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Tuning the magnetic dressing of atomic spins

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Abstract

The dynamics of a spin precessing in a static magnetic field $\vec{B}_0$ is at the basis of optical magnetometry. Such dynamics is deeply modified by the presence of a strong, transverse, time-dependent field $\vec{B}_d$ non-resonantly oscillating at a frequency much above the Larmor frequency. This is a well-known phenomenon denominated *magnetic dressing*.

In a recent work [1], we have studied –both theoretically and experimentally– unexpected effects occurring when a (weak) third field $\vec{B}_t$ is applied in a direction perpendicular to both $\vec{B}_0$ and $\vec{B}_d$.

This additional field is denominated *tuning field*, because, despite its weakness, it may markedly tune the dressing phenomenon. The tuning can be such to produce effects not accessible in the traditional single-field dressing experiments.

The tuned-dressing configuration introduces an extra handle to design and control the spin dynamics, with implications not limited to atomic magnetometry, but extending to other important research and application areas. Amplitude, harmonic content, and $B_d - B_t$ relative phase are control parameters.

References

[1] G. Bevilacqua, V. Biancalana, A. Vigilante, T. Zanon-Willette, and E. Arimondo, "Harmonic fine tuning and triaxial spatial anisotropy of dressed atomic spins," *Phys. Rev. Lett.*, vol. 125, p. 093203, Aug 2020.