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ASTROBIOLOGY IN THE ITALIAN SPACE AGENCY: AN OVERVIEW OF ONGOING RESEARCH PROJECTS

Abstract

Expanding knowledge on life, on the potential habitability of planets and on the co-evolution between life forms and the environment are fundamental Astrobiology issues to define future planetary exploration missions. The Italian Space Agency (ASI) promoted the creation of a national platform for scientific communities working on different topics with the goal of generating synergies and identifying future opportunities for joint activities. The Roadmap identifies specific areas of interest for the community, including the Planetary Field Analogues (PFA) which are considered hot topic for the understanding of where and how life (as we know it) may exist and evolve, how we can search life beyond Earth and how to prepare future exploration missions. In this framework, ASI selected and financed seven research projects in two main areas: (1) identification and development of prototypes/demonstrators/technologies for data analysis and modeling to support future space missions aimed, in particular, at the study of the origin of life and human and robotic space exploration (four projects); (2) identification of elements for human and robotic space exploration, using Terrestrial Analogue sites for scientific experimentation (three projects). Within the first area, the project VENOM proposes to develop a lab-on-a-chip able to provide a highly-integrated multiparametric in situ platform utilizing immuno- and/or enzyme-assay for the assessment of biogenic compounds from icy samples extracted from the Europa surface and Enceladus plume; BE-SIDES aims at developing a lab-on-chip technology for the search of past and present life in robotic and human space exploration missions, based on the recognition of organic molecules and molecular biosignatures correlated with life processes; MIGLIORA aims to define an highly innovative astrochemical, chemical-prebiotic and biomolecular experimental models capable of predicting and analyzing the mechanisms that regulate molecular complexity evolution and the Origin of Life; CASPR proposes studies on how solar UV irradiation and ferromagnetic fields induces homochirality due to interactions between the electron spin and the chiral molecular structure. Within the second area, the selected projects, ASTERIA, CRYPTOMARS, and HELENA, aim at exploring the Origin of Life, evolution, and habitability in PFA by combining planetary science, geology, and microbiology. By studying the strategies adopted by microorganisms to resist simulated or real stressful conditions, the projects may identify an unexpected mechanism of resistance, and, they will help in the definition of the boundary conditions under which life can thrive on Earth's extreme environments discussing whether life could originate, evolve, or survive elsewhere in our Solar System.