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Memorandum

To : The members of the EEC and the NPRC.

From : CERN/HOLLAND GROUP (C. Daum, F. Erné, J.P. Lagnaux, J.C. Sens, M. Steuer, F. Udo).

Subject : Status K^- - polarized proton scattering experiment.

In response to a request from the EEC and the NPRC some points are presented concerning the present status of the experiment K^- scattering on polarized protons.

APPARATUS

The equipment consists of hodoscopes of counters, surrounding the polarized target; two secondary charged particles are required by the electronics, one in one of the left polar and azimuthal counters, the other in one of the right polar and azimuthal counters. Data are stored on tape. Selection of coplanar events is done by the computer. Non-coplanar events are used for background subtraction.

PS TIME

The experiment has been set up in November 1966. In Nov - Dec 1966 103 equivalent hours of 100 % beam on PS target # 1 have been available (weeks 46, 48, 50, 51). They have been used for a beam survey and preliminary data-taking on a CH_2 target.

From Jan - April 1966 183 equivalent 100 % hours have been used for production with the polarized target (weeks 2, 4, 9, 10, 11, 12).

DATA

Angular distributions and polarizations have been measured at the following energies :

p_K GeV/c	EVENTS ON TAPE (SCATTERS ON FREE + BOUND PROTONS + BACKGROUND)	GOOD EVENTS
1.50	50021	6588
1.60	45201	5472
1.70	43585	4933
1.80	28350	2617
1.90	26715	2417
2.00	52442	5507
2.05	31290	3744
2.10	24288	1939
2.30	39000	3088

The angular distributions and polarizations calculated from these events are given in Fig. 1 and 2 for 1.5, 1.6, 1.7 and 1.8 GeV/c. The angular distribution data, in particular the forward peaks, are subject to corrections which have not yet been made. The polarization data at 1.5, 1.6 and 1.7 GeV/c are final; those at 1.8 GeV/c show that insufficient running leads to meaningless results : Further data-taking at this point is planned.

ANALYSIS

At all energies strong polarization effects are observed. The pattern changes slowly with energy. In all cases, the polarization changes sign near the diffraction minimum. The data are analyzed in two ways. The first is a fit to the data at each energy with Legendre polynomials. The resulting coefficients B_1, which fit the polarization data best, are plotted in Fig. 3. The corresponding coefficients A_1 of the available litterature angular distributions (we have not yet used the data on angular distributions from this experiment) are shown in Fig. 4a and 4b. While the A's are monotonically rising, the B's shows a resonance type behaviour at $\sim$1.7 GeV/c, where the $Y_0^*(2100)$ has been found. A further decomposition into angular momentum amplitudes, of which the A's and B's are well-known functions, is presently being carried out. The second way is to fit the data to the sum of a diffraction amplitude and Breit-Wigner amplitudes due to one or more resonances, whose quantum numbers, mass, width and elasticity are to be determined from a fit to the angular distributions and polarizations over a range of energies. This model has been very successfull in fitting lower energy Kp angular distributions (Levisetti and Predazzi, EFINS 66-80).

FUTURE

From the data obtained thus far it appears that, at 1.5 GeV/c, a total of $\sim$ 50.000 scatters on tape leads to a sufficiently accurate polarization curve (see Fig. 2). For 2.5 GeV/c, a total of $\sim$ 80.000 is required, due to the increased forward peaking at higher energies. A reasonable programme of measurements is for example a total of 20 energies spaced by 50 MeV/c, and going from $\sim$ 1.4 to 2.4 GeV/c.

Table 1 shows a table of known resonances. As a basis of an estimate of interference of adjacent resonances, it is assumed, that the influence of the resonance is appreciable between $E_R - \Gamma/2$ and $E_R + \Gamma/2$. It can be seen from the table, that adjacent resonances may cause quite strong interference effects, and that all resonances within the limits $E_R - \Gamma/2$ and $E_R + \Gamma/2$ interfere with adjacent resonances on both sides. Hence, a mesh of 50 MeV/c is a minimum requirement for a proper study of these resonances and their interference effects. Moreover, a good phase shift analysis of the K^-p interaction itself also requires a continuous series of measurements with not too large spacing. For both reasons, a close joining up with measurements at lower incident momentum is desirable.

