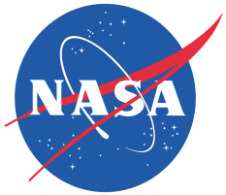
What We Learnt About Mercury: From MESSENGER to BEPI-COLOMBO

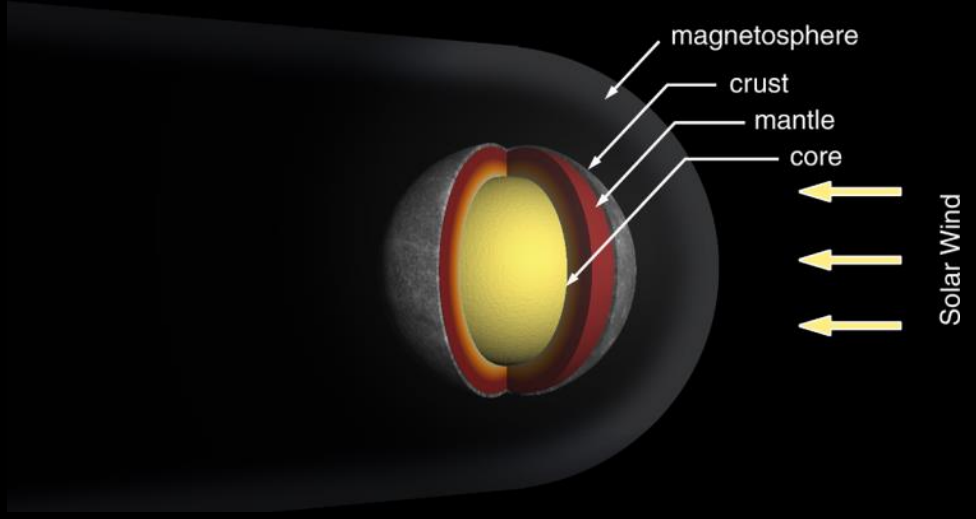
A Little About Myself

- Went to U.S after NS in 2010 for college
- Graduated from University of Colorado in Physics and Astronomy
  - First MESSENGER research project with Prof. Daniel Baker at CU LASP
- Started PhD program (space science/plasma physics) at University of Michigan in 2012
  - Finished my dissertation on Mercury's magnetosphere with Prof. James Slavin and Prof. Xianzhe Jia in 2017
- Postdoctoral position in the Planetary Magnetosphere Lab at NASA GSFC since 2018.
- Research Topics: Data Analysis, Space Plasma Physics, Planetary Science, Space Weather, Earth's (and planetary) magnetosphere, Heliophysics



Partner

Mercury



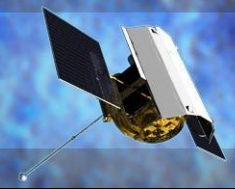
- Internal Structure:
  - Radius ~ 2440 km.
  - Iron core radius ~ 2000 km

- Celestial Mechanics
  - Mercury has the most eccentric orbit in the Solar System (e ~ 0.21) with perihelion and aphelion ~ 0.31 and 0.46 AU, respectively.
  - Slow rotator with a 59-days rotation period.
  - Full orbit around the Sun every 88 Earth days

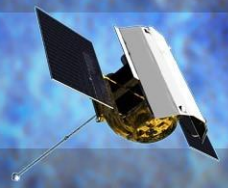
- Discovery of a global dipole magnetic field by Mariner 10.
  - Dipole tilt relative to spin axis ~ zero degrees.
  - Southward pointing dipole moment (similar to Earth) that is 1/100th intensity of Earth's.
  - The center of dipole field has a northward offset of ~ 484 km.
  - Interaction of Mercury's weak dipole field with intense solar wind conditions creates a small, intrinsic and dynamic Earth-like magnetosphere.

