Dipolar atoms in a one-dimensional optical lattice

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The dipolar interaction between magnetic atoms in an ultracold quantum gas has recently allowed the discovery of new states of matter [1] [2] [3] [4] that emerge from their anisotropic and long-range nature. In these new states, the usually dominant mean-field interactions are small and the system is governed by the quantum fluctuations [5]. We here report on measurements of ultracold dipolar erbium atoms confined in a one-dimensional lattice. In the regime of small mean-field interactions, we observe that the dipole-dipole interactions play an important role in determining the number of occupied lattice sites. We additionally perform Bloch oscillation measurements varying the scattering length, from the contact dominated regime to the dipolar dominated one. We compare our findings with numerical calculations based on a discrete 1D variational theory, which shows good agreements. This study constitutes a first building block towards the exploration of the phase diagram of dipolar atoms trapped in a one-dimensional lattice.

References

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