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Large ring laser gyroscopes: geometry stabilization and control

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Ring laser Gyroscopes (RLG) are very versatile devices that find application in many fields as navigation, seismology and geophysics. Moreover, thanks to their sensitivity and accuracy, in the last years they have been used in fundamental physics research field.

GINGER (Gyroscopes IN GEneral Relativity) research group aims to exploit a large RLG to test general relativity theory. Our research team has two working RLG, both with a square shape, one installed in Pisa and named GP2 (1.6 m side), and the other installed in the INFN underground laboratory of Gran Sasso near L'Aquila named GINGERINO (3.6 m side). The final goal of GINGER is to measure the earth rotation rate with enough precision to take into consideration general relativity predicted corrections.

To reach this target, one of the requirements is the stability of the laser and the optical cavity of the RLG. We will show the last developed techniques aimed to satisfy this stability requirement. Working on GP2 we have tested two different techniques to control the ring shape. One is based on the stabilization of the two Fabry-Pérot resonators formed along the square diagonals by the opposite mirrors of the RLG. The other consists of controlling the ring perimeter by monitoring its free spectral range through a beat-note between one of the counterpropagating beams and a frequency stabilized laser source. We will show the characteristics, the potentialities and the tests of these two methods.

Primary authors: Dr GIACOMELLI, Umberto (GSSI - INFN sez. Pisa - Università di Pisa); Prof. NICOLÒ, Beverini (Università di Pisa); Dr CARELLI, Giorgio (Università di Pisa - INFN Sez. Pisa); Prof. CIAMPINI, Donatella (Università di Pisa - INFN sez. Pisa); DI VIRGILIO, Angela D. V. (INFN-Pisa); Prof. FUSO, Francesco (Università di Pisa - INFN sez. Pisa); Dr MACCIONI, Enrico (Università di Pisa - INFN sez. Pisa); Dr MARSILI, Paolo (Università di Pisa - INFN sez. Pisa); Dr SIMONELLI, Andreino (INFN sez. Pisa)

Presenter: Dr GIACOMELLI, Umberto (GSSI - INFN sez. Pisa - Università di Pisa)

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