



Setting the Agenda: Preparing for the 2020s

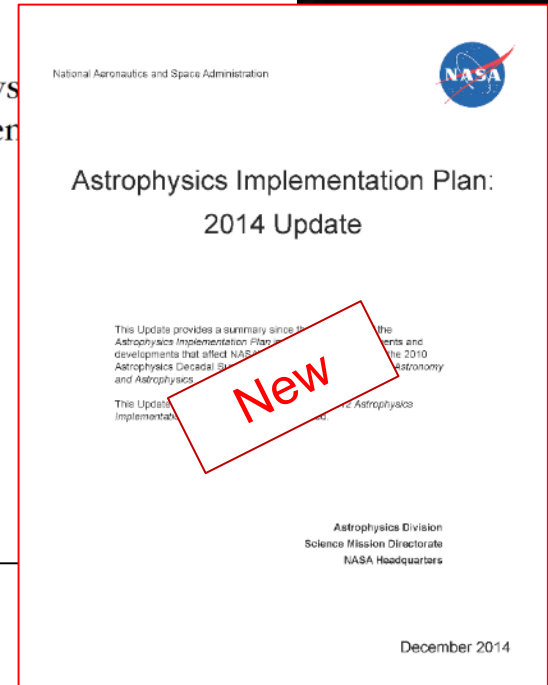
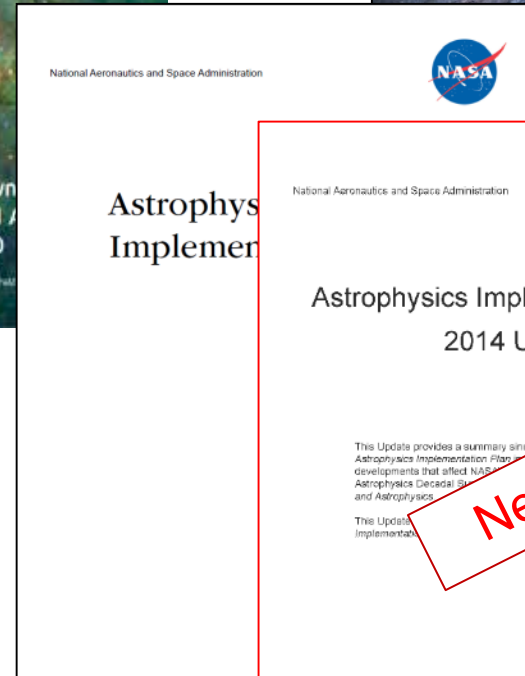
Joint PAG Meeting
at the IAU General Assembly
Honolulu, HI
August 7, 2015

Astrophysics

Paul Hertz
Director, Astrophysics Division
Science Mission Directorate
[@PHertzNASA](https://twitter.com/PHertzNASA)

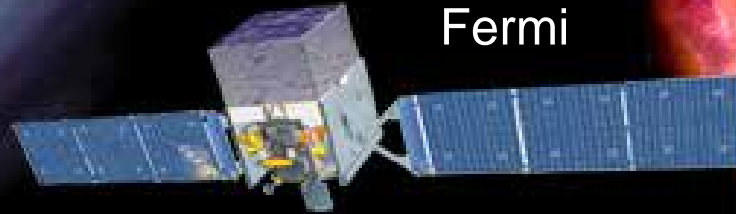


Astrophysics Driving Documents



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

Astrophysics Missions Launched



Fermi

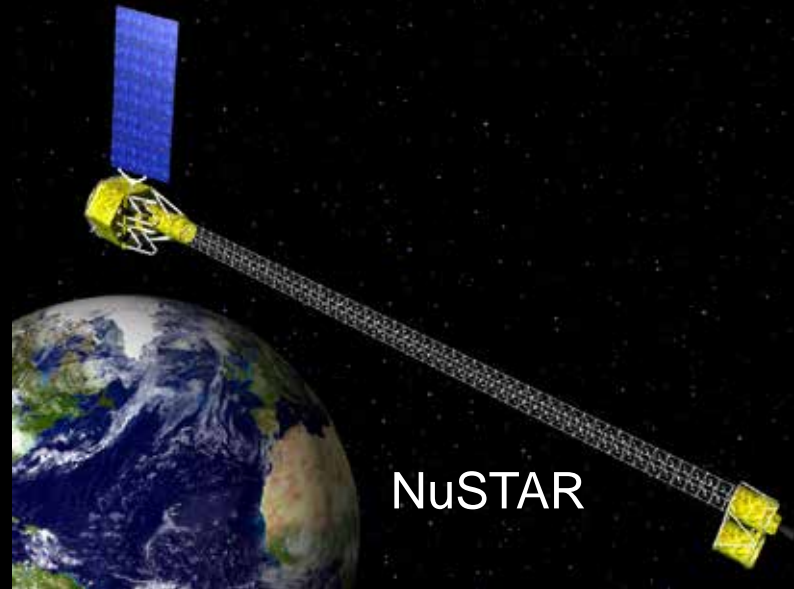
Fermi – June 2008
Kepler – March 2009
NuSTAR – June 2012
SOFIA – May 2014 (full operations)



