CLASSICAL SIMULATION OF QUANTUM ANALOG COMPUTATION

MARENOSTRUM5 GPP

Led by

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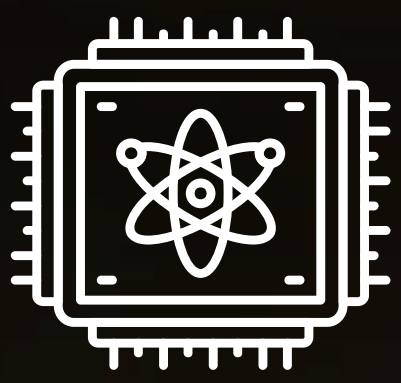
Quantum Tech

1 WHY DESIGN QUANTUM CIRCUITS CLASICALLY?



Analog quantum computers **use their natural properties** under very controlled conditions to solve problems, without using quantum gates

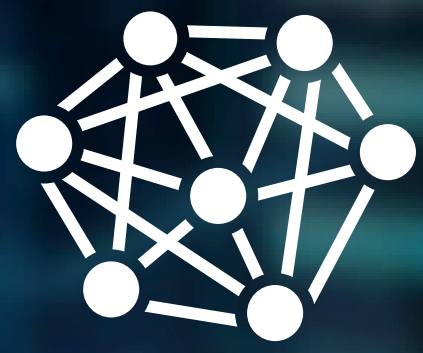
Superconducting quantum circuits are **very promising for analog quantum computing,** but the design can be costly or unfeasible with traditional methods

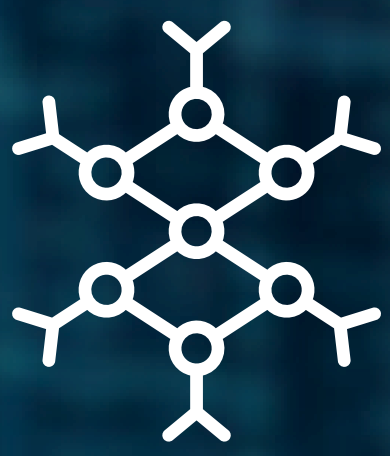
For this reason, it is necessary to **find new tools** to understand the circuits even before building them

THE ROLE OF HPC RESOURCES

2

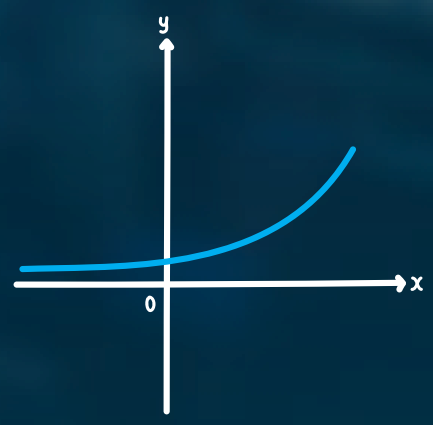
Quantum models describing these circuits have **many variables**, making exact simulations extremely demanding





Tensor networks are an alternative approach that **compress the quantum states** into a structured, manageable form

These networks **become large when simulating complex circuits**, and HPC resources become crucial



