At PNPI, the differential cross sections (DCS) π^-p and π^+p elastic scattering were measured with a high accuracy at twelve energies of incident pions in the range from 300 to 640 MeV. More than three hundreds of new values of DCS were obtained with a typical statistical error of 2–5% and a systematic uncertainty about 2.5%. The experiment was carried out on a liquid hydrogen target and a multi-channel hodoscopic setup consisting of 40 scintillation counters.

Besides experiments on studying πp scattering, an investigation of the process $\pi^+d \to pp$ and a test of charge symmetry in π^+d and π^-d elastic scattering at the energy $T_\pi = 417$ MeV were performed at the PNPI pion channel.

At the next stage, the polarization parameter P was measured at seven energies for π^-p and π^+p elastic scattering. The experiment was done with a polarized proton target, several arrays of magnetostrictive spark chambers (four chambers in each array) were used to reconstruct trajectories of the scattered pions and recoil protons. The precise reconstruction of kinematics of πp scattering allowed to select the elastic scattering events from the background. A typical value of statistical errors was at a level of $\Delta P \approx \pm 0.1$.

A key experiment in all experimental program of studying $\pi^\pm p$ elastic scattering is a measurement of the spin rotation parameter A and R since only such measurement permits to remove discrete ambiguities arising in the course of phase shift analysis. This experiment requires development of a special type of polarized proton target with a polarization vector lying in the horizontal plane. Such target was designed and manufactured by the Laboratory of Meson Physics together with the Laboratory of Polarization Effects. A container filled with the target material is placed into magnetic field of 2.5 T created by a Helmholtz pair of superconducting coils.The polarization is pumped by the dynamic nuclear orientation method up the value of 70–80% at the temperature of about 0.5 K. Scattering of the incident pions on such a target results in the recoil protons polarization which value P_f is connected with the parameters A and R. Experimentally the P_f value is determined by measuring the asymmetry of the secondary scattering of the recoil protons by nuclei of a substance (usually carbon) with the known analyzing power. To perform such measurements, a multi-plate carbon polarimeter was built at the Laboratory of Meson Physics. It consists of optical spark chambers with graphite electrodes. A special automatic television system was designed and created at the Laboratory for performing filmless read-out from these optical spark chambers. The polarimeter with the TV system provided the accuracy of 0.8° in measuring the secondary scattering angle and of 8 MeV in determining the kinetic energy of the recoil protons in the second vertex. Measurements of the spin rotation parameters A and R were performed for π^-p elastic scattering at four energies in the range from 450 to 600 MeV The use of obtained data in the new phase shift analysis PNPI-94 allowed to find a unique solution in the energy range up to 600 MeV.