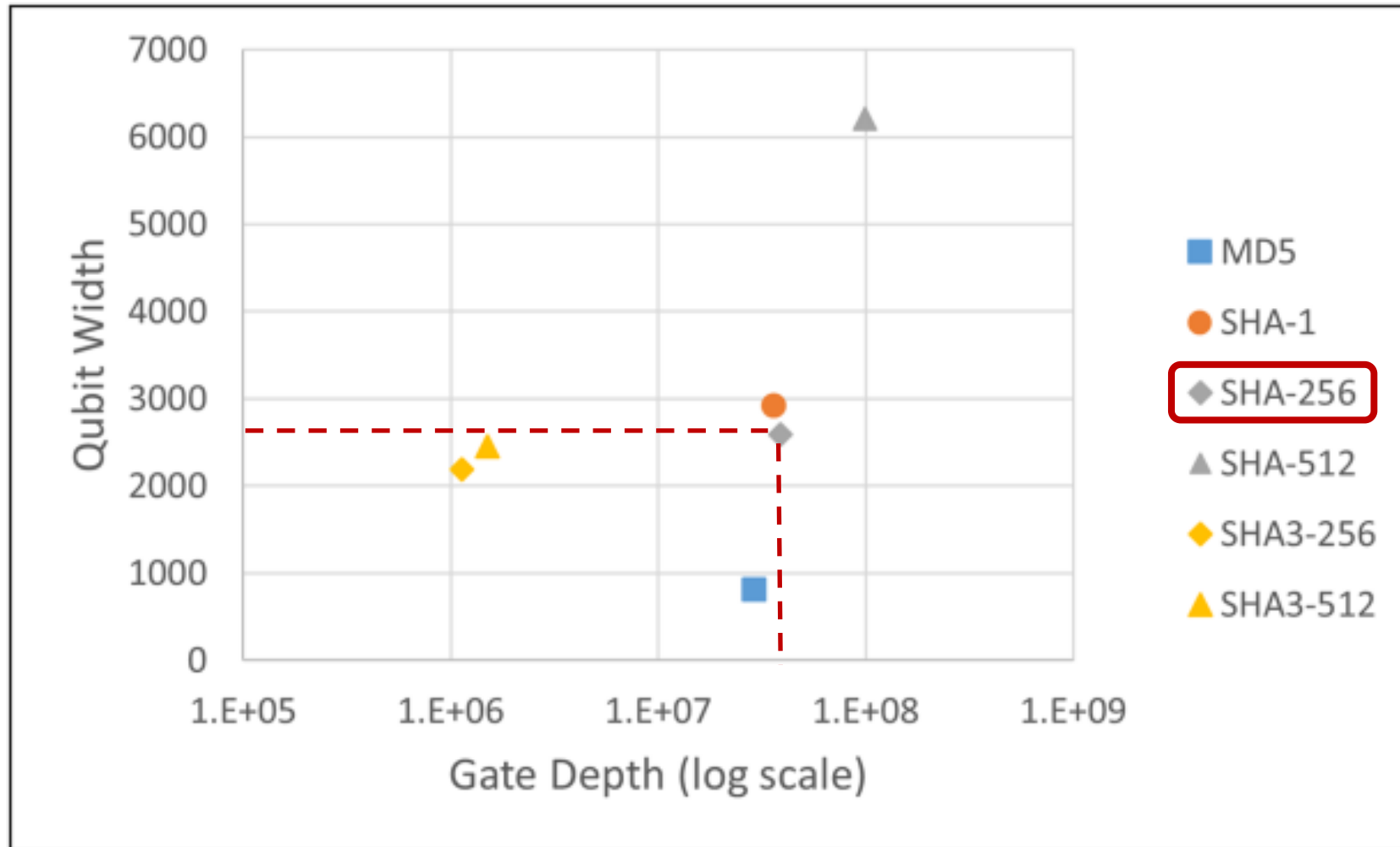


「專題製作」說明

A Study on Stabilizer Codes (穩定器碼) and Quantum Error Correction

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2024 Spring

When Will Quantum Computing Break Bitcoin?

