

Allgemeines Physikalisches Kolloquium

Donnerstag, 28.11.2019 um 16 Uhr c.t.

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Quantum computational supremacy

On October 23rd the “Google AI Quantum” team published an article entitled “Quantum supremacy using a programmable superconducting processor” [1], which describes how a random circuit sampling problem on 53 qubits was solved in 200 seconds. Such problems are believed to be hard to solve using classical computing resources and the Google team estimated a run-time of 10,000 years on today’s highest performance computers with access to one million cores. Many immediately regarded this striking difference in runtime as a milestone for the field of quantum computing. Some, most notably a team at IBM Watson Research Center, where a quantum computer similar to Google’s device is under development, argued that Google’s supremacy claim is illegitimate, because the problem could in fact be solved in a matter of 2.5 days on a current classical supercomputer [2].

As we find ourselves at a technological inflection point, I will briefly review relevant considerations from complexity theory, describe the random circuit sampling problem and its experimental implementation on Google’s Sycamore quantum processor. We will assess the claims made by the Google team and discuss what is actually meant by the term “quantum supremacy”. As popular media coverage of the topic suggests, it is exciting times for quantum computing and we will look ahead to what challenges persist, what steps will likely be taken next, what alternative approaches exist, what consequences we can expect as a result of the ongoing development, and how do efforts at the WWU relate to the emerging quantum computing paradigm.

References:

[1] F. Arute et al., Nature 574, 505 (2019)

[2] E. Pednault et al., arXiv:1910.09534 (2019)