

National Aeronautics and
Space Administration



EXPLORE SOLAR SYSTEM & BEYOND

Lori S. Glaze, Ph.D.

NASA Planetary Science Division Director

2023–2032 Planetary Science and Astrobiology Decadal Survey

Venus Panel

October 20, 2020





Lunar Discovery and Exploration



Artemis and PSD



- Initial Commercial Lunar Payload Service (CLPS) flights will study the lunar surface and resources at the lunar poles, starting from 2021
- **VIPER**: Golf-cart-sized rover will investigate volatiles in lunar polar soil
 - Astrobotic CLPS delivery by end of 2023
- **Artemis III** (2024): Crew will travel to the Moon and use Human Landing System to touch down on the lunar surface
 - Science Definition Team (chaired by Renee Weber, MSFC, and HLS Science Lead) will define detailed science objectives
- Working with ESSIO on many lunar projects, e.g., ANGSA, instrument and technology development, international collaborations



Mars Program



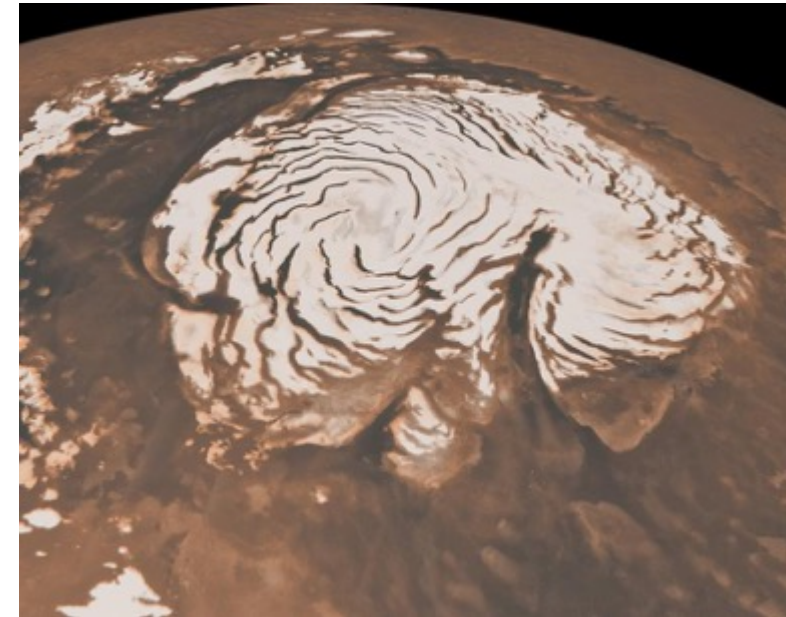
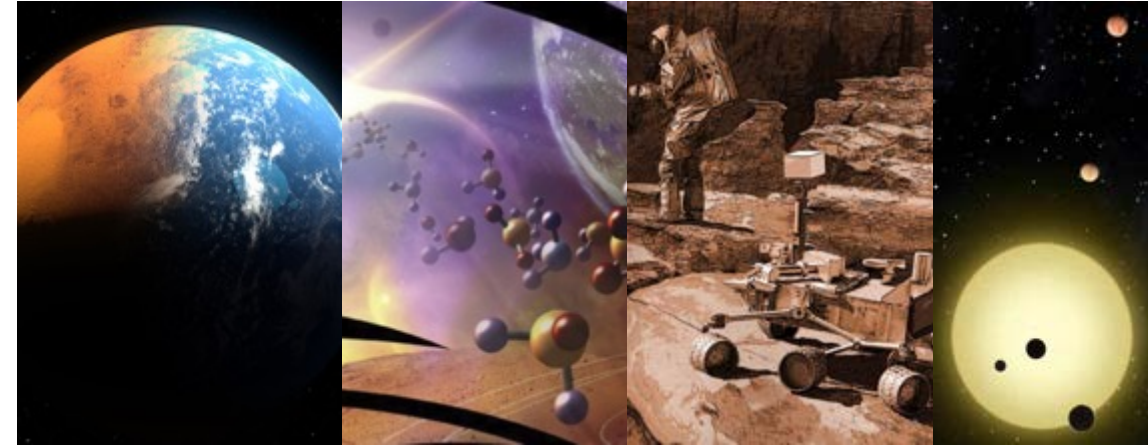
Mars Sample Return



