

Asteroid sample return missions: The collaboration between OSIRIS-REx and Hayabusa2

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The Origins Spectral Interpretation, Resource Identification, and Security-Regolith Explorer (OSIRIS-REx) is scheduled to launch on September 8, 2016 as the NASA's third New Frontiers mission. OSIRIS-REx will arrive at the target (101955) Bennu [1], which is a B-type asteroid spectroscopically similar to carbonaceous chondrites, in August 2018. With detailed engineering and scientific mapping, OSIRIS-REx will sample the surface regolith of Bennu late 2019. The amount of sample is expected to be up to 2 kg. The samples will be delivered to the Earth in September 2023. The surface regolith from Bennu will be pristine samples with a record of the Solar System history. They also record the recent dynamical evolution and surface geological processes on Bennu [2]. Another asteroid explorer, JAXA's Hayabusa2, is now heading for a C-type asteroid (162173) Ryugu, also spectroscopically similar to carbonaceous chondrites, after its successful Earth swing-by on December 3, 2015. Hayabusa2 will get to Ryugu in June, 2018, obtain surface samples from Ryugu nominally at three different locations, and return to the Earth in December 2020. The samples from Ryugu are also expected to record the Solar System evolution [3] and recent surface geological activities [2].

This is the first since the Apollo and Luna era that two sample return missions operated by different space agencies are occurring at the same time. Therefore intimate collaboration between the two missions will enhance the mutual scientific return. NASA and JAXA signed a Memorandum of Understanding (MOU) for official collaboration between the missions in 2014. In addition to the MOU, the two missions will have a Joint Project Implementation Plan (JPIP), with meeting the provisions of the MOU, for the scientific collaboration during the cruise phase, the asteroid proximity operation phase, the sampling phase, and the sample analysis phase. The JPIP includes the agreement of having three co-investigators from the other mission (Dante S. Lauretta, Olivier Barnouin, and Harold C. Connolly Jr. as Hayabusa2 Co-I's from OSIRIS-REx and Sei-ichiro Watanabe, Makoto Yoshikawa, and Shogo Tachibana as OSIRIS-REx Co-I's from Hayabusa2). The JPIP also includes the agreement of participation of OSIRIS-REx (Hayabusa2) team members in the preliminary examination and curation of the Hayabusa2 (OSIRIS-REx) returned samples. The intimate collaboration between the two missions defined by the JPIP will maximize the scientific return from both missions and help to establish long lasting collaborations within the science, engineering, and space exploration communities.

[1] D. S. Lauretta et al. (2014) *Meteorit. Planet. Sci.* 50, 834-849.

[2] H. C. Connolly, Jr. et al. (2015) *Earth Planets Space* 67, 1-6.

[3] S. Tachibana et al. (2014) *Geochemical J.* 48, 571-587.