

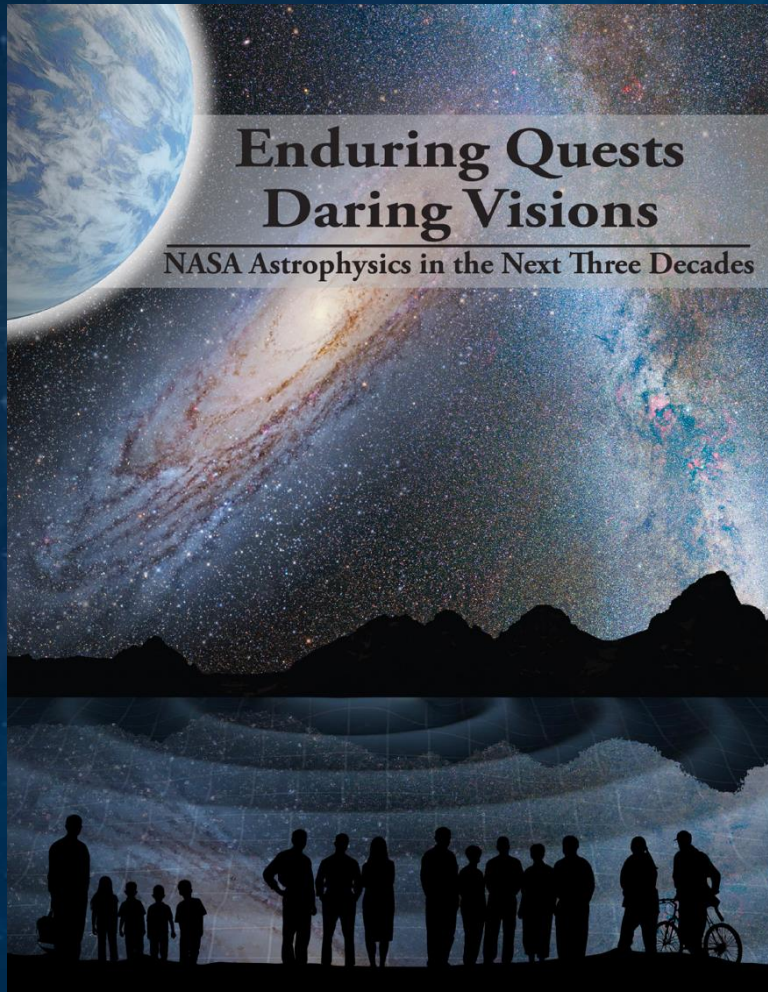
The NASA 2020 Decadal Planning

Rita M. Sambruna

NASA's Goddard Space Flight Center

Rita.m.Sambruna@nasa.gov

'twas the year 2013...