- New Mars Sample Return (MSR) Program, Director: Jeff Gramling
- Michael Meyer is serving as Lead/Chief Scientist for MEP and MSR
- NASA/ESA MOU signed on October 5th
- SMD-commissioned Independent Review for MSR will provide findings in late October
- Working towards two launches in 2026 (NASA lander and ESA orbiter) – on track to enter Phase A this fall
- NASA/ESA MSR Sample Planning Group - Phase 2 will address science and curation planning questions
- Perseverance/MSR Caching Strategy Workshop is being planned for January 2020

Future Mars activities

- **Mars Architecture Strategy Working Group (MASWG)** established by PSD in October 2019 to:
 - Determine science exploration of Mars beyond MSR
 - Survey compelling science addressable from 2020 to 2035
 - Define mission candidates to guide future MEP planning
 - Define strategic technologies, infrastructure, and partnerships (international and commercial)
- **Mars Ice Mapper Mission:**
 - Emerging multilateral partnership is assessing the feasibility of the mission (launch as early as 2026), as well as studying next-gen communications needs that provide redundancy for Mars Sample Return and a critical infrastructure for all future Mars missions





Outer Planets and Ocean Worlds



Europa Clipper

Project Schedule: Final instrument CDR was in June, Project & Flight System CDR will be December 2020

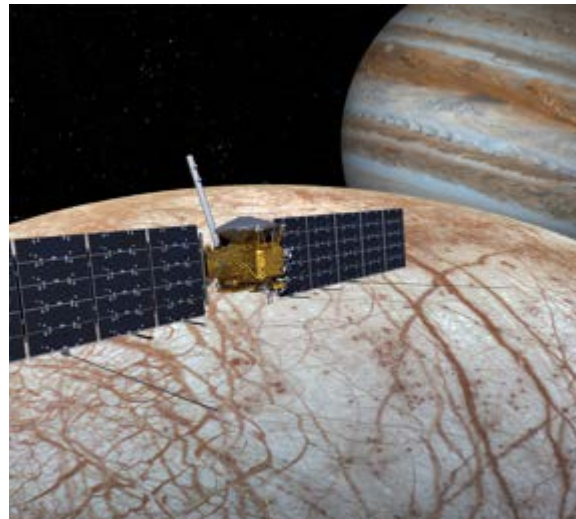
Launch Date: Team working to launch readiness in 2024

Instrument Cost Control: Steps taken to control cost growth on EIS and MASPEX, including changes to Level 1 requirements

Gravity/Radio Science Team: Competitively selected a team of seven, led by Erwan Mazarico (GSFC), to join the Clipper science team

Launch Vehicle: LV uncertainty remains a concern; Congress directs use of SLS, but availability before 2025 is not clear

Instrument & Flight System Hardware: Now being built!



Above: Upper cylinder of propulsion module
Top right: Thermal radiator flight unit