Extending the data-taking beyond these limits (although technically possible; the equipment functions without alterations between 1 and 3 GeV/c) may put too great a strain on the PS schedule; reducing these limits, on the other hand, would imply inefficient use of the equipment and data analysis programmes which have been build up over the last year and a half. For an average of 65000 scatters on tape per energy and an average rate of ~ 2000 scatters/hour with 100 % beam, one arrives at 475 hours of 100 %, or <u>5 new PS weeks with ~60 % beam on target # 1 after the shutdown Mai 1967</u>. Of these, 4 weeks have been allocated on the provisional PS schedule to date.

It is felt that the data acquisition and analysis system is performing satisfactorily and that the success of the experiment is now mostly dependent on the machine time allocated.

TABLE 1 - Known $\overline{K}N$ resonances (MUB-13977

M_{res} MeV	Γ MeV	p_- *) GeV/c	p GeV/c	p_+ *) GeV/c	I	J	Decay mode Fraction(%) into $\overline{K}N$
1910	60	1.12	1.25	1.38	1	$(\frac{5}{2}^+)$	8
2035	160	1.35	1.53	1.72	1	$\frac{7}{2}^+$	16
2100	160	1.50	1.68	1.87	0	$\frac{7}{2}^-$	29
2260	180	1.84	2.06	2.29	1	?	14 (if $J=\frac{9}{2}$)
2340	105	2.13	2.27	2.56	0	?	10 (if $J=\frac{9}{2}$)

*) It is assumed, that the influence of the resonance is appreciable between $E_R - \Gamma/2$ and $E_R + \Gamma/2$ (neglcting the energy dependence of Γ), occuring at incident momenta of p_- and p_+, respectively.

