Synthetic quantum systems with ultracold two-electron fermions

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Ultracold gases of neutral atoms are a powerful resource for engineering synthetic many-body quantum systems. In a "quantum simulation" perspective, it is possible to control the atomic state to provide almost exact experimental realizations of fundamental theoretical models and to achieve new "extreme" states of matter.

I will report on recent experiments performed at University of Florence with degenerate gases of ultracold ^{173}Yb fermions. These two-electron atoms exhibit a rich internal structure, with distinct degrees of freedom – nuclear spin and electronic state – that can be both manipulated with high levels of quantum control. For instance, coherent coupling between nuclear spin states allowed the implementation of synthetic magnetic fields for effectively charged atoms, where the nuclear spin can be mapped onto an effective synthetic dimension [1]. Recently, we have implemented synthetic flux ladders using single-photon transitions between long-lived electronic states, which allowed us to measure chiral edge currents as a function of a fully tunable synthetic magnetic flux [2], also opening new directions for the study of spin-orbit-coupled ultracold Fermi gases with tunable interactions [3] for the realization of topological states of matter.

References

[1] M. Mancini et al., Science **349**, 1510 (2015).
[2] L. F. Livi et al., Phys. Rev. Lett. **117**, 220401 (2016).
[3] G. Pagano et al., Phys. Rev. Lett. **115**, 265301 (2015).

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