

Coherence protection of electron spin in Earth-field range by all-optical dynamic decoupling

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In recent years, unshielded atomic systems have been attracting researchers' attention, in which decoherence is one of the major problems, especially for high precision measurements. The nonlinear Zeeman (NLZ) effect and magnetic field gradient are the main decoherence sources of atomic electron spin in Earth-field range [1]. Dynamic decoupling (DD) is a method to cancel out the decoherence effects, which is usually realized by pulsed microwave fields [2]. Here, we design an all-optical DD sequence $90^\circ y - \tau/2 - 180^\circ y - \tau/2 - 90^\circ y$ via Raman processes to cancel out the two dominant broadening effects simultaneously. We analyze the state evolution of atomic spin under the Raman light control sequence in detail. The results show that both the NLZ effect and magnetic field gradient can be significantly suppressed.

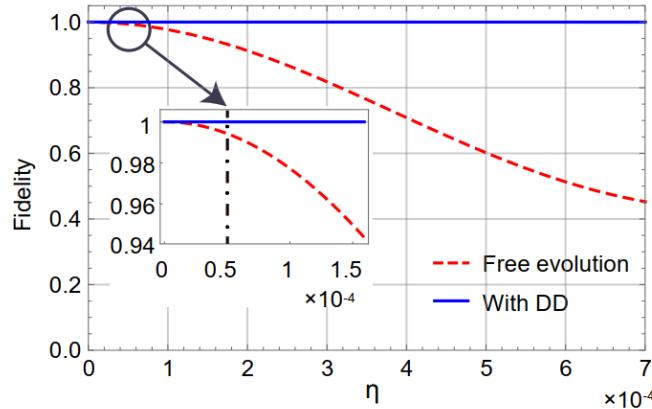


Figure 1: The state fidelity comparison between the cases free evolution and with DD applied after five cycles. η is the ratio of the revival frequency ω and Larmor frequency Ω_L . Insert is the zoom in where real experimental parameters locate. Dot-dashed line corresponds to the case of ^{87}Rb atoms in the Earth-field range.

References

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