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Gravity and Fundamental Physics (1)

Author: Mr. Manuel Rodrigues
Office National d'Etudes et de Recherches Aérospatiales (ONERA), France, manuel.rodrigues@onera.fr

Mr. Pierre Touboul
ONERA, France, pierre.touboul@onera.fr
Mr. Gilles Metris
France, gilles.metris@obs-azur.fr
Dr. Emilie Hardy
France, emilie.hardy@onera.fr
Dr. Joël Bergé
Office National d'Etudes et de Recherches Aérospatiales (ONERA), France, joel.berge@onera.fr
Mr. Ratana Chhun
Office National d'Etudes et de Recherches Aérospatiales (ONERA), France, ratana.chhun@onera.fr
Mr. Alain Robert
Centre National d'Etudes Spatiales (CNES), France, alainjm.robert@cnes.fr

CURRENT RESULTS OF THE MICROSCOPE SPACE MISSION: A TEST OF EQUIVALENCE PRINCIPLE.

Abstract

Launched in April 2016, the satellite of the MICROSCOPE space mission should end its operations in autumn 2018. The science objective is the test of the weak Equivalence Principle (EP) with an accuracy of 10^{-15}. The EP is one cornerstone of General Relativity (GR); it states the equivalence between gravitational and inertial mass. Most of the alternative quantum gravity theories or the extensions of GR have to confront this founding principle. In 2017, MICROSCOPE's first results settled a new frontier of the EP lower than 2×10^{-14} with only 10% of the available data. Since then, all data are available and are being analysed to accomplish the primary objective.

The in-orbit test is based on the comparison of the acceleration of two cylindrical bodies in free-fall around the Earth at 710km altitude. The two bodies are the test-masses of two concentric electrostatic accelerometers which constitutes the science payload of the satellite. The acceleration measurements are also used by the satellite acceleration and attitude control system. This system embarks cold gas thrusters which are capable of micro-newton thrusts in order to maintain the payload case free of surface forces like the atmospheric residual drag or the solar pressure disturbances but also free of the disturbing torques (mainly magnetic or gravitational torques).

MICROSCOPE is a dedicated fundamental physics mission with a very accurate acceleration measurement achieved in a rather low orbit. In this talk, after detailing the experiment objective and principle, we will describe the payload with a particular focus on the way it has been characterized in orbit. We will then show some results in terms of acceleration measurements to femto-g resolution. Finally, a status of the science mission results will be given.