# From wave-function collapse and Galois solvability to the realization of non-Abelian topological order on a quantum device

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## 1. Abstract

Non-Abelian topological order (TO) is a coveted state of matter that despite extensive efforts has remained elusive. I will present the first unambiguous realization of non-Abelian TO and demonstrate control of its anyons. Using an adaptive circuit, we create the ground state wavefunction of D4 TO on a kagome lattice of 27 qubits on Quantinuum's H2 trapped-ion quantum processor and obtain fidelity per site exceeding 98.4%. Moreover we are able to experimentally confirm the various features that are unique to non-Abelian phases of matter including: 1) a non-square ground state degeneracy of 22, 2) an excited state with a single anyon on a torus, and 3) a non-trivial phase factor upon tracing three non-Abelian anyons in the shape of Borromean rings in spacetime.
https://arxiv.org/abs/2305.03766