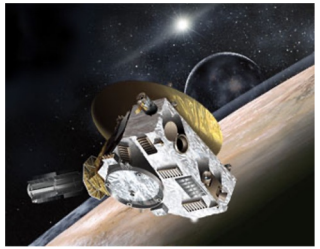
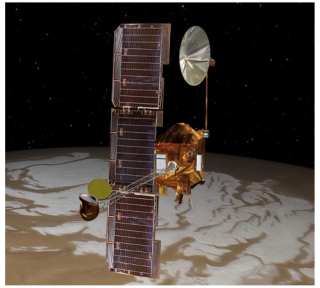
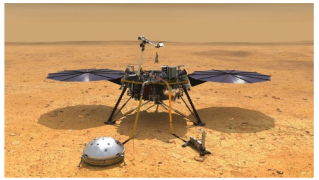


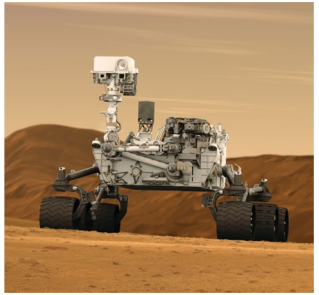


2022 Planetary Mission Senior Review (PMSR22)

Henry Throop + Lindsay Hays
June 21, 2022

NASA Planetary Science Advisory Council (PAC)





Senior Review – Overview

- Extended missions can offer great benefits to NASA at a much lower cost than a new mission.
- But missions need to make the case that an extended mission is worth the cost.
  - Science needs to be high quality.
  - Any programmatic benefits (relay, site selection, international cooperation, etc.) need to be well justified.
- Senior Review typically reviews all operating PSD s/c approaching their End of Mission (EOM), and occurs every three years.
- Missions submit proposals, which are evaluated by a panel. NASA makes decisions based on Final Report.

History of PSD Extended Missions and Senior Reviews

Mission Calendar - Senior Reviews — **Calendar Year**

Mission	Launch	Arrival	Last Contact	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
NEAR	17-Feb-1996	14-Feb-2000	28-Feb-2001	r	e																														
DS1	24-Oct-1998	29-Jul-1999	18-Dec-2001	r	e																														
Galileo	18-Oct-1989	8-Dec-1995	21-Sep-2003	r	e	r	e																												
MGS	7-Nov-1996	11-Sep-1997	2-Nov-2006	r	e	r	e	r	e	r																									
Stardust / NeXT	7-Feb-1999	24-Jan-2004	24-Mar-2011	c	c	c	c	p	p	p	e	e	e	e	e																				
Cassini	15-Oct-1997	1-Jul-2004	15-Sep-2017	c	c	c	c	p	p	p	r	e	r	e	e	r	e	r	e	e	e														
Genesis	8-Aug-2001		8-Sep-2004		cp	p	p	p																											
Odyssey	7-Apr-2001	24-Oct-2001			cp	p	p	r	e	r	e	r	e	r	e	r	e	r	e	r	e	e	r	e	e	r									
Express	2-Jun-2003	25-Dec-2003					cp	p	p	r	e	r	e	r	e	r	e	r	e	r	e	e	r	e	e										
Spirit	10-Jun-2003	4-Jan-2004	22-Mar-2010				c	p	p	r	e	r	e	r	e																				
Opportunity	7-Jul-2003	25-Jan-2004	10-Jun-2018				c	p	p	r	e	r	e	r	e	r	e	r	e	r	e	e	e												
MESSENGER	3-Aug-2004	18-Mar-2011	30-Apr-2015					c	c	c	c	c	c	c	pr	p	r	e	e	e															
Rosetta	4-Mar-2004	6-Aug-2014	30-Sep-2016					c	c	c	c	c	c	c	c	c	c	p	p	p															
Deep Impact / EPOXI	12-Jan-2005	4-Jul-2005	13-Aug-2013						cp	p	e	e	e	e	e	r	e																		
MRO	12-Aug-2005	10-Mar-2006							c	p	p	r	e	r	e	r	e	r	e	r	e	e	r	e	e	r									
New Horizons	Jan 19 2006	July 14 2015								c	c	c	c	c	c	c	c	p	p	r	e	e	e	e	e	r									
Phoenix	4-Aug-2007	25-May-2008	2-Nov-2008								c	cpr																							
Dawn	27-Sep-2007	16-Jun-2011	30-Oct-2018								c	c	c	c	p	p	p	p	p	r	e	e													
LRO	18-Jun-2009	23-Jun-2009											cp	p	p	r	p	r	e	r	e	e	r	e	e	r									
Juno	5-Aug-2011	5-Jul-2016													c	c	c	c	c	p	p	p	p	r	e	e	e	e	e						
GRAIL	10-Sep-2011	1-Jan-2012	17-Dec-2012												c	p																			
MSL / Curiosity	26-Nov-2011	6-Aug-2012													c	p	p	r	e	r	e	e	r	e	e	r									
MAVEN	18-Nov-2013	22-Sep-2014															c	p	p	r	e	e	r	e	e	r									
OSIRIS-REx	8-Sep-2016	3-Dec-2018				c	Cruise													c	c	c	p	p	p	r	p								
InSight	5-May-2018	26-Nov-2018				p	Prime															cp	p	r	e	r									
Perseverance	30-Jul-2020	18-Feb-2021				e	EM																	c	cp	p									
Lucy	16-Oct-2021	2025				r	Senior Review held this CY																		c	c	c	c	p	p	p	p	p	p	p
Psyche	Aug-2022	January-2026																								c	c	c	c	p	p				
Clipper	2024	2030-2031																										c	c	c	c	c	c	p	p
Dragonfly	2027	2036																													c	c	c	c	c
VERITAS	2028	2029																														c	p	p	p
DAVINCI+	2029	2030				HBT 11-Apr-2022																											c	p	

