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Interleaved matter-wave gyroscope with 3×10^{-10} rad.s^{-1} stability

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Cold-atom inertial sensors target several applications in navigation, geoscience and tests of fundamental physics. Reaching high sampling rates and high inertial sensitivities, obtained with long interrogation times, represents a challenge for these applications. We report on the interleaved operation of a cold-atom gyroscope, where 3 atomic clouds are interrogated simultaneously in an atom interferometer featuring a 3.75 Hz sampling rate and an interrogation time of 801 ms. Interleaving improves the inertial sensitivity to 3×10^{-9} rad.s^{-1}.Hz$^{-1/2}$ by efficiently averaging vibration noise, and allows us to perform dynamic rotation measurements in a so-far unexplored range. We demonstrate a stability of 3×10^{-10} rad.s^{-1} after 30 000 s, which competes with the best stability levels obtained with fiber-optics gyroscopes. Our work validates interleaving as a key concept for future atom-interferometry sensors probing time-varying signals, as in on-board navigation and gravity-gradiometry, searches for dark matter, or gravitational wave detection.