Paper ID: 19378
student

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

Author: Mr. Harshit Bisen
SRM University Chennai, India

Ms. Harleen Kaur
India

RADIO WAVE AND ION CYCLOTRON THRUSTER

Abstract

Advanced propulsion systems are required to make space missions more feasible, less time consuming and economically viable. We are proposing a propulsion system which would make long period missions like those involving innumerable orbital maneuvers in LEO and GEO orbits and interplanetary and inter solar system probes (may be inter galaxy with future developments). It comprises of a source tube where the propellant (a neutral gas such as Argon or Xenon) is first injected and ionized to plasma state followed by an ion cyclotron heating section where this plasma is heated. When the gas is introduced to tubular chamber with one open end. Radio frequency AC power is coupled into a specially shaped antenna wrapped around the chamber. The electromagnetic wave emitted by the antenna causes the gas to break down and form a plasma. The presence of a considerable number of charge carriers makes the plasma electrically conductive so that it responds strongly to electromagnetic fields. The Ion Cyclotron Heating (ICH) section, emits electromagnetic waves in resonance with the orbits of ions and electrons as they travel through the engine. Resonance of the waves and plasma is achieved through a reduction of the magnetic field in this portion of the engine which slows down the orbital motion of the plasma particles. In magnetically confined plasma, particles rotate around magnetic field lines with frequencies.Therefore, if an electromagnetic wave with cyclotron resonant frequency is launched into the plasma, all the targeted particles are heated.Motion of ions and electrons through the engine can be approximated by lines parallel to the engine walls; however, the particles actually orbit those lines at the same time that they are traveling linearly through the engine. The final, diverging section of the engine, contains a steadily expanding magnetic field which forces the ions and electrons in to steadily lengthening spiral orbits in order to eject from the engine parallel and opposite to the direction of motion at speeds of up to 50,000 m/s, propelling the rocket forward through space. This system has two main advantages over most other ion thruster designs; first, it creates an accelerating electric field without inserting unreliable components like high voltage grids into the plasma (the only plasma facing component is the robust plasma vessel). Secondly, a neutralizer isn't needed, since there are equal numbers of electrons and (singly charged) positive ions emitted.