Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Measuring spin correlations in optical lattices K.G.L. PEDERSEN, B.M. ANDERSEN, Niels Bohr Institute, University of Copenhagen, Denmark, G.M. BRUUN, Department of Physics and Astronomy, Aarhus University, Denmark, O.F. SYLJUÅSEN, Department of Physics, University of Oslo, Norway, A.S. SØRENSEN, Niels Bohr Institute, University of Copenhagen, Denmark — The study of ultracold atoms in optical lattices has produced several groundbreaking results. A major, but presently unrealized goal, is to study quantum magnetism using atoms in optical lattices. We suggest three different experimental methods for probing both short- and long-range spin correlations of atoms in optical lattices. The first method involves an adiabatic doubling of the periodicity of the underlying lattice to probe neighboring singlet (triplet) correlations for fermions (bosons) by the occupation of the resulting vibrational ground state. The second method utilizes a time-dependent superlattice potential to generate spin-dependent transport by any number of prescribed lattice sites, and probes correlations by the resulting number of doubly occupied sites. The third method relies on the difference in tunneling times for the vibrational ground state and the first excited state. Correct timing then allows for the spin correlations to be fingerprinted. For experimentally relevant parameters, we demonstrate how all three methods yield large signatures of antiferromagnetic correlations of strongly repulsive fermionic atoms in a single shot of the experiment.

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Date submitted: 15 Dec 2011 Electronic form version 1.4