



**水星探査計画「BepiColombo」
におけるMMO搭載用ダスト
計測器の開発**

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Mercury Dust Monitor (MDM)

Working Team (16 members)

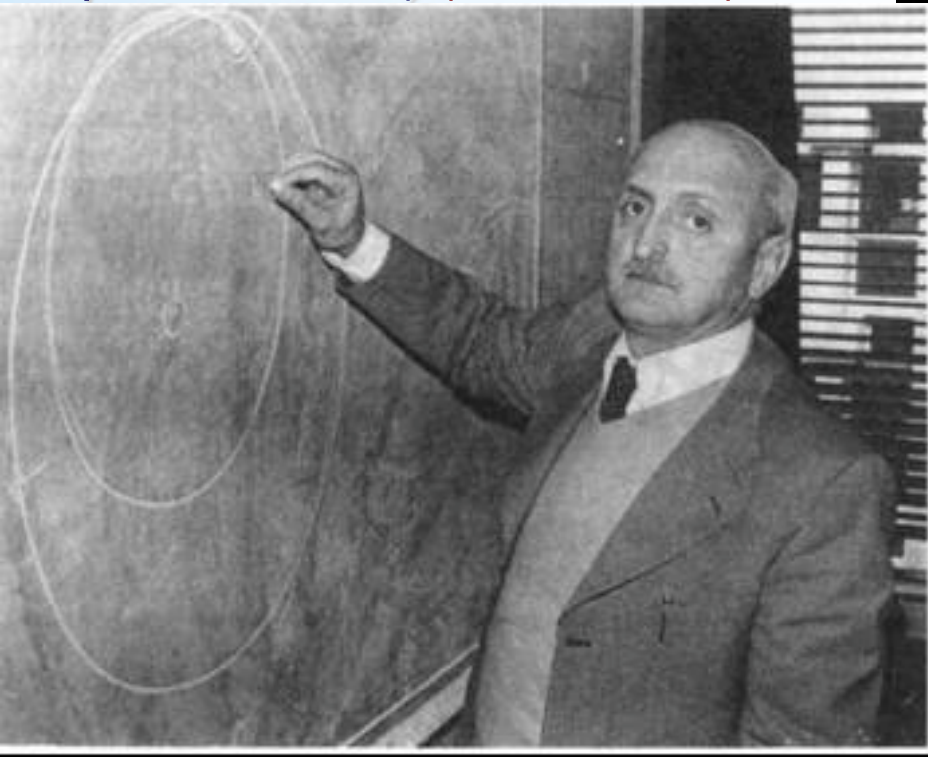
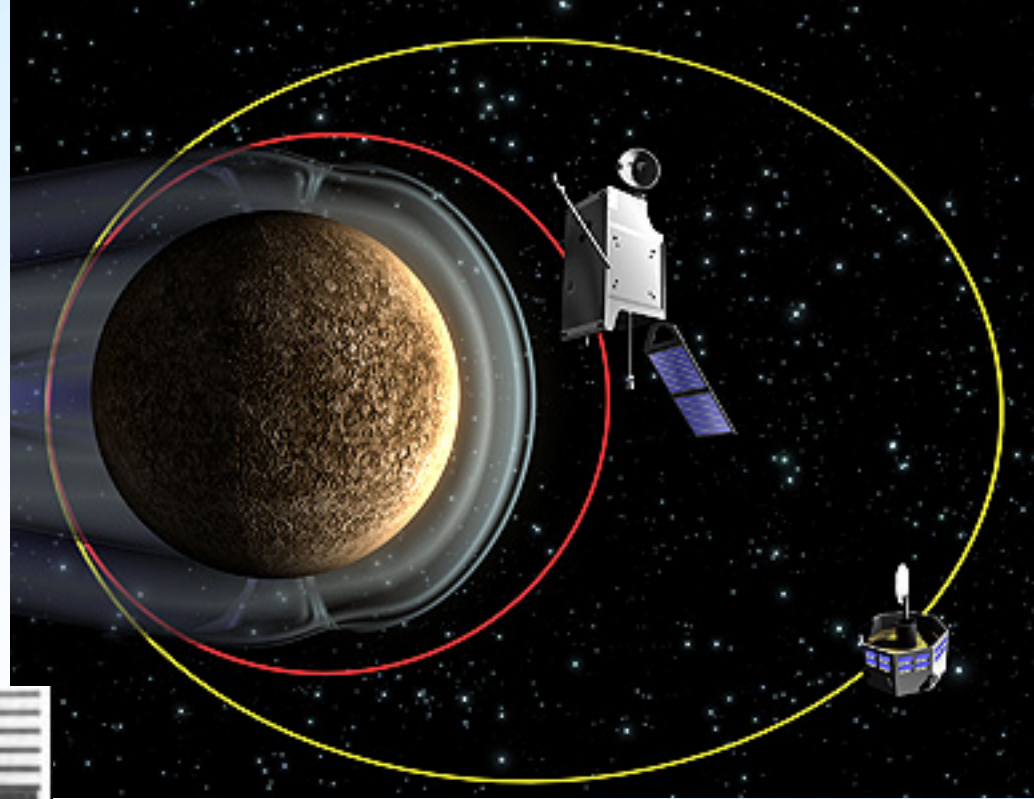
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Ralf Srama	(Univ. Stuttgart)
Eberhard Grün	(Univ. Colorado)

