On my acquaintance with the 2023 Nobel Prize laureate

On the fourth of October, 2023, I got a dispatch from Moscow by the journalist Natalya Demina, which said „Your colleague has became a Nobel Prize laureate“. At that time I already had known who was awarded the Nobel Prize in Physics (and for which achievements), so I wrote to Natalya that something wrong was here. But her letter contained an internet link (https://www.eduspb.com.node/3691), and by clicking it, I understood that Natalya was right - it was the prize in chemistry for the three people including Alexey Ivanovitch Yekimov, who was well-known to me. I even had no chance to look at the Yekimov's curriculum vitae, when the telephone rang and some TV correspondents started asking me about Yekimov and his work. I had already known that the prize was awarded for „quantum dots“ in glasses. I was not an expert in this field, so I conveyed the ringing persons to my academician colleague R.A. Suris contenting myself with my acquaintance with Yekimov and my satisfaction on the honor to him. It was a long time ago and I needed time to remember everything.

It began in 1974. At that time I was a member of the dissertation council of Ioffe Physico-Technical Institute and at some session a council chairman V.M. Tuchkevitch (who was the academician Institute Director) suggested that I should oppose the PhD thesis of the young employee Alexey Yekiomov on a new and then-popular subject of optical orientation of electrons and nucleuses in the semiconductors. (Personally, I was a specialist in optical orientation of atom vapors, so the subject was partially known to me). Yekimov pleased me in all respects. He perfectly understood the new and complicated topic and prepossessed me with his straightforwardness and open-heartedness when answering a quite trivial question of mine - why he then failed to observe dependencies of nuclei relaxation on concentration of impurities in samples. He was plain and honest in his answer, saying that he had only one sample, in which he had succeeded to observe this nuclei orientation!

The field of optical orientation of semiconductors had been exhausted quite soon and Yekimov passed from Ioffe Physico-Technical Institute to Vavilov State Optical Institute with the new topic related to investigation of coloring glasses with semiconductor compounds, where he was pioneering (as far as I understood) an idea of spatial quantization of excitons in nanocrystals.

I seldom saw Yekimov in Vavilov State Optical Institute (my place of work then), who was engaged by the branch Vavilov State Optical Institute dealing with technologies of optical materials (later that branch was renamed to be Research and Technology Institute of Optical Material Science) in the M.N. Tolstoy laboratory. But in 1980, I happened to ask Yekimov about important favor. At that time, me and V.S. Zapasskiy thought of carrying a fundamental „century experiment“, deciding to radically review an E.K. Zavoisky approach to radio spectroscopy of spin paramagnetics. The traditional approach included polarization of the paramagnetic with further excitation of paramagnetic resonance by means of the monochromatic microwave field. The resonance was accompanied with decrease in the polarization and appearance of collective variable transverse magnetization at a frequency of the applied microwave field. But we proposed to skip the polarization of the paramagnetic and impact of the resonance field. We considered that it was enough to investigate noises of the transverse magnetization of the paramagnetic, which had to contain the resonance increase in power. In principle, the frequency and width of this power resonance would have provided the same information as the traditional method of the paramagnetic resonance. Everything was reduced to development of an extremely sensitive method for analysis of a spectrum of the magnetization noises.

We stopped at technique of investigating the noises of Faraday rotation of the polarization plane of the light beam, which was directed across the magnetic field and tuned to the frequency near the optical line of the absorption of the paramagnetic. A modeling object selected by us was sodium vapors in the terrestrial magnetic field. But our experiment included a necessary element, which had to be a laser tuned near one of the yellow resonance lines of sodium. As they notified us, such a laser was available at Alexey Yekimov. It was a very expensive and very ideal tool manufactured by the American „Spectra-Physics“ company and it was miraculously obtained from our ministry through heroic efforts of Yekimov. No retunable solid-state laser was designed at that time, so it was the laser based on the solution of the Rhodamine 6G organic dye to be excited by green light of the high-power ion argon laser. The argon laser consumed approximately 20 kilowatts and required three-phase powering and abundant water supply to cool the quartz gas-discharge tube. Alexey Yekimov was very kind to provide us with all this bulky equipment together with a working place in a basement room of Vavilov State Optical Institute. We had only just started the work, and a failure occurred - the laser power supply unit burnt out so much that a hole appeared due to burning through a 5-mm-thick aluminum panel of the unit. We were in despair due to damaging an extremely expensive equipment not belonging to us and had no hope from the manufacturer because of secrecy of our Vavilov State Optical Institute. But „necessity is the mother of invention“ — so we managed to diagnose with our own efforts a breakdown in one of the high-voltage electrolytic condensers in a filter of the three-phase rectifier. At the same time,

one of the three power rectifier diodes burnt out. We managed to get the diode and condenser and the laser was revived. Then, in no less time than one week we coped with our task to be in euphoria of having a presentiment about imminent Noble Prize. In this state we banqueted in honor of our sponsors, i.e. Alexey Yekimov and his superior Mikhail Tolstoy. The banquet was opened with a seminar, which included our enthusiastic explanation of the content of our work and our confident statement that now the time had come to cancel historic injustice in relation to Zavoisky, who was obviously to be awarded the Nobel Prize for the discovery of the paramagnetic resonance. I well remember the last statement made by Yekimov. (He is 9 years younger than me, and it was essential in his age of 35 years. But it turned out that he was wiser than me). Here his approximate words „You would have to apply a lot of efforts in order to get appreciation of the work done by you from the science community".

Alexey Yekimov was right. Our work was not appreciated abroad, where we conveyed a triumph article through „the iron curtain". The article was accepted in Moscow's Journal of Experimental and Theoretical Physics, but with no response to it. It was in 1980, and we were just much ahead of our time. Our work was appreciated abroad in twenty years and substantially improved, and in 2021 we got Russian Federation National Award for it.

And in that banqueted seminar in 1980 Yekimov was humbly silent that in the same year he got critical evidence about the effects of spatial quantization of his nanocrystals in the glasses, thereby having obtained his USSR's Doctor of Science Degree in 1989 and Nobel Prize in 2023 as well, but in USA.

Congratulations!

E.B. Aleksandrov
October, 2023