

# Ground-based Optical Calibration Plan for DESTINY<sup>+</sup> on-board Cameras, TCAP and MCAP

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DESTINY<sup>+</sup> (Demonstration and Experiment of Space Technology for INterplanetary voYage with Phaethon fLyby and dUst Science) on-board cameras, TCAP (Telescopic Camera for Phaethon), and MCAP (Multiband Camera for Phaethon) will observe the asteroid (3200) Phaethon. The following four scientific objectives will be achieved by the cameras depending on the distance between the spacecraft and the asteroid: (1) Observing the global shape of Phaethon by obtaining the outline and the light curve, (2) Observing the semi-global features of Phaethon by making the 3-D topographic model, (3) Observing the local features of Phaethon such as the topography related to dust ejection, (4) Observing the material distribution on Phaethon by obtaining multiband images. Calibration of the cameras must be conducted to extract the correct signal and convert it into scientifically valuable data for achieving the objectives. We are planning to conduct both the ground-based and in-flight optical calibration of TCAP and MCAP. In this presentation, we focus on the ground-based optical calibration.

Data acquisition for calibrating the two cameras in ground-based optical calibration is classified into the following three categories; (a) the characteristics of the image sensors for understanding the performance, (b) sensitivity calibration for converting the digital number on the pixels into scientifically valuable data, and (c) geometric calibration for correcting the measurement position captured by the cameras into the accurate position. The data of category (a) are obtained before the installation of the optical system, including the examination of the temperature dependence. On the other hand, the calibration data, including the optical system, are obtained in sensitivity calibration (b) and geometric calibration (c). These calibrations are conducted in the final phase after various environmental tests using the EM (Engineering Model) and FM (Flight Model) of the cameras. In addition to acquiring these calibration data, we will also conduct Multiband Imaging Test (MIT) of MCAP. In this test, imaging of a spectrum-known samples is performed to confirm that the spectrum of the sample can be reproduced by the calibration using the acquired data (a-c).

At the time of writing this manuscript, the EMs of TCAP and MCAP are being manufactured. Since the EM manufacture of MCAP is earlier than that of TCAP, the calibration data for MCAP EM are acquired prior to TCAP EM. We obtained the calibration data of category (a) for MCAP EM in February 2023 and will obtain the category (b-c) data and MIT for MCAP EM in April-May 2023. In this presentation, we will report the results of the analysis of the calibration data and MIT. Those results will be reflected in the acquisition procedures of the calibration data of the FMs.

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