MESSENGER

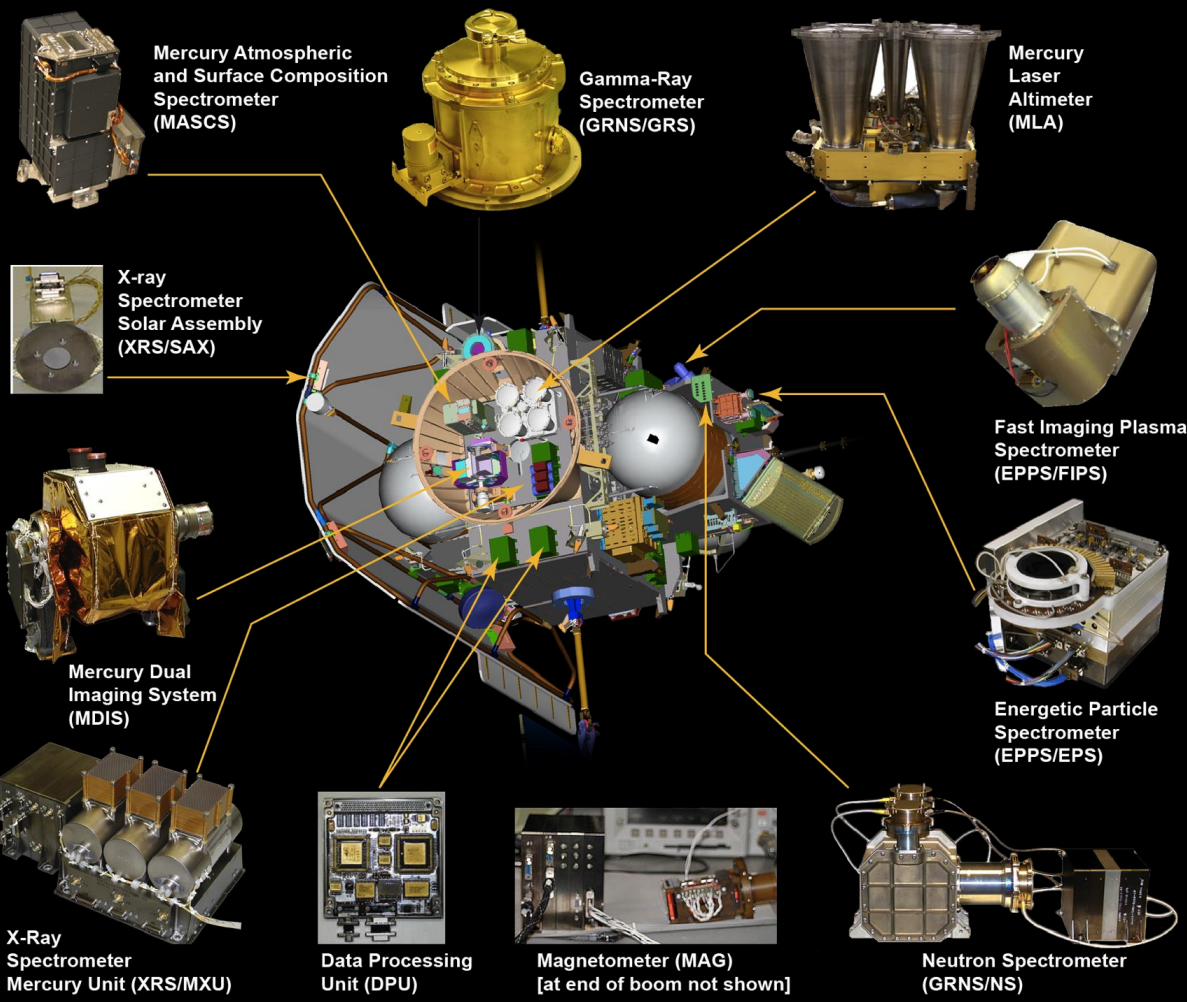
MErcury Surface, Space ENvironment, GEochemistry, and Ranging



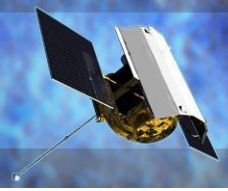
- **ME**cury, **S**urface, **S**pace **EN**vironment, **GE**ochemistry and **R**anging (MESSENGER)
- ~$300 million Discovery-Class NASA mission
- Launched on a Delta II rocket from Cape Canaveral Air Force Station on 3rd August 2004.
- Begin its 6.6 years long journey to Mercury with multiple Earth, Venus and Mercury flybys.
  - Went into orbital insertion on 18th March 2011 and become the first spacecraft to orbit Mercury.
- Put into a near polar (~ 80 degrees), highly elliptical, 12-hour orbit during the primary mission.
  - Periapsis ~ 200 km & Apoapsis ~ 15,000 km.
  - Orbit was changed into a 8-hour orbit during the extended phase of mission.
- Mission ended with MESSENGER crashing into Mercury's surface on 30th April 2015.

