

**The development of the PZT type cosmic dust detector.
“The dependence of the response signal on the collisional position”**

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BepiColombo will explore Mercury as a joint project between JAXA and ESA and the spacecraft and the onboard instruments are being built and tested. Since the measurement of dust ambient Mercury is one of the approved programs, the Mercury Dust Monitor (MDM) [1] has been developed to be onboard the Mercury Magnetospheric Orbiter (MMO). Because of restricted resources of the MDM, it comprises four piezoelectric PZT elements and a set of electronic circuits. Each element is a PZT plate of its dimensions; 40 x 40 mm² square and 2mm thick. One of the plate surfaces is entirely coated with a silver layer. On the other side a 5 x 5 mm² and ~5 μm thick electrode is embedded at the center of the plate as a collector of induced signal. The electrode size is determined to optimize an input capacitance allowable for the amplifier.

We have investigated how to obtain physical parameters of dust by analyzing output waveforms produced during collision with the PZT detector. According to previous studies, the output signal forms depend on the detector shape and the configuration of the collectors that are embedded in the PZT plate. In addition, the output signal waveforms are varied with the coordinates at which the collision occurs. This position dependent behavior is essential to establish a calibration method of the PZT detector.

One of the objectives of our study is to derive the momentum transferred to the element by analyzing the waveforms that are position-dependent. Therefore, the position dependence of waveform should be studied in detail. So far, we have investigated the characteristics of the PZT detector by hypervelocity impacts of micro-particles using the Van de Graaff accelerator of MPI-K and HIT. This report, in addition, handles with the position dependent behavior using the Nd:YAG laser.

We confirm that output waveform is clearly position dependent. Thereby, this fact indicates another subject; the calibration procedure is considered to be different between the cases where the collision occurs on and off the electrode. This is applicable to the calibration method of MDM.

Keywords: cosmic dust; in-situ measurement; PZT sensor; BepiColombo mission.

References

- [1] Nogami et al., *Planet.Space Sci.* **58**, 108 (2010).