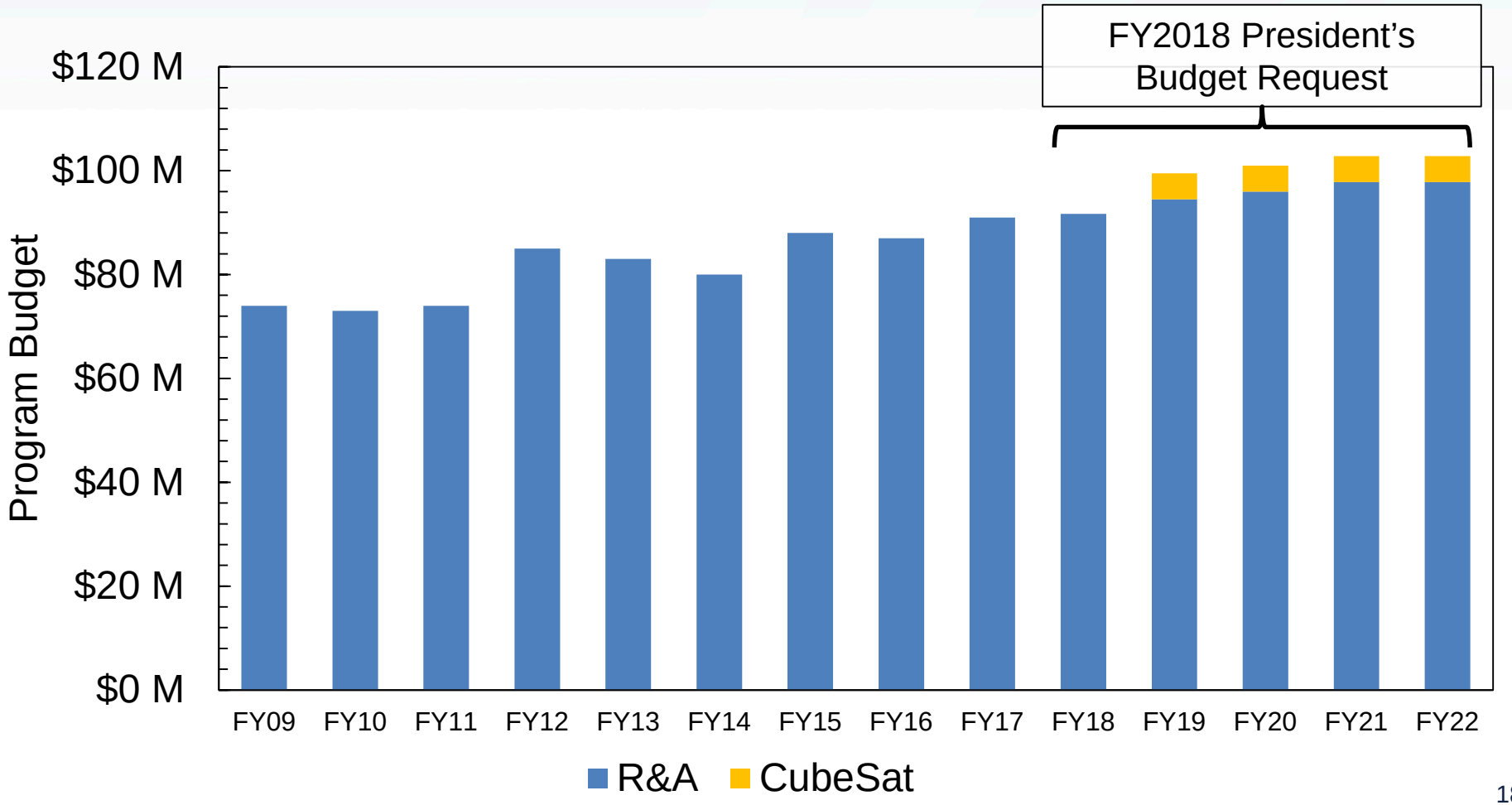
Large Interferometer Space Antenna (LISA)

- The ESA has started Phase 0 (June – December 2017) with a series of technical meetings to study the payload trades. Phase A will start January 2018.
- NASA has established a LISA Study Office at GSFC. The LISA Study Office serves as a liaison with the ESA LISA project. The LISA Study Office is attending ESA Phase 0 design runs and will attend the final report.
- NASA and ESA discussions for US contributions to LISA are advanced. NASA is funding five US-based technologies with the aim of reaching TRL 5/6 by Adoption (nominally 2022). The candidate technologies are managed by the LISA Study Office.
- ESA formed the LISA Study Science Team (SST) and asked NASA to nominate 3 members of the US astrophysics community. The first meeting of the ESA LISA SST was held September 21-22. The NASA Program and Study Scientists attended.
- The NASA L3 Study team (L3ST) had its final face-to-face meeting on July 12 in Pasadena. The L3ST was then disbanded.
- In August, NASA issued a call for nominations for the US LISA Study Team (ST) and for NASA-nominated members of the ESA LISA SST.
  - 60 applications were received by NASA.
  - Selections announced October 2017. LISA ST has 18 members and is chaired by Kelly Holley-Bockelman (Vanderbilt). Core Team has 11 members.
- The NASA LISA ST will
  - Prepare a report to the 2020 Decadal Survey re-stating the science case for US participation in LISA;
  - Provide a NASA-endorsed interface with the European-led LISA Consortium;
  - Support the NASA LISA Study Office with analysis on scientific and technical issues.