E U R O P A
C L I P P E R

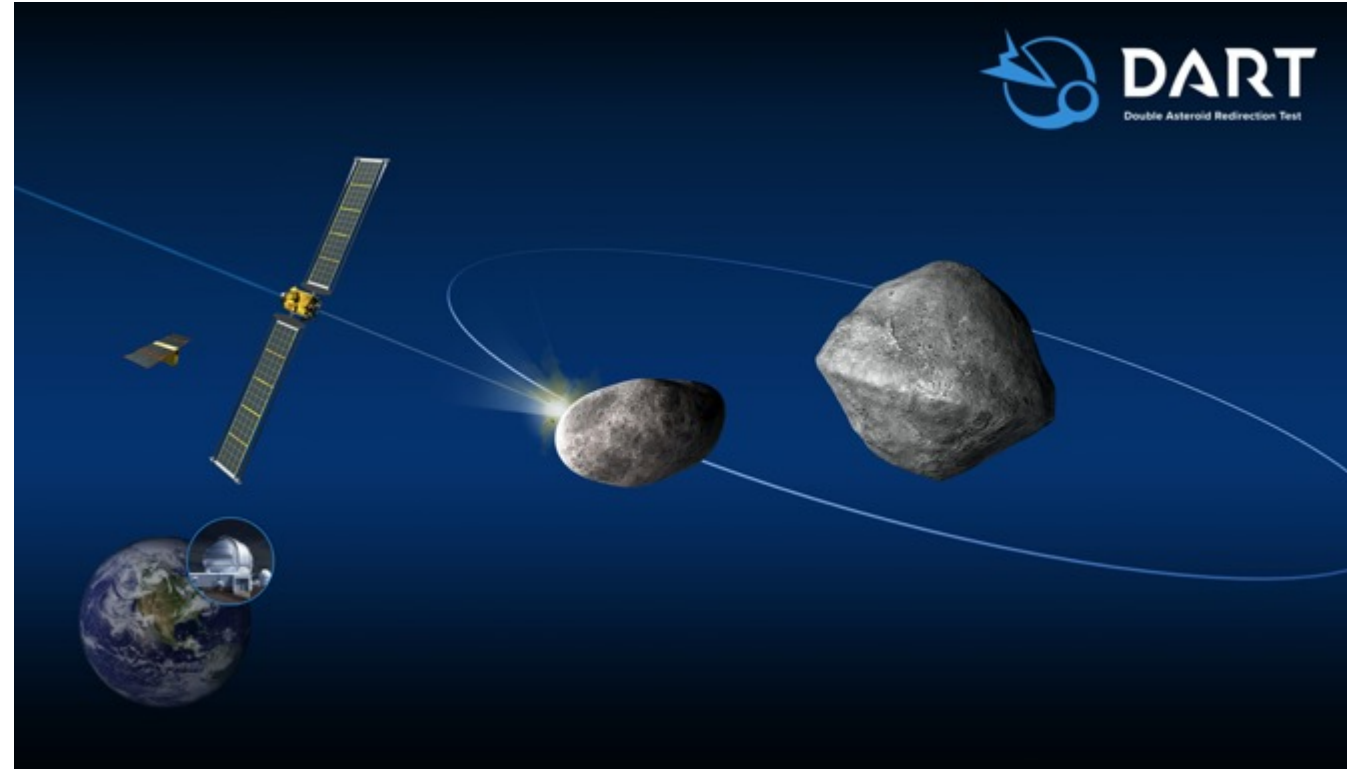


Planetary Defense



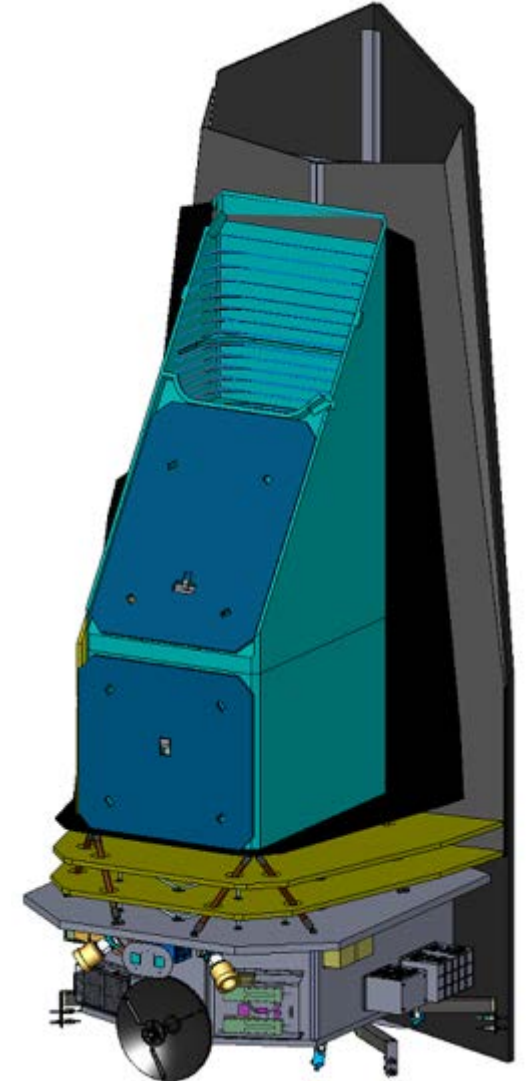
Double Asteroid Redirection Test (DART)

- First mission to demonstrate asteroid deflection technique; first mission from NASA's Planetary Defense Coordination Office
- Kinetic impact will change the motion of asteroid Dimorphos (moon of 65803 Didymos)
- Binary target allows measurement of deflection by ground-based observations
- Dimorphos, will be only 0.07 AU from Earth at impact in October 2022
- ATLO has started; spacecraft core structure is at APL after COVID-19-related shipping delay
- LICIACube manufacturing, integration, and test has started; on track for delivery March 2021
- Mission is on track for July 2021 launch aboard a SpaceX Falcon 9



NEO Surveillance Mission (NEOSM)