3 DESIGNING QUANTUM CIRCUITS SMARTLY

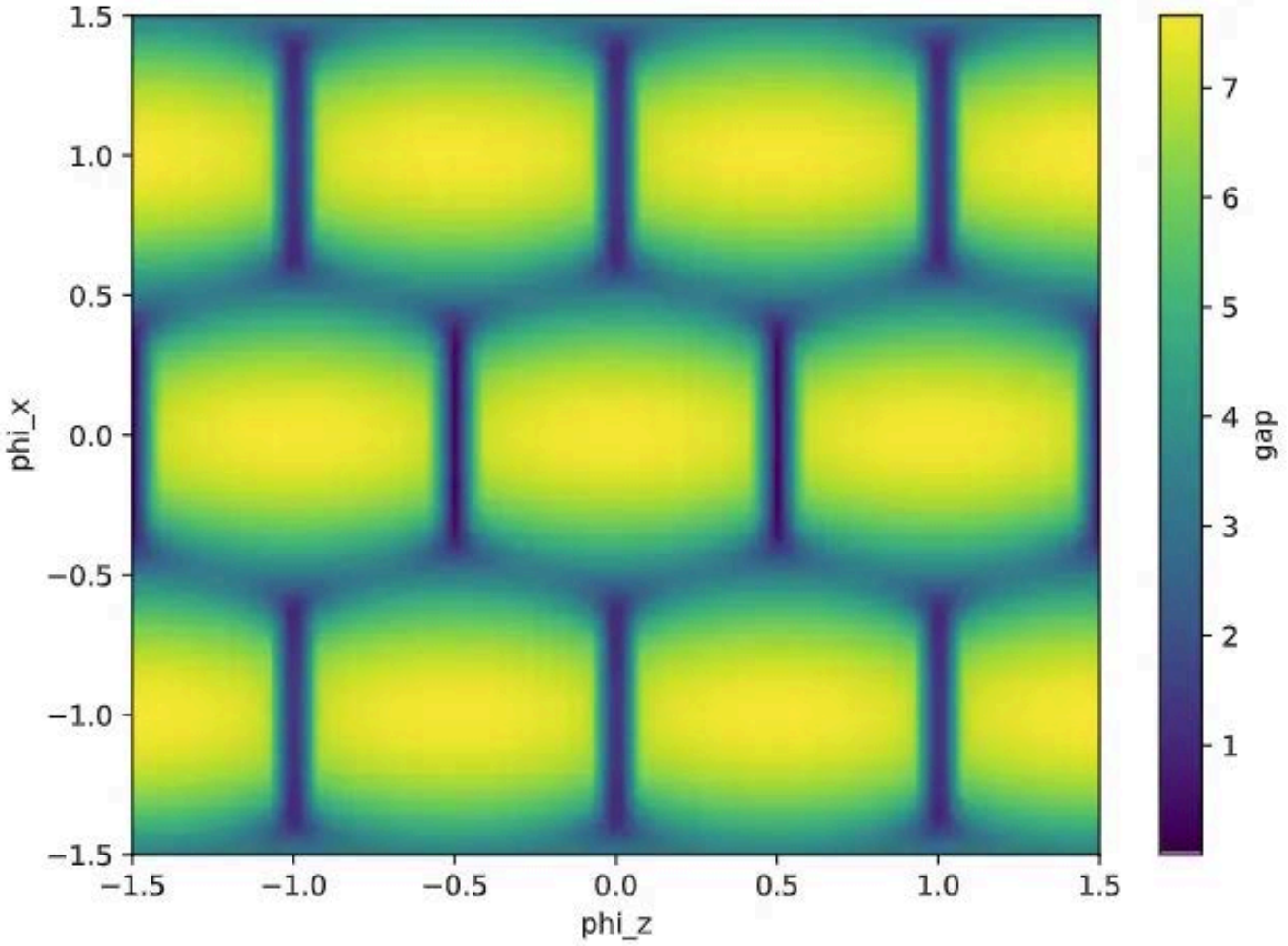
They reproduced the simulations **with real superconducting qubits** and the results closely resembled the simulated behaviour

The results confirm the accuracy of the numerical model and **the suitability of the approach for realistic circuit models**

