Radiofrequency Resonant Cavity Thruster Research Project

Research has been conducted in this field of propulsion for nearly a decade. The first example of this method propulsion being tested can be traced to Roger Shawyer and his development of the Emdrive. Three years later, the Chinese Academy of Sciences at the Northwestern Polytechnical University in Xi’an conducted experiments to determine if the device produces thrust. In 2011, a similar thrust was developed by Guido Fetta known as the Cannae Drive, which is comparable in design and methodology to the Emdrive. This thrust was then tested by NASA in 2013 at the Johnson Space Center by Eagleworks. The Chinese Academy of Sciences’ and NASA’s findings and conclusions are detailed below:

Abstract

In order to meet the needs of new and more ambitious space missions, a new form of space propulsion must develop. The method of propulsion with the greatest potential to influence the space industry is the RF Resonant Cavity Thruster. This thruster is a new type of technology that was developed by Roger Shawyer and Guido Fetta as a way of producing small amounts of thrust without any onboard reaction mass. This project focuses on learning from the experiments conducted by NASA and the Chinese on this form of propulsion to design and build a new version of the thruster. These previous results and conclusions, combined with other equations and design methodologies for building a resonant cavity/waveguide will be used to design a different variation of thruster. The research is primarily focused towards a conceptual design project over the next year, but there is potential to build and test the device. The research is based on topics such as resonant cavity/waveguide particle accelerator design, quantum mechanics, and superconductivity.

Are RF Resonant Cavity Thrusters a feasible method of propulsion? If so, is there a better way to produce more thrust than has already been seen in previous experiments?

Although the previous tests of radio frequency resonant chambers have produced minimal thrust, this is primarily because the chambers have been designed and built only as proof of concept. The purpose of this research project will be to take the concept and optimize it to prove the viability of the technology. The optimization will focus on the equations behind the design, which stem from waveguides and pillbox cavities, and the material with which the chamber is made. Different techniques will also be utilized to power the device compared to conventional methodologies.

Hypothesis

This new form of propulsion offers to greatly reduce the travel times for missions in deep space. Other applications also include satellite deployment and the possibility of multiple missions and destinations for a single space probe. More detailed applications have also been described by NASA’s Report[1]:

Based on test data and theoretical model development, the expected thrust to power for initial flight applications is expected to be in the 0.4 newton per kilowatt electric (N/kWe) range, which is about seven times higher than the current state of the art Hall thruster in use on orbit today. The following figures show the value proposition for this class of electric propulsion. Figure 23 shows a conservative 300 kilowatt solar electric propulsion roundtrip human exploration class mission to Mars/Deimos. Figure 24 shows a 90 metric ton 2 megawatt (MW) nuclear electric propulsion mission to Mars that has considerable reduction in transit times due to having a thrust to mass ratio greater than the gravitational acceleration of the Sun (0.6 milli-g’s at 1 AU). Figure 35 shows the same spacecraft mass performing a roundtrip mission to the Saturn system spending over a year around two moons of interest, Titan and Enceladus. Even in this last class of mission which requires only a single heavy lift launch vehicle, the mission has less mission duration than is common with a current conjunction-class Mars mission using chemical propulsion systems and which would require multiple heavy lift launch vehicles.

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