

Long- term operation of a large-scale passive laser gyroscope

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Large-scale laser gyroscopes with sufficiently high sensitivity are inertial sensors with the capability to measure the rotational components of various geophysical motions. However, the specific application require that the instrument can be run continuously. The cavity perimeter fluctuations and laser frequency noise become challenges in larger-scale passive resonant gyroscopes (PRGs). In this talk, we introduce a three-wave differential locking scheme for a 3 m by 3 m large-scale PRG, resulting in an in-situ measurement of the cavity perimeter with nanometer resolution. Furthermore, the laser frequency noise is effectively suppressed with an additional gain of 30 dB by a double-stage locking system, based on the three-wave differential locking scheme. Finally, the rotation rate resolution of our 3 m×3 m gyroscope improves to 1.1×10^{-9} rad/s over 200 s and operated for 5 months without interruption. Several teleseismic events with a Love wave content larger than 10^{-9} rad/s have been routinely recorded during the long-term run. The simplicity, robustness, and effectiveness of the locking scheme are important to the long-term operation of large-scale PRGs aiming for applications in the geosciences.

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