European asteroid sample return mission: MarcoPolo-R and its future

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MarcoPolo-R is a sample return mission study to a primitive Near-Earth Asteroid (NEA) carried out at ESA from 2008 in the framework of ESA's Cosmic Vision (CV) programme, with the objective to answer to the fundamental CV questions "How does the Solar System work?" and "What are the conditions for life and planetary formation?".

The returned material will allow us to study in terrestrial laboratories some of the most primitive materials available to investigate early solar system formation processes, to explore initial stages of habitable planet formation, to identify and characterize the organics and volatiles in a primitive asteroid. In fact, only in the laboratory can instruments with the necessary precision and sensitivity be applied to individual components of the complex mixture of materials that forms an asteroid regolith, to determine their precise chemical and isotopic composition. Such measurements are vital for revealing the evidence of interstellar medium, pre-solar nebula and parent body processes that are retained in primitive asteroidal material, unaltered by atmospheric entry or terrestrial contamination.

In addition to addressing these major science goals, the MarcoPolo-R mission study (ESA/SRE (2013)4) also involved innovative European technologies for which ESA technical development programs are still under way. As a result of the several industrial studies, ESA designed a remarkably cost-effective and robust asteroid sample return mission scenario. The spacecraft has been defined making use of low-cost units for most of the sub-systems. The key sample return capabilities, i.e. asteroid navigation, touch and go, sampling mechanism and the re-entry capsule have reached at ESA a validation status to enter implementation phase.

In this new era of international effort and interest of sample return with the selected missions of Hayabusa-2 (JAXA) and OSIRIS-Rex (NASA), the development of sample return technology represents in Europe a crucial element for planetary science and for the space technology development.

The status of the mission study at ESA will be presented and the future for European asteroid sample return will be discussed.

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