PMSR22

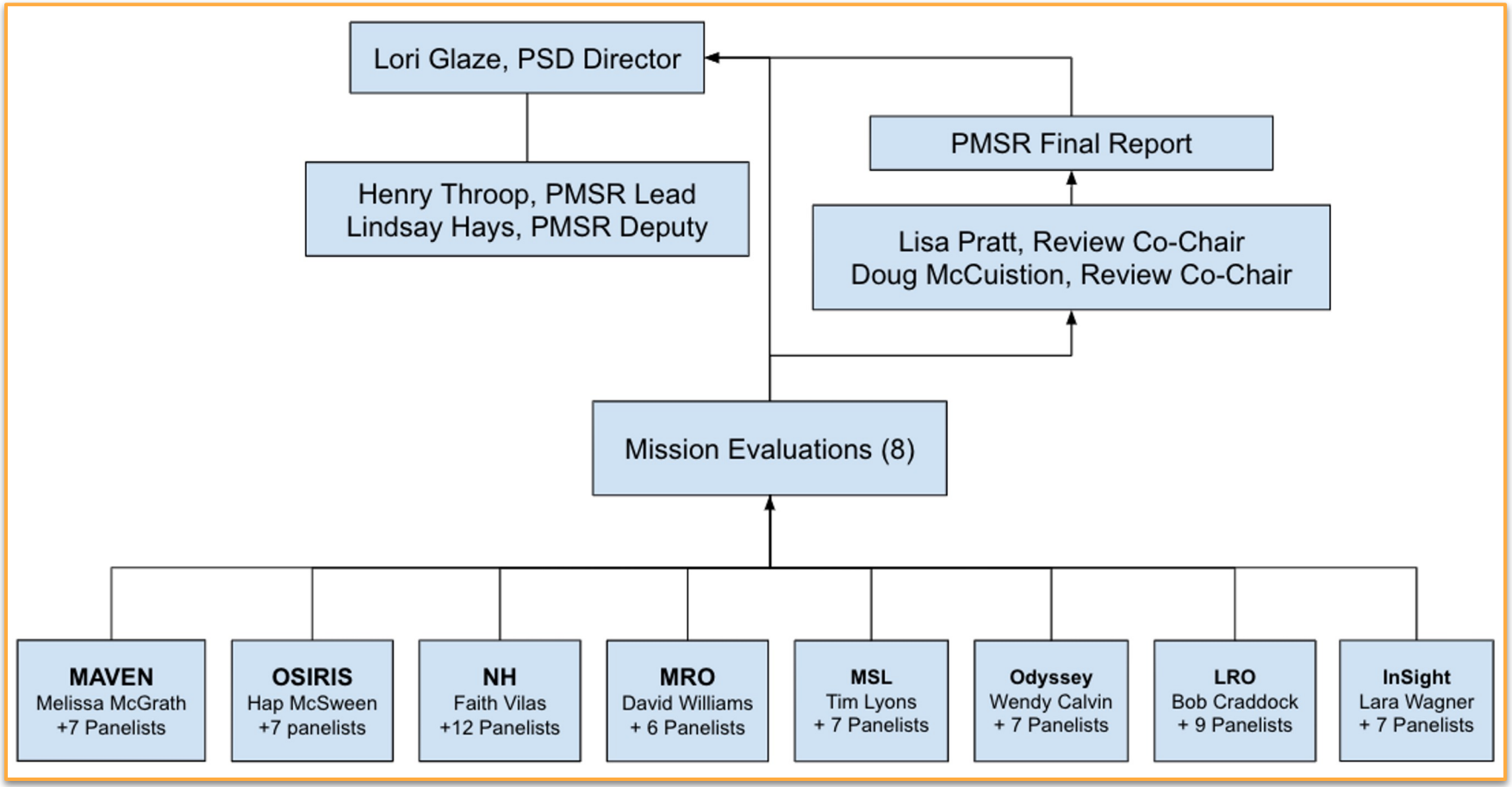
PMSR22 – Overview

- **Eight missions** were reviewed during PMSR22.
  - 5 Mars missions: **MAVEN, MSL, InSight, MRO, Odyssey**
  - 3 missions to other targets: **LRO, OSIRIS, New Horizons**
- All missions were asked to submit **three-year proposals,** except OSIRIS, which was asked to submit a nine-year proposal describing an encounter with Apophis in 2029.
- Proposals were based on **guideline budgets provided by NASA**. Missions were encouraged to provide both **descopes and overguides**.
- Any or all missions could be selected for extension. Missions were not considered to be in competition with each other.

Review panel structure:

- **8 panels**, each with one proposal. Each panel had a Chair & 7-12 Panelists.
- **Two Review Chairs** sat on all panels.
- Calendar:
  - June 2021 — Draft Call for Proposals, with evaluation criteria; comments solicited.
  - January 2022 — Proposals due
  - Feb-March 2022 — Presentations and review
  - April 2022 — Results to missions

PMSR22 Panel Structure and Composition

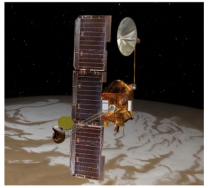


Results of the Senior Review

All eight missions will be extended.

MAVEN - 3 years