BepiColombo

*ESA /JAXA joint mercury
exploring mission*

**MPO (Mercury Planetary
Orbiter) (ESA)*

**MMO (Mercury Magneto-
spheric Orbiter) (ISAS/JAXA)*

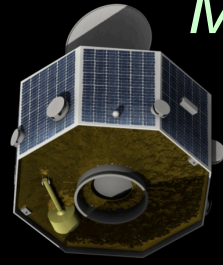


*Launch Aug 2015 Ariane 5
Arrival Jun 2022
One year research at least
from early 2022*

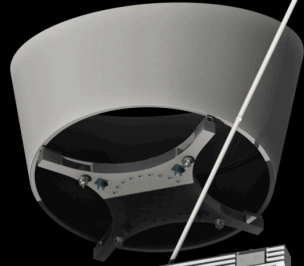
*Giuseppe (Bepi) Colombo
(1920-1984) Italy
Applied mathematician*

BepiColombo

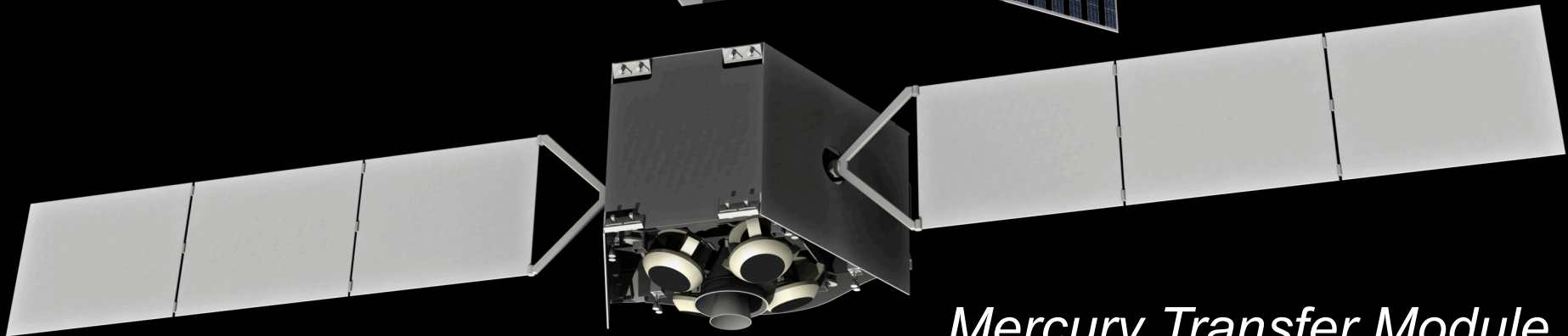
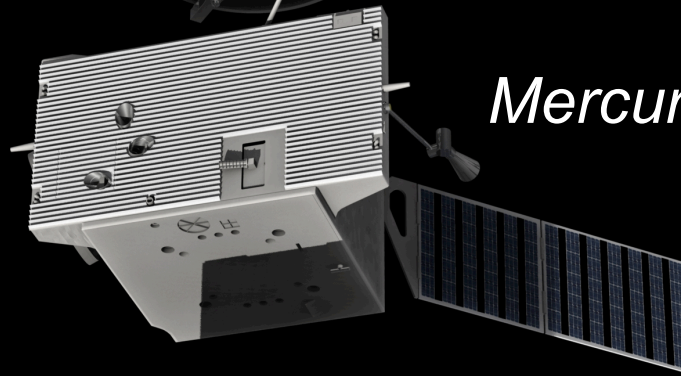
Mercury Magnetospheric Orbiter