Enduring Quests – Daring Visions

NASA - Astrophysics Division Roadmap

The Roadmap team

Chryssa Kouveliotou, *Chair*

Eric Agol

Natalie Batalha

Jacob Bean

Misty Bentz

Neil Cornish

Alan Dressler

Scott Gaudi

Olivier Guyon

Dieter Hartmann

Enectali Figueroa-Feliciano

Jason Kalirai

Mike Niemack

Feryal Ozel

Chris Reynolds

Aki Roberge

Kartik Sheth

Jonas Smuidzinas

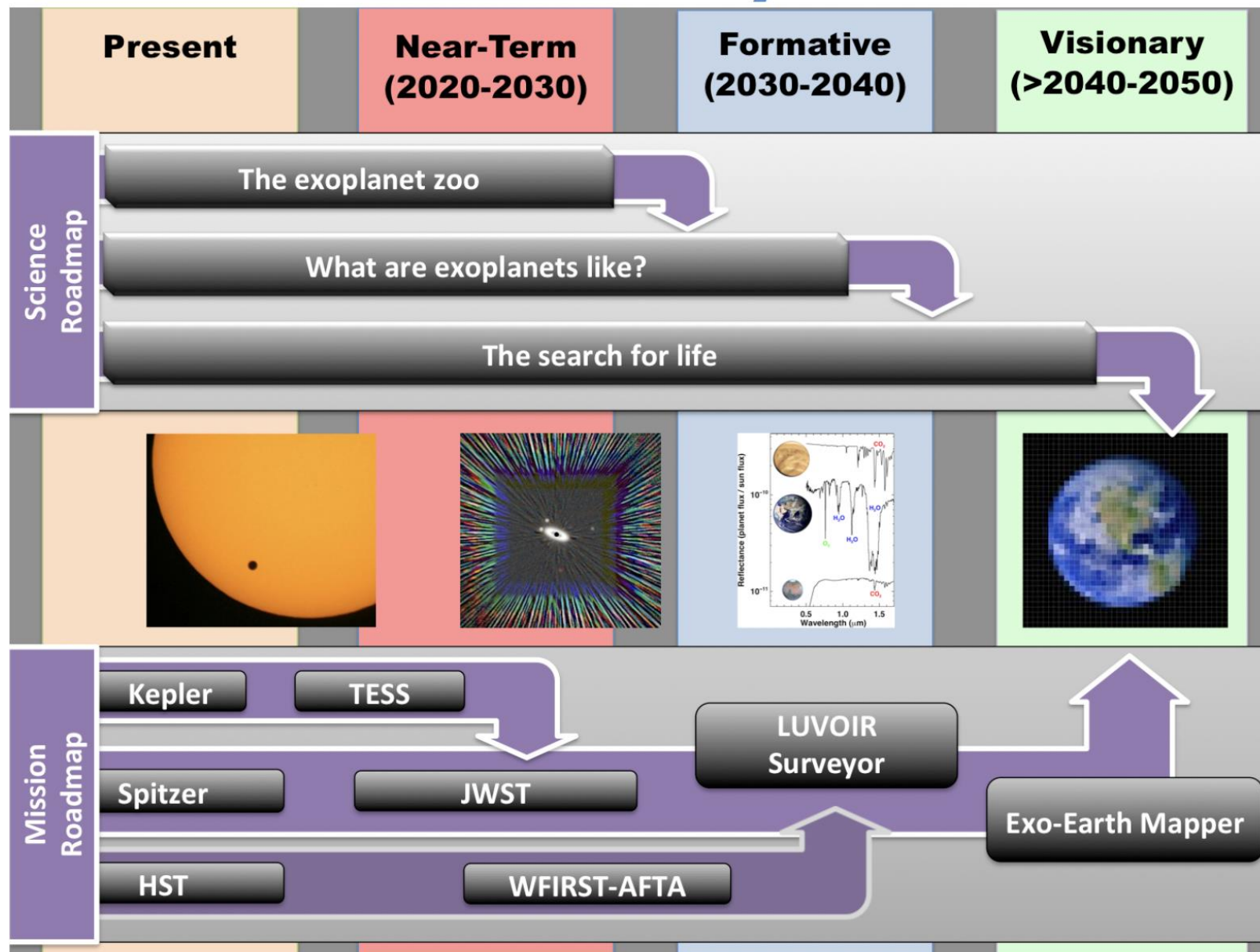
Amber Straughn

David Weinberg

Brad Peterson, *APS Chair*

Joan Centrella, *APS Exec Sec*

Activities by Era



Rethinking Decadal Survey Planning

- To avoid historical cost overruns and inaccurate risk assessments, in 2014 NASA proactively funded community-led, center-supported concept studies to provide the National Academy of Sciences (NAS) with mature, credible reference designs.
- **Rationale:**
 - Past Decadal Surveys suffered from immature, poorly costed mission concepts.
 - 2010 Decadal: Probe-class concepts failed largely due to a lack of detailed design, leading to unfavorable costing by independent contractors.
 - Flagship Challenges: High-profile cost growth and schedule delays (e.g., JWST) created a need for transparent, realistic pre-Phase A data.
 - Need for independent cost credibility reviews for A2020 concepts

