SEMINAR: Trapping loading and imaging fermionic ytterbium atom arrays

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Seminar Room

In recent years, a new generation of cold-atom experiments has emerged, realizing the vision of scalable quantum many-body systems with resolution at the single-particle level. In particular, arrays of optically trapped alkalineearth-like atoms have become one of the leading platforms for quantum information processing, metrology and quantum simulation. In this talk I will present recent results from our Yb tweezers platform, aiming to engineer and investigate fermionic many-body systems with single-particle resolution. In our experiment we load a tweezer array of ytterbium atoms from a narrowline MOT operating in a five-beam configuration [1]. We detect single atoms with a fast and low-loss imaging scheme without active cooling, enabled by the favorable properties of ytterbium [2]. Using a pulsed excitation scheme, we collect fluorescence on microsecond timescales, reaching single-atom discrimination fidelities above 99.9% and single-shot survival probabilities above 99.5%. Owing to its short timescale, this imaging scheme does not induce parity projection and enables number-resolved detection in multiply-filled traps. Leveraging such atom-counting capability, we investigate the dynamics of blue-detuned light-assisted collisions leading to enhanced loading in optical tweezer arrays. We also employ our scheme to detect atoms in tightly-spaced arrays or propagating in free space after being released from a single trap. Combining the fast imaging scheme with techniques for the preparation of few-fermion ensembles, which we are working to extend to alkaline-earth-like atoms, will allow us to investigate SU(N) symmetric and two-orbital models in mesoscopic systems.

Hosted by: Prof. Dr. Leticia Tarruell