Kepler



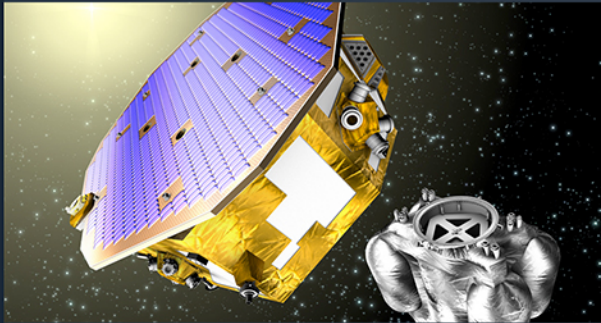
SOFIA



NuSTAR

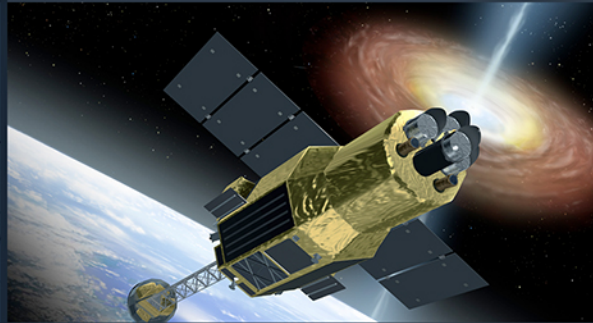
Astrophysics Missions in Development

LISA Pathfinder 11/2015
NET
ESA-led Mission



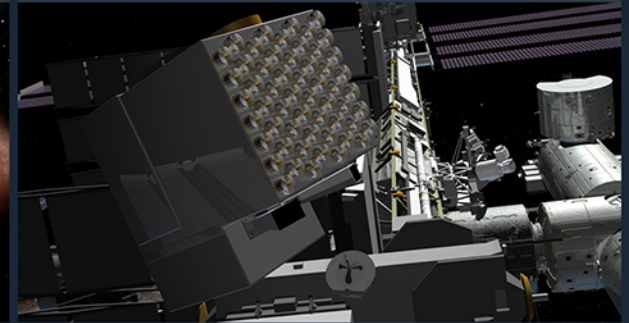
NASA supplied the ST7/Disturbance Reduction System (DRS)

ASTRO-H 11/2015
NET
JAXA-led Mission



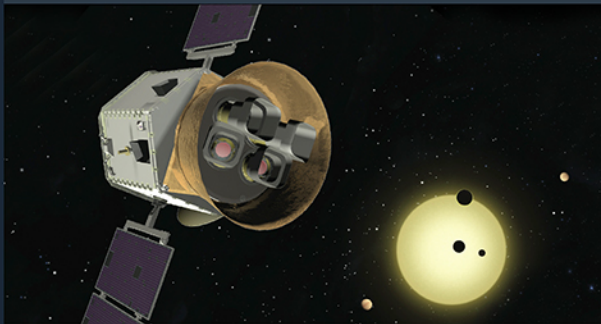
NASA supplied the Soft X-ray Spectrometer (SXS) instrument

NICER 8/2016
NASA Mission



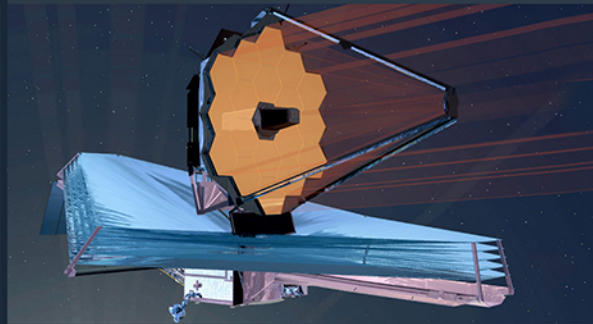
Neutron Star Interior Composition Explorer

TESS 8/2017
NASA Mission



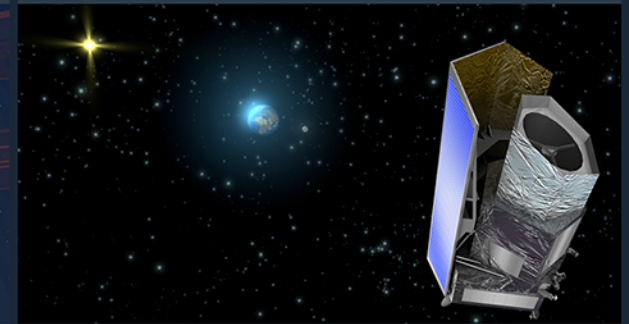
Transiting Exoplanet Survey Satellite

JWST 10/2018
NASA Mission



James Webb Space Telescope

Euclid 2020
ESA-led Mission



NASA is supplying the NISP Sensor Chip System (SCS)

Astrophysics Missions in Pre-Formulation



WFIRST-AFTA



Athena



SMEX / MO – 2019/2020

SPHEREx (J. Bock)
PRAXyS (K. Jahoda)
IXPE (M. Weisskopf)

LiteBIRD (A. Lee)
GUSTO (C. Walker)

