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Generation of many-body entanglement in long-range interacting systems MICHAEL FOSS-FEIG, National Institute of Standards and Technology and the Joint Quantum Institute, ZHE-XUAN GONG, Joint Quantum Institute, ALEXEY GORSHKOV, CHARLES CLARK, National Institute of Standards and Technology and the Joint Quantum Institute — The existence of long-ranged interactions generally complicates the description of many-body systems. However, in the limit where the interactions become infinitely long-ranged—i.e. independent of distance—the emergence of extra conserved quantities typically makes the behavior quite simple. Such infinite-ranged interactions are often assumed in the description of experiments aiming to produce large scale entangled states, for instance via spin-squeezing, but of course "infinite" in this context is an idealization. We consider the generation of entanglement in Ising models with long (but not infinite) ranged interactions, which are relevant to the description of a variety of quantum information/simulation platforms including trapped ions, polar molecules, Rydberg atoms, and nitrogen vacancy centers in diamond. We demonstrate that there exists a notion of sufficiently long-ranged interactions, for which the scaling of entanglement with system size expected from the infinite-range idealization is completely unmodified. Our results have direct applications to experimental protocols aiming to achieve quantum-enhanced metrology.

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