Guidance to Astro2020

Statement of Task

The binding guidance is the Statement of Task

1. Provide an overview of the current state of astronomy and astrophysics science … ;
2. Identify the most compelling science challenges and frontiers in astronomy and astrophysics … ;
3. Develop a comprehensive research strategy to advance the frontiers of astronomy and astrophysics for the period 2022-2032 … The strategy should be balanced … ;
4. Utilize and recommend decision rules … that can accommodate … deviations in the projected budget or changes … precipitated by new discoveries or unanticipated competitive activities;
5. Assess the state of the profession ... Where possible, provide specific, actionable and practical recommendations to the agencies and community to address these areas. This report shall be made available following the completion of the study.

https://sites.nationalacademies.org/DEPS/Astro2020/DEPS_192912

Statement of Task

The Agencies consider the “Additional counseling for the Committee and staff as they carry out their work” to be part of the Statement of Task

Scope

- In: Ground/Space A&A, Observational/Theoretical/Computational/Laboratory/Archival A&A, Solar Astronomy (ground only), Gravitational Wave Observations, Multi Messenger Astrophysics, Exoplanets
- Out: Fundamental Physics, Dark Matter Direct Detection, Microgravity Research, Projects under construction (JWST, DKIST, LSST, DESI)
- Advise but do not rank: WFIRST, Athena, LISA

Considerations

- Future budget scenarios, Activities of all sizes, Programs of Record, Balanced Program, Other NASA capabilities, Technology needs, Cyber-infrastructure, Existing and proposed U.S. facilities, Non-Federal entities

Approach

- Recipients of advice, Composition of Committee, Use of Panels, Assembling Committee and Panels, Town Halls, Independent cost analysis, Unrealized activities from prior surveys, Binning recommended activities

https://sites.nationalacademies.org/cs/groups/ssbsite/documents/webpage/ssb_190177.pdf

Strategic Missions and Competed Missions

NASA science missions are generally initiated in two different ways

Strategic missions are initiated to respond to specific science objectives

- Mission architecture and acquisition strategy is tailored to the science objectives
- Project management is generally directed to a NASA Center
- Aspects of the mission may be competed through an AO (instruments), ROSES (science team, key science projects), or an RFP (spacecraft, integration and test)
- Can be any mission size: Flagship, Medium/Probe, International Contribution, or Small
- Astro2020 should recommend strategic missions

Competed missions are initiated through an AO

- AO solicits both the science objectives and the implementation plan (architecture, team)
- NASA selection of PI-led proposal is generally “take it or leave it”
- Can be any size except flagship, though only small (MIDEX, SMEX, MOs) are in the current astrophysics program
- Astro2020 should recommend competed programs, but not specific competed missions

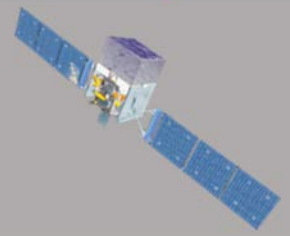
Full presentation to Astro2020 available on Astro2020 website

Program of Record

Supporting Research & Technology	**R&A**: ADAP, ATP, TCAN, XRP, Hubble Fellows, GO programs	**Technology**: APRA, SAT, Roman Fellows, Future flagship technologies	**Research support**: Keck, Balloon project, Astrophysics archives
Operating Missions	**Explorers**: Gehrels Swift, NuSTAR, NICER, TESS	**International Partnerships**: XMM-Newton	**Strategic Missions**: Hubble, Chandra, Spitzer, Fermi, SOFIA
Missions in Development or Under Study	**Explorers**: IXPE, GUSTO, SPHEREx, AO2019, AO2021, etc.	**International Partnerships**: Euclid, XRISM, Athena, LISA	**Strategic Missions**: Webb, WFIRST

Medium Mission Concepts (Probes)

Probes are strategic missions that have had a strong impact on astrophysics, either through a focused investigation or as a broadly-capable observatory

COBE 11/89 NASA Strategic Explorer	EUVE 06/92 NASA Strategic Explorer	Rossi XTE 12/95 NASA Strategic Explorer	GP-B 04/04 NASA Strategic Mission	Fermi 6/08 NASA Strategic Mission	Kepler 3/09 NASA Discovery Mission
					
