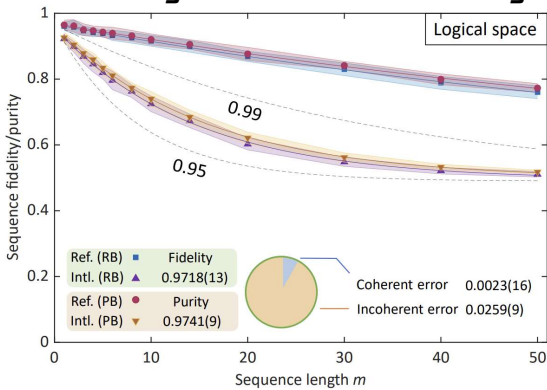


A FUNDAMENTAL PROGRESS IN SIMULATING NON-ABELIAN ANYONS AND THEIR BRAIDING
 A STEP TOWARD UNIVERSAL TOPOLOGICAL QUANTUM COMPUTATION
 A PROOF OF PRINCIPLE



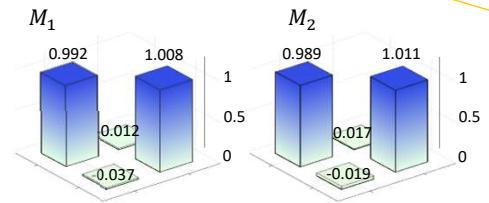
Experimental realization of A TOPOLOGICALLY PROTECTED HADAMARD GATE

The experimental gate fidelity reaches 97.18% by randomized benchmarking.

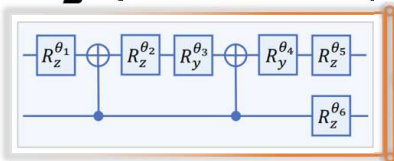


via braiding
 Fibonacci anyons

Topological protection
 Experimental results of the effective operation of the two kinds of interferences on the logical qubit, which are both Identities.

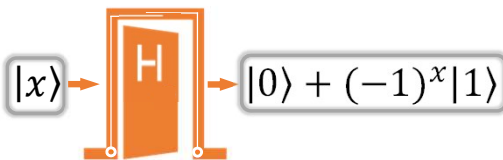


Braiding operations are pulses



Hadamard Gate

Realized by 30 braiding operations.



One in the pair may annihilate with a tracked Fibonacci anyon.

One in the pair may braid with a tracked Fibonacci anyon and then annihilate with the other in the pair.

Thermally excited anyon pairs

Braiding the Fibonacci anyons

Performs unitary transformations.

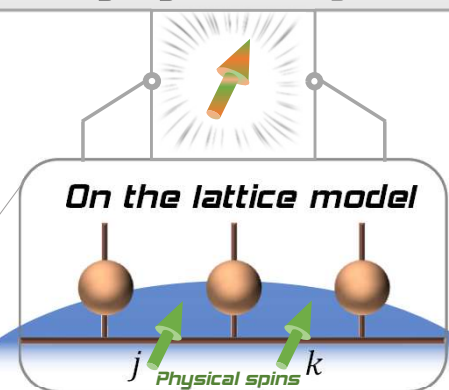
Generates all single-qubit gates

$$\begin{aligned} \text{Crossing 1} &\Rightarrow \begin{pmatrix} e^{-i\frac{4\pi}{5}} & 0 \\ 0 & e^{i\frac{3\pi}{5}} \end{pmatrix} \\ \text{Crossing 2} &\Rightarrow \begin{pmatrix} e^{i\frac{3\pi}{5}} \frac{2}{1+\sqrt{5}} & e^{i\frac{7\pi}{5}} \sqrt{\frac{2}{1+\sqrt{5}}} \\ e^{i\frac{7\pi}{5}} \sqrt{\frac{2}{1+\sqrt{5}}} & -\frac{2}{1+\sqrt{5}} \end{pmatrix} \end{aligned}$$

Boundary Fibonacci anyons

Tracked in experiments

A topologically protected logical qubit!



The lattice model

- The lattice model describes the doubled Fibonacci phase on a disk.
- Two spin degrees of freedom j and k represent the subsystem.