Quantum Simulation Using Ytterbium Atoms in an Optical Lattice and Beyond

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In this talk, I will report our recent experiments using ultracold two-electron atoms of ytterbium (Yb) loaded into an optical lattice. In particular, by utilizing the mixed dimensional experimental platform of ultracold ^{173}Yb atoms consisting of the two-orbital system with an itinerant one-dimensional repulsively interacting Fermi gas in the ground state and a resonantly interacting impurity atom in the metastable state localized in the lattice, we successfully realize the spin-space quantum transport induced by an atomic quantum point contact [1]. The controllability of the transport current via an orbital Feshbach resonance as well as the dynamical switching of the quantum transport by optical excitation of an impurity atom is demonstarted. In addition, the unique spin degrees of freedom of ^{173}Yb with SU(N) symmetry enable us to successfully realize a three-terminal quantum transport system.
In addition, our experimental platform for quanum simulation is applied to the search for the new physics beyond Standard Model [2], which will be also reported in this talk.

References:
[1] K. Ono, et al, “Observation of spin-space quantum transport induced by an atomic quantum point contact”, to appear in Nature Communications (2021).
[2] K. Ono, et al, “Observation of non-linearity of generalized King plot in the search for new boson”, arXiv: 2110.13544.