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

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EARTH-TO-ORBIT BEAMED ENERGY EXPERIMENT (EBEX)

**Abstract**

As a means of primary propulsion, beamed energy propulsion offers the benefit of offloading much of the propulsion system mass from the vehicle, increasing its potential performance and freeing it from the constraints of the rocket equation. For interstellar missions, beamed energy propulsion is arguably the most viable in the near- to mid-term. A near-term demonstration showing the feasibility of beamed energy propulsion is necessary and, fortunately, feasible using existing technologies.

Key enabling technologies are 1) large area, low mass spacecraft and 2) efficient and safe high power laser systems capable of long distance propagation. NASA is currently developing the spacecraft technology through the Near Earth Asteroid Scout solar sail mission and has signed agreements with the Planetary Society to study the feasibility of precursor laser propulsion experiments using their LightSail-2 solar sail spacecraft.

The capabilities of Space Situational Awareness assets and the advanced analytical tools available for fine resolution orbit determination now make it possible to investigate the practicalities of an Earth-to-orbit Beamed Energy eXperiment (EBEX) – a demonstration at delivered power levels that only illuminate a spacecraft without causing damage to it. The degree to which this can be expected to produce a measurable change in the orbit of a low ballistic coefficient spacecraft is investigated. Key system characteristics and estimated performance are derived for a near term mission opportunity involving the LightSail-2 spacecraft and laser power levels modest in comparison to those proposed previously. A more detailed investigation of accessing LightSail-2 from Santa Rosa Island on Eglin Air Force Base on the United States coast of the Gulf of Mexico is provided to show expected results in a specific case.

While the technology demonstrated by such an experiment is not sufficient to enable an interstellar precursor mission, it is a first step toward that goal.