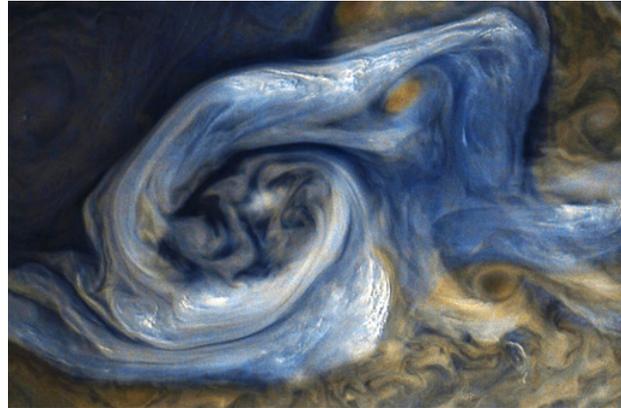
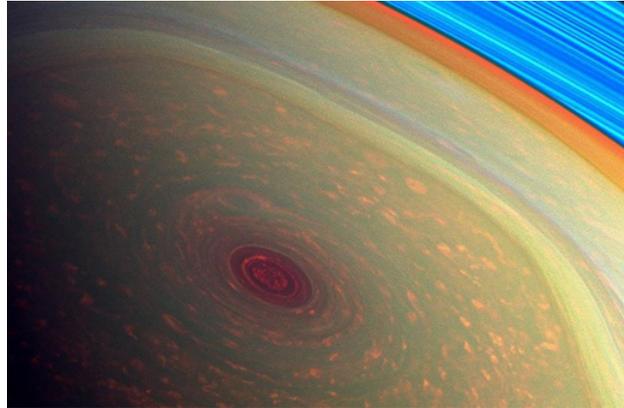
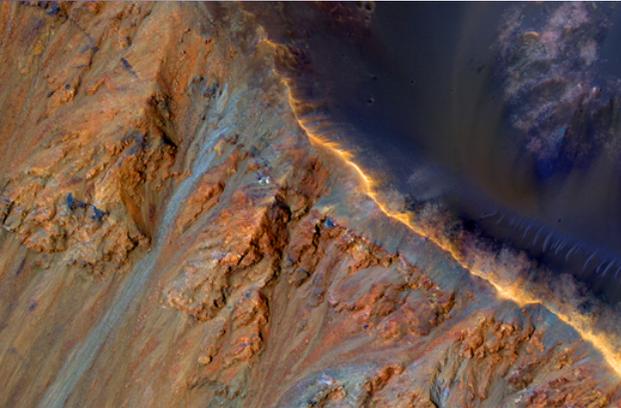


National Aeronautics and
Space Administration



SCIENCE



AAS Division for Planetary Sciences

PLANETARY SCIENCE DIVISION STATUS

Lori S. Glaze

Planetary Science Division Director (Acting)
Science Mission Directorate, NASA

October 22, 2018

Planetary Science Missions: Events

2017

- January 4 – Discovery Mission selection announced
- February 9-20 – OSIRIS-REx conducted Earth-Trojan search
- April 22 – Cassini began plane change maneuver for the “Grand Finale”
- August 21 – Solar Eclipse across America
- September 15 – Cassini end of mission at Saturn
- September 22 – OSIRIS-REx Earth flyby
- October 28 – International Observe the Moon night (1st quarter)

