RICE QUANTUM GROUP MEETING SEMINAR SERIES

Trapped-Ion Quantum Simulation with Ground, Optical, and Metastable Qubits

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Midhuna Duraisamy Suganthi is a graduate student in Dr. Guido Pagano's group, where she works on trapped-ion quantum simulation platform. Her research interests include exploring the atomic and optical properties of Ytterbium ions and using them for simulation and computation of quantum systems.

ABSTRACT

Trapped ions offer a pristine platform for quantum simulation and computation using hyperfine, optical, and metastable qubits. Yb^+ ions have a complex atomic structure due to transitions involving electrons from the f orbital closed inner shell. This allows for the existence of highly excited states that can be useful for repumping, detection, and state preparation in the metastable state qubits. Here, we report spectroscopic and time-resolved data to characterize the atomic state $4f^{13}({}^2F^o_{5/2})5d6s({}^1D)^1[5/2]_{5/2}$ in $172Yb^+$ ions. We observe an unexpectedly long lifetime of $\tau = 38.0(9)$ µs that allows visible Rabi oscillations and sideband resolved spectroscopy. We also measure its branching ratio to the low-lying metastable states.

I will also talk about the progress on generation of beam arrays with both arbitrary phase and amplitude control using a single phase-only Spatial Light Modulator, realized via a modified GSW algorithm with iterative feedback. Such a beam array can be used to generate a $\sigma_z\,\sigma_z$ light shift gate while coupling to axial modes of motion.

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