



National Aeronautics and
Space Administration

Preparing for Astro2030

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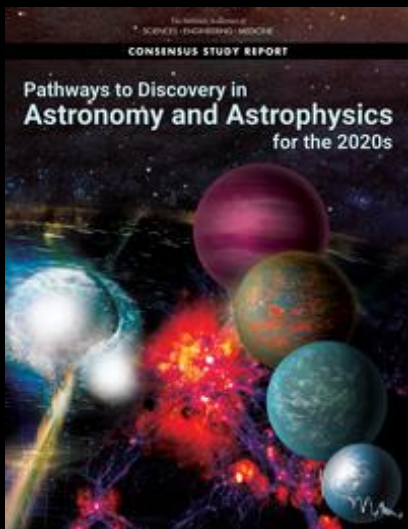


Decadal Survey Goals

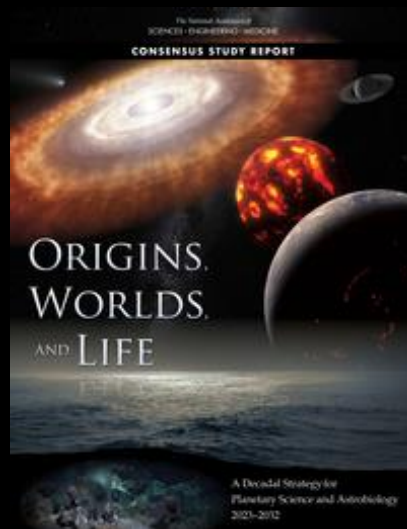
“...reach consensus on a visionary 10-year program to advance the highest-priority science.... A successful survey program also serves societal goals, resonates with the interests and curiosity of the public, motivates Congress, aligns with the initiatives of the executive branch, and fits within the fiscal constraints of the federal budget.”

– *The Space Science Decadal Surveys: Lessons Learned and Best Practices, 2015*

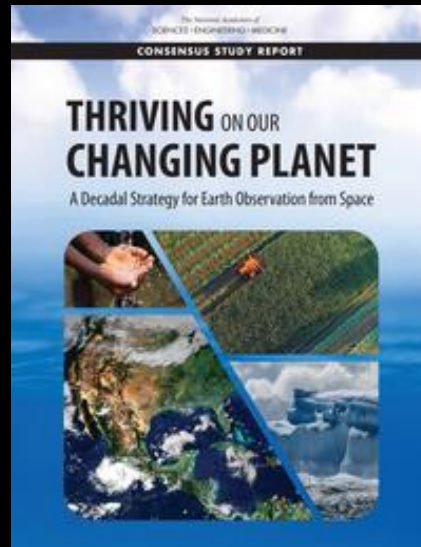
Astronomy & Astrophysics



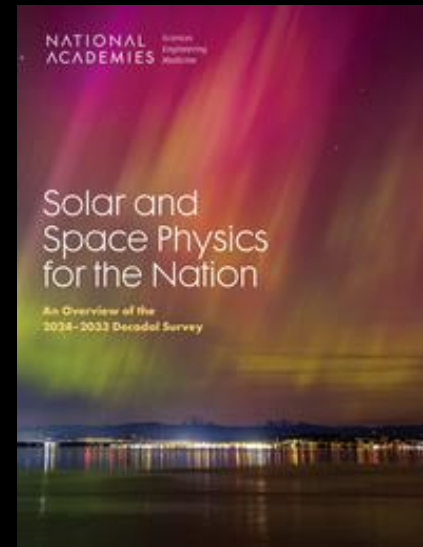
Planetary



Earth



Heliophysics



Biological & Physical Sciences



Decadal Survey Mission concepts are derived from a variety of sources, including:

- Concepts that were studied during prior decadal survey(s) that had not been selected or not survived Phase A study
- **Concepts that were studied by a community group or NASA center**
- New concepts that were brought to the decadal survey either in white papers from the community or community groups
- Novel concepts that evolved from discussions during meetings of the decadal survey panels.

