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POLARIZATION MEASUREMENTS IN HADRON-HADRON SCATTERING AT HIGH ENERGY[1]

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This short paper is only experimental and does not conform with the general programme of this Colloquium. First, a brief description of a typical polarization experiment will show how expensive it is, in time and money, to obtain an accurate experimental point. A set of polarization measurements at high energy will be presented, including elastic forward scattering $\pi^{\pm}p$, $K^{\pm}p$, and $p^{\pm}p$, from 6 to 17.5 GeV/c, performed by a CERN, Orsay-I. P. N., Pisa cooperation, and backward elastic $\pi^{\pm}p \to p\pi^{\pm}$ at 6 GeV/c, performed by a CERN, Orsay-I. P. N., Oxford cooperation.

It is known that the backward scattering and charge exchange are, from the theoretical point of view, "easy experiments", only a limited number of Regge trajectories being involved. On the other hand, for experimentalists, these kinds of experiments are very difficult, as the cross-sections are very low. The hadron-proton elastic forward cross-section is of the order of milibarns, but the backward cross-section is only of the order of microbarns. However, backward experiments are now possible due to the large improvement in experimental technics (targets, counters, electronics and acquisition systems); improvements were performed while measuring the forward elastic scattering. We describe here briefly the main components of the backward experiment (Fig. 1):

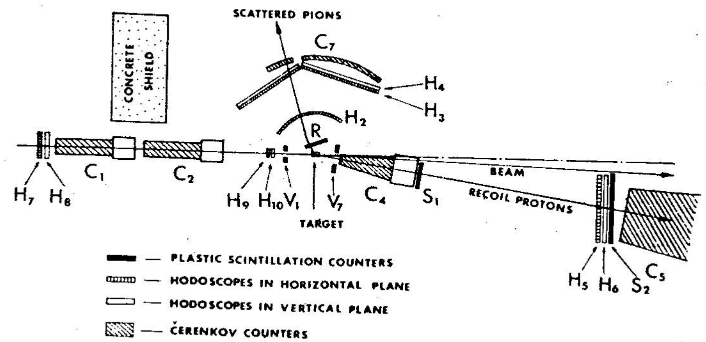

Fig. 1.

[1] Talk given at Elementary Particle Physics Seminar at Pezinská Baba, September 22—25, 1971.

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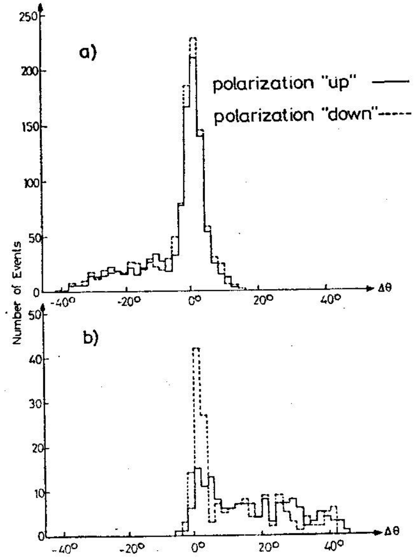

Fig. 2.

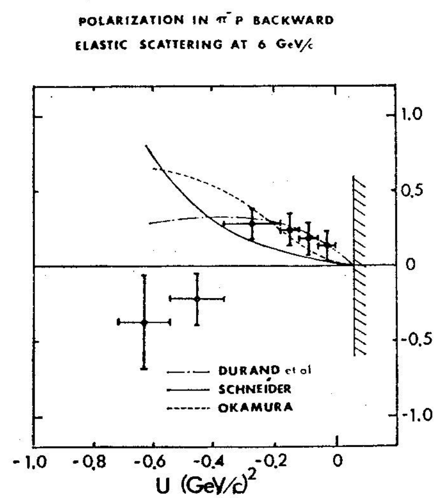

Fig. 4.

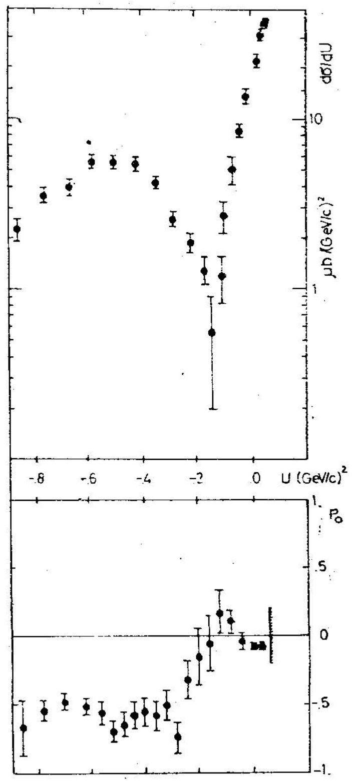

Fig. 3.

