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ЦЕНТРАЛЬНЫЙ НАУЧНО-ИССЛЕДОВАТЕЛЬСКИЙ ИНСТИТУТ
ИНФОРМАЦИИ И ТЕХНИКО-ЭКОНОМИЧЕСКИХ ИССЛЕДОВАНИЙ

ПО АТОМНОЙ НАУКЕ И ТЕХНИКЕ

ЕРЕВАНСКИЙ ФИЗИЧЕСКИЙ ИНСТИТУТ

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CROSS SECTION ASYMMETRY OF THE $\gamma n \rightarrow \pi^- p$

REACTION BY POLARIZED PHOTONS IN THE THIRD

AND FOURTH RESONANCE REGIONS

ЕРЕВАН-1984

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The polarized beam asymmetry Σ for the $\gamma n \rightarrow \pi^- p$ reaction was measured in the energy range 0.85 + 1.7 GeV at π^- -meson c.m. angles between 45° and 90° . The preliminary results are compared with existing phenomenological analysis predictions.

Yerevan Physics Institute

Yerevan 1984

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АСИММЕТРИЯ СЕЧЕНИЯ РЕАКЦИИ $\gamma n \rightarrow \pi^- p$ ЛИНЕЙНО-
ПОЛЯРИЗОВАННЫМИ ФОТОНАМИ В ОБЛАСТИ ЭНЕРГИИ ТРЕТЬЕГО И
ЧЕТВЕРТОГО (πN) - РЕЗОНАНСОВ

реф { Проведены измерения асимметрии сечения $\langle \Sigma \rangle$ реакции $\gamma n \rightarrow \pi^- p$
в области энергии $E_\gamma = 0,85 - 1,7$ ГэВ и углов в СЦМ $\theta_{\pi}^* =$
 $= 45 - 90^\circ$. Предварительные результаты измерений сравниваются с
предсказаниями феноменологических анализов.

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The investigations of isotopic structure of baryon resonances in the photoproduction processes $\gamma n \rightarrow \pi^- p$ are based on a determination of baryon radiative widths through an amplitude analysis and require experimental data from the proton and neutron targets. Because of the scarcity of neutron data, especially on the polarization parameters, the photon-nucleon couplings (χ_N) for a neutron target are still ambiguous, while (χ_P) couplings have been well established.

In this paper, we present the preliminary results of the cross-section asymmetry measurements for $\gamma n \rightarrow \pi^- p$ reaction in the third and fourth resonance regions from 0.85 to 1.7 GeV at pion c.m. angles 45° , 60° , 75° and 90° .

The experiment was performed on the linearly polarized photon beam of the Yerevan synchrotron [1], using a double-arm spectrometer and liquid deuterium target (Fig.1). The π^- -mesons were detected by magnetic spectrometer with momentum resolution $\delta p/p \approx 2.5\%$, geometrical acceptance $\Delta\Omega_{\pi^-} = 3.5$ msr and momentum acceptance $\Delta p/p = 12\%$. Protons were detected by range spectrometer (Fig.1). The spectrometer configuration was chosen for each kinematical position individually, depending on detected protons' energy. The geometrical acceptance ($\Delta\Omega_p$) of the proton arm was approximate-

ly 15 msr. The energy and angular resolutions of the setup ($\sigma E_\gamma/E_\gamma$ and $\sigma_{\theta_{\pi^*}}$) varied in the investigated kinematical region within (4 - 6)% and (1 - 2)%, respectively.

The background contribution in the yield of the investigated reaction didn't exceed 5%.

The cross-section asymmetry Σ was defined using the yield of $\pi^- p$ coincidences N_\perp and $N_{||}$ corresponding to the perpendicular and parallel polarization of photons relative to the reaction plane:

$$\Sigma = \frac{1}{P_\gamma} \cdot \frac{N_\perp - N_{||}}{N_\perp + N_{||}}$$

where P_γ is the effective photon polarization.