– *The Space Science Decadal Surveys:
Lessons Learned and Best Practices, 2015*

**Planning for the 2020 Decadal Survey
An Astrophysics Division White Paper**

POC: Paul Hertz, Astrophysics Division Director (paul.hertz@nasa.gov)
January 4, 2015

A well informed prioritization by the 2020 Decadal Survey Committee requires that any large mission be studied sufficiently to provide, at a minimum, the following information for the consideration of the 2020 Decadal Survey Committee:

- Science case
- Design reference mission with strawman payload
- Technology development needs
- Cost requirements assessment

Overall Process

The process of developing the necessary science case and technical information for candidate large mission concepts may be described as a two-part process:

- Part A: Identification of a small set of candidate large missions, and
- Part B: Development of the science case and technical information for each member of the small set of candidate large missions.

The process planned for identifying a small set of candidate mission concepts is as follows.

1. A small set of notional large mission concepts will be nominated by the Director of the NASA Astrophysics Division. Nominated large mission concepts will be drawn from existing strategic planning studies: *New Worlds, New Horizons in Astronomy and Astrophysics* and *Enduring Quests, Daring Visions*.
2. Each of the three astrophysics Program Analysis Groups (PAGs: Cosmic Origins PAG³, Exoplanet Exploration PAG⁴, Physics of the Cosmos PAG⁵) will solicit community input to modify the starting set of mission concepts by adding or subtracting large mission concepts. The PAGs will consider what set of mission concepts should be studied to advance astrophysics as a whole; there is no desire for mission concepts to be identified as “belonging” to specific Programs or PAGs. E by the NAC Astrophysics Subcommittee; the coordinated or joint reports.
3. At its fall 2015 meeting, the NAC Astrophysics reports and suggest to NASA a consolidated
4. The Director of the NASA Astrophysics Division will be studied as input for the 2020 Decadal Astrophysics Subcommittee will inform this likelihood that the 2020 Decadal Survey Commission strategic mission to follow JWST and WFIRST

Part A: Identification of mission concepts for study

It is not necessary to start from a blank sheet of paper to identify the community's highest priority mission concepts for the coming decades. The community has invested considerable resources in discussing notional mission concepts for consideration as large missions following JWST and WFIRST.

The 2010 Decadal Survey, *New Worlds New Horizons in Astronomy and Astrophysics*¹, provides advice to NASA on technology investments that should be made to enable consideration of missions by future NRC studies, including the 2020 Decadal Survey.

The 2014 NASA Visionary Roadmap, *Enduring Quests, Daring Visions*², provides multiple notional missions in the so-called formative era which have been identified as the missions required to advance NASA's strategic objective in astrophysics, as well as the science goals of the 2010 Decadal Survey, in the period beyond the current decade.

In 2015, The Director tasked the Astrophysics' Program Analysis Groups (PAGs) to conduct a community discussion on possible concepts using existing strategic documents.

November 2015 the PAGs presented their findings to the Astrophysics Advisory Committee (APAC), who recommended four candidate mission concepts to APD for further study.

- LUVOIR (Large UV/O/IR Surveyor)
- HabEx (Habitable Exoplanet Imager)
- Origins Space Telescope (Far-IR Surveyor)
- Lynx X-ray Observatory (X-Ray Surveyor)

The final STDT deliverable, the final reports, were submitted to HQ on August 23, 2019, 4.5 years after the start of the Studies.



The PAGs also recommended studies for mid-size mission concepts (“Probes”, defined as missions with cost < \$1B).

The following Probe proposals were selected by APD, based on the peer review:

1. AXIS: A High Spatial Resolution X-ray Probe Satellite, PI: R. Mushotzky (Univ. of Maryland)
2. CDIM, Cosmic Dawn Intensity Mapper, PI: A. Cooray (Univ. of California, Irvine)
3. CETUS, Cosmic Evolution through UV Spectroscopy, PI: W. Danchi (NASA Goddard Space Flight Center)
4. EarthFinder: A Diffraction-Limited Precise Radial Velocity Observatory in Space, PI: P. Plavchan (Missouri State Univ.)
5. GEP, Galaxy Evolution Probe, PI: J. Glenn (Univ. of Colorado)
6. PICO, Probe of Inflation and Cosmology, PI: S. Hanany (Univ. of Minnesota)
7. POEMMA, Probe Of Extreme Multi Messenger Astrophysics, PI: A. Olinto (Univ. of Chicago)
8. Starshade Rendezvous, PI: S. Seager (Massachusetts Institute of Technology)
9. STROBE-X: X-ray Timing and Spectroscopy on Dynamical Timescales from Microseconds to Years, PI: P. Ray (Naval Research Laboratory)
10. TAP, Transient Astrophysics Probe Concept Study, PI: J. Camp (NASA Goddard Space Flight Center)

