Paper ID: 49174
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IAF SPACE PROPULSION SYMPOSIUM (C4)
New Missions Enabled by New Propulsion Technology and Systems (6)

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THE KON-TIKI MISSION – DEMONSTRATING LARGE SOLAR SAILS FOR DEEP SPACE MISSIONS

Abstract

Two key NASA strategic documents, Our Dynamic Space Environment: Heliophysics Science and Technology Roadmap for 2014-2033 and 2013 Solar and Space Physics: Science for a Technological Society, contain over a dozen references describing the value of solar sails to enable revolutionary new observational capabilities. Based on these needs, the NASA Marshall Space Flight Center (MSFC) developed the Kon-Tiki mission concept to mature solar sail technology for use in future Heliophysics missions as well as missions of interest across a broad user community (e.g., space weather and Earth polar observatories). Kon-Tiki would serve as a pathfinder for missions that observe the solar environment from unique vantage points such as the Solar Polar Imager (SPI), opening a fundamentally new range of observational capabilities for the Heliophysics Program and for space weather monitoring. Observations away from the Sun-Earth line (SEL) present unique opportunities for answering the outstanding science questions of Heliophysics, for improving space-weather monitoring and prediction, and for revealing new discoveries about our Sun and solar system. High solar inclinations are particularly compelling. Investment in, and demonstration of, the technology needed to enable polar missions is essential to making this unique vantage point a reality in the next decade.

Propellantless solar sails can be used to create artificial equilibria and indefinite station keeping at locations sunward of L1 along the SEL or at any desired offset from the SEL leading or trailing the Earth in its orbit. They can change the heliocentric inclination of a spacecraft from the ecliptic to as high as solar polar, stopping and remaining at any intermediate inclination orbit in between. Sails can be used to hover over the Earth's poles, using solar photon pressure to offset the Earth's gravitational attraction, creating functional equivalents of geostationary earth orbits.

The Kon-Tiki mission would fly a small spacecraft with a large (>1500 square meter) solar sail containing embedded reflectivity control devices (RCDs) and photovoltaic cells. The mission concept includes successful deployment of the solar sail, validation of all sail subsystems, controlled station-keeping inside of the Sun-Earth L1 point, attitude control of the sail with the RCDs (including spinning and despinning), demonstration of pointing performance for science imaging, and finally an increase in heliocentric inclination (out of the ecliptic).