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Correlated tunneling dynamics of atom pairs in double well potentials SIMON FÖLLING, PATRICK CHEINET, STEFAN TROTZKY, ARTUR WIDERA, MICHAEL FELD, Johannes Gutenberg-Universitaet Mainz, TORBEN MÜLLER, ETH Zuerich, IMMANUEL BLOCH, Johannes Gutenberg-Universitaet Mainz — The interplay between atom-atom interaction and tunneling governs the dynamics of many strongly correlated systems of ultracold atoms. The most elementary realization of such a system is a set of two potential wells coupled via tunneling and occupied by two interacting atoms. By superimposing the periodic potentials of two standing light waves with a periodicity of 382.5nm and 765nm, respectively, we create a one-dimensional array of double well potentials for atoms with adjustable tunnel coupling and energy offset. Additional standing waves on the two orthogonal axes provide axial confinement, creating a three-dimensional array of up to 10^5 double wells occupied by one or two ^{87}Rb atoms each. Loading only one side of each double well before enabling the tunneling, we can directly observe the dynamics of single atoms as well as of atom pairs. Since the ratio of the tunneling matrix element J and the on-site repulsive interaction U between two atoms can be modified in a wide range, the crossover from a tunneling- to an interaction-dominated regime can be observed. Here, the independent motion of two atoms changes to a correlated tunnel process of the pairs.

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