LATEST ORBITAL MEASUREMENTS OF BENNU BY REXIS: REGOLITH X-RAY IMAGING SPECTROMETER ABOARD OSIRIS-REX. R. P. Binzel[1] and B. Allen[2], J. Hong[2], D. Hoak[2], D. Guevel[2], J. Grindlay[2], R. Masterson[1], M. Chodas[1], C. Thayer[1], M. Lambert[1], A. Cummings[1], L. F. Lim[3], B. E. Clark[4], T. J. McCoy[5], D. S. Lauretta[6]. [1]Massachusetts Institute of Technology, Cambridge, MA, [2]Harvard University, Cambridge, MA, [3]NASA Goddard Space Flight Center, Greenbelt, MD, [4]Ithaca College, Ithaca, NY, [5]Smithsonian Institution National Museum of Natural History, Washington, DC, [6]Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ.

Introduction: In this presentation, we will report measurements obtained by the Regolith X-ray Imaging Spectrometer (REXIS) aboard OSIRIS-REx obtained during the Orbital R mission phase in November 2019. REXIS is a Class-D student collaboration experiment to complement the remote sensing payload of NASA's OSIRIS-REx asteroid sample return mission. REXIS's primary objective is to directly engage students at the undergraduate and graduate levels in the conception, design, implementation, and operation of space flight instrumentation for the mission. To date, more than 80 students have worked on the REXIS project, and more than a dozen master's and doctoral theses have resulted.

Instrument Description: REXIS is an x-ray spectrometer designed to take advantage of the incident solar x-ray flux that generates a diagnostic fluorescence signature from the asteroid's surface. REXIS joins a lineage of x-ray fluorescence experiments flown in space dating back to the Apollo era and previously demonstrated for asteroid science [1]. As described in [2], REXIS consists of two components: a main imaging spectrometer with a coded aperture mask and a separate solar X-ray monitor to account for the Sun's variability. The REXIS main spectrometer employs a detector array consisting of four MIT Lincoln Laboratory CCID-41 charge-coupled devices (CCDs) in a 2×2 array allowing measurement of the x-ray spectrum over the range of 0.4 to 8 keV with an energy resolution (FWHM) of <220 eV at 5.9 keV. REXIS seeks to measure fluoresced lines in the Fe-L, Al-K, Mg-K, S-K, and Si-K complexes. Characterization of the X-ray fluorescence measured from Bennu requires knowledge of the incoming solar X-ray flux. REXIS's second component is a solar X-ray monitor (SXM) designed to measure the variable incoming solar flux and its energy distribution. The SXM utilizes an Amptek XR-100SDD silicon drift diode (SDD) with a collimated effective area of about 0.8 mm^2, providing spectral coverage over the range of 1 to 20 keV.

REXIS Orbital R Measurements: REXIS completed 200 hours of integration in November 2019 as a follow-on to a set of initial measurements obtained in the Orbital B mission phase in July 2019. Lessons learned from Orbital B included a fine tuning of the detection threshold for x-ray photons in the presence of internal scattered visible light from the asteroid. Threshold adjustments proved successful for significant improvement in x-ray flux count in Orbital R. Preliminary analysis shows a low flux rate of x-ray photons fluorescing from Bennu's surface, relative to the residual cosmic x-ray background in the regions of the field of view not filled by the asteroid. Up-to-date results on the signal processing and implications for the nature and composition of Bennu's surface will be presented.

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References:

[1] Nittler L. R. et al. (2001) *MAPS 36*, 1673–1695.
[2] Masterson R.A. et al. (2018) *Space Sci. Rev. 214*, 48.