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MICROSCOPE, A CNES MICROSATELLITE TO CHECK EINSTEIN EQUIVALENCE PRINCIPLE, AND ITS RF EQUIPMENTS

Abstract

MICROSCOPE microsatellite will be launched mid-April 2016. The main goal of this mission is to verify the Einstein equivalence principle, related to weighting versus inertial mass. The idea is to measure the acceleration of two in-orbit masses made of different materials, only subject to gravitation. A violation of the equivalence principle would be of tremendous importance since it would question the general relativity basis. This mission requires acceleration measurements with an accuracy of 10E-15 G, a very stable satellite environment and a careful analysis of the in-orbit perturbations, to be accurately compensated by an ultra-precise accelerometer and propulsion systems. CNES is responsible for the MICROSCOPE satellite design, platform manufacturing, payload integration and tests, control ground

segment and operations. The science mission is insured by ONERA and Observatoire de la Cote d'Azur (OCA). MICROSCOPE is realized in collaboration with ESA, DLR, ZARM and PTB. MICROSCOPE is a 300 kg microsatellite, using a MYRIADE series based platform. The MYRIADE Program first generation is a brilliant success with 16 satellites launches since 2004 such as the launched constellations ESSAIM, SPIRALE and ELISA, the DEMETER, PARASOL and PICARD CNES satellites and the exported spacecraft ALSAT, VNREDSAT and SSOT. After a brief introduction to the mission, the MYRIADE TTC architecture used by MICROSCOPE will be presented in the paper, as well as the S-band link budget designed by CNES. The two dual frequency S-band antennas are connected to two Syrlinks EWC15 transceivers through a hybrid 3 dB coupler, thus permitting ground access to both hot redundant receivers from all satellite angles. This architecture with the Syrlinks TTC transceivers was used on Rosetta/Philae ESA/CNES/DLR and Deep Impact NASA missions. The chosen antenna configuration allows omnidirectional coverage during non-stabilized phases or during the sun-pointed safe mode. One of the two redundant TTC interface card inside the on board computer is in charge of CCSDS protocol management. The TTC ground stations are dedicated to MYRIADE missions. They are low cost ground stations (3.1 meters reflector) designed by ELTA and equipped with a dedicated system for Doppler compensation of the transmitted signal. MICROSCOPE also uses a low cost Syrlinks GNSS receiver (G-SPHERE-S), to allow accurate on board operational orbit restitution and timing. Equipment design will be presented, as well as the spacecraft GNSS subsystem, using only the GPS constellation. The TTC and GNSS localization/navigation architectures are the baseline for most of the CNES LEO satellites, for cost performance reasons