Speaker: Prof. Josiah Sinclair

Talk time: 16:00 - 17:00, Monday 27.04.2026

Location: Schrödinger Saal, IQOQI, ICT building top floor

Website: https://sinclair.physics.wisc.edu/

Towards modular fault-tolerant neutral atom quantum computers

Abstract: The central challenge to harnessing large-scale quantum entanglement is its fragility to errors. Quantum error correction offers a promising route to suppressing errors, but because many qubits are required for each error-corrected qubit, the number of physical qubits needed for useful applications is very large. As neutral-atom systems approach practical size limits, true scalability will require connecting arrays in a modular architecture. My group is pursuing this goal by combining large neutral-atom processors containing multiple logical qubits with short-range, high-speed, cavity-based photonic interconnects to create an intrinsically scalable platform for quantum information science. In this talk, I will describe our experimental plans, and present some of my previous theoretical results which shape this program including my work on connecting surface code logical qubits with noisy links [1, 2], leveraging loss errors in fault-tolerant algorithms [3], and some unpublished work on connecting interfacing XZZX logical qubits via interfaces with biased noise.

1. **J. Sinclair**, J. Ramette, B. Grinkemeyer, D. Bluvstein, M.D. Lukin, V. Vuletić. “Fault-tolerant optical interconnects for neutral-atom arrays,” Phys. Rev. Research **7**, 013313
2. J. Ramette, **J. Sinclair**, N.P. Breuckmann, and V. Vuletić. Fault-tolerant connection of error-corrected qubits with noisy links. npj Quantum Inf 10, 58 (2024). doi.org/10.1038/s41534-024-00855-4.
3. G. Baranes**,** C. Madelyn, J. P. Bonilla Ataides, D. Bluvstein, **J. Sinclair,** V. Vuletić, H. Zhou, and M. D. Lukin. “Leveraging Qubit Loss Detection in Fault-Tolerant Quantum Algorithms,” Phys. Rev. X **16,** 011002 (2025).