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THERMAP: a mid-infrared spectro-imager based on an uncooled micro-bolometer for space missions to small bodies of the solar system

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We report on the feasibility study of a mid-infrared (8-18 μm) spectro-imager called THERMAP, based on an uncooled microbolometer detector array. Due to the recent technological developments of these detectors, which have undergone significant improvements in the last decade, we wanted to test their capabilities for the Marco Polo R ESA Cosmic Vision mission. In this study, we demonstrate that the new generation of uncooled microbolometer detectors has all the imaging and spectroscopic capabilities to fulfill the scientific objectives of this mission.

To test the imaging capabilities of the detector, we built an experiment based on a 640x480 ULIS microbolometer array, a germanium lense and a black body. Using this experiment, we show that calibrated radiometric images can be obtained down to at least 258 K (lower limit of our experiment), and that two calibration points are sufficient to determine the absolute scene temperature with an accuracy better than 1 K. Extrapolation to lower temperature should allow to measure the temperature down to 180 K with an accuracy of $\sim$5 K. Adding flux attenuating neutral density mid-infrared filters (transmittance : 50%, 10%, 1%) to our experiment, we were able to evaluate the spectroscopic performances of the detector. Our results show that we can perform spectroscopic measurements with a spectral resolution of R$\sim$100 at 350 K, the typical surface temperature of a Near Earth Asteroid at 1 AU from the Sun.

The mid-infrared spectro-imager THERMAP, based on the above detector, is therefore well suited to the Marco Polo R mission.