https://lisa.gsfc.nasa.gov/

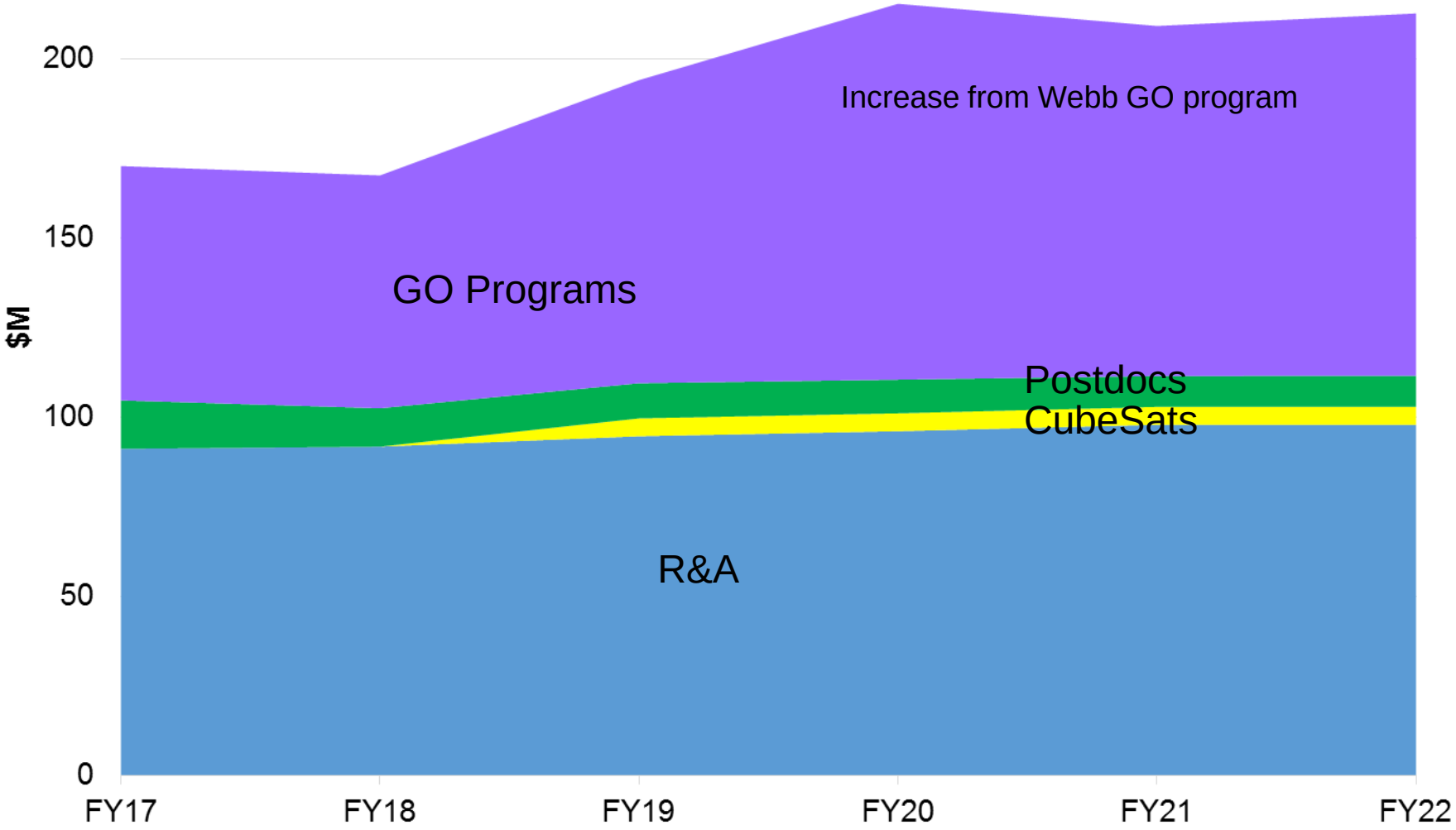
Growth in R&A Support

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	$83 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**	**$83 M**	**$80 M**	**$88 M**	**$87 M**	**$91 M**	**$92 M**	**$100 M**	**$101 M**	**$103 M**	**$103 M**



