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Comet Interceptor: A proposed ESA Mission to a Dynamically New Comet

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Abstract

In response to the recent European Space Agency's call for proposals for a Fast (F) Mission, a multi-spacecraft project has been submitted to ESA to encounter a dynamically new comet or interstellar object. Such an encounter with a comet approaching the Sun for the first time would provide valuable data to complement that from all previous comet missions, which have by necessity studied short-period comets that have evolved from their original condition during their time orbiting near the Sun.

The mission's primary science goal is to characterise, for the first time, a dynamically-new comet or interstellar object, including its surface composition, shape, and structure, and the composition of its gas coma. A unique, multi-point 'snapshot' measurement of the comet- solar wind interaction region is to be obtained, complementing single spacecraft observations made at other comets. Additional science will include multi-point studies of the solar wind pre- and post-encounter over gradually-changing separation distances.

The spacecraft would be delivered to L2 with the ESA *Ariel* mission, and would therefore by default be placed in a holding location suitable for later injection onto an interplanetary trajectory to its target. Suitable cometary targets would be searched for prior to launch, and after launch if necessary, with a short period comet serving as a backup target. With the advent of powerful facilities such as the *Large Synoptic Survey Telescope, LSST*, the prospects of finding a suitable dynamically new comet nearing the Sun for the first time are very promising. The possibility also exists for the spacecraft to encounter an interstellar object if one is found on a suitable trajectory. A known short-period comet will act as a reserve target.

Following insertion onto an interplanetary trajectory, the two sub-spacecraft – one provided by ESA, the other by JAXA – would be released from the primary craft. With suitable instrumentation, these would allow valuable multi-point measurements of the solar wind over different length-scales as these craft separate.

For the comet encounter, the primary spacecraft, planned to also act as the primary communication point for the whole constellation, would be targetted to pass outside the hazardous inner coma, on the sunward side of the comet. At least one sub-spacecraft would be targetted for the nucleus/inner coma region. The various component spacecraft will carry a range of miniaturised instruments for remote and in situ studies of the object's composition, nucleus, coma, and plasma environment. Following an initial proposal submission stage in October 2018, Comet Interceptor was selected by ESA as one of only six submission invited to submit a full proposal by March 2019. At that time of writing, the mission proposal is currently undergoing evaluation by ESA, with a selection decision expected in July 2019.

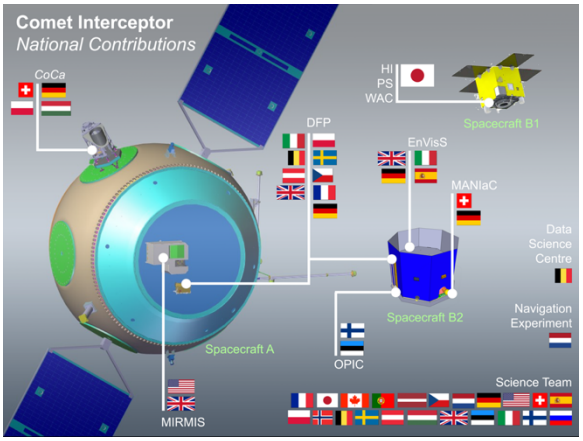

Figure 1: National agency contributions to Comet Interceptor.