Sun Shield



Mercury Planetary Orbiter



Mercury Transfer Module

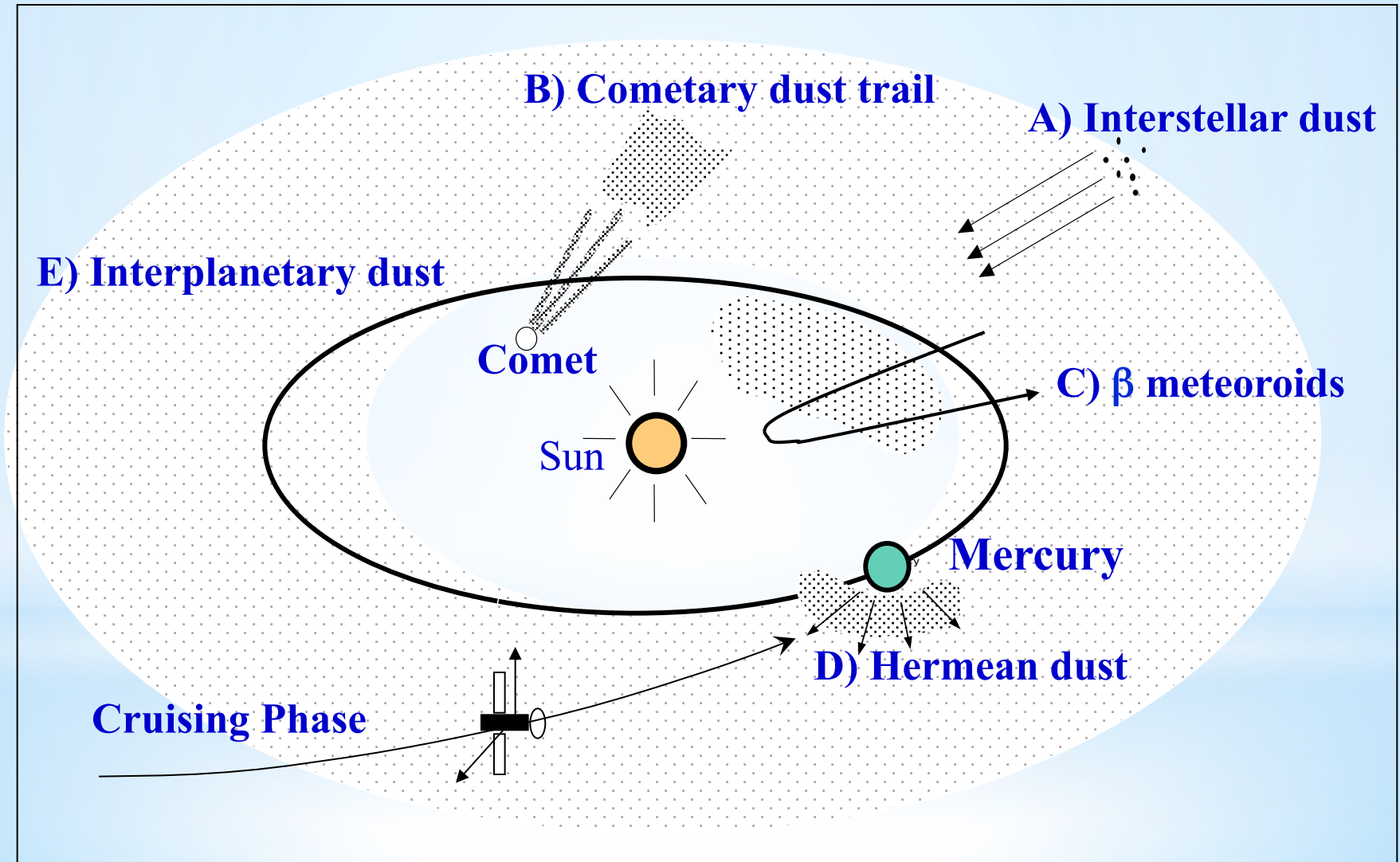
MMO's scientific Payload

- MGF** Magnetic Field Investigation studies magnetic field from the planet, magnetosphere, and interplanetary solar wind.
PI: W. Baumjohann, Austrian Academy of Science, Austria
- MPPE** Mercury Plasma Particle Experiment studies plasma & neutral particles from the planet, magnetosphere, and interplanetary solar wind.
PI: Y. Saito, JAXA/ISAS
- PWI** Plasma Wave Investigation studies electric field, electromagnetic waves, and radio waves from magnetosphere and solar wind.
PI: H. Matsumoto, Kyoto Univ. → Y. Kasaba, Tohoku Univ.
- MSASI** Mercury Sodium Atmosphere Spectral Imager studies the thin sodium atmosphere.
PI: I. Yoshikawa, Univ. Tokyo
- MDM** Mercury Dust Monitor studies dust from the planet and interplanetary & interstellar space.
PI: K. Nogami, Dokkyo Med. Univ. → H. Shibata, Kyoto Univ.