The obtained results are listed in Table 1 and shown in Fig.2 as a function of photon energy in the neutron rest frame, for pion c.m. angles 45° , 60° , 75° and 90° together with the results of the phenomenological analysis of MW [7] and BCP [8]. The Cambridge data [6] for $\theta_{\pi^*} = 90^\circ$ and energy range $0.8 \div 1.8$ GeV are in agreement with our ones. As can be seen from Fig.2, the predictions of MW analysis in the third resonance region satisfactorily describe the energy dependence of experimental data at $\theta_{\pi^*} = 45^\circ$, but are worse for backward angles $\theta_{\pi^*} = 60^\circ, 75^\circ, 90^\circ$. This tendency was observed better for angular dependence of asymmetry $\Sigma(\theta)$, as shown in Fig.3, where data are presented at $E_\gamma = 1.05$ GeV together with the results of phenomenological analysis of MW, BCP and MOR [9]. The predictions of BCP analysis agree well with the Cambridge asymmetry data, which have been included in BCP data fit. However for the other angles $\theta_{\pi^*} (\lesssim) 90^\circ$, as can be seen in Figs.2, 3, experimental data disagree with BCP predictions, especially in the fourth resonance region, where BCP results contradict the asymmetry data both in sign and energy dependence.

Because of the information lack, we cannot compare the data with the results of Arai phenomenological analysis [10, 11], which involve the data of our previous work [4].

Thus, the obtained results make it necessary to perform new analyses involving data of our works and later data on $\gamma N \rightarrow \pi N$ processes.

Table 1

θ_{π}^*	E_{γ} , GeV	Σ	θ_{π}^*	E_{γ} , GeV	Σ
45°	0.85	0.37±0.05	90°	1.00	-0.41±0.05
	0.90	0.34±0.05		1.06	-0.45±0.05
	0.95	0.33±0.06		1.12	-0.52±0.07
	1.00	0.27±0.05		1.18	-0.46±0.06
	1.05	0.25±0.05		1.25	-0.46±0.06
	1.10	0.20±0.06		1.32	-0.29±0.08
	1.16	0.11±0.05		1.37	-0.24±0.06
	1.22	0.21±0.05		1.45	-0.17±0.06
	1.28	0.19±0.06		1.53	-0.07±0.09
	1.34	0.08±0.06		1.61	-0.11±0.09
	1.41	0.13±0.06		1.70	-0.20±0.07
	1.48	0.07±0.07		1.79	-0.07±0.10
	1.53	-0.11±0.07		0.85	-0.40±0.05
	1.62	-0.13±0.07		0.90	-0.36±0.05
1.71	-0.21±0.08	0.95	-0.36±0.07		
60°	0.85	0.11±0.05	1.01	-0.48±0.06	
	0.90	0.17±0.05	1.07	-0.43±0.06	
	0.95	0.13±0.06	1.13	-0.32±0.08	
	1.00	0.14±0.05	1.20	-0.40±0.07	
	1.05	0.05±0.05	1.27	-0.21±0.06	
	1.10	-0.09±0.06	1.34	-0.05±0.10	
	1.17	-0.13±0.05	1.42	0.03±0.06	
	1.23	-0.14±0.05	1.50	0.18±0.05	
	1.29	-0.18±0.07	1.58	0.16±0.07	
	1.36	-0.09±0.05	1.00	0.11±0.06	
	1.43	-0.09±0.05	1.05	0.21±0.06	
	1.50	-0.02±0.06	1.10	0.36±0.08	
	1.56	-0.04±0.07			
	1.65	-0.09±0.06			
1.74	-0.21±0.08				
75°	0.85	-0.31±0.05			
	0.90	-0.45±0.05			
	0.95	-0.46±0.07			