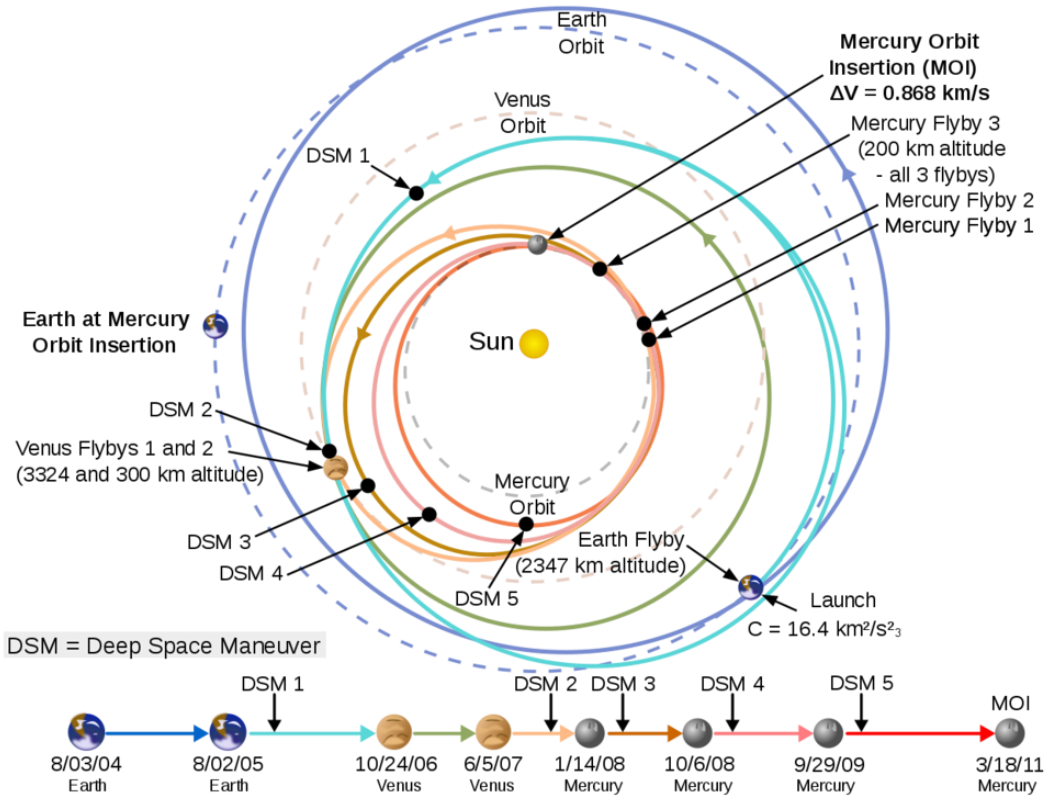


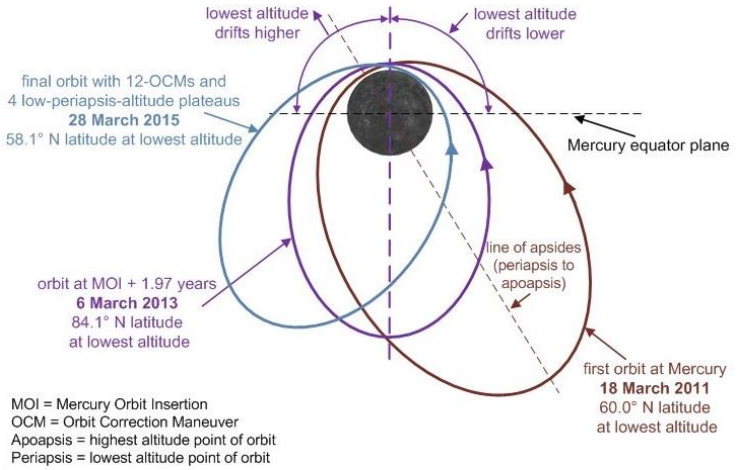
MESSENGER Instrument Suites



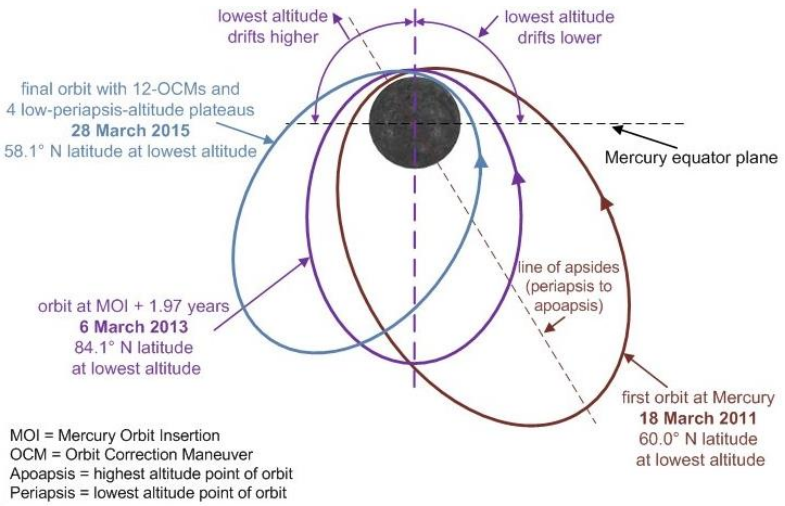
http://messenger.jhuapl.edu/About/Spacecraft-and-Instruments.html

