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GEOLOCATION AND NAVIGATION IN SPACE AND TIME

Galileo gravitational redshift test with eccentric satellites

Test de l'effet de redshift gravitationnel avec les satellite Galileo excentriques

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Abstract/Résumé

We are going to present the results of the analysis of the GREAT (Galileo gravitational Redshift test with Eccentric sATellites) experiment from SYRTE (Observatoire de Paris), funded by the European Space Agency. The General Relativity (GR) predicts that time flows differently for two clocks that have a relative speed and are placed in different gravitational potentials. It is therefore possible to test GR by comparing the frequencies of two clock, in a so-called gravitational redshift test. The best test to date was performed with the Gravity Probe A (GP-A) experiment in 1976 with an uncertainty of 1.4 × 10^(−4).

An elliptic orbit induces a periodic modulation of the fractional frequency difference between a ground clock and the satellite clock, while the good stability of Galileo clocks allows to test this periodic modulation to a high level of accuracy. Galileo 201 and 202, with their large eccentricity and on-board H-maser clocks, are perfect candidates to perform this test. However, the accuracy of the gravitational redshift test is limited by the systematic uncertainty due to orbital errors, and Satellite Laser Ranging (SLR) measurements are crucial to understand them. SLR data allows us to reduce the effect of the systematics, in particular to partly decorrelate the orbit perturbations from the clock errors. By analyzing several years of Galileo satellites data we have been able to improve on the GP-A test of the gravitational redshift.