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Detecting correlations in deterministically prepared quantum states with single-atom imaging ANDREA BERGSCHNEIDER, VINCENT M. KLINKHAMER, JAN HENDRIK BECHER, PHILINE L. BOMMER, JUSTIN F. NIEDERMAYER, GERHARD ZUERN, PHILIPP M. PREISS, SELIM JOCHIM, Physikalisches Institut, Heidelberg University, Germany — We deterministically prepare quantum states consisting of few fermions in single and double-well potentials. Here we report on a new imaging scheme for ^{6}Lithium with which we detect the correlations of the quantum state on a single-atom level and with spin resolution. The detection method uses fluorescence imaging at high magnetic field where the optical transitions for the used hyperfine states are almost closed. With a high-resolution objective we image about 15 scattered photons per atom on an EMCCD camera. This is sufficient to identify and locate single atoms in our imaging plane. We can perform this scheme in situ or after an expansion in time-of-flight and additionally resolve the spin by subsequently adressing the different hyperfine states. By combining this scheme with our deterministic preparation, we measure the two-point momentum correlations to probe the spatial symmetry of the two-particle wavefunction. The high contrast and the scalability of the detection technique allows us to go beyond measuring two-point correlations and characterize many-body quantum states.

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