From accurate machining towards accurate measurements with MICROSCOPE

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Observing any violation of the Equivalence Principle at a level as low as 10^{-15} needs both a very soft and stable environment and a very accurate instrument. The MICROSCOPE space laboratory allows testing of the universality of free fall with two masses made of a Platinum Rhodium alloy and a Titanium alloy in a 10 pico-g environment. The two test-masses are accurately controlled by electrostatic forces to follow a common geodesic within a CNES drag-free microsatellite. Accurate centring and alignment of the test-masses is mandatory to prevent any artefact signal due to the Earth's gravity gradient or any on-board gravity gradient. To this purpose, the MICROSCOPE instrument, called Twin-Space Accelerometer for Gravitation Experimentation, T-SAGE, has been designed to minimise the gravity gradient disturbances. A laboratory model and a first representative model for vibration tests have been produced, integrated and tested. These models have allowed verification of the manufacturing and integration processes and of their accuracy, which gives a first budget for the expected centring and alignment of the flight-models. This paper describes the micro-meter machining and integration challenges of T-SAGE and their impact on the instrument performance. In particular, the shape of the test-mass has an effect on the differential accelerometer output due to the gravity gradient and also on the instrument capacitive position output used for the electrostatic servo-loop. First results obtained with the fully integrated models are also presented to assess the performance.