- Designed to meet George E Brown NEO Survey Goal
- Objectives:
 - Find 65% of undiscovered Potentially Hazardous Asteroids (PHAs) >140 m in 5 years (goal: 90% in 10 years)
 - Estimate sizes directly from infrared (IR) signatures
 - Compute cumulative chance of impact over next century for PHAs >50 m and comets
 - Deliver new tracklet data daily to the Minor Planet Center
- KDP-B targeted in Fall 2020





New Frontiers

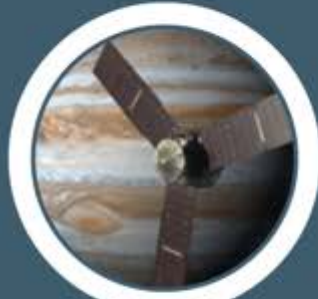


NEW FRONTIERS MISSIONS



2006–Present

NEW HORIZONS
Pluto-Kuiper Belt



2011–Present

JUNO
Jupiter polar orbiter



2016–Present

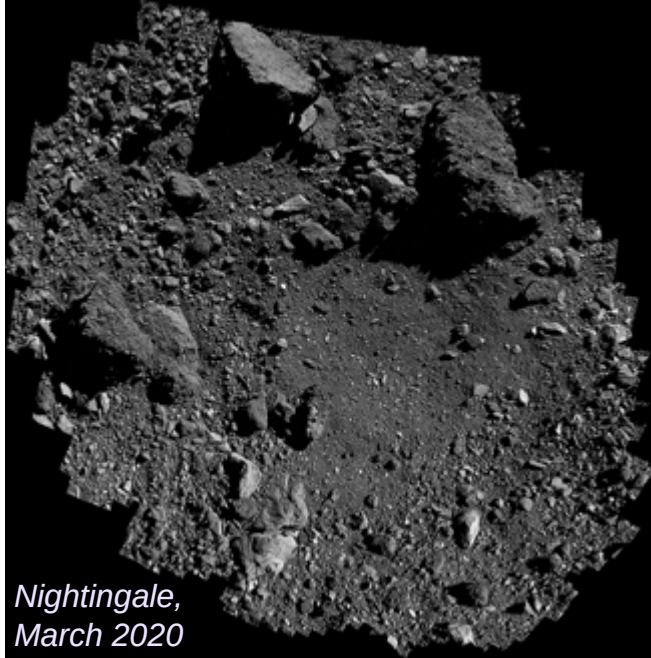
OSIRIS-REx
Asteroid
sample return



2027–

DRAGONFLY
Titan drone

OSIRIS-REx



*Nightingale,
March 2020*



*Osprey,
May 2020*



*Matchpoint
rehearsal,
Nightingale
(SamCam)*



- Spring 2020: Completed recon of primary (Nightingale) and secondary (Osprey) sites
- April 14, 2020: Check point rehearsal – 75 m above surface
- Aug 11, 2020: Matchpoint rehearsal – 40 m above surface
- Oct 20, 2020: Sampling event (TAG) at Nightingale

New Frontiers Target List Evolution

Recommended Target	Report	NF2	NF3	NF4	NF5 ?	Selected mission
Kuiper Belt-Pluto Explorer	NF					New Horizons (NF1)
Jupiter Polar Orbiter	NF	X				Juno (NF2)
Lunar South Pole-Aitken Basin Sample Return	NF, NOSSE, V&V	X	X	X	?	
Venus In Situ Explorer	NF, NOSSE, V&V	X	X	X	?	
Comet Surface Sample Return	NF, NOSSE, V&V	X	X	X	?	
Network Science	NOSSE		X			
Trojan/Centaur Reconnaissance	NOSSE, V&V		X	X		Lucy (Discovery)
Asteroid Rover/Sample Return	NOSSE		X			OSIRIS-REx (NF3)
Io Observer	NOSSE, V&V		X		?*	
Ganymede Observer	NOSSE		X			
Ocean Worlds (Titan/Enceladus)				X	?**	Dragonfly (NF4)
Saturn Probe	V&V			X	?	
Lunar Geophysical Network	V&V				?	

