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Polarization-selective locking scheme in a passive resonant gyroscope

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Passive resonant gyroscope (PRG) is a type of rotation detector based on Sagnac effect, which has shown application potentials in inertial navigation, geophysics, and fundamental physics. Laser-frequency-locking techniques are essential in PRGs to keep the external injection laser resonant with the passive ring cavity. Here we realize a locking scheme based on the polarization property of the ring cavity, which does not require phase modulations on the laser source, avoiding the residual amplitude modulation noise introduced by electro-optic modulator as in the traditional Pound-Drever-Hall locking method. The phase shifts of the two orthogonal polarization eigen-modes used for locking are analyzed, and the influences of polarization elements on locking performance are also evaluated. Ultimately, we implement the polarization-selective locking scheme on a $30\ \mathrm{cm}\times 30\ \mathrm{cm}$ sized PRG, achieving a rotation sensitivity of $1.0\times 10^{-7}\ \mathrm{rad/s}/\sqrt{\mathrm{Hz}}$.

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