

The MASCOT Radiometer MARA for the Hayabusa 2 Mission

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Knowledge for Tomorrow



MASCOT on Hayabusa II



- Hayabusa II to be launched in 2014, asteroid rendezvous in 2018
- Target asteroid is C-type 1999JU3
- Hayabusa primary mission goal is sample return in 2020
- MASCOT is a mobile lander to be deployed by Hayabusa II
- MASCOT carries a magnetometer, a camera, an infrared hyperspectral microscope (MicrOmega), and a radiometer

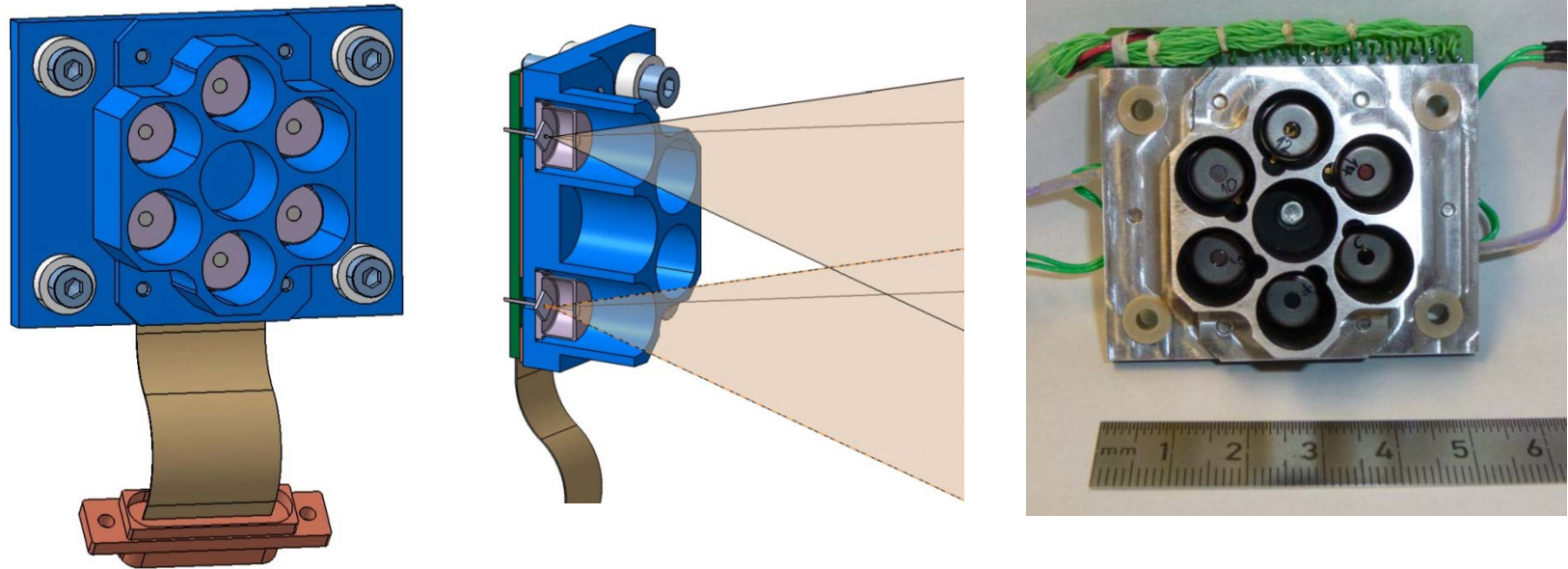


MAscot RAdiometer (MARA) Science Goals

- Radiometric determination of surface temperature for a full asteroid rotation, possibly at multiple sites
- Derivation of surface thermal inertia
- Determination of surface emissivity in selected wavelength channels
- Constrain the landing site mineralogy using 4 IR wavelength channels