Science will focus on response of Mars' atmosphere and magnetosphere to upcoming solar maximum in Solar Cycle 25. Mission to continue role in Mars Relay Network. ***PI: Dr. Shannon Curry, UC Berkeley.***

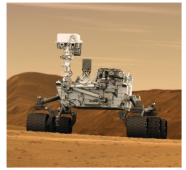


Mars Odyssey - 3 years

Continue 20-year record of climate and radiation monitoring, and undertake new thermal studies of subsurface ice and rocks. Continue relay operations.

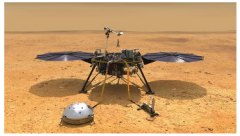
MRO - 3 years

Continue broad studies of Mars' surface, ices, active geology, and atmosphere, plus contributions to relay. CRISM to be shut down entirely after the loss of its cryocooler ended the use of one of its two spectrometers.



MSL - 3 years

Rover will traverse to higher elevations to reach sulfate-bearing layers in Gale crater, and investigate 'boxwork' structure to explore past groundwater flow. Address mismatch in methane results between those of MSL and ESA's ExoMars TGO.



InSight - until Dec 2022 or inoperable due to power

Continue seismic monitoring, including weather station, through up to two more 'quiet seasons.' Mission is threatened by drop in power due to dust buildup on solar panels, and lack of cleaning events.

