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THE COMET INTERCEPTOR MISSION - MAKING A CASE FOR SOLAR ELECTRIC PROPULSION

Abstract

The Comet Interceptor plans to be the first mission to visit a Dynamically New Comet — by definition, a comet visiting the inner Solar System for the first time. Dynamically New Comets are detected very shortly before their closest passage to the Sun; the mission and spacecraft will have to be designed, and may be even launched, without a known target. The mission is scheduled for launch in 2028 and will stay parked in the Sun-Earth Lagrange Point 2 until the start of the transfer to the target. We analyzed a Solar Electric Propulsion (SEP) transfer for The Comet Interceptor Mission. Specifically, the possible encounter locations were parametrically defined and mapped according to the Δv required to reach them with SEP; we also studied a transfer to a Comet Interceptor backup target. We compared the results to available performance data for the Chemical Propulsion (CP) baseline system, establishing the superiority of the SEP option in maximizing both payload mass and reachable locations. We concluded that SEP, when compared to CP, delivers trajectories requiring less propellant mass. We also show that a SEP system allows savings of more than 125 kilogram for 50% of the comet encounter locations; 75% of the encounter locations are reached with the same or even inferior transfer duration compared to CP.

The entire range of encounter locations is reachable with less than 160 kilogram and a time-of-flight under 4 years for an SEP system compared to 280 kilogram and 4.6 years with CP. SEP transfers carry a time-of-flight penalty of 3 years to improve all the CP trajectories in terms of propellant mass. Minimizing transfer duration with SEP carries a penalty of 50 kilogram to reduce the time-of-flight for 75% of the encounter locations and not all the encounter locations are reached in less time compared to CP: 25% of the encounter locations require more time with SEP.

We concluded that 73P/Schwassmann-Wachman — a backup target for Comet Interceptor — is reachable with just 16 kilogram of propellant. It was also established that the Earth's gravity field can be leveraged when departing SEL2 to lower the propellant mass required to reach the target. Increasing the available power to the engine results brings performance gains between 6 kilogram and 18 kilogram compared to the baseline EP system.