The scientific program"Physics with η mesons", getting in the Russian State Scientific-Technical Program "Fundamental Nuclear Physics" and including a wide spectrum of experiments on the study of η production and η interaction with nucleons and nuclei, is under way at the Meson Physics Laboratory since 1992. Experiments are carried out at the pion channel of the PNPI synchrocyclotron, which is very suitable by its characteristics (pion energy up to 640 MeV, pion flux up to $(2–5)\cdot 10^5$ 1/s) for studying processes of η production on nucleons and nuclei in the near-threshold region.

In particular, yields of the reaction $\pi^- p \to \eta n$ were measured at 12 energies from the threshold (560 MeV) to 585 MeV. Measurements were made by detecting neutrons (and determining their time of flight) for 9 different values of neutron emission angles at the lab. frame. Measured energy dependences of yields were compared with calculated curves obtained using a Monte Carlo simulation; while calculating, the value of η-mass $M_\eta = 547.3$ MeV/c^2 given in the last version of Particle Data Group Listings was used. The results of calculations agree well with the experimental data for all 9 neutron angles that confirms correctness of the above value of M_η.

The above mentioned experiment was carried out in collaboration with USA physicists from the University of California at Los Angeles (The Head of group – Prof. B.M.K.Nefkens) and Abilene Christian University (the Head of group – Prof. M.E.Sadler).

In the framework of the program "Physics with η-mesons", at the pion channel of the AGS accelerator of Brookhaven National Laboratory a new test of charge symmetry in η production on deuterium was done. The ratio of the differential cross sections of the charge-symmetric reactions $\pi^+ d \to pp\eta$ and $\pi^- d \to nn\eta$ were measured in the energy region of the η threshold. Obtained results is $R = d\sigma(\pi^+ d \to pp\eta)/d\sigma(\pi^- d \to nn\eta) = 0.938 \pm 0.009$. The deviation of R from unity is an indication of charged symmetry breaking, which is mostly due to π^0–η mixing. A theoretical model which includes π^0–η mixing was used to fit the data and yields a mixing angle of $(1.5^\circ \pm 0.4^\circ)$.