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Exotic magnetism and new states of matter with alkaline earth atoms[1]

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A crucial basic property of antiferromagnetic insulators with SU(2) symmetry is that adjacent spins can (and tend to) combine to form singlets, or valence bonds. The classical analog of this fact is that adjacent spins prefer to be antiparallel. These two facts underly much of our thinking about ground states of quantum antiferromagnets. Ultracold alkaline earth atoms can be used to realize magnetic insulators with SU(N) symmetry, where a minimum of N spins is required to form a singlet, and where N can be as large as 10. These systems belong to a largely unexplored class of quantum magnets. In this talk, I will discuss some of the remarkable new states of matter that are strong candidates to arise in these systems, including chiral spin liquids with fractional and non-Abelian statistics. I will also briefly discuss the issue of temperature, and point out an advantage of high-spin alkaline earths as compared to spin-1/2 magnetic systems.

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