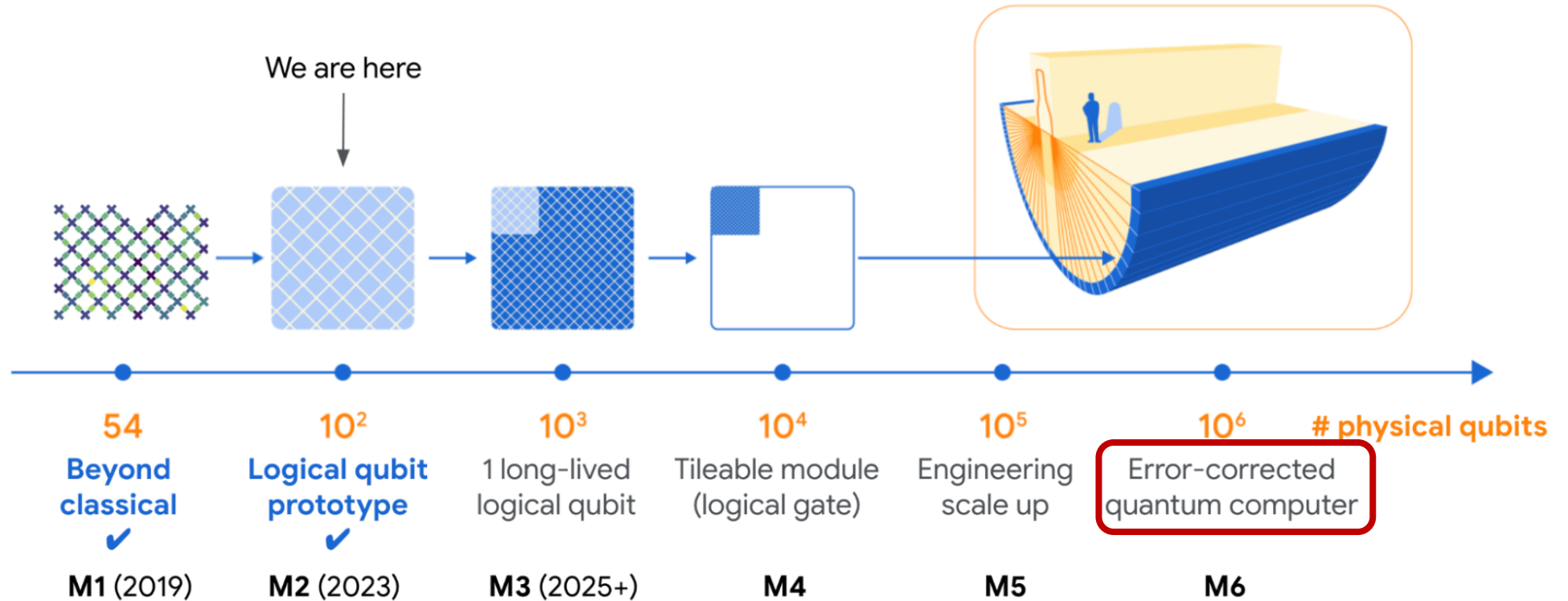


[IBM Quantum Roadmap](#)
@2030+: Qubit width 2000
Gate Depth 10^9

Figure. Qubit width over gate depth for various hash functions. [Preston2022]