2020 Astrophysics Decadal Survey: A new model for NASA
-Rita M. Sambruna

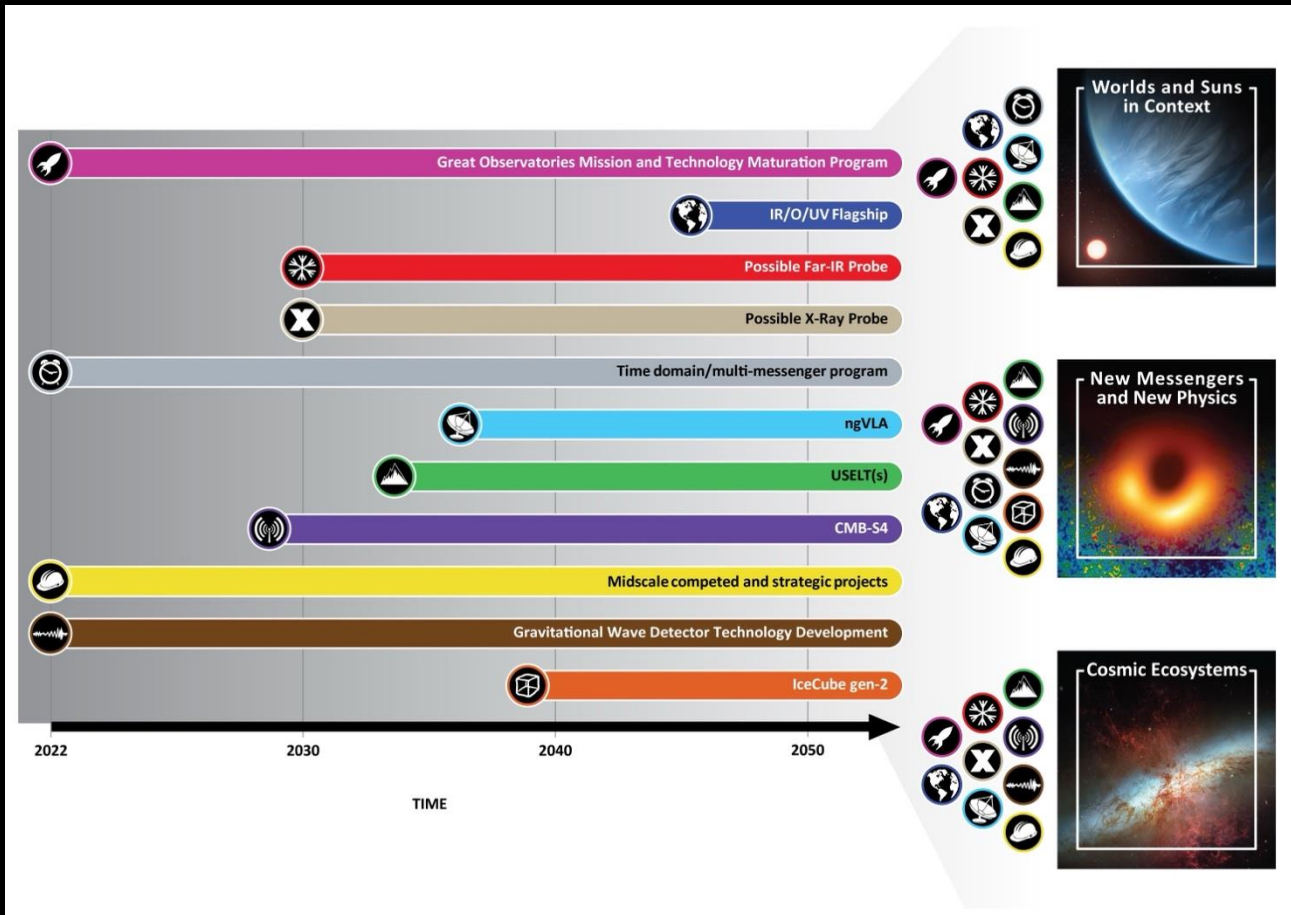
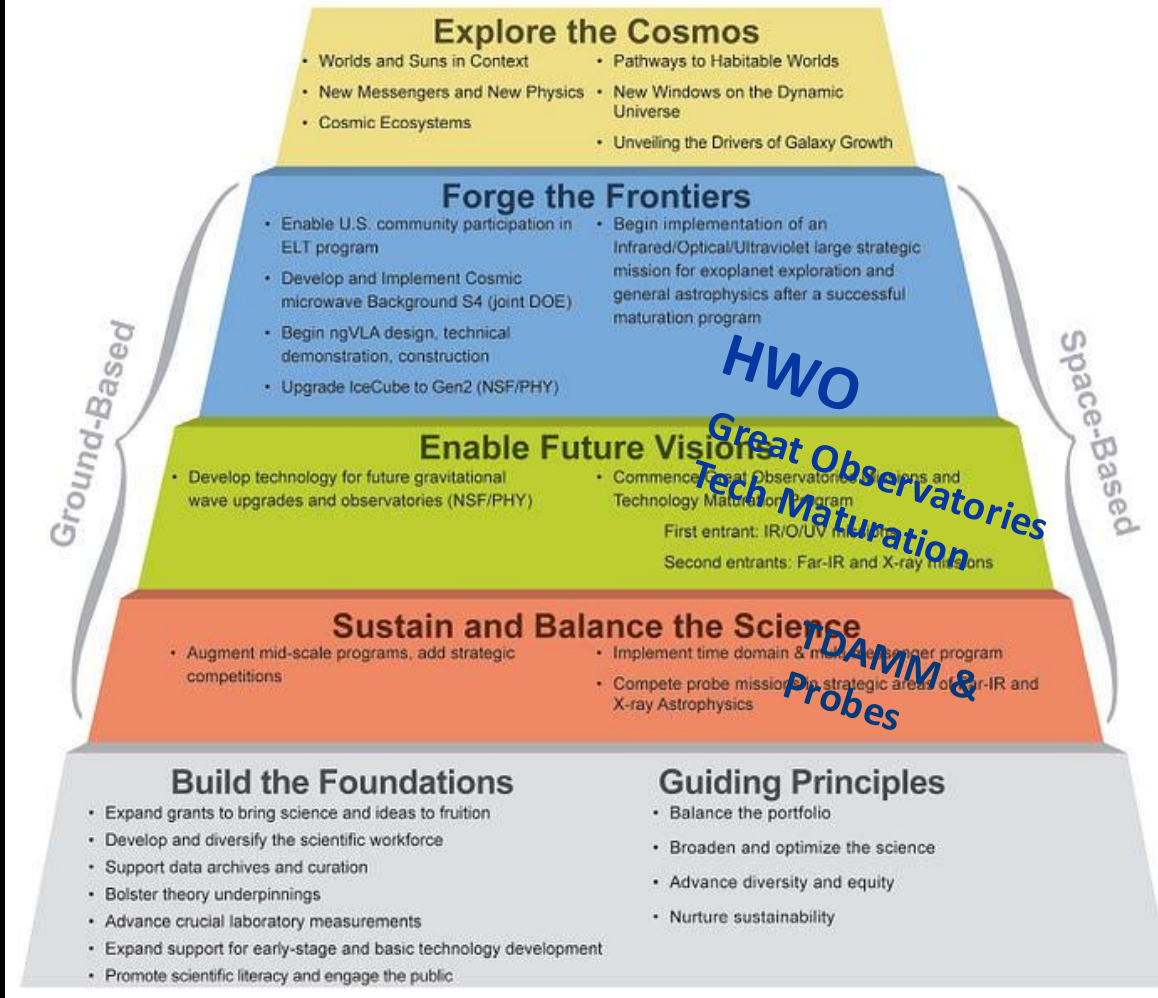


