EBERHARD KARLS UNIVERSITÄT TÜBINGEN

iRyd

SPP 1929 – Seminar

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Universität Tübingen
Physikalisches Institut, Raum D4 A19, Gebäude D
Auf der Morgenstelle 14, 720736 Tübingen

David Petrosyan
(Institute of Electronic Structure and Laser [IESL], Heraklion, Greece)

High-fidelity quantum gates with Rydberg superatoms: Counting atoms in mesoscopic ensembles

Strong, long-range interactions between atoms in high-lying Rydberg state can block multiple Rydberg excitations in mesoscopic atomic ensembles. Such Rydberg superatoms, composed of several hundred atoms, are attractive systems for quantum information processing, storage and communication via coherent emission/absorption of single photons. But achieving these tasks with high fidelity requires knowing the number of atoms with small uncertainty.

In this talk, after quantifying the fidelities versus the atom number uncertainty, I will present an efficient adaptive protocol to assess with high precision the number of atoms within a Rydberg superatom. This is done by interrogating the atomic ensemble with resonant pulses while monitoring the resulting Rydberg excitations. A feedback from the measurement after each pulse is used to adjust the area of the next pulse, which, after several steps, results in achievable gate fidelities commensurate with the fault-tolerant quantum computation.