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THE SPACE-TIME EXPLORER AND QUANTUM TEST OF THE EQUIVALENCE PRINCIPLE MISSION (STE-QUEST)

Abstract

The Space-Time Explorer and Quantum Test of the Equivalence Principle mission (STE-QUEST) is devoted to a precise measurement of the effect of gravity on time and matter using an atomic clock and an atom interferometer. It tests a fundamental prediction and one of the most fundamental assumptions of Einstein's Theory of General Relativity, i.e. the Universality of Gravitational Redshift and the Universality of Free Fall. The first primary goal of the mission will be to measure space-time curvature via the precise determination of gravitational time dilation, i.e. the difference in the tick rate of the satellite's clock when it is compared with a ground-based clock. Making use of a highly elliptic orbit and advanced atomic clocks STE-QUEST aims to achieve an improvement by a factor 450, compared to the most precise gravitational time dilation measurement. The second primary goal is a quantum test of the Universality of Free Fall (UFF). STE-QUEST will test UFF by measuring the free propagation of coherent matter waves of 85Rb and 87Rb under the influence of the Earth's gravity with precision cold atom interferometry, striving for an accuracy better than one part in $10^{-}15. The use of ultra-cold matter at quantum degeneracy will go far beyond the current accuracy of tests and permit to search for hints of quantum eff$