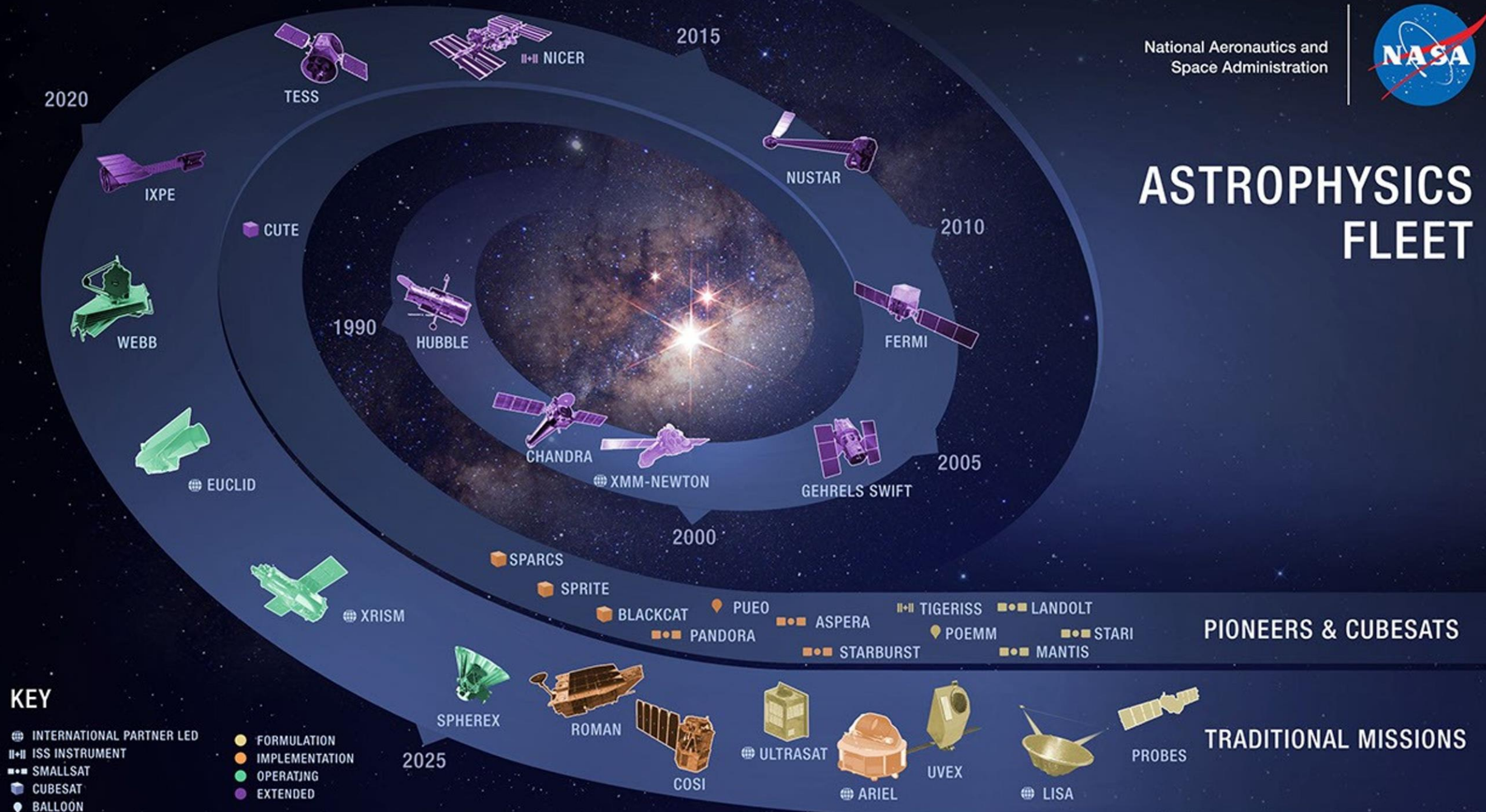
Figure S.1 from the 2020 Decadal survey report.