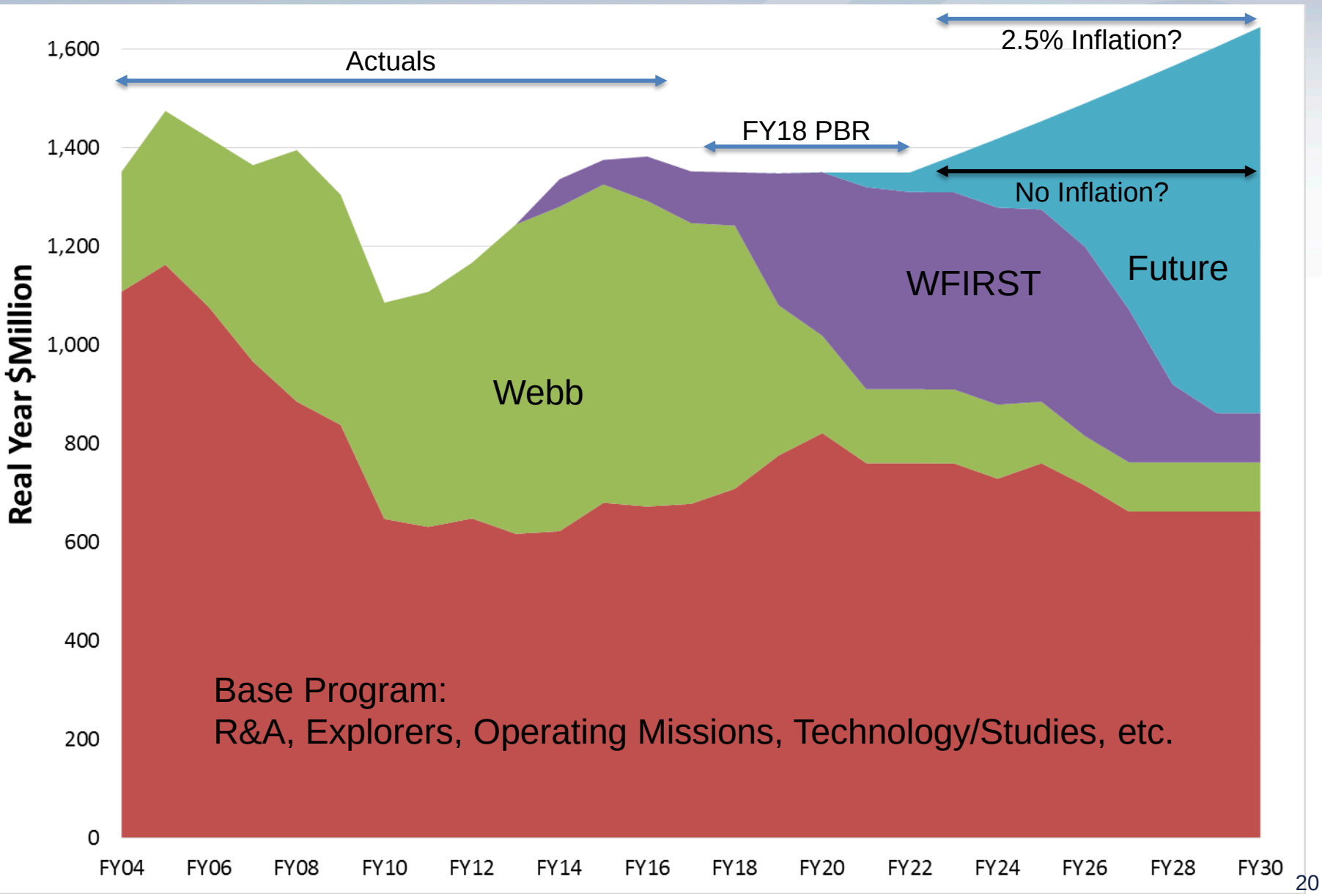
Growth in Total Community Support

Does not include SAT or flight projects (e.g. TESS)



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.

Planning for the Future



Preparing for the 2020 Decadal Survey

- Large Mission Concept Studies
  - Habitable Exoplanet Imaging Mission (S. Gaudi & S. Seager, Chairs)
  - Large UV/O/IR Surveyor (D. Fischer & B. Peterson, Chairs)
  - Lynx (X-ray Surveyor) (F. Ozel & A. Vikhlinin, Chairs)
  - Origins Space Telescope (Far Infrared Surveyor) (A. Cooray & M. Meixner, Chairs)
- Astrophysics Probes / Medium Mission Concepts
  - 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)

* Partial selection

What else should the community be studying? What other studies should NASA be supporting?

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

Preparing for the 2020 Decadal Survey

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

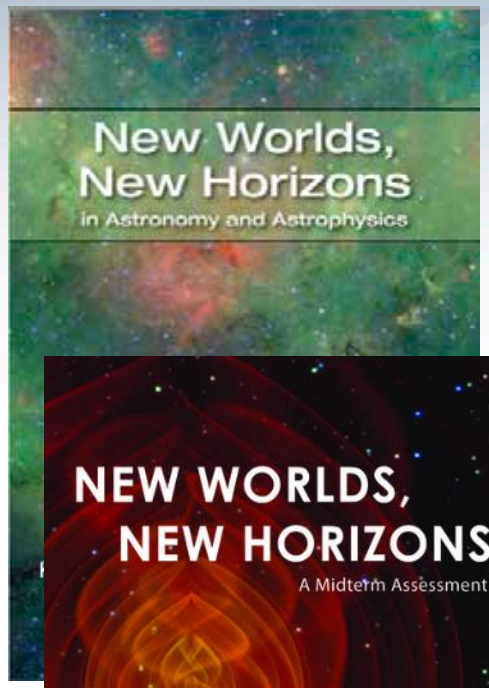

+ MIDEX/MO (2023), SMEX/MO (2025), etc.
Spitzer 8/25/2003
Kepler 3/7/2009
Formulation
Implementation
Primary Ops
Extended Ops
WFIRST Mid 2020s
Webb 2018
Euclid (ESA) 2020
Chandra 7/23/1999
XMM-Newton (ESA) 12/10/1999
TESS 2018
NuSTAR 6/13/2012
Swift 11/20/2004
Fermi 6/11/2008
IXPE 2021
Hubble 4/24/1990
XARM (JAXA) 2021
ISS-NICER 6/3/2017
ISS-CREAM 8/14/2017
GUSTO 2021
SOFIA Full Ops 5/2014
+ Athena (late 2020s), LISA (mid 2030s)
Revised October 1, 2017

