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Quantum Computational Resource Quality of a Symmetry-Protected Topologically Ordered Phase JACOB MILLER, AKIMASA MIYAKE, University of New Mexico — Symmetry-protected topologically ordered (SPTO) states are many-body quantum states invariant under an on-site symmetry group, which can be grouped into distinct SPTO phases based on their non-local entanglement structure. While originally arising in the context of condensed matter physics, SPT states have also attracted interest in quantum information for their ability to be used as resource states for quantum computation. We investigate entanglement naturally present in the 1D SPTO phase associated with on-site octahedral symmetry and show that, as long as certain characteristic lengths are finite, all its ground states can be used to efficiently implement any one-qubit gate operation with arbitrary accuracy. This feature is an intrinsic property of the entire phase, and we show that it can also be probed by means of a particular string-order parameter. Our approach may pave the way toward a novel program to classify quantum many-body systems based on their operational use for quantum information processing.

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