Progress towards the development of a cold-atom inertial measurement unit for onboard applications

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Cold atom interferometers (AIs) have proven to be extremely sensitive and accurate inertial sensors measuring gravity [1], gravity gradients [2] and rotations [3]. Unlike classical sensors, they do not require any calibration and exhibit an inherent long-term stability and accuracy : they are promising candidates for geodesy, geophysics or inertial navigation. We present our progress towards the development of a cold-atom inertial measurement unit, a device measuring each component of acceleration and rotation. We demonstrate two techniques allowing to perform acceleration measurements using a Mach-Zehnder type AI in a single diffraction regime, even for atoms with close to zero velocity. The first technique lifts the degeneracy between the two Raman transitions $\pm\hbar k_{\text{eff}}$ by using a frequency chirp on the Raman lasers. In the second technique, we use the selection rules of the $\sigma_+\sigma_-$ Raman transitions between the states $F = 1, m_F = \pm1$ and $F = 2, m_F = \pm1$ to select between one of the two possible transitions. We compare the performances and the bias induced by both methods and highlight their relevance for multiaxis inertial sensors or atom interferometry in a microgravity environment.

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