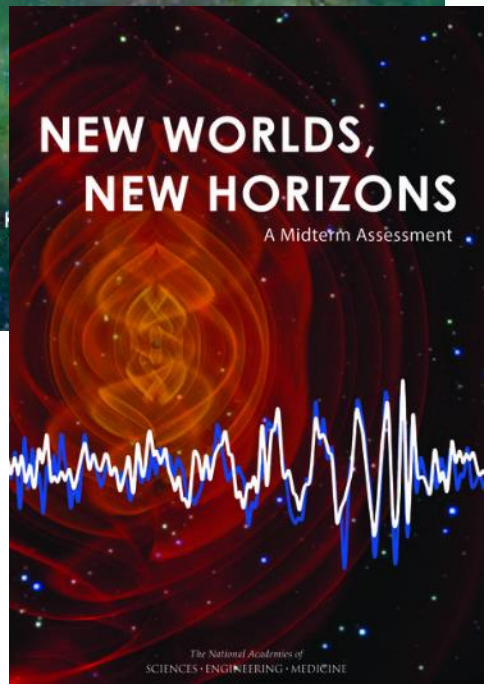
NASA Astrophysics

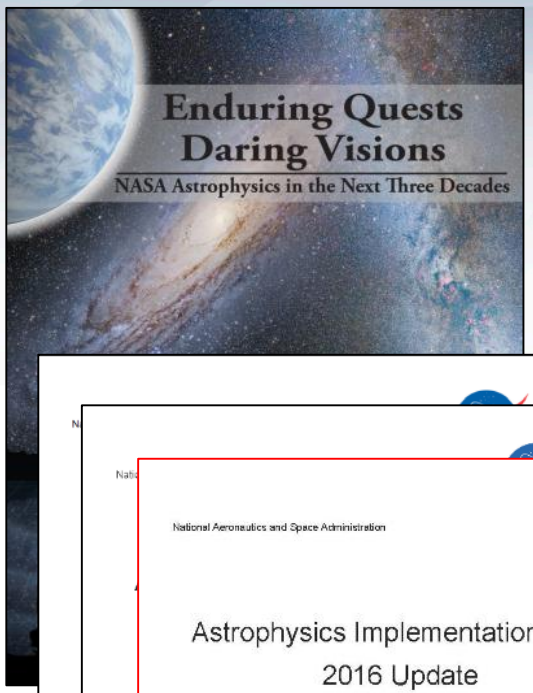
Backup

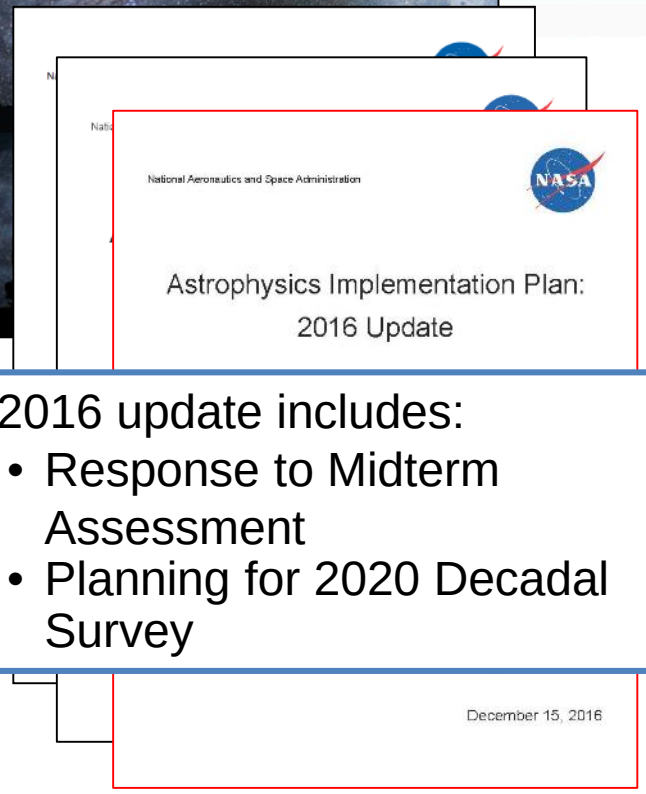
Astrophysics Strategic Planning

To be updated in 2018 (per GPRAMA)









2016 update includes:

- Response to Midterm Assessment
- Planning for 2020 Decadal Survey

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

Big Picture (1 of 2)

- **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.

Big Picture (2 of 2)

- **The operating missions continue to generate important and compelling science results, and new missions are under development for the future.**
  - Senior Review in Spring 2016 recommended continued operation of all missions (Chandra, Fermi, Hubble, Kepler, NuSTAR, Spitzer, Swift, XMM); next Senior Review is in 2019.
  - SOFIA is adding new instruments: HAWC+ instrument commissioned; HIRMES instrument in development; next gen instrument call planned.
  - ISS-NICER launched on June 3, 2017; ISS-CREAM launched on August 14, 2017.
  - NASA missions under development making progress toward launches: TESS (2018), Webb (2019), IXPE (2021), GUSTO (2021), WFIRST (mid-2020s).
  - Independent WFIRST technical/management/cost review underway; report to be released October 19, 2017.
  - Partnerships with ESA and JAXA on future missions create additional science opportunities: Euclid (ESA; 2020), XARM (JAXA; 2021), Athena (ESA; 2028), LISA (ESA; 2034).
  - Explorer AOs are being released every 2-3 years: IXPE downselected in January 2017, GUSTO downselected in March 2017, MIDEX/MO missions selected for Phase A studies in August 2017, next SMEX/MO AO in Spring 2019.

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, 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

Exoplanet Exploration (EXEP)

Program	**Doug Hudgins**	**John Gagosian**
	Program Scientist	*Program Executive*
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**
	Program Scientist	*Program Executive*
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**
	Program Scientist	*Program Executive*
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

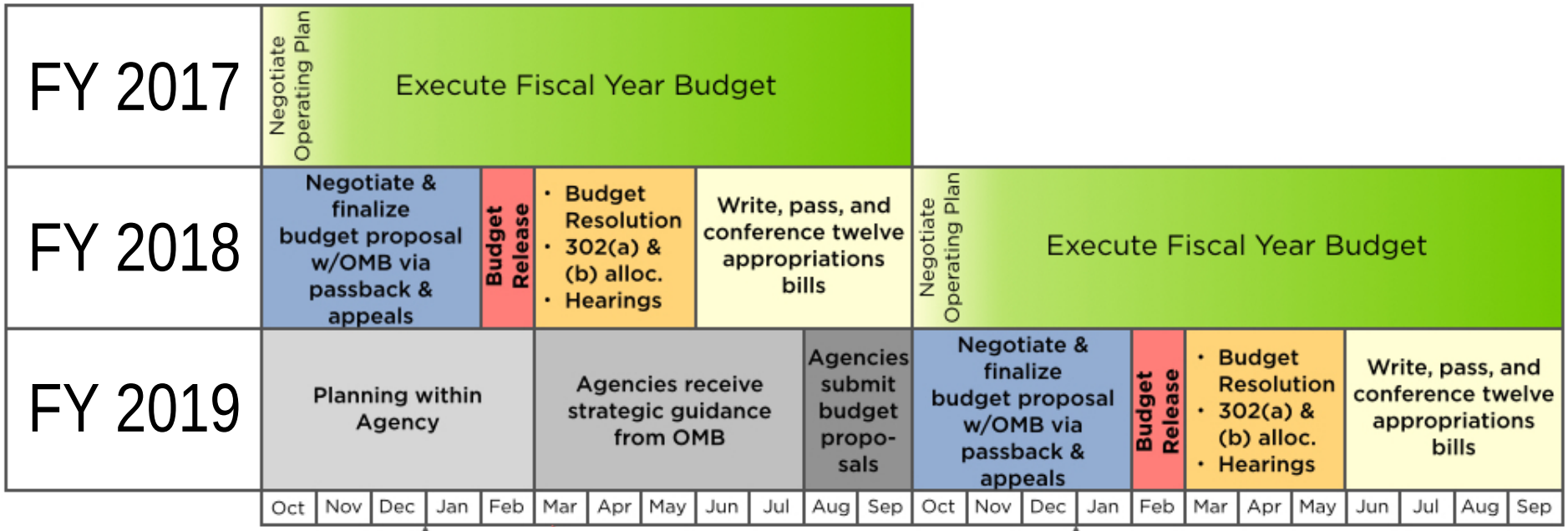
Astrophysics Explorers (APEX)

Program	**Linda Sparke**	**Mark Sistilli**
	Program Scientist	*Program Executive*
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

Federal Budget Cycle



Start of Calendar Year 2017

We are here.

