# Entanglement of a quantum dipolar gas loaded in optical lattices

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**Abstract**

I will present experimental results obtained in our group with chromium atoms loaded in a 3D optical lattice, in the correlated insulator Mott state with one or two atoms per site [1]. Recent results in the Rice group have shown the possibility to study ground state quantum magnetic phases with cold atoms in lattices [2]. In our case, we have studied spin exchange dynamics in an out of equilibrium state [3], after atoms are prepared in the first excited Zeeman state.
We obtain an interesting many-body system for quantum simulation, which realizes a spin model used in condensed matter physics, but with true spin-spin interactions between atoms occupying different sites of the lattice. This is due to the long range character of the dipolar interactions between chromium atoms [4].

As correlations build up between the few thousands atoms loaded in the lattice, entanglement between many particles should emerge. We are currently trying to demonstrate entanglement using an entanglement witness adapted to our system, by measuring collective spin fluctuations during the spin exchange dynamics, as in [5]. These measurements, if successful, will answer to open questions, like the speed at which entanglement develops, or the nature of the (metastable) final state obtained. More generally, entanglement measurements are expected to reveal thermodynamics properties of magnetic quantum phases [6].

References

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