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Magnetic Order and Transport in Bose Gases with Spin

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Abstract:

I) We investigate spin-order of ultracold bosons in an optical lattice by means of Dynamical Mean-Field Theory. A rich phase diagram with anisotropic magnetic order is found, both in the ground state and at finite temperatures. Within the Mott insulator, a ferromagnetic to antiferromagnetic transition can be tuned using a spin-dependent optical lattice. In addition we find a supersolid phase where superfluidity coexists with antiferromagnetic spin order. We present detailed phase diagrams at finite temperature for the experimentally realized heteronuclear Rb-K mixture in a three-dimensional optical lattice.

II) We consider a neutral spinor condensate moving in a periodic magnetic field. The spatially varying magnetic field induces an effective spin-dependent Lorentz force which in turn gives rise to a spin-dependent Hall effect. Simulations of the Gross-Pitaevskii equation quantify the Hall effect. We discuss possible experimental realizations.