Differential Cross Section at

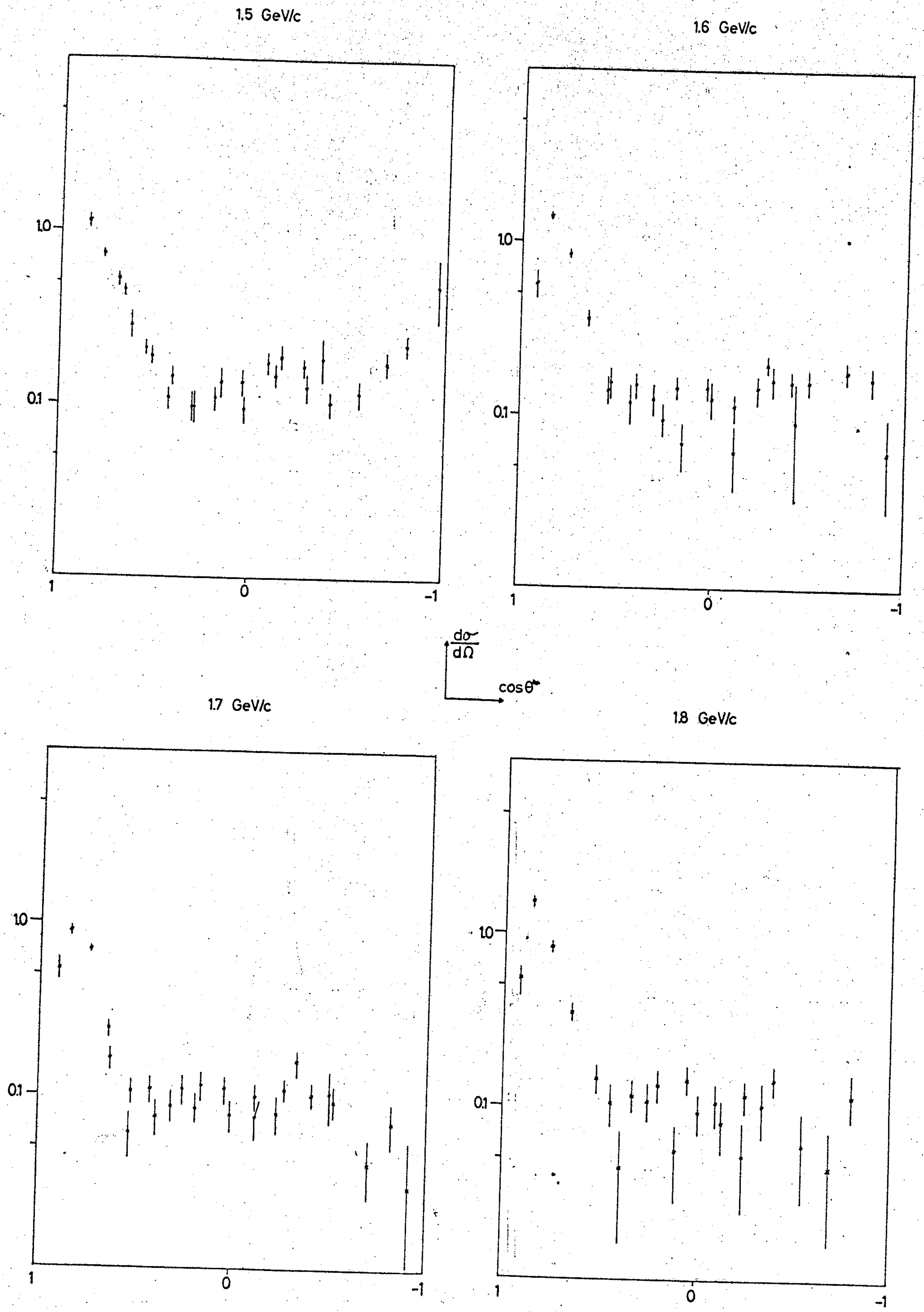