Strategy

- **Community-driven process (Centers, academia, industry):**
 - **Flagships:** Derived from the 2013 *Enduring Quests, Daring Visions* roadmap and 2010 Decadal recommendations, then vetted through Program Analysis Groups (PAGs), CAA, and APAC.
 - **Probes:** PAG provided input for viability of science. ROSES-2017 solicitation yielded 27 proposals, peer reviewed; 10 PI-led concept studies were selected across diverse astrophysics disciplines.
 - Trade-off study CML vs. breadth of science topics

Independent Evaluation & Review Framework

- **Flagship Reviews (LRT & LCIT):**

- **Large Mission Concept Studies Report Team (LRT):** Evaluated 2018 Interim Reports to ensure teams were on track for CML 4.
 - This report went to study teams
- **Large Mission Concept Studies Independent Team (LCIT):** External experts reviewed in 2019 draft final reports, pressure-testing science-to-requirement traceability and cost credibility.
 - This report went to the Decadal

- **Probe Reviews (PCAT):**

- **Probes Cost Assessment Team (PCAT):** Conducted a high-level "sniff test" to determine if concepts could realistically be executed under \$1B.
- Reconciled PI grassroots estimates with independent center estimates (GSFC RAO and JPL CEPS).

Flagship Governance & Technical Maturity

- **Community-Led Architecture:**

- Four Science and Technology Definition Teams (STDTs) comprised of ~18 community members, co-chaired by community and Center study scientists, and paired with NASA Center engineering leads.
- GSFC oversaw LUV0IR and Origins; MSFC oversaw Lynx; JPL oversaw HabEx.

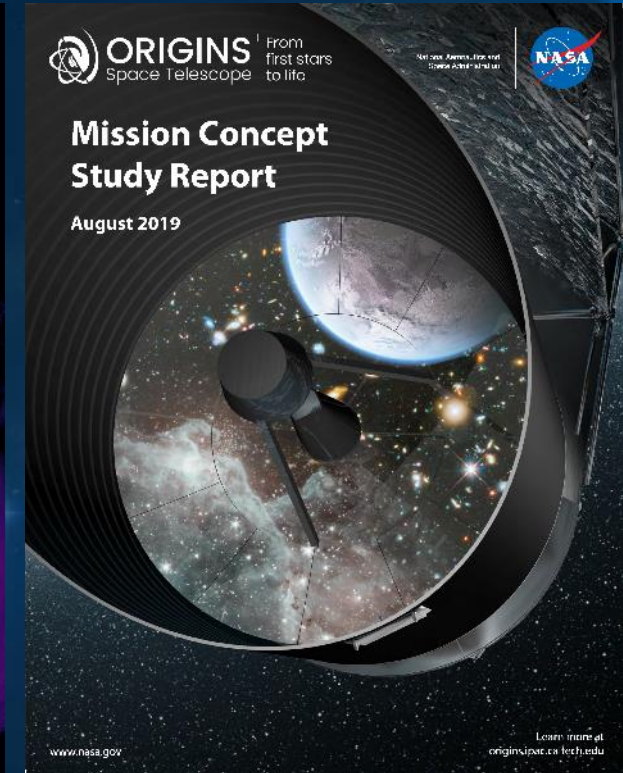
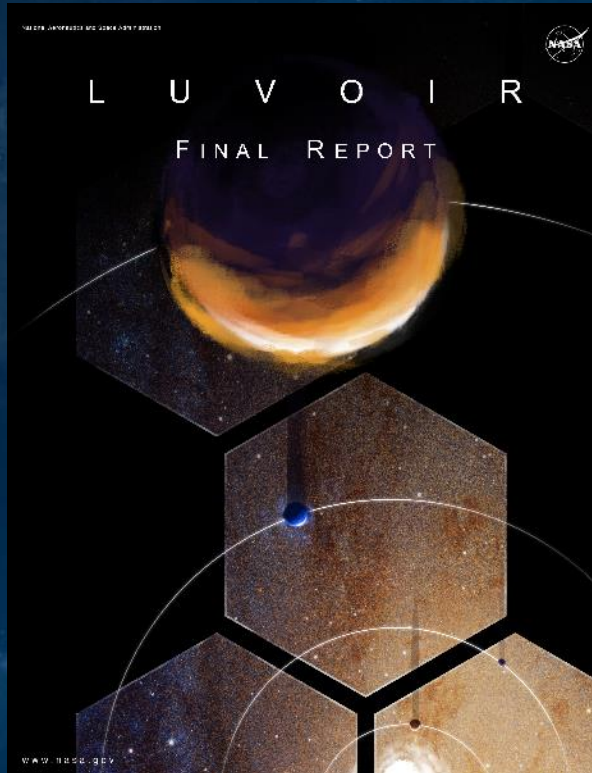
- **Mandating Concept Maturity Level 4 (CML 4):**