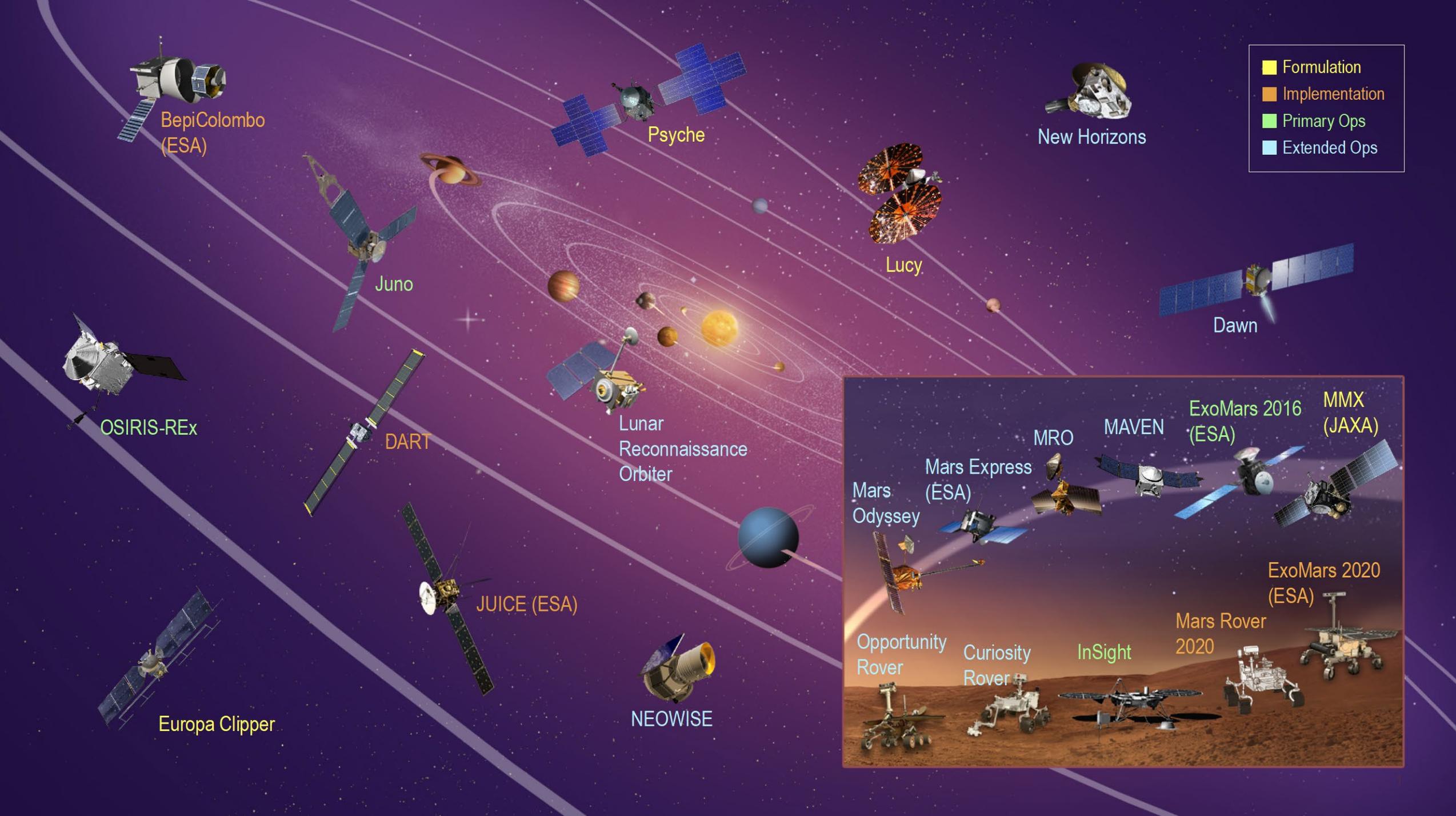
*Completed

2018

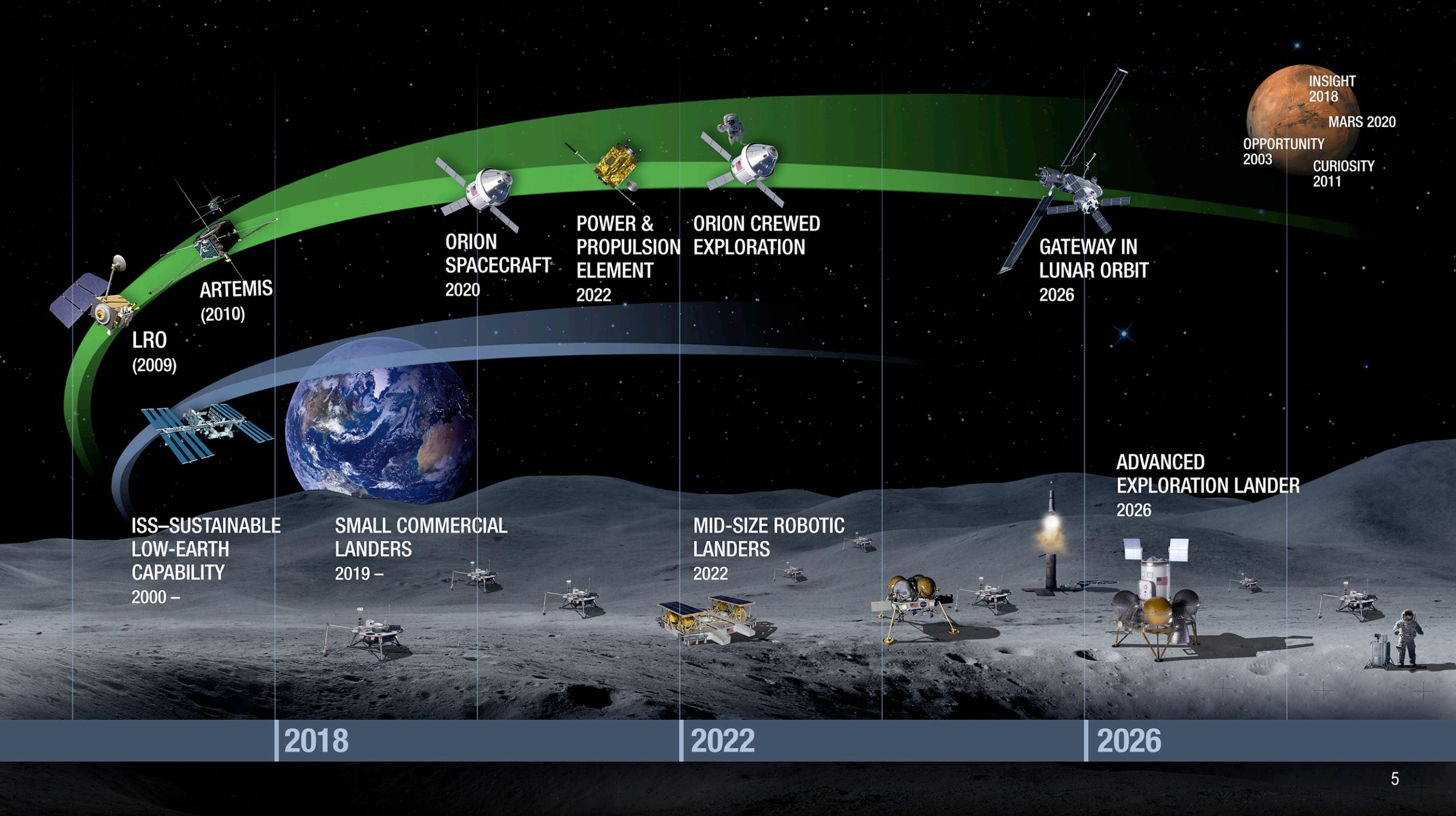
- May 5 – Launch of InSight mission to Mars
- June 27 – Hayabusa2 arrived at asteroid Ryugu
- August 16 – New Horizons begins observing Ultima Thuli
- August 17 – OSIRIS-REx begins observing Bennu
- September 21 – MINERVA-II1 of Hayabusa2 Touches Down Ryugu
- October 3 – Deployment of the MASCOT lander of Hayabusa2
- October 19 – Launch of ESA’s BepiColombo to Mercury
- November 26 – InSight landing on Mars
- December 03 – OSIRIS-REx rendezvous with Bennu

2019

- January 1 – New Horizons flyby of Kuiper Belt object Ultima Thule



NASA Exploration Campaign



LRO
(2009)

