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Earth and Moon Observations by Thermal Infrared Imager TIR on Hayabusa2 and Applications to Asteroid 162173 Ryugu

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The Earth and the Moon were imaged by the thermal infrared imager TIR on Hayabusa2 during the Earth swing-by operation to change the trajectory of the spacecraft with a gravity assist of the Earth's mass. Hayabusa2 is the second sample-return from a near-Earth asteroid organized by Japan Aerospace Exploration Agency, and will visit and explore C-type small asteroid 162173 Ryugu, collect samples from the surface of the asteroid, and return them to the Earth [1-3]. TIR is a thermal infrared imager based on uncooled micro-bolometer array. It covers the temperature range from 150 to 460 K, and resolves the surface by 16° x 12° with 328 x 248 pixels with 0.05° per pixel [4, 5]. After the launch on 3 December 2014, TIR has been proven to work well by function tests, and its operation temperature has been adjusted by using the in-flight deep sky images. On 14 October 2015, TIR has detected the Earth and the Moon simultaneously from the distance of 2 x 107 km, and the alignment of –Z axis between TIR and the spacecraft attitude control system was checked. Afterwards, the Earth-Moon system were imaged many times and we could determine the alignment more precisely. Just after the Earth swing-by, TIR observed the Earth on 4 December 2015 and the Moon on the next day. We compared those thermal images with the calculated temperatures on the Earth and the Moon. It was a good opportunity to check the performance of thermal radiometry of this instrument, because there is no known calibration target before arrival at Ryugu. We found the temperature pattern on the Earth and the Moon are almost equal to the theoretical estimates [6]. The point spread feature shows that a point is imaged as a point, just the same as taken during the pre-flight tests. More detailed results will be presented.

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