

**Yuri Alexeev**

**Title: Large-Scale Parallel Tensor Network Quantum Simulator**

**Abstract:**

We will present a quantum circuit simulator designed to run in parallel on large supercomputers. It is based on the tensor network representation of quantum circuits. We propose a novel parallelization strategy that is based on splitting partially contracted tensor expression. The simulator is very flexible and agnostic to both connectivity map of the quantum device and types of gates used in the circuit. The simulator benchmarking studies were performed for Quantum Approximate Optimization Algorithm (QAOA) circuits. We computed 210 qubit QAOA circuits with depth 1,785 gates on 1,024 nodes and 213 TB of memory on the Theta supercomputer. To the best of our knowledge, this constitutes the largest QAOA quantum circuit simulations reported to this date. Danylo Lykov, Roman Schutski, Valerii Vinokur, Yuri Alexeev