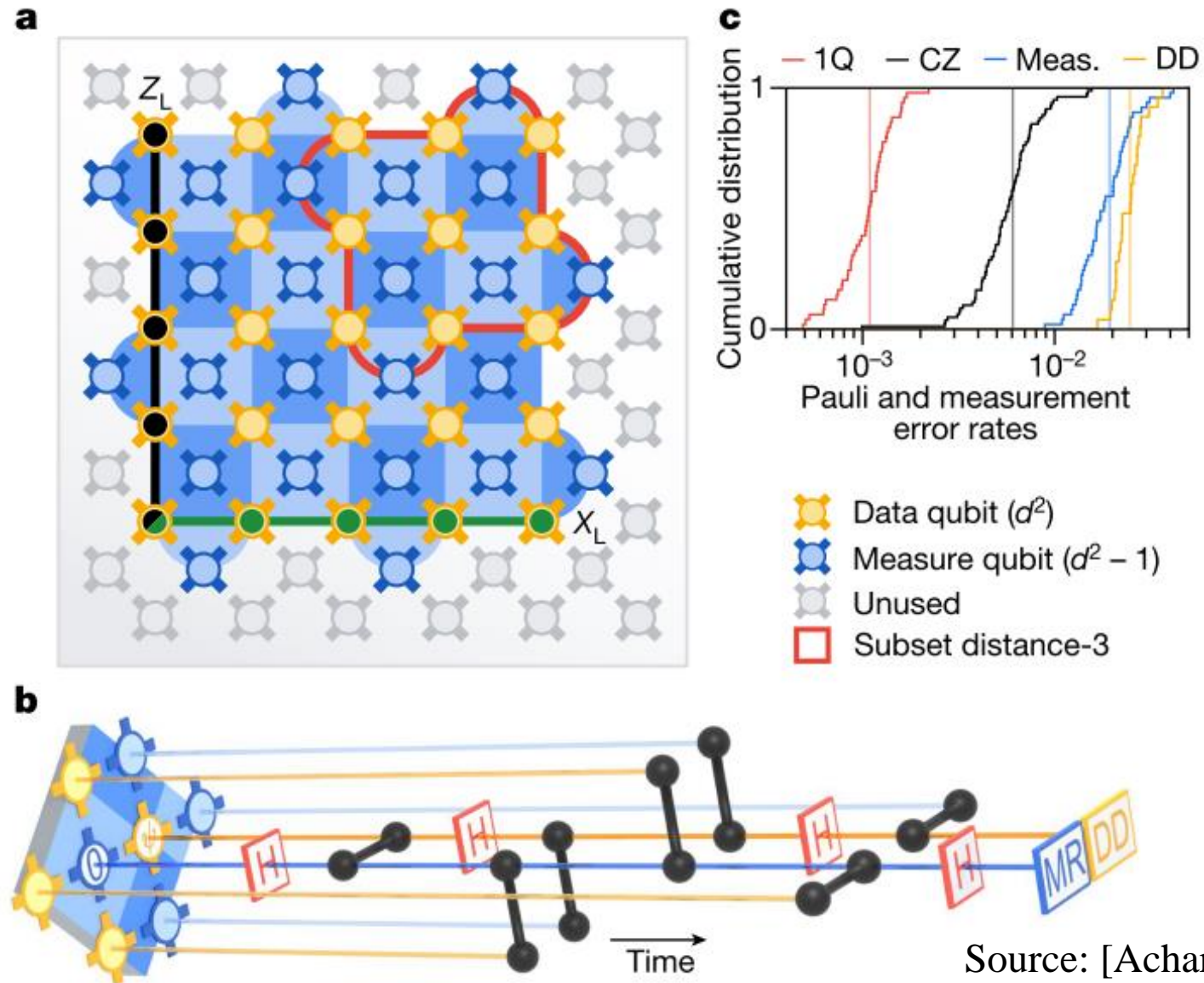
Error-Corrected Quantum Computer Roadmap (Google)

Quantum error correction	–	Enabled	At scale
# Physical qubits	10 – 100	100 – 1000	$10^4 – 10^6$
# Logical qubits	–	1	10 – 1000+
Logical error	10^{-3}	$10^{-2} – 10^{-6}$	$10^{-6} – 10^{-12}$



Source: <https://research.google/blog/suppressing-quantum-errors-by-scaling-a-surface-code-logical-qubit/>

Suppressing Quantum Errors via Surface Code



Source: [Acharya2023]

