High-performance two axis cold-atom gyroscope for rotational seismology

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The Sagnac effect is at the heart of the modern precision inertial sensors. An interferometer with a physical area, when spun, exhibits a phase shift at its output. Measuring this phase-shift leads to a direct measurement of the rotation rate.

The SYRTE dual-axis cold-atom gyroscope represents the state-of-art of atomic gyroscopes. With its large physical area ($11cm^2$) and a long interrogation time of 800 ms, it offers both the sensitivity and stability 3×10^{10} $rad.s^{-1}$ to push the Sagnac measurement to an unprecedented accuracy level [1]. Demonstrating such performance required the control and characterization of the experimental parameters and systematic effects and the precise knowledge of the scale factor.

The cold-atom gyroscope experiment is based on atomic interferometry, where cooled Cesium-atoms (2μK) are launched vertically ($\sim 5m/s$) to be interrogated with a sequence of four Raman pulses (allowing an internal and external control over atomic states). The pulses play the role of atomic optics by splitting and guiding the matter-waves along the arms of the interferometer. By the end, transition probability measurement gives access to the phase-shift induced by rotation.

I will present our recent work done to develop new methods that will improve the gyroscope sensitivity. The Double diffraction, atom diffraction in both $\pm\hbar\vec{k}_{eff}$ directions, should enables a measurement setup with no dead time based on the use of two correlated interleaved interferometers [2]. Thus, the vibration and rotation noises that limits the sensitivity should average to achieve the detection noise, targeting the standard quantum projection noise.

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[2] D. Savoie, M. Altorio, B. Fang, L. A. Sidorenkov, R. Geiger, and A. Landragin, *Science Advances* **4.12**, (Dec. 2018), eaau7948.

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