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Finite temperature properties of alkaline earth atoms in a lattice KADEN HAZZARD, JILA and Dept. of Physics, U. of Colorado-Boulder, VICTOR GURARIE, Dept. of Physics, U. of Colorado-Boulder, MICHAEL HERMELE, Dept. of Physics, U. of Colorado, Boulder, ANA MARIA REY, JILA, Dept. of Physics, and NIST, U. of Colorado, Boulder — We show that alkaline earth atoms, possessing a large spin degeneracy $N = 2I + 1$ up to $N = 10$, when loaded into optical lattice are capable of creating significantly colder Mott insulators as N increases. The recent experimental achievement of quantum degeneracy in alkaline earths opens a new vista of quantum many- body physics when these are loaded into optical lattices. These atoms possess an SU(N) symmetric interaction that can stabilize frequently exotic phases, such as antiferromagnets, valence bond solids, and spin liquids. A crucial challenge for alkalis has been reaching sufficiently cold temperatures to stabilize these phases. As a first result, we examine the temperatures achieved after standard adiabatic lattice loading protocols, for temperature in the Mott regime but above the temperature where spin physics is relevant. Our results can be stated in two illuminating ways: (1) For current initial gas temperatures, the temperatures after adiabatically loading alkaline earths with $N > 2$ can be much colder than for $N = 2$, even relative to the temperatures of interesting physics. (2) The "critical" entropy of the Mott insulator grows much more rapidly with N than does the initial gas entropy.

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