
Controlled many-body physics with Rydberg atoms

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Abstract

The extremely strong interactions between Rydberg atoms offer exciting possibilities to explore novel quantum many-body systems. Especially when combined with fully controlled ultracold samples trapped in optical lattices, they provide a new platform for the experimental study of long-range interacting systems. Here we report on single atom resolved microscopic studies of such systems. Especially, we report on the controlled creation of magnetic crystals and the detection of entanglement in driven systems of up to 200 atoms that feature collective enhancement of the atom-light coupling. Finally, we present first experiments with off resonantly coupled (Rydberg-dressed) systems in the many-body regime.

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