

MarcoPolo-R: Asteroid Sample Return Mission

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MarcoPolo-R is a sample return mission to a primitive Near-Earth Asteroid (NEA) selected for an assessment study at ESA in the framework of ESA Cosmic Vision 2 program. The assessment study started at ESA on May 2011 and will continue until the middle of 2013. MarcoPolo-R is a European-led mission with a proposed NASA contribution. MarcoPolo-R will rendezvous with a primitive NEA, scientifically characterize it at multiple scales, and return a unique sample to Earth unaltered by the atmospheric entry process or terrestrial weathering. This project is based on the previous Marco Polo mission study, which was selected for the Assessment Phase of the first round of Cosmic Vision. Its scientific rationale was highly ranked by ESA committees, and it was not selected to proceed to the next step because the estimated cost was higher than the allotted amount for an M-class mission. The aim of the new Assessment Study is to reduce the cost of the mission while maintaining its high science level, on the basis of advanced studies and technologies, optimization of the mission, and consolidation of the collaboration with other partners.

The baseline target is a binary asteroid (175706) 1996 FG3, which offers a very efficient operational and technical mission profile. A binary target also provides enhanced science return. The choice of this target will allow new investigations to be performed more easily than at a single object, and also enables investigations of the fascinating geology and geophysics of asteroids that are impossible at a single object. Several launch windows have been identified in the time-span 2020-2024. The baseline mission scenario of MarcoPolo-R to 1996 FG3 is as follows: A single primary spacecraft, carrying the Earth re-entry capsule and sample acquisition and transfer system, will be launched by a Soyuz-Fregat rocket from Kourou.

The scientific payload includes state-of-the-art instruments, e.g. a camera system for high resolution imaging from orbit and on the surface, spectrometers covering visible, near-infrared and mid-infrared wavelengths, a neutral-particle analyser, a radio science experiment and optional laser altimeter. If resources are available, an optional Lander will be added to perform in-situ characterization close to the sampling site, and internal structure investigations.

MarcoPolo-R will return bulk samples from an organic-rich binary asteroid to Earth for laboratory analyses, allowing us to:

- * explore the origin of planetary materials and initial stages of habitable planet formation;
- * identify and characterize the organics and volatiles in a primitive asteroid;
- * understand the unique geophysics, dynamics and evolution of a binary NEA.

In addition to addressing the exciting science goals, the MarcoPolo-R mission also involves technologies for which technical development programmes are well under way. It is the ideal platform to (i) demonstrate innovative capabilities such as: accurate planetary navigation and landing, sample return operational chain; (ii) prepare the next generation of curation facilities for extra-terrestrial sample storage and analysis; (iii) develop high-speed re-entry capsule; (iv) pave the way as a pathfinder mission for future sample returns from bodies with high surface gravity.