# How do we best utilize alternative computational models?

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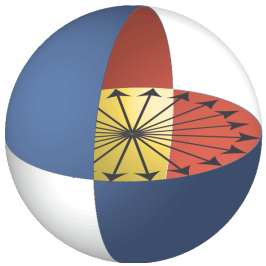

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# Outline

Match computations & computational models

How much topological protection is optimal?

# Match computations & computational models

Quantum computations relevant to DOE mission:

- physical science applications (e.g. find ground states of lattice models to design materials with unprecedented electromagnetic, thermal, structural properties),
- quantum algorithms (e.g. in linear algebra, optimization, graph theory, etc…)
- …

Different computations rely on different operations, resources (e.g. entanglement), etc…

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Quantum computational models:

- measurement-based
- gate-based (with different basic gate sets)
- Hamiltonian-based (with different basic underlying Hamiltonians)
- …

Different computational models are best (fastest, most robust to noise, most resource-efficient, etc…) at different tasks.

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Which computational model most suited for a given computation?

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Example of research in my group: systems with long-range interactions can generate long-range entanglement faster

# How much topological protection is optimal?

Topological quantum computing architectures can be topological to different degrees:

- full topological protection: all gates implemented via braiding (e.g. Fibonacci anyons)
- partial topological protection: some gates implemented via braiding, while other gates implemented without topological protection (e.g. Majorana fermions or parafermions)
- no topological protection: all gates implemented without topological protection

Topological systems are often engineered (as opposed to found in nature).

Gates without topological protection require error correction.

Engineering choice between complexity required to make a gate topologically protected vs error-correction overhead involved if that gate is not topologically protected.

How much topological protection is optimal?

Example of research in my group: engineering full spectrum of topological quantum computing machines

# Summary

Which computational model most suited for a given computation?

How much topological protection is optimal?

(will likely depend on what computation one wants to do)

Thank You