NF: New Frontiers in the Solar System (Decadal Survey 1)
NOSSE: New Opportunities in Solar System Exploration
V&V: Vision and Voyages (Decadal Survey 2)

*CAPS recommends removing from NF5 list if IVO is selected in Discovery

**CAPS recommends keeping Ocean Worlds Enceladus on NF5 list



Discovery



DISCOVERY MISSIONS



1996–1999

**NEAR
SHOEMAKER**
Near Earth asteroid
rendezvous



1996–1997

**MARS
PATHFINDER**
Mars rover



1998–1999

**LUNAR
PROSPECTOR**
Moon orbiter



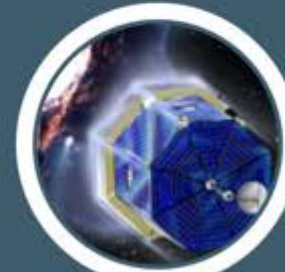
1999–2011

STARDUST
Cosmic dust
collector



2001–2004

GENESIS
Solar wind
collector



Lost 2002

CONTOUR
Comet nucleus tour



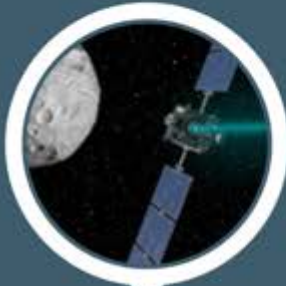
2004–2015

MESSENGER
Mercury orbiter



2005–2012

DEEP IMPACT
Comet impactor



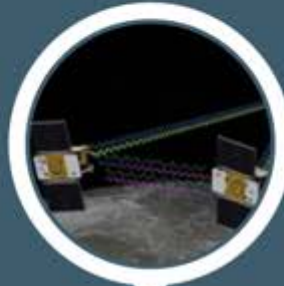
2007–2018

DAWN
Vesta and
Ceres orbiter



2009–2018

KEPLER
Exoplanet
observatory



2011–2012

GRAIL
Gravitational mapping
of the Moon



2018–Present

INSIGHT
Mars interior exploration



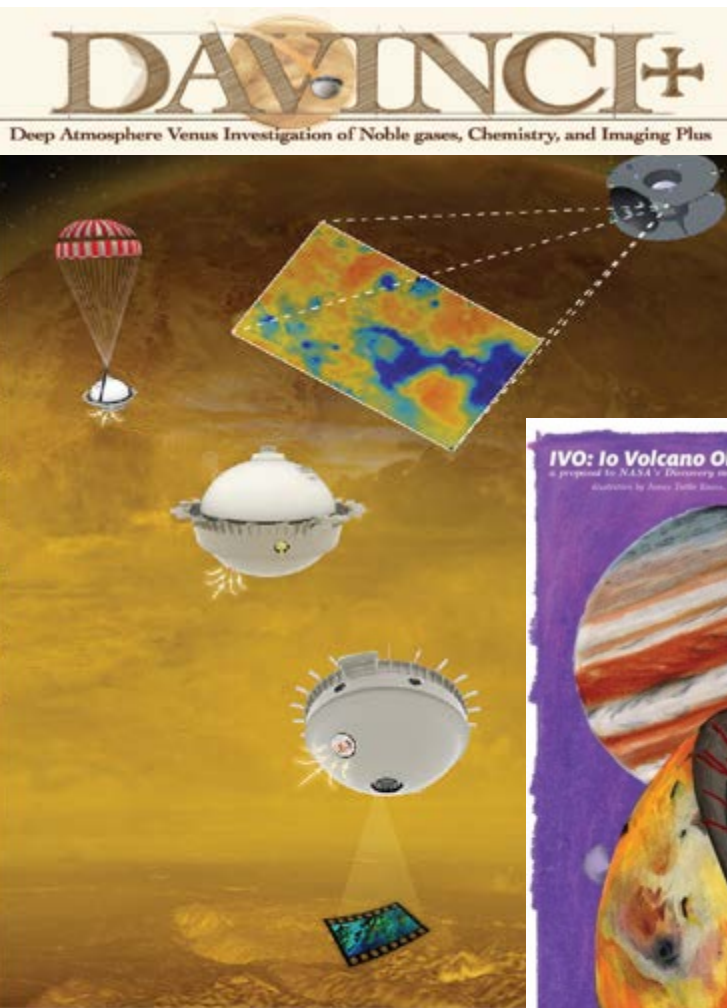
2021–

LUCY
Trojan asteroid tour



2022–

PSYCHE
Metallic
asteroid
orbiter

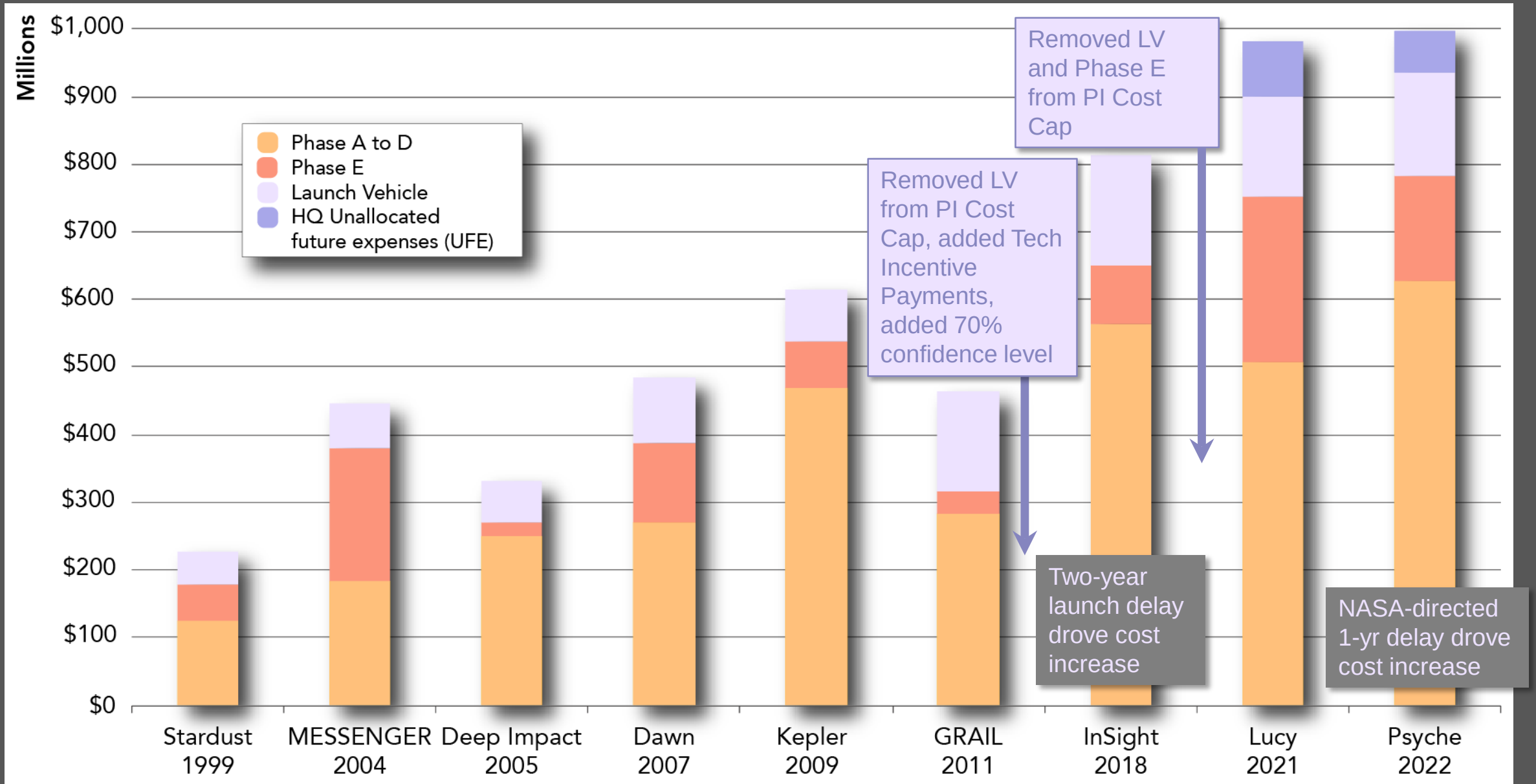


Four Discovery Concepts in Phase A



Selections
planned NET April
2021

Discovery Cost Growth* from Strategic Decisions (RY\$)

