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A Schroedinger Cat Matter Wave Gyroscope Using Collective Excitation of Atomic Ensembles SELIM SHAHRIAR, RESHAM SARKAR, MAY KIM, YANFEI TU, Northwestern University — The phase shift in an atom interferometric gyroscope (AIG) of area A, induced by a rotation rate of Ω, is given by $\delta\varphi = 2A\Omega m/\hbar$, where m is the mass of the atom. This is seen transparently when we consider the time delay (computed using special relativistic dynamics) between the signals arriving at a detector, given by $\delta t = 2A\Omega/C^2$. The phase shift is found by multiplying the delay by the Compton frequency, $mC^2/\hbar$. The fact that the Compton frequency of an alkali atom is nearly ten orders of magnitude larger than a typical optical frequency is the basic reason why an AIG is much more sensitive than an optical gyroscope. In this talk, we describe a matter-wave gyroscope with a Compton frequency much larger than that of a single atom. Here, an ensemble of atoms are excited by two counter-propagating Raman beams corresponding to a Λ transition. In the limit of symmetrized collective excitation, the ensemble can then be split, with a recoil of $2\hbar k/(Nm)$, where N is the number of atoms in the ensemble. Using the standard $\pi/2$-$\pi-\pi/2$ excitation sequence results in a gyroscope with $\delta\varphi = 2A\Omega Nm/\hbar$, since the Compton frequency is larger by a factor of N.

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