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Quantum gas microscopy of triangular-lattice Mott insulators

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Ultracold atoms in triangular optical lattices are a versatile platform to study strongly correlated systems in which exotic states of matter appear due to the interplay between charge and magnetic order. Large degeneracies in the many-body ground state of triangular lattices could result in a quantum spin liquid that has been numerically predicted to appear between the metallic and magnetically ordered phases [1]. Kinetic frustration leads to polarons in hole-doped regime even at elevated temperatures [2]. Here, we report on the observation of lithium-6 Mott insulators in a frustrated triangular Hubbard system. The Mott insulators are compared to Determinant Quantum Monte Carlo (DQMC) and Numerical Linked-Cluster Expansions (NLCE) calculations [3]. We observed temperatures of the system below the tunneling energy scale in the lattice, which are consistent with temperatures extracted from spin-spin correlations [4]. Finally, we demonstrate a doublon detection technique using a microwave transfer. We are planning to introduce nearest-neighbor interactions in the frustrated triangular system using Rydberg-dressing implementing an extended triangular Hubbard model which is predicted to host a variety of exotic quantum phases.
[1] Nature 464, 7286 (2010)
[2] Morera et al., arXiv2209.05398 (2022)
[3] Garwood et al., Phys. Rev. A 106, 013310 (2022)
[4] Mongkolkiattichai et al., arXiv2210.14895 (2022)

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