Abstract Submitted
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The spin-2 AKLT state on the square lattice is a universal resource for quantum computation[1] TZU-CHIEH WEI, Stony Brook University, ROBERT RAUSSENDORF, University of British Columbia — Universal quantum computation can be driven by local measurement only, provided a suitable entangled state is used. The family of graph states of spin-1/2 entities, including the cluster state as a special case, have been extensively studied. Examples of universal states include graph states on square, honeycomb, and triangular lattices, as well as some faulty square lattices. As of present, it is an open question to characterize all possible universal resource states. Are there any other families of states with different entanglement structures than the graph-state family that can also provide universal resource? We have investigated the family of two-dimensional Affleck-Kennedy-Lieb-Tasaki (AKLT) states and identified that many states in this family indeed can serve as universal resource. Similar to graph states, AKLT states can be defined on any graph, but their spin magnitude depends on the coordination number. Here, we report that the spin-2 AKLT state on the square lattice is a universal resource for quantum computation. The enabling elements include (1) a generalized measurement that converts a five-level local Hilbert space (spin-2) to a two-level one (spin-1/2), and (2) an analytic formula for the probability distribution for any given outcome of the measurement.

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