Cosmic Background Explorer	Extreme Ultraviolet Explorer	Rossi X-ray Timing Explorer	Gravity Probe B The Relativity Mission	Fermi Gamma-ray Space Telescope	Kepler Space Telescope

NASA funded probe studies are available at https://science.nasa.gov/astrophysics/2020-decadal-survey-planning

Options for 2020 Decadal Survey

- Do not recommend a medium mission in Astro2020
- Recommend specific probe(s) as medium-size strategic missions
- Recommend several specific science concepts for an AO (New Frontiers)
- Recommend an unconstrained AO (Super-Explorer)

Why Flagships

Flagships drive science

Flagships drive US capabilities and contribute to US leadership

Flagships drive NASA budget and create stakeholder support

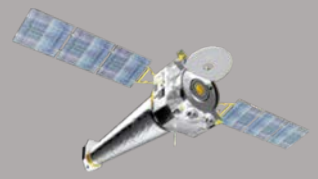
Hubble 04/90
NASA Great Observatory

Hubble Space Telescope

Compton 05/91
NASA Great Observatory

Compton Gamma Ray Observatory

Chandra 09/99
NASA Great Observatory



Chandra X-ray Observatory

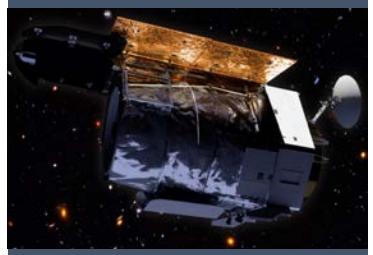
Spitzer 8/03