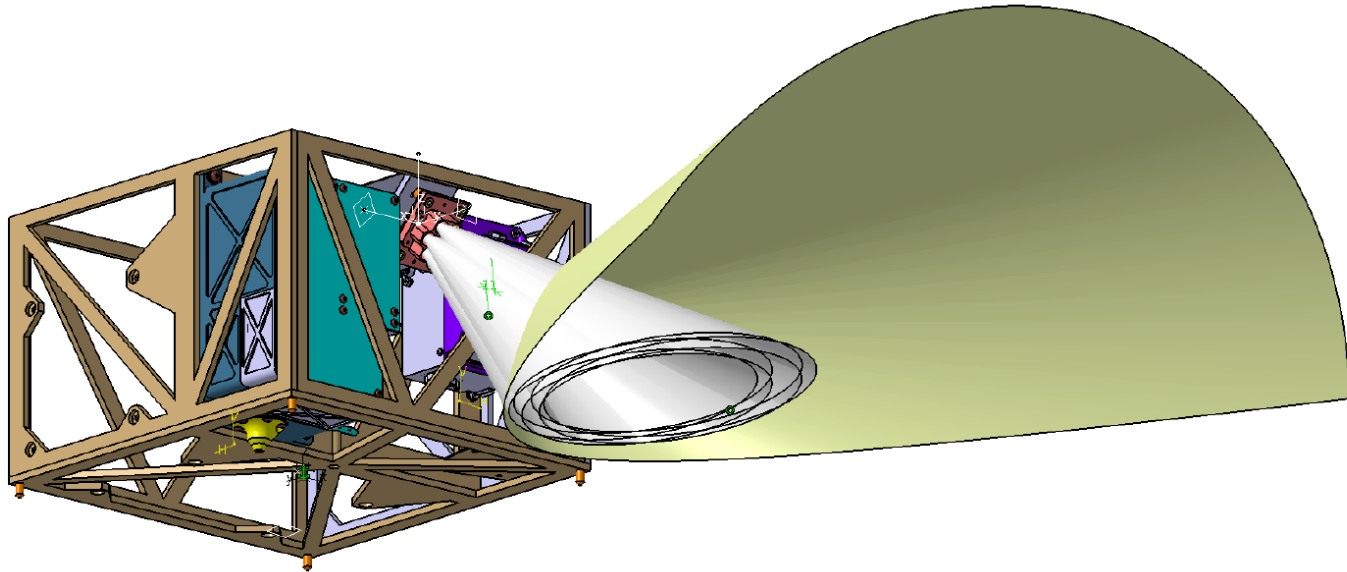
Instrument Overview



- MARA Sensor head houses 6 individual thermopile sensors
- Each sensor is fitted with its own IR filter
- The sensor head is actively controlled to be at constant temperature



