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**Topological phases with long-range interactions** ZHEXUAN GONG, ANZI HU, MOHAMMAD MAGHREBI, MICHAEL FOSS-FEIG, ALEXEY GORSHKOV, Joint Quantum Institute, NIST/University of Maryland — Topological phases of matter, including symmetry protected topological phases, typically require the underlying many-body system to posses only short-range interactions, such that the notion of locality is well defined. Whether various topological phases can survive in the presence of long-range interactions, however, is largely unknown. Here we show that a paradigmatic example of a symmetry protected topological system, known as the spin-1 Haldane chain, surprisingly remains in its topological phase under arbitrary algebraically-decaying long range interactions. Our conclusion is supported by strong numeric evidence using variational Matrix Product State (vMPS) algorithms, and is also consistent with analytical calculations using renormalization group theory. The topological phase of this long-range interacting spin-1 chain should be experimentally realizable in a recently developed trapped-ion quantum simulator [1]. Our work will enable further study of various topological phases under the presence of long-range interactions.

[1] C. Senko, P. Richerme, J. Smith, A. Lee, I. Cohen, A. Retzker, and C. Monroe. "Experimental Realization of a Quantum Integer-Spin Chain with Controllable Interactions." arXiv:1410.0937.

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