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MarcoPolo-R: Near Earth Asteroid Sample Return Mission in ESA assessment study phase

John Robert Brucato (1), Antonella Barucci (2), Patrick Michel (3), Hermann Böhnhardt (4), Elisabetta Dotto (5), Pascale Ehrenfreund (6), Ian Franchi (7), Simon Green (7), Luisa Lara (8), Bernard Marty (9), Jens Romstedt (10), David Agnolon (10), and Detlef Koschny (10)

(1) INAF, Osservatorio Astrofisico Arcetri, Firenze, Italy (jbrucato@arcetri.astro.it), (2) LESIA-Observatoire de Paris, Meudon, France, (3) Univ. Nice, CNRS, France, (4) MPS, Katlenburg-Lindau, Germany, (5) INAF-Obs. of Roma, Italy, (6) Univ. of Leiden, The Netherlands , (7) Open Univ., Milton Keynes, (8) IAA-CSIC, Granada, Spain, (9) CRPG, Nancy, France, (10) 10ESTEC, ESA, The Netherlands

MarcoPolo-R is an European-led sample return mission to a primitive Near-Earth Asteroid (NEA) selected in February 2011 for the Assessment Study Phase at ESA in the framework of ESA's Cosmic Vision 2 program. MarcoPolo-R will rendezvous with a unique kind of target, a primitive NEA, scientifically characterize it at multiple scales, and return a unique pristine sample to Earth unaltered by the atmospheric entry process or terrestrial weathering. The baseline target of MarcoPolo-R is the primitive (341843) 2008 EV5, which offers a very efficient operational and technical mission profile.
MarcoPolo-R will allow us to study the most primitive materials available to investigate early solar system formation processes and it will provide a sample from a known target with known geological context. Direct investigation of both the regolith and fresh interior fragments is also impossible by any means other than sample return. Primitive material, having experienced less alteration on the asteroid, will be more friable and would not survive atmospheric entry in any discernible amount. 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 stellar, interstellar medium, pre-solar nebula and parent body processes that are retained in primitive asteroidal material, unaltered by atmospheric entry or terrestrial contamination. It is no surprise therefore that sample return missions are considered a priority by a number of the leading space agencies.