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DESIGN AND QUALIFICATION OF A XUHV SYSTEM FOR THE USE ON SOUNDING ROCKET PAYLOAD

Abstract

The MAIUS-1 experiment is a high precision quantum optics experiment about to fly on a VSB30 sounding rocket in autumn 2015. The rocket will be launched from Esrange in the north of Sweden. It will lift the payload to 260km in altitude providing approximately 360s of micro gravity. During ascent (burning phase) the motors will cause accelerations up to 16g. During re-entry the friction of the atmosphere will cause even higher accelerations of more than 20g. These high accelerations and the strong vibrations (8.1 g RMS qualification level) during motor burn have to be considered in the process of the mechanical design of the vacuum system.

The scientific objective of the mission is to demonstrate the feasibility of creating a Bose-Einstein Condensates and performing atom interferometry in Space. In order to achieve this goal a vacuum pressure of ¡ 5E-10 mbar in the scientific chamber of the experiment is necessary. In the qualification process especially the (commercial) ultra-high vacuum components (such as pumps, seals, etc.) appear to be sensitive to high-frequency vibrations as caused by the rocket motors.

The vacuum system of the MAIUS-1 payload is designed to get along with as little seals as possible. The titanium chamber is silver brazed and manufactured in only three parts. Wherever necessary commercial conflate (CF) copper seals or self-prepared indium seals are used in the MAIUS vacuum chamber. For gauging and pumping a commercial cold cathode sensor, an ion-getter pump and a titanium sublimation pump have been qualified for the use on a sounding rocket. The detailed design and the components of the MAIUS experiment chamber will be presented in this paper. Moreover the results of the qualification of customized and commercial components under static and vibrational loads will be presented.