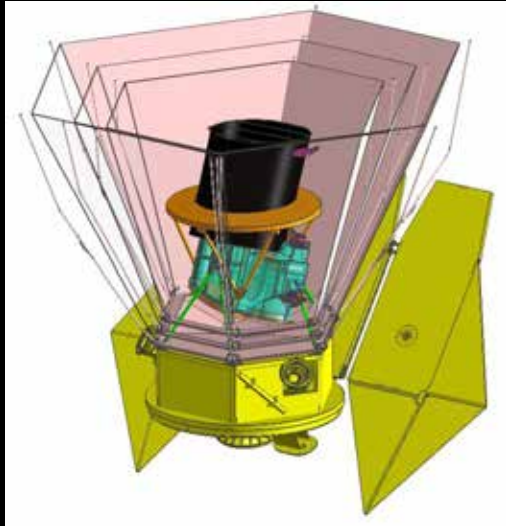
MIDEX / MO – 2022/2023

WFIRST-AFTA – 2024/2025

Athena – 2028

all launch dates notional

Astrophysics SMEX/MO Missions in Formulation



SPHEREx

PI: J. Bock, Caltech
An All-Sky Near-IR
Spectral Survey



PRAXyS

PI: K. Jahoda, GSFC
Polarimeter for Relativistic
Astrophysical X-ray
Sources



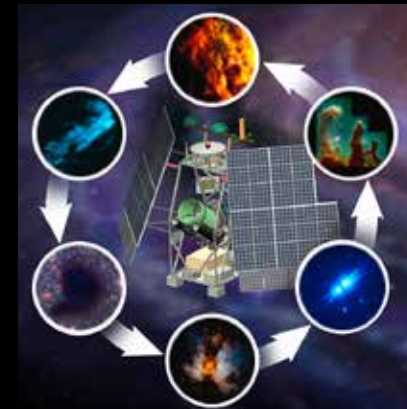
IXPE

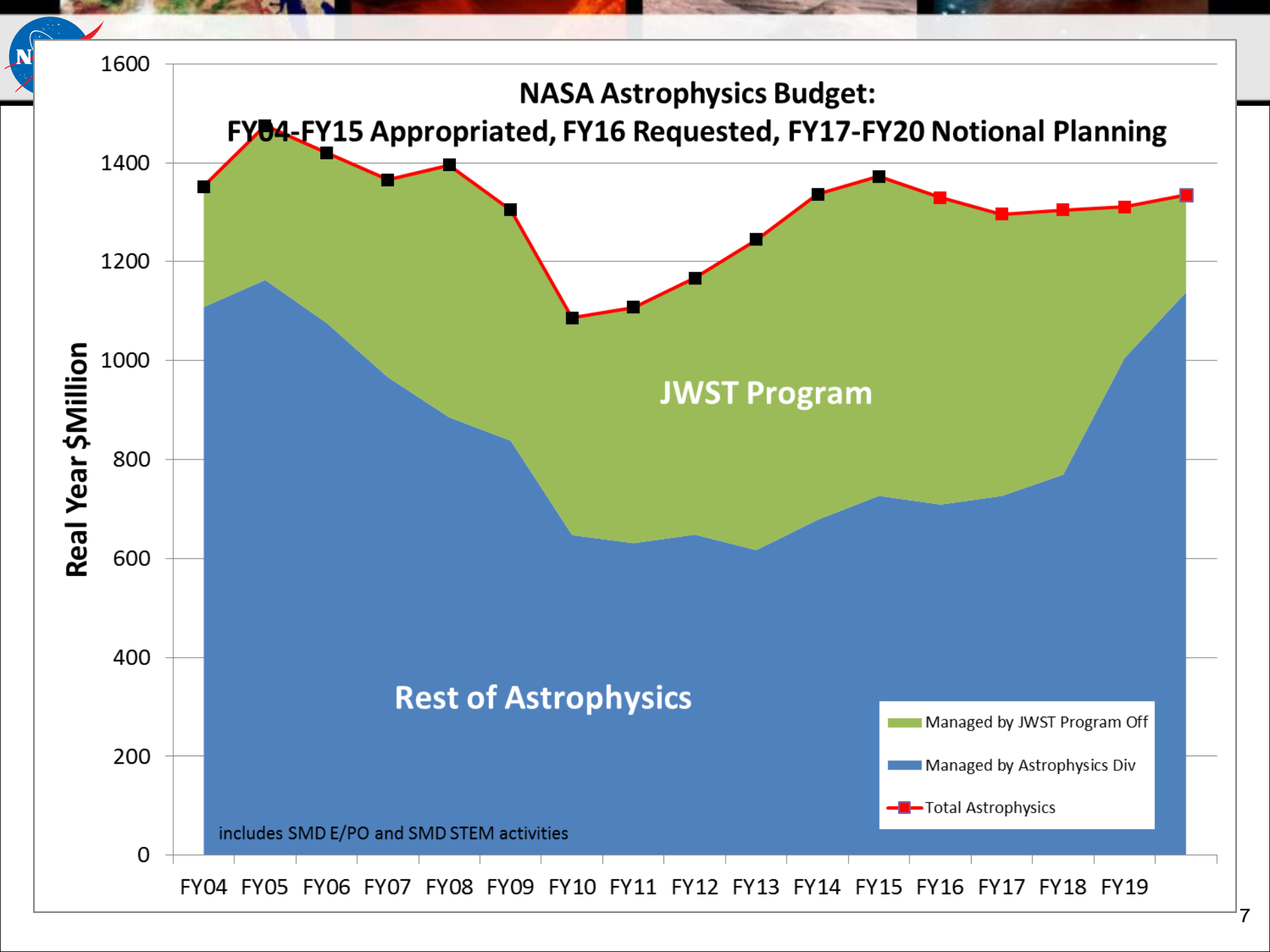
PI: M. Weisskopf, MSFC
Imaging X-ray Polarimetry
Explorer

