Paper ID: 21913
oral

SPACE PROPULSION SYMPOSIUM (C4)
Advanced and Combined Propulsion Systems (8)

Author: Mr. Roger Shawyer
Satellite Propulsion Research Ltd, United Kingdom, sprltd@emdrive.com

SECOND GENERATION EMDRIVE PROPULSION APPLIED TO SSTO LAUNCHER AND INTERSTELLAR PROBE.

Abstract

In an IAC13 paper, the dynamic operation of a second generation, superconducting EmDrive thruster was described. A mathematical model was developed, and in this paper that model is used to extend the performance envelope of the technology. Three engine designs are evaluated. One is used as a lift engine for a launch vehicle, another as an orbital engine for the launcher, and a third as the main engine for an interstellar probe. The engines are based on YBCO superconducting cavities, and performance is predicted on the basis of the test data obtained in earlier experimental programmes. The Q values range from 8 x 107 to 2 x 108, and provide high specific thrusts over a range of acceleration from 0.4 m/s/s to 6 m/s/s.

The launch vehicle is an "all electric" single stage to orbit (SSTO) spaceplane, using a 900 MHz, eight cavity, two axis gimballed lift engine. A 1.5 GHz fixed orbital engine provides the horizontal velocity component. Both engines use total loss liquid hydrogen cooling. Electrical power is provided by fuel cells, fed with gaseous hydrogen from the cooling system and liquid oxygen. A 2 Tonne payload, externally mounted, can be flown to Low Earth Orbit in 27 minutes. The total launch mass is 10 Tonnes, with an airframe styled on the X-37B, which allows aerobraking and a glide descent and landing.

The full potential of EmDrive propulsion for deep space missions is illustrated by the performance of the interstellar probe. A multi-cavity, fixed 500 MHz engine is cooled by a closed cycle liquid nitrogen system. The refrigeration is carried out in a two stage Reverse-Brayton Cycle. Electrical power is provided by a 200 kWe, indirect cycle nuclear generator. The 9 Tonne spacecraft, which includes a 1 Tonne science payload, will achieve a terminal velocity of 0.67c and cover a distance of 4 light years, over the 10 year propulsion period.

The work reported in this paper has resulted in design studies for two Demonstrator spacecraft. The launcher will provide the long-sought-after, low cost access to space, and also meet the mission requirements of the proposed DARPA XS-1 Spaceplane. The probe will enable the dream of an interstellar mission to be achieved within the next 20 years.