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Experimental demonstration of Rydberg dressing in a many-body system JOHANNES ZEIHER, PETER SCHAUSS, SEBASTIAN HILD, ANTONIO RUBIO-ABADAL, JAE-YOON CHOI, Max-Planck-Institut für Quantenoptik (MPQ), 85748 Garching, Germany, RICK VAN BIJNEN, THOMAS POHL, Max-Planck-Institut für Physik komplexer Systeme, 01187 Dresden, Germany, IMMANUEL BLOCH, MPQ & LMU München, 80799 München, CHRISTIAN GROSS, Max-Planck-Institut für Quantenoptik, 85748 Garching, Germany — Rydberg atoms offer the possibility to study long range interacting systems of ultracold atoms due to their strong van der Waals interactions. Admixture of a Rydberg state to a ground state, known as Rydberg dressing, allows for increased experimental tunability of these interactions and promises to study novel phases of matter.
Here we report on our results of the realization of Rydberg dressing in a many-body spin system. Starting from a two-dimensional spin-polarized Mott insulator of an ultracold gas of rubidium-87, we optically couple one spin component to a Rydberg p-state on a single photon ultra-violet transition at 297 nm. Using microwave Ramsey interferometry in the ground state manifold, we measure the spin-spin correlations emerging due to the admixture of long range interactions to the ground state. To show the predicted versatility of Rydberg dressing, we tune the range and anisotropy of the interaction. We furthermore discuss loss processes affecting our dressed ensembles and present initial indications of improved lifetimes in our system. Our results constitute an important step towards the realization of novel spin models with Rydberg dressed interactions.

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