NASA Great Observatory

Spitzer Space Telescope

Webb 2021
NASA Mission

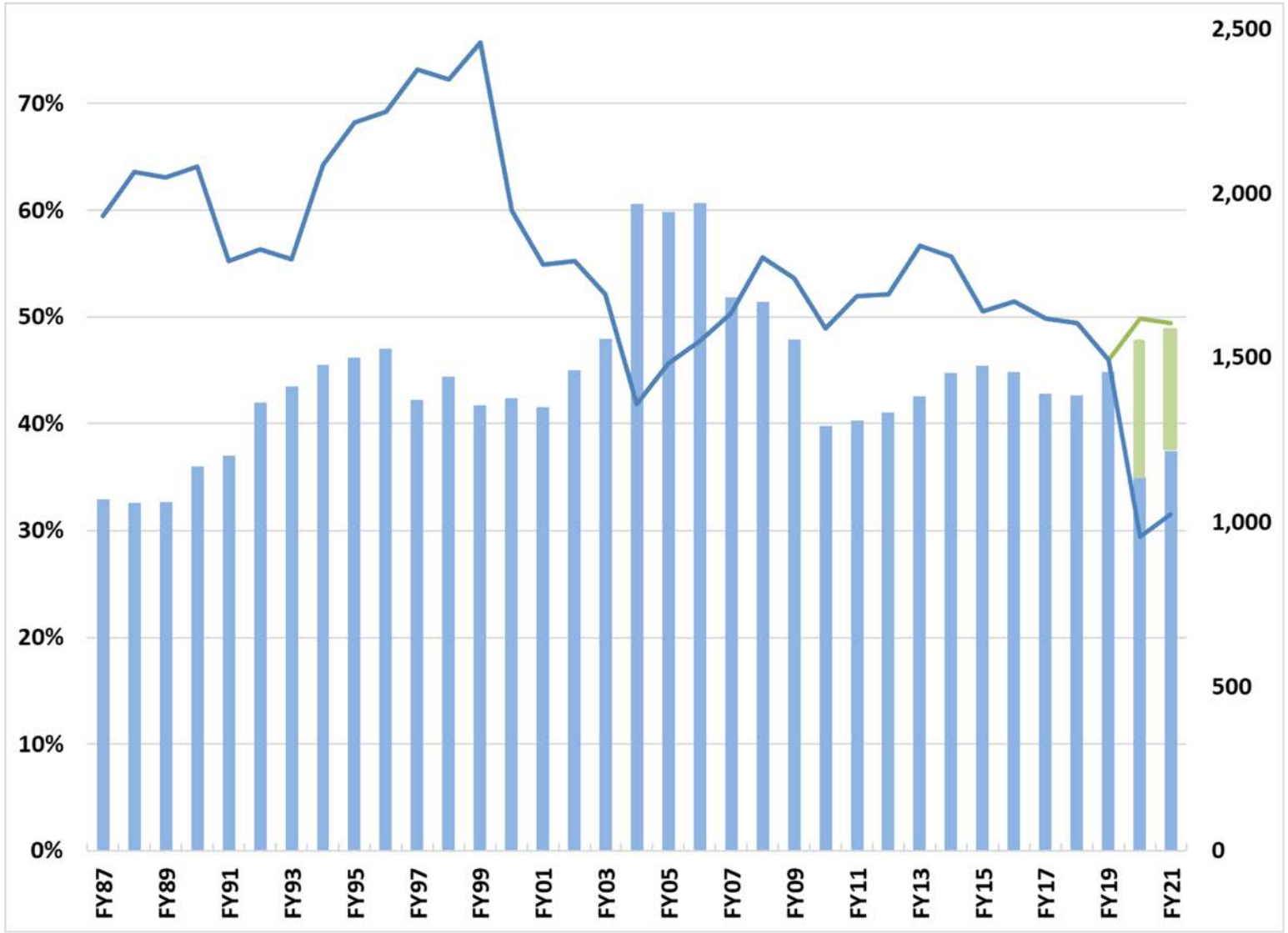
James Webb Space Telescope

WFIRST Mid 2020s
NASA Mission



Wide Field Infrared Survey Telescope

Flagship Fraction of Astrophysics Budget



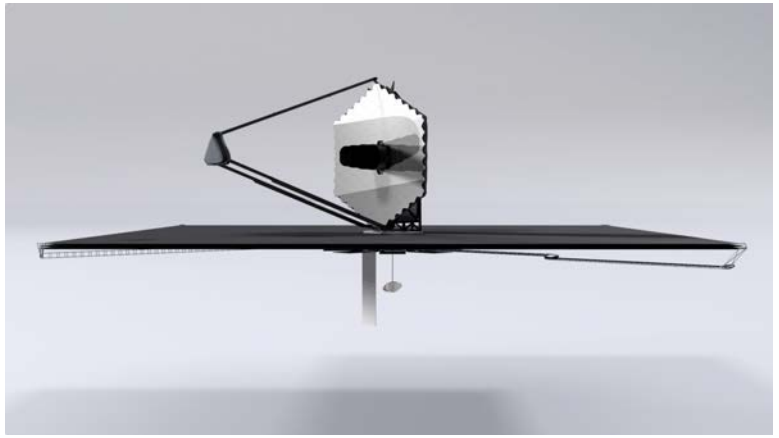
All dollars inflated to FY18$.
Development only, no ops.

- Large mission fraction (left scale)
- Inflation adjusted Astrophysics budget (right scale)
- Current planning budget (without WFIRST beyond FY19)
- What if WFIRST is funded as needed on top of FY20 President's Budget Request?

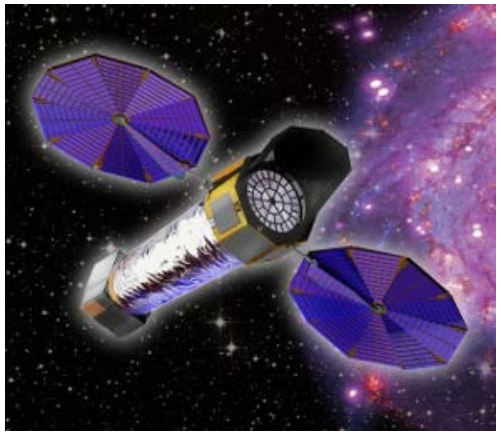
Large Mission Concepts

"NASA should ensure that robust mission studies that allow for trade-offs (including science, risk, cost, performance, and schedule) on potential large strategic missions are conducted prior to the start of a decadal survey. These trade-offs should inform, but not limit, what the decadal surveys can address." – Powering Science: NASA's Large Strategic Science Missions (NAS, 2017)

