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New Missions Enabled by New Propulsion Technology and Systems (9)

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A HIGH INCLINATION SOLAR MISSION ENABLED BY NEAR-TERM SOLAR SAIL PROPULSION

Abstract

The Decadal Survey for Heliophysics calls for NASA to develop the technologies required to implement a solar polar imager mission. Our current understanding of the Sun, its atmosphere, and the heliosphere is severely limited by a lack of good observations of the Sun's polar regions. A High Inclination Solar Mission (HISM) mission would go into a 0.48-AU circular orbit with at least a 60 inclination to conduct long-term observations of the Sun's poles using both situ and remote-sensing instruments to study the connections between the Sun, the solar wind, and solar energetic particle events.

The propulsion requirements to implement HISM are beyond the capability of conventional chemical propulsion and extremely challenging even for highly efficient solar electric propulsion. To enable HISM and a host of other propulsion-intense space science missions, NASA is actively developing solar sail propulsion, capable of continuous low thrust for the extended periods of time required to meet the V requirements of HISM. Upcoming solar sail missions include the Near Earth Asteroid (NEA) Scout (2021 planned launch) and Solar Cruiser (candidate for flight in 2024).

Solar sails use sunlight to propel vehicles through space by reflecting solar photons from a large, highly-reflective sail. This continuous photon pressure provides propellantless thrust, allowing for very high V maneuvers on long-duration, deep-space exploration. Since the Sun supplies the necessary propulsive energy, solar sails require no onboard propellant, thereby potentially increasing useful payload mass.

NASA MSFC recently completed a detailed mission concept study of HISM based on the solar sail propulsion technologies being developed for NEA Scout and Solar Cruiser. The HISM spacecraft concept envisions carrying a Doppler Stokes Imager, a coronagraph, magnetometer, Faraday Cup, a plasma spectrometer, and a radio and plasma wave package to meet the science objectives established in the Heliophysics Decadal Survey. This paper will describe the mission concept and its solar sail propulsion system.