ARTEMIS
(2010)

ISS-SUSTAINABLE
LOW-EARTH
CAPABILITY
2000 -

SMALL COMMERCIAL
LANDERS
2019 -

ORION
SPACECRAFT
2020

POWER &
PROPULSION
ELEMENT
2022

ORION CREWED
EXPLORATION

MID-SIZE ROBOTIC
LANDERS
2022

GATEWAY IN
LUNAR ORBIT
2026

ADVANCED
EXPLORATION LANDER
2026

INSIGHT
2018
MARS 2020
OPPORTUNITY
2003
CURIOSITY
2011

2018

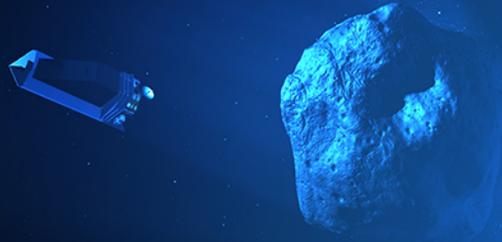
2022

2026

Planetary Defense

ASSESS

[CENTER FOR NEAR EARTH
OBJECT STUDIES]



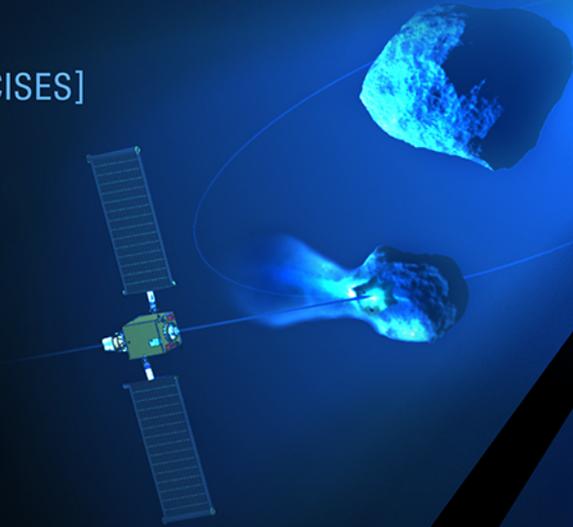
SEARCH, DETECT & TRACK

[GROUND-BASED & SPACE-BASED
OBSERVATIONS, IAWN]



MITIGATE

[DART, FEMA EXERCISES]



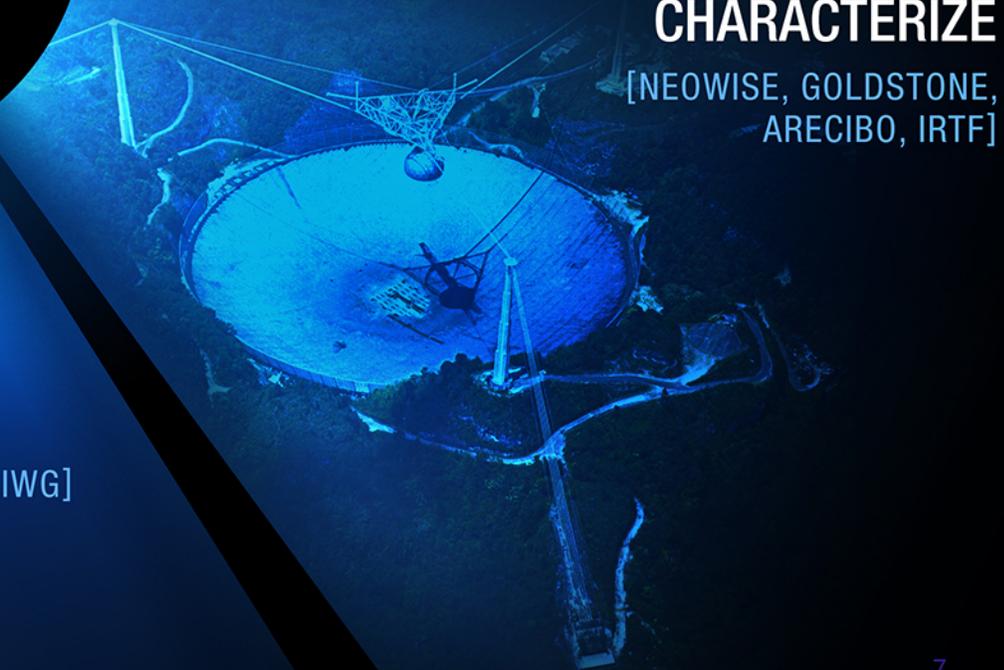
PLANETARY DEFENSE

PLAN & COORDINATE

[SMPAG, PIERWG, DAMIEN IWG]

CHARACTERIZE

[NEOWISE, GOLDSTONE,
ARECIBO, IRTF]