MPO's scientific Payload

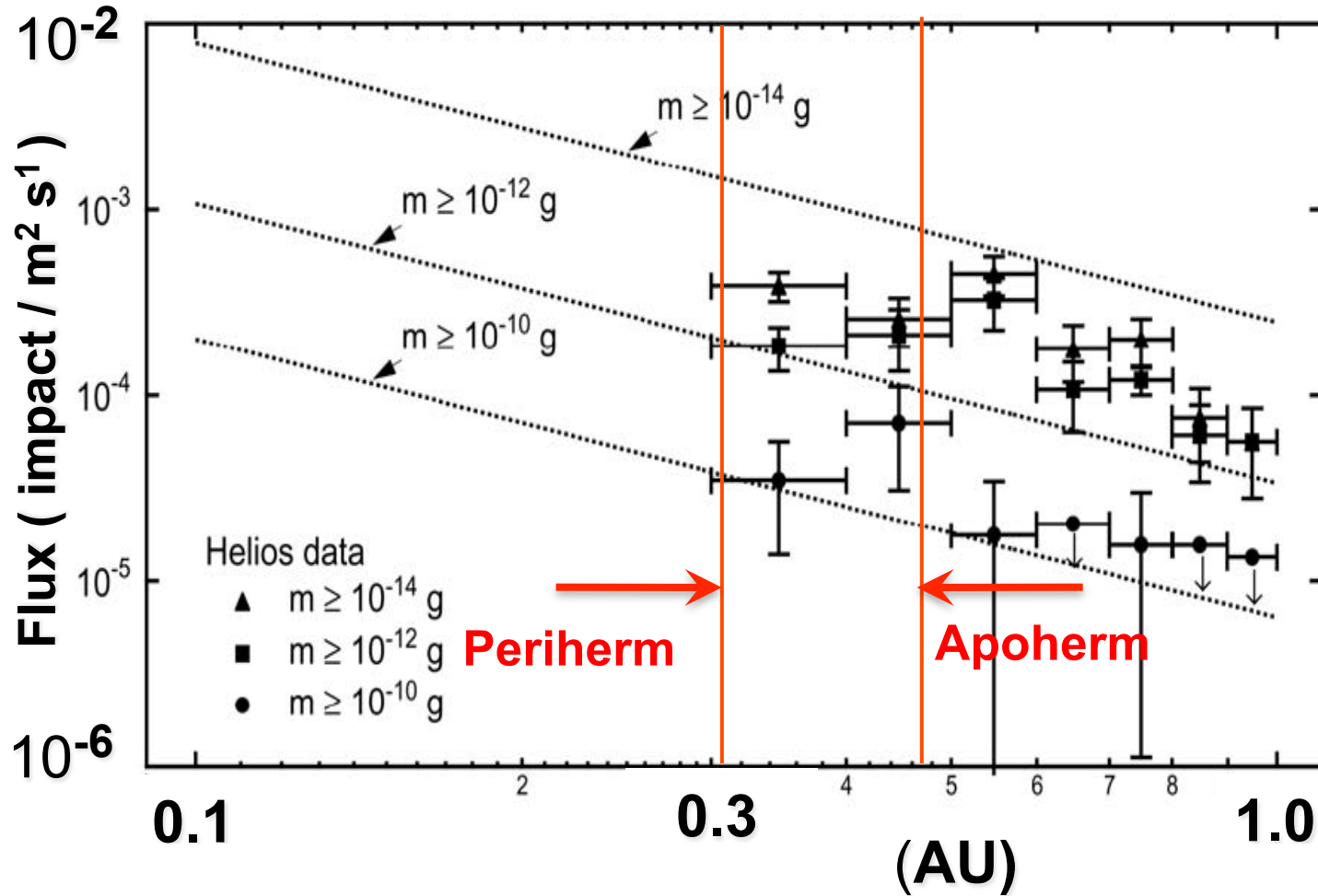
- 1) ISA -Italian Spring Accelerometer
- 2) MERMAG -Mercury Magnetometer
- 3) MERTIS-TIS -Mercury Thermal Infrared Spectrometer
- 4) MGNS -Mercury Gamma ray and Neutron Spectrometer
- 5) MIXS -Mercury Imaging X-ray Spectrometer
- 6) MORE -Mercury Orbitor Radio science Experiment
- 7) PHEBUS -Probing of Hermean Exosphere by Ultraviolet Spectroscopy
- 8) SERENA -Search for Exosphere Refilling and Emitted Neutral Abundances (Neutral and ionized particle analyzer)
- 9) SIMBIO-SYS -Spectrometers and Imagers for MPO BepiColombo Integrated Observatory System (High resolution and stereo cameras, Visual and NIR spectrometer)
- 10) SIXS -Solar Intensity X-ray Spectrometer

