

Spin squeezing and entanglement quantification in spin-j atomic gases

Tuesday, 29 June 2021 12:00 (30 minutes)

I will present some recent results on entanglement detection and quantification with collective spin measurements in many-body ensembles. After a brief review of the idea of “Spin Squeezing” and its relation with multipartite entanglement and quantum metrology, I will show how the original spin squeezing approach can be generalized in several respects and how it allows to quantify multipartite entanglement by means of the so-called depth of entanglement. Especially, I will present particular examples of criteria that has been recently applied to detect the depth of entanglement in (i) unpolarized Dicke states, produced dynamically in a Rb BEC [1,2]; (ii) Planar Quantum Squeezed states, produced with Quantum-Non-Demolition measurements in a Rb atomic cloud [3]. Similarly, I will present EPR-like criteria tailored to detect bipartite entanglement in generalized spin squeezed states split in two spatially separated modes [4,5], analogous to other well known criteria [6], but applicable to a wider set of states. In the final part, I will focus on the quantification of entanglement by means of entanglement monotones with similar methods [7]. I will consider broad families of entanglement criteria that are based on variances of arbitrary operators and analytically derive the lower bounds these criteria provide for two relevant entanglement measures: the best separable approximation (BSA) and the generalized robustness (GR). As a concrete application, I will show the results of applying this method with experimental data of a spin-squeezed Bose-Einstein condensates of 500 atoms.

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