Testing and Comprehensive Modeling of a GIE Utilizing Atmospheric Propellants

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Abstract: These This paper presents the results of a test campaign on a radio frequency ion thruster running with atmospheric propellants O2 and N2. The results are used for a detailed plasma theoretical based modeling of the RIT thrusters running utilizing atmospheric propellants.

I. Introduction

EARTH observation is one of the most important application of the space technology for example for providing the temporal variations of the Earth's gravity field over a time span of several years with high spatial resolution (i.e. ~100 km, comparable to that provided by GOCE, while it is about ~500 km in GRACE) and higher temporal resolution than GRACE (which is limited to ~1 month interval between successive gravity field maps). Such a mission will significantly improve our understanding on ice sheet and glaciers melting trends, continental water cycles, ocean masses dynamics, solid-earth deformations and other geophysical phenomena through the mass transportation (and the consequent temporal variations of the gravity field) produced within the Earth system. The

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widely used weather satellites use detectors for electromagnetic waves for environmental monitoring, meteorology, map making etc. Most Earth observation satellites carry instruments that should be operated at a relatively low altitude, although the altitudes below 500-600 kilometers are in general avoided, because of the significant air-drag at such low altitudes. The idea of RAM-EP is using the gases in this height as propellant for a solar electric propulsion system for drag compensation1.

Under an ESA contract two types of electric thrusters were tested to show their ability to work with atmospheric gasses2. In the TransMIT GmbH at the University of Giessen a gridded ion thruster of RIT type was foreseen for this study. The thruster was based on the RIT-10 already flown on ARTEMIS. Figure 1 shows the RAM-RIT-10 EBB running with a mixture of N2 and O2. The thruster was being ran without any modifications in the main thruster parts like discharge chamber and extraction system. The RF generator was however to be modified to pass to the different plasma discharge in the thruster. The first tests with showed the ability of the thruster to work with N2 without a major problem. Using O2 as propellant showed however a strong degradation of the graphite made acceleration grid due to the chemical reactions between O2 and Graphite. Replacing the grid material showed a dramatic enhancement of the life time.