[[8,3,2]] Color Code Implementation

Quantum error correction hackathon

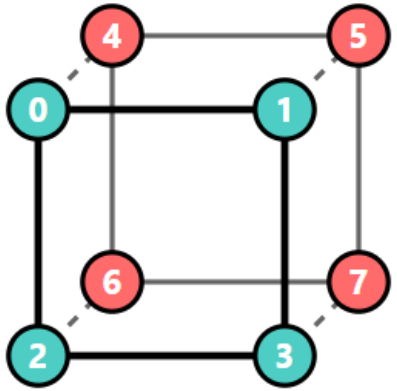
Qiskit fall fest Entropica Labs

Bring Your Own Code to Loom

By Nandini Gantayat

Github/Video: https://github.com/nandinii27/Quantum_error_correction

8-Qubit Cube



System Architecture

ColorCode832 Class
Stabilizers + Logical Operators

↓

StimCircuitBuilder
State Prep + Measurement

↓

Loom RL Scheduler
Adaptive Measurement Strategy

✅ Sanity Check 1

$|0\rangle_L \rightarrow$ Z measurement
Outcome: |000⟩ (100%)

✅ Sanity Check 2

$|1\rangle_L \rightarrow$ Z measurement
Outcome: |100⟩ (100%)

✅ Sanity Check 3

$|0\rangle_L \rightarrow$ X measurement
Q0: 49.4% / 50.6% (expected 50/50)

⚠️ Sanity Check 4

$|+\rangle_L \rightarrow$ X measurement
~25% each (partial X decoding)

Loom Integration & Future Directions

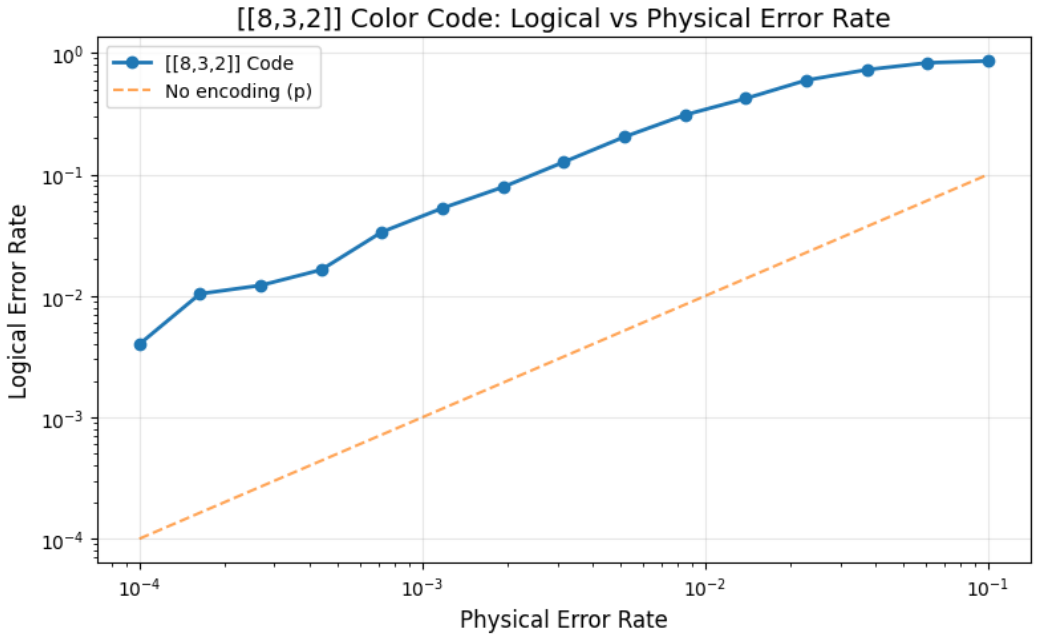
Modular Loom Integration

- ✓ ColorCode832 + StimCircuitBuilder → Stim circuits
- ✓ Full and adaptive measurement strategies
- ✓ Noise models and logical decoding → Loom experiments

The decoder is not handling multiple or correlated errors properly.

Not fully using measurement outcomes (flag qubits / superpositions).

Static tessarect code



Adaptive RL Measurement Scheduling

Strategy Comparison

Strategy	Reward	Measurements	Detection	Missed	Efficiency
Full	24.09	150	69.43%	1.03%	0.00%
Adaptive	24.10	145	70.78%	2.05%	3.31%
Random	17.28	76	49.40%	20.32%	49.49%

Learning **which stabilizers** to measure each round

→ with error-aware reinforcement learning
→ reducing quantum hardware load
→ while maintaining fault detection reliability

Neural automata decoders or sheaf NN/topological syndrome extraction


Thank you
université
PARIS-SACLAY
QISKIT FALL FEST
2025
IBM Quantum
Unitary Foundation
QUANDELA
ALICE & BOB
aqora
Entropic Labs