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NUCLEON DIFFRACTION DISSOCIATION (EXPERIMENT)

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In this paper the present situation in nucleonic diffraction dissociation into $(N\pi)