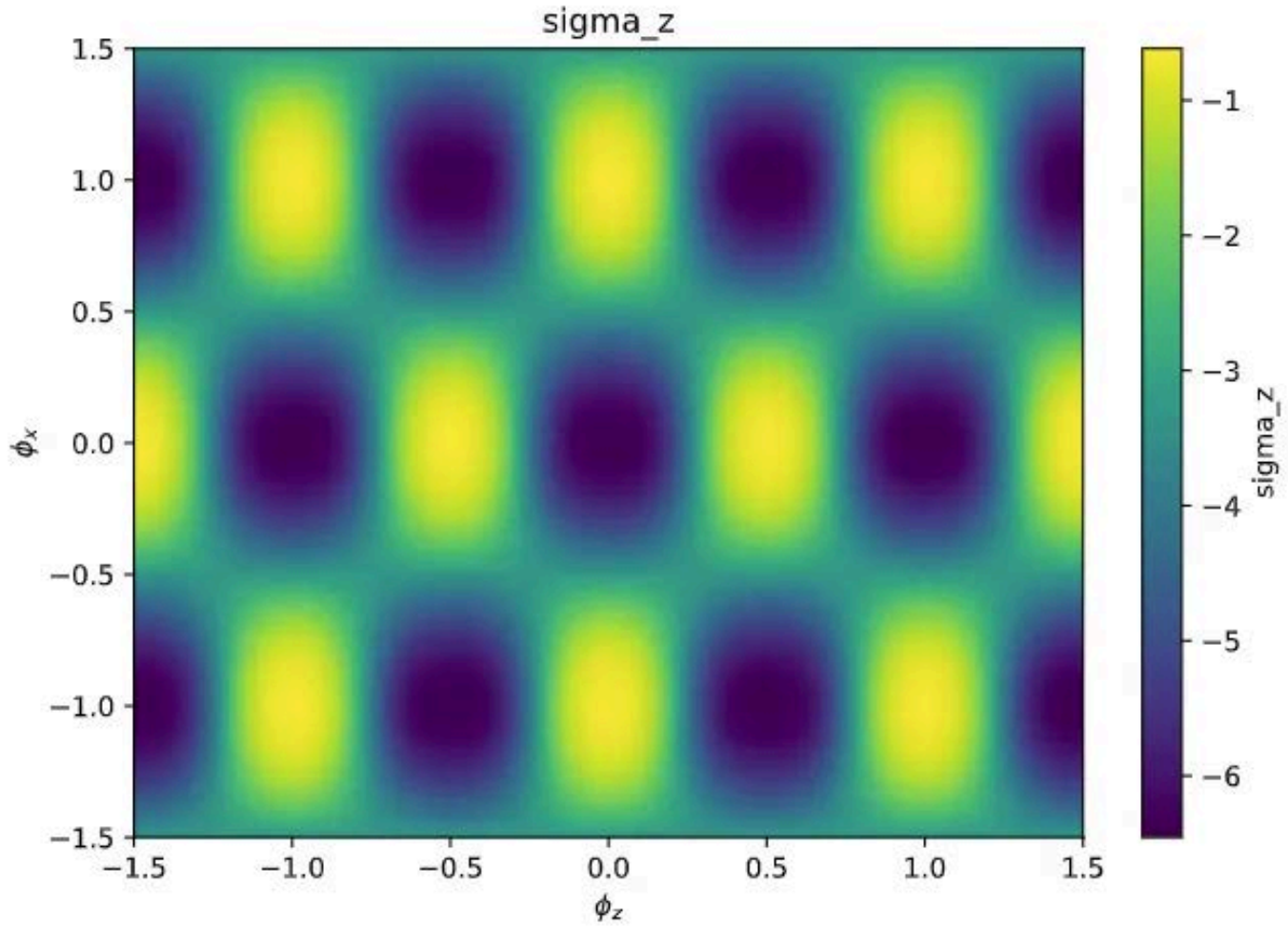
A NEW WAY TO SIMULATE QUANTUM CIRCUITS 4

The results lay the foundation for extracting simplified models that can **capture the complexity of the circuits in a manegeable way**

The team is currently working on **improving agreement with experimental data** and studying Machine Learning approaches for **an even higher optimization**



This graph shows how a external magnetic field applied to the two control loops of the circuit affects the energy gap of the qubit



This graph shows how a external magnetic field applied to the two control loops of the circuit affects the qubit's natural preference for one state over the other

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