SEMINAR: Positioning Atoms, Spins, and Quantum Information in a Lattice

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12:00 to 13:00
Seminar Room

Neutral atoms trapped in optical lattices represent one of the most promising and highly coherent platforms for quantum information processing, quantum simulation, and precision measurement. However, unlocking their full potential requires the ability to dynamically manipulate and route individual atoms to induce controlled interactions. In this talk, I will present a robust transport method based on topological pumping (a concept borrowed from condensed-matter physics) to precisely and bi-directionally shuttle atoms across an optical lattice. We demonstrate that when two atoms are brought together at a single lattice site, they undergo a highly coherent collision process, allowing us to realise fundamental two-qubit quantum logic gates [1]. By leveraging this technique, we showcase the programmable creation of entangled quantum states [2]. Finally, we will discuss how this scalable architecture opens new frontiers for building large-scale quantum computers and exploring novel regimes in quantum simulation.

[1] Kiefer et al. Nature (2026) i¿½Protected quantum gates using qubit doublons in dynamic l optical latticesi¿½
[2] Kiefer et al. arXiv:2606.13772 i¿½Programming spin correlations in a fermionic latti e quantum simulator"

Hosted by: Prof. Dr. Leticia Tarruell