Canadian Association of Physicists
Association canadienne des physiciens et physiciennes

Contribution ID: **186** Type: **Oral Competition (Graduate Student) / Compétition orale (Étudiant(e) du 2e ou 3e cycle)**

Survey of all additive quantum codes for small systems via graphs

Monday 9 June 2025 15:30 (15 minutes)

Scalable, fault-tolerant quantum computing depends on the development of efficient quantum error correction codes. While many good quantum low-density parity-check (qLDPC) codes have been introduced, there is still potential to discover better ones, particularly for small numbers of qubits relevant to the current era of noisy intermediate-scale quantum devices. This research systematically searches for efficient and useful codes by exhaustively analyzing all possible additive codes for small numbers of physical qubits n through a graph representation. Specifically, we examine all non-isomorphic connected simple graphs for $n \leq 10$, and likewise all bipartite graphs for $n \leq 14$ corresponding to CSS codes. Our findings include codes that saturate quantum coding bounds, are competitive with topological codes requiring much larger values of n, are suitable for architectures with local connectivity, and which provide insights into the graph patterns of families corresponding to good codes for larger qubit systems. This work helps to lay the foundation for a systematic code design framework for large-scale quantum systems.

Keyword-1

Quantum error correction codes

Keyword-2

graph states

Keyword-3

Authors: MEHRANI, Mohsen (University of Calgary); Prof. L. FEDER, David (University of Calgary)

Presenter: MEHRANI, Mohsen (University of Calgary)

Session Classification: (DQI) M2-5 | (DIQ)

Track Classification: Technical Sessions / Sessions techniques: Division for Quantum Information / Division de l'information quantique (DQI / DIQ)