

A Camera for the MASCOT lander on-board Hayabusa 2

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1. Introduction

The Hayabusa 2 spacecraft, developed by the Japanese Space Agency (JAXA), is the successor of the highly successful Hayabusa mission to asteroid Itokawa. It is scheduled for launch in the 2014/2015 time frame for a rendezvous with 1999 JU3 [1]. This small asteroid of about 1 km in size, is of the C-type, and has a low geometric albedo of 0.06 typical for its type [2]. On-board is a variety of small landers, one of which is the Mobile Asteroid Surface Scout (MASCOT), developed by the German Aerospace Center (DLR) and the National Centre for Space Studies (CNES), with German and French instrument contributions [3]. Its four main instruments are an imaging spectrometer, a radiometer, a magnetometer, and a wide-angle camera (Fig. 1).

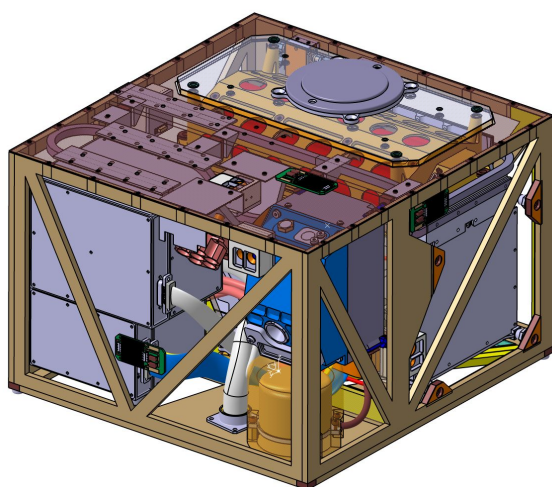


Figure 1: The MASCOT lander with the camera in the top right corner and the spectrometer at left. The magnetometer and the radiometer are located below and left of the camera, respectively.

2. Camera Design

The MASCOT camera is built at the DLR Institute of Planetary Research in Berlin, Germany. It is mounted inside the lander slightly tilted, such that the center of its 55° field-of-view (FOV) is aimed at the surface at an angle of 22° with respect to the surface plane (Fig. 2). This means that both the surface close to the lander at a distance of 15 cm and the horizon are in the FOV. The optics are designed according to the *Scheimpflug* principle, which ensures that the entire scene is in focus. The camera is equipped with a 1024 × 1024 pixel CMOS sensor sensitive in the 400-1000 nm wavelength range, and LED arrays of different colors (RGB, NIR) to illuminate the surface at night (Fig. 3).

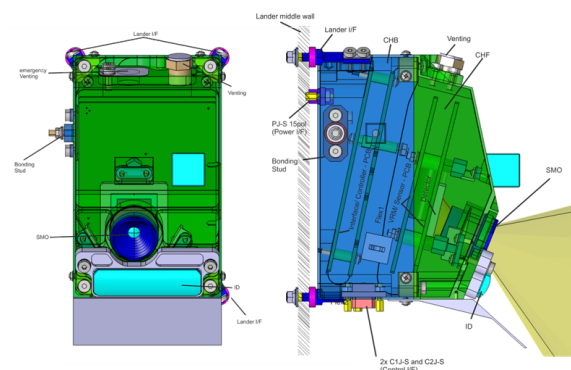


Figure 2: Front and side views of the MASCOT camera.

3. Imaging Campaign

The camera is expected to operate at least 12 hours after release by the orbiter. Images will be acquired during the descent to the surface and after landing, both during the asteroid day and night. During the day, clear filter images will be acquired, whereas during the night, LED illumination of the dark surface will permit color imaging. Dozens of images will be taken, including those required by the auto-exposure algorithm. At least 15 images will be valuable for science.

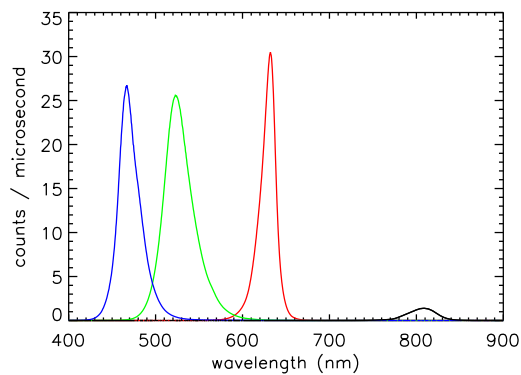


Figure 3: Spectra of the three types of LED used for illuminating the asteroid surface at night.

4. Scientific Rationale

It is the first time a C-type asteroid will be examined in-depth and up-close. It is hoped that the Hayabusa 2 mission will shed more light on the nature and origin of this enigmatic type of asteroids. The MASCOT camera will provide the ground truth for the orbiter remote sensing observations. In addition, it will provide context for measurements by the other lander instruments (radiometer, spectrometer) and the orbiter sampling experiment. By imaging during the descent and on the surface it will characterize the geological context, the mineralogical composition, and the physical properties of the surface, like the rock and regolith particle size distributions. Night time color imaging may allow us to identify minerals, organics, and, possibly, ices. Continued imaging during the surface phase will characterize time-dependent processes and the photometric properties of the regolith.

References

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