USE OF LUNAR SWINGBYS FOR SOLAR ELECTRIC SPACECRAFT ON ESCAPE MISSIONS*

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ABSTRACT

Initial use of solar electric propulsion (SEP) to solar system bodies will be modest. The Jet Propulsion Laboratory plans to fly the NSTAR SEP system as a first mission of its New Millennium program, demonstrating several new technologies. Targets for this mission will likely be asteroids or comets, or a combination, with launch in 1998. Duration will be 1.5 to 2 years. Solar power, using solar arrays, will be limited to about 2.5 kW_e.

This paper examines the possibilities of using one or more lunar swingbys to enhance the launch capability: either increased escape energy or increased payload mass. Initial result-s for a single lunar flyby indicate an energy increase of 2--3 units of C3 (escape energy) . A second flyby can increase this to 4-5 units of C3. Use of SEP can play an active role in re-encountering the Moon by shaping the trajectory from one encounter to the next. In a previous analysis (see Reference), solar perturbation is used for this trajectory shaping. This is very efficient, but can significantly restrict launch dates to when the sun-Earth-Moon angle at the first lunar arrival is within certain limits. These limits are removed with the use of SEP, which can counteract the sun's effect, and shape the trajectory to that desired. The analysis presented in this paper will be parametric with launch date and SEP parameters, to develop the thrust history necessary for enhancing lunar gravity assist. To the author's knowledge, this is the "first analysis which addresses the problem of using SEP , together with lunar swingbys, to develop missions to other bodies .

Reference: Penzo, P. A., Bender, D. F., Cassell, C. R., "Multiple Lunar Swingbys for Small Body and Planetary Missions", Paper AAS 95-0147, presented at the AAS/AIAA Spaceflight Mechanics Meeting, Albuquerque, N.M., 13-16 February 1995.

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