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EUREKA: A LOW-COST FLYBY MISSION TO EUROPA

Abstract

Search for extraterrestrial life is one of the primary drivers of contemporary space exploration. While many organic compounds and even simple amino-acids have already been found in space, it is of immense importance to higher-level biomarkers and confirm their biogenic origin. Multiple space missions are already planned and funded with the aim of finding signs or precursors of life on Venus, Mars, Titan, and Enceladus.

Europa, a Jovian icy moon, with a subsurface ocean adjacent to a rocky layer, is considered to potentially harbor extraterrestrial life in the present or the past. Two major missions: JUICE, and Europa Clipper, are being launched now which primary goals include accessing its geology and potential habitability.

We propose to fill in the gap with a mission of opportunity, and to find and quantify biomarkers from orbit. The mission will launch in early 2030-s, and will arrive at Jupiter system after several years, using a multiple gravity assist orbit strategy. The spacecraft will perform only a few Europa and potentially other Jovian moons flybys, without entering orbit. Following completion of the flyby(s) it will fly back towards Earth's vicinity, during which time the accumulated scientific data will be transmitted, by RF or optical link, at an increasing rate.

This flyby mission approach, markedly different from large-mass, high-powered, heavily-rad-protected mission type of architecture most other missions to Outer Solar System were based on. It allows to have much smaller and lighter propulsion, communications, power and radiation protection, greatly reducing mass, complexity and cost. This allows rapid development and launch, and scientific results to come on time before the next flagship-type mission is finalized, allowing beneficial adjustments.

Our proposed mission includes several scientific goals and aims to support future Europa in-situ investigations. The scientific goals include: 1. Detection of Tryptophan and Tyrosine – largest and most complex amino acids, essential for all earth life, that were never discovered in extraterrestrial environments before, and are composed of aromatic rings, enabling remote detection by UV-fluorescence spectroscopy. 2. Organic molecules composition of the target, supporting biotic origin. 3. Potential landing sites characterization. 4. Magnetic fields characterization in the Jovian system, adding on JUICE and Clipper.

In this paper, we describe the detailed mission plan, trajectory options and trade-offs, initial spacecraft design, communication and power strategies, and preliminary instruments package.