Ring Laser "G" – Monumentation and Environmental Effects

Thomas Klügel

Bundesamt für Kartographie und Geodäsie, Fundamentalstation Wettzell
(e-mail: kluegel@wettzell.ifag.de)

Ring lasers as inertial rotation sensors are strongly subjected to local changes. This may either affect the orientation of the ring laser plane, or the geometry of the instrument itself. The use of Zerodur as base material, the operation in an underground lab and the excellent thermal isolation reduce the effect of temperature variations, which are in the order of a few mK over several days, to a minimum. Orientation changes due to local tilts are reduced by a deep and stable foundation, but cannot be prevented in the required magnitude. It is thus necessary to monitor the orientation of the ring laser body. A set of 6 high resolution tiltmeters are placed at different locations on top of "G" for mutual control and for the discrimination between rigid body tilts and distortions. Local tilts are mainly of hydrologic origin and reach the order of some μrad. These events can be identified in the timeseries of the Sagnac frequency. Interestingly, the removal of such events using the tiltmeter timeseries does not always work properly, which is not yet understood. Crustal deformations by atmospheric or oceanic loading cause tilts on a regional scale and affect, for example, the orientation of the C-II ring laser in Christchurch in a detectable magnitude, where the ocean with up to 2 m tidal range is only 5 km away. On a global scale, the tidal deformation of the entire Earth as well as the diurnal motion of the instantaneous Earth rotation axis alter the angle between ring laser and Earth axis. While polar motion is one signal of interest, the effect of the tidal deformations has to me removed carefully. But first the tiltmeter timeseries have to be corrected for the tidal attractional before applying as an orientation correction on the ring laser timeseries. However, not only the direct attraction of the tidal bodies, but also the change of the potential due the shifted masses of the tidally deformed Earth has to be taken into account. After having applied the attractional correction, the tidal orientation effect of the "G" ring laser can nearly completely be removed, that the diurnal polar motion can clearly be identified.