

# The Quiet Leap Forward: Qubits with $0-\pi$ Protection

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## Abstract

Quantum computing has made remarkable progress, yet scalability remains constrained by the limited coherence and noise sensitivity of today's leading qubit platforms. This talk will present a new route toward scalable superconducting quantum hardware based on the  $0-\pi$  qubit [1-3], a circuit designed for intrinsic protection against both charge and flux noise. I will discuss why the  $0-\pi$  qubit is particularly attractive for fault-tolerant quantum computing, and why its experimental realization remains a major open challenge. The central challenge is to uncover the operating principles of the  $0-\pi$  qubit, identify the dominant decoherence mechanisms, and develop design strategies that preserve noise protection while enabling fast control and high-fidelity qubit-qubit interactions. The talk will also outline a modular architecture for scaling qubits across multiple chips using flip-chip assembly and 3D integration with silicon-on-insulator technology. This approach aims to overcome the limitations of single-chip quantum processors by combining protected qubits, and high-quality interconnects into a distributed quantum processing unit.

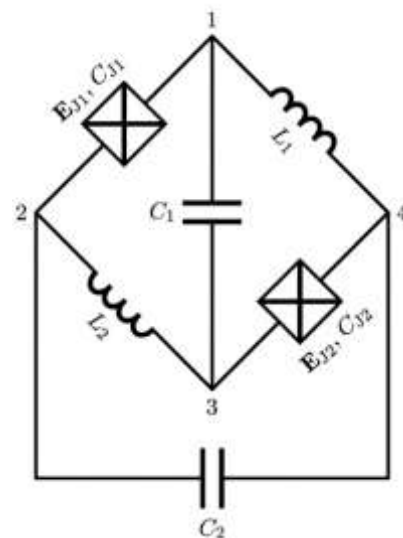
## References

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## Figures



**Figure 1:** Simplified equivalent circuit diagram of the  $0-\pi$  qubit [1]