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ACES: THE CLOCKS ABOVE AND BEYOND. IN-FLIGHT CALIBRATION

Abstract

Atomic Clock Ensemble in Space (ACES) will bring a new generation of atomic clocks in the microgravity environment of the International Space Station (ISS). Besides putting Einstein's theory of General Relativity to the test, direct comparison of ultra-precise atomic clocks is nowadays required in fundamental physics, time and frequency metrology, geodesy and precise orbit determination. To this aim, onboard ACES, a primary frequency standard based on laser cooled caesium atoms (PHARAO - Projet d'Horloge Atomique par Refroidissement d'Atomes en Orbite) and an active H-maser (SHM - Space Hydrogen Maser) will offer a compound stable and accurate time signal for space-to-ground and ground-to-ground clock comparisons. With a fractional frequency stability of $1\text{E-}16$ after 10 days of integration time and an accuracy of 1 to $2\text{E-}16$, ACES will provide an absolute measurement of the gravitational redshift, search for time variations of fundamental constants, perform Standard Model Extension tests, measure geopotential differences and even offer insight into atmospheric models. We shall delineate the overall pre- and post-launch tuning activities of the space and ground segments and concentrate on the Micro-Wave Link (MWL) subsystem due to its complex and challenging calibration process.

References L. Cacciapuoti et al., Eur. Phys. J. D 74, 164 (2020).