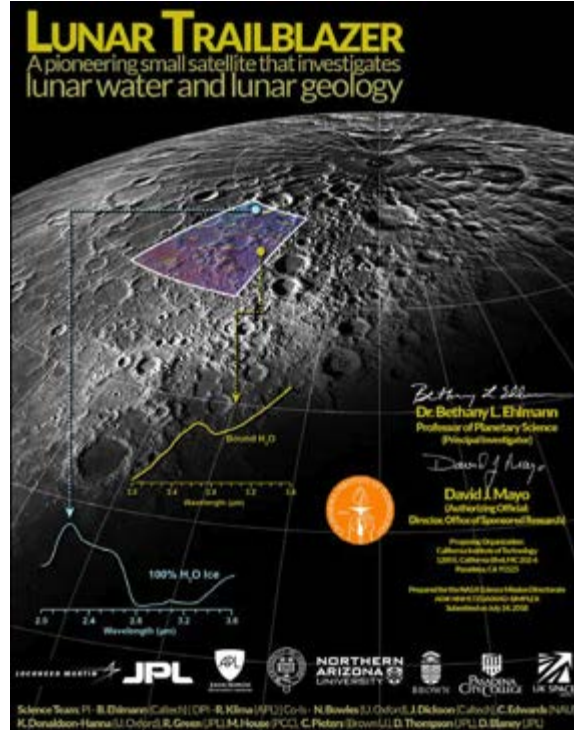
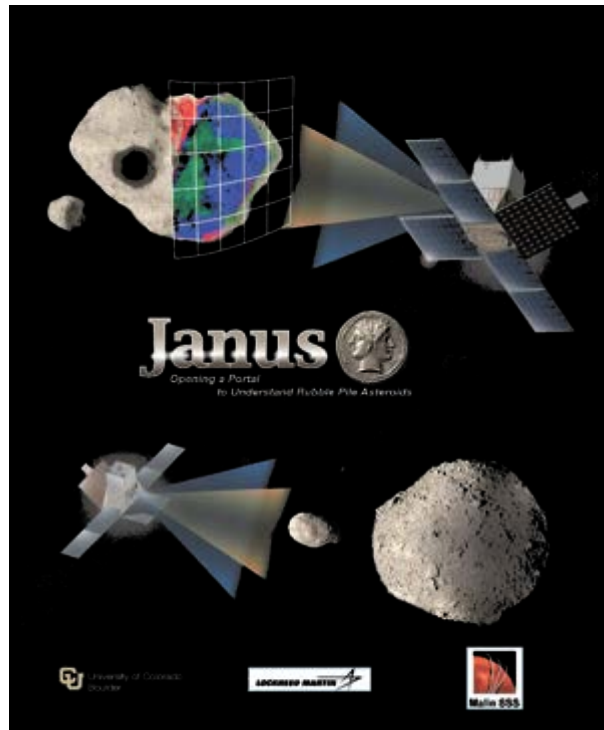
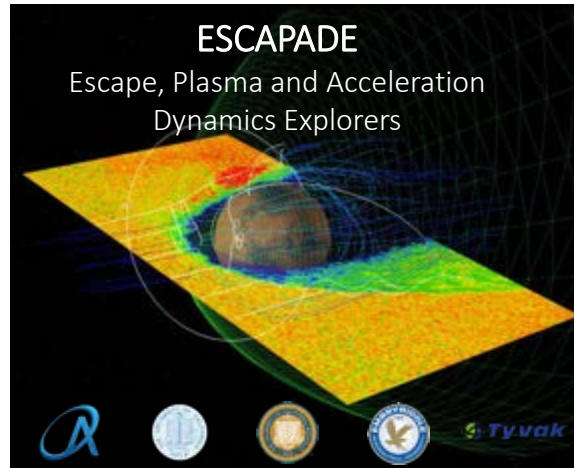
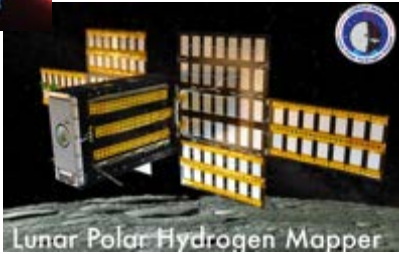
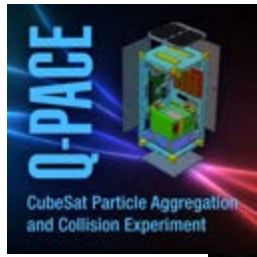


*Cost data from CADRE



Small Innovative Missions for Planetary Exploration (SIMPLEx)





SIMPLEx

SIMPLEx-1:

- Solicited as an appendix in ROSES-2014
- Low budget/very-low-cost missions
- Two missions selected in 2015: **Q-PACE** (due for launch November on Virgin Orbit's LauncherOne) and **LunaH-Map** (will launch on Artemis I, NLT November 2021)
- Lessons learned: larger cost cap and need to run as an AO

SIMPLEx-2:

- Solicited as an appendix in SALMON-3 AO
 - Required significant science goals
- PI-managed mission cost cap (all mission phases): \$15–55 million
- Three missions selected in 2019:
 - **Janus** (Psyche rideshare)
 - **EscaPADE** (TBD Rideshare)
 - **Lunar Trailblazer** (IMAP rideshare)



Research and Analysis (R&A)