Dust particles in the solar system



Dust Flux around Mercury Orbit

from Mann et al. 2003



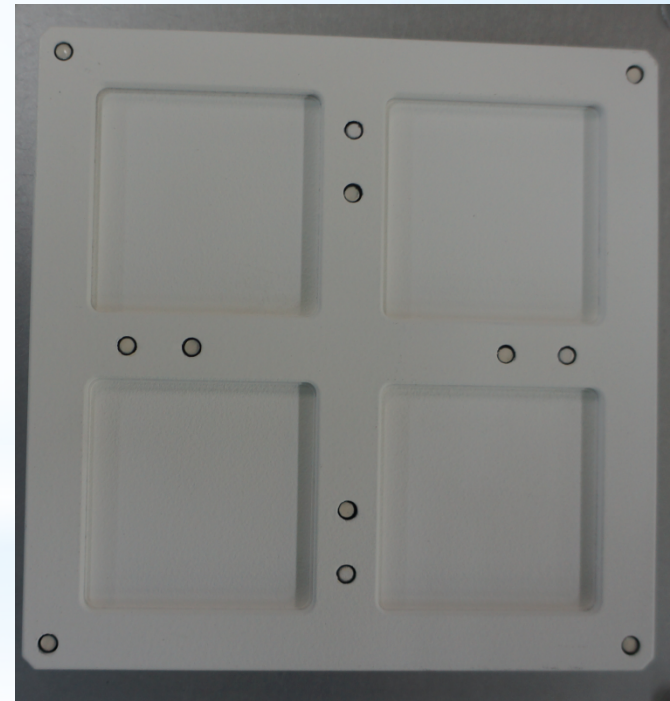
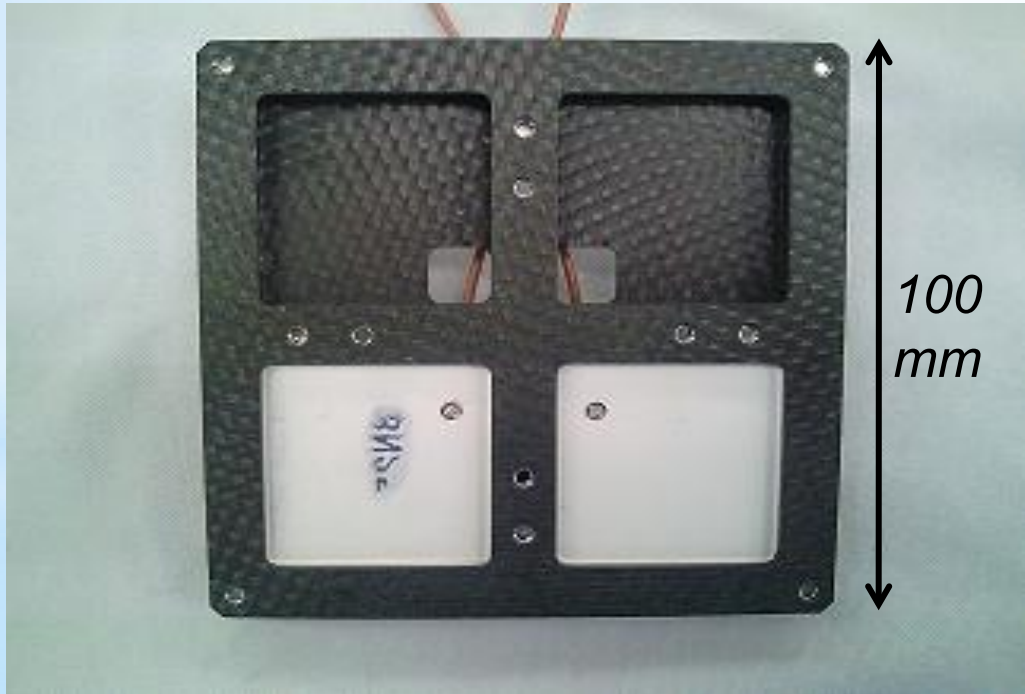
Expected impacts will be 0.5 impact/day with MDM.

Advantages in characteristics of piezo-electric sensor

- No need of bias power supply
- Usable at high temperature ($\sim 250^{\circ}\text{C}$)
- Long term stability
- Enough tolerance of radiation damage
- Easy to shape any structure

MDM-S (piezo-electric sensor & CFRP frame)

PZT(Pb-Zi-Ti): 40 mm × 40 mm × 2 mm



Covered with white paint (FM)

