

Cover Letter

To: The Editor-in-Chief
Quantum Machine Intelligence (Springer Nature)

Date: July 4, 2026

Article Type: Short Communication

Dear Editor,

We are pleased to submit our manuscript entitled “**Circuit Topology as a First-Order Noise-Response Parameter in Variational Quantum Circuits**” for consideration as a Short Communication in *Quantum Machine Intelligence*.

Summary of the Work

Circuit topology—the pattern of two-qubit entangling gates—has been largely overlooked as a factor in VQC noise response. Prior work by Lozano-Cruz et al. (2026, QMI) showed that data encoding dominates ansatz choice, with topology variation explaining $<5\%$ of variance. Our work fills the gap within a fixed ansatz, showing that topology accounts for 48.9% of explainable $D(0.05)$ variance (ω^2 decomposition) in the ranking-decorrelation diagnostic, a previously unreported effect. We introduce a Heisenberg-picture analytical model that qualitatively predicts the characteristic decorrelation timescale $\tau(n, L)$ from circuit structure alone, and validate the qualitative topology ranking on IBM `ibm_fez` hardware (135 circuits).

Key Contributions

1. First demonstration that circuit topology is a first-order noise-response parameter (Type II ANOVA, $F = 295.7$, $p = 7.1 \times 10^{-12}$)
2. Heisenberg-picture analytical model qualitatively predicting $\tau(n, L)$ from CNOT-graph adjacency matrix spectral decomposition (correlation $r = 0.645$, $p = 0.013$, $R^2 = 0.35$)
3. Hardware validation on IBM `ibm_fez` (156-qubit Eagle r3 processor, 135 circuits, 4,096 shots each)
4. Practical design heuristics for NISQ-era circuit topology selection

Relevance to QMI

This work directly extends the agenda of the QMI journal, bridging quantum circuit design and noise characterization. It complements the Lozano-Cruz et al. (2026, *QMI*, vol. 8, art. 49) framework by examining topological sub-structure within a fixed ansatz, and introduces a theoretical model connecting graph-theoretic circuit properties to empirically observed noise response.

Declarations

- This manuscript has not been published and is not under consideration elsewhere.
- All authors have approved the manuscript and agree with its submission to *Quantum Machine Intelligence*.
- The authors have no competing interests to declare.
- All simulation data, code, and analysis pipelines are included in the supplementary material and will be deposited in a public repository with a permanent DOI upon acceptance.

Suggested Reviewers

The following researchers have expertise in quantum circuit noise characterization and VQC design and could provide thorough reviews:

1. Prof. Abhinav Kandala (IBM Quantum) — hardware-efficient VQCs on superconducting hardware
2. Prof. Marco Cerezo (Los Alamos National Laboratory) — barren plateaus and VQC trainability
3. Prof. Alán Aspuru-Guzik (University of Toronto) — quantum circuit expressibility and variational algorithms

We appreciate your consideration and look forward to your response.

Sincerely,
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