SP-1312

Extract of Marco Polo section

ESA's Report to the 37th COSPAR Meeting

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European Space Agency
Agence spatiale européenne

5.5 Marco Polo

Introduction

As part of ESA's Cosmic Vision programme, a consortium of over 300 scientists under the lead of Antonella Barucci from the Paris Observatory submitted a proposal for a mission to return a sample from a Near-Earth Object, to be performed in collaboration with the Japanese space agency, JAXA. Together with six other studies, Marco Polo was selected as a potential candidate for a future mission and will be analysed in detail in an industrial assessment study in 2008 and 2009.

Scientific goals

The main questions Marco Polo will answer are:

— What were the initial conditions and evolution history of the solar nebula?

— What were the properties of the building blocks of the terrestrial planets?

— How did major events (e.g. agglomeration, heating) influence the history of planetesimals?

— Do primitive class objects contain presolar material that is unknown in meteoritic samples?

— What are the organics in primitive materials?

— How can organics in Near-Earth Objects shed light on the origin of molecules necessary for life?

— What is the role of impacts by Near-Earth Objects in the origin and evolution of life on Earth?

These questions will be addressed by analysing the material of a Near-Earth Object (NEO) in the laboratory. The mission will be designed to return a sample of a NEO to the Earth. Additional *in situ* investigations will be included to make observations with the following priorities:

Figure 5.5.1 Artist's impression of the Marco Polo spacecraft.

For further information, see http://sci.esa.int/spica

— To enable the safe operation and manoeuvering of the spacecraft in close proximity to the NEO and safe collection of the sample(s).

— To place the samples in their global and local context.

— To provide complementary science results not achievable from the samples themselves.

Potential target objects would be C-type or D-type NEOs, which are considered to be of primitive material, important to fulfill the scientific goals.

Configuration

One possible configuration would be to have the main (mother) spacecraft built by JAXA. It could be launched by a European launcher and, via a lunar swingby, be sent to the target object. After a few years of cruise phase, the mother spacecraft would arrive at the asteroid and go into orbit around it, at a distance of ~10–20 km. It would characterise the gravity field of the asteroid and map it in the visible and infrared spectral ranges to determine its surface structure. Next, the mother spacecraft would go down to only a few 100 m altitude, to take a closer look at up to five potential sampling sites, one of which would be selected for sampling. The mother spacecraft would land on the NEO surface or go down far enough such that the sampling device can take its sample. Optionally, more than one sample could be taken. The sample would be transferred into the Earth Reentry Vehicle. The mother spacecraft would return to the Earth and send the Earth Reentry Vehicle on a path into the Earth's atmosphere. The Earth Reentry Vehicle would be built to survive the flight through the atmosphere. It would perform a hard landing on the ground, where the samples would be retrieved and distributed to different laboratories via a curation facility.

Depending on the available resources, a lander could be added to the mission, which would touch down on the surface of the asteroid and perform additional measurements.

The complete mission duration should be less than 8 years, with a potential launch date in 2017 or 2018.

Status

The Science Study Team is currently active in finalising the Science Requirements Document, which will serve as a starting point for the internal ESA study in March/April 2008, and the industrial study starting before summer 2008. Work is ongoing in putting together the Payload Definition Document, which gives details about the potential payload that could fly on this mission. The industrial study is expected to finish in summer 2009, when the results of all Cosmic Vision studies will be reported to the ESA advisory bodies for a down-selection.

Table 5.5.1. The ESA and European Science Study Team for Marco Polo

The European Science Study Team for Marco Polo.

Maria Antonietta Barucci	Observatoire de Paris	Meudon, F
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The ESA team

David Agnolon	Study Manager
Jens Romstedt	Payload Manager
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