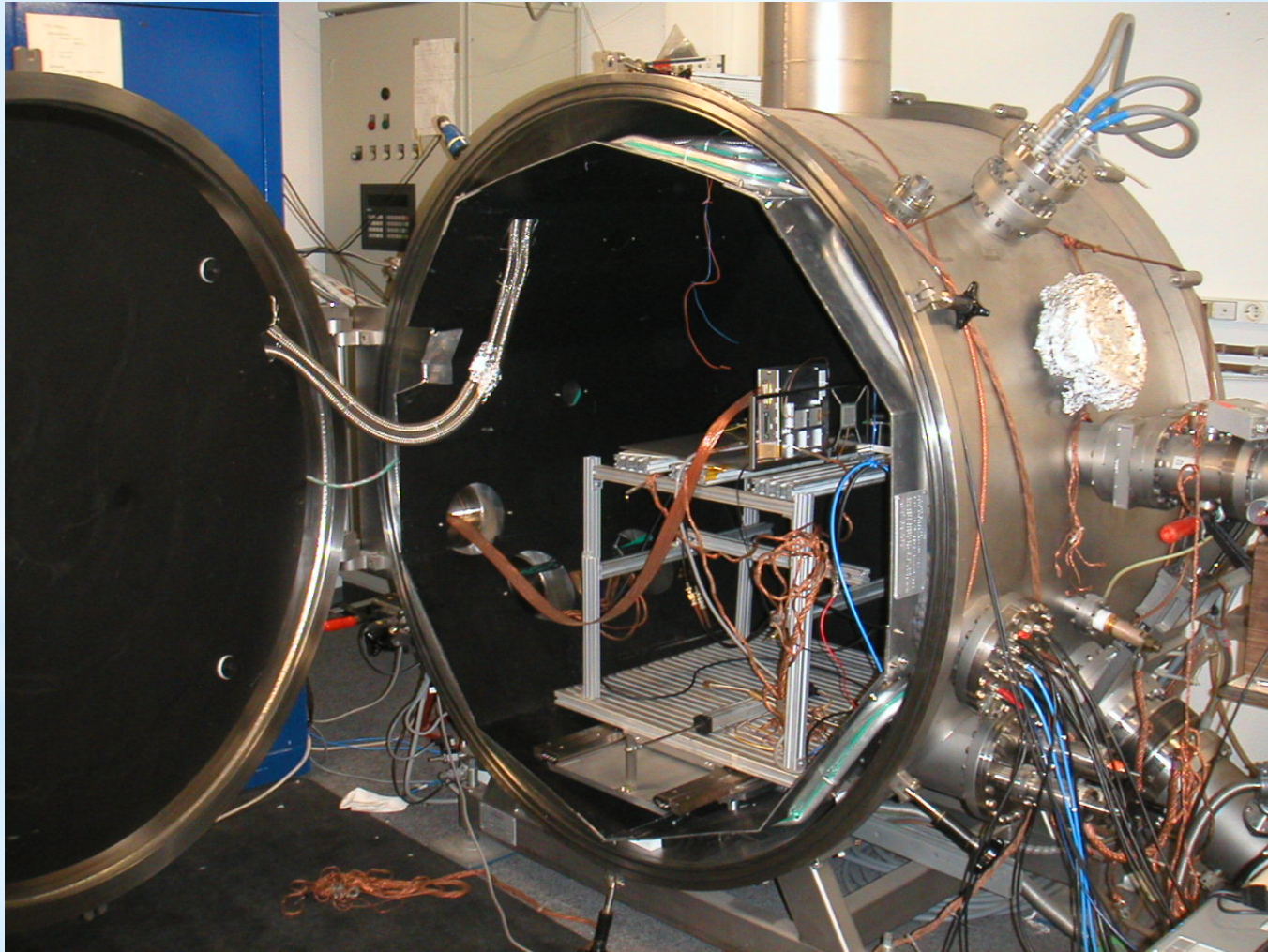
MDM-S and MDM-E (Flight Model)