ROSES-2020 PSD Program Elements

Core Programs		
Early Career Award	Solar System Workings	
Emerging Worlds	Exobiology	
Exoplanets Research**	Habitable Worlds**	
Laboratory Analysis of Returned Samples	Interdisciplinary Consortia for Astrobiology Research*	
Planetary Data Archiving, Restoration, and Tools	Planetary Science and Technology Through Analog Research*	
Planetary Protection Research*	Yearly Opportunities for Research in Planetary Defense	
Solar System Observations	Planetary Major Equipment and Facilities	
Technology Programs	Data Analysis Programs	
Development and Advancement of Lunar Instrumentation	Cassini Data Analysis	Discovery Data Analysis
Maturation of Instruments for Solar System Exploration	Lunar Data Analysis	Mars Data Analysis
Planetary Instrument Concepts for the Advancement of Solar System Observations	New Frontiers Data Analysis	

PSPs not included

*Not solicited in ROSES-20

**Cross-divisional program

Funding Source:

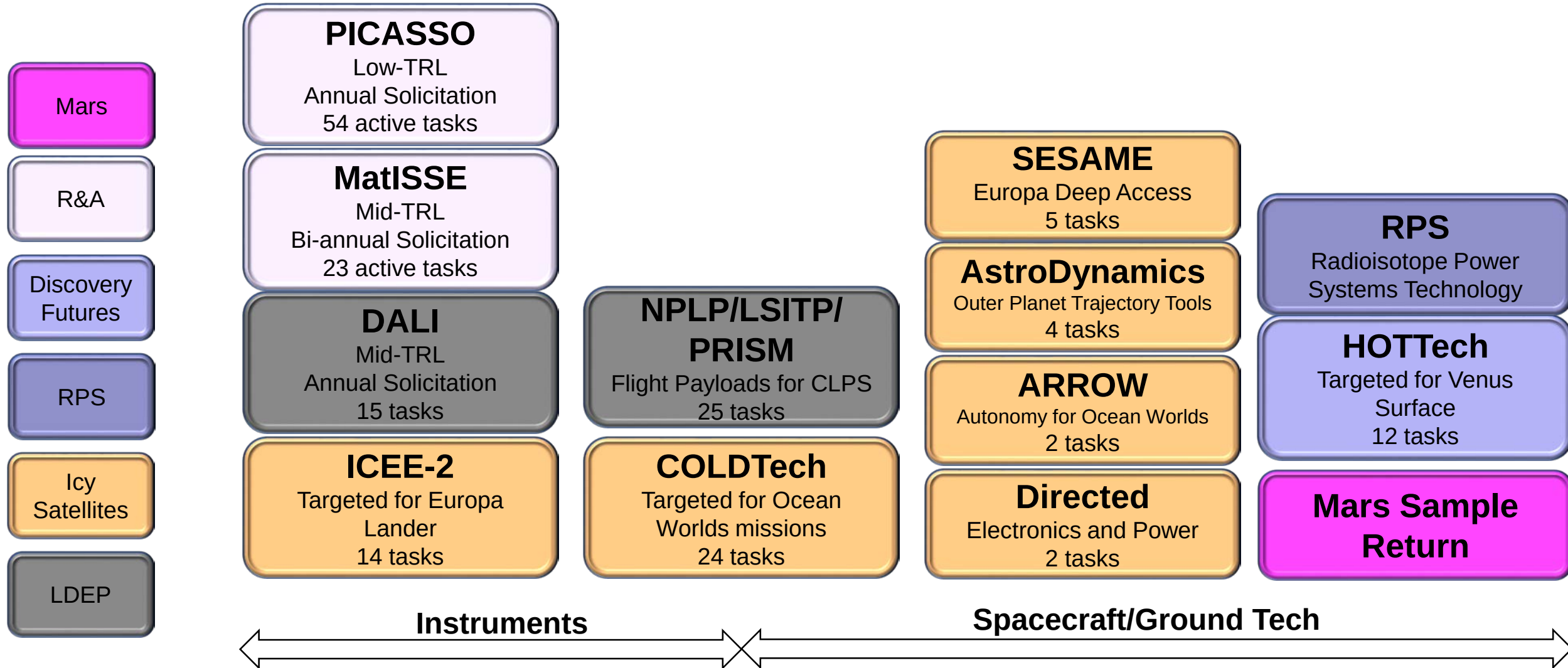
R&A	PDCO
Astrobiology	New Frontiers
Technology	Outer planets
LDEP	Discovery
Facilities	Mars



Technology Development



Technology Program Elements



What's next?

