Ramsey Interferometry via Fractional Stimulated Raman Adiabatic Passage

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Ramsey interferometry, which utilizes the phenomenon of coherent superposition to precisely measure the frequency of atomic transitions, has found several applications, including the development of atomic clocks and sensors. Fractional Stimulated Raman Adiabatic Passage (F-STIRAP) is a good candidate for robust and adiabatic creation of coherent superposition in a quantum system. We introduce a novel method for Ramsey interferometry to improve the sensitivity and readout contrast based on the F-STIRAP method. A double quantum (DQ) 4-Ramsey protocol was recently employed to measure the frequency shifts due to rotation in a nuclear magnetic resonance (NMR) rotation sensor [1]. It is based on the nitrogen-14 (^{14}N) nuclear spins intrinsic to the nitrogen vacancy (NV) color centers in diamond. When F-STIRAP is used for Ramsey interferometry in the nuclear spin triplet of ^{14}N, the results are substantially more robust with respect to moderate changes in pulse area while providing better contrast than the conventional DQ Ramsey interferometry, making the scheme highly promising for advanced NV-based sensors.

[1] A. Jarmola, S. Lourette, V. M. Acosta, A. G. Birdwell, P. Blümler, D. Budker, T. Ivanov, and V. S. Malinovsky. Demonstration of diamond nuclear spin gyroscope. *Sci. Adv.*, 7(43), 2021.