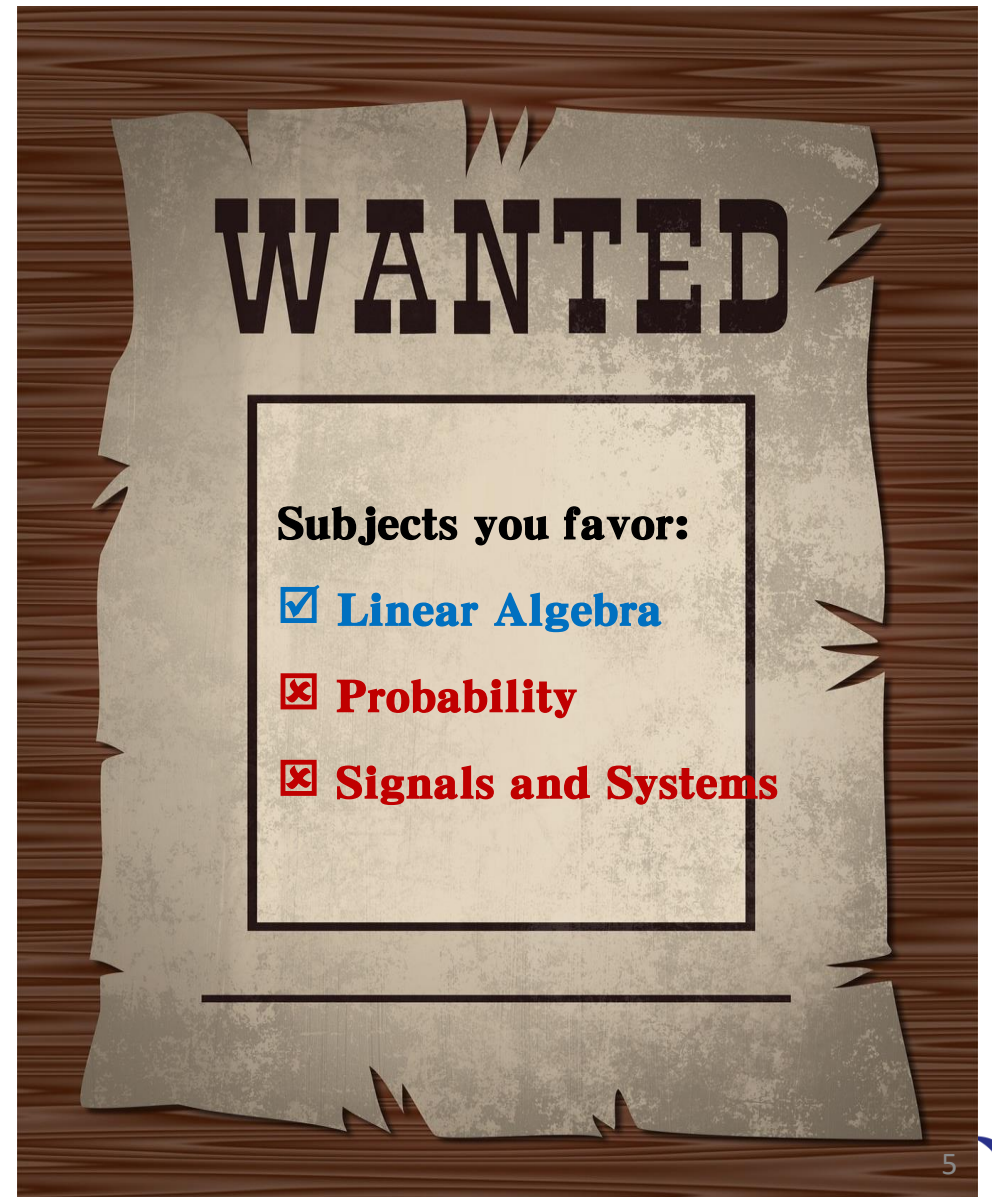
Expected Results

Goal:

- Become familiar with Stabilizer Codes (Basis of Surface Codes)
- Simulate quantum error correcting circuits

Development tool:

- Quantum Information Software Kit (Qiskit)



Reference

[Preston2022] R. H. Preston, “Applying Grover’s Algorithm to Hash Functions: A Software Perspective,” *IEEE Transactions on Quantum Engineering*, vol. 3, pp. 1–10, 2022.

[Acharya2023] R. Acharya et al., “Suppressing quantum errors by scaling a surface code logical qubit,” *Nature*, vol. 614, no. 7949, pp. 676–681, 2023.