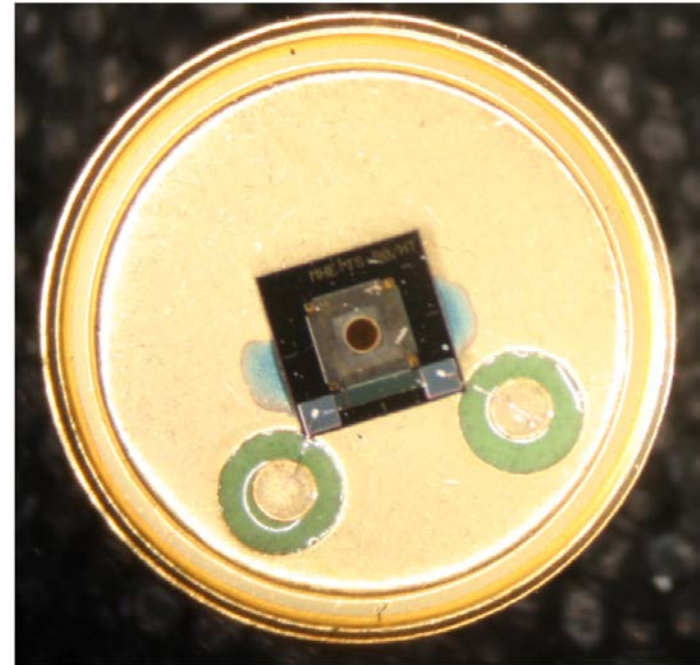
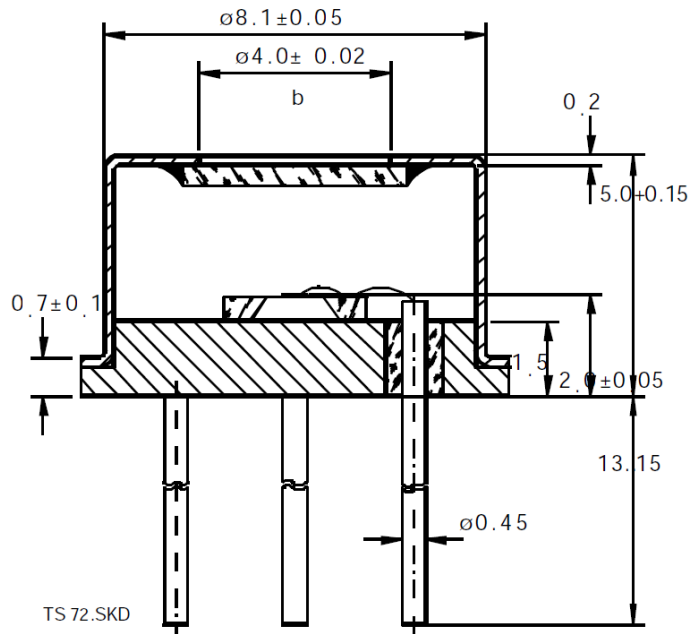
MARA Accommodation inside MASCOT



- MARA is mounted inside the MASCOT Payload Compartment