**NATIONAL NEAR-EARTH OBJECT
PREPAREDNESS STRATEGY AND
ACTION PLAN**

A Report by the

**INTERAGENCY WORKING GROUP FOR DETECTING AND MITIGATING
THE IMPACT OF EARTH-BOUND NEAR-EARTH OBJECTS**

of the

NATIONAL SCIENCE & TECHNOLOGY COUNCIL

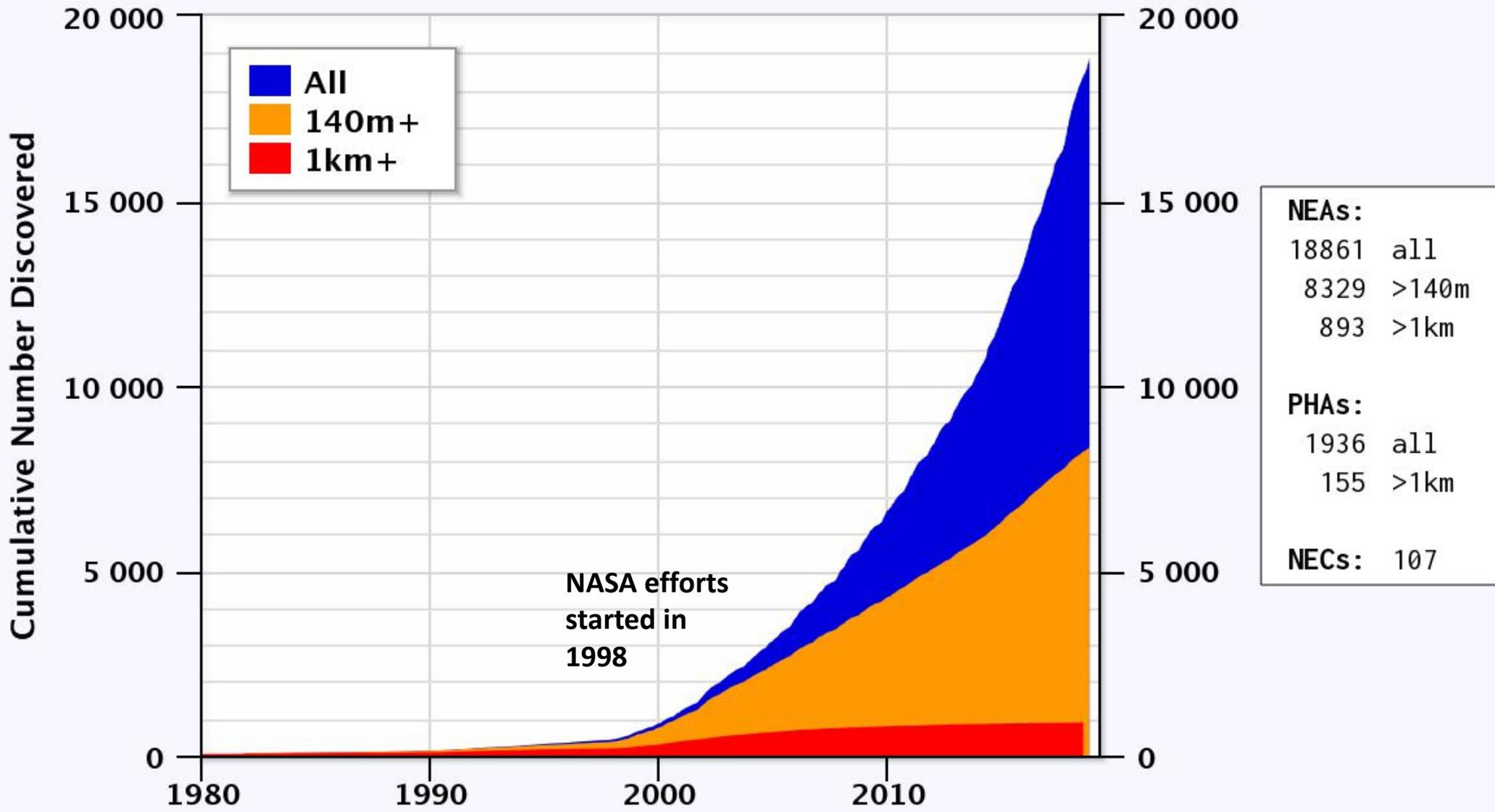
JUNE 2018

New Guidance released by White House on 20 June 2018

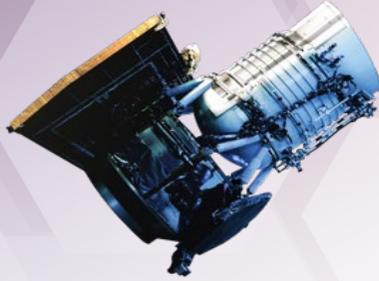
<https://www.whitehouse.gov/wp-content/uploads/2018/06/National-Near-Earth-Object-Preparedness-Strategy-and-Action-Plan-23-pages-1MB.pdf>

Near-Earth Asteroids Discovered

Most recent discovery: *2018-Oct-14*



PDCO Flight Mission Projects

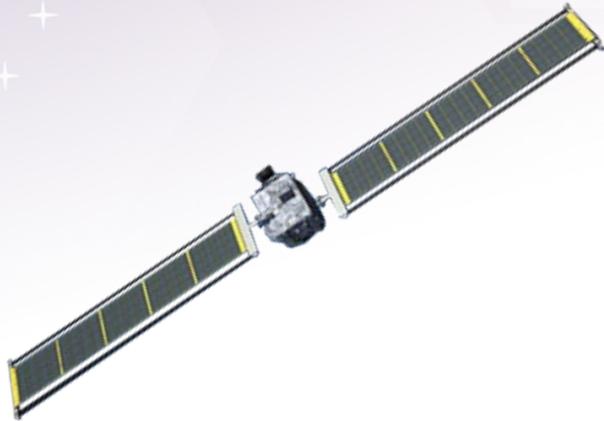


NEOWISE

- Continues in extended NEO survey operations
- Expected to exceed max useful temps in Summer 2019

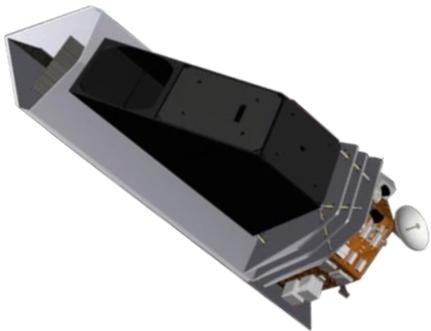
DART: Double Asteroid Redirection Test

- Demonstration of kinetic impactor technique
- Target - Moon of 65803 Didymos
- Launch NET Jun 2021, impact Oct 2022
- Completed Mission-level PDR 10-12 April 2018
- KDP-C “Confirmation” signed 16 August 2018
- CDR scheduled for June 2019



NEOCam: Near-Earth Object Camera

- Infrared survey telescope optimized for meeting congressional goal to find and characterize NEOs down to 140 meters in size
- Finished Extended Phase A Study
- SRR/MDR completed 27-28 February 2018
- Space-based infrared survey instrument development to continue.



