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Strategies for Rapid Implementation of Interstellar Missions: Precursors and Beyond (4)

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USING GRAPHENE INTERSTELLAR SOLAR PHOTON SAILS: SENSITIVITY STUDIES FOR PICO-PROBES AND ARKS

Abstract

A linear BASIC program has been applied to perform performance sensitivity studies for two types of interstellar spacecraft propelled by absorptive graphene solar-photon sails. In all cases, the pre-perihelion solar orbit is parabolic and the sail is always oriented normal to the Sun. The sail is exposed to sunlight at perihelion. After demonstrating the accuracy of the software, Starwisp-type thin-film probes were first considered. If reflectance of monolayer sails can be increased and very-close perihelion passes and enormous accelerations can be tolerated, travel durations to Alpha/Proxima Centauri of less than a century are possible. Similar calculations are performed for an interstellar ark. For a perihelion distance of 0.7 AU, a fixed maximum acceleration of 3g, a sail fractional Sunlight absorption of 0.4 and a fractional reflection of 0.6, the areal mass density is about 0.00005 kilograms per square meter. For the ark, areal mass density increases with reflectivity in an approximately linear fashion. For all cases considered, peak perihelion temperatures are less than the maximum operational temperature of graphene.