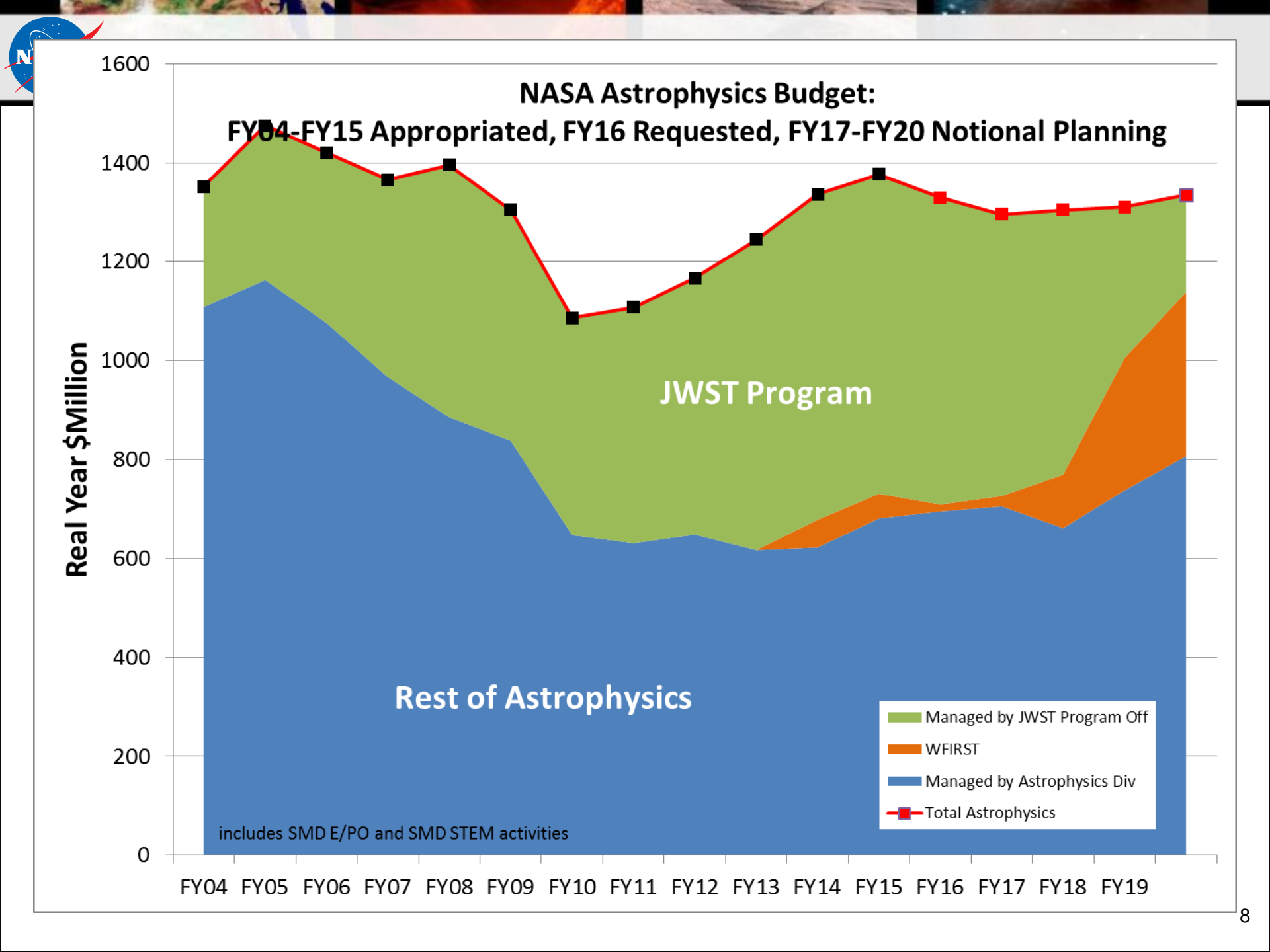


PI: A. Lee, UC Berkeley
US Participation in JAXA's
LiteBIRD CMB Polarization Survey

PI: C. Walker, U. Arizona
GUSTO: Gal/Xgal U/LDB Spectroscopic
- Stratospheric Terahertz Observatory





