DYNAMICS OF MOLECULES IN IR–LASER RADIATION

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There are many papers devoted to the theoretical and experimental study of molecules dynamics in powerful infrared laser radiation. In this work we present further theoretical results in this direction based on the multilevel systems as simple molecular models. The numerical methods are usually applied for the description of dynamics of considered system because of the large number of the energy levels. All analytically solvable examples are closely connected with some symmetry, which may be realized on the basis of the group-theoretical approach. In particular, the time dynamics is defined by the classical linear algebras SU(1,1); SU(2) and SU(3) in [1]. On the other hand, there is a method based on employment of integral transformation and orthogonal polynomials [2]. So, combining of these methods the aim of our work is formulated as to give the general classification of the quantum systems with the analytical description of dynamics and some examples.

For the multiphoton vibration excitation of molecules by powerful infrared laser radiation in the rotating-wave approximation the exact analytical solutions are presented in the following way. There are three important characteristics of given system: function of the transition dipole moments f_n; the energy spectrum $E_n = E_0 + n\omega_l + \Lambda(S_n - S_0)$; the detuning $\epsilon_n = S_n - S_0$ of the frequency of the transition $\omega_{n,n-1}$ from the field frequency ω_l. It is found that (1) in common case both the functions f_n and $\epsilon_n = S_n - S_0$ have five common parameters; (2) the function f_n is the forth order characteristic polynomial $P_4(x)$ of it's argument x. The latter depends on the considered graticule; (3) the function ϵ_n is the ratio of two polynomials of the second order $P_a(x')/P_b(x')$. The type of dynanics for the quantum systems is defined by the degree of characteristic polynomial $P_4(x)$. The physical consequences of the classification obtained are discussed.

[1] Datoli *G*, Di Lazzano *P* and Torre *A* 1987 *Phys. Rev.* **A35** 1582

[2] Makarov *A A* 1987 *Hyperfine Interactions.* **37** 49