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SOLAR OCCULTER APPLICATION TO EXTRA-SOLAR SUNDIVER MISSIONS

Abstract

One method of propelling robotic probes on trajectories to explore heliopause or Oort Cloud destinations is the Sun Diver maneuver in which a solar-photon sail is unfurled at the near-Sun perihelion of a solar orbit. Although controlled variation of the sail's solar aspect angle during the pre-perihelion trajectory has been suggested as a method of achieving a close solar approach, such an operation might required many months of sail exposure to the space environment prior to the perihelion pass. An alternative possibility is to use planet gravity assists to direct the sail towards perihelion and to utilize a solar occulter (perhaps constructed of space debris or mined asteroid material) to shield the sail from the Sun during the pre-perihelion trajectory and thereby reduce solar electromagnetic (EM)-radiation back-pressure on the sail prior to perihelion. The sail would ideally be oriented edge-on towards the Sun before perihelion and would emerge from behind the occulter at perihelion. In this paper, the required occulter/(disc) sail radius ratio is investigated for perihelion solar distances of 0.05-0.2 Astronomical Units. It is shown that the occulter/sail solar-EM radiation-pressure acceleration ratio is a function of (opaque) sail and occulter reflectivity to sunlight and areal mass thicknesses.