Continuing resolution through December 8

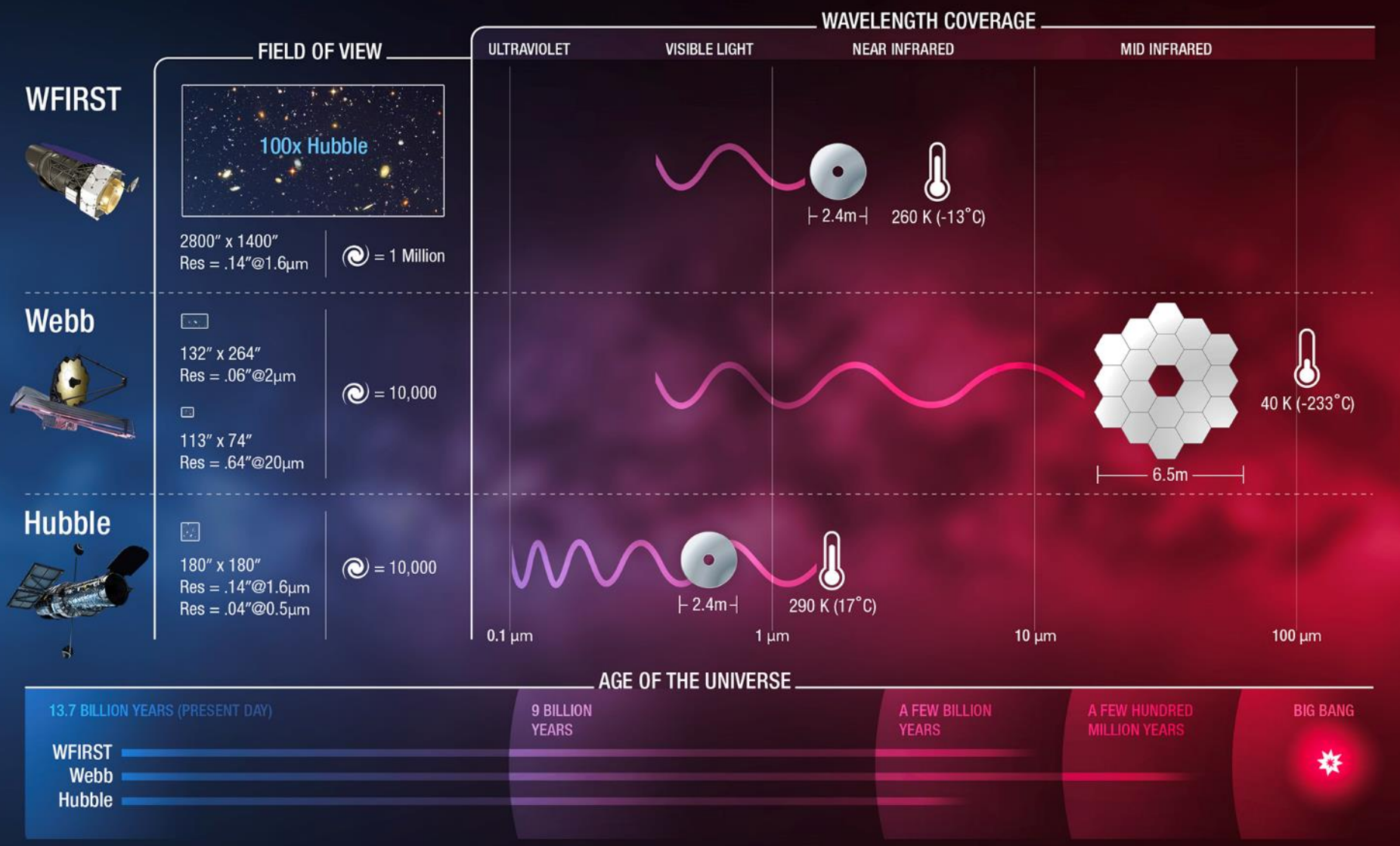
Start of Calendar Year 2018

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

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

GREAT OBSERVATORIES



Current and Future Explorer AOs

- NASA is maintaining a cadence of 4 Astrophysics Explorers AOs per decade, as recommended by Decadal Survey and validated by Midterm Assessment.
  - Midterm Assessment Recommendation 4-3: “NASA’s Astrophysics Division should execute its current plan, as presented to the committee, of at least four Explorer Announcements of Opportunity during the 2012-2021 decade, each with a Mission of Opportunity call, and each followed by mission selection.”
- Most recent Astrophysics Explorers Program AO, released in September 2016, was for a MIDEX and Mission of Opportunity (MO).
  - Three MIDEX mission proposals and three Mission of Opportunity proposals selected in August 2017 for 9-month competitive Phase A studies
  - Down-selection: Early 2019 (target)
  - MIDEX launch readiness date no later than December 2023
  - MO launch readiness date no later than December 2022, except for Partner MOs whose launch date is set by the host mission.
- Next Astrophysics Explorers Program AO will be for a SMEX and MO and is targeted for release in early 2019.
- Subsequent Astrophysics Explorers Program AO is for a MIDEX and MO and is targeted for release in late summer 2021.

