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Non-equilibrium dynamics of arbitrary-range Ising models with decoherence: an exact solution MICHAEL FOSS-FEIG, NIST Gaithersburg and the Joint Quantum Institute, KADEN HAZZARD, NIST Boulder and JILA, JOHN BOLLINGER, NIST Boulder, ANA MARIA REY, NIST Boulder, JILA, and the University of Colorado at Boulder — Understanding the interplay between dissipation and interaction driven many-body correlations is crucial to the fields of quantum simulation, quantum metrology, and quantum information. Dissipation can degrade the delicate correlations that are often sought in isolated many-body quantum systems, but it can also give rise to rich non-equilibrium dynamics and steady-state behaviors not otherwise possible. Motivated by experiments with trapped ions and Rydberg atoms, we have obtained an exact solution for the dynamics of arbitrary-range Ising models in the presence of generic Markovian decoherence [1]. Our solution enables us to exactly quantify the spin-squeezing achievable in present day trapped ion experiments [2]. We find that the interplay between interactions and decoherence causes many-body correlations to decay much faster than predicted by simple mean-field or single-particle arguments. In addition to revealing the precise mechanism of this enhanced decoherence, our exact solution points to a possible avenue toward mitigating it.

[1] M. Foss-Feig, K. R. A. Hazzard, J. J. Bollinger, and A. M. Rey, arXiv:1209.5795 [quant-ph] (2012)
[2] J. W. Britton et al., Nature 484, 489-492 (2012)

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