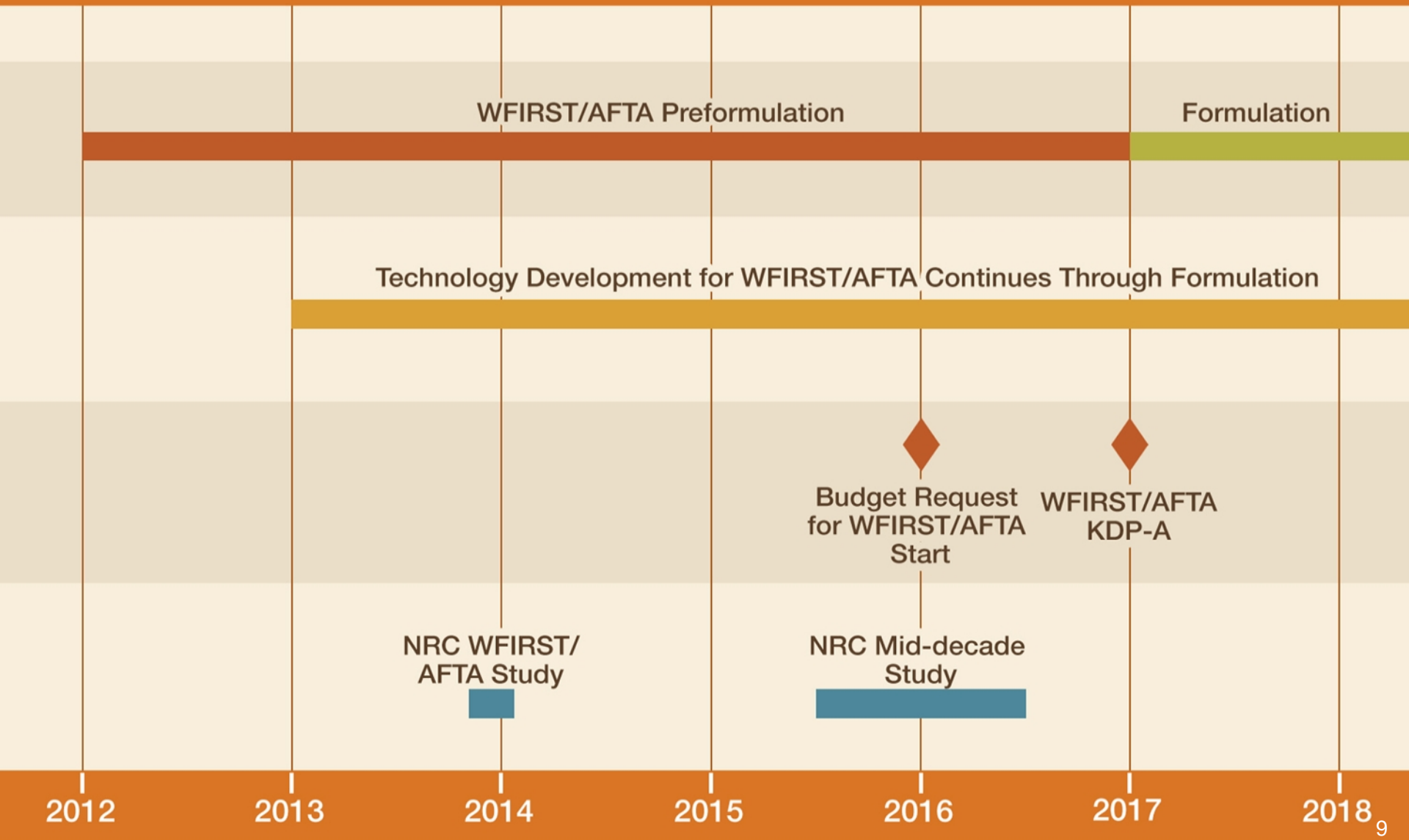




Plan for WFIRST/AFTA Preformulation

Widefield Infrared Survey Telescope using Astrophysics Focused Telescope Assets

WFIRST/AFTA timeline





Progress Toward Decadal Survey Priorities

The NASA FY15 Appropriation, the President's FY16 Budget Request, and the notional out year budget planning guidance in the President's FY16 Budget Request, support:

Large-scale 1. WFIRST
(wide-field infrared survey telescope)

Preformulation and focused technology development for WFIRST-AFTA (a 2.4m version of WFIRST with a coronagraph) underway to enable a new start NET FY2017. Budget line established for an Astrophysics Decadal Strategic Mission.

Large-scale 2. Augmentation to Explorer Program

Astrophysics Explorers planning budget increased to support decadal cadence of AOs including SMEX AO in Fall 2014 and MIDEX AO in late 2016/early 2017.

Large-scale 3. LISA
(large GW space observatory)

Partnership discussions for ESA's L3 gravitational wave observatory; Participating in ESA-led assessment in 2014-2015; Strategic astrophysics technology (SAT) investments; Continued support of LISA Pathfinder.

Large-scale 4. IXO
(large X-ray observatory)

Partnership plans for ESA's L2 Athena X-ray observatory, Athena study phase, with U.S. participation, is underway; Strategic astrophysics technology (SAT) investments.

Medium-scale 1. New Worlds Technology Development Program

Focused technology development for a coronagraph on WFIRST-AFTA; Strategic astrophysics technology (SAT) investments; Exoplanet probe mission concept studies; Partnership with NSF to develop extreme precision Doppler spectrometer as facility instrument; Exozodi survey using NASA-developed LBTI.



Progress Toward Decadal Survey Priorities

The NASA FY15 Appropriation, the President's FY16 Budget Request, and the notional out year budget planning guidance in the President's FY16 Budget Request, support:

Medium-scale 2. Inflation Probe Technology Development Program

Balloon-borne investigations; strategic astrophysics technology (SAT) investments.

