THE LENSEŰTHIRRING EFFECT DERIVATION AND THE LAGEOS SATELLITES ORBIT ANALYSIS WITH THE NEW GRAVITY FIELD SOLUTION FROM CHAMP

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The Lense-Thirring effect represents one of the most peculiar manifestations of Einstein's theory of general relativity (GR) in the limit of weak field and slow motion. Indeed, the effect represents the gravitomagnetic interaction between mass-currents, the so-called frame-dragging effect. In GR the concept of inertial frame has only a local meaning: they are the frames where locally, in space and time, the metric tensor of the curved spacetime is equal to the metric tensor of flat spacetime. In particular, a local inertial frame is "rotationally dragged" by mass-currents, that is to say, moving masses influence and change the orientation of the axes of a local inertial frame. In the case of a satellite orbiting the Earth, the Lense-Thirring effect is equivalent to an additional precession of its orbit produced by the angular momentum of the rotating Earth on the moving mass. Considering the LAGEOS satellites this relativistic effect produces a precession of their ascending node longitude with a rate of about 31 mas/yr (1 mas/yr = 1 milli-arc-second per year), i.e., equal to an along-track displacement of about 1.8 m/yr! This effect has been derived from the study of the LAGEOS satellites orbit since 1996. As models for the Earth gravitational field, we first used JGM-3 and then the EGM96 solution. The accuracy of the relativistic effect derivation, obtained through a linear combination of the orbital residuals in the ascending node longitude of the satellites and in LAGEOS II argument of perigee, is improved during the years. The error due to the different perturbative sources, both gravitational and non-gravitational, is now estimated to be about 25% of the relativistic effect (60.1 mas/yr) over a period of about 7 years using the last gravity field solution EGM96. In the present work we present the results obtained from a new study based on the analysis of about 10 years of LAGEOS satellites orbit using the new gravity field solution EIGEN-2. EIGEN-2 is a CHAMP-only gravity field model derived from CHAMP GPS satellite-to-satellite and on-board accelerometer data. In this study the Lense-Thirring effect has been obtained from a linear combination of the nodes only of the LAGEOS satellites. This particular combination has the advantage of excluding LAGEOS II argument of perigee, which is subjected to larger errors from the non-gravitational perturbations compared to the nodes of the satellites. Indeed, with the nodes only combination the error bud-

get from the non-gravitational perturbation is about a few % of the relativistic effect (48.1 mas/yr), while the error from the full covariance matrix of the EIGEN-2 solution is about 17.8%. Therefore, taking in consideration these two sources of error, we obtained an error budget less than 18% for the Lense-Thirring effect derivation (computed in a root-sum-square fashion). In the present work the details of the relativistic measurement derivation will be given together with the analysis of the various error sources.