The HEMP-Thruster: current development and perspective

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ABSTRACT

The High Efficiency Multi-Stage Plasma Thruster HEMPT is a relatively new ion thruster concept where the ion beam is emitted from magnetically confined plasma. It has been developed by the business unit Electron Devices of Thales Deutschland with first patents in 1998. The concept offers unique features including no discharge channel erosion leading to a high lifetime, the possibility of high acceleration voltage, a flexible thrust range and minimal complexity [1]. An electric propulsion system based on the HEMPT 3050 thruster has been developed as part of the HEMP-TIS DLR program for the in orbit verification on the Heinrich Hertz mission. The manufacturing and formal environmental test has been completed successfully. Currently the lifetime test of the HEMP 3050 is performed with two thrusters. One thruster will be operated for 4932h and 3000 operation cycles and a second thruster for 8583h in 10200 cycles with reduced cooldown time. The test is performed in the facilities of AEROSPACIO in Italy and the total test duration will be 2.5a [2].
In parallel a second propulsion system is under development with a target throttle range of 200W to 700W. The thruster will have an improved magnetic field topology that will enhance the thruster performance. In a second step the thruster module complexity will be further reduced. The development is accompanied with plasma simulations and will be supported by DLR and ESA. The new thruster will fulfil the needs of the emerging market of low earth orbit satellite constellations and will be tailored for the use in mega constellations. The development is part of the HEMP development roadmap that also includes a high power thruster in the 3kW to 5kW range that will also be based on the improved magnetic field topology.
The Thales test facility ULAN is currently upgraded with a thrust vector measurement diagnostic comprised of a rotation boom equipped with 37 retarding potential analysers. With this diagnostic it will be possible to determine the thrust vector of a thruster by measuring the energy distribution of the emitted ions over the full halve sphere. To know the direction of the thrust vector and its stability over time is very important for the operation in space and will be possible in for the first time in this facility.

References

[1] N. Koch, et al., “The HEMPT Concept - A Survey on Theoretical Considerations and Experimental Evidences”, IEPC-2011-236, Wiesbaden, 2011
[2] A. Lazurenko, et al. Qualification Test Results of HEMP Thruster Modules, IEPC-2015-347, Kobe-Hyogo, Japan, 2015