

Möbius Quantum Computation

A New Topological Boundary Framework for Quantum Information Processing

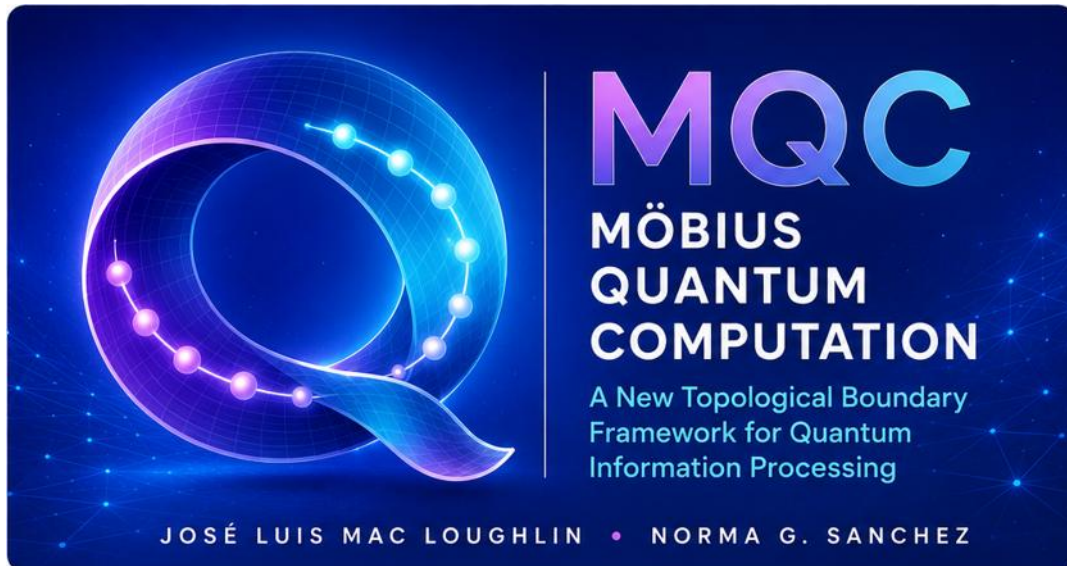
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Executive Summary

Quantum computing is widely regarded as one of the most transformative technologies of the twenty-first century. The new work by José Luis Mac Loughlin and Norma G. Sanchez introduces an original theoretical framework in which the topology of the Möbius strip becomes an active ingredient for quantum information processing.

Instead of treating topology merely as a mathematical description, the proposed framework explores how non-orientable boundary conditions influence quantum evolution, geometric phases, future quantum computing architectures and quantum error mitigation.

The work establishes a new conceptual direction at the intersection of topology, geometry, and quantum information science, it also yields to an information vision of vacuum physics in several contexts from the quantum laboratory to gravitational physics.

Keywords: Quantum Computing • Quantum Information • Möbius Strip • Topology • Geometric Quantum Evolution • Topological Boundary Conditions • Quantum Gates • Quantum Technologies