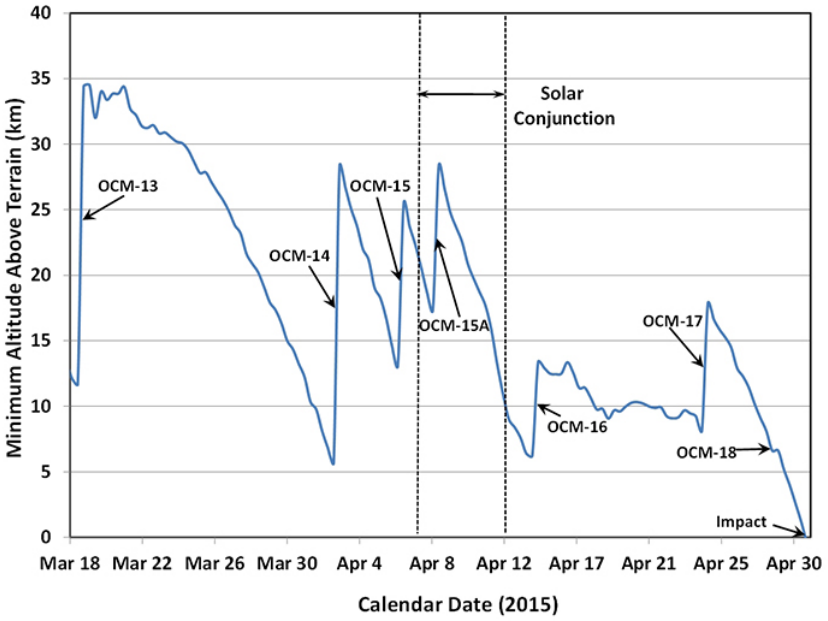


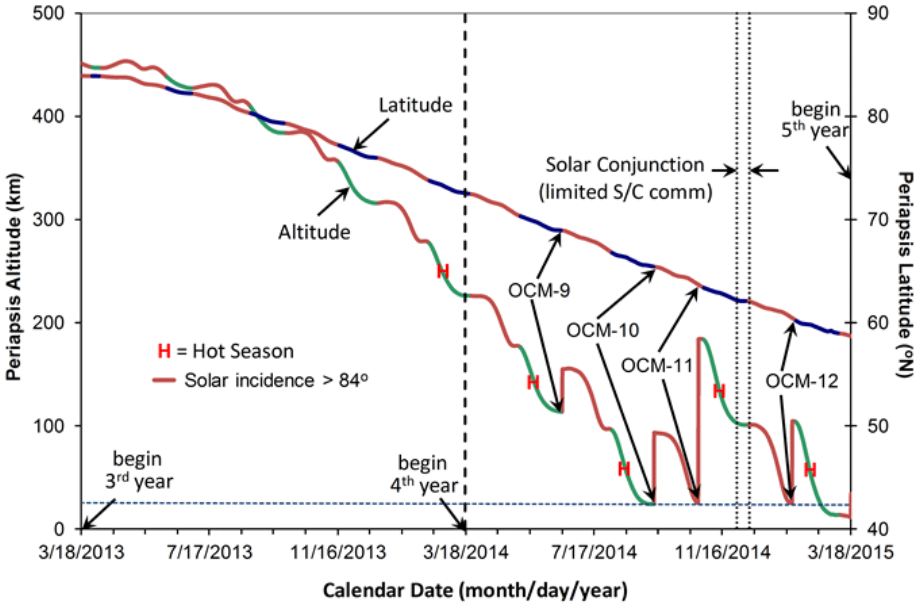




Figures from http://messenger.jhuapl.edu



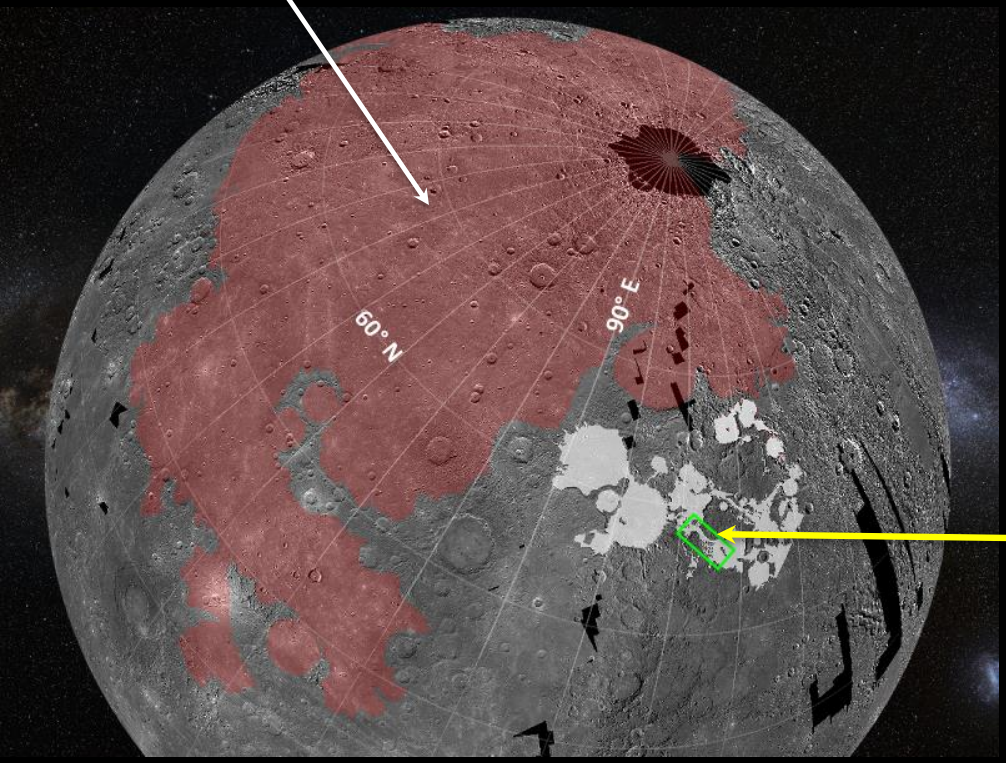


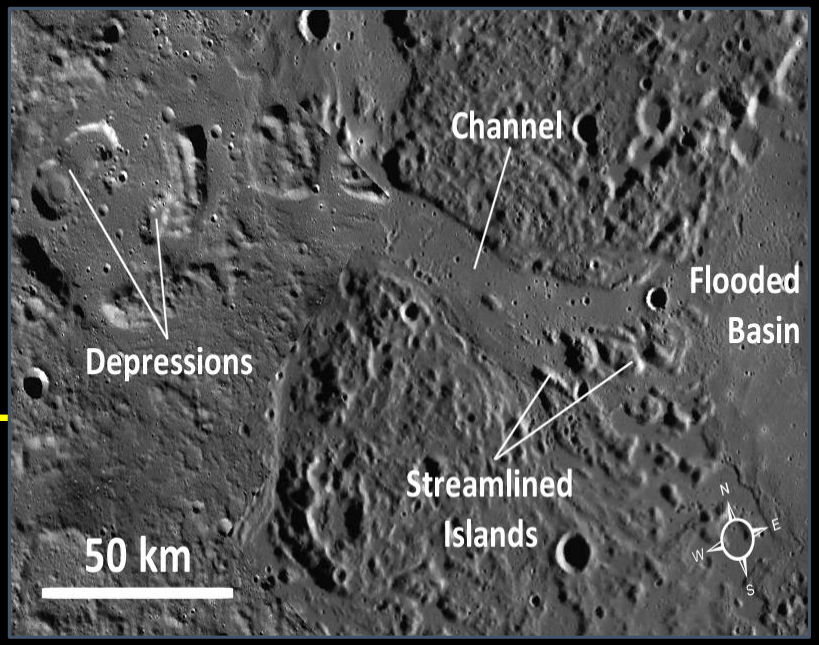