Realizing the Astro2020 Program: Pathways From Foundations to Frontiers

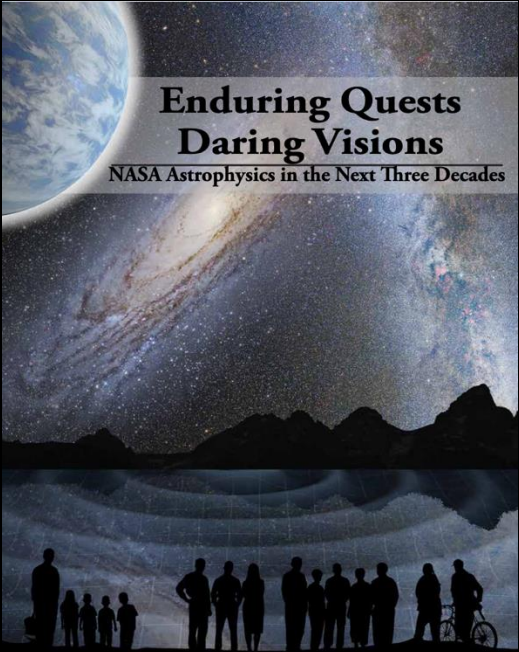


Astro2020 decadal survey includes a variety of initiatives and pathways, ensuring a successful long-term and short-term future for astronomy and astrophysics. (Credit: NAS/Astro2020)