SOFIA

- Observing Cycle 5 Flights
  - The FORCAST instrument planned eleven (11) flights during September 12- 27, 2017; three (3) were successful
  - The Triton Occultation took place successfully October 5, 2017, from Daytona FL utilizing the FLIPO instrument
- Instrument Status
  - 535 observing hours awarded for Cycle 5
  - High Resolution Mid Infrared Spectrometer (HIRMES) completed its CDR August 30, 2017, and is continuing development activities
  - High-resolution Airborne Wideband Camera-plus (HAWC+) pre-flight readiness activities continued in support of the mid-October science flight series
  - Next Generation instrument solicitation draft in work
- Programmatic
  - Building 703 deluge repair RFAs distribution approval has been granted to repair the Science Instrument labs and personnel offices

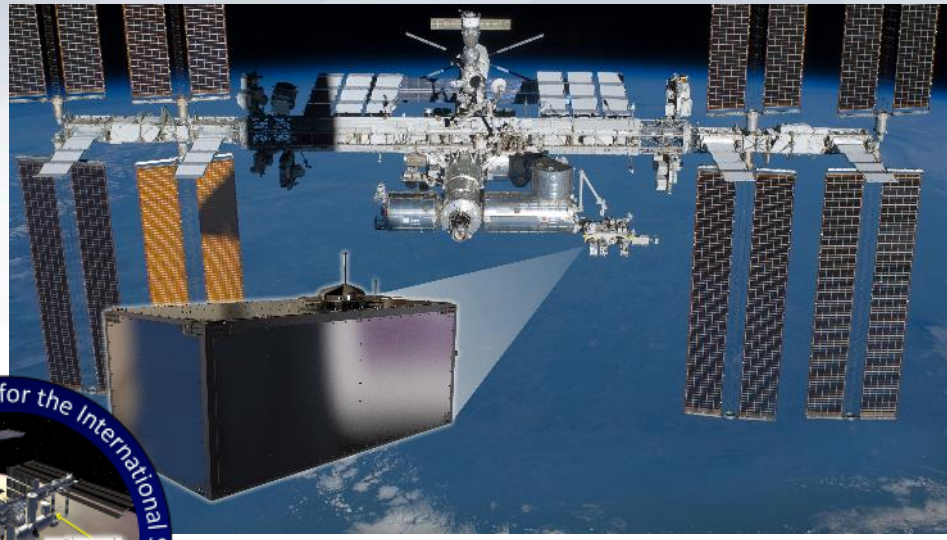
https://www.sofia.usra.edu/

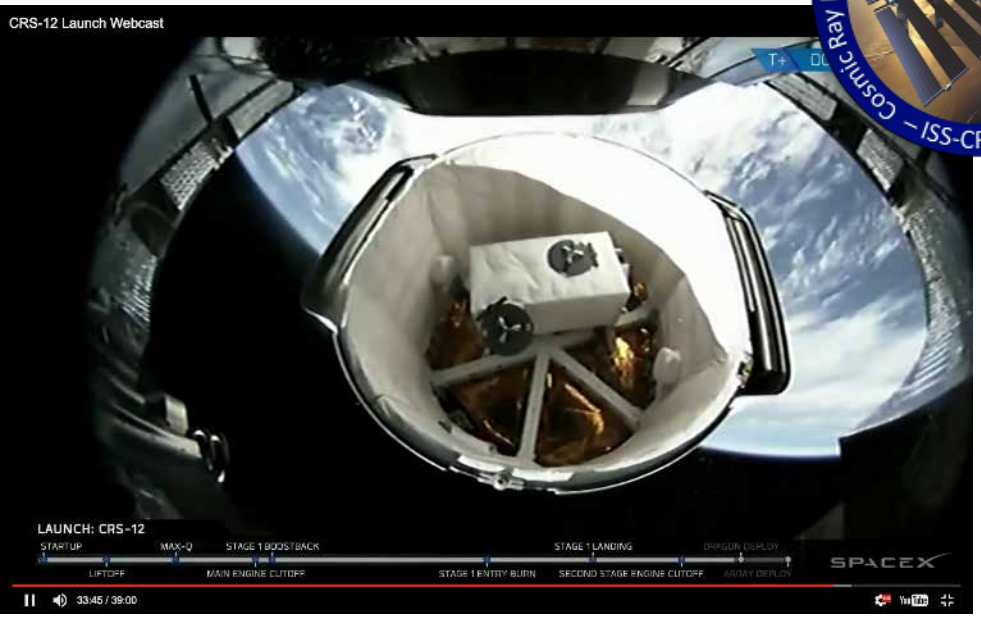
ISS-CREAM

Cosmic Ray Energy and Mass

http://cosmicray.umd.edu/iss-cream/

Launched August 14, 2017

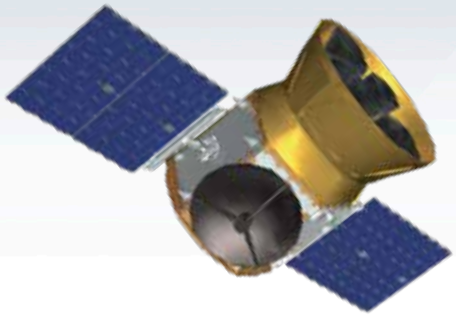




Hurricane Harvey

TESS

Transiting Exoplanet Survey Satellite



Medium Explorer (MIDEX) Mission

PI: G. Ricker (MIT)

Mission: All-Sky photometric exoplanet mapping mission.

Science goal: Search for transiting exoplanets around the nearby, bright stars.

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: NLT June 2018 launch with a 3-year prime mission including 2 years of spacecraft operations and an additional 1 year ground-based observations and analysis. High-Earth elliptical orbit (17 x 58.7 Earth radii).

CURRENT STATUS:

- Both instrument and spacecraft bus completed and integrated.
- Observatory environmental testing started in Sept. 2017.
- Spare camera long-duration testing has shown no unexpected focus drift anomalies to date.

SCHEDULE:

ü July 2017 – SIR

ü August 2017 – KDP-D

ü Sept 2017 - PER

- October - Vibration testing
- November - TVAC testing
- Late Jan 2018 - Observatory I&T complete
- Early Feb 2018 – Delivery to KSC payload processing facility
- March 2018 – Launch readiness date from Cape Canaveral FL

