Abstract Submitted
for the DAMOP06 Meeting of
The American Physical Society

Coherent collisional spin-dynamics in an optical lattice ARTUR WIDERA, Physics Department, University of Mainz, 55099 Mainz, Germany, SIMON FÖLLING, FABRICE GERBIER, TORBEN MÜLLER, IMMANUEL BLOCH — Coherent control over the spin degree of freedom in ultracold atomic samples is an important ingredient for many applications in quantum information and solid state simulations. We show that the spin-dependent interaction between two ^{87}Rb atoms sharing one site of an optical lattice leads to a coherent evolution of the interacting spins. We measure several low- damped coherent oscillations between different spin-states, induced by these on-site interatomic collisions. For most of the cases that we have investigated, these spin-oscillations can be described by a Rabi-type model. Moreover, we are able to control these oscillations by external magnetic fields or by microwave fields using the AC-Zeeman effect analogue of the AC- Stark shift. In particular, we can tune the spin-oscillations into resonance yielding full transfer of spin-population or we can completely suppress them. This allows us to use them as a means of measuring the atom number squeezing as the system is brought from the superfluid into the Mott-insulator regime, similar to cavity QED experiments.

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Date submitted: 25 Jan 2006 Electronic form version 1.4