Figures from http://messenger.jhuapl.edu

Geologic History: Widespread Volcanism

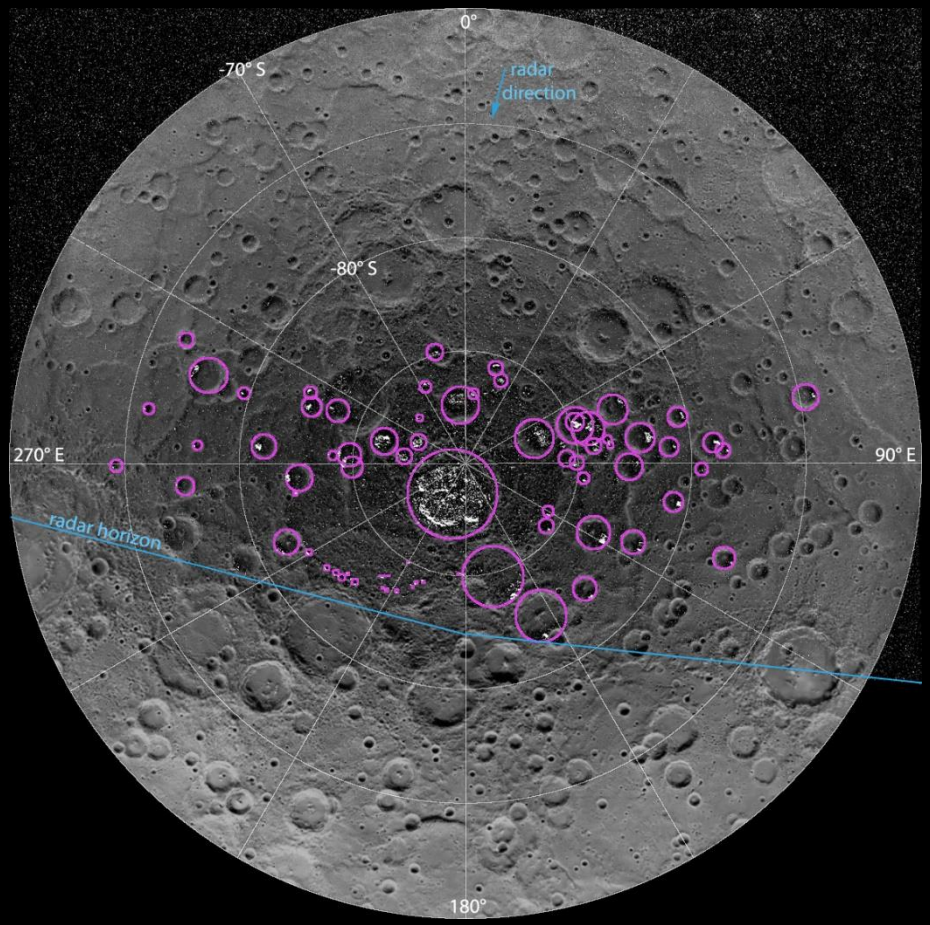
Northern Plains



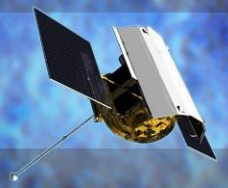


Head et al. [2011]

