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Dynamics of Atoms and Heteronuclear Dimers Conversion in Bose-Einstein Condensate

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In the last two decades, experiments have been associated with the birth and study of the properties of cold diatomic homo - and heteronuclear molecules. Therefore, at the initial stage of research can be attributed to the study of coherent atomic-molecular (atomic-dimer) conversion $A + A \rightarrow A_2$ and $A + B \rightarrow AB$, where A and B – atoms and A_2 and AB – molecules (dimers).

The paper presents the results of a theoretical study of the dynamics of the photodissociation process (or photoassociation) of triatomic Bose-condensed ultracold ABC molecules with the formation of $AB + C$ or $A + BC$ atomic-molecular pairs under the action of two Raman pulses of resonant laser radiation. Here, the symbols A and C refer to atoms, AB and BC refer to diatomic molecules (dimers), and ABC refers to a heteromolecule (trimer) consisting of atoms A, B and C. The states of atoms and molecules are macro-filled.

Considering a special case when the densities of atoms and diatomic molecules in each reaction channel are the same, one can make a general conclusion that the system evolution in the in-phase mode is aperiodic and irreversible in time. In the process of evolution, all atoms and diatomic molecules are bound into triatomic molecules, which is how evolution completes. The antiphase case is characterized by periodic evolution of the conversion of Bose-condensed atoms and molecules.

In the case of considering the time evolution of the system in the approximation of given densities of diatomic molecules, it is possible to obtain an analytical solution for the density of atoms. For this case, the possibility of only a periodic mode of transformation of atoms and molecules into triatomic molecules and vice versa has been proved.

As for the antiphase evolution, the dynamics of the system is also periodic, the amplitude of fluctuations of the density of atoms of grade C over time, unlike the in-phase evolution, does not change at a fixed value of the normalized density of atoms of grade A.