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Thermal infrared (TIR) imager onboard Hayabusa-2

Tatsuaki Okada[1*], Makoto Taguchi[2], Tetsuya Fukuhara[3], Ryosuke Nakamura[5], Takeshi Imamura[1], Tomohiko Sekiguchi[6], Sunao Hasegawa[1], Takehiko Wada[1], Tsuneo Matsunaga[7], Yoshiko Ogawa[4], Takehiko Arai[8]

[1]ISAS/JAXA, [2]Rikkyo University, [3]Hokkaido University, [4]University of Aizu, [5]AIST, [6]Hokkaido University of Education, [7]NIES, [8]NAOJ

A mid-infrared or thermal infrared (TIR) imager is a nominal remote-sensing instrument onboard HAYABUSA-2, to investigate physical properties of the surface of C-class asteroid 1999JU3. The instrument is based on the LIR (long-infrared imager) onboard AKATSUKI (former Planet-C), a Japanese Venus climate orbiter launched in 2010. Science objectives and current situation of the instrument are briefly reported.

HAYABUSA-2 is the follow-on mission after the Japanese asteroid explorer HAYABUSA and primarily an NEO sample-return mission, but remote sensing have much importance to characterize global features of the target body, complementary with the analysis of returned samples. Since the target body is a C-class asteroid, optimal set of instruments should be different from that of HAYABUSA. Telescopic (multi-band) imagers, laser ranger (LIDAR = Light detection and ranging), near-infrared spectrometer to identify 3 micron absorption band, and a thermal infrared imager are selected as nominal instruments. In HAYABUSA, measurement of thermal emission from asteroid has been done using the radiator of the XRS, but in HAYABUSA-2 the thermal infrared imager will take the role.

The original LIR instrument on AKATSUKI has been developed for mapping Venus clouds at the temperature range of 220-250K. The instrument is applicable to mid-infrared imaging to investigate thermal inertia of asteroid surface. The instrument uses a non-cooled bolometer as detector. The instrument has a field of view of 16 x 12 degree, detector of 344 x 260 pixels, and its detection temperature range of 250 to 400K. The total mass is about 3.5 kg including the detector, hood, electronics.

The main scientific missions are to investigate the global and local areal distribution of the surface physical properties. Surface physical properties are determined in 10 m spatial resolution from Home-Position. Images of higher resolution are taken by observation at lower altitude during the descent. Thermal inertia represents the surface physical condition. The surface thermal inertia is small (<50) for sandy material, moderate (100˜300) for pebbles, and higher (1000) for monolithic rocks, respectively.

The TIR imager will contribute to giving an information for the selection of sampling site by its surface physical condition and for the temperature range important for touchdown operation of spacecraft.

The development of the thermal infrared (TIR) imager for Hayabusa-2 is just started. This instrument should help understand the nature of the asteroid 1999JU3.

Keywords: Hayabusa2, asteroid, thermal property, mid-infrared imager, remote sensing, thermal inertia