MEASUREMENTS OF DIFFERENTIAL CROSS SECTIONS FOR BINARY $\pi^- p$ REACTIONS WITH BOTH NEUTRAL PARTICLES IN FINAL STATE IN REGION OF $P_{11}(1440)$ AND S_{11} (1535) RESONANCES

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The general program of studying binary $\pi^- p$ reactions with both neutral particles in the final state is now in progress at LNPI. This program includes measurements of differential cross section and the polarization parameter P for the reactions $\pi^- p \to \pi^0 n$, $\pi^- p \to \gamma n$ in the energy range from 400 to 650 *MeV* and also for the near-threshold η production $\pi^- p \to \eta n$. The experiments are being performed by the collaboration LNPI-UCLA-ACU.

The main goal of these investigations is to remove ambiguities yet existing in partial wave analyses (PWA) and to solve finally the problem of possible charge dependence of partial wave amplitudes.

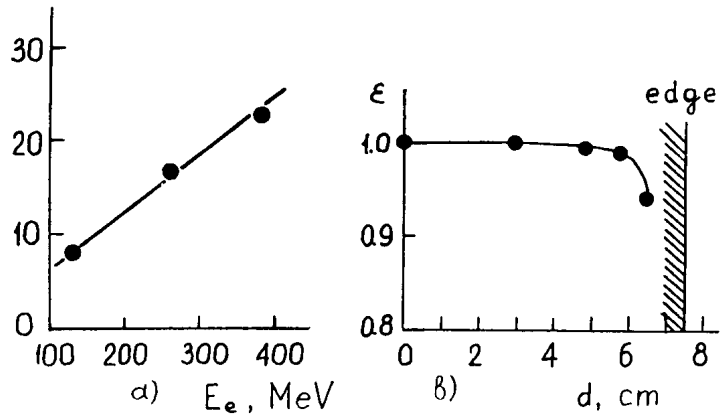

Fig.1. Characteristics of gamma detectors:
a — amplitude in maximum of spectrum (the number of channels) as a function of electron energy; b — efficiency vs position of 2 cm diameter electron beam relative to centre of lead-glass block

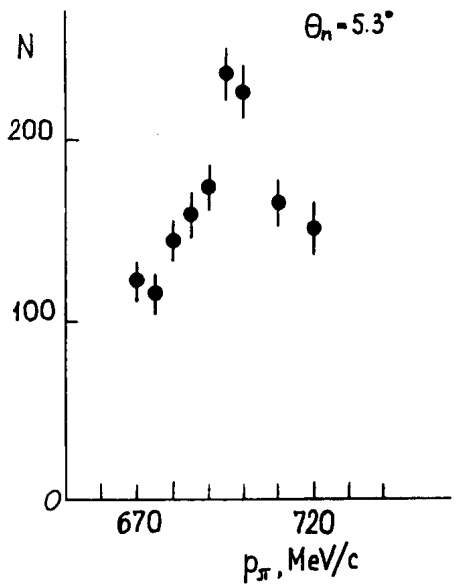

Fig.2. Momentum dependence of neutron yield from reaction $\pi^- p \to \eta n$

The first stage of the program is a measurement of the $\pi^- p$ charge exchange differential cross sections near η production threshold (p_π = 686.9 *MeV/c*). The opening of a new reaction channel $\pi^- p \to \eta n$ should manifest itself as a cusp in the $\pi^- p \to \pi^0 n$ cross section as a function of incident momentum. A detailed study of the momentum dependence of the cusp for different angles can, in principle, lead to a complete determination of the non-spin-flip πN scattering amplitude at the energy corresponding to the η production

threshold. Comparing the amplitude obtained in such a manner with the one given by a PWA one is able at last to check validity of theoretical constrains used in PWAs.

Since a rather high momentum resolution is needed for the cusp measurement, a hodoscope of narrow scintillation counters has to be placed behind the first bending magnet of a pion channel; this hodoscope serves to divide a total momentum acceptance of the pion channel into eight momentum bins with $\Delta p/p \approx 0.7\%$.

The main parts of the detecting apparatus are six neutron counters and six gamma detectors. The neutron counters were designed, constructed and calibrated by the scientists of UCLA [1,2]; each counter consists of three contiguous scintillation blocks totalling $26.7 \times 25.4 \times 25.4\ cm^3$ viewed by six photomultiplier tubes. For detecting gamma rays from π^0 decay lead-glass cherenkov counters are used. Each gamma detector consists of two optically isolated lead-glass blocks each having size $15 \times 15 \times 30\ cm^3$. The thickness of lead-glass provides practically total absorption of the electromagnetic shower up to 300 *MeV*.

In July 1991 equipment was installed and tested on beams of the LNPI synchrocyclotron. Characteristics of the lead-glass gamma detectors were studied using electron beams with energy from 150 to 400 *MeV*. The neutron counters were tested using a ^{60}Co radioactive source and neutrons from the reaction $\pi^- p \to \eta n$. Preliminary experimental estimations of the neutron yields in this reaction in the near-threshold region were obtained for the neutron angles from 1° to 7°; the momentum acceptance of the pion channel was $\Delta p/p \approx 0.7\%$.

In 1992 we plan to perform the measurements of differential cross sections for the near-threshold η production and to start the experiment for studying cusp effects in the $\pi^- p$ charge exchange reaction.

References

1. Wightman J.A. et al. //Nucl.Instr.Meth., A275. 1989. 281.
2. Kessler R.S. et al. //Nucl.Instr. Meth., A275. 1989. 285.