PSD R&A Update

ROSES 18 Due Dates

Program Name	Step-1 Due Date	Step-2 Due Date
Juno PSP	<i>03/01/2018</i>	<i>04/26/2018</i>
Exobiology (EXOB)	<i>04/16/2018*</i>	<i>05/24/2018</i>
Exoplanets (XRP)	<i>03/29/2018</i>	<i>05/30/2018</i>
Emerging Worlds (EW)	<i>04/12/2018</i>	<i>06/01/2018</i>
Development & Advance of Lunar Instruments (DALI)	<i>04/03/2018</i>	<i>06/05/2018</i>
Solar System Obs. (SSO)	<i>04/05/2018</i>	<i>06/07/2018</i>
MatISSE	<i>04/18/2018</i>	<i>06/20/2018</i>
Laboratory Analysis of Returned Sample (LARS)	<i>04/26/2018</i>	<i>06/28/2018</i>
Planetary Data Archiving, Restoration, Tools (PDART)	<i>05/10/2018</i>	<i>07/12/2018</i>
Cassini Data Analysis (CDAP)	<i>06/01/2018</i>	<i>08/14/2018</i>
New Frontiers Data Analysis Program (NFDAP)	<i>06/12/2018</i>	<i>08/23/2018</i>
Instrument Concepts for Europa Exploration 2	<i>06/22/2018</i>	<i>09/07/2018</i>
Planetary Major Equipment/Facilities (PMEF)	<i>07/17/2018</i>	<i>09/17/2018</i>
Discovery Data Analysis (DDAP)	<i>08/30/2018</i>	11/01/2018
Rosetta Data Analysis Program (RDAP)	<i>08/30/2018</i>	11/01/2018
CDAP Data Release 54	<i>09/18/2018</i>	12/7/2018
PICASSO	<i>09/20/2018</i>	11/20/2018
Habitable Worlds (HW)	11/15/2018	01/17/2019
Solar System Workings (SSW)	11/15/2018*	01/31/2019
Lunar Data Analysis (LDAP)	11/29/2018	02/28/2019

Reviewers: Needed, Welcomed, Appreciated

- Reviews → Panel of your peers
- Community Involvement is Critical:
 - Quality of the review is dependent on you: the community
- Volunteer @ SARA.

<https://science.nasa.gov/researchers/volunteer-review-panels>

High Risk/High Impact Research at NASA

NAS Recommendation

- “NASA needs to investigate appropriate mechanisms to ensure that high-risk/high-payoff fundamental research and advanced technology-development activities receive appropriate consideration during the review process.” *Review of the Restructured Research and Analysis Programs of NASA’s Planetary Science Division, 2017, p. 31.*
- There is also the wide spread perception that NASA peer review, and possibly all peer review, is hostile to truly innovative, high-risk research and technology development proposals.

Data on High Risk/High Impact Proposals

- For one year, asked our peer reviewers to answer the following questions:
- **IMPACT:** How large an effect on current thinking, methods, or practice would this project have, if successful?
 - Three choices: high (H), medium (M), low (L)
- **RISK:** To what extent would this proposal test novel and significant hypotheses, for which there is scant precedent or preliminary data or which run counter to the existing scientific consensus.
 - Three choices: A great extent (G), to some extent (S), little or none (L)
- Looked at the results for 1,577 proposals submitted to ROSES-2017.

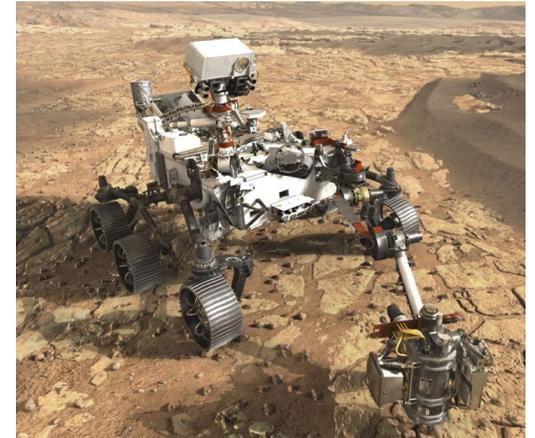
Results

- 10% of proposals in examined set were judged to be high-impact/high-risk
- 24% of all proposals (regardless of risk or impact) were selected for funding
- 35% of high-risk/high-impact proposals were selected for funding
- Merit score driven by perceived impact regardless of perceived risk
- Panel process seems agnostic to risk level for proposals judged to have high-to-moderate impact.

Mars Exploration Program

MEP News & Status

- All Operating Missions are doing well
 - Opportunity status pending outcome after dust storm subsides, we are attempting to communicate
 - MAVEN orbit adjustment (in 2019) to facilitate improved communications relay for Mars 2020
- + All Development Missions and systems are doing well
 - + • Successful Mars 2020 Systems Integration Review (SIR) and Agency KDP-D
 - Excellent technical progress
 - MOMA instrument delivered for ExoMars Rover integration
- Progressing in our technology maturation program for key technologies that would support a potential future Mars Sample Return (MSR) mission
- Beginning preparations for the next Decadal; considering studies and roadmap activities