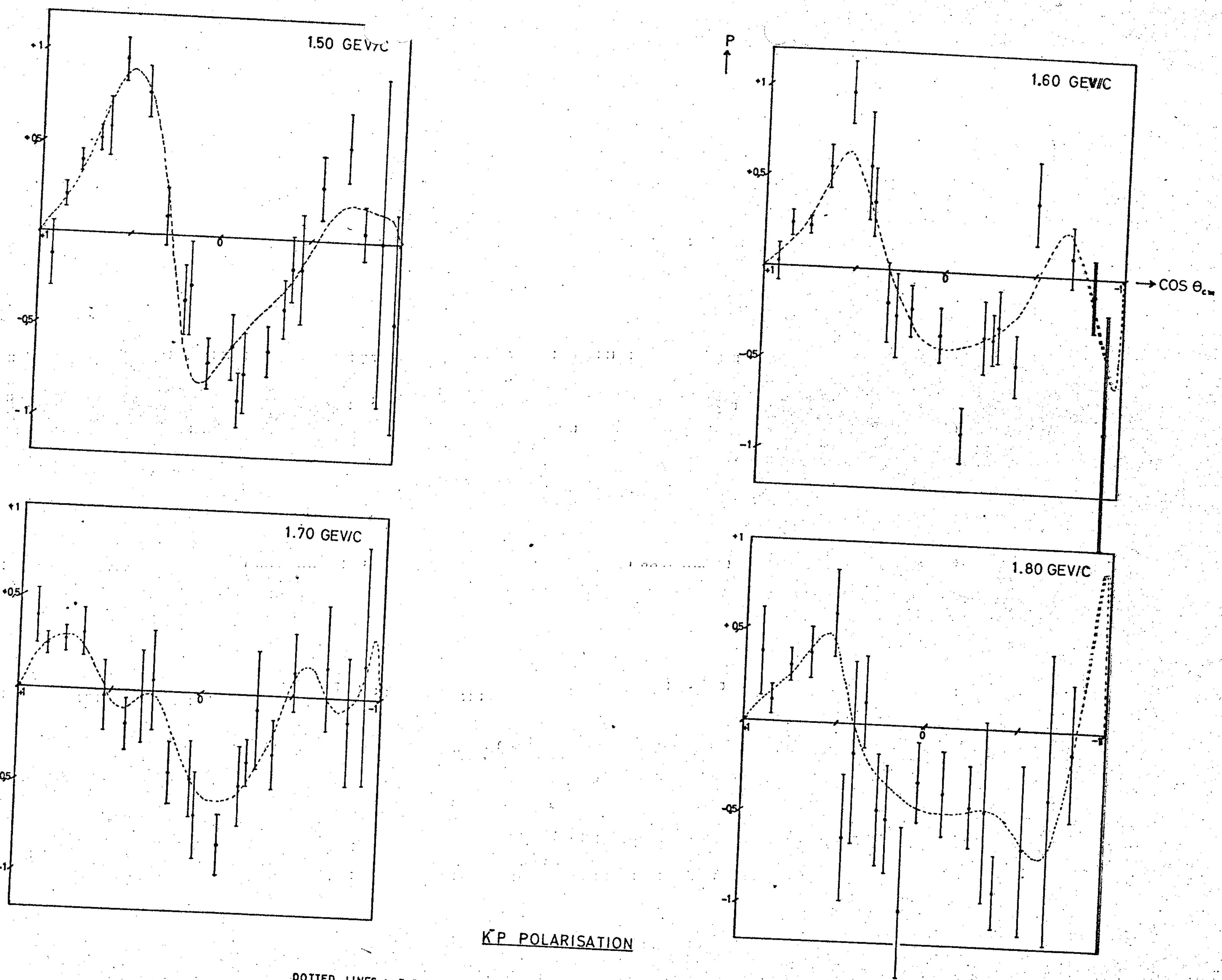
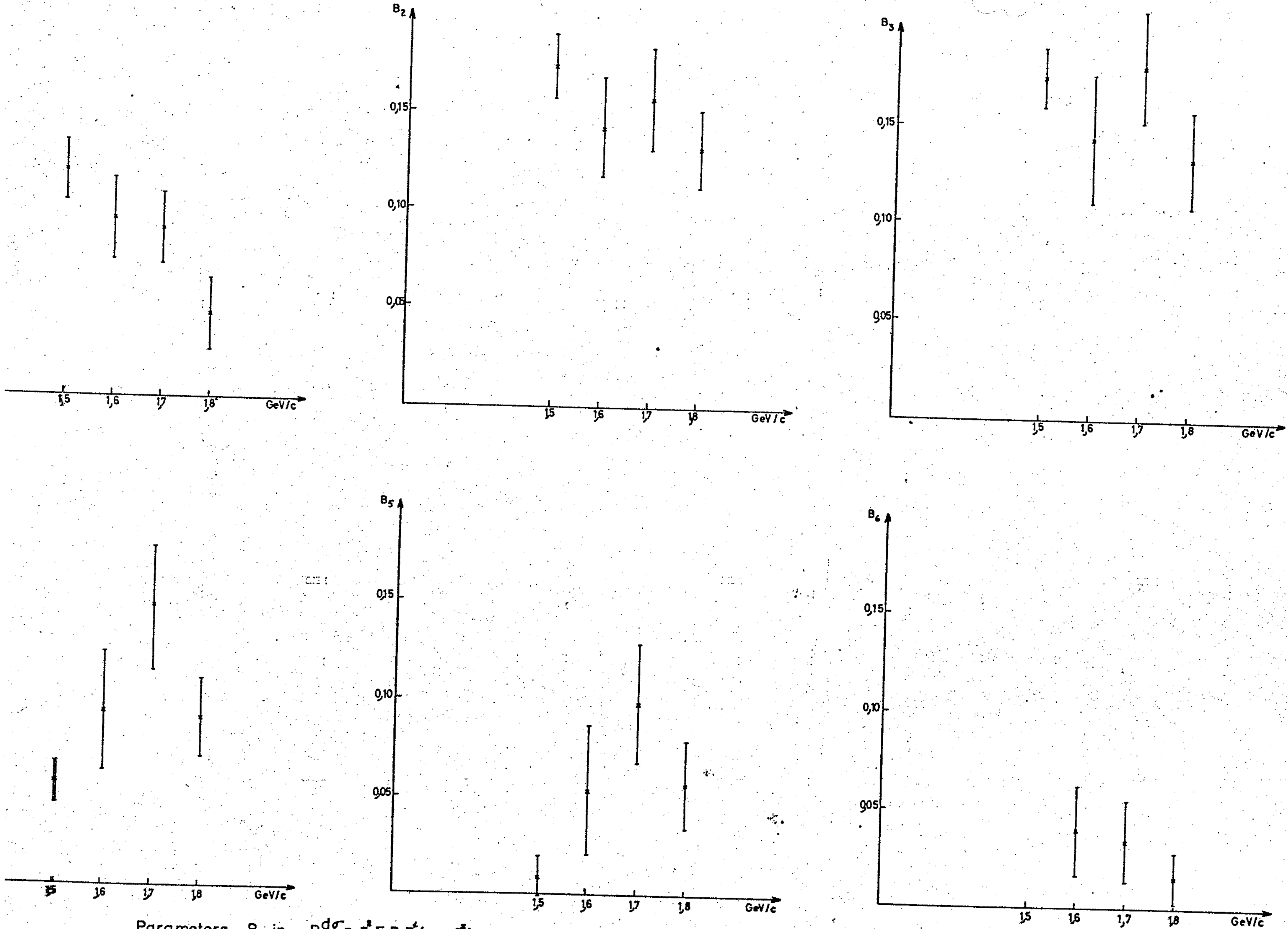


