Abstract Submitted
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A method to measure hyperfine interaction beyond standard statistical limit[1] KILHYUN BANG, WEN YANG[2], L. J. SHAM, Department of Physics, University of California San Diego — We propose a method to measure the hyperfine interaction between a single electron spin and a nuclear spin and apply it to the trapped electron and the ^{15}N nuclear spin in a diamond nitrogen-vacancy (NV) center. The electron spin is prepared in a pure quantum state and the nuclear spin acquires an unknown partial polarization as a consequence of the preparation of the electron state. The proposed quantum measurement protocol is independent of the incoherence of the initial nuclear spin state. The model utilizes the time τ of a sequence of quantum operations as well as the number N of repeated sequences to increase the accuracy and the precision of the estimation. The deleterious effect of the electron spin decoherence on the precision during time τ is included in the simulation. While in the statistical limit the standard deviation (measure of imprecision) of the estimation is proportional to $1/\sqrt{N}$, the quantum operations in time τ enables the imprecision to decrease faster as $1/\tau$ instead of the equivalent statistical limit of $1/\sqrt{\tau}$. Thus, the net imprecision of the estimation dips below the statistical limit. The robustness test of our simulation shows that experimental implementation of such a precision measurement is possible.

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