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THE IMPACT OF EMDRIVE PROPULSION ON THE LAUNCH COSTS FOR SOLAR POWER SATELLITES

Abstract

This paper addresses the problem of achieving the major launch cost reduction required for the economic viability of any SPS system. The EmDrive (Electromagnetic Drive) is a novel propulsion technology which has been the subject of worldwide Research and Development activity over the last 20 years. One of the early requirements was for a heavy launch vehicle which would, in the words of the USAF, "provide a space elevator without the cables". At the 2008 IAC conference an aerodynamic model of a spaceplane was exhibited. In a 2013 IAC conference paper, a hybrid EmDrive propelled, reusable spaceplane was described, with a 50 tonne payload to GEO. Using 3 spaceplanes for 134 launches, a 2GW SPS would take less than a year to build in orbit using tele-robot assembly. The total launch cost was then estimated at $1.5Bn.A further spaceplane concept, this time a single stage to orbit type, based on the USAF X37B outline, was described the following year. These early launch vehicle concepts used second generation EmDrive thrusters, with YBCO superconducting technology, cooled with Liquid Hydrogen. Although these engines would provide the required high levels of thrust, they suffered from acceleration limitations due to internal Doppler shifts. A solution was established using pulsed Doppler correction, circular polarisation and dual cavity thrusters. These third generation thrusters were incorporated into a number of design studies, including the Heavy Launch Vehicle described in this paper. The vehicle resembles the original spaceplane concept of 2008, and is unmanned and fully reusable, with a 500 mission lifetime. The launch mass is 116 tonnes and the payload capacity is a minimum of 50 tonnes to GEO. The acceleration levels are very low (.014 g mean) which allows a simple, low stressed, airframe, and the ability to carry an un-faired payload attached underwing. The maximum velocity through the atmosphere is a mere 70 mph, though 6 hours of continuous acceleration eventually gives GEO velocity. Both take off and landings can be carried out vertically, from any airfield. It is truly a space elevator without cables, with the additional advantage of precision manoeuvrability, to assist positioning and assembly of the SPS components in orbit. Early cost estimates give a specific launch cost to GEO of $11/kg. Clearly the use of EmDrive propulsion will make the economic case for SPS unassailable in the future.