

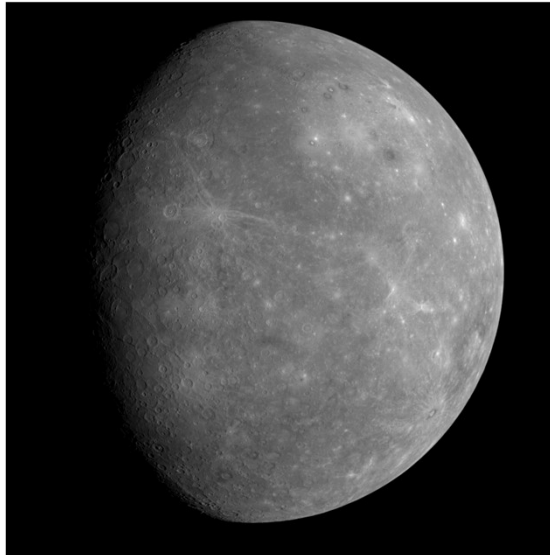


Mercury science & exploration update

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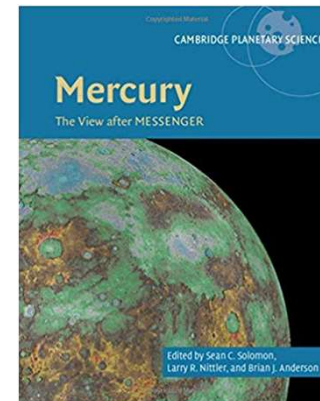
Mercury exploration to date

- ▶ Mariner 10 (NASA)
 - ▶ Three Mercury flybys (1974-75)
- ▶ MESSENGER (NASA)
 - ▶ Three Mercury flybys (2008-09)
 - ▶ 3.5-year orbital mission (2011-15)
- ▶ BepiColombo (ESA/JAXA)
 - ▶ Launched October 2018
 - ▶ Currently in cruise phase, with several upcoming milestones:
 - ▶ Earth flyby (April 2020)
 - ▶ two Venus flybys (October 2020 & August 2021)
 - ▶ six Mercury flybys (October 2021, June 2022, June 2023, September 2024, December 2024, January 2025)
 - ▶ Orbit insertion December 2025, one-year nominal mission



Recent Mercury science

- ▶ **Mercury: The View After MESSENGER** (Ed. Solomon, Nittler & Anderson), published by Cambridge University Press in 2018
 - ▶ 20 chapters, written mostly by MESSENGER Science Team members
- ▶ Elements Magazine 'Planet Mercury' issue (Ed. Charlier & Namur), February 2019
- ▶ Genova et al., 2019, **Geodetic evidence that Mercury has a solid inner core**, Geophys. Res. Lett.
- ▶ Rubanenko et al., 2019, **Thick ice deposits in shallow simple craters on the Moon and Mercury**, Nat. Geosci.
- ▶ Peplowski & Stockstill-Cahill, 2019, **Analytical identification and characterization of the major geochemical terranes of Mercury's northern hemisphere**, JGR Planets



Mercury community

- ▶ Mercury conferences
 - ▶ Current and future science of the innermost planet was held in May 2018 (Columbia, MD)
 - ▶ From MESSENGER to BepiColombo will be held in 2020 (June 2-4, Orleans, France)
- ▶ Mercury-focused conference sessions
 - ▶ AGU Fall Meeting 2019, Mercury: The continuing and future exploration of the innermost planet
 - ▶ DPS/EPSC 2019, Mercury science and observation
 - ▶ LPSC 2019, Mercury: magnetism, magma and more
- ▶ Mercury email list-serve: started in 2018, now has ~140 members
- ▶ Community White Paper (2018): On the Case for Landed Mercury Exploration and the Timely Need for a Mission Concept Study (68 signatories)



