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The Vacuum Arc Ion Thruster for Space Science Applications

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The Vacuum Arc Thruster (VAT) is a simple electric propulsion system utilising pulsed arc discharges. Due to its low mass and power requirements, it is a candidate for small satellite space science missions. However, its thrust to power ratio, fuel efficiency and total impulse are much lower than larger, more traditional systems such as Hall effect and gridded ion thrusters. In this work the VAT is investigated as a plasma source for a high performance gridded ion thruster, a so-called Vacuum Arc Ion Thruster. This device seeks to combine the low mass and power advantages of the VAT with the high performance of a gridded ion thruster.

Several vacuum arc thrusters, as well as the pulsed power circuits that drive them, were built and characterised. Attention was given to their performance as thrusters themselves, as well as as plasma sources for the ion thruster. Different arc current pulse shapes and different cathode materials were experimented with. Total ion currents were measured for planar and coaxial thruster designs and a ballistic pendulum was constructed to provide individual impulse bit thrust measurements. The grid setup used to extract the ions into a beam as well as the extractor power supply design are presented. Attention was also given to beam neutralisation to ensure that beam ions do not return and coat sensitive spacecraft components.

Finally, the overall performance of the vacuum arc ion thruster is reviewed in the context of its application to a variety of space science missions.

Apply to be considered for a student ; award (Yes / No)?

Yes

Level for award;(Hons, MSc, PhD, N/A)?

MSc

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