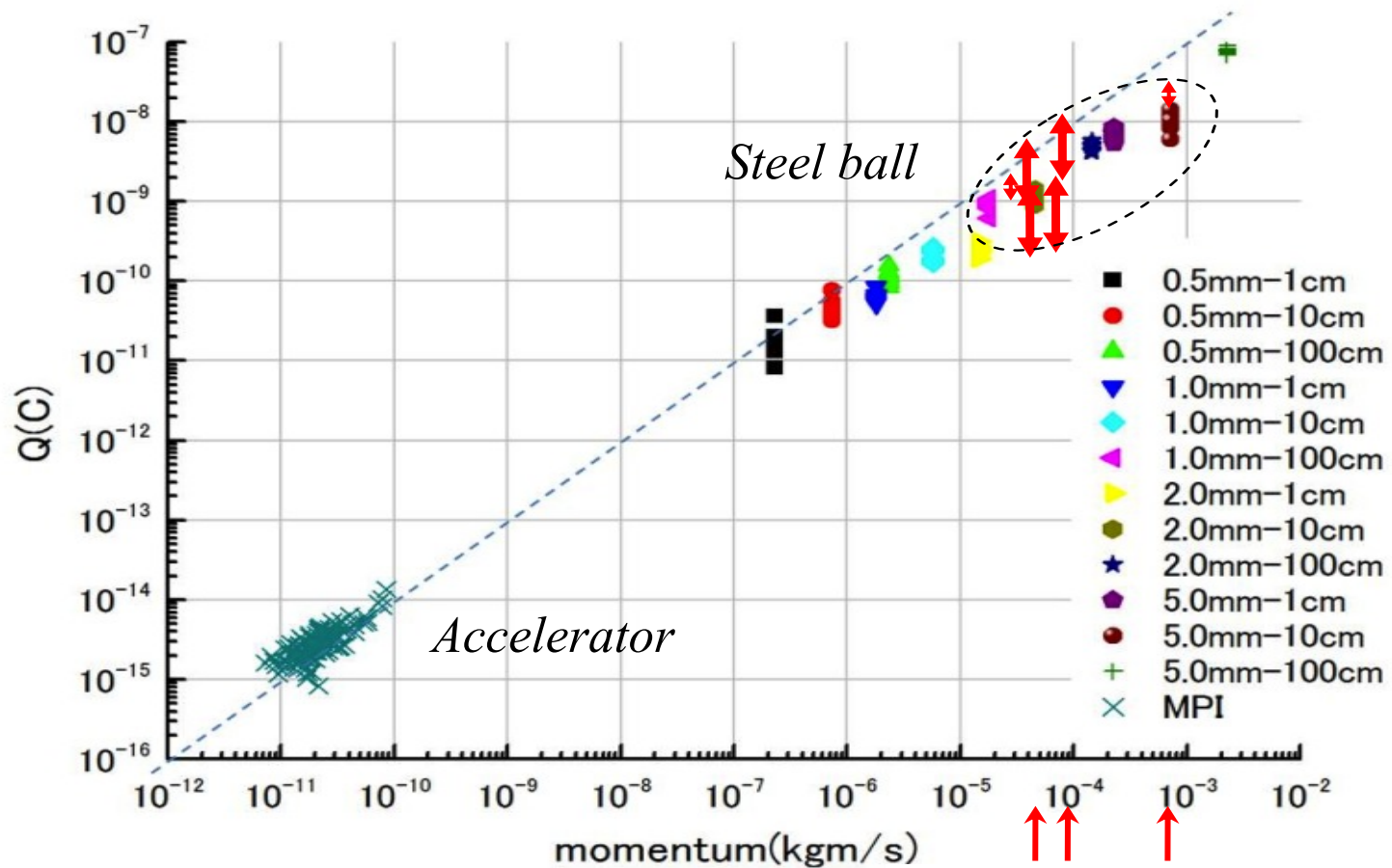
PZT sensors

Electronics

PZT sensor calibration experiment at MPI-K accelerator facility



Output charge vs. momentum of particles



Light gas gun

まとめ

- MDM は水星周回軌道での最初のダスト計測
- 惑星間ダスト、 β メテオロイド、星間ダスト等のダストフラックスを計測
- 水星大気のNa源やスペースウェザリングの原因と考えられる水星へ流入するダスト及び流出するダストの計測
- ダスト計測器としてPZT 素子を選択
- 開口面積 64 cm^2 で、ダストの大まかな入射方向、個数、運動量を計測
- 衝突予測は約0.5個/日で、2022年より1年以上計測