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Decoherence of fermions in optical lattices due to spontaneous emissions SAUBHIK SARKAR, STEPHAN LANGER, Department of Physics and Astronomy, University of Pittsburgh, Pittsburgh, Pennsylvania 15260, USA, JOHANNES SCHACHENMAYER, JILA, NIST, Department of Physics, University of Colorado, 440 UCB, Boulder, CO 80309, USA, ANDREW J. DALEY, Department of Physics and Astronomy, University of Pittsburgh, Pittsburgh, USA and Department of Physics, University of Strathclyde, Glasgow, Scotland — A major experimental challenge in reaching low-entropy states with ultra cold fermionic atoms in optical lattices arises from various heating and decoherence mechanisms. Here we study systems exhibiting quantum magnetism, investigating how these many-body states are affected by spontaneous emission processes at a rate that can be comparable to the typical dynamical timescales. We show, by deriving a many-body master equation for two spin fermions, that the spin order can be robust against this decoherence mechanism when we work in appropriate parameter regimes. This formalism can also be generalized to group-II species exhibiting SU(N) magnetism. The decoherence processes in these systems is measurable in current experiments. In addition to strongly repulsive regimes, we also look at attractive interactions, where decay rates of correlations can be enhanced by superradiance. We also consider processes involving higher bands, and dynamics of thermalization of the excitations created in the lattice after spontaneous emissions have occurred.

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