Small-scale. Research Program Augmentations

Increased annual R&A budget by 10% from FY10 to FY12 and another 10% from FY14 to FY16. Within R&A: established Theoretical and Computational Astrophysics Networks (TCAN) program with NSF; funding available for astrophysics theory; funding available for lab astrophysics; funding available for suborbital payloads.

Small-scale. Intermediate Technology development Augmentation

Established competed Strategic Astrophysics Technology (SAT) program element; directed technology funding for WFIRST and other decadal priorities.

Small-scale. Future Ultraviolet-Visible Space Capability

Strategic Astrophysics Technology (SAT) investments.

Small-scale. SPICA (U.S. contribution to JAXA-led large infrared space telescope)

Not supported as a strategic contribution; candidate for Explorer Mission of Opportunity.



Astrophysics Timeline

Decadal Survey Mission
MIDEX/MO (AO NET 2016)
Euclid (ESA)
SMEX/MO (AO 2014)
JWST (ESA, CSA)
TESS
NICER
ASTRO-H (JAXA)
ST-7/LPF (ESA)
ISS-CREAM (South Korea)
SOFIA (DLR)
NuSTAR (ASI, Denmark)
Kepler
Fermi (DOE, Intl team)
Suzaku (JAXA)
Swift (ASI, UK)
Spitzer
XMM-Newton (ESA)
Chandra (SRON)
Hubble (ESA)

Early Science
Prime Mission
Extended Mission

TIMELINE CY 2000 2003 2006 2009 2012 2015 2018 2021 2024

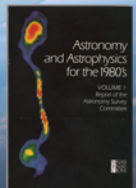
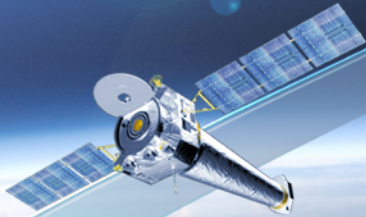
Dates beyond 2016 are contingent upon the results of the 2016 Senior Review

