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Effective Hamiltonian for Strongly Interacting Atoms in Low Dimensions JASON KESTNER, LUMING DUAN, FOCUS Center and MCTP, Department of Physics, University of Michigan — For a dilute atomic gas in a strong transverse trapping potential, one normally expects that the transverse mode will be in the trap ground state. We show, however, that for the strongly interacting gas under a Feshbach resonance, the ground state of the system includes a large fraction of atoms in excited states of the trap, even if the gas is very dilute and the trap is very strong. This is due to an effect wherein trapping with a characteristic length a_t along the transverse dimension(s) induces a pairing of characteristic length a_t along the untrapped dimension(s). This typically enhances the coupling to many times the trap frequency and forces consideration of the conventionally neglected excited states of the trap when forming the effective Hamiltonian. Therefore, we introduce a dressed molecule state comprising a superposition of the bare molecule and the atomic Cooper pairs in excited trap states. Using an operator projection method, we derive the coupling between the dressed molecules and the unexcited atoms, which is a function of the physical detuning. We use this Hamiltonian to determine the confinement-induced shift of resonance in one and two dimensions and the resonance width.

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