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Qubitization strategies for bosonic field theories

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Simulations of bosonic field theories on quantum computers demand a truncation in field space to "fit" the theory onto limited quantum registers. We examine two different truncations preserving the same symmetries as the 1+1-dimensional $O(3)$ non-linear σ-model - one truncating the Hilbert space of functions on the unit sphere by setting an angular momentum cutoff and a fuzzy sphere truncation inspired by non-commutative geometry. We find evidence that the angular-momentum truncation fails to reproduce behavior of the σ-model, while the anti-ferromagnetic fuzzy model agrees with the full theory. These lessons will inform how we qubitize lattice gauge theories.

Topical area

Quantum Computing and Quantum Information

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