BepiColombo AO for IDSs and GIs

- ▶ AO for Interdisciplinary Scientists (IDSs) and Guest Investigators (GIs) in the BepiColombo mission
 - ▶ Released May 2019 (proposal deadline July 15, 2019)
 - ▶ Purpose: “to augment the scientific return of the mission as a whole”
 - ▶ IDS role: Expected to focus on scientific cross-fertilization (should cover science themes rather than instrument-specific domains); expected to be heavily involved in scientific activities of mission
 - ▶ GI role: Individual scientists wishing to make use of the data collected by one/more instruments; expected to spread use of, and complement, BepiColombo data more widely in the planetary science community
 - ▶ Up to six IDSs and 11 GIs may be appointed, for initial period of three years (renewable)
 - ▶ Open to proposers based in ESA Member states, Japan, and the USA
 - ▶ NASA funding available to selected US-based investigators: up to one US IDS and two US GIs likely to be appointed (level of funding will be dependent upon the outcome of the budget process)



BepiColombo AO for IDSs and GIs

- ▶ 30 compliant IDS proposals received
 - ▶ 19 proposals (63%) from US-based scientists
- ▶ 37 compliant GI proposals received
 - ▶ 28 proposals (76%) from US-based scientists
 - ▶ 8 proposals (22%) focused on Venus or cruise-phase science
- ▶ Maximum selection rates for US-based scientists:
 - ▶ IDS: 17%
 - ▶ GI: 18%
- ▶ ESA/JAXA review ongoing; appointments likely to be confirmed by November 2019
- ▶ Additional AOs later in the mission are a possibility



High-priority questions for Mercury

- ▶ July 2019: Lori Glaze asked Analysis Group Executive Secretaries to contact their AGs to gauge each group's highest priority questions (to compare with six general planetary science 'big' questions being considered in structuring the upcoming Decadal Survey)
- ▶ As Mercury remains the only major Solar System body without its own Analysis Group, Shoshana Weider asked (upon direction from Lori Glaze) Steven Hauck (Case Western Reserve University), as a representative of the Mercury community, to coordinate the community's response
- ▶ Steven Hauck assembled an *ad hoc* committee of nine others:

David Blewett (APL)	Paul Byrne (NCSU)
Nancy Chabot (APL)	Carolyn Ernst (APL)
Catherine Johnson (University of British Columbia)	Erwan Mazarico (GSFC)
Jim Raines (University of Michigan)	Kathleen Vander Kaaden (JSC)
Ronald Vervak (APL)	
- ▶ *Ad hoc* committee then engaged the wider Mercury community via an online survey (distributed on list-serves and social media)
 - ▶ Received >30 responses (beyond the *ad hoc* committee) within a week

High-priority questions for Mercury

- ▶ Survey results indicated six Mercury-focused questions are of high priority to the planetary science community:
 - ▶ How did Mercury form?
 - ▶ How did Mercury differentiate and acquire its interior structure?
 - ▶ What is the history of Mercury's magnetic field and its generation?
 - ▶ How do Mercury's surface and interior reflect the evolution of the planet?
 - ▶ What is the nature of the complex interactions among Mercury's external drivers and the planet's magnetosphere, exosphere, surface, and interior?
 - ▶ What is the origin, history, and inventory of Mercury's volatiles?

High-priority questions for Mercury

		Mercury questions					
		Formation?	Differentiation & interior?	Magnetic field?	Surface/ interior & evolution?	Magnetosphere, exosphere, surface, and interior interactions?	Volatiles?
General planetary questions	Life elsewhere?						
	Habitability?				1		1
	Formation & evolution of planetary bodies?	3	3	3	3	3	3
	Surfaces/geology?	2	2	2	3	3	3
	Atmospheres?					3	2
	Interiors & surface/ atmosphere interactions?		3	2	3	3	3

1: Weak link

2: Some link

3: Strong link

Summary

- ▶ Mercury science continues to flow in the wake of MESSENGER and in the lead up to BepiColombo's orbital mission
- ▶ There is substantial interest in Mercury science and exploration within the planetary science community
- ▶ The review of proposals to the BepiColombo AO for IDs and GIs is ongoing
 - ▶ The level of funding to support US investigators will be dependent upon the outcome of the budget process
- ▶ An *ad hoc* committee has recently provided six high-priority Mercury-focused science questions to help guide Decadal Survey planning
- ▶ PAC has previously (2018) recommended the creation of an analysis group
 - ▶ Steps to create the 'Herman Analysis Group' (Hag) are underway (e.g., working on defining Terms of Reference)