- HQ required studies to hit tailored CML 4 standards.
- **Deliverables required for Decadal:** Master Equipment Lists (MELs), top-level science requirements, architectural block diagrams, power/mass estimates, and Advanced Technology Development (ATD) roadmaps.

- **Governance Structure:**

- Managed via HQ's Decadal Studies Management Team (DSMT).
- Bi-annual "Pause & Learn" meetings brought all teams together to share resources, preventing counterproductive competition.

Large Mission Concept 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/>

Flagships: What went well?

- Early start
- Enthusiastic community response (PAGs engagement, STDs nominations, attendance to decadal sessions at AAS, etc.)
- Unbelievable support from NASA Centers and Industry
- Buy-in from SMD Front Office, other SMD Divisions, OMB
- Transparent process
- Substantial funding from NASA HQ, supplemented by funding from Centers and industry
- Independent NASA validation
- Ability of the Teams to work together (after initial differences) – e.g., HabEx and LUVOIR
- International observers and later partners in selected missions
- Strong integration between community scientists, Center engineering teams, and industry consortia.
- Allowing architectures to evolve mid-study (e.g., Origins redesigning to a lower-risk Spitzer-like architecture) created far better, more cost-credible products.

Flagships: What could be improved?

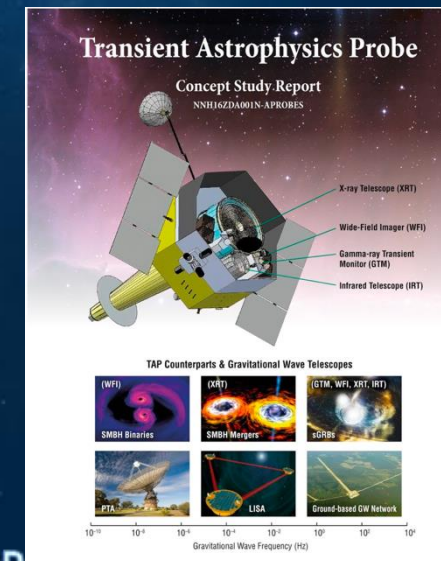
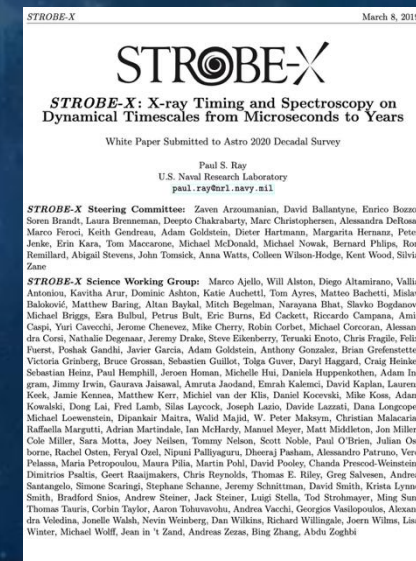
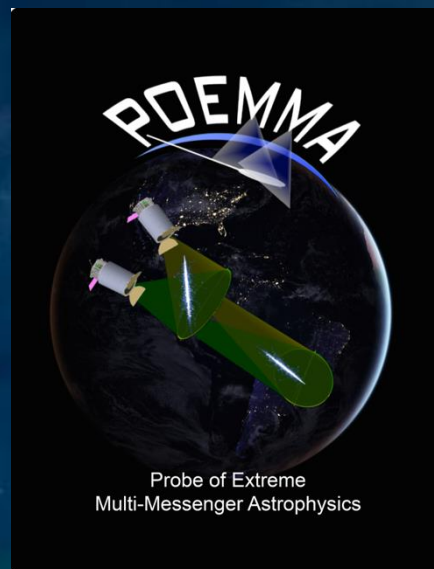
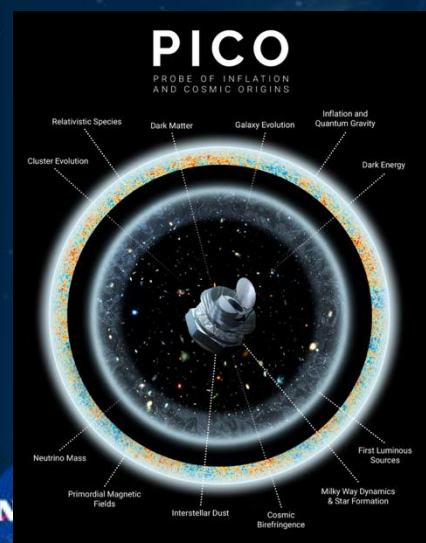
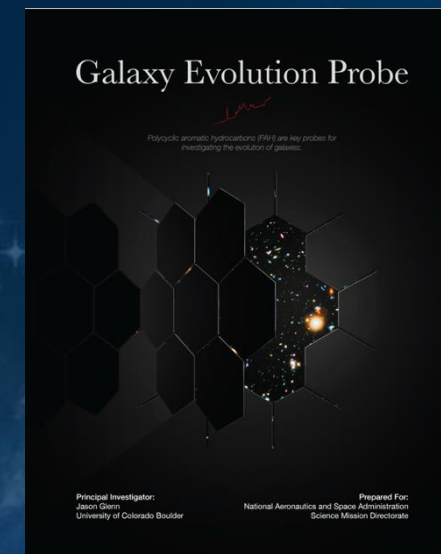
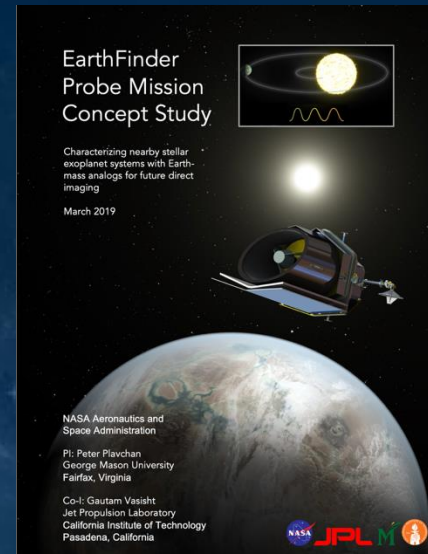
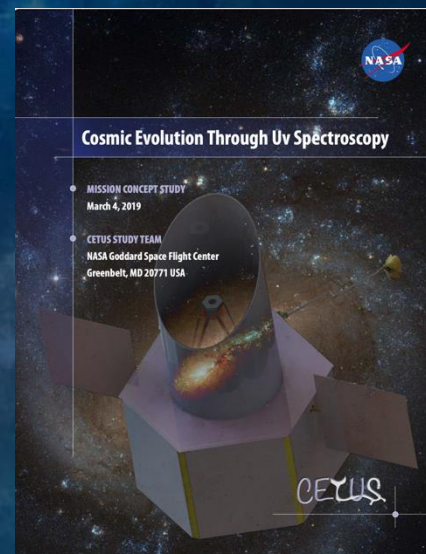
- Communication between HQ and the Studies leadership (e.g., “descope” memo)
 - Mistakes were made!
- Clarify relationship between STDT and Center Study Team
 - Established in Center assignment memo (Nov 2015) & STDT charter (Dec 2015)
- More consistent guidelines thought out in advance so people don't get confused
 - Protocols and processes established in advance and firm (e.g., ATD templates, reports formats, etc.)
 - Clear Cost instructions and more transparency of the costing processes at Centers and in the reporting
- **Management Structure:**
 - HQ management teams should start lean, with direct involvement from designated Program Scientists rather than large, flat committees.
- **Clear Expectations Upfront:**
 - Standardization is mandatory: Provide uniform templates for Advanced Technology Development (ATD), Master Equipment Lists (MEL), and Science Traceability Matrices (STM) on Day 1.
- **Realistic Funding Profiles:**
 - Early-phase funding needs to be higher to support CML 4 requirements without relying on emergency Center subsidies.