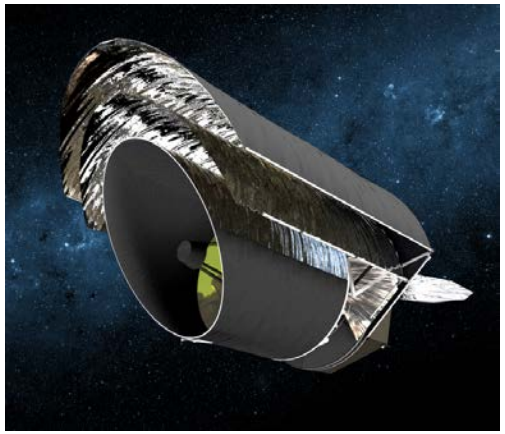
HabEx



LUVOIR

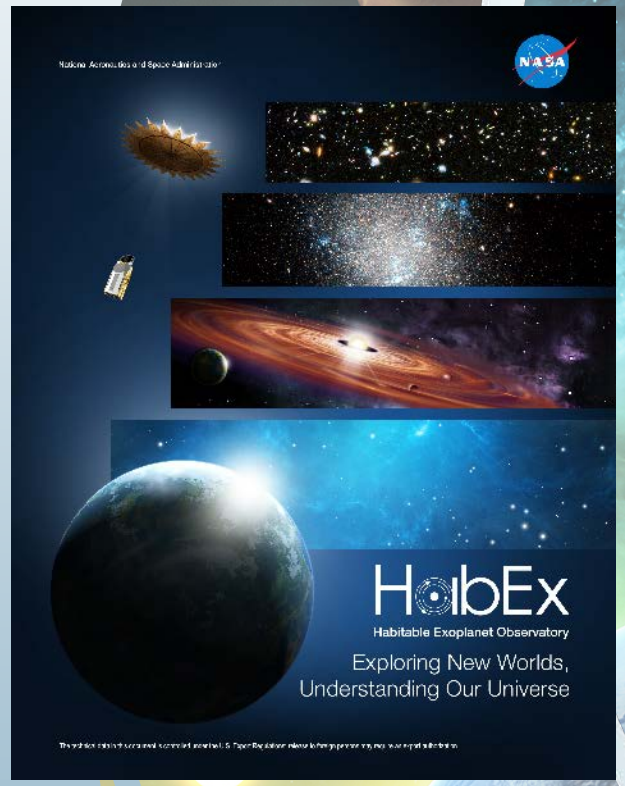


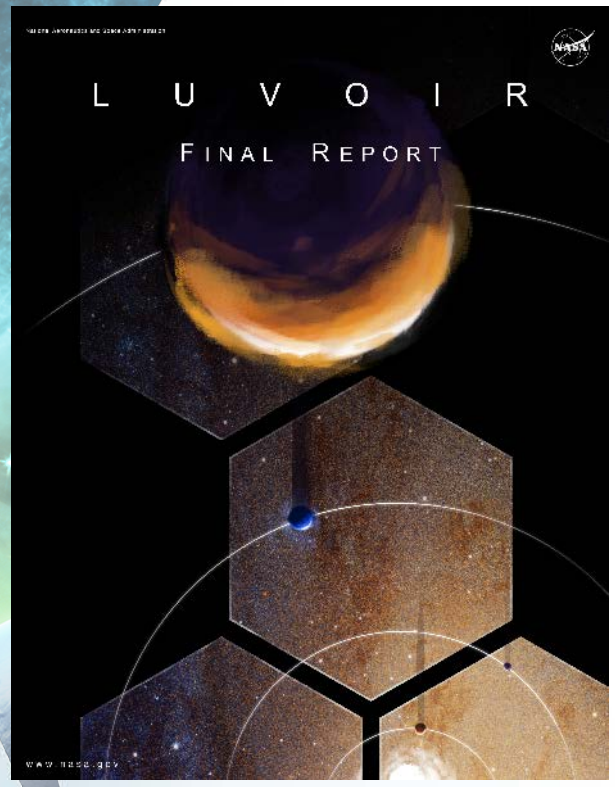
Lynx



Origins

Large Mission Studies





Links to the concept study reports are posted at
https://science.nasa.gov/astrophysics/2020-decadal-survey-planning
and at
https://www.greatobservatories.org/

