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Free Core Resonance parameters from the analysis of strain data recorded by the Gran Sasso geodetic interferometers

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The Free Core Nutation (FCN) is a rotational eigenmode which appears in addition to the well-known Chandler period. The period and the quality factor of the FCN depend on the core mantle boundary (CMB) ellipticity, the Earth anelasticity, and the viscomagnetic coupling of the CMB. The features of the FCN can consequently be used to put constrains on the structure and dynamics of the Earth.

The FCN has been observed using tidal gravimetry, because the amplitude and phase of some diurnal tides of lunisolar origin are perturbed by a resonance process, and Very Long Baseline Interferometry (VLBI), which allows to measure changes in the Earth orientation. Strain data are more affected by local effects (e.g. topographic distortion of the strain field) than gravimetric data, but changes of the Love numbers at frequencies near to resonance induce relative disturbances in strain that are about ten times larger than in gravity tide.

We have carried out tidal analysis of about 5-yr strain data recorded by two 90-m long laser strainmeters, installed in the Gran Sasso underground labs (Central Italy, 1400 m under the free surface). Instrumental sensitivity is about 3 picostrain (Crescentini et al., 1997). The effects of meteorological variations on recorded data are expected to be low, and environmental noise is mainly due to activities in the labs. The cavity effects on both strainmeters are expected to be negligible, while the topographic effects are expected to be negligible for one of the instruments and to reduce measured strain by 20-40% for the other one. Recorded data are consistent with what expected.

We estimate the parameters of the transfer function Earth tides-instrument using three

different tidal analysis codes (ACS, Amoruso et al. 2000; ETERNA 3.40, Wenzel 1996; VAV, Venedikov et al. 2003), and by minimizing a L1 norm cost function by means of ASA (Ingber, 1993) in order to identify regions of the parameter space that give a good fit. Ocean loading effects are computed using GOTIC2 (Matsumoto et al., 2001) and SPOTL (Agnew, 1996). Preliminary analyses show that values of the FCN period are consistent with but slightly lower than those previously published (Mukai et al., 2004 and references therein), values of the quality factor Q are consistent with results in Florsch and Hinderer (2000), but ocean loading corrections suggest supplement by local tidal models.