Flagships: What could be improved?

- Communication between HQ and the Studies leadership (e.g., “descope” memo)
 - Mistakes were made!
- Clarify relationship between STDT and Center Study Team
 - Established in Center assignment memo (Nov 2015)
- More consistent guidelines thought out in advance
 - Protocols and processes established (e.g., reports formats, etc.)
 - Clear Cost Institute processes at Centers and in the reporting
- More consistent start lean, with direct involvement from designated Program Manager, flat committees.
- Clear Standards Upfront:
 - Standardization is mandatory: Provide uniform templates for Advanced Technology Development (ATD), Master Equipment Lists (MEL), and Science Traceability Matrices (STM) on Day 1.
- Realistic Funding Profiles:
 - Early-phase funding needs to be higher to support CML 4 requirements without relying on emergency Center subsidies.

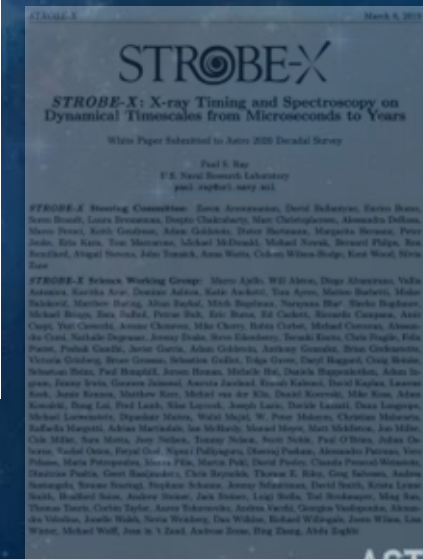
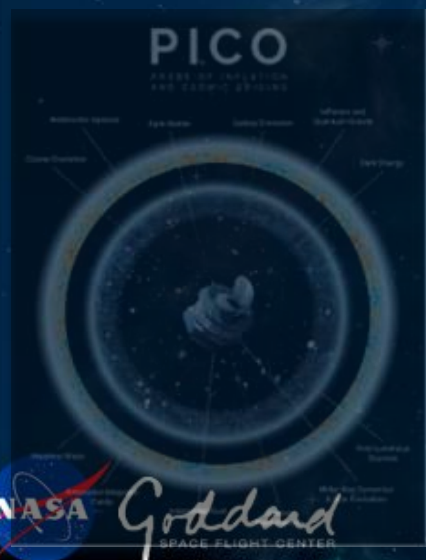
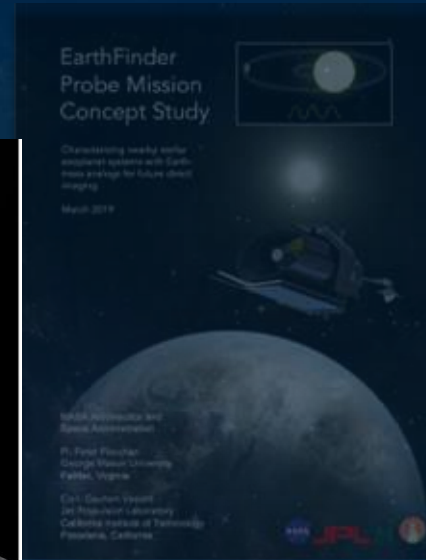
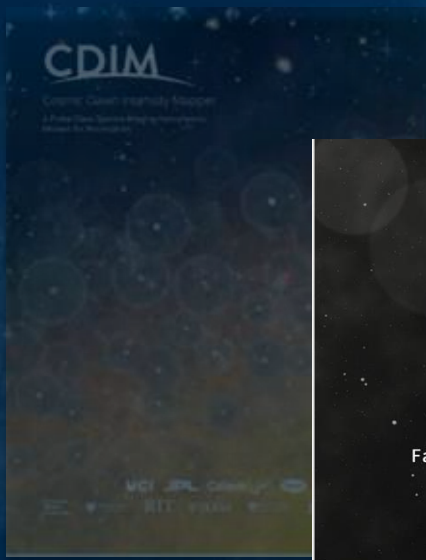
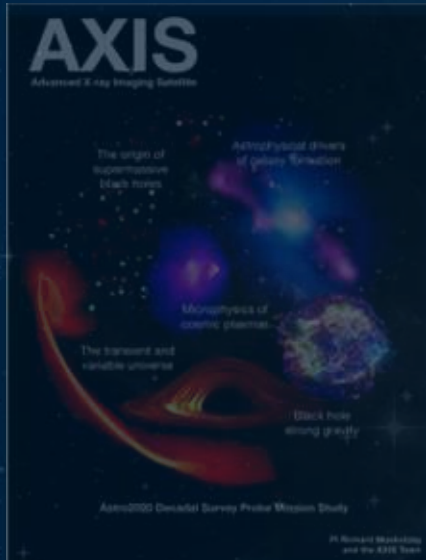
**It is really hard to plan everything in advance
when you are making it up as you go**

