The OSIRIS-REx laser altimeter (OLA): Development progress

M. Daly[1], O. Barnouin[2], C. Johnson[3,4], E. Bierhaus[5], J. Seabrook[1], C. Dickinson[6], T. Haltigin[7], D. Gaudreau[7], C. Brunet[7], G. Cunningham[8], D. Lauretta[9], W. Boynton[9], and E. Beshore[9]

[1]Centre for Research in Earth and Space Science, York University
[2]Johns Hopkins University Applied Physics Laboratory
[3]University of British Columbia
[4]Planetary Science Institute
[5]Lockheed Martin Corporation
[6]MacDonald Dettwiler & Associates
[7]Canadian Space Agency
[8]Optech Inc.
[9]University of Arizona

Introduction: The NASA New Frontiers Origins Spectral Interpretation Resource Identification Security Regolith Explorer (OSIRIS-REx) mission will be the first to sample the B-type asteroid (101955) Bennu [1]. This asteroid is thought to be primitive and carbonaceous, and is probably closely related to CI and/or CM meteorites [2]. The OSIRIS-REx mission hopes to better understand both the physical and geochemical origin and evolution of carbonaceous asteroids through its investigation of Bennu. The OSIRIS-REx spacecraft will launch in September 2016, and arrive at Bennu two years later. The Canadian Space Agency is contributing a scanning lidar system known as the OSIRIS-REx Laser Altimeter (OLA), to the OSIRIS-REx Mission. The OLA instrument is part of suite of onboard instruments [3] including cameras (OCAMS) [4], a visible and near- infrared spectrometer (OVIRS) [5], a thermal emission spectrometer (OTES), and an X-ray imaging spectrometer (REXIS) [6].

OLA Objectives: The OLA instrument has a suite of scientific and mission operations purposes. At a global scale, it will update the shape and mass of Bennu to provide insights on the geological origin and evolution of Bennu, by, for example, further refining constraints on its bulk density. With a carefully undertaken geodesy campaign, OLA-based precision ranges, constraints from radio science (2-way tracking) data and stereo OCAMS images, it will yield broad-scale, quantitative constraints on any internal heterogeneity of Bennu and hence provide further clues to Bennu's origin and subsequent collisional evolution. OLA-derived global asteroid maps of slopes, elevation relative to the asteroid geoid, and vertical roughness will provide quantitative insights on how local-regional surfaces on Bennu evolved subsequent to the formation of the asteroid. In addition, OLA data and derived products support the assessment of the safety and sampleability of potential sample sites. At the sample-site scale, the OLA instrument will provide detailed information on the geological and geophysical processes which influence the surface regolith at scales relevant to the samples that will be collected. High resolution (meter-scale) spatial measurements of surface topographic slopes, center-of-mass referenced elevation, and vertical roughness within the sample ellipse will provide quantitative data on regolith processes such as surface granular flows that could have displaced the regolith sampled by OSIRIS-REx spacecraft. The OLA system will also be responsible for assessing hazards at any proposed sample site. Specifically, the OLA system will measure the slope distribution within the sample ellipse and characterize backscatter roughness at or below the scale of the OLA spot size.

Technical Specifications: The completed OLA instrument is expected to achieve all these objectives through its specifications that are based on the characteristics of Bennu and operational considerations: Maximum Operational Range, 7.5 km; Minimum Operational Range, 0.150 km; Range Accuracy, 5–20 cm (range dependent); Range Resolution, <4 cm; Scanner Field of Regard, ±10 deg. (each axis); Laser Spot Size (on surface), 0.015–2 m (range dependent).

Progress To-date: A prototype of the OLA system has been developed and successfully tested. Results from this testing will be presented and compared with the instrument requirements. Simulated OLA datasets will be presented along with the first engineering model hardware and test results.

Acknowledgements: The support of the Canadian Space Agency for OLA is gratefully appreciated.

References: [1] Lauretta et al. (2012), LPSC 43, this issue. [2] Clark et al., Icarus, 216, 462–475. [3] Boynton et al. (2012), EPSC2012-875. [4] Smith et al. (2013), LPSC 44, 1690. [5] Simon-Miller and Reuter (2013), LPSC 44, 1100. [6] Allen et al. (2013), Proc. of SPIE Vol. 8840.