Spin squeezing in Bose-Einstein condensates : ultimate limits and prospects for applications

Alice Sinatra
Laboratoire Kastler Brossel, Ecole Normale Supérieure, Paris, France

A class of states directly useful for metrology are *spin squeezed states*. Recently such states have been obtained using controlled interactions in condensates with two internal states [1, 2], thus realizing the ideas proposed in [3, 4, 5]. In order to determine the actual potentialities of this squeezing scheme, a crucial question is the maximum metrology gain achievable and its scaling with the atom number. We shall attack this problem by including both the effect of decoherence due to particle losses [6] and the effect of thermal excitations [7, 8, 9]. In the end of the talk I will try to draw a conclusion about this path to spin squeezing and imagine prospects for applications.

References

[1] C. Gross, T. Zibold, E. Nicklas, J. Estève, M.K. Oberthaler, Nature **464**, 1165 (2010).

[2] M.F. Riedel, P. Böhi, Li Yun, T.W. Hänsch, A. Sinatra, P. Treutlein, Nature **464**, 1170 (2010).

[3] M. Kitagawa and M. Masahiro Ueda, Phys. Rev. A **47**, 5138 (1993).

[4] A. Sorensen, L.M. Duan, J.I. Cirac, P. Zoller, Nature **409**, 6816 (2001).

[5] Yun Li, P. Treutlein, J. Reichel and A. Sinatra, Eur. Phys. J. B **68**, 365381 (2009).

[6] Li Yun, Y. Castin, A. Sinatra Phys. Rev. Lett. **100**, 210401 (2008).

[7] A. Sinatra, E. Witkowska, J.-C. Dornstetter, Li Yun, Y. Castin, Phys. Rev. Lett. **107**, 060404 (2011).

[8] A. Sinatra, E. Witkowska, Y. Castin, Eur. Phys. J. ST (Special Topics) **203**, 87 (2012).

[9] A. Sinatra, Y. Castin and E. Witkowska, Europhysics Letters. **102**, 40001 (2013).