

## NEUTRON INELASTIC SCATTERING ON EXCITONS IN CRYSTALS AND DYNAMICAL GAMMA QUANTUM-NUCLEAR PROCESSES IN ATOMIC SYSTEMS

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In last years with appearance of the intensive neutron pencils, powerful laser sources especial interest attracts a group of problems, connected with excitation of molecules, semiconductors and solids by neutrons and photons. These problems are of a great interest for construction of new sensors. A consistent quantum-mechanical approach based on the S-matrix Gell-Mann and Low formalism [1-4] here is used for studying the inelastic scattering cross-section of neutrons on exciton in crystals of the LiH type. Cited cross-section is proportional to cross-section of neutrons scattering on nuclei and the force function of phonons on the polariton frequency. Twice differential cross-section of inelastic scattering of neutrons in crystal, provided by neutrons scattering on nuclei and taking pace with destroying one quasiparticle (phonon, exciton etc.) is received. It is natural the presence of multiplier, provided by scattering on nucleus, and one, describing the effect lattice. As concrete example it was carried out the estimate for inelastic scattering of the heated neutrons on crystal of LiH. For laser with emission energy  $\sim 100$  kJ during time  $10^{-4}$  a part of neutrons  $10^{-5}$  is inelastically scattered and obtain energy of  $\sim 0,1$  eV. Other new effects are discovered in the interaction between gamma quantum, electron shells and nuclei nucleons in atoms in the mediums (plasma, solid) [2,3]. Firstly speech is about new opened channels of photon-electron-nuclear processes. We developed new approach to calculation the electron satellites in spectra of the electron-nuclear gamma-transition of the nucleus in atoms and molecules. It is based on the S-matrix formalism and consistent QED formalism [1-3]. As example, the nuclear transition in the isotope  $^{57}\text{Fe}$  with energy 14,41 keV is considered for plasma of O-and F-like ions of Fe. It is shown that the electron-nuclear lines in spectra of emission or absorption can be experimentally observed in plasma of the O-and F-like multicharged ions. Such situation is realized in the thermalized plasma. It is supposed that the K shell is significantly destroyed. An average kinetic energy for ions in a such plasma:  $\sim E/10 \sim 1/20$  c.u. (coulomb units), where  $E_i$  is 1s electron bond energy. The Doppler shift is as follows:  $hw_D \sim aw/(10M)^{1/2}$ . The value  $aw$  is connected with the energy of gamma quantum by the relation:  $E[\text{keV}] \sim 4Z(aw)$ ; If, say,  $aw=1$ , then  $hw_D \sim 1/200(Z)^{1/2}$  c.u.  $\sim 0,15(Z)^{1/2}$  eV. For comparison let us give the values of 1-2 electron transitions for 1-electron ions with  $Z=10-50$ :  $E(1s-2p_{3/2})=1,3 \cdot 10^3 - 2,3 \cdot 10^4$  eV,  $E(2s-2p_{3/2}) \sim E(2s-2p_{3/2})=0,1-3,3 \cdot 10^2$  eV.

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