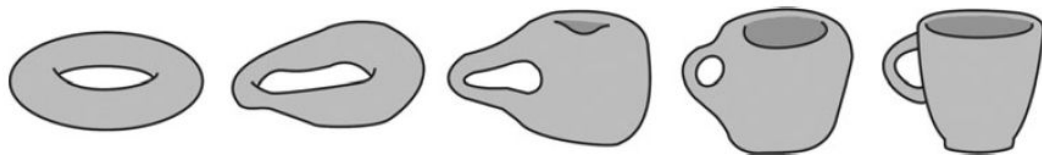

Topological Quantum Computing

— Megan Lilly —
COSC 594 Unconventional Computation

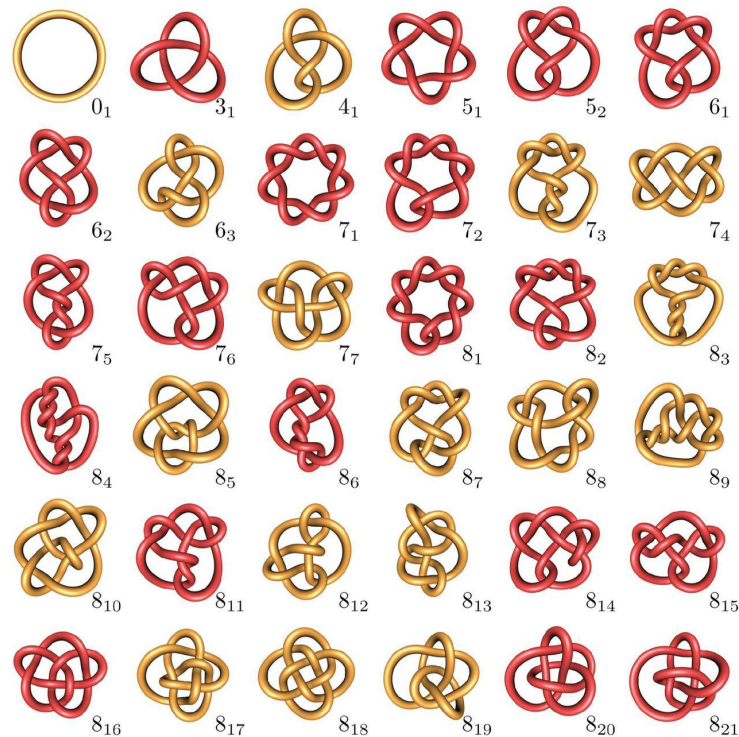
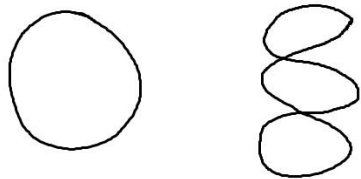
A Little Topology

- Coffee and donuts:



- Knots:

- Exponentially hard problem!



A Little More Topology

Topological Quantum Field Theory:

- Amplitudes depend only on the topology of the process

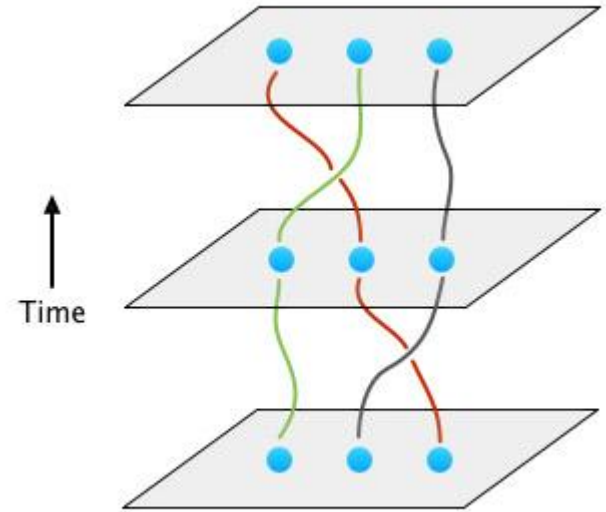
Therefore,

- Amplitudes = knot invariants

TQFT computer!