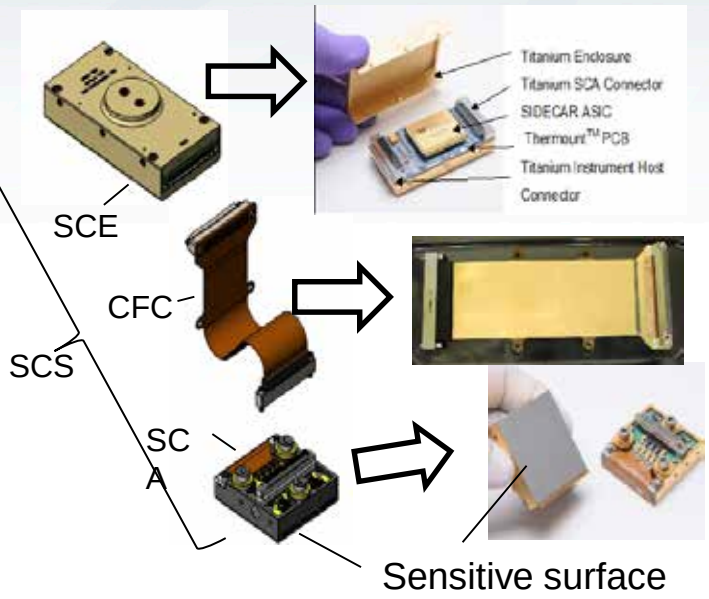
https://tess.gsfc.nasa.gov/

Euclid

http://sci.esa.int/euclid/

UPDATE:

- Problems were encountered in the sensor chip electronics (SCE).
- SCE Tiger Team initiated and report received in September.
- ESA has proposed relaxing the operating and qualification testing temperatures to reduce thermal stresses in SCEs.
- Two proposed paths forward with 12-18 month impact.
  - Option A (warm): Redesign of the enclosure and qualification for a higher Euclid operating temperature.
  - Option B: Total redesign of enclosure, PCB interface, ASIC mounting technique and design qualification.
- JPL conducting Option A testing in parallel with option B. Plan to test two additional SCEs at 115K.
  - Convening an independent panel to review the results to help to determine if Option A qualification is needed.

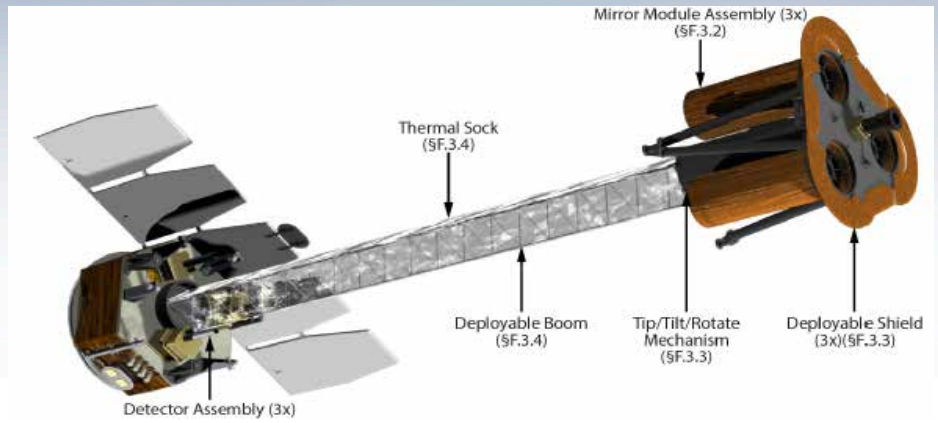


- Sensor Chip System (SCS)
- Sensor Chip Assembly (SCA)
- Cryo-Flex Cable (CFC)
- Sensor Chip Electronics (SCE)

UPCOMING EVENTS:

- Report on status to ESA to support November meeting of ESA's Science Programme Council.
- Decision point for proceeding with Option A (warm) expected in November.
- Detailed plan for Option B due in December followed by decision point.

Imaging X-ray Polarimetry Explorer (IXPE)



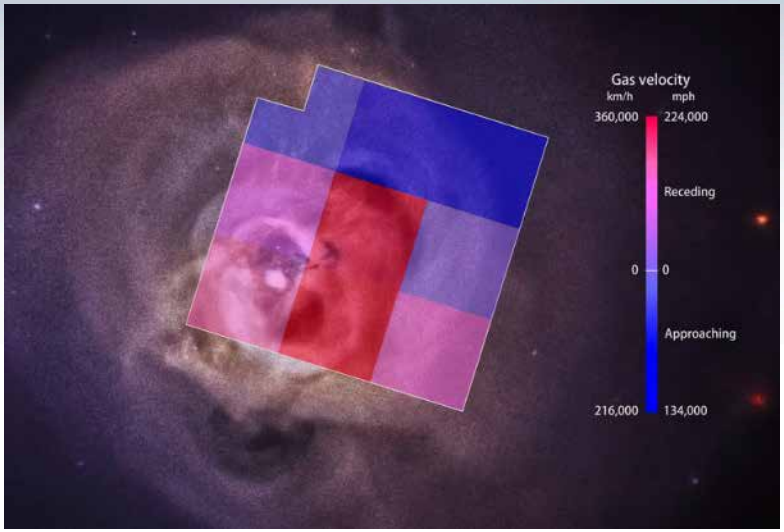
- Next Astrophysics SMEX: IXPE, PI: Martin Weisskopf, MSFC (announced January 2017)
- IXPE has a 2-8 keV energy range, proportional counter energy resolution, 11´ FOV, and ≤ 30" angular resolution
- IXPE targets AGNs and microquasars, pulsars and pulsar wind nebulae, magnetars, accreting X-ray binaries, supernova remnants, the Galactic center.
- Addresses fundamental questions about:
  - the geometries of the flows, emission regions, and magnetic fields
  - physical processes leading to particle acceleration and X-ray emission
  - physical effects of gravitational, electric, & magnetic fields at their extreme limits

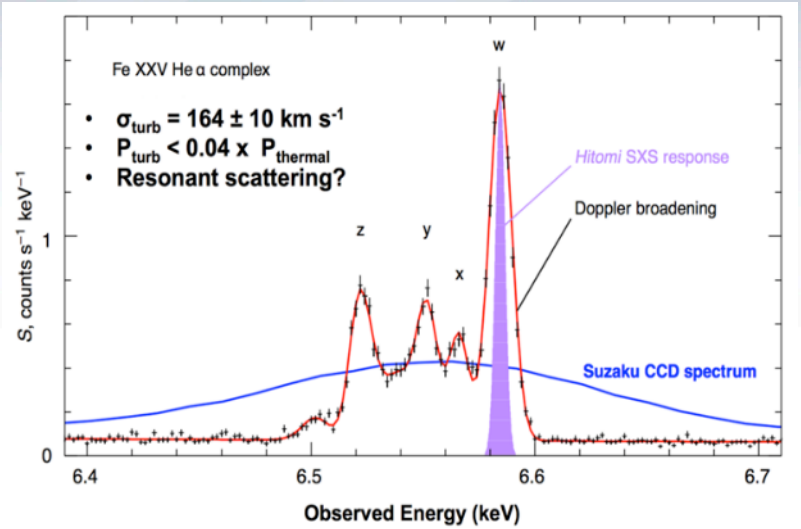
UPDATE:

