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The OSIRIS-REx Thermal Emission Spectrometer (OTES)

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The OSIRIS-REx (Origins, Spectral Interpretation, Resource Identification, and Security-Regolith Explorer) mission is a planetary science mission that will study and return a sample from the carbonaceous asteroid Bennu (1999 RQ36). It is the third mission selected under NASA's New Frontiers Program, and is scheduled to be launched in September of 2016 [1]. The spacecraft will carry a suite of instruments designed to map the physical and mineralogical/chemical properties of Bennu at extremely high spatial resolution (down to cm-scales) to both characterize the asteroid in detail (providing context for the returned sample and data for comparison to astronomical observations) and select a safe and scientifically compelling sample site.

The OSIRIS-REx Thermal Emission Spectrometer (OTES) is an uncooled, FTIR point spectrometer that will map the thermal flux and spectral properties of the asteroid Bennu to characterize the Yarkovsky effect and map the surface mineralogy. OTES measures from $\sim$5 – 50 μm with a signal to noise ratio (SNR) of >325 between 7.4 and 33.3 μm for a 325 K target. The design of the spectrometer is heritage from the Mars Global Surveyor TES and the Mars Exploration Rovers Mini-TES instruments. The heart of the instrument is a Michelson interferometer that collects one interferogram every two seconds (where each two-second data acquisition is called an ICK, for Incremental Counter Keeper). OTES's spectral resolution is 10 cm-1 and its field of view is 8 mrad, which is achieved with a 15.2-cm f/3.91 Ritchey-Chretien telescope. At Bennu, OTES will have an accuracy of better than 3% and a precision (noise equivalent spectral radiance, NESR) of $\leq$2.3x10-8 W cm-2 sr-1 /cm-1 between 300 and 1350 cm-1. These values are sufficient to quantify the thermal flux responsible for the Yarkovsky effect and detect signatures of key minerals having band depths $\geq$5%. OTES in-flight calibration will be achieved via a two-point calibration that uses space and an internal, conical blackbody calibration target. The first in-flight observations will be collected during Earth gravity assist, which also will permit verification of co-alignment with the OSIRIS-REx OVIRS (visible and near infrared) spectrometer [2]. Mapping of the thermal and compositional variation of Bennu will take place at global ($\sim$40 m/pixel) and sample site ($\sim$4 m/pixel) scales over several mission phases and at multiple times of day, providing a comprehensive data set for thermophysical and compositional studies.

[1] Lauretta, D. S. and the OSIRIS-REx Team (2012) Lunar and Planet. Sci., 43, #2491. [2] Simon-Miller, A. A. and D. C. Reuter (2013) Lunar and Planet. Sci., 44, #1100.