HISTORY

Experimental Physics Division (EPD) at AANL (Yerevan Physics Institute) has had a long lasting tradition of experimental research in a wide range of topics since the operation of Yerevan electron synchrotron (ARUS) with energy of up to 6 GeV in 1967.

Despite a large volume of research carried out or planned in the USA (Cambridge – 5 GeV, Cornel – 9 GeV, SLAC – 20 GeV), in Germany (DESY – 6 GeV), and England (NINA – 4 GeV) at that time, physicists of YerPhI succeeded in receiving a number of important results which promoted the understanding of hadron and nuclei structure and fundamental properties of elementary particles interaction.

During 1970-1991 the Yerevan synchrotron operated productively and many scientific results have been obtained in the energies range up to 4,5 GeV, including: the measurement of the proton and neutron electromagnetic radii, the study of hadronic properties of photons in reaction of π- meson photoproduction on nuclei, structures of nucleon resonances in multi-polarization experiments, structure and characteristics of a nuclear matter, study of properties of X-ray transition radiation and radiation of relativistic electrons at channeling in monocrystals, etc.

In 1980 academician H.Vartapetian (Deputy Director of YerPhI in 1974-1993) with a group of his colleagues was awarded the State Prize of the Armenian Soviet Socialistic Republic for an outstanding contribution and remarkable scientific results obtained at YerPhI's synchrotron.

The YerPhI experimental physics program included the following research directions and the study of:

- properties and structures of baryons (nucleons and nucleon resonances)
- few nucleon systems properties
- excited nuclear systems properties
- nuclear matter in short distance
- electron interaction with crystals
- methodical studies

Since 1991, when the accelerator was stopped because of an energy crisis in Armenia, only short-term experiments have been periodically performed.

The reputation of the Institute as the nuclear physics and accelerator center during the most difficult years of 1991-1996 lets us preserve and develop international collaborations with scientific centers of the USA, Germany, Switzerland and others, fully participating in the experimental research program in these centers.

Brief summary of scientific results for the period of 1970-1991

The main achievements of the YerPhI in high energy experimental particle and nuclear physics obtained by EPD scientists on Yerevan synchrotron for the period of 1970-1991:

The phenomenon and properties of X-ray transition radiation, which was predicted in theory at YerPhI, were systematically studied. These results are well known and used worldwide for ultrarelativistic particle detection [1, 2].

The electromagnetic radius of proton and deuteron were measured using the 4.5 GeV electron elastic scattering that showed proper coincidence with the most precise measurements and supplemented world data bases [3, 18].

From the measurements of single π-meson photoproduction on nuclei in the wide energy range it was shown that the simplest version of vector dominance model (VMD) is unable to describe the hadronic properties of photons [4].

To check the quark structure of η – meson the total cross section of η – meson – nucleon interaction was determined from the measurements of incoherent η – photoproduction on nuclei [5].

A quasi-monochromatic photon beams with 0.5-2.0 GeV peak energy and the record degree of polarization were obtained at YerPhI. This fact provided the priority of the YerPhI in the research of spin correlations in photoproduction on nucleons and nuclei [7].

In the π– and η–meson photoproduction on nucleon the structure of nucleon resonances in multipolarized experiments (beam, target and recoil nucleon polarization) was investigated. These data together with the other results allowed to determine the electromagnetic constants of nucleon resonances and to check the predictions of quark models [6, 8, 13, 20, 23, 24, 32, 37, 43, 48, 51, 58].

The nucleon properties in nuclei was studied in the inclusive (e,e') and exclusive (e,e'p) scattering measurements [10, 11, 14, 15, 17, 22, 25-29, 31, 33, 35, 36, 40, 41, 47, 49, 50, 53, 57].

The structure of deuteron and quasideuteron was studied in polarization and multipolarization experiments of photodesintegration [38, 39, 44, 46, 50, 54-57].

In the studies of high energy (up to about hundreds MeV) photo- and electro-excitation of nuclei (with further fragmentation) a possible production of very heated clusters as a radiation sources of the nuclear fragments was demonstrated [12, 21, 34, 42].

The new intensive radiation of relativistic electrons was observed at channeling regime in the monocrystals, which can be useful for fundamental and applied research. Another new type of extremely monochromatic ($\delta\omega/\omega \approx 10^{-3}$) radiation– the so-called parametric X-radiation (PXR) - was obtained and studied in various conditions [19, 45].

Various modifications of scintillator, gaseous, porous and other type detectors were developed and used in the experiments on photo- and electro-production [9, 16, 47].

As an achievement we can mention the experiment, performed in our underground laboratory together with ITEP (Moscow), in which the first observation of two-neutrino double beta decay of ^{76}Ge was made, and the most stringent limit (for that time) on half-life of neutrinoless double beta-decay in this germanium isotope was set. It allowed us to estimate the lowest upper limit for Majorana mass of neutrino [62].