Fig. 1



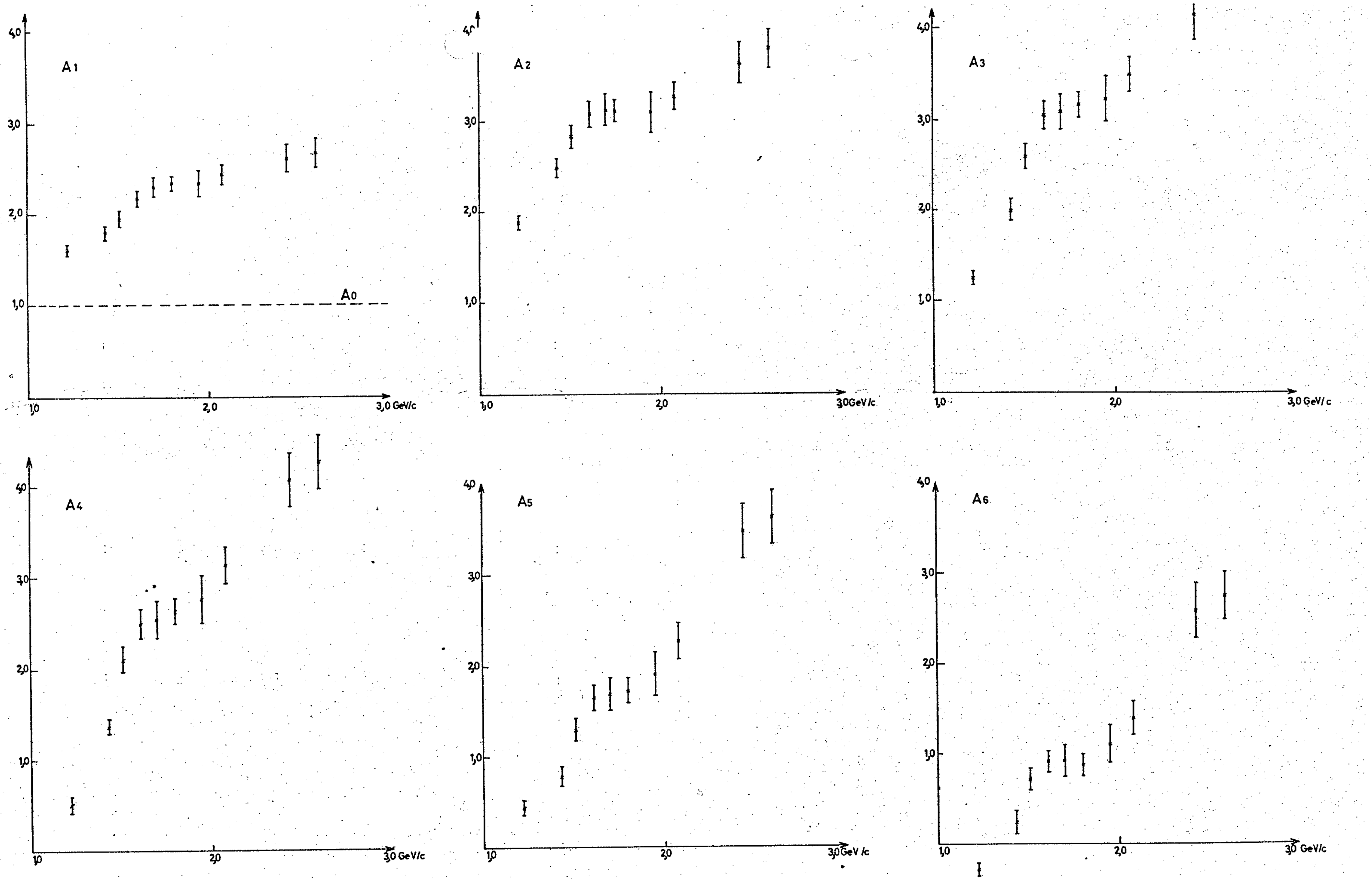
K^-P POLARISATION

DOTTED LINES : 7 PARAMETER LEGENDRE POLINOMIAL FITS



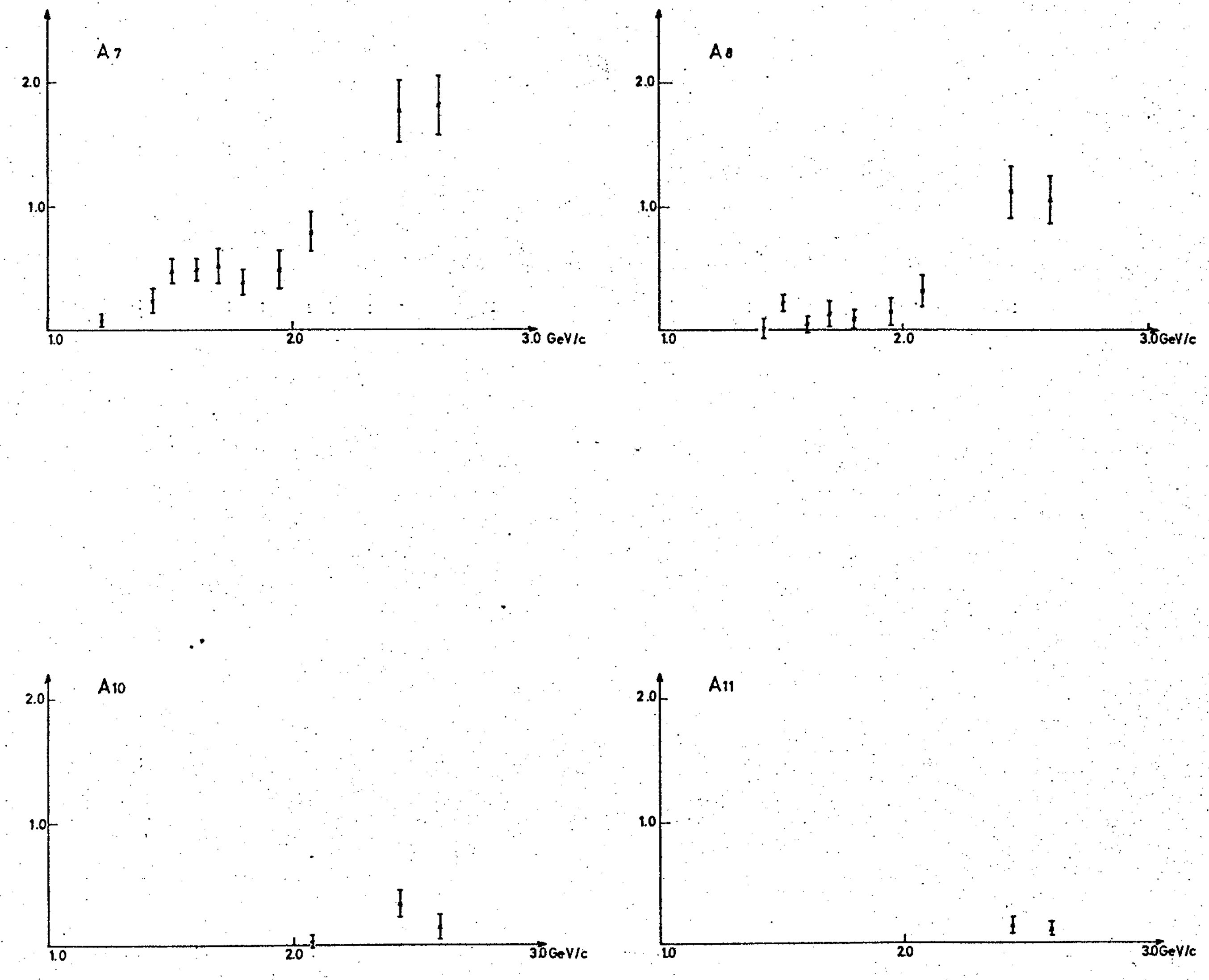
Parameters B in $P\frac{d\sigma}{d\Omega} = \lambda^2 \sum_\ell B_\ell P_\ell^1(\cos\theta^*)$
as fct of Inc. Momentum

Fig. 3



Parameters A in $\frac{d\sigma}{d\Omega} = \lambda\!\!\!^{-2} \sum A_\ell P_\ell(\cos\theta^*)$
as fct of Inc. Momentum

Fig. 4a



Parameters A in $\frac{d\sigma}{d\Omega} = \lambda^2 \Sigma A_l P_l (\cos\theta^*)$
as fct of Inc. Momentum

Fig. 4b