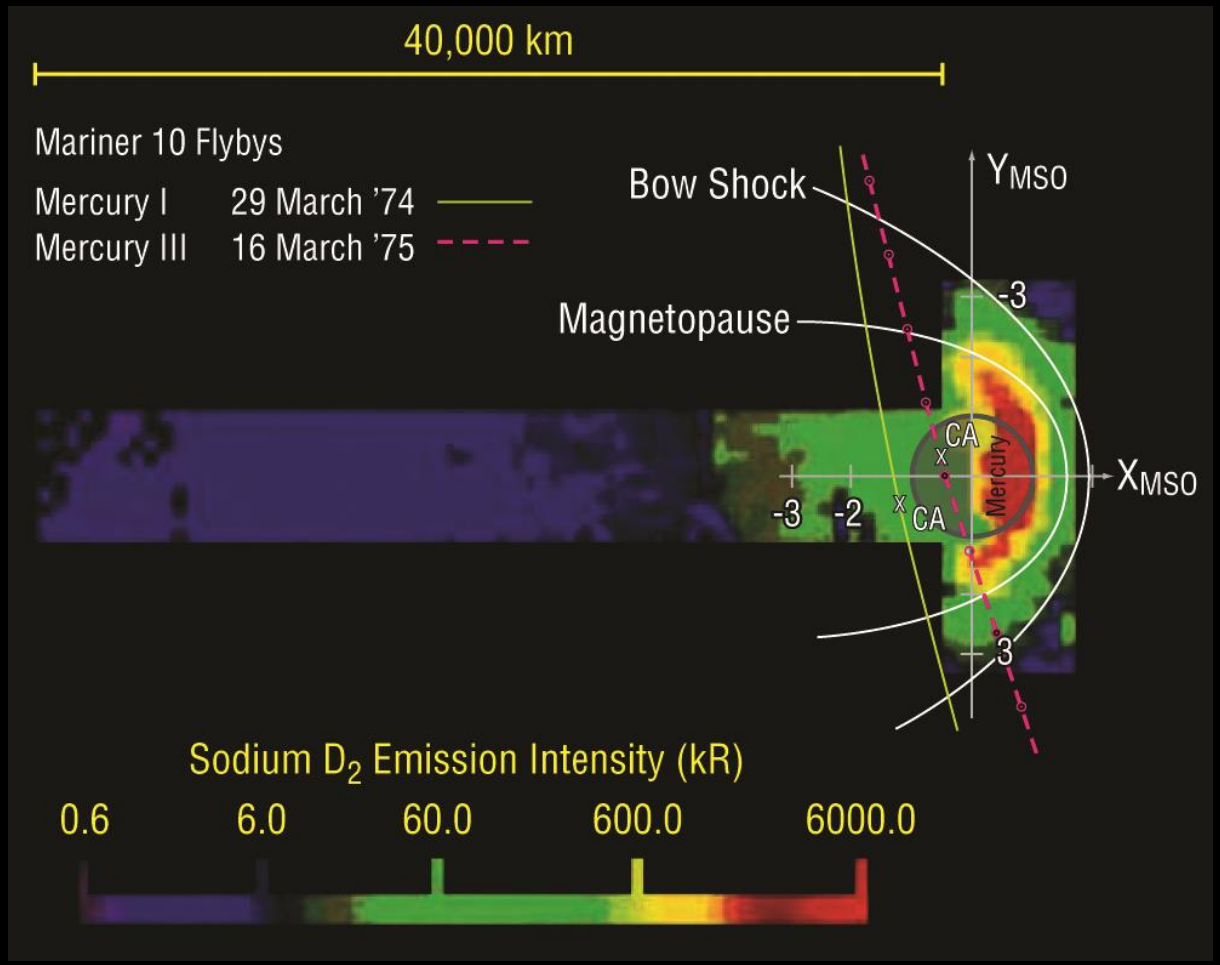
Ice in Permanently Shadowed Craters



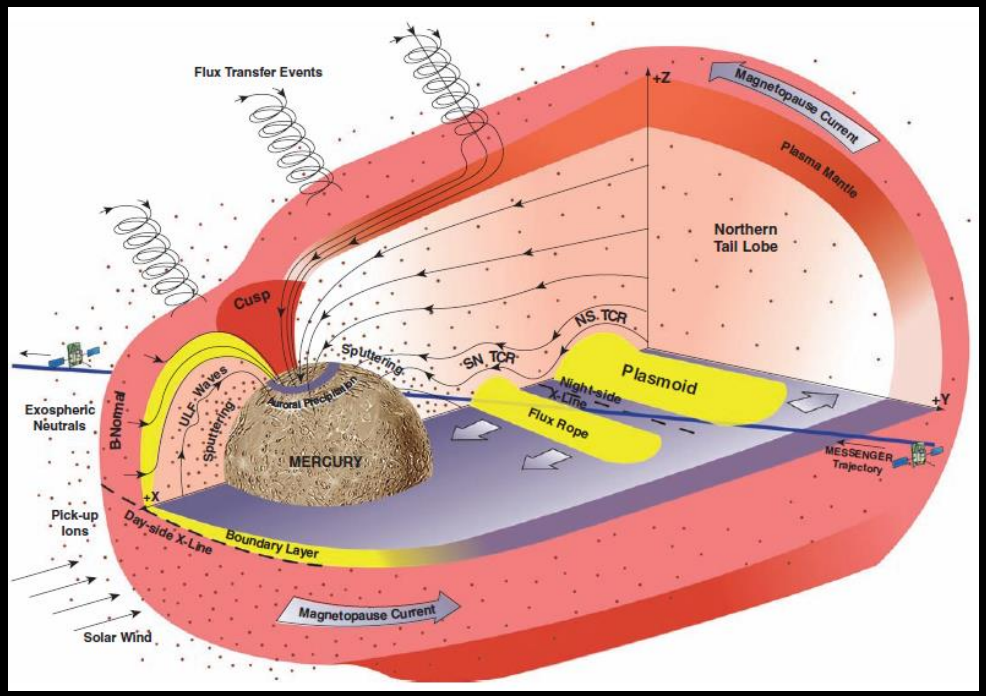
Chabot et al. [2012]

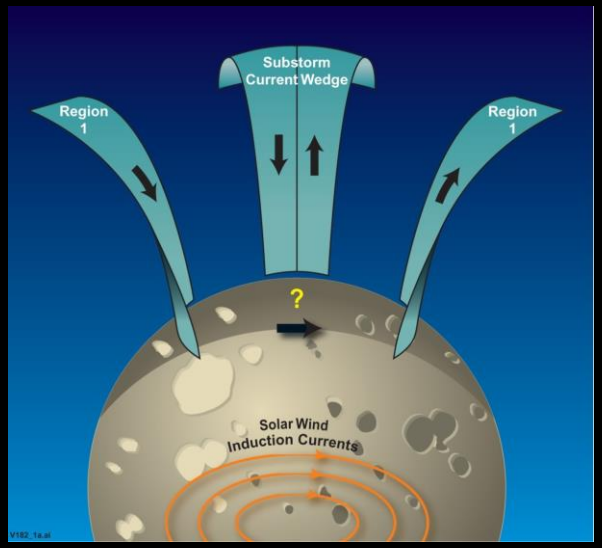


