Useful Quantum Computing

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Quantum Supremacy Using a Programmable Superconducting Processor

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Google Sycamore

54 qubits $\times$ 20 clock cycles
$\sim$100 ft$^2$
1 million samples
200 seconds
Oak Ridge *Summit* (Schrödinger-Feynman)

54 qubits $\times \sim 20$ clock cycles
6,000 ft$^2$
1 million samples
10,000 years?
Oak Ridge *Summit* (Schrödinger)

54 qubits \times \sim 20 \text{ clock cycles}
6,000 \text{ ft}^2
128\text{PiB SSD}
Arbitrarily many samples
6 days
Error Correction Threshold

Google
Research
Direction

Useful error
corrected QC

Near-term
applications

Classically
simulatable

Limiting error rate

Number of Qubits

Figure credit:
\[ |j_0\rangle = |0\rangle \quad H \quad H \]
\[ |j_1\rangle = |0\rangle \quad H \]
\[ |j_2\rangle = |0\rangle \quad H \]
\[ |s_0\rangle \quad U^4 \quad U^2 \]
\[ |s_1\rangle \]

\[ 10^8 \]

\[ T \quad S \quad H \quad \text{etc.} \]
\[ N_{\text{physical}} \sim 10,000 \times N_{\text{logical}} \]
PsiQ $P1^*$

100 qubits $\times$ 1 million clock cycles
Few thousand ft$^2$
1 million physical qubits
Minutes
Oak Ridge *SuperSummit*

100 qubits $\times$ 1 million clock cycles

$6,000 \times 2^{100-54} = 400,000,000,000,000,000,000$ ft$^2$

$128 \times 2^{100-54} = 9,000,000,000,000,000$ PiB SSD

A very long time
Approximate transistor count

- Google Sycamore
- PsiQ Vega
- PsiQ Polaris