

## AREAL: NEW RESEARCH DIRECTIONS

The realization of AREAL project at CANDLE SRI has basically changed the possibilities of experimental research in Armenia. The development of a new advanced accelerator gave the researchers the chance to study ultrafast processes. Recently, radiobiological experiments on AREAL were carried out by a research group headed by Prof. A. Osipov from Federal Medical Biophysical Center after A. I. Burnazyan (Moscow, RF). The obtained results will have not only scientific but also practical importance in cancer therapy. The experimental researches of scientific groups from Yerevan State University, National Polytechnic University of Armenia, Institute of Molecular Biology NAS RA and A. I. Alikhanyan National Laboratory (YerPhI) are actively being carried out.

“For the production of ultrashort 5 MeV electron beams at AREAL linac a high energy ultrafast laser is used”, head of AREAL project Dr. Bagrat Grigoryan says. “The advantage of laser driven photo-electrons’ generation is the production and control of ultrashort relativistic electron beams, the parameters of which by a few orders of magnitude exceed the ones accelerated in conventional accelerators. This is a principal issue, since it gives the possibility to study important ultrafast processes and techniques in physics, biology, chemistry, materials science, which are not possible on conventional accelerators. During project realization the latest achievements in laser and accelerator physics, vacuum technology, diagnostic and control systems, ultrashort pulse generation and synchronization were used. A valuable contribution to the project realization was made by our colleagues from DESY accelerating center and Swiss Paul Scherrer Institute. AREAL project main design study and implementation were realized by the scientists, engineers, MS and PhD students of our institute. More than 70 various accelerator components were designed and fabricated at CANDLE. Nowadays, AREAL accelerator is considered to be one of the advanced facilities for ultrafast process study with the use of ultrashort electron bunches. And the results of our users on a wide range of fields definitely inspire us. AREAL facility is being continuously upgraded, and soon new experimental possibilities will be available for our researchers”, Bagrat Grigoryan told.

For already two years, a number of experimental studies are being carried out by the scientific team headed by a leading researcher Prof. Hrant Yeritsyan from A. I. Alikhanyan National Science Laboratory (Yerevan Physics Institute). A research is carried out for sub-picosecond pulse duration electron beam effect study on the electro-physical properties of silicon and silicon-dielectric structures. These materials are the base of modern electronics, thus, the radiation influence on their properties is of both scientific and practical interest. As a result of radiation effect the location of atoms in silicon and the charge state of atoms of chemical impurities in silicon are changed, due to this the electro-physical, optical and other characteristics are modified. This helps to regulate the properties of the material under irradiation. The new opportunities can effectively be used in various spheres of practical activities.

“The researches that our group deals with are related to the field of solid state radiation physics”, Prof. H. Yeritsyan says. “This is the applied science, which is a result of nuclear and solid state physics intersection. The first results of our investigations can be applied when developing new types of electronic devices, particularly, precise electronics, specific equipments, etc. According to the obtained results a number of articles have been published in international scientific journals (Journal of Electronic Materials, Nuclear Instruments and Methods, Journal of Modern Physics), where the scientific data, obtained for the first time in the

world, and also the possibilities and advantages of the new method are presented. The study that our group works on at AREAL is conducted in the framework of State Committee of Science of RA project. I do not know whether we will manage to receive another grant to go on with these studies, but the participants of our group are sure that CANDLE Institute will provide us with all the necessary opportunities for future researches”, H. Yeritsyan said.

The publications provoked a wide resonance in scientific community and showed the advantages of ultrashort pulse usage. Several scientific groups from Tbilisi State University, Institute of Microelectronics of the Russian Academy of Sciences, Institute for Physical Researches (Academy of Sciences of Ukraine) expressed a wish to participate in the experiments being carried out at AREAL. Particularly interesting will be the creation of nanostructured clusters by local irradiation of crystals. It is promising that young researchers also take part in the experiments, and the new direction may become a perspective theme for PhD dissertations.

Ultrafast solid state radiation physics is actually a new scientific field, which originated on AREAL accelerator. It is starting to develop and the practical applications of the results obtained by ultrafast irradiation are still hard to be predicted. However, the primary published results are claimed by the scientific community, and today we already have enough reasons to suppose that AREAL accelerator will open new and unexpected areas of practical application.