Estimation of entanglement monotones in spin systems

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We are interested in finding optimal entanglement witnesses and entanglement monotones for interacting many-body systems that can be connected to experimentally relevant collective observables. For spin observables corresponding to two-body correlators, generalized spin squeezing inequalities [1, 2] are generally considered optimal witnesses. To begin with, we study thermal states of fully connected spin systems in the mean-field approximation. These states are typically permutationally invariant, as are their marginals that correspond to fully separable states which is known as the quantum de Finetti theorem. We illustrate how this connection can be used to estimate entanglement monotones of such states, how this connects to the spin squeezing inequalities, and how this approach compares to numerical studies. In addition, we explore the use of non-Hermitian collective spin observables, and how the breaking of permutational symmetry impacts entanglement detection and quantification, in particular using spin squeezing inequalities.

References

[1] G. Tóth, C. Knapp, O. Gühne, H.J. Briegel, Journal, Physical Review A, 79.4 (2009) 042334
[2] G. Vitagliano, I. Apellaniz, I. Egusquiza, G. Tóth, Physical Review A, 89(3), 032307

Figures

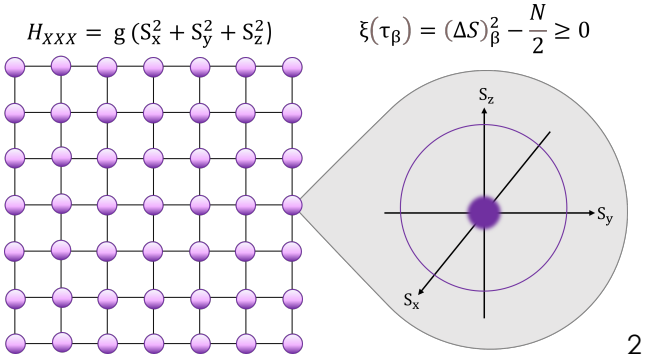

Figure 1: Spin squeezing in the fully connected XXX model (left). Up to a critical temperature T_c, thermal states close to many-body singlets can be detected using the spin squeezing criterion (right).