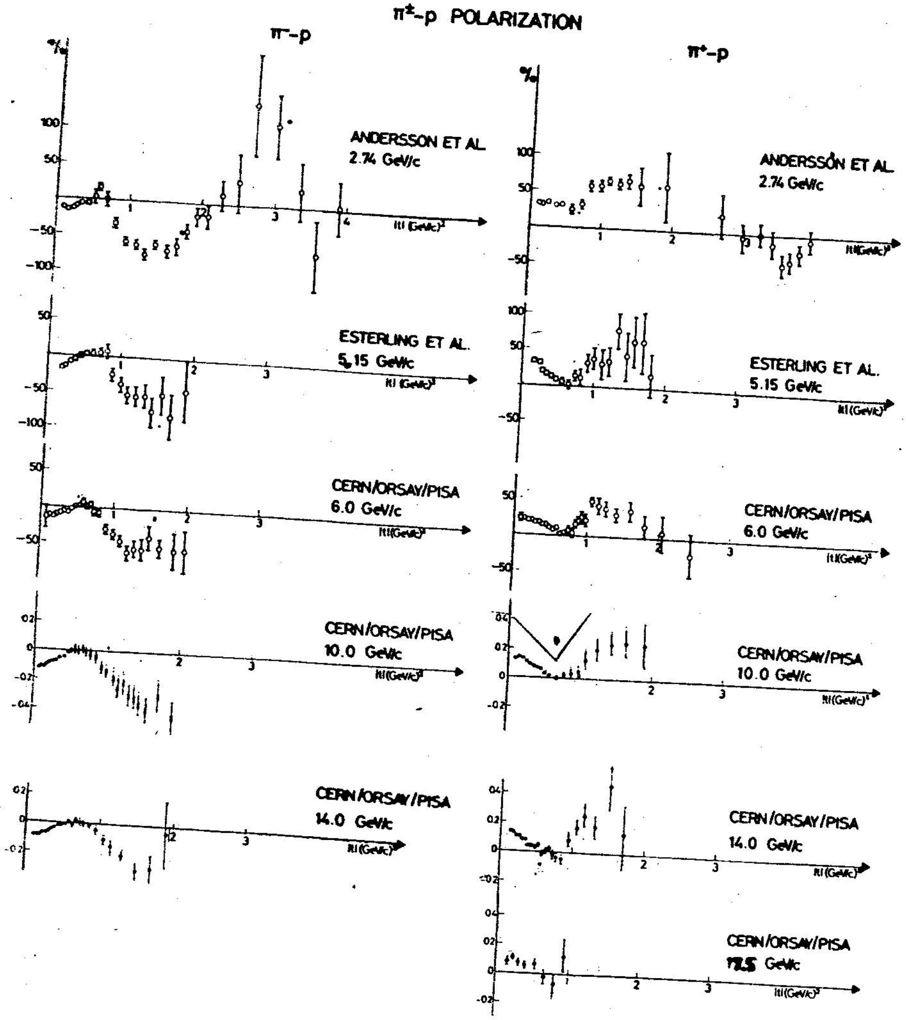

Fig. 5.

A butanol polarized target (a complicated object which needs a high magnetic field, a very low temperature (0.5 °K), electronics and special high frequency electronics), giving rise to the polarization of free protons up to 70 %. A beem intensity of 3×10^6 π/burst with 1% momentum precision; this high intensity gives after a few weeks' running time only a few thousand good events. Cerenkov counters giving signatures of particles. Veto counters surrounding the target outside the useful solid angle reject most of the inelastic events. Fast trigger counters permitting fast electronic logic circuits, a high

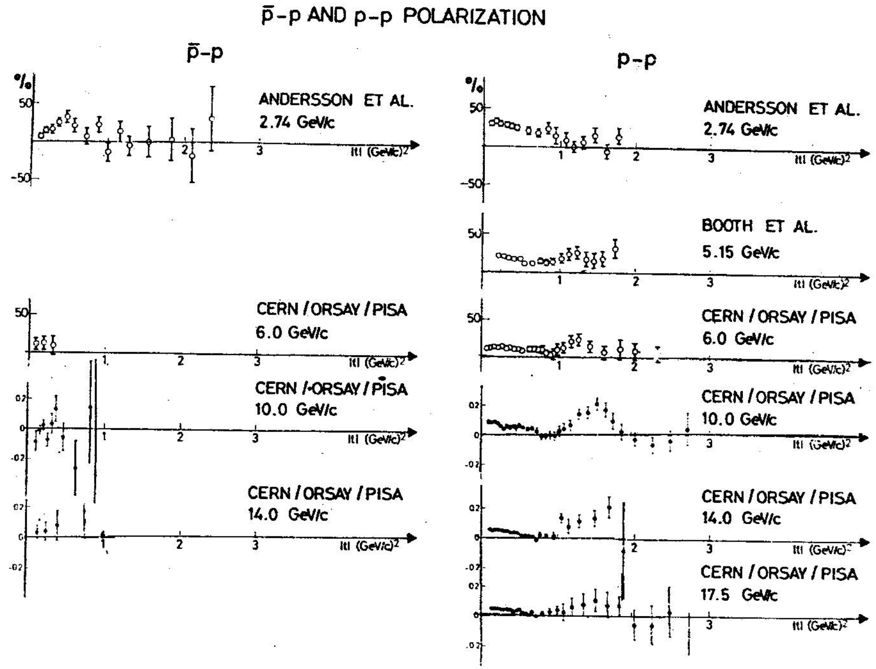

Fig. 6.

intensity beam and large statistics. An acquisition system and an IBM 360/44 computer processing on line all the events and providing a continuous check of the experiment.

