

Non-linear spin dynamics in atomic magnetometers

R. Gartman¹, V. Guarrera¹, G. Bevilacqua², W. Chalupczak¹

¹ National Physical Laboratory, Hampton Road, Teddington, TW11 0LW, United Kingdom

² Università di Siena, Siena, Italy

Atomic magnetometers create a versatile platform for magnetic field measurement with applications ranging from fundamental physics, navigation, and chemical analysis to security and medical screening. The simplicity of the experiment instrumentation is matched by the richness of the linear and non-linear couplings between system components (atomic vapour and pump/probe lasers).

We are going to show experimental studies indicating that the couplings introduced by the pump beam, the optical probe as well as spin-exchange collisions could generate non-linear atomic spin dynamics. This might lead to an increase in the coherence lifetime and generation of atomic spin squeezing. The former will be demonstrated and discussed in context of so-called spin maser, and the latter in a framework of parametric excitation in Bell-Bloom pumping process, where the atomic coherences are created by the train of optical excitation pulses.

[1] W. Chalupczak, and P. Josephs-Franks, *Phys. Rev. Lett.* **115**, 033004 (2015).