Results of the Senior Review

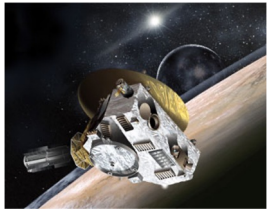
OSIRIS-APEX ('APophis EXplorer') - 9 years

Mission will orbit 350-meter diameter Apophis in 2029, after its 30,000 km pass of Earth, giving close-up look at rubble pile asteroid. Will explore regolith and tidal forces. Some thermal risk to s/c due to multiple 0.5-AU perihelia. **PI: Dr. Daniella DellaGiustina (UA)**

LRO - 3 years

New orbit will move away from pole and allow deeper study of N and S Permanently Shadowed Regions (PSR). Additional studies on tectonics and volcanism. Programmatic goals for CLPS and Artemis.

Results of the Review



New Horizons - 2 years

The New Horizons (NH) project proposed a three-year interdisciplinary second Kuiper Belt extended mission taking advantage of the NH spacecraft’s unique position in the solar system, which was independently reviewed by PSD, APD and HPD panels.

In the two-year extended mission, New Horizons will make distant observations of Uranus and Neptune, observing them from unique geometries not possible from Earth, enabling astronomers to compare them with distant exoplanets. NH's cameras can also be used to map the very faint 'cosmic background' in visible and ultraviolet (UV) light, making important observations of the local interstellar medium that are not possible from Earth. And, NH will explore the heliosphere outward of 54 Astronomical Units (AU), using its instruments to understand the motions of charged particles as they interact with the solar wind, and to understand our heliosphere's large-scale structure.

At the conclusion of this extended mission, New Horizons will be given the opportunity to submit a plan to become a part of NASA's Heliophysics System Observatory (HSO) as infrastructure for Heliophysics' fleet of spaceflight missions.

Final Report and NASA Response are Posted

2022 Planetary Mission Senior Review (PMSR-22) Final Report

30 March 2022

1. Executive Summary
2. Review Process
   - 2.1 Background and Panel Construct
   - 2.2 Preparatory Meetings
   - 2.3 Mission Presentations Overview
   - 2.4 Review Chairs' Synthesis Process and Observations
   - 2.5 Lessons Learned from the Review Process
   - 2.6 Applicable Documents
3. Summary and Assessment of Mission Proposals
   - 3.1 InSight
   - 3.2 Lunar Reconnaissance Orbiter (LRO)
   - 3.3 Mars Atmosphere and Volatile EvolutioN (MAVEN)
   - 3.4 Mars Odyssey (ODY)
   - 3.5 Mars Reconnaissance Orbiter (MRO)
   - 3.6 Mars Science Laboratory (MSL)
   - 3.7 New Horizons
   - 3.8 OSIRIS-APEX
4. Top-Level Findings and Recommendations
   - 4.1 Review Process
   - 4.2 Missions
   - 4.3 Overarching Coordination
5. Conclusion

Appendices

1—Review and Panel Leadership

2—NASA Ranking Definitions

3—PMSR 2022 Evaluation Criteria

National Aeronautics and
Space Administration

Mary W. Jackson Headquarters
Washington, DC 20546-0001
Science Mission Directorate / Planetary Science Division

April 25, 2022
Update: May 26, 2022

Reply to Attn of: Science Mission Directorate/PSD

NASA Response to the 2022 Planetary Mission Senior Review

NASA's Planetary Science Division is currently operating more than a dozen spacecraft across the solar system. Upon completion of their Prime Mission (PM), each of these missions may undergo a Senior Review every three years to assess whether operations should continue during an Extended Mission (EM). These extended missions leverage NASA's large investment in order to perform continued science operations at a cost far lower than developing a new mission. In some cases, EMs allow missions to visit new targets with entirely new science goals, while in other cases, the extensions allow missions to continue to acquire valuable long-duration datasets while supporting NASA's programmatic goals.

2022 Senior Review

In the summer of 2021, NASA initiated a review of eight flight projects which were nearing the end of their current missions. These missions were Mars Odyssey, MAVEN, MRO, MSL, InSight, LRO, New Horizons, and OSIRIS-REx. Each team was invited to submit a proposal for an extended mission. The proposals were submitted in January 2022 and were reviewed by independent panels of experts from academia, NASA, and industry. The panels reported to two Review Chairs, who oversaw the process and provided summary findings to NASA.

Seven of the eight missions were asked to submit three-year extensions for operations through the end of FY25. The OSIRIS-REx mission was asked to submit a proposal for an encounter with the asteroid 99942 Apophis in 2029. This extended OSIRIS mission would begin in FY23 shortly before the delivery of the Sample Return Capsule to Earth and would close out in FY31.

