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MEASUREMENT OF THE ASYMMETRY OF THE
REACTION $\gamma p \rightarrow p\pi^0$ CROSS SECTION FOR
PION PRODUCTION ANGLES IN C.M.S.
 $65^\circ-80^\circ$ IN THE RESONANCE ENERGY RANGE

ԵՐԵՎԱՆ 1983 ԵՐԵՎԱՆ

In the present paper the results of cross section asymmetry of measurement for the reaction of pion production on protons at $E_\gamma (0,7 - 1,3)$ GeV of γ - quanta at the π^0 meson production angles in the c.m.s. $\theta_{\pi^0}^* = 65^\circ - 80^\circ$ are presented [1,2,3]. The investigation of the dependence of the asymmetry Σ on E_γ and $\theta_{\pi^0}^*$ in the $\theta_{\pi^0}^* = 40^\circ - 60^\circ$ range of angles has been carried out earlier [4,5].

The measurements were carried out on the linearly polarized beam of γ - quanta of the Yerevan Synchrotron, obtained by means of coherent bremsstrahlung of 4.6 GeV electrons on a diamond crystal. The required direction of γ - quanta beam polarization vector was achieved by appropriate orientation of the planes /022/ and /0 $\bar{2}2$ / of the crystal [6]. In the process of measuring the shape of bremsstrahlung spectra and the position of polarized γ - quanta peak was regularly controlled by a pair γ - spectrometer. A theoretical spectrum was fitted to the measured spectrum by introducing such free parameters as the angular spread in the electron beam and photon beam collimation. After that the γ - quanta polarization versus their energy was calculated for these parameters [7]. In Fig. 1 a typical bremsstrahlung spectrum with a calculated polarization curve is presented. The experimental setup by means of which the present measurements were carried out [8] is schematically shown in Fig.2. The identification of the reaction

$\gamma p \rightarrow p \pi^0$ was carried out by the detection of recoil protons in coincidence with a photon from π^0 -meson decay. Separation of protons from accompanying π^\pm -meson was carried out by means of two (dE/dx) - counters. The energy of protons was

determined by a range spectrometer, for which the Monte Carlo calculation of energy spectra of protons stopping in the spectrometer counters was carried out elsewhere [9]. The energy resolution of the spectrometer was from ± 3 MeV to ± 4 MeV depending on the proton energy. The outlet angles of protons were found by means of four two-coordinate multiwire proportional chambers with an accuracy of ± 3 mrad. The detection of photons from the π^0 - meson decay was made by means of $\text{NaJ}(\text{Te})$ total absorption counter [10]. Under the kinematical conditions of the experiment the setup allowed to determine the energy of γ - quanta with an accuracy from ± 12 MeV to ± 22 MeV and the pion production angle in c.m.s. with an accuracy from ± 2.8 to ± 3.0 degree as a function of the angle $\theta_{\pi^0}^*$. The experimental setup worked on-line with the computers Electronica-60 and EC-1022. For the estimation of background reactions the measurements were carried out at various angles of the γ Spectrometer with respect to the correct kinematics of the reaction $\gamma p \rightarrow p \pi^0$ and measurement results were compared with the Monte Carlo calculations with the contribution of background reactions being not more than 7%.

The results of the measurement of the energy dependence of the cross section asymmetry for the angles $\theta_{\pi^0}^* = 80^\circ$ (3a), 70° (3b), 65° (3c) are presented in Fig.3 as well as in table. The given errors of $\sigma(\Sigma)$ include both statistical errors of asymmetry measurement and errors due to the determination of γ quanta efficient polarization. The data are compared with results of theoretical analyses Feller et al [11], Metcalf et al. [12], Aznaurian et al [13] as well as the experimental data de-

tained by Knies et al [14] for the angle $\theta_{\pi^0}^* = 70^\circ$. The measured energy dependences of cross-section asymmetry better agree with the data from ref. [13] based on the use of dispersion relations at fixed t for the angle $\theta_{\pi^0}^* = 70^\circ$.

The angular dependence of the cross-section asymmetry for three values of γ - quanta energies $\bar{E}_\gamma = 0.8; 1.0; 1.2$ GeV is presented in Fig.4a,4b,4c respectively along with the results of the experimental works [4,5,14,15,16,17] and theoretical analyses [11,12,13]. It follows from the comparison that in the whole considered range of γ - quanta energy only the phenomenological analysis by Feller et al. [11] adequately describe the experimental angular dependence of the cross-section asymmetry.

Table

80°		70°		65°	
\bar{E}_γ	$\Sigma = \delta(\bar{z})$	\bar{E}_γ	$\Sigma = \delta(\bar{z})$	\bar{E}_γ	$\Sigma = \delta(\bar{z})$
726	0,65±0,08	752	0,79±0,09	810	0,16±0,1
754	0,54±0,0055	790	0,71±0,05	854	0,365±0,05
782	0,58±0,045	828	0,68±0,04	898	0,315±0,04
810	0,54±0,04	866	0,54±0,04	942	0,315±0,03
838	0,41±0,05	904	0,48±0,04	986	0,44±0,03
866	0,37±0,065	942	0,42±0,05	1030	0,52±0,03
884	0,44±0,07	996	0,47±0,06	1074	0,55±0,04
908	0,43 0,05	1030	0,47±0,04	1118	0,585±0,06
932	0,40±0,035	1064	0,52±0,03	1162	0,465±0,12
956	0,32±0,03	1098	0,54±0,03	1220	0,28±0,065
980	0,265±0,03	1132	0,50±0,03	1260	0,265±0,07
1004	0,25±0,03	1166	0,64±0,04	1300	0,38±0,075
1028	0,31±0,03	1200	0,55±0,05	1340	0,35±0,097
1052	0,33±0,04	1234	0,69±0,08	1380	0,21±0,12
1076	0,39±0,65	1268	0,72±0,12		
1100	0,25±0,085				
1124	0,375±0,13				