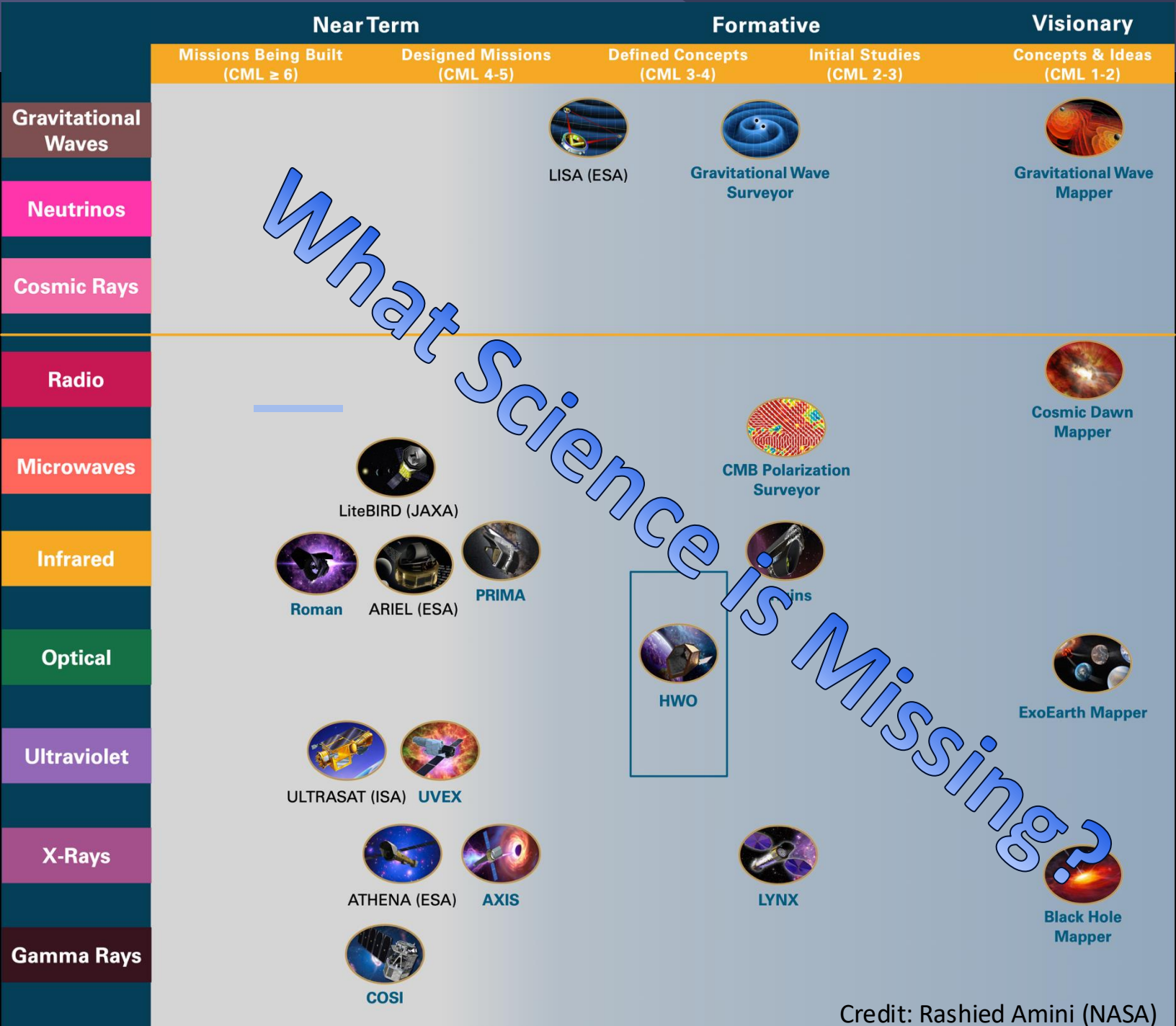
ASTROPHYSICS FLEET



Astrophysics Roadmap & The Ever-Changing Space Environment



Released in 2014

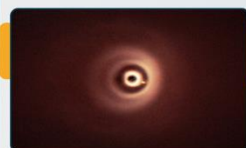


Credit: Rashied Amini (NASA)

Present



The Exoplanet Zoo



What Are Exoplanets Like?



The Search for Life

HST

JWST

TESS

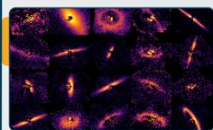
CUTE

Science Theme

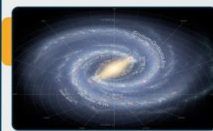
Cosmic Origins

Missions

Present



Stars & Planets



Local Galaxies



Black Holes



History of Galaxies

HST

Chandra

JWST

SphereX

Discover near

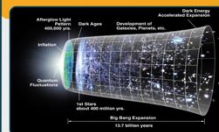
Map the entire

Find the first

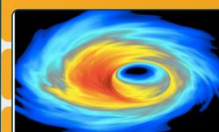
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Physics of the Cosmos Science Theme

Present



Origin & Fate of the Universe



Cosmic Extremes



Listening to the Cosmos

HST

IXPE

Chandra

JWST

Swift

XRISM

Fermi

SphereX

NuSTAR

NICER

Near Term

Measure dark energy & history of cosmic growth

Probe the epoch of inflation

Completely characterize the Cosmic Microwave Background (CMB)

Measure cosmic expansion history with standard sirens

Constrain neutron star equation of state

Understand black hole-powered engines

Measure black hole masses & spins

Map black holes using gravitational waves (GW)

Image sources detected by aLIGO

Chart super massive black hole mergers

Search for Electroweak Era gravitational waves

Hear the Big Bang

ASPERA

Roman

BlackCAT

Starburst

LUSSE-Night

TIGERISS

SPRITE

UVEX

COSI

AXIS

CMB
Polarization
Surveyor

Lynx

Origins

GW
MapperCosmic
Dawn
MapperBlack Hole
Mapper

Informing Concepts to be studied:

- Existing and Planned International Mission Portfolio
- Current Commercial & Space-Based Mission Environment
- Existing Strategic Documents (Astro2020 and submitted CSRs, Astro Roadmap , etc...)
- On-Going Studies (e.g., SAGs and NASA Center Independent Studies, ...)
- Probe Selection
- Mid-Decadal
- Workshop on Innovation for Astrophysics Missions
Rita Sambruna (NASA, GSFC)
- Astro2030 Decadal Survey Preparation Community Workshop
David Ardila (NASA, Exoplanet Exploration PO)

- **FIG SAG** co-chaired by Michelle Hui (MSFC), Christopher Lee Fryer (LANL), Paolo Coppi (Yale), Milena Crnogorcevic (U. Stockholm) , Tiffany Lewis (Michigan Tech), Marcos Santander (U of Alabama), Zorawar Wadiasingh (U. Maryland/GSFC)
- **Lynx2030 SAG** co-chaired by Steven Ehlert (MSFC) and Fabio Pacucci (CfA)
- **Hi-ReX SAG** co-chaired by Breanna Binder (Cal Poly Pomona), Herman Marshall (MIT), Mark Schattenburg (MIT), and Kim Weaver (GSFC)
- **BBX SAG** co-chaired by Chien-Ting Chen (MSFC), Kristin Madsen (GSFC), and Daniel Stern (JPL)
- **CMB SAG** co-chaired by Thomas Essinger-Hileman (GSFC), Brendan Crill (JPL), Shaul Hanany (U. Minn)
- **Foundations for Discovery: A Coordinated Fleet Approach to NASA Astrophysics** – GSFC Science Task Group (Regina Caputo)



APD PoCs

**Mid-Decadal
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**Astro2030
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