

First Investigations of Plasma Waves around Mercury during the 1st and 2nd Flybys observed by PWI aboard BepiColombo Mio spacecraft

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The Plasma Wave Investigation (PWI) [1] aboard the Mio spacecraft of BepiColombo, ESA-JAXA joint mission to Mercury was launched in 2018. The PWI will deploy all sensors after the orbit insertion at the end of 2025. The full observational capabilities of electric fields, plasma waves, and radio waves enables the measurement of electron density and temperature, electromagnetic turbulences, and radio waves in and around the Hermean magnetosphere and exosphere, in the electric field from DC to 10 MHz along the spin plane and in the magnetic field from 0.3 Hz to 20 kHz in three-axis and from 2.5 kHz to 640 kHz in one-axis.

During the cruising phase from its launch in 2018, unfortunately, long wire antennas (15-m x 4) for electric fields and the solid boom (4.5-m) for magnetic fields are not yet deployed. For electric field, one of the antenna pairs, WPT, is exposed to space, but with the length of few cm and grounded to the spacecraft body with several k-ohm. For magnetic field, the search-coils are active but under large noise environment from the spacecraft body. Although under such severe conditions, the PWI saw plasma waves around Mercury during the 1st and 2nd flybys in Oct. 2021 and June 2022 (**Fig. 1**). In this paper, we show this ‘first historical measurements’, with the results from the 3rd flyby in June 2023 if possible.

In the 1st and 2nd flybys, we saw two signatures related to the structure and wave-particle interaction. The former one is the electric turbulences in several 10s kHz, which can be interrupted as the first measurement of cold electron density in and around the magnetosphere of Mercury [2]. The latter is the magnetic turbulences in several kHz in the dawn side magnetosphere after the closest approach, which can be interrupted as the first whistler-wave detection [3]. Those results promise us the bright success of the PWI on the Hermean orbit.

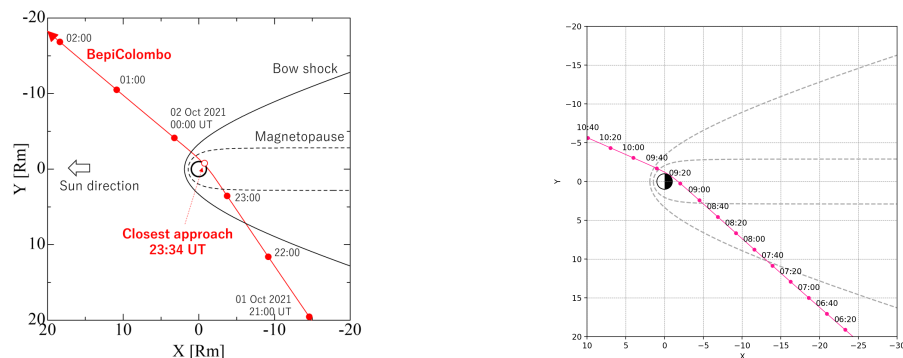


Figure 1. Orbits of the 1st and 2nd flybys of BepiColombo in Oct. 2021 and June 2022.

References

- [1] Y. Kasaba et al. (2020), “Plasma Wave Investigation (PWI) aboard Mio/BepiColombo Mercury Magnetospheric Orbiter (MMO) on the trip to the first measurement of electric fields, electromagnetic waves, and radio waves around Mercury”, *Space Sci. Rev.* **216:65**. <https://doi.org/10.1007/s11214-020-00692-9>
- [2] L. Griton et al., “Electron density revealing the boundaries of Mercury’s magnetosphere via serendipitous measurements by SORBET during BepiColombo first and second Mercury swing-bys”, *Astronomy & Astrophysics*, accepted
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