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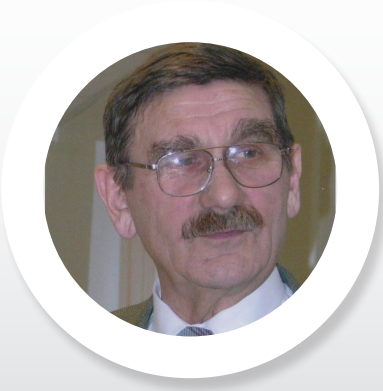
Experimental manifestation of the residual strong nuclear interaction via renormalization of the elementary excitations energy of solids



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When nuclear physics developed, two new short – ranged interactions joined to the well – known long – ranged interactions of the gravitational and electromagnetic forces. These are nuclear force, which acts between nucleons (protons, neutrons) and weak force which manifests itself in nuclear β – decay. The nuclear force is a result of the residual strong force binding quarks to form protons and neutrons. There is a common place in contemporary physics that the strong force does not act on leptons. Our experimental results show the violation of this strong conclusion. Until now macroscopic manifestation of the strong nuclear interaction are restricted to radioactivity and the release of nuclear energy. Our report is devoted to the description of the significantly new kind manifestation of the residual strong force. We have studied the low – temperature (2 K) optical spectra (luminescence, reflection and scattering of light) of the LiH and LiD crystals which differ by term of one neutron from each other. In dielectrics crystals an electron from valence band is excited into conduction band. The attractive Coulomb potential between the missing electron in valence band, which can be regarded as a positively hole, and electron in conduction band forms exciton which energy En =1s<Eg, where Eg is the energy of the band – to band transition. As demonstrated early most low – energy electron excitation in LiH (LiD) insulating crystals are large – radius excitons. In our experiment, we used samples with clean surface cleaving the crystals in the bath of helium cryostat with normal or superfluid helium.

Free exciton luminescence is observed when studied crystals are excited in the midst of fundamental absorption. The spectrum of free exciton luminescence of LiH (LiD) crystals cleaved in superfluid helium consists of narrow phononless emission line and its broader phonon replicas which arise due to radiative annihilation of excitons with the production of one to five LO phonons. At the adding one neutron (using LiD crystals instead LiH ones) is involved the increase exciton energy on 0.103eV. As far as the gravitation, electromagnetic and weak interaction are the same of both kind crystals it only changes the residual strong interaction therefore a doubtless conclusion is made that the renormalization of the energy of electromagnetic excitation (excitons, phonons) is carried out by the residual strong nuclear interaction. According to quantum chromo dynamics electric – like color

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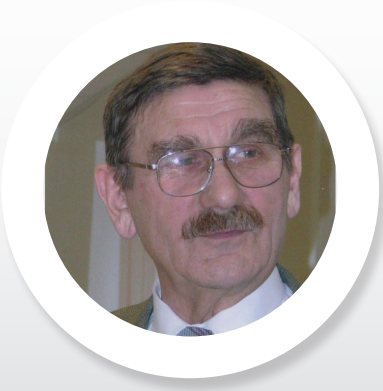
forces should be confined inside nucleons given that gluons have their emission and absorption in individual colored quarks. On the other hand, perhaps magnetic – like strong fields are by their very nature difficult to be contained within nucleons and may be could be acting, at least in principle, far beyond nucleon realm. Thus, the direct observation of residual strong nuclear interaction in the optical spectra of solids opens a new avenue in nuclear and elementary particles physics.



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Biography

Vladimir G Plekhanov was graduated Tartu State University in 1968, Ph. D. (Physics and Mathematics, 1972), Doctor of Science (Physics and Mathematics, 1982). Main interest fields: the origin of the mass (quantization of matter) as well as the experimental manifestation of the strong nuclear interaction in the spectroscopy of solids. He is author approximately 200 publications both in English and Russian. Main books:

1. Isotope Effects in Solid State Physics (Academic Press, San Diego, 2001).
2. Isotope - Based Quantum Information (Springer, Heidelberg, 2012).
3. Isotopes in Condensed Matter (Springer, Heidelberg, 2013).
4. Isotope Effect - Macroscopical Manifestation of the Strong Interaction (Lambert Academic Publishing, Deutschland, 2017).

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