ASTROPHYSICS

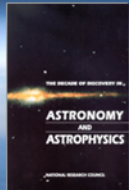
Decadal Survey Missions



1972
Decadal Survey
Hubble



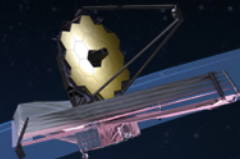
1982
Decadal Survey
Chandra



1991
Decadal Survey
Spitzer, SOFIA



2001
Decadal Survey
JWST

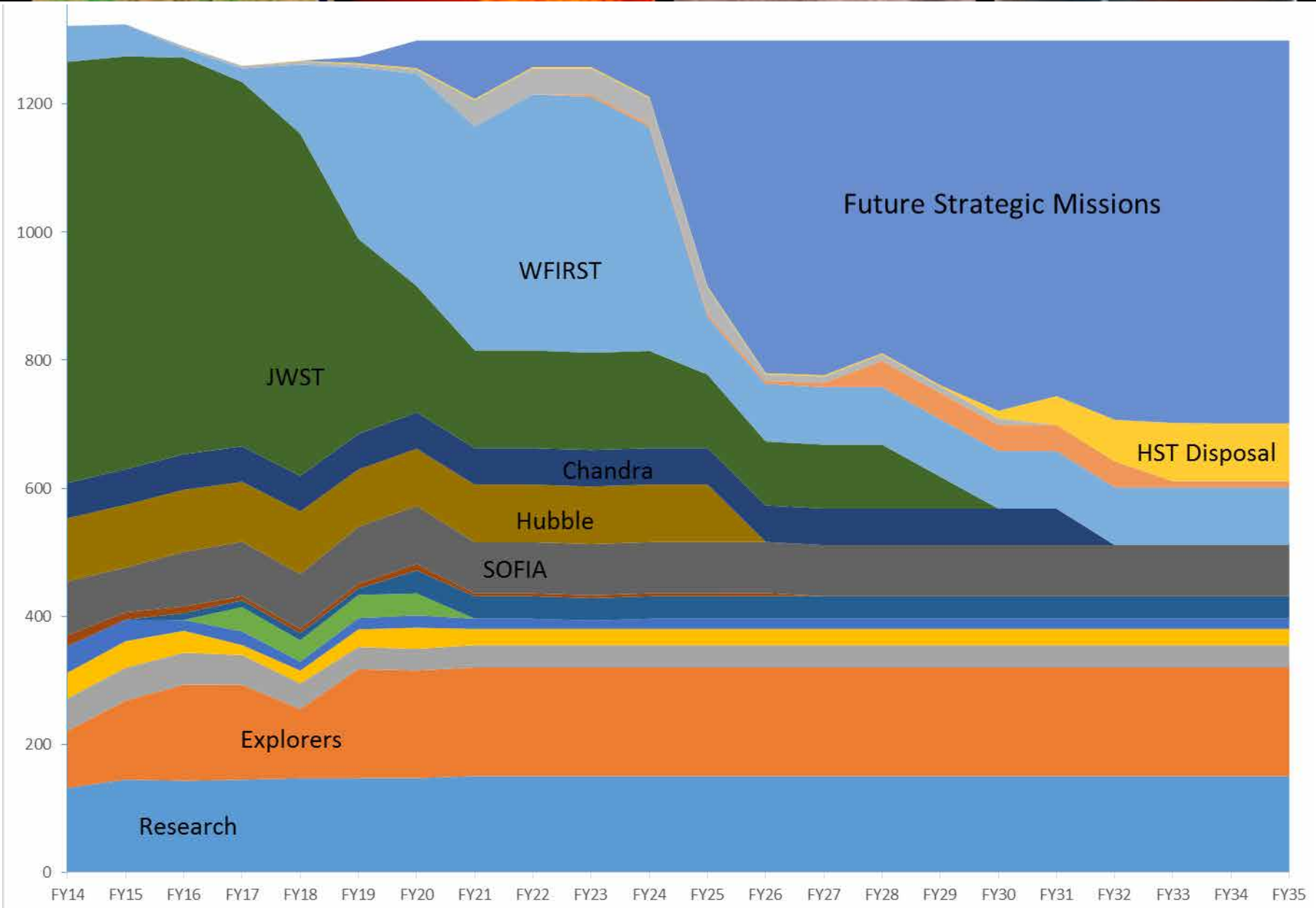


2010
Decadal Survey
WFIRST





20 Year Sandchart





Preparing for the 2020 Decadal Survey Large Mission Concepts

- Study 3-4 large mission concepts as candidate prioritized large missions
 - Science case
 - Technology assessment
 - Design reference mission with strawman payload
 - Cost assessment
- Charge to the PAGS (December 2014)
 - “I am charging the Astrophysics PAGs to solicit community input for the purpose of commenting on the small set [of large mission concepts to study], including adding or subtracting large mission concepts.”
- NASA Plan for Community Input
 - 2015: PAGs gather community input on selecting concepts for study
 - 2016: Appoint STDT and Center study office, STDT assesses technology
 - 2017: Fund technology development through SAT, STDT develops DRM
 - 2018: STDT submits DRM for cost assessment
 - 2019: STDT issues report and provides input to Decadal Survey



Preparing for the 2020 Decadal Survey Large Mission Concepts

Community workshops

- January 3, 2015: PAGs charged @ AAS, Seattle. All PAGs meet.
- February 10-11, 2015: ExoPAG SIG #1 meeting @ JPL, Pasadena
- March 10, 2015: COPAG Virtual Town Hall
- March 19, 2015: Joint PAG EC meeting @ STScI, Baltimore
- April 11-14, 2015: PhysPAG SIGs meet @ Am Phys Soc, Baltimore
- June 2, 2015: ExoPAG Virtual Meeting
- June 3-5, 2015: COPAG Far-IR Workshop @ Pasadena
- June 13-14, 2015: ExoPAG meeting @ AbSciCon, Chicago
- June 25-26, 2015: COPAG UV/Vis SIG meeting @ Greenbelt
- July 1, 2015: PhysPAG session @ HEAD Symposium, Chicago
- July 3, 2015: Joint PAG EC Chair telecon
- July 13, 2015: Joint PAG EC Chair telecon with Paul Hertz
- July 14, 2015: ExoPAG Virtual Meeting
- August 7, Joint PAG Splinter Session @ IAU GA, Honolulu
- August 18, 2015: ExoPAG Virtual Meeting
- August 20, 2015: COPAG Virtual Town Hall
- August 31, 2015: Joint PAG Present @ AIAA Space 2015 Pasadena
- October 7, 2015: Deliver reports to Hertz
- October 21-22, 2015: Astrophysics Subcommittee Meeting



Preparing for the 2020 Decadal Survey Large Mission Concepts

The initial short list (in alphabetical order):

- **FAR IR Surveyor** – The Astrophysics Visionary Roadmap identifies a Far IR Surveyor as contributing through improvements in sensitivity, spectroscopy, and angular resolution.
- **Habitable-Exoplanet Imaging Mission** – The 2010 Decadal Survey recommends that a habitable-exoplanet imaging mission be studied in time for consideration by the 2020 Decadal Survey.
- **UV/Optical/IR Surveyor** – The Astrophysics Visionary Roadmap identifies a UV/Optical/IR Surveyor as contributing through improvements in sensitivity, spectroscopy, high contrast imaging, astrometry, angular resolution and/or wavelength coverage. The 2010 Decadal Survey recommends that NASA prepare for a UV mission to be considered by the 2020 Decadal Survey.
- **X-ray Surveyor** – The Astrophysics Visionary Roadmap identifies an X-ray Surveyor as contributing through improvements in sensitivity, spectroscopy, and angular resolution.



Preparing for the 2020 Decadal Survey Thinking about Probes

- What was done 10 years ago?
 - Origins Probes Mission Concepts (2004)
 - ROSES call for quick (~9 month) paper concept studies
 - ~9 concepts selected in 2004; total ~\$1M (\$100K average)
 - Astrophysics Mission Concepts Study (AMCS; 2007)
 - ROSES call for ~1 year concept studies with mission design lab run
 - ~19 ASMC concepts selected in 2007; total \$13M (\$700K average)
 - Was this effective? Efficient? Appropriately impactful?
- Possibilities this time
 - Real mission concept studies
 - Just like we are doing for large mission concepts
 - How would we select them? Where does funding come from?
 - Paper mission concept studies, with or without mission design lab run
 - Just like AMCS or Origins Probes, but limited to Probes
 - Self selected, self funded
 - Anybody can submit a white paper to the 2020 Decadal Survey
- Awaiting input from the PAG reports

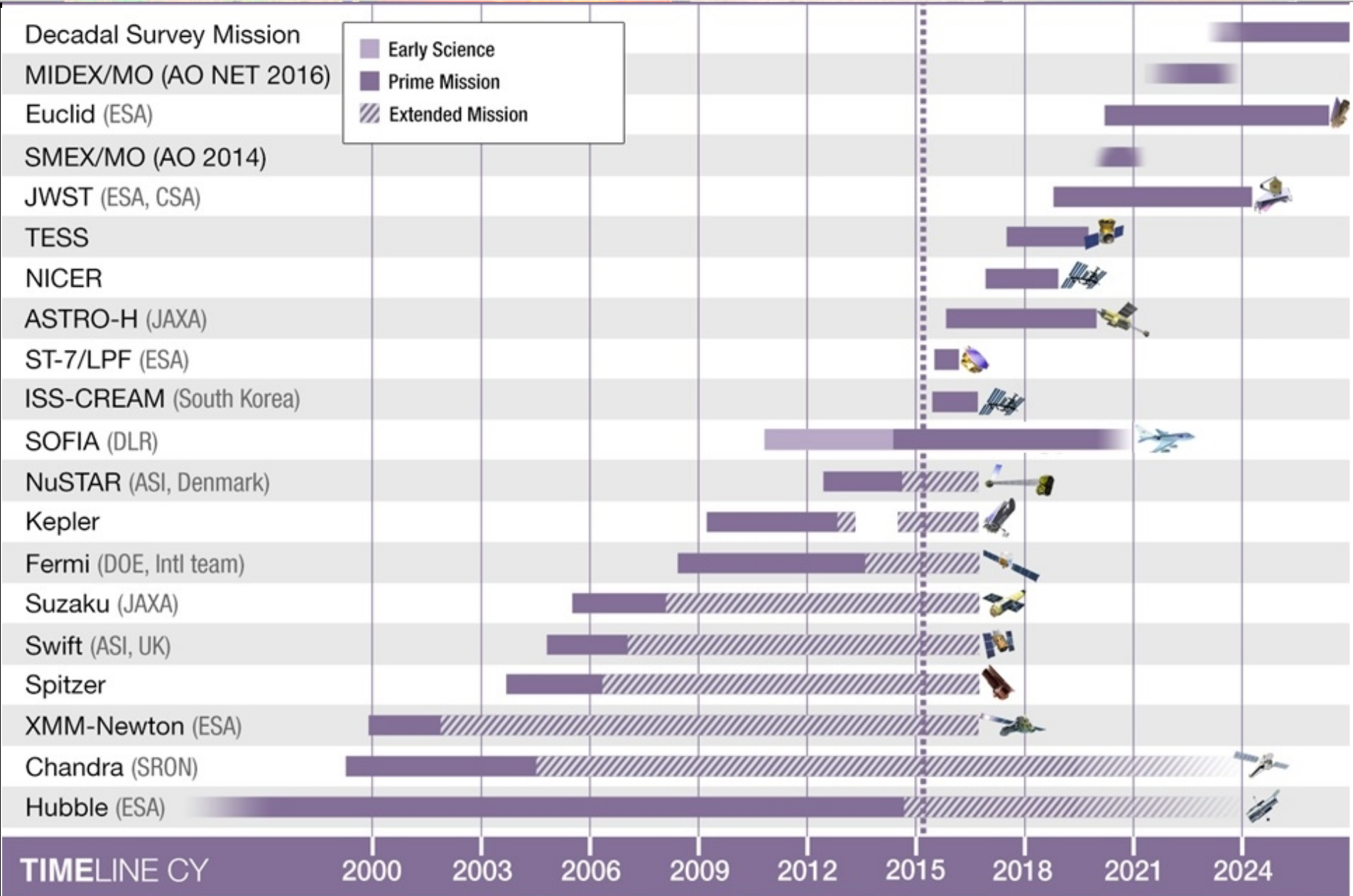


Preparing for the 2020 Decadal Survey Thinking about Probes

- Suggestion for the Decadal Survey: Recommend a Probe AO
 - Similar to Planetary Science Division's New Frontiers AO
 - Recent Probe-class missions include
 - Spitzer, Fermi, Kepler
 - New Horizons, JUNO, OSIRIS-Rex (New Frontiers missions)
 - Community identifies to the Decadal Survey mission concepts that could plausibly be done as Probes
 - Decadal Survey prioritizes a short list of mission concepts that should be accomplished on a Probe budget for the Probe AO
 - NASA issues a Probe AO and selects a Probe proposal that is responsive in a compelling manner to Decadal Survey identified science objectives for one of the mission concepts (determined by peer review) and can be accomplished as a Probe (determined by TMC review)
- Funding allotted to Probes "slows down" the large mission(s) that follow WFIRST
- NASA Astrophysics expects to announce a path toward Probe input for the Decadal Survey by the January 2016 AAS meeting



Astrophysics Timeline



Dates beyond 2016 are contingent upon the results of the 2016 Senior Review