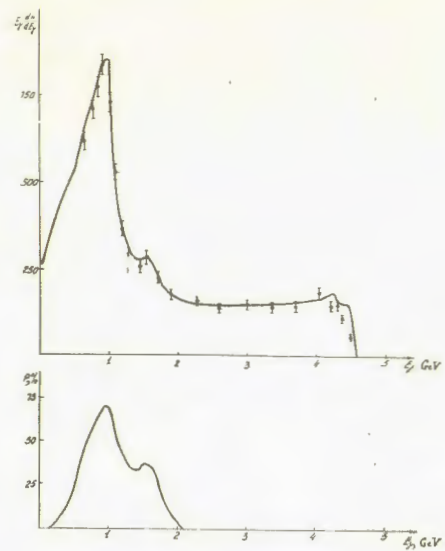


Fig.1

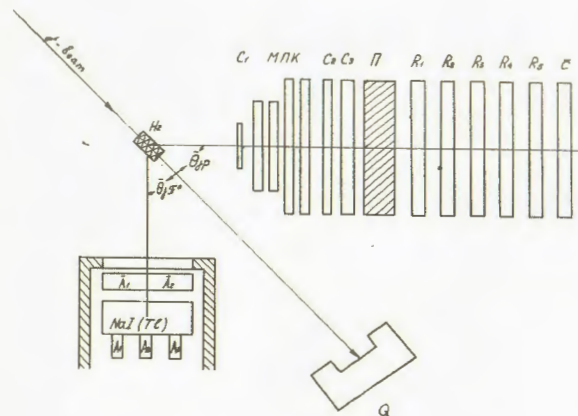


Fig.2

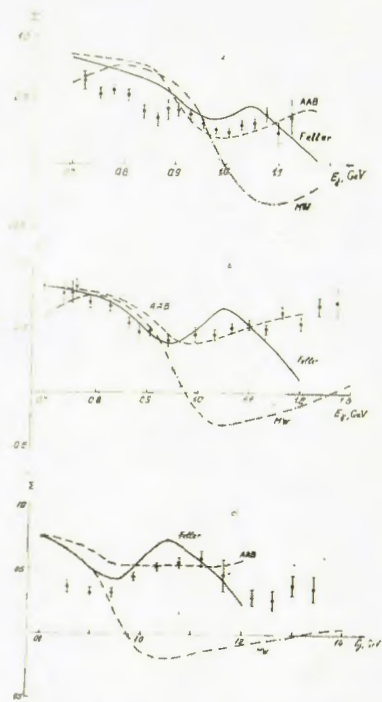


Fig. 3

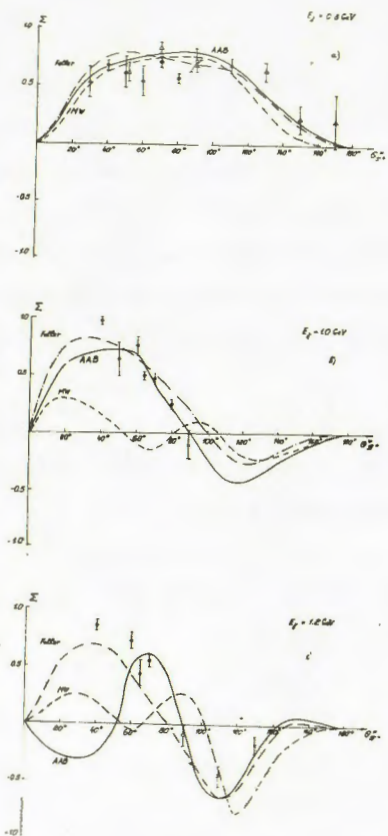


Fig. 4

Figure Captions

Fig.1 Bremsstrahlung spectrum of γ - quanta with a calculated polarization curve.

Fig.2 Diagram of experimental setup: H_2 - liquid hydrogen target, C_1 - aperture counter, MPC-multiwire proportional chambers, C_2 -and C_3 - (dE/dx)-counters, Π -copper absorber, R_1 - R_5 - counters of range spectrometer, \bar{C}, \bar{A}_1 and \bar{A}_2 -veto counters, A_1 - A_3 -photoelectron multipliers of the total absorption detector.

Fig.3 Energy dependence of the reaction $\gamma p \rightarrow p \pi^0$ cross-section asymmetry: a) $\bar{\theta}_{\pi^0}^* = 80^\circ$ b) $\bar{\theta}_{\pi^0}^* = 70^\circ$ c) $\bar{\theta}_{\pi^0}^* = 65^\circ$ ● - the present experiment, x-data ref. [14], solid curve-ref [11], dashed line-ref. [13], dashed-dot line-ref [12]

Fig.4 Angular dependence of the reaction $\gamma p \rightarrow p \pi^0$ cross-section asymmetry: a) $\bar{E}_\gamma = 0.8$ GeV, b) $\bar{E}_\gamma = 1.0$ GeV, c) $\bar{E}_\gamma = 1.2$ GeV. ● - our data, o-data from ref. [17], x-ref. [15, 16], ref. [4], solid curve-ref. [13], dashed-dot line-ref. [11], dashed line-ref. [12]

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ИЗМЕРЕНИЕ АСИММЕТРИИ СЕЧЕНИЯ РЕАКЦИИ $\chi p \rightarrow p \pi^0$ ДЛЯ
УГЛОВ РОЖДЕНИЯ ПИОНА В СИМ $65^\circ - 80^\circ$ В РЕЗОНАНСНОЙ
ОБЛАСТИ ЭНЕРГИИ

(на английском языке, перевод Л.Н.Багдасаряна)

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