Interleaved Matter-wave Gyroscope with 2×10^{-10} rad.s^{-1} Stability

Remi Geiger[a], Denis Savoie[a], Matteo Altorio[a], Bess Fang[a], Leonid Sidrorenkov[a], Arnaud Landragin[a]

[a] *LNE-SYRTE, Observatoire de Paris, Université PSL, CNRS, Sorbonne Université, 61 avenue de l'Observatoire, F-74014 Paris*

Inertial sensors based on atom interferometry have the potential to address several applications ranging from navigation, tests of fundamental physics, gravitational wave astronomy, geoscience and metrology.

One important drawback of such sensors has been their reduced sampling rate, due to the cold-atom sample preparation, and to the long time of interrogation of the atoms in the interferometer which is required to achieve high inertial sensitivity. Here we report the interleaved operation of a cold-atom inertial sensor, where 3 atomic clouds are interrogated simultaneously in an atom interferometer featuring a 4 Hz sampling rate and a long interrogation time of 800 ms. Interleaving allows us to demonstrate a short term sensitivity of 30 nrad.s^{-1}.Hz$^{-1/2}$ in a matter-wave gyroscope of 11 cm^2 Sagnac area.

We also report a stability of 2×10^{-10} rad.s^{-1}, which competes, for the first time, with the best long-term stability level obtained with fiber-optics gyroscopes, and establishes cold-atom gyroscopes as a promising alternative to current technologies for inertial navigation.

Our experiment validates interleaving as a key concept in future atom-interferometry sensors aiming at probing time-varying signals, such as gravitational wave detectors, inertial measurement units, or gravity gradiometers.