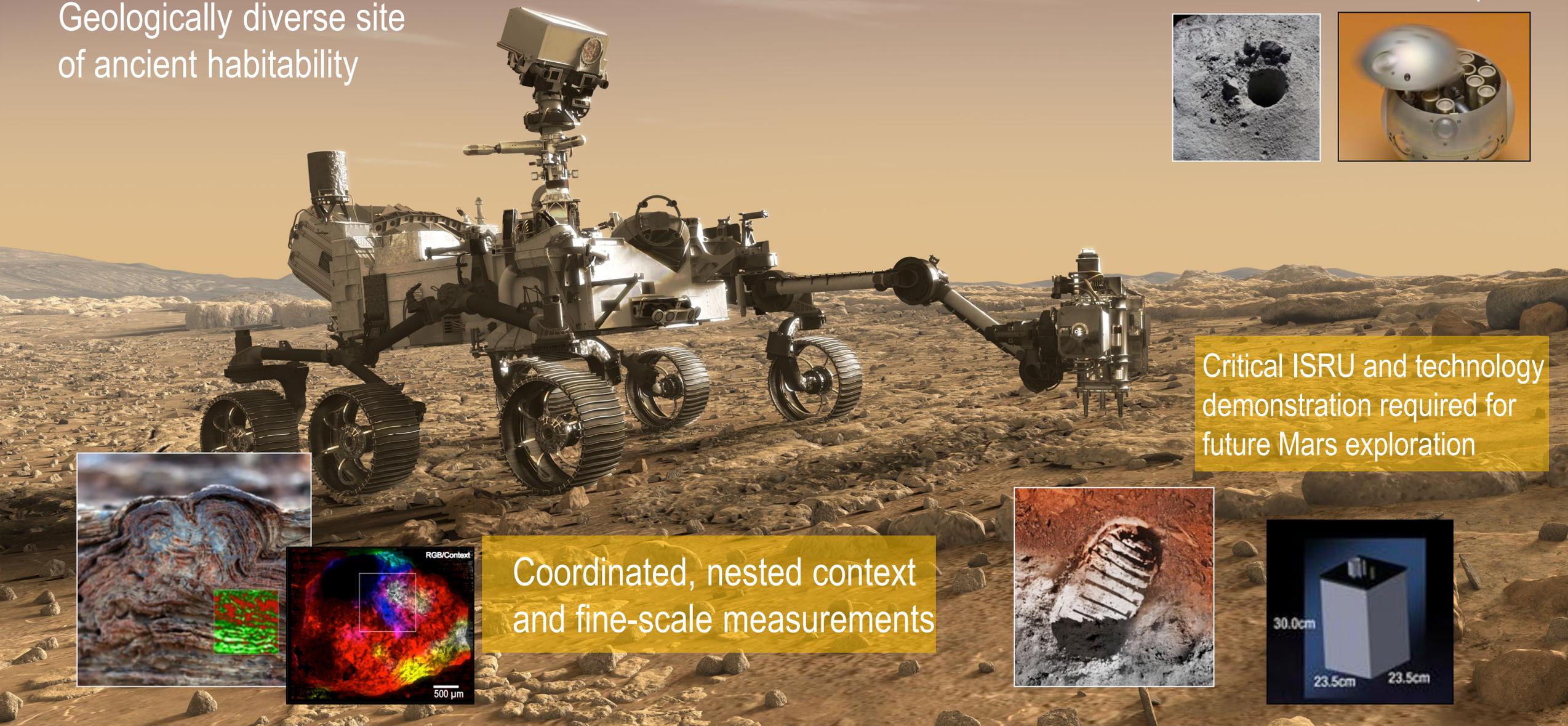




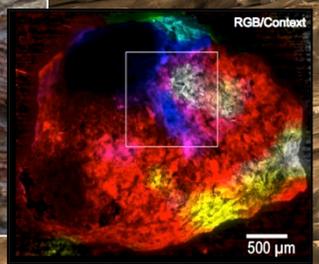
Seeking Signs of Life: Mars 2020 Rover

Geologically diverse site
of ancient habitability

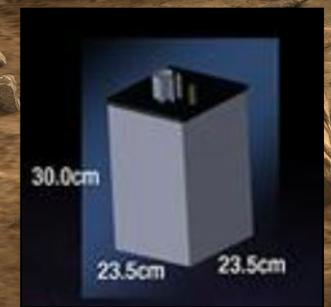
Returnable cache of samples

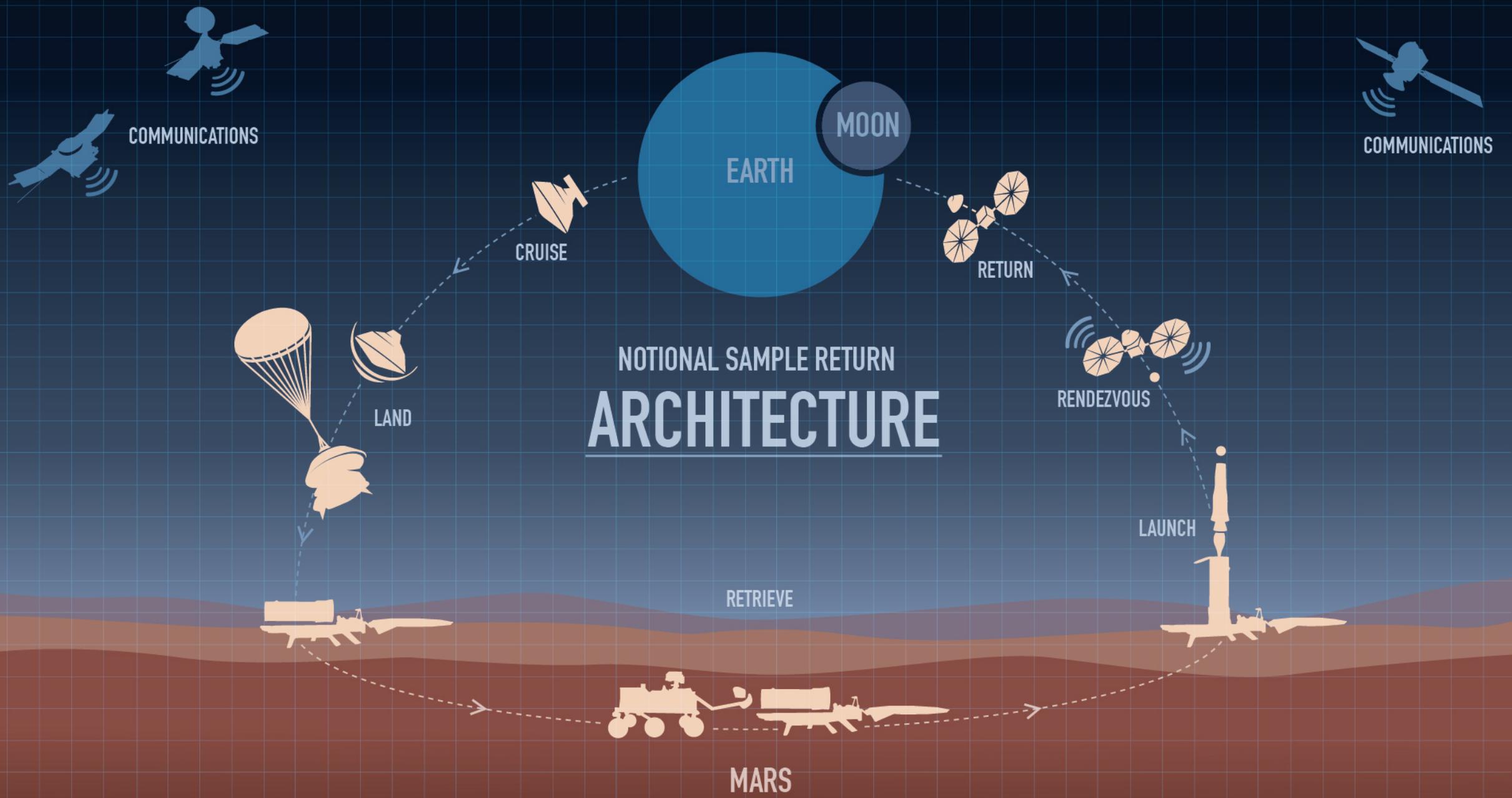


Critical ISRU and technology
demonstration required for
future Mars exploration



Coordinated, nested context
and fine-scale measurements





Discovery Program

Discovery Long-Range Planning

- Cost Cap ~\$495M Phase A-D (FY19) excluding LV
- May propose the use of radio-isotope power systems (RPS)
- May include radioisotope heater units (RHUs)

Release of draft AO	October 2018 (target)
Release of final AO	February 2019 (target)
Pre-proposal conference	~3 weeks after final AO release
Proposals due	90 days after AO release
Selection for competitive Phase A studies	December 2019 (target)
Concept study reports due	November 2020 (target)
Down-selection	June 2021 (target)
Launch readiness date	Latter half of 2020's

New Frontiers Program

New Frontiers 4 AO

Investigations (listed without priority)

- Comet Surface Sample Return
 - Lunar South Pole-Aitken Basin Sample Return
- Ocean Worlds (Titan, Enceladus)
 - Saturn Probe
 - Trojan Tour and Rendezvous
 - Venus In Situ Explorer

12 Proposals received on April 28, 2017

Step-1 Selections Announced December 2017

Phase A Concept Study Reports due..... December 2018

Down selection for Flight (target)..... July 2019

Launch Readiness Date..... NLT December 31, 2025

Oceans Worlds

Europa Clipper

- Preliminary Design Review conducted August 20 – 24
- The Standing Review Board Highlighted:
 - The Europa Clipper Team is exceptional
 - The payload complement is very robust with margin against the Level 1 requirements
 - The system approach and design is sound
 - Most areas met requirements for a PDR, with the exception of the Solar Array design which has not yet passed it's PDR, and the associated accommodation of radar on the solar array
 - This mission is as complex as it is exciting
- Programmatic analysis continues with multiple independent cost and schedule estimates in development
- At this time we expect the Mission to come forward for a Confirmation Review in spring, 2019.

NASA Astrobiology Institute

Building a Research Collaboration Network

NASA SMD is committed to interdisciplinary and interdivisional research:

- There are numerous ways to stimulate and support this type of research
