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

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Fermionic alkaline-earth atoms have unique properties that make them attractive candidates for the realization of atomic clocks and degenerate quantum gases. At the same time, they are attracting considerable theoretical attention in the context of quantum information processing. In this talk, we demonstrate that when such atoms are loaded in optical lattices, they can be used as quantum simulators of unique many-body phenomena. In particular, we show that the decoupling of the nuclear spin from the electronic angular momentum can be used to implement many-body systems with an unprecedented degree of symmetry, characterized by the SU(N) group with N as large as 10. Moreover, the interplay of the nuclear spin with the electronic degree of freedom provided by a stable optically excited state should enable the study of physics governed by the spin-orbital interaction. Such systems may provide valuable insights into the physics of strongly correlated transition-metal oxides, heavy-fermion materials and spin-liquid phases. [Reference: Nature Phys. 6, 289 (2010)]