New Perspectives on Quantum Simulation with Alkaline-Earth Atoms

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Ultracold atoms have been proposed as ideal quantum simulators of condensed matter systems. Recent advances in cooling, trapping and manipulating alkaline-earth atoms (AEA) --currently the basis of the most precise atomic clock in the world--, are opening new exciting opportunities for the exploration of a wide range of many-body phenomena. This is possible thanks to their unique atomic properties with decoupled nuclear spins degrees of freedom and highly symmetric interaction parameters. In this talk I will discuss ideas to use of AEA dressed by laser fields to engineer analogs of spin-orbit coupled Hamiltonians which can display topologically quantized particle transport and which in the presence of interactions exhibit peculiar laser field-induced Kondo-type resonances that significantly alter the particle transport. Those resonance give rise to the analog of a magneto-electric response where the induced magnetization is controlled by a mass current (electric). Finally I will discuss how dipolar interactions between AEA prepared in two electronic internal states can naturally give rise to emergent Weyl quasiparticles in a 3D lattice which are detectable by standard spectroscopic methods.