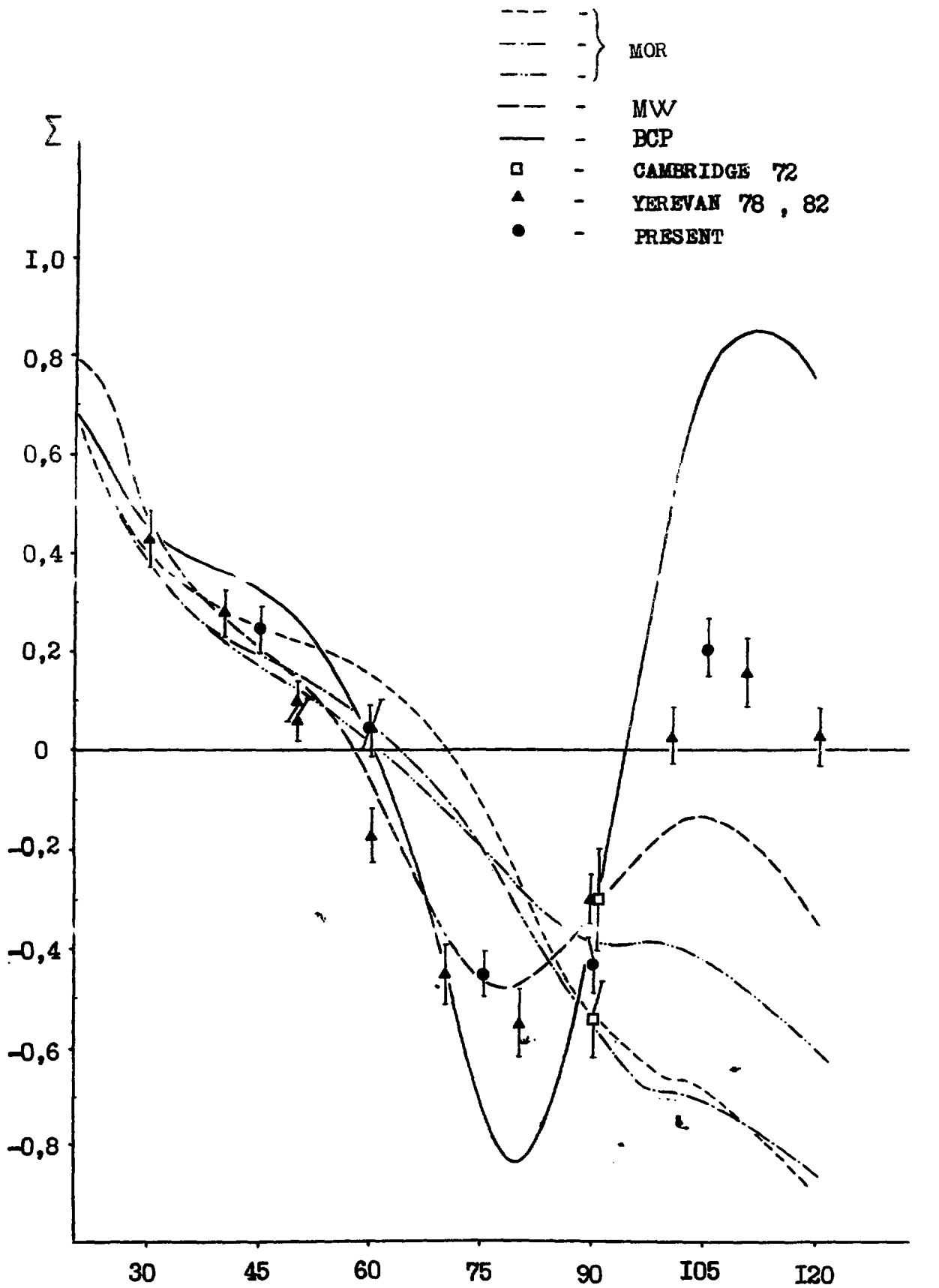


Fig.2

PION C.M. ANGLE

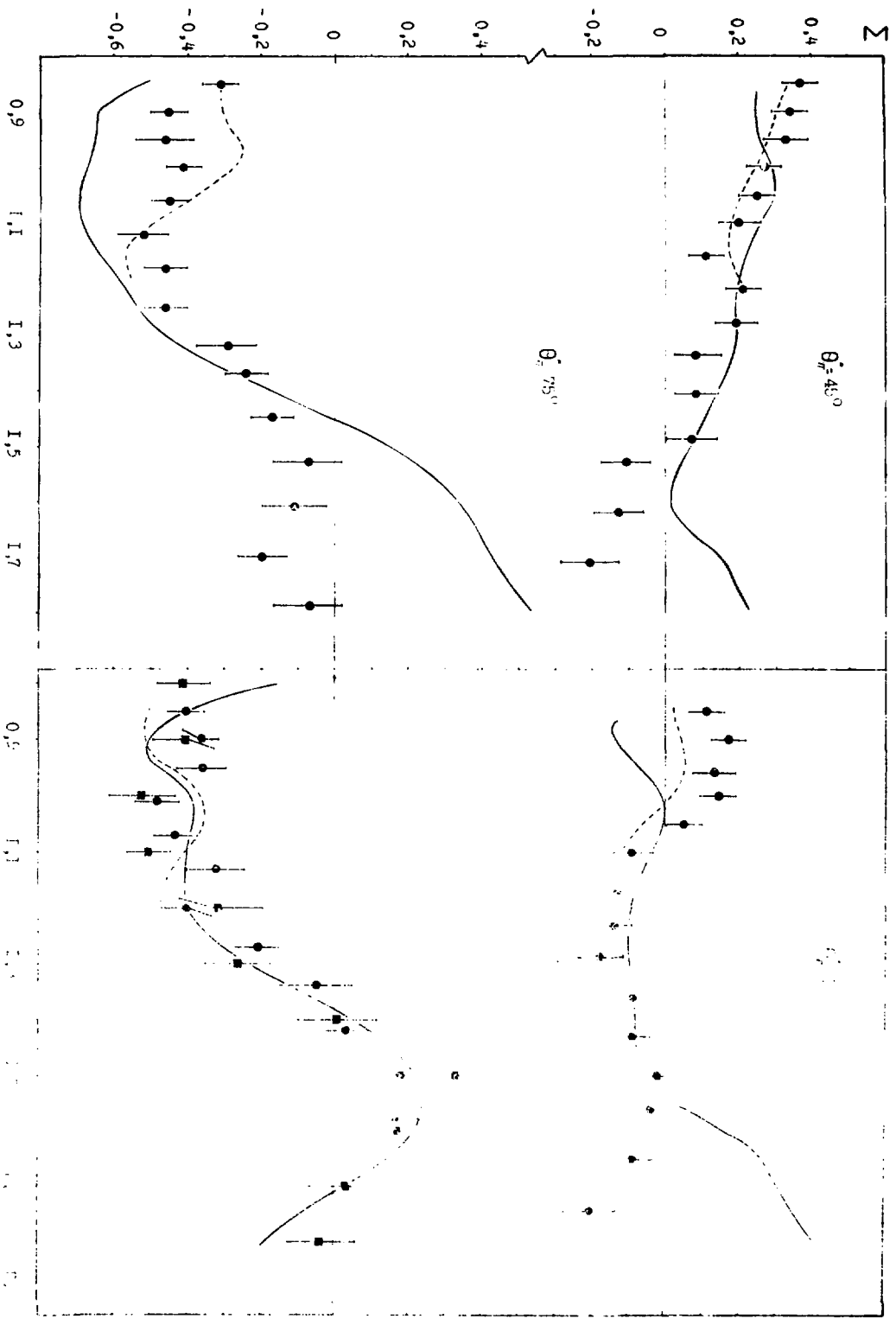


FIG. 3

FIGURE CAPTIONS

Fig.1. A diagram of the two-arm experimental apparatus.

D - diamond target, K - beam collimators, SM- cleaning magnets •
PS - 9-channel pair spectrometer, T - liquid deuterium target,
Q - quantometer, MC - magnetic spectrometer consisting of
quadrupole lens doublet (L1, L2), bending magnet (M) ($\alpha = 30^\circ$),
trigger counter telescope $S_1 + S_4$ and momentum hodoscope H_p ;
RS - range spectrometer consisting of trigger counters
 $T_1 + T_4$, anticoincidence counter T_5 , absorbers A_1 , A_2 and
liquid glycerine threshold Cerenkov \checkmark .

Fig.2. The energy dependence of the cross-section asymmetry Σ
for $\gamma n \rightarrow \pi^- p$ at $\theta_{\pi^-}^* = 45^\circ, 60^\circ, 75^\circ, 90^\circ$.

Fig.3. The angular dependence of the cross-section asymmetry Σ
for $\gamma n \rightarrow \pi^- p$ at $E_\gamma = 1.05$ GeV.

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