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Effect of One Axis Twist and Two Axes Twist Spin Squeezing on Collective State Atomic Interferometer and Clock RESHAM SARKAR, RENPENG FANG, MAY KIM, SELIM SHAHRIAR, Northwestern University — An ensemble of N independent, noninteracting 2-level atoms with states $|1\rangle$ and $|2\rangle$, interacting with a laser, can be represented as a Coherent State of spin, depicting a superposition of N+1 symmetric collective states. This model is also valid for 3-level atoms where the ground states $|1\rangle$ and $|2\rangle$ are mutually coupled via off-resonant Raman interaction through an intermediate excited state $|3\rangle$, upon adiabatic elimination thereof. We recently proposed a Collective State Atomic Interferometer (COSAIN) that splits, redirects and recombines such an ensemble to yield a signal that is a measurement of the ensemble state where all the atoms are simultaneously in state $|1\rangle$. The width of the COSAIN signal fringe scales as $1/\sqrt{N}$. This narrowing occurs due to the simultaneous interference of the N+1 arms of the COSAIN. A similar narrowing is also predicted for a Collective State Atomic Clock (COSAC) proposed by us. We will describe the effect of one-axis twist and two-axes twist spin squeezing on the behavior of the COSAIN and the COSAC in order to approach Heisenberg limited sensitivity. We will also discuss the prospect of implementing spin squeezed versions of these devices via the use of Rydberg assisted interaction among the atoms.

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