Quantum Physics

Generation of macroscopic singlet states in atomic ensembles

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We study squeezing of the spin uncertainties by quantum non-demolition (QND) measurement in non-polarized spin ensembles. Unlike the case of polarized ensembles, the QND measurements can be performed with negligible back-action, which allows, in principle, perfect spin squeezing as quantified by [G. Toth et al., Phys. Rev. Lett. 99, 250405 (2007)]. The generated spin states approach many-body singlet states, and contain a macroscopic number of entangled particles, even when individual spin is large. We introduce the Gaussian treatment of unpolarized spin states and use it to estimate the achievable spin squeezing for realistic experimental parameters. Our proposal might have applications for magnetometry with a high spatial resolution or quantum memories storing information in decoherence free subspaces.

Comments:	9 pages including 2 figures, revtex4; v2: longer introduction, more details of the derivation are presented
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