

9th SYMPOSIUM ON VISIONS AND STRATEGIES FOR FAR FUTURES (D4)  
Human Exploration in Deep Space (1)Author: Mr. Andrea Messidoro  
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Politecnico di Torino, ItalyCONCEPTUAL DESIGN OF A HUMAN MISSION TO THE NEAR-EARTH ASTEROID 1999 AO10 IN  
2025-2026**Abstract**

A manned mission to the Near-Earth Asteroid (NEA) 1999 AO10 in 2025-2026 represents an intermediate and incremental step towards the human exploration of Mars. It would bring a large suite of benefits: high scientific return, operational experience on human space exploration missions beyond LEO, test technologies and assessment of human factors for future long-duration missions, test of asteroid collision avoidance techniques and nevertheless evaluation of in-situ resource utilization. A space system modular architecture composed of 5 elements: 1 NASA Orion-like Command Module (CM), 1 Mission Habitation Module (MM) and 3 Propulsions Modules (PM1, PM2 and a Service Module SM of the CM), that use chemical storable cryogenic propulsion for the main orbital maneuvers (total  $\Delta V = 7.23$  [km/s]), is able to send in 2025-2026 a crew of 3 astronauts on the NEA 1999 AO10 for a space mission lasting 165 days, and bring them back safely to the Earth. The whole 5 modules spacecraft (S/C) of almost 210 [t] in total will be launched separately by 2 equal crew and cargo HLLV of around 110 [t], still to be developed. The assembly in LEO will anticipate the injection into the NEA Transfer Orbit (NTO) by the PM1, then expended. Once the S/C is in proximity of the asteroid, a rendez-vous maneuver is performed by the PM2, then expended. Afterwards the MM, CM and SM will attend a docking to a pre-installed platform, anchored on the NEA surface by a previous robotic mission. After 14 days of operations, including the deployment of instrumentation and high challenging EVAs, the remained 3 modules' S/C will come back to the Earth and the CM, with the crew on board, will be able to land safely after an atmospheric direct re-entry. The assessment of the mission concept includes a top-level function definition and allocation in the 5 S/C modules, an S/C elements interfaces functional analysis, a S/C sub-systems definition and initial characterization, preliminary mass and power budgets and a first mission costs estimation. The space human mission the NEA 1999 AO10 would be the first human expedition to an interplanetary body beyond the Earth-Moon system. The challenge of increasing the interest of the international community on the human spaceflight and inspiring the new generations about science, technology and space has been accepted.