Exploration of Near Earth Asteroids (06)
Precursor Missions to NEAs (2)

Author: Dr. Patrick Michel
University of Nice-Sophia Antipolis, CNRS, Observatoire de la Cote d'Azur, France

Dr. Maria Antonietta Barucci
Observatoire de Paris, France
Dr. Andy Cheng
The Johns Hopkins University Applied Physics Laboratory, United States
Dr. Hermann Böhnhardt
Max-Planck-Institut für Solar System Research, Germany
Dr. John Robert Brucato
Italy
Dr. Elisabetta Dotto
Italy
Dr. Pascale Ehrenfreund
Space Policy Institute, George Washington University, United States
Dr. Ian Franchi
United Kingdom
Dr. Simon Green
United Kingdom
Dr. Luisa M. Lara
Instituto de Astrofisica de Andalucia, Spain
Dr. Bernard Marty
Centre de Recherches Pétrographiques et Géochimiques (CRPG), France
Dr. Detlef Koschny
European Space Agency (ESA), The Netherlands
Dr. Stephan Ulamec
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Germany

MARCOPOLO-R: NEAR EARTH ASTEROID SAMPLE RETURN MISSION SELECTED FOR THE ASSESSMENT STUDY PHASE OF THE ESA PROGRAM COSMIC VISION 2

Abstract

MarcoPolo-R is a sample return mission to a primitive Near-Earth Asteroid (NEA) selected for the assessment study phase of the ESA program Cosmic Vision 2 in February 2011 through mid-2013. The high international interest for sample return missions to primitive asteroids is demonstrated by their recent selections by main space agencies: NASA selected OSIRIS-REx in spring 2011 in the program New Frontiers for launch in 2016 and Earth return in 2023; Hayabusa 2 is in phase B at JAXA for launch in 2014 and Earth return in 2020. Both missions will greatly improve our knowledge of the material composing primitive asteroids. Given the diversity of those objects and the different sampling strategies that may sample different kinds and amounts of material, it is important that several such missions are sent to different objects using different sampling approaches. This should lead to a complete knowledge of what primitive bodies are. Moreover, in the preparation for human exploration, understanding the

diversity of the asteroid population, in particular their surface properties, is required. The baseline target of MarcoPolo-R is the binary NEA (175706) 1996 FG3. A binary target provides enhanced science return: new investigations can be performed more easily than at a single object, in particular regarding 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. This project is based on the previous Marco Polo mission, which was selected in the ESA Cosmic Vision 1 Program. Its scientific rationale was highly ranked by ESA committees, but its estimated cost exceeded the allotted amount. The cost of MarcoPolo-R for ESA can be reduced by a better optimization of the mission design and through possible collaboration with NASA. MarcoPolo-R will rendezvous with a primitive NEA, characterize it at multiple scales, and return a sample to Earth. The sample will contribute to the inventory of material that is probably missing in the meteorite collection, to the exploration of the origin of planetary materials and habitable planet formation, to the characterization of the organics and volatiles in a primitive asteroid and to the understanding of the unique geomorphology and dynamics of a hazardous binary NEA. MarcoPolo-R will also play a role in preparing for human exploration of asteroids, by improving our knowledge of the surface properties of one of these objects and investigating its mechanical response to the sampling mechanism.