Laser-electron spectroscopy: electron satellites spectra in intense laser field on nuclei in atom, ion, molecule

S.V. Malinovskaya[1], A.V. Glushkov[2]

[1] *NPO "Comput. Centre", a/c 116, Odessa-9, 65009, Ukraine*
[2] *Atom.-Mol.-Laser Spectr. Centre & IAM*
E-mail: glushkov@paco.net

The following new directions in a laser- electron-atomic (nuclear) spectroscopy are considered: the mixed Y-optical quantum transitions; use of this effect in nuclear-atomic-molecular studies with use of lasers; spectroscopy of Y resonances, creation of additional satellites and narrow resonances inside the Doppler contour of Y-line; governing by the intensity of the complicated Y-transitions due to the changing of the molecular excited states population under action of laser radiation [1-2]. Under emission or adsorption of the nuclear Y-quantum in atom (molecule) there is changing of the electron (vibration-rotation molecular) states. Probability of the vibration or rotation state changing (in difference from the atomic electron state changing) is not small and must be taken into account even in "0" approximation [1]. We present the consistent QED approach to calculation of the electron-nuclear Y transition spectra (set of vibration satellites in molecule) of nucleus in atom and molecule. The intensities of satellites are defined in the relativistic version of the energy approach (S-matrix formalism) [3]. Decay and excitation probability are linked with imaginary part of the 'atom-field' system. For radiate decays it's manifested as effect of retarding in interaction and self-action and calculated within QED perturbation theory. Calculation results of the electron-nuclear Y-transition spectra (set of electron satellites) of the nucleus in a multicharged atomic ion FeXIX are presented. It's predicted situation when electron satellites are not overlapped by the Doppler contour of the Y line (plasma source). For diatomic molecules, when parameter: $Z \gg 1$ ($Z \sim Rm/Mhw$, R- the Doppler effect frequency shift, w - vibration frequency, m, M -atomic masses) then insist if the soled lines of the Y-emission or absorption of the nuclei there has been arisen the set of the vibration-nuclear satellites at frequencies $E \pm R$ (E-nuclear transition energy), which may take all energy from main line. The vibration excitation with Y-emitted nuclei may compensate an emission (absorption) Y-line shift due to shaking effect. Some calculations results are presented [4].

[1] V.S. Letokhov, *Laser Spectroscopy* (N.-Y., 1977); *Phys. Lett. A* **46** 257 (1974).
[2] L.N. Ivanov, V.S. Letokhov, *Sov. JETP* **93** 396-405 (1987).
[3] A.V. Glushkov, L.N. Ivanov, *Phys. Lett.* **170** 33-38 (1992); *J. Phys. B* **26** L376-388 (1993).
[4] A.V. Glushkov, S.V. Malinovskaya, *J. Quant. Spectr. Rad. Transfer*, to be publ.