- IXPE rephasing activity ongoing at MSFC due to reduction in their FY18 planning budget.
- IXPE replan schedule would result in a launch date slip from Nov 2020 to Apr. 2021.
- SRR completed in Sept 2017.

https://wwwastro.msfc.nasa.gov/ixpe/

X-ray Astronomy Recovery Mission





- XARM is the successor to Hitomi.
- Designed to provide breakthrough advances in our knowledge of winds, outflows, clusters, and dark matter.
- Mission will include an X-ray microcalorimeter and an X-ray imager.
- XARM now in Phase A. PDR/CDR mid-November, KDP B/C in January.
- U.S. Community Involvement
  - The U.S. science community should expect a high level of involvement in the planning and execution of the XARM science mission.
  - ROSES element for XARM Science Team members (aka Participating Scientists) released. Mandatory Step-1 deadline October 24; Step-2 deadline December 13.

X-ray Astronomy Recovery Mission (XARM)

- US Community Participation in XARM
  - Participating Scientists: JAXA and NASA will each appoint a small number of Participating Scientists to the XARM Science Team; NASA has an open solicitation in 2017. The Science Team consists of the researchers who directly contribute to the development, operation, and management of the project. As members of the XARM Science Team, Participating Scientists will have full access to Performance Verification (PV) phase data.

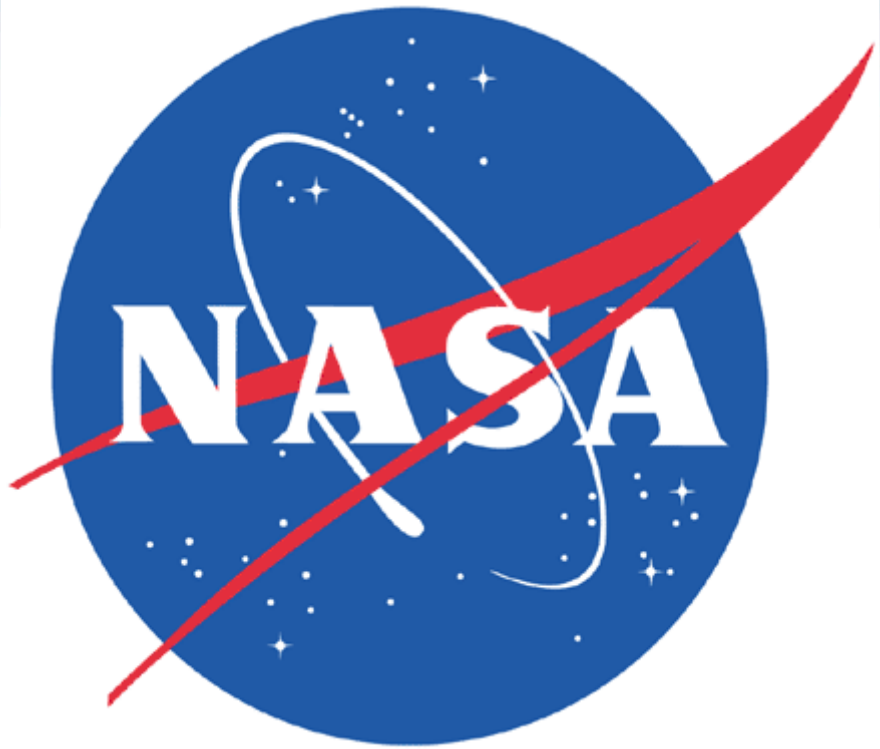
    Ø Solicitation released September 12 as ROSES-17 Appendix D.14: Mandatory Step-1 deadline October 24; Step-2 deadline December 13.

  - PV Phase Target Team Participation: JAXA and NASA will enable broad scientific participation in the early operation of XARM. Approximately one year before launch the Agencies will openly solicit additional community members to participate in the analysis of targets observed in the PV phase of the mission that are led by the XARM Science Team. Each PV Target Team member will become a member of an object-specific team, and will receive access to the PV data for that object.

  - General Observer Program: Following the conclusion of the PV phase of the mission approximately six to nine months after launch, XARM observing time will be dedicated to General Observations allocated through an open solicitation process.

NASA LISA Study Team Membership

Study Team:		* US reps to ESA Science Study Team	
Jillian Bellovary	CUNY-Queensborough	Brittany Kamai	Caltech
Peter Bender	Univ. of Colorado	Joey Key	U. Washington, Bothel
Emanuele Berti	Univ. of Mississippi	Shane Larson	Northwestern
Warren Brown	SAO	Sean McWilliams	West Virginia Univ.
Robert Caldwell	Dartmouth	Guido Mueller	Univ. of Florida
Neil Cornish	Montana State U.	Priyamvada Natarajan	Yale
Mike Eracleous	Pennsylvania State U.	David Shoemaker*	MIT
Craig Hogan	Fermilab	Deirdre Shoemaker	Georgia Tech
Kelly Holley-Bockelman* (Chair)	Vanderbilt Univ.	Robin (Tuck) Stebbins*	Univ. of Colorado
Core Team:			
John Baker	NASA GSFC	Tyson Littenberg	NASA MSFC
Jordan Camp	NASA GSFC	Jeff Livas	NASA GSFC
John Conklin	Univ. of Florida	Kirk McKenzie	NASA JPL
Curtis Cutler	NASA JPL	Michele Vallisneri	NASA JPL
Ryan DeRosa	NASA GSFC	John Ziemer	NASA JPL
William Klipstein	NASA JPL		
Pre-Formulation Office (Ex Officio):			
Ira Thorpe	NASA GSFC	Ann Hornschemeier	NASA GSFC



Astrophysics Division
Science Mission Directorate
National Aeronautics and Space Administration