Guidance on Future Budgets

All guidance is for Astrophysics including Webb Telescope

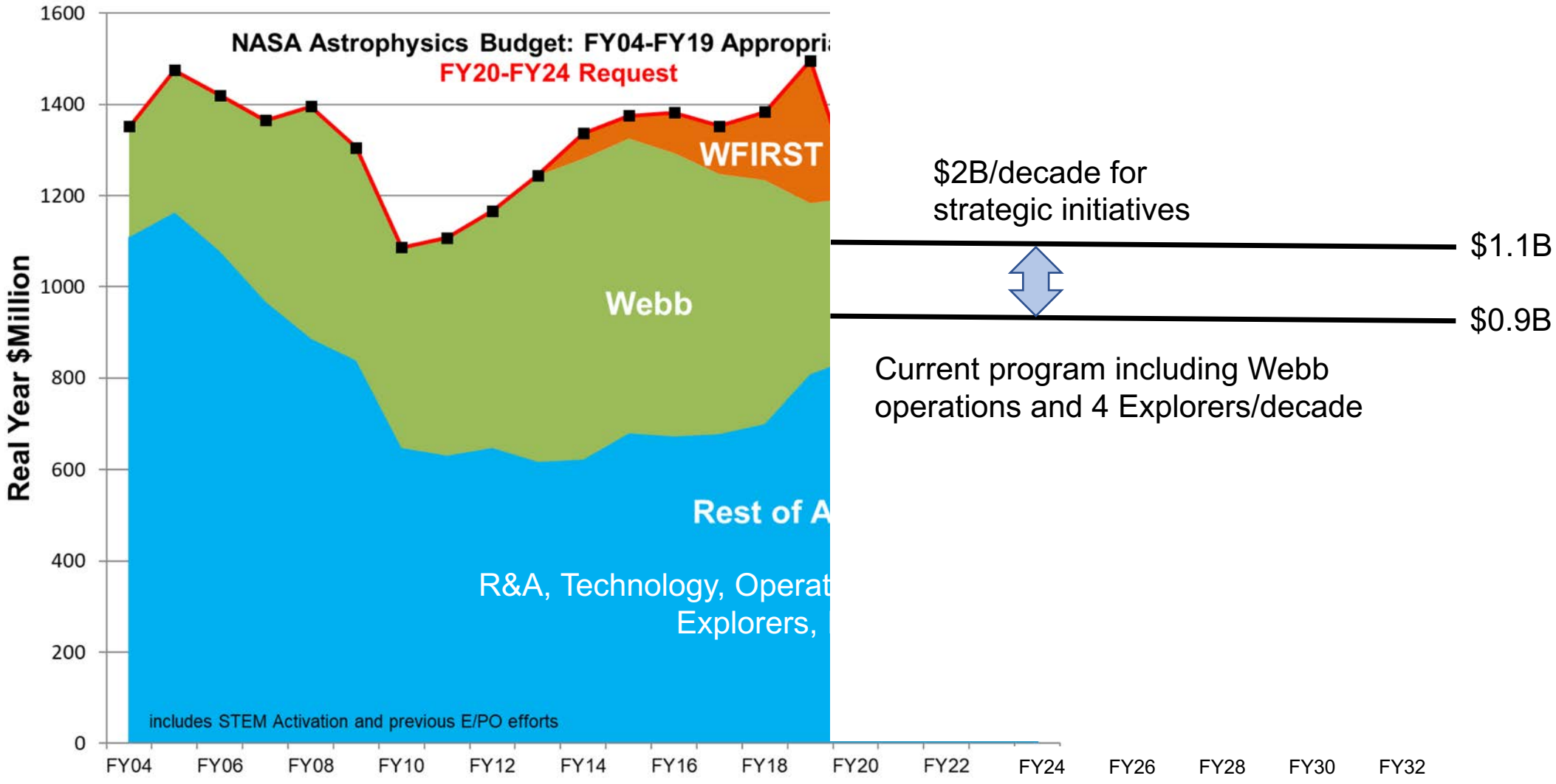
Lower bound budget projection – Extrapolation of out year planning numbers for President's FY20 budget request. Average of FY22-FY24 planning numbers is $1.1B/yr

Empirical budget projection – Extrapolation of recent NASA Astrophysics appropriations. Average of FY17-FY19 appropriations is $1.4B/yr