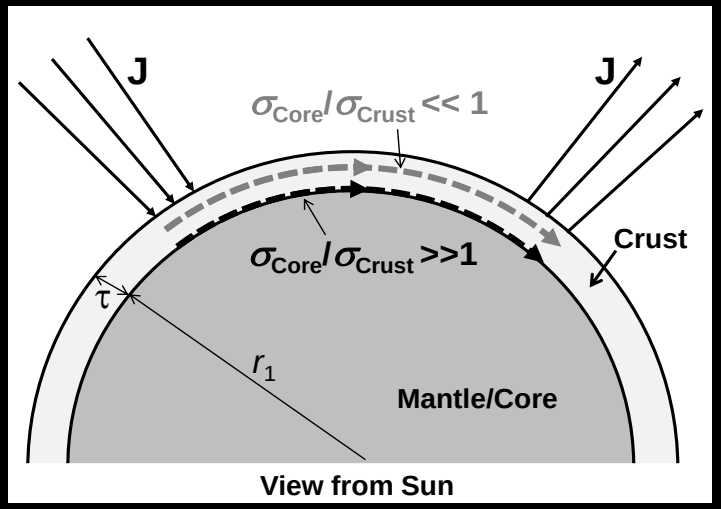
Mercury's Sodium Exosphere and Tail



Most Dynamic Magnetosphere in the Solar System







Slavin et al. [2007; 2009]
Anderson et al. [2014]