The experiment consists essentially in the determination of the coplanarity of the 3 particles (incoming, scattered, recoiled), the interaction vertex and the angular correlation between these particles. On the angular correlation distribution, after correct cuts on the coplanarity and the reconstructed vertex, the events are seen as a peak superposed on a background due to the quasi elastic and inelastic events. For example, Fig. 2 gives this kind of peaks for two different u values, and shows the asymmetries with target polarization + and —.

Polarization and differential cross-section results on $\pi^+ p \to p\pi^+$ (backward scattering) at 6 GeV/c, [1] and [2], are presented in Fig. 3. The polarization is small in the region of the backward peak and definitily negative in the region of $u < -0.3$.

The large polarization at $u < -0.3$ (GeV/c)^2 indicates a large change in the structure of the amplitude as compared with the backward peak region. No model actually fits correctly these results.

Fig. 4 show as preliminary polarization results for $\pi^- p$ backward scattering [2]. Final results with complete statistics will be published later, after the data have been completed and analysed. As shown in Fig. 4 the polarization increases slowly until $u = -0.3$ and then falls rapidly to attain negative values. If in the first u-region the experimental

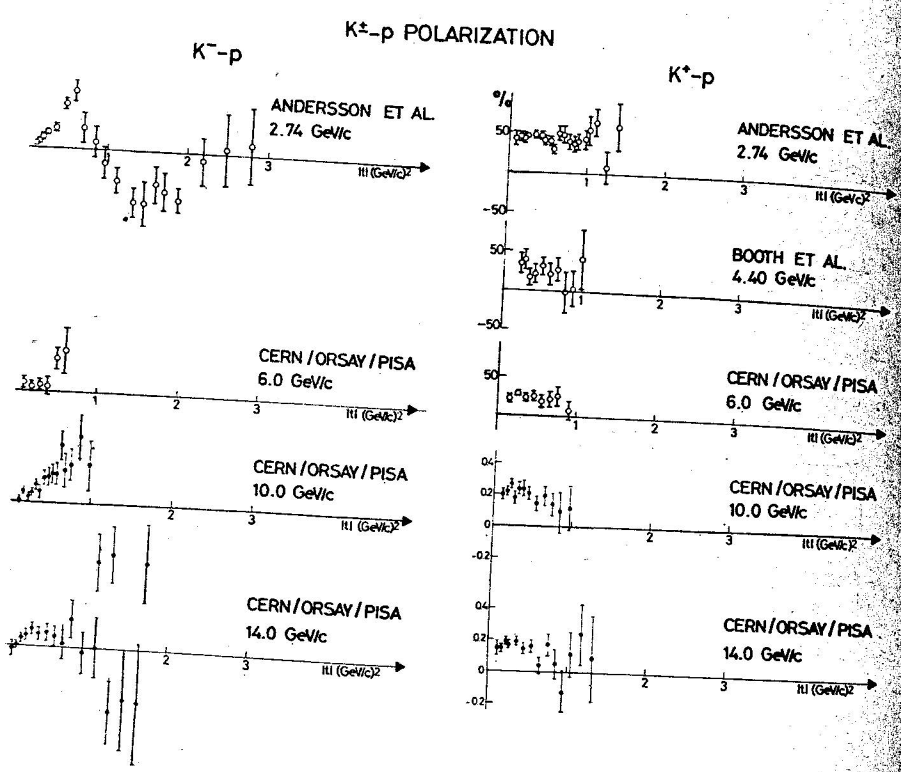

Fig. 7.

results are in good agreement with some of the theoretical predictions, from $u = -0.4$ on they are definitely in contradiction with most current models.

Figs 5, 6 and 7 show a set of final polarization results obtained for $\pi^{\pm}p$, $K^{\pm}p$ and $p^{\pm}p$, elastic forward scattering from 6 to 17.5 GeV/c, incident momenta [3—5], and results at lower momenta obtained by other experimental groups. We will not discuss here all the models which fit well and which can explain the behaviour of the polarization parameter. We wish only to remark that this complete set of precise and detailed P values, for the large s and t domain, will probably be appreciated as a highly useful material for any model-independent amplitude analysis.

REFERENCES

[1] Aoi H. et al., Phys. Letters *35 B 1* (1971), 90.
[2] Aoi H. et al., Submitted to the *Conference on High Energy Physics*, Amsterdam 1971.
[3] Borghini M. et al., Phys. Letters *36 B 5* (1971), 493.
[4] Borghini M. et al., Phys. Letters *36 B 5* (1971), 497.
[5] Borghini M. et al., Phys. Letters *36 B 5* (1971), 501.
For more complete bibliography see detailed references in papers [1] to [5].

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