At the time of proposal submission, all the missions except for InSight were healthy enough to conduct their proposed EM. InSight's future operations were threatened by decreasing solar flux due to dust buildup on its solar panels, and its EM proposal described a scenario of continued operations which the team acknowledged might not be possible unless the panels were cleaned by a statistically unlikely dust-clearing event.

https://science.nasa.gov/solar-system/documents/senior-review

Backup Slides

Review Logistics

Two-week long virtual panel, with logistics coordinated by NRESS.

Each mission had roughly 2.5h of presentation + 10h of discussion.

Planetary Mission Senior Review 2022 -- Draft Schedule

				Panel Week 1 - Main Sessions					Panel Week 2 - Main Sessions				
ET	CT	MT / AZ	PT	Monday Feb 21	Tuesday Feb 22	Wednesday Feb 23	Thursday Feb 24	Friday Feb 25	Monday Feb 28	Tuesday Mar 1	Wednesday Mar 2	Thursday Mar 3	Friday Mar 4
10:00 AM	9:00 AM	8:00 AM	7:00 AM	Holiday	MAVEN	MAVEN	ODY	ODY	NH	NH	LRO	LRO	
10:30 AM	9:30 AM	8:30 AM	7:30 AM		MAVEN	MAVEN	ODY	ODY	NH	NH	LRO	LRO	
11:00 AM	10:00 AM	9:00 AM	8:00 AM		MAVEN	MAVEN	ODY	ODY	NH	NH	LRO	LRO	
11:30 AM	10:30 AM	9:30 AM	8:30 AM		MAVEN	MAVEN	ODY	ODY	NH	NH	LRO	LRO	
12:00 PM	11:00 AM	10:00 AM	9:00 AM		MAVEN	MAVEN	ODY	ODY	NH	NH	LRO	LRO	
12:30 PM	11:30 AM	10:30 AM	9:30 AM		Break	Break	Break	Break	Break	Break	Break	Break	
1:00 PM	12:00 PM	11:00 AM	10:00 AM		MAVEN	MAVEN	ODY	ODY	NH	NH	LRO	LRO	
1:30 PM	12:30 PM	11:30 AM	10:30 AM		MAVEN	MAVEN	ODY	ODY	NH	NH	LRO	LRO	
2:00 PM	1:00 PM	12:00 PM	11:00 AM		MAVEN	MAVEN	ODY	ODY	NH	NH	LRO	LRO	
2:30 PM	1:30 PM	12:30 PM	11:30 AM		MAVEN	MAVEN	ODY	ODY	NH	NH	LRO	LRO	
3:00 PM	2:00 PM	1:00 PM	12:00 PM										
3:30 PM	2:30 PM	1:30 PM	12:30 PM		MRO	MRO	MSL	MSL	OREx	OREx	InSight	InSight	GC + RC Meeting
4:00 PM	3:00 PM	2:00 PM	1:00 PM		MRO	MRO	MSL	MSL	OREx	OREx	InSight	InSight	GC + RC Meeting
4:30 PM	3:30 PM	2:30 PM	1:30 PM		MRO	MRO	MSL	MSL	OREx	OREx	InSight	InSight	GC + RC Meeting
5:00 PM	4:00 PM	3:00 PM	2:00 PM		MRO	MRO	MSL	MSL	OREx	OREx	InSight	InSight	GC + RC Meeting
5:30 PM	4:30 PM	3:30 PM	2:30 PM		MRO	MRO	MSL	MSL	OREx	OREx	InSight	InSight	GC + RC Meeting
6:00 PM	5:00 PM	4:00 PM	3:00 PM		Break	Break	Break	Break	Break	Break	Break	Break	
6:30 PM	5:30 PM	4:30 PM	3:30 PM		MRO	MRO	MSL	MSL	OREx	OREx	InSight	InSight	
7:00 PM	6:00 PM	5:00 PM	4:00 PM		MRO	MRO	MSL	MSL	OREx	OREx	InSight	InSight	
7:30 PM	6:30 PM	5:30 PM	4:30 PM		MRO	MRO	MSL	MSL	OREx	OREx	InSight	InSight	
8:00 PM	7:00 PM	6:00 PM	5:00 PM		MRO	MRO	MSL	MSL	OREx	OREx	InSight	InSight	