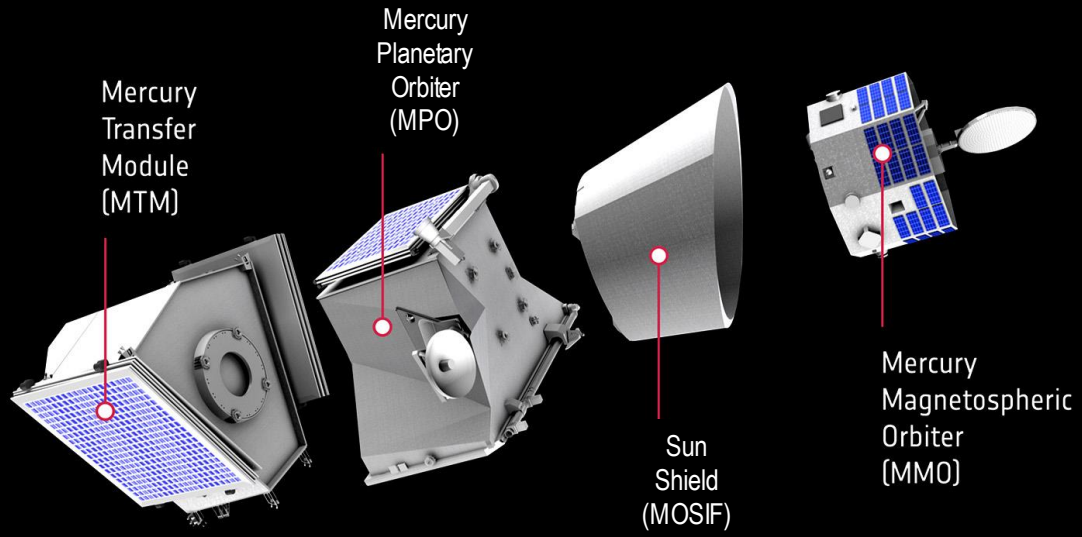
bepicolombo

ESA & JAXA Flagship

Launched From ESA Spaceport at French Guiana on October 20th 2018 on a Ariane 5 rocket

Currently on a 7 year journey to Mercury. Set to arrive around 2026.

First Mercury Flyby coming up in October 2021.

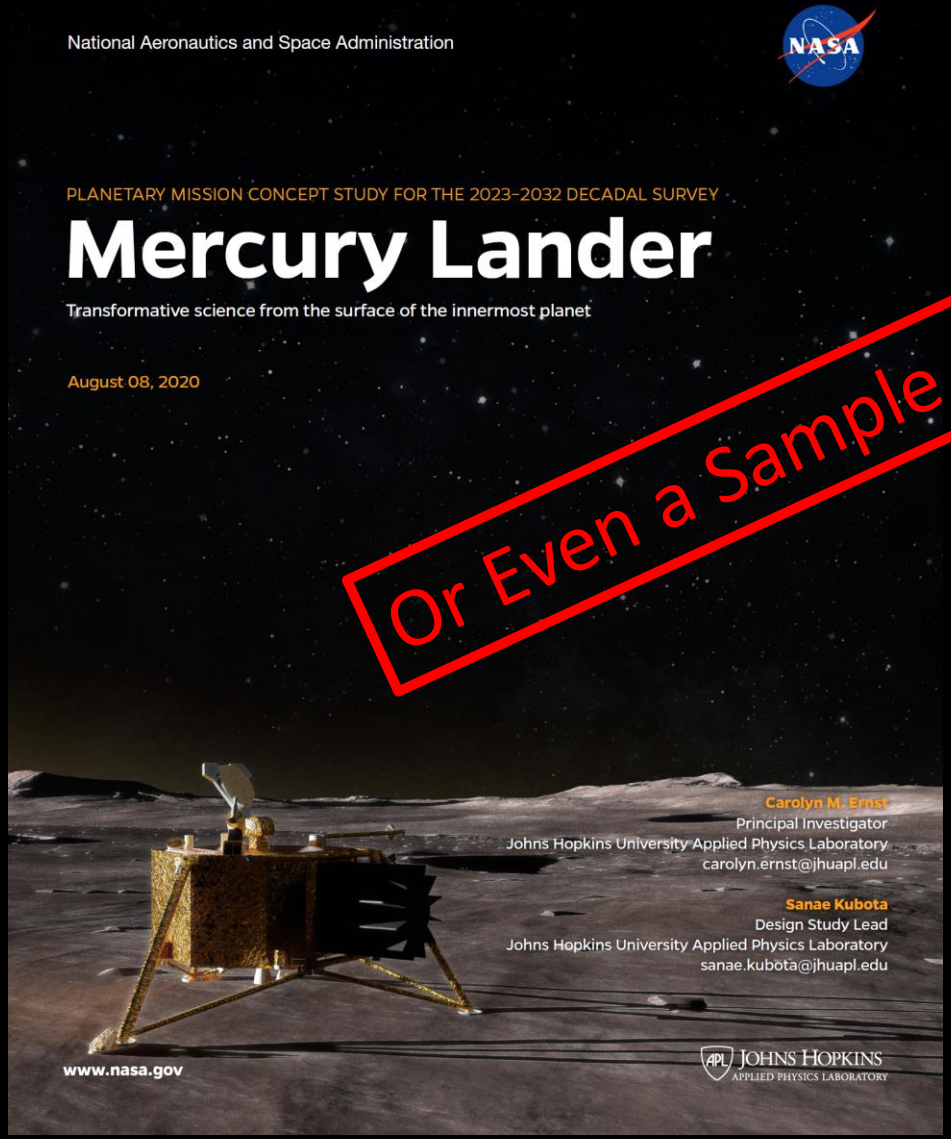


Mercury Composite Spacecraft (MCS)

bepicolombo

Credit: http://www.airbus.com/space/space-exploration/bepicolombo.html

What's after Bepi-Colombo?



http://science.nasa.gov/science-red/s3fs-public/atoms/files/Mercury%20Lander.pdf