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Author: Prof.Dr. Yan Shen
Beijing Insitude of Control Engineering, China

PRIMARY IN-SPACE EXPERIMENTAL RESULTS OF THE HEP-100MF ELECTRICAL PROPULSION SYSTEM

Abstract

HEP-100MF is a magnetic-focused type Hall effect thruster with a discharge channel of 100mm in diameter. The HEP-100MF thruster is designed to achieve an extremely low plume divergence angle to allow better distribution freedom for instruments of satellite. According to the ground performance test results, its thrust is around 81mN and specific impulse is 1800s at standard working condition of 1350W anode power and 4.2mg/s anode flow rate. The ground test was performed in a 2m*5m vacuum chamber, the pressure in which was kept below 8*10-3Pa all through the experiment. Plume divergence angle was measured with Langmuir probe method simultaneously, and its half angle is below 15 degree at 90 percent beam density. As all ground verification test was accomplished and the technique was flight-ready, it is so lucky that an in-space experiment opportunity was provide by a new technology verification satellite of CAST. According to the satellite installation layout, the rotation rates variation of momentum wheel during the HEP-100MF thruster firing was adopted to demonstrate its actual in-space performance. And a series of firings was also arranged to verify reliability of the HEP-100MF thruster. The satellite was launched in November 2016, and till December 2016 the in-space experiments was completed. The electric propulsion system worked extremely well after the parameters were adjusted initially. 23 times of long duration firings were successfully accomplished and the longest firing was 8 hours 23 minutes. In these long duration tests the thruster achieved thermal equilibrium according to the telemetry data of temperature at installation interface. And the output thrust kept very stable all through the firing duration which is shown obviously from the linear rotation rates variation of momentum wheel. In nominal working condition, the average thrust is 79.1mN, a little lower than the results of ground test in vaccum chamber. Similar phenomenon happened in the in-space result of previous in-space experiment. An possible reason for this phenomenon is that the residual gas in the vacuum chamber contribute to the slight difference from in-space results. This paper provides the fundamental of HEP-100MF thruster and its verification progress. Overview of development process of the electrical propulsion system, including the PPU, DICU, and Xenon Management Unit is also introduced. Finally, the results of in-flight experiments of HEP-100MF electric propulsion system are presented and discussed in detail.