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Erbium atoms in optical tweezers

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Laser-cooled neutral atom arrays in optical tweezers are rapidly advancing as a scalable platform for quantum computing. Alkaline-earth metals and lanthanides provide unique advantages in atomic manipulation due to their rich spectra, enabling new possibilities in quantum science. We have built a novel system for quantum computation based on erbium atoms [1]. In my talk, I will explore the possibility of using different optical transitions for cooling, single-atom operation, and imaging and investigate the Rydberg excitation spectrum. We performed a detailed study of the dynamics of erbium atoms on the narrow intercombinational transition both experimentally and theoretically. We developed a Monte Carlo algorithm, validated it in experiments, and used it to identify conditions for efficient in-trap Doppler cooling. Allowing us to have continuous non-destructive imaging on intercombinational transition.
As a preliminary investigation of erbium atoms excited to Rydberg states, we performed spectroscopy for the 47s and 48d states in tweezers, confirming earlier results obtained with a hot erbium beam [2]. Additionally, we demonstrated the excitation of single atoms to the Rydberg state, marking the first step toward two-atom entanglement in erbium atoms.

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