Chair of Solid State Physics
Research Laboratory of Solid State Physics

The Chair of Solid State Physics of Yerevan State University was founded in 1956. The founder and first head of the chair was prof. Norayr Kocharyan. Later the chair was headed by prof. Petros Bezirgaryan (1960-1987), prof. Arshak Durgaryan (1987-1989), prof. Karapet Trouni (1989-1993), NAS RA academician, prof. Eduard Ghazaryan (1993-2000). From 2000 until now the head of the Chair of Solid State Physics is NAS RA corresponding member, prof. Albert Kirakosyan.

Solid state physics is a sphere of fundamental physics, which studies the structure and physical properties of solid states, and for explaining such properties develops theoretical and experimental methods.

The arsenal of experimental and theoretical researches of this field of fundamental physics is extremely rich. The sustainable development of the experimental techniques, namely, roentgenography, neutronography, electronography and thorough development of the electron, tunnel, modulated and moesbauryan spectroscopy, the study of magnetic, magnetic resonance, optical and other methods is one of the most important factors, which in recent decades has provided the incredible progress of solid state physics. Another important factor is the achievements of the solid state theory. The crystal “gives an opportunity” to the theorist-physicist of the sphere of solid state physics to apply all the models and methods of quantum physics and quantum field theory, i.e. perturbation theory, method of secondary quantization, Feynman’s diagrams techniques, Green's function method, Monte Carlo quantum simulation, the theory of groups and so on. Moreover, in solid state physics for studying different models the developed theoretical methods applied not only in the related spheres of physics, but also in economics and marketing. Nowadays, without a deep knowledge of the theories of solid state quantum and quantum field is hard to imagine a physicist’s achievements in such spheres of condensed matter physics as biophysics, modern photonics, laser physics and so on.

A wide range of physical properties of solid states, the possibility of their control, the limitless ways of practically receiving of solid-state compounds in different branches of science (chemistry, metallurgy, biology and medicine, etc.) represent wide opportunities for the application of solid state physics.

Solid state physics currently is the most comprehensive sphere of physics, which includes more than a quarter of researchers working in physics and the relevant part of scientific publications is devoted to it.

Solid state physics is one of the cornerstones on which a modern technological society is based. Actually, the whole army of engineers is working to use to the fullest the hard materials in the spheres of various devices, machine tools, as well as communication,

transport, computer technology for designing and making the necessary mechanical and electronic components.

Solid state physics is that sphere of knowledge where new fundamental discoveries directly find the practical applications. This sphere is the basis on which the technologies of new materials are formed as well as micro and nanostructured elements of solid-state electronics are made. The development of computing, telecommunication and cryptography technologies in the 21st century, is probably related to the recent acquisitions of fundamental physics of mesoscopic systems and the use of sub-micron technologies (electron lithography, molecular beam epitaxy, tunnel scanning microscopy, atomic force microscopy). The successes registered in these spheres can provide reliable and manageable production and various applications of mesoscopic objects in electronics.

Mesoscopic electronic systems as a whole in low temperatures manifest such quantum properties, as in the case of individual atoms and molecules. Its investigation and utilization paves the way for the data processing and transmission for the next step of miniaturization of electronic elements, bringing its sizes comparable to de Broglie's wavelength. All this suggests that the detailed knowledge of such systems (josephson smallest transitions, two-dimensional electronic layers, semiconductor quantum dots and wires, sub-micron systems consisting of superconductors and semiconductors) of quantum physics or in other words "Nanophysics" is needed. The successes of solid-state nanophysics in mesoscopic systems in the case of the control of the behavior of separate quasi-particles is conditioned by the above mentioned miniaturization of opto-electronic devices, leading these devices not only to dramatic improvements of applied characteristics but also to the enormous material and energy savings.

Nowadays, the new sphere of solid state nanophysics-the spintronics started its triumphal campaign, it is the science about the controlable change of quasi-particles spin in single-particle and multi-particle misoscopic systems. It can register unprecedented successes in the spheres of quantum computers, quantum information and quantum cryptography.

The Chair of Solid State Physics together with Research Laboratory is the academic centre for perspective researches and new technologies.

Today, in undergraduate and graduate studies of the Chair of Solid State Physics the following courses are thought: Crystalophysics, X-ray physics, Crystallography, Physics of metals, Introduction to semiconductor physics, Solid state quantum theory, Physics of magnetic phenomena, X-ray structural and spectroscopy analysis, Kinetic phenomena in solids, Physics of electronic nanostructures, Optical phenomena in solids, Physics of real crystals, Elementary excitations in condensed matter, Quantum theory of the magnetism, Fundamentals of solid-state electronics, X-ray defectoscopy of solids, Application of group theory in solid state physics, Material Science, Computer Methods in Condensed Matter Physics, Dynamic theory of X-ray scattering. These courses create sufficient basis for successfully implementing fundamental and applied researches in various spheres of solid state physics, including in the sphere of nanoelectronics and spintronics.

Theoretical and experimental studies of X-ray carried out in the Chair of Solid State Physics and Research Laboratory are mainly related to the interferometry, diffractometry and their related areas. It gives an opportunity to solve the problems of X-ray research in their entirety, that is, to make X-ray structural analysis, X-ray defectoscopy, X-ray spectroscopy, X-ray holography of various physical systems, as well as to implement medical and biological researches.

The studies carried out in the sphere of solid-state nanophysics are devoted to energy spectrums of quasi-particles in semiconductor nanostructures (quantum wells, wires, dots, rings, etc.) of various dimensions, as well as kinetic, optical and magnetic properties of those structures. Their control via various external factors (electric and magnetic fields, pressure, diffusion) is especially highlighted.

The aim of implemented researches in the sphere of low temperature physics and magnetic phenomena is to create a modern basis for the implementation of the researches in the sphere of superconductivity, as well as to develop other areas of low temperature physics in the Republic.

The existing comfortable working conditions in the Chair is greatly contributed to the level increase of educational process and students' scientific works and the wide integration of young specialists in scientific researches.

The teaching process and scientific researches in the Chair of Solid State Physics are carried out in close cooperation with research centres and universities of different countries (Japan, France, Russia, Germany, Canada, Belgium, Cyprus, Iran, Mexico, Chile, Colombia).

The Chair won a number of different scientific grants (INTAS, CRDF, ANSEF, NFSAT, etc.) from which operates about ten in 2013-2015. Six of these leaders are young scientists. Meanwhile, the young scientists of the Chair won the three financial youth programs of State Committee of Science in the Faculty of Physics. Three of 8 effective scientists (according to the State Committee of Science of 100 effective scientists of the Republic) of the faculty are working in the Chair of Solid State Physics and Research Laboratory.

The undergraduates, postgraduates and employees of the Chair actively participate in different international and armenian conferences.

Since then, the Chair of Solid State Physics prepared 120 candidates, 19 doctors of science, as well as published more than 1500 scientific articles, 15 monographs and manuals, received 50 copyright.

In the last five years postgraduate students and employees of the Chair have defended 10 candidate and 3 doctoral dissertations and have published over 270 scientific works, of which 90 in various international scientific journals having high impact indexes, e.g. Phys. Rev. A, Phys. Rev B, J. of Phys.: Condens Matter, Phys. Lett. A, Euro.Phys. J. B, Phys. E, etc.