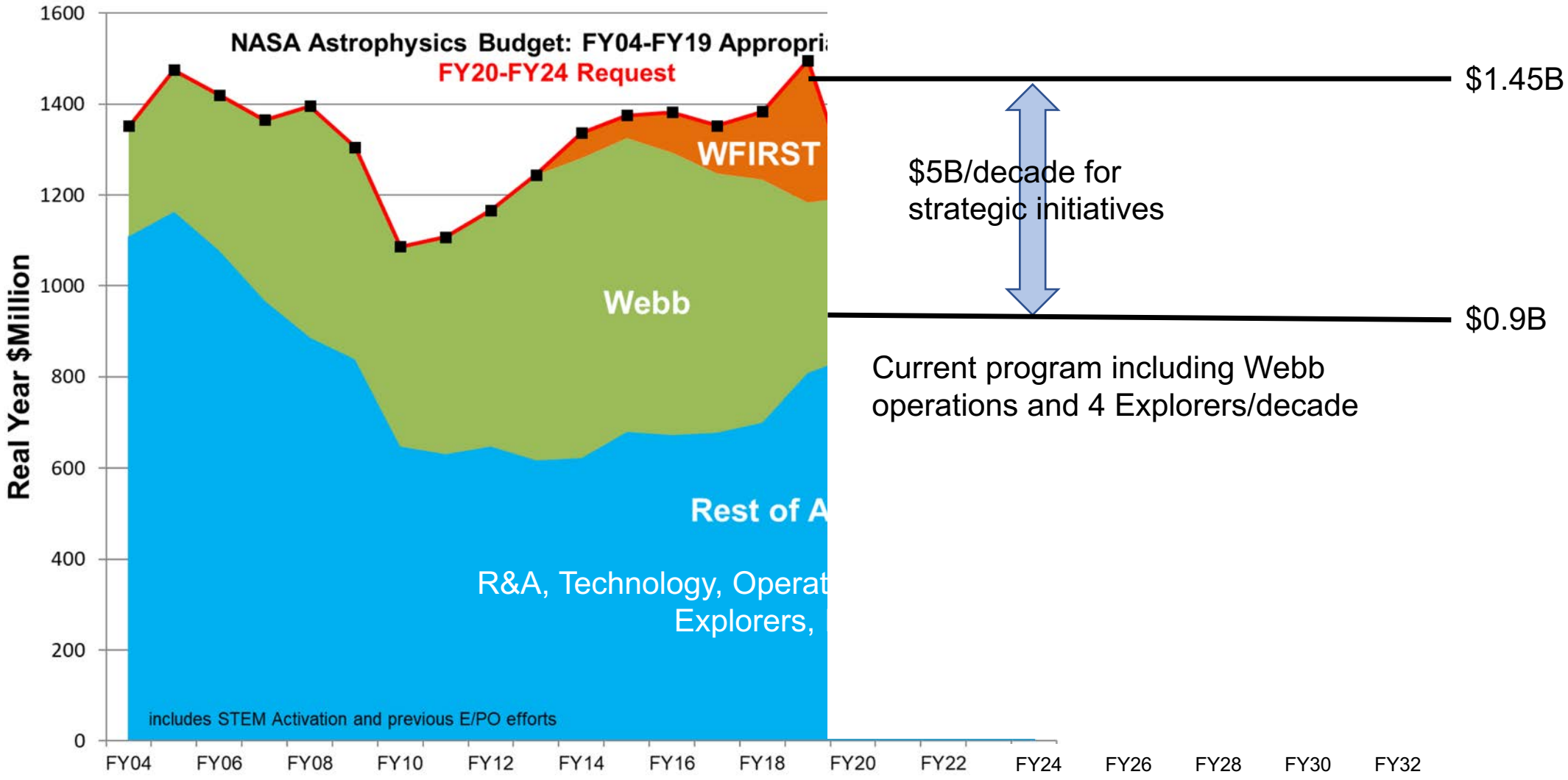
Optimistic budget projection – Empirical budget projection plus 1% inflationary growth in the out years. Budget grows from $1.5B (FY19) to $1.6B (FY25) to $1.7B (FY30)

Upper bound budget projection – Empirical budget projection plus 2% inflationary growth in the out years. Budget grows from $1.5B (FY19) to $1.7B (FY25) to $1.9B (FY30)

