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Quantum state engineering of a Hubbard system with ultracold fermions[1] GEOFFREY JI, CHRISTIE CHIU, MUQING XU, ANTON MAZURENKO, DANIEL GREIF, MARKUS GREINER, Harvard University — Accessing new regimes in quantum simulation requires development of new techniques for quantum state preparation. We demonstrate quantum state engineering of a strongly-correlated many-body state of the two-component repulsive Fermi-Hubbard model on a square lattice. Our scheme makes use of an ultra-low entropy doublon band insulator created through entropy redistribution. After isolating the band insulator, we change the underlying potential to expand it into a half-filled system. The final many-body state realized shows strong antiferromagnetic correlations and a temperature below the exchange energy. We observe an increase in entropy, which we find is likely caused by many-body physics during the expansion process. Finally, we investigate possible means of improving the adiabaticity of the scheme. This technique is promising for low-temperature studies of cold-atom-based lattice models.

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