- NAI is one, another is NExSS which is based on a Research Collaboration Network (RCN) model

NAI cutting-edge nature and the collaborations it fostered play a critical role in:

- Growing the astrobiology discipline and community
- Leading the international astrobiology community for much of its 20 years of existence

NExSS experiment has proven itself and a key reason is that it is run by the community itself

Recent NAS reports

- Exoplanet Science Strategy (Sept 2018)
 - Finding: The search for life outside the Solar System is a fundamentally interdisciplinary endeavor. The Nexus for Exoplanet Systems Science (NExSS) research coordination network encourages the cross-disciplinary and cross-divisional collaborations needed to support NASA exoplanet research and missions.
 - Recommendation: Building on the NExSS model, NASA should support a cross-divisional exoplanet research coordination network that includes additional membership opportunities via dedicated proposal calls for interdisciplinary research.
- An Astrobiology Strategy for the Search for Life in the Universe (Oct 2018)
 - Finding: Cross-divisional collaborations promoted by NASA's Astrobiology Program between Earth science, astronomy, heliophysics, and planetary science have begun the task of breaking down disciplinary entrenchments and are helping the astrobiology and exoplanet communities reach their full potential
 - Recommendation: NASA's programs and missions should reflect a dedicated focus on research and exploration of subsurface habitability in light of recent advances demonstrating the breadth and diversity of life in Earth's subsurface, the history and nature of subsurface fluids on Mars, and potential habitats for life on ocean worlds.
 - Recommendation: To advance the search for life in the universe, NASA should accelerate the development and validation in relevant environments, of mission-ready, life detection technologies. In addition, it should integrate astrobiological expertise in all mission stages—from inception and conceptualization, to planning, to development, and to operations.

NASA Planetary Exploration Science Technology Office (PESTO)

Planetary Exploration Science Technology Office (PESTO)

HQ office managed at GRC to:

Recommend technology investment strategy for future planetary science missions

- Instruments
- Spacecraft Technology
- Mission Support Technology

Manage PSD technology development (non-mission specific, non-nuclear)

- PICASSO, MatISSE, HOTTech, COLDTech, DALI, SESAME...

