Comet Interceptor Mission. Deepening the Probe B2 design

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ABSTRACT

The Comet Interceptor (CI) mission was selected by the ESA's Science Programme Committee in June 2019 as a Fast track mission (F-mission) in its Cosmic Vision Programme. The planned launch date is 2028, and the mission will share the launch with the ESA mission ARIEL.

The primary objective of the Comet Interceptor mission is to characterize a long period comet (LPC), which could potentially be a dynamically new comet (DNC), or an Interstellar Object (IO). Previous comet missions encountered short-period comets, i.e., comets that have experienced many close approaches to the Sun along their orbits and consequently have been subjected to significant changes. In contrast, the target of the CI mission will be a comet visiting the inner Solar System for the first time (i.e., a pristine comet), which will offer a unique view of comets' morphology, composition, and plasma environment.

Comet Interceptor mission is composed of three elements: one mother spacecraft (S/C-A), provided and operated by ESA; and two probes, named Probe B1 and Probe B2, provided by JAXA and by ESA respectively. To achieve the scientific goals, several remote sensing and in situ measurement instruments will be accommodated on-board the platforms to allow multi-point observations of the target object during the fly-by.

The mission will be launched to the Sun-Earth Lagrangian point L2 (SEL2), where a waiting phase will take place until a suitable target appears. After object selection, Comet Interceptor will transfer to encounter the comet, and both probes will be released 24-48 hours before the closest approach. Following this sequence, the two probes will operate according to a pre-loaded timeline on an autonomous mode. The scientific data acquired by the probes during the encounter will be transmitted to the main spacecraft using inter-satellite link communications. Following the encounter, the main spacecraft will be in charge to downlink it to ground.

Focusing on the Probe B2, it is envisaged as a high risk but high scientific return element of the mission. Its design is based on a simplified yet compact spacecraft, characterized for following a low redundancy and design to cost approach. This is mainly due to its short lifetime after separation from the mother spacecraft. A release of the probe is expected approximately 27 hours before the closest approach with the target, and a survival timeframe of at least 3 hours after, leading to a desired total lifetime of 30 hours.

The probe design accommodates all the required subsystems and payloads within a mass of approximately 35kg. The structure is based on a main octagonal deck panel, supported by a central cylinder which provides interface with the separation mechanism and thus with the S/C-A. Furthermore, one of the main challenges

of the design is to ensure the survivability of the probe during the fly-by in the harsh dust environment. For this reason, the mechanical architecture, below the main deck, also implements a dust shield to protect the equipment and the instruments from the dust flow during the encounter phase. Finally, the ISL antenna supporting struts raise on top of the main deck, providing support to a tent of MLI which thermally insulates the whole Probe B2 envelope.

To be in line with the design philosophy, a passive attitude control based on spin stabilization is selected, taking advantage of the inherent gyroscopic stability of the probe. In the same way, the mission's constraints also lead to the use of primary batteries, with an energy capacity matched to B2 mission profile. Regarding the instruments, the Probe B2 accommodates an Entire Visible Sky multi-channel camera, EnVisS; an Optical Periscope Imager for Comets (OPIC); and a Dust Field & Plasma instrument (DFP-B).

The Phase I of the project, also known as the Definition Phase A/B, was awarded to two different consortia, being one of them led by Thales Alenia Space UK as Prime for the S/C-A, and Deimos Engineering and Systems as Subcontractor for the Probe B2.

The conference will guide the audience through the description and objectives of the Comet Interceptor mission, focusing on the Probe B2 design achieved by Deimos during the first phase of the project.