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SPACEDRIVE – THRUST BALANCE DEVELOPMENT AND FIRST MEASUREMENTS OF
MACH-EFFECT AND EMDRIVE THRUSTERS

Abstract

Forces claimed by potential propellantless propulsion systems like the Mach-Effect thruster, developed by Prof. Woodward, and the EMDrive, developed by R. Shawyer, are in the N or even sub-N range. Within the framework of our SpaceDrive project, an automated thrust balance design capable of measuring forces of at least 100 nN for thrusters and their electronics with a mass up to 10 kg is described. The torsion balance features two different calibration methods, adjustable magnetic damping and tilt control as well as electromagnetic shielding. All onboard electronics can be controlled wirelessly via an infrared module for serial communication or via a laser module for fast Ethernet communication. Power is supplied to the balance using three separate liquid metal feedthroughs: one for voltages of 500 V and frequencies up to 200 kHz, one for high voltage up to 30 kV DC or AC, and one for high frequency signals around 3 GHz. The thruster can be rotated up to 180 to measure different thrust directions without breaking the vacuum and changing the setup in order to gain confidence and refute e.g. thermal drifts. The whole balance is controlled via a script language implemented in Labview. Calibration, noise and force measurements for both Mach-Effect as well as EMDrive thrusters are shown and discussed.