- MARA electronics are mounted inside the warm electronics box
- MARA has a common Field of View with the camera



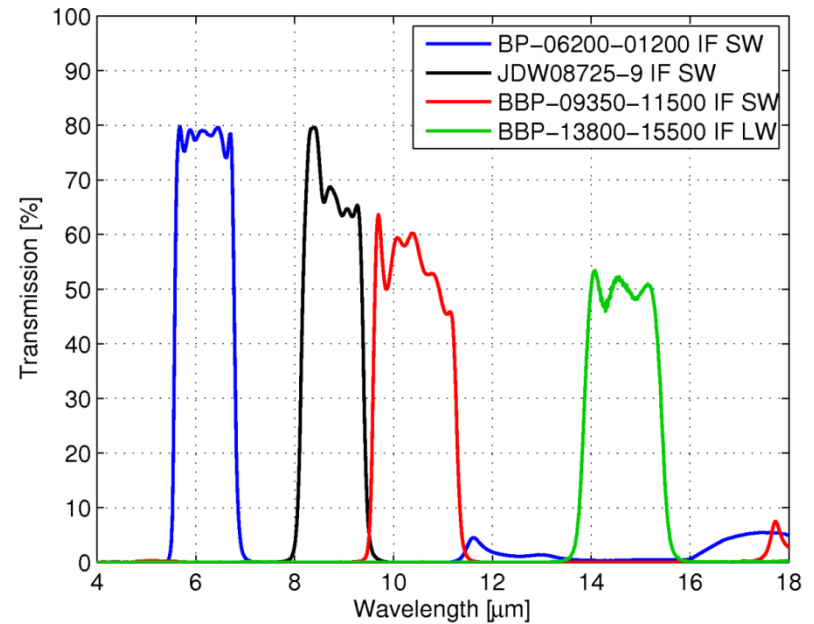
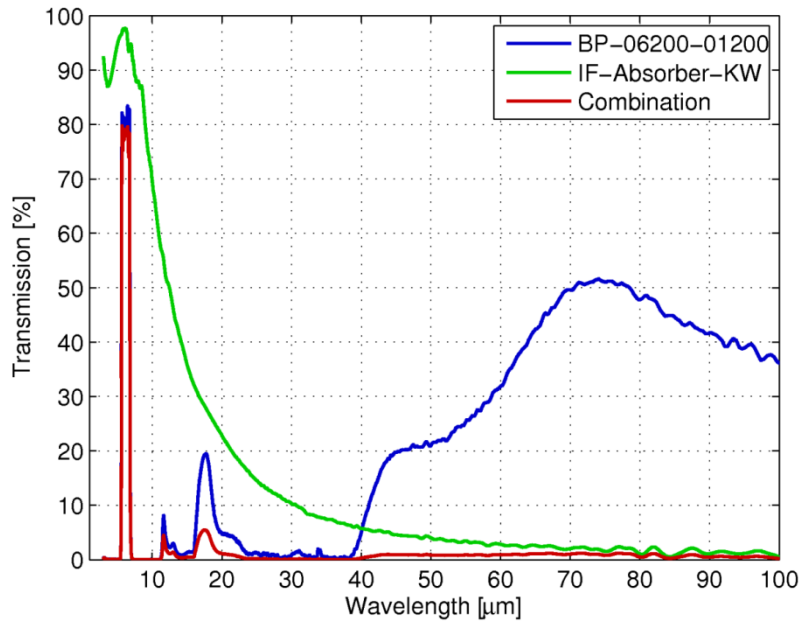
Thermopile Sensors



