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Two results in topology, motivated by quantum computation

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The field of quantum computation is built on the foundation of physics, mathematics, and computer science. While it has taken much from these fields, there are also interesting examples where it has given back. I will discuss two new results of this kind. In both cases, we use very basic ideas from quantum computation to prove an interesting fact about low-dimensional topology. First, we use the Solovay-Kitaev universality theorem with exponential precision to give a simple proof of the #P-hardness of certain 3-manifold invariants. We then apply this result to show the existence of rather exotic 3-manifold diagrams. Second, we show a relationship between the distinguishing power of a link invariant, and the entangling power of the linear operator associated to braiding. More precisely, we show that link invariants derived from non-entangling solutions to the Yang-Baxter equation are trivial. The former is joint work with Catharine Lo (Caltech), and the latter is joint work with Stephen Jordan and Michael Jarett (UMD).