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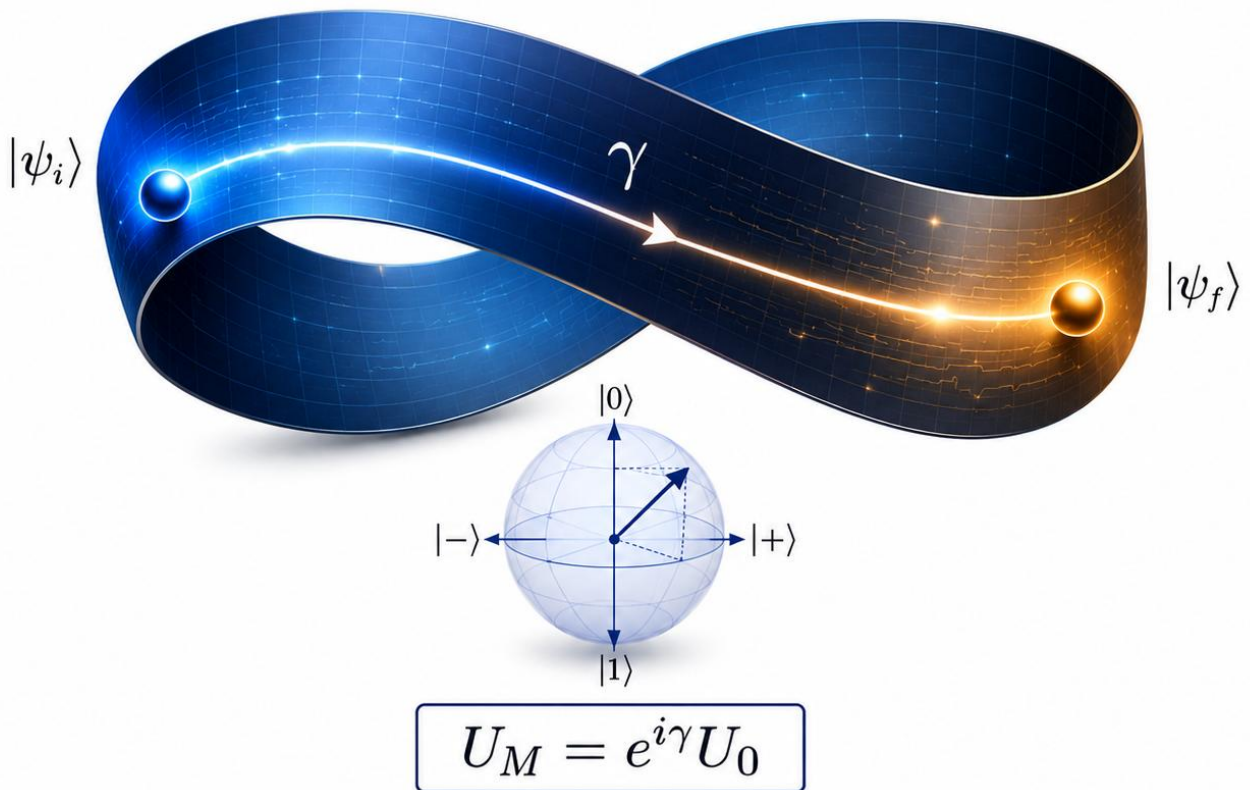


Figure 0. Graphical abstract. Quantum evolution on a Möbius strip. A quantum state $|\psi_i\rangle$ evolves along a closed path γ on the Möbius geometry and returns to $|\psi_f\rangle$ after a single traversal. The non-orientable boundary identification induces an additional topological phase factor, leading to an effective evolution $U_M = e^{i\gamma} U_0$, where U_0 is the conventional evolution operator. The Bloch sphere illustrates the state space of a qubit.

Why is this work different?

Most present approaches investigate: • quantum algorithms • superconducting qubits
• trapped ions • photonic quantum computers • topological quantum matter

This work asks a different question:

Can the topology of the computational space itself become a quantum resource?

That question motivates the Möbius Quantum Computation framework.

Main Contributions of this work :

- ✓ Introduces the concept of Möbius Quantum Computation.
- ✓ Proposes non-orientable boundary conditions for quantum information.

- ✓ Develops a geometric description of quantum evolution.
- ✓ Suggests new directions toward robust quantum architectures.
- ✓ Opens a new research program connecting topology and quantum technologies.

Potential Future Applications

Although the present work is theoretical, it suggests applications in • quantum error mitigation • fault-tolerant quantum computation • geometric quantum gates • topological quantum architectures

Frequently Asked Questions

Why a Möbius strip?

Because it is the simplest non-orientable surface and naturally exhibits unique global topological properties that imply new quantum boundary conditions and quantum evolution.

Is the proposal experimentally testable?

The present work is theoretical, but it provides a conceptual framework that may motivate future experimental and computational work , computer architecture designs. and their optimization.

Is this a new quantum computer? No.

It is a new theoretical framework that may inspire future quantum computing architectures.

Does it replace current quantum computing? No.

It complements existing approaches by introducing a new topological viewpoint.

Article

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