				Panel Week 1 - Backup Sessions					Panel Week 2 - Backup Sessions				
ET	CT	MT / AZ	PT	Monday Feb 21	Tuesday Feb 22	Wednesday Feb 23	Thursday Feb 24	Friday Feb 25	Monday Feb 28	Tuesday Mar 1	Wednesday Mar 2	Thursday Mar 3	Friday Mar 4
10:00 AM	9:00 AM	8:00 AM	7:00 AM	Holiday				MAVEN	ODY		NH		InSight
10:30 AM	9:30 AM	8:30 AM	7:30 AM					MAVEN	ODY		NH		InSight
11:00 AM	10:00 AM	9:00 AM	8:00 AM					MAVEN	ODY		NH		InSight
11:30 AM	10:30 AM	9:30 AM	8:30 AM					MAVEN	ODY		NH		InSight
12:00 PM	11:00 AM	10:00 AM	9:00 AM					MAVEN	ODY		NH		InSight
12:30 PM	11:30 AM	10:30 AM	9:30 AM					MAVEN	ODY		NH		InSight
1:00 PM	12:00 PM	11:00 AM	10:00 AM										
1:30 PM	12:30 PM	11:30 AM	10:30 AM					MRO	MSL		OREx	LRO	
2:00 PM	1:00 PM	12:00 PM	11:00 AM					MRO	MSL		OREx	LRO	
2:30 PM	1:30 PM	12:30 PM	11:30 AM		Backup sessions will be used only if needed, for extra discussion / writing time.			MRO	MSL		OREx	LRO	
3:00 PM	2:00 PM	1:00 PM	12:00 PM					MRO	MSL		OREx	LRO	
3:30 PM	2:30 PM	1:30 PM	12:30 PM					MRO	MSL		OREx	LRO	
4:00 PM	3:00 PM	2:00 PM	1:00 PM					MRO	MSL		OREx	LRO	

New Horizons – Interdivisional Review

New Horizons will write one extended mission proposal submitted to PSD in response to the PMSR22 call

- This proposal should be prepared with an understood audience of interdisciplinary expertise crossing PSD, APD, and HPD science communities
- The Science Objectives and the Science Traceability Matrix should link to goals and questions of the Decadal Survey(s) relevant to the appropriate division(s)
- The budget section should (where appropriate) make note of budget aspects that are more relevant to the science of a particular division
- The proposal should include a 2-4 page appendix where the team specifically responds to any aspect of the 2022 Astrophysics Senior Review that are not included in the PMSR22 (e.g. DEIA), and frames for the APD reviewers how to understand the proposal
- The proposal should include a 2-4 page appendix where the team specifically responds to any details not part of the PMSR22 call but requested by HPD, and frames for the HPD reviewers how to understand the proposal

For Integrated Proposal Review/Selection/Funding:

- The PMSR22 panel for New Horizons extended mission proposal will have interdisciplinary expertise crossing PSD, APD, and HPD science communities
- The PMSR22 panel evaluation for the NH EM proposal (at least in preliminary form) will be provided to APD and HPD
- APD will receive the <u>same</u> proposal to review as part of their planned Senior Review in 2022 in order to assess the NH EM proposal in the context of the other missions undergoing Senior Review
- HPD will receive the <u>same</u> proposal to review as part a special Senior Review panel in order to assess the NH EM in the context of the other extended missions in HPD

Schedule

Draft Call for Proposals Issued to Missions	8-Jun-2021
Draft Call Comment Due	25-Jun-2021
Final Call Released	9-Jul-2021
Guideline Budgets to Missions	9-Jul-2021
List of Mission Team Members, Presenters and Suggested and Non-suggested Reviewers Due to NASA (*)	1-Sep-2021
Proposals Due	18-Jan-2022
Questions to Missions (Panel Week 1)	4-Feb-2022
Questions to Missions (Panel Week 2)	11-Feb-2022
Panel Week 1: MAVEN / ODY / MSL / MRO	Week of 21-Feb-2022
Panel Week 2: InSight / NH / OREx / LRO	Week of 28-Feb-2022
Panel Findings due to NASA	1-Apr-2022
NASA Response and Direction to Missions	15-Apr-2022