The Probes Concept Studies



The Probes Concept Studies

PRIMA



ASTROPHYSICS SCIENCE DIVISION

Probes: What went well?

- Enthusiastic response of the community (27 submissions!)
- Broad swath of Astrophysics topics to demonstrate viability of mid-size concepts
- Lean management team at HQ (PS, PE) and Centers (Probes engineers)
- Centers & Industry independent investments

Probes: What could be improved?

- **Wide Disparity in Concept Maturity:**
 - Concepts with heavy flight heritage differed vastly from brand-new, novel concepts.
 - This inhomogeneity introduced major uncertainties into parametric cost modeling.
- **Cost Proxy Insights:**
 - Orbit type (LEO vs. L2 vs. Deep Space) and science type were found to be more significant drivers of cost and technical risk than sheer spacecraft mass.
- **Future Workaround:**
 - Group future Probe studies into two distinct buckets: *Heritage-based* and *Novel/New-Technology concepts*, evaluating them under tailored frameworks.

Top 5 Recommendations to HQ

- **Standardize Deliverables Early:** Enforce strict advanced tech development and costing templates from the study kickoff.
- **Engage Independent Reviewers (LCIT) Sooner:** Embed independent review teams during the design phase rather than just at final delivery.
- **Use Standard Contracts for Industry:** Abandon CANs in favor of flexible early-phase contracts.
- **Maintain Technology Investments:** Continue funding precursory technology development via Strategic Astrophysics Technology (SAT) programs across candidate concepts during NAS deliberations.
- Keep the governance and the management SIMPLE

December
19, 2019

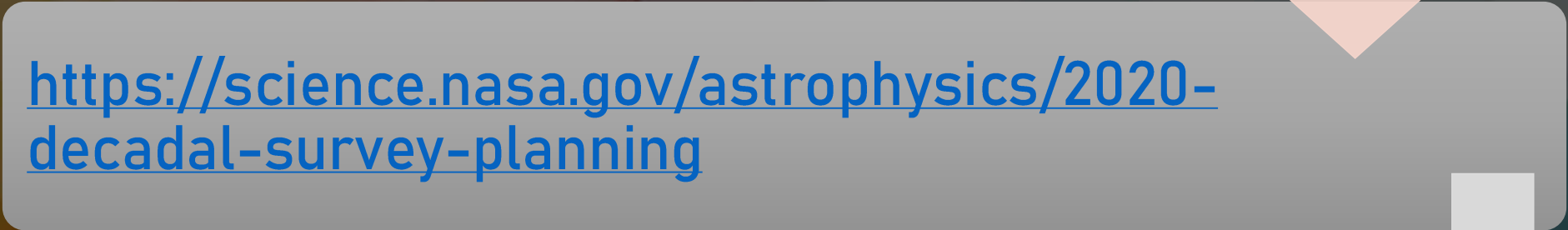


Resources

Links to study reports and all public documents:



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



<https://www.greatobservatories.org/>