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A CUBESAT DEMONSTRATOR OF QUANTIZED INERTIA PROPULSION

Abstract

We present results of an effort to demonstrate a novel propellentless propulsion concept based on the theory of quantized inertia (QI), developed over the past decade by Prof McCulloch. In QI theory, Inertial mass is based on Casimir-like interactions with the surrounding vacuum, where an imbalance between Rindler and Cosmic Horizons leads to inertial properties. For electromagnetic cavities, the cavity walls act as the 'Horizon'. QI theory predicts that a force can be generated in high-Q asymmetric electromagnetic cavities without the use of propellant.

Propulsion without propellant has been demonstrated in space by solar sails and laser propelled micro-sails are being pursued as a method to send gram sized payloads to interstellar distances. Unfortunately, these methods are not well suited to accelerating more significant payloads to high velocities - propulsion based on momentum exchange with photons is fundamentally limited to a thrust efficiency of approximately mN/MW. To enable human exploration of the outer solar system and the stars, propulsion engineers need to combine a propellentless engine operating at much higher thrust efficiency (>100N/MW) with an on-board energy source able to provide high specific power(<10kg/kW) to that engine over the entire mission duration.

Based on Phase 1/II DARPA study on QI, a 3U CubeSat thruster was designed with the intent of demonstrating an orbital inclination change under QI propulsion. Building up to this effort, a lab demonstration of the QI engine core and measurement of the thrust efficiency was performed at USC Space Engineering Research Center using a mechanically and electrically isolated/levitated platform in UHV, capable of micro-newton thrust measurements. The main technical challenges were manufacture and coating of the complex optical cavity shapes and isolating the thrust measurement from sources of error. The CubeSat design challenges included incorporation of unique QI cavity into the CubeSat standard geometry, integration of medium power solid state laser and supporting power distribution, and thermal design.