Coordinate planetary science-relevant technologies

- Within PSD, SMD, STMD, HEOMD...

Promote technology infusion

- Infusion starts before solicitations are written, ends with mission adoption

Technology Investment Goal: Per the Decadal, 6-8% of Planetary Science Division budget \$110-150M per year for technology, excluding infrastructure investments or sustainment



Lori Glaze
PSD Division Chief (acting)

David Schurr
PSD Deputy Division Chief

Bryan Smith
Space Flight Systems Director

Tibor Kremic
GRC Science Office Chief

Len Dudzinski
PSD Chief Technologist

Jonathan Rall
PSD R&A Director

Planetary Exploration Science Technology Office
Headquarters Office, Managed at Glenn

Carolyn Mercer – Propulsion, Autonomy
Jim Gaier – Instruments
Stephen Rinehart – Instruments, Science
Pat Beauchamp – Mars, Planetary Protection
Rainee Simons – Instruments, Communications
Dave Anderson – Structures/Materials, Financial
Ryan Stephan – Heat Shields, Ice Mechanisms, Lunar
Quang-Viet Nguyen – Precision Landing, Electronics, Computing

***Ad Hoc members
for Strategy
Florence Tan
Stephanie Getty***

PICASSO
Jim Gaier

MatISSE
Rainee Simons

HOTTech
Viet Nguyen

COLDTech
Ryan Stephan

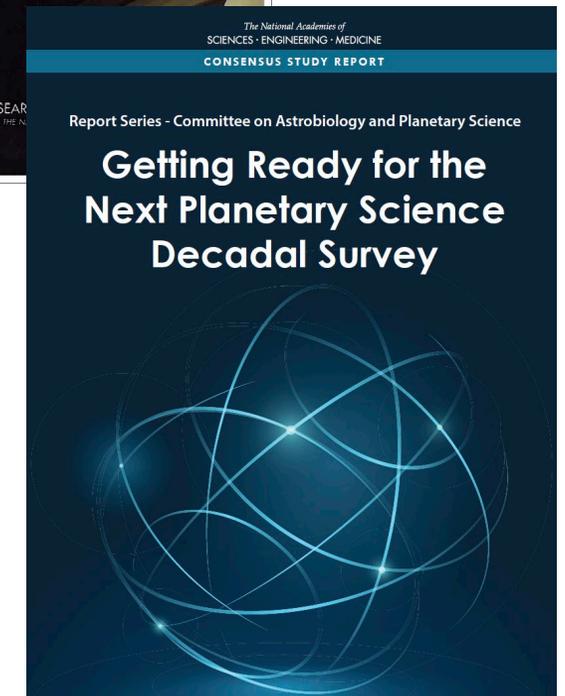
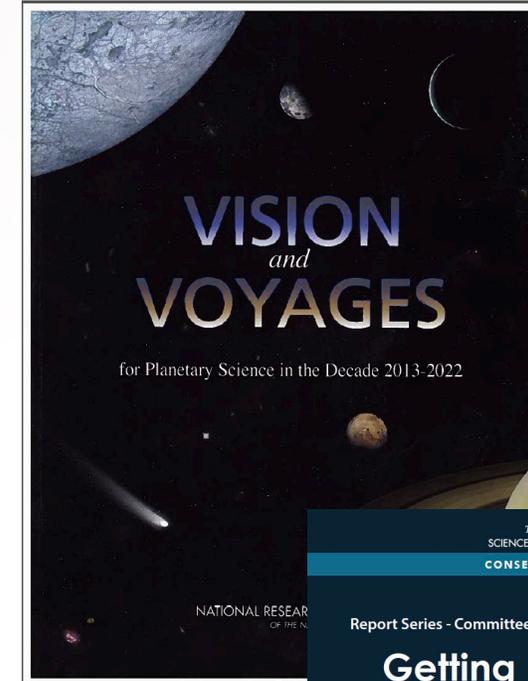
DALI
Jim Gaier

SESAME
Ryan Stephan

NASA Planetary Science Studies

Timeline of Studies

- 1st Planetary decadal: 2002-2012
- 2nd Planetary decadal: 2013-2022
- CubeSat Review: Completed June 2016
- Extended Missions Review: Completed Sept 2016
- R&A Restructuring Review: Completed June 2017
- Searching For Life : Completed Sept 2017
- Large Strategic Science Missions: Completed Aug 2017
- Midterm evaluation:
 - Tasked August 26, 2016
 - Above NAS studies will be input
 - Report to NASA released in August 2018
- Sample Analysis Investment Strategy
 - Started November 2017
- 3rd Planetary Decadal: 2023-2032
 - To be tasked *before* October 2019
 - Expect report to NASA due 1st quarter 2022
- CAPS reviewed completed studies and recommended several more to be completed



Plan for Conducting Pre-Decadal Mission Concept Studies

- Ceres study has been initiated at JPL
 - SDT members are being vetted per FACA requirements
- Mars Sample Return architecture studies are underway
- Propose to conduct remaining studies through a competed ROSES opportunity for science teams
 - Approximately 6-12 months duration studies, staggered
 - Support for ~2 face-to-face meetings and ~2 Team runs
 - Requirement for community updates at Analysis Group meetings and/or town halls as well as at a final Findings Workshop
 - Final reports, including advocacy cost estimates, to be provided to the Decadal Survey as input

Reminder

We Are All Responsible For Addressing Harassment In The Workplace.

- Anti-harassment message from NASA Associate Administrator for the Science Mission Directorate *Thomas H. Zurbuchen*
- Thank you to PEN, LPI, and DPS for helping to disseminated to the Planetary Community
- Already received positive feedback form Community.

“.... relentlessly passionate about: building effective and innovative teams that achieve amazing results for NASA Science.

.... To achieve excellence, we need focus and commitment from the best and brightest of all backgrounds.

.... This goes hand-in-hand with my strong belief in the value and imperative of diversity and inclusion....”

QUESTIONS ?

