universität innsbruck

Department of
Theoretical Physics

Seminar Talk

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"Quantum processing with neutral atoms: from analog to digital"

Abstract

Neutral-atom quantum processors have emerged as a leading platform for quantum science, featuring coherent control of hundreds to thousands of atomic qubits. In this talk, I will discuss recent results leveraging high-fidelity control of Rydberg atoms for both quantum simulation and quantum computation. First, we combine efficient many-body analog evolution with fully programmable digital control to realize and probe an out-of-equilibrium critical quantum spin liquid of the Rokhsar-Kivelson type, using loss detection for error mitigation and local single-qubit gates to measure in arbitrary bases. Second, to achieve precise computation, we utilize reconfigurable arrays of up to 448 neutral atoms to experimentally explore the key elements of a fault-tolerant quantum processing architecture, including below-threshold error correction, fault-tolerant gate operations, universality, and physical error removal during deep-circuit computation. These results demonstrate neutral atom arrays as a versatile platform for programmable quantum simulation and establish foundations for scalable, universal error-corrected processing.

Thursday | 02.04.2026 | 4:15pm

Schrödinger-Saal | ICT building