

PECULIARITIES OF THE DYNAMICS OF THE ATOM-MOLECULAR CONVERSION STIMULATED BY GAUSS PULSES

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The study of the properties of cold and ultracold molecular gases at temperatures of a few micro- or nanokelvin is one of the most promising scientific directions in atomic and molecular physics and physical chemistry. Advances in controlling the interaction of ultracold atoms raise the question about the possibility of achieving such control for ultracold molecules as well. Therefore, further investigations of physical processes involving Bose condensed particles are of current interest both in theoretical and practical aspects. Below, we present the results of studying of stimulated Raman atom–molecular conversion under the action of two resonance laser pulses in a mixture of two different atoms with the formation of heteromolecules in the condensate.

Dynamics of the process of atom-molecular conversion is studied assisted by two ultra short with definite envelopes. This process, actually, is the process of optic Raman nutation in the conditions of atom-molecular conversion consisting in periodical changing of population of atoms and molecules assisted by two Raman pulses of coherent laser emission. Two free atoms from Bose – condensate transform into ground state of heteronuclear molecule through virtual excited molecular state absorbing and emitting light quantum. It was studied the evolution of the system in dependence on new variable $\tau(t)$, the pulse area which is introduced when the evolution of the system of two – level atoms is studied under the influence of electromagnetic wave field. The function $\tau(t)$ is the final one for short Raman pulses and is determined by the degree of overlapping of their envelopes.

We consider the case, when the field of the second pulse is given. A powerful ultrashort pulse with given envelope falls on the system, overlap of which is the initial function of time. It is proved that there is the periodic and aperiodic evolution of the system in dependence on parameters of the system and especially on the area of the second pulse. As this pulse has limited area above, then the variable τ can change from zero to maximal value τ_{\max} which equals to the full area of the pulse. Thus, if the density of the molecules oscillates in dependence on τ , these oscillators continue as τ changes from zero to τ_{\max} , and further the density of the molecules remains constant. As for the time evolution, after the initial step of periodical change, the density of the molecules stops changing and gets constant value which is determined by full area of the pulse. With the increasing of half-width of the pulse, the increasing of oscillation part of the system takes place, after that the density of the molecules goes to almost permanent value. In the case of small half-width of the pulse, only monotonous rise of the density of the molecules with the time takes place with approaching of the steady state. With the increase of τ_0 , the oscillations of the density of the molecules appear, the number of which increases with the rise of τ_0 . The amplitudes of these oscillations rise with the increasing of the initial concentrations of atoms (Fig. 1).

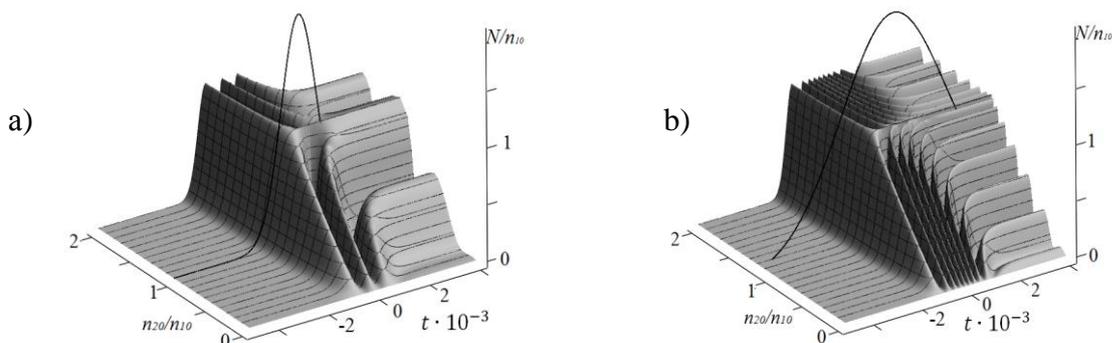


Figure 1. The normalized density of molecules on the time t and the normalized initial density of atoms in a) $\tau_0 = 1 \cdot 10^{-3}c$; b) $\tau_0 = 3 \cdot 10^{-3}c$.