- Same technology as MUPUS-TM Sensors, built by IPHT (Jena)
- Thermopile voltage generated by 72 Bismuth-Antimony thermopair junctions, absorber size is 0.5 mm diameter
- Cold junction temperature measured by bonded mini-Pt-100



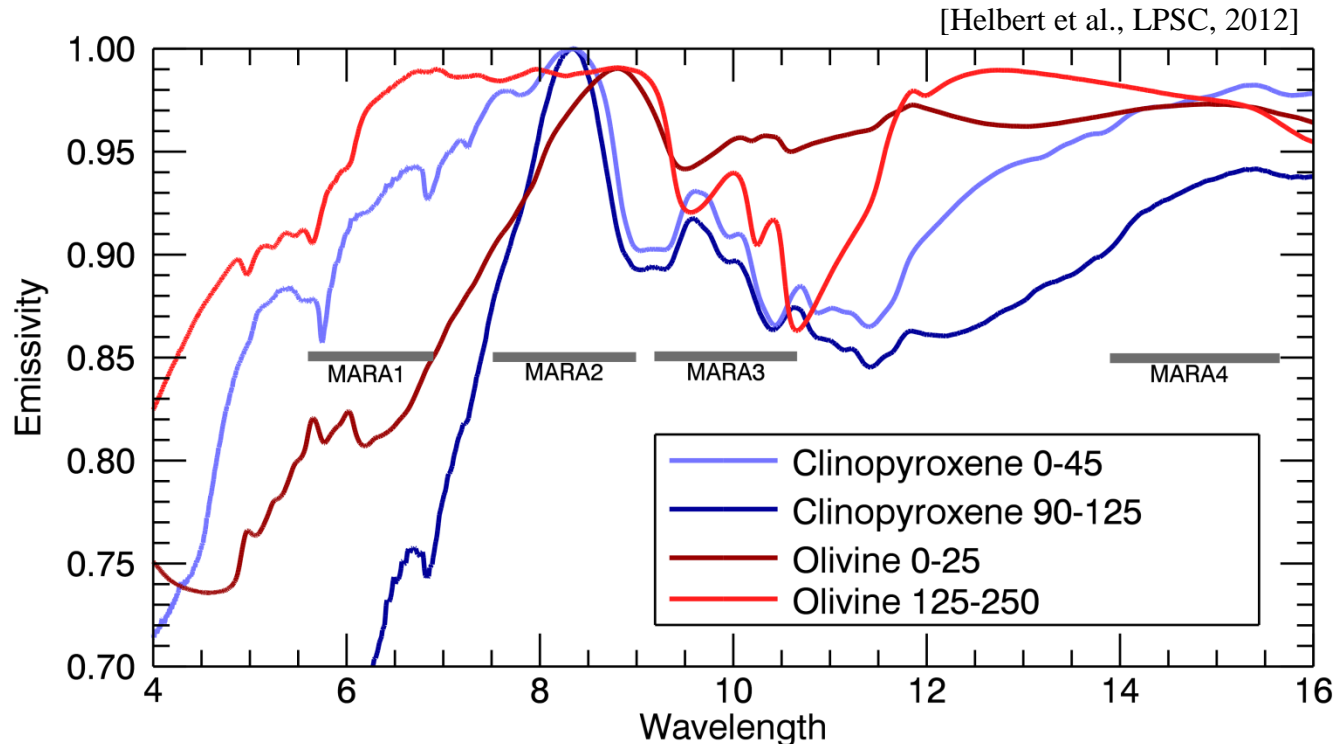
MARA Filters



- Use of different absorber surfaces allows for blocking long wavelength contributions
- In this way, clean band-passes are obtained
- One channel will be similar to the orbiter instrument (8-12 μm)



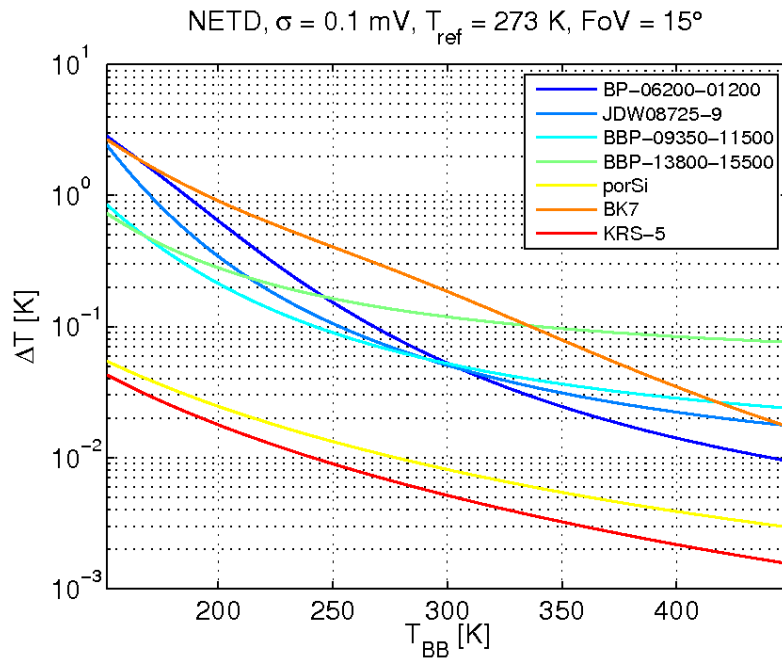
Mineralogical Characterization



- 4 bandpass channels will be used to constrain the position of the emissivity maximum (DIVINER approach)



Expected Temperature Performance



- Low night time temperatures (150K) can be measured using the long-pass filters to better than 0.1 K
- Daytime temperature can be measured by all sensors



Engineering Budgets

- Thermopile sensor mass: 1.2 g
- Sensor head total mass: 90 g
- Calibration target mounted on Hayabusa II for inflight calibration verification: 100 g
- Electronics: 50 g
- **Total Mass: 240 g**
- Electronics Power dissipation: 0.7 W
- Temperature Control Power dissipation: 1-2 W, depending on thermal environment
- **Average Power dissipation: 1.7 W**



Summary

- MASCOT will investigate 1999JU3 at multiple (2-3) sites
- MARA will measure the asteroids surface temperature for a full day-night cycle at at least one location.
- The instrument weights 240 g and uses 1.7 W on average
- A long-pass channel measures surface temperature
- 4 bandpass channels constrain mineralogy and emissivity
- One channel provides ground truth for the orbiter thermal mapper (TM)