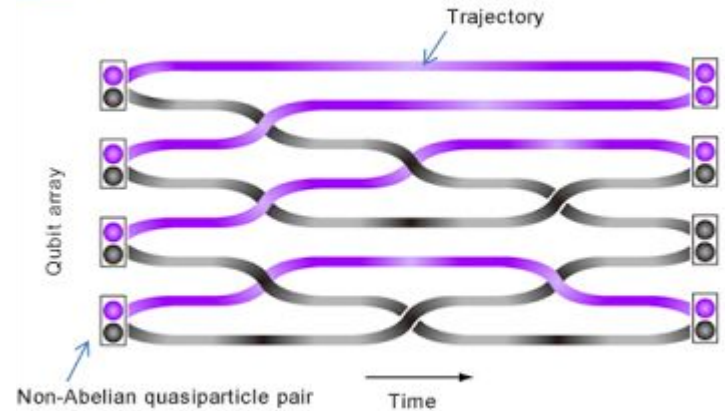
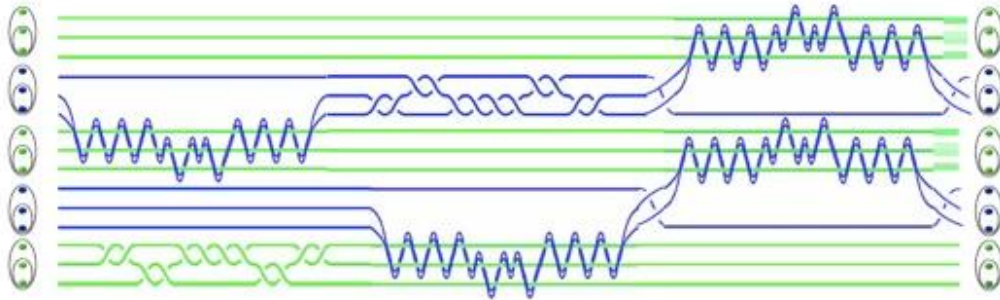
Non-Abelian Statistics and Anyons

- Non-Abelian = non-commuting
- Anyons = 2D quasiparticles
- Ground state is degenerate
- Braiding quasiparticles creates transitions between ground states
- Local operators cannot mix ground states



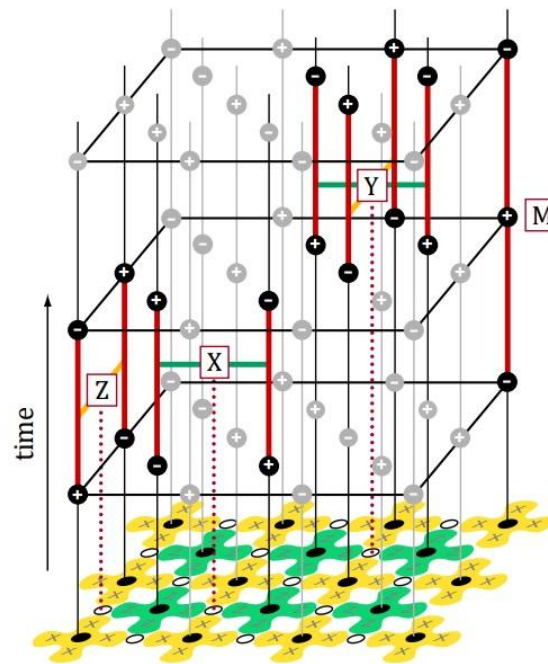
Topological Quantum Computation

- Qubits = degenerate ground states
 - Input = particle pairs from vacuum
 - Output = particle pairs that are not annihilated
- Gates = braids



Surface Codes

- Topological methods to encode information
- Existing qubit technology
- Scalability
- Error correction/suppression



Resources

<https://www.youtube.com/watch?v=FAiXp9loBk>

<https://arxiv.org/pdf/0707.1889v2.pdf>

<https://arxiv.org/pdf/quant-ph/0101025v2.pdf>

<https://www.youtube.com/watch?v=igPXzKjqrNg>

<http://stationq.cnsi.ucsb.edu/~freedman/publications/96.pdf>