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Two-orbital SU(N) magnetism with ultracold alkaline-earth atoms[1]

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Recently, substantial experimental efforts have been directed at cooling, trapping, and manipulating alkaline-earth metal atoms, and many of the capabilities previously demonstrated with alkali atoms are starting to be reproduced with alkaline-earth atoms. In this talk I will describe our proposal to exploit the decoupling between the nuclear spins and the electronic degrees of freedom present in the 1S0 and 3P0 states of alkaline-earth atoms to implement atomic analogs of Hamiltonians which rely on the interplay between charge, spin and orbital degrees of freedom. As an example, I will discuss the implementation of the Kondo lattice model used in condensed matter to describe heavy fermion materials. The decoupling between nuclear and spin degrees of freedom also leads to an enlargement of the spin rotation symmetry from SU(2) to SU(N), with N as large as 10. I will show that this enlarged symmetry can have striking physical consequences, such as the disappearance of magnetic ordering and the formation of spin liquid phases.

[1] Two-orbital SU(N) magnetism with ultracold alkaline-earth atoms, A. V. Gorshkov et.al. arXiv:0905.2610 (to appear in Nature Physics).
[2] Mott Insulators of Ultracold Fermionic Alkaline Earth Atoms: Underconstrained Magnetism and Chiral Spin Liquid, M. Hermele, V. Gurarie, A, M. Rey , Phys. Rev. Lett. 103, 135301 (2009).
[3] Probing the Kondo Lattice Model with Alkaline Earth Atoms, M. Foss-Feig, M. Hermele, A.M. Rey, arXiv:0912.4762

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