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Author: Mr. Renan Almeida
Universidade de Brasília, Brazil

Dr. Rodrigo Andrés Miranda
University of Brasilia, Brazil

NUMERICAL SIMULATIONS OF THE HELICAL PLASMA THRUSTER EXPERIMENT UNDER DIFFERENT MAGNETIC CONFIGURATIONS

Abstract

This paper describes a numerical investigation of magnetic field effects on a Helicon Plasma Thruster (HPT). This type of thruster is not correlated to those using high voltage ion acceleration or neutralizing beams, due to the restrictions they impose on the life of the engine components.

The HPT performs plasma production, ie particle excitation, through a radio frequency (RF) antenna. The plasma is contained in a tubular medium with a dielectric material and in contact with two flanges with conductive characteristic.

The magnetic field, generated by coils, is intended to keep its values constant throughout the tube and diverging section at the end of the tube. Upon contact with the magnetic field, the plasma generates internal field structures which can be used to control coupling power and the diffusion rate of plasma in the magnetic nozzle section.

The methods proposed in this paper seeks to use a numerical analysis, together with an experimental part, of the magnetic field itself. These data can be used to validate the experimental engine of the Plasma Laboratory (LP) of the University of Brasilia.

The numerical analysis attempts, through the theory of oriented objects and the aid of finite element theory, to approximate the interactions of particles with various magnetic fields imposed throughout the work, which were performed at the Plasma and Space Propulsion Simulation Laboratory. In order

These interactions will be essential so that, together with future experimental research, we can define which parameters are missing to validate the experimental engine of LP.

Through iterations using Wheeler's formulation, the dimensioning of coils for the ideal magnetic field was defined for the bench model in the plasma laboratory of the University of Brasília. The simulation results are promising and are able to consistently predict the plasma flow, in addition to its interaction with the structure. In this way, the research adjusts the experimental model so that engineering parameters such as thrust, specific impulse and efficiency can be analyzed.