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ELXIS: a satellite to accurately measure general relativistic dragging effects

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Using a geocentric ecliptical coordinate system to analyze the data of a proposed new Earth's satellite, provisionally named ELXIS, in a circular orbit perpendicular to both the equator and the reference direction of the Vernal Equinox should allow, in principle, to measure the general relativistic Lense-Thirring and De Sitter effects on the satellite's inclination I and node Ω to a relative accuracy of $\simeq 10^{-2}$, 10^{-5} , respectively. Indeed, the long-term perturbations on I, Ω , referred to the ecliptic, due to the zonal harmonic coefficients J_{ℓ} , $\ell = 2, 3, 4, 5, \ldots$ of the geopotential vanish for e = 0, $I = \Omega = 90 \text{ deg}$. Departures $\Delta I = \Delta \Omega \simeq 0.01 - 0.1 \text{ deg}$ from such an ideal orbital configuration would not compromise the stated accuracy goals. The most insidious competing perturbations are due to the ocean component of the K_1 tide of degree $\ell = 2$ and order m = 1: they do not vanish for $I = \Omega = 90 \text{ deg}$, and our knowledge of its tidal height $C_{2,1,K_1}^+$ is relatively inaccurate. A suitable linear combination of the rates of change of I, Ω allows to cancel out them and enforce the De Sitter effect. By assuming a relative uncertainty of the order of $\simeq 10^{-3}$ in $C_{2,1,K_1}^+$ from a comparison of some rather recent global ocean tide models, the resulting systematic bias on each of the Lense-Thirring precessions would be at the percent level. Other sources of potential systematic uncertainties like the 3rd-body perturbations due to the Moon and the non-gravitational accelerations allow to meet the desired accuracy levels.

Summary

ELXIS is a concept study for a satellite-based mission to measure the De Sitter and Lense-Thirring precessions in the field of the Earth to a $\simeq 10^{-5}$ and $\simeq 10^{-2}$ relative accuracy, respectively.

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