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Quantum magnetism with highly magnetic atoms

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We experimentally investigate many-body spin dynamics associated to the interaction of many spins coupled by dipole-dipole interactions. The experiment is performed using a Chromium Bose-Einstein condensate loaded into a 3D optical lattice. We excite the spin state of the each of the atoms uniformly across the lattice, and we study spin dynamics after this excitation procedure. Spin dynamics is primarily driven by inter-site dipole-dipole interactions. As each atom is coupled to many neighbors, the dynamics is intrinsically driven by many-body effects. We specifically study the conditions in which spin-spin quantum correlations may arise in the lattice, i.e. the conditions in which magnetism can be considered as quantum, in contrast to classical magnetism. I will present our latest experimental results as a function of the lattice depth, and as a function of how the spins are excited in the lattice.