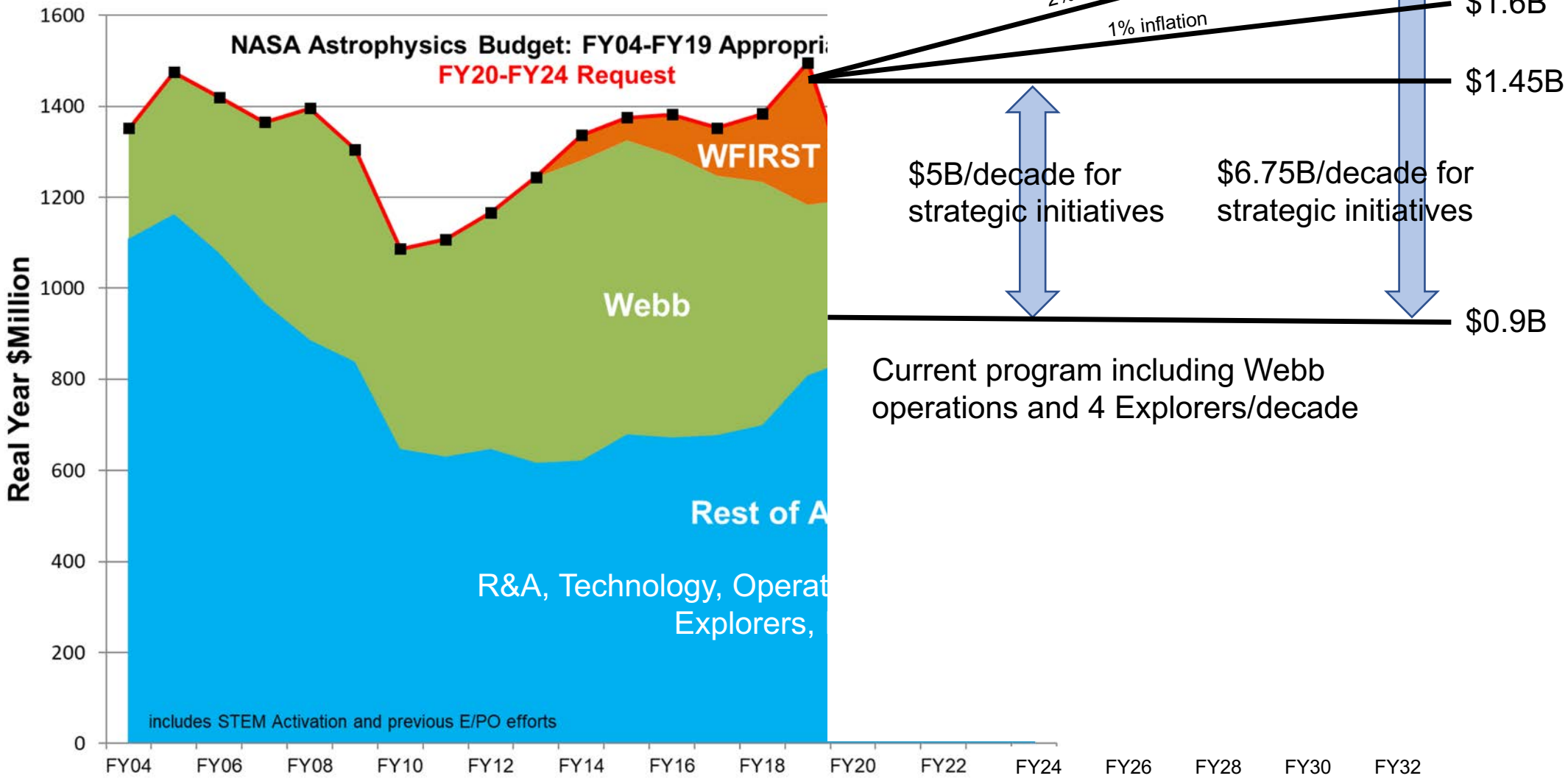
NASA Astrophysics Budget



NASA Astrophysics Budget



NASA Astrophysics Budget



Decadal Survey Goal

- NASA's highest aspiration for the 2020 Decadal Survey is that it be ambitious
  - The important science questions require new and ambitious capabilities
  - Ambitious missions prioritized by previous Decadal Surveys have always led to paradigm shifting discoveries about the universe
- If you plan to a diminishing budget, you get a diminishing program.
  - Great visions inspire great budgets.

Carpe Posterum