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Engineering Strongly Correlated Magnetic States with Ultracold Atoms[1]

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Optical lattices containing ultracold alkali atoms represent nearly ideal manifestations of Hubbard models. Hubbard models are centerpieces of solid-state physics. They can, for example, reveal intriguing magnetic states that are thought to hold the key to understanding high temperature superconductivity. Optical lattice experiments can therefore be used to study quantum states of matter of fundamental importance. Some of the work in my group uses numerical modeling to help guide ultracold atom experiments in these searches. I will review our recent work that compares with ongoing optical lattice experiments trying to realize a quantum antiferromagnet in a cubic optical lattice containing fermions in particular. I will also discuss recent work in our group that examines the impact of speckle disorder on the transport properties of ultracold fermions in a strongly correlated paramagnetic state in a trapped optical lattice. In both cases we find that the temperatures are high enough to make direct quantitative comparison with experiments.

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