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Strong correlations in quantum gases

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Atomic gases cooled to Nanokelvin temperatures are a new exciting tool to study a broad range of quantum phenomena. In particular, the outstanding degree of control which has been achieved over these quantum systems facilitates access to strongly correlated quantum many body physics. For example optical lattices have been created to mimic condensed matter systems. We perform a theoretical study of a fermionic gas with two hyperfine states confined to an optical lattice. We derive a generic state diagram as a function of interaction strength, particle number, and confining potential and discuss the connection to current experiments.