Abstract Submitted
for the DAMOP15 Meeting of
The American Physical Society

Effect of One Axis Twist and Two Axes Twist Spin Squeezing
on Collective State Atomic Interferometer and Clock
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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 elimi-
nation 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.