Control of ultracold molecular gases by optical shielding.

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Abstract

In this work, we propose a theoretical model to reduce the experimentally measured losses of the ground-state molecules in ultracold molecular gases. The study involves the bosonic RbCs species which is, as well as other bi-alkali-metal molecules, a good candidate for various applications due to their strong permanent electric dipole moment in their absolute ground state. Such a property induces long-range interactions between molecules that could be engineered in a way to reduce those losses. The model relies on the optical shielding: the entrance attractive channel of two colliding molecules in their absolute ground state is coupled by light to a repulsive channel of one molecule in the absolute ground state interacting with a molecule in an electronically-excited state. This coupling is made by an optical photon with a frequency blue-detuned with respect to the transition between the lowest rovibrational level of the electronic ground state X1Sig+(v=0,j=0) and of the long-lived excited state b3Pi(v=0,j=1). Here, we present the adiabatic long-range potential energy curves of the tetramer (RbCs)_2 complex calculated by taking into account the dipole-dipole interaction which is coupled to the rotation of each of the two interacting dimers. By dressing the states with the photon energy to the system, we show the crossings that could be used to keep the two interacting molecules in their absolute ground state at large distances. Both linear and circular polarization of the applied laser could be used with higher chances of shielding in the case of circular polarization.

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