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How many states are gauge invariant?

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Hamiltonian methods, such as quantum simulation, are often advocated as a long term solution to some sign problems. In this context, it is more natural to work with a finite-dimensional Hilbert space; as such, a truncation method must be employed. Moreover, for gauge theories, only a small subsets of states are gauge invariant and therefore physical. In this context, both for technical reasons and for resource estimation, it is sometimes useful to know the exact number of gauge invariant states. We show a full solution to this problem in the case where the Hilbert space truncation is achieved by replacing the gauge group with a finite subgroup, both for pure gauge theories and for gauge-scalar theories. We also discuss choices of bases for the gauge-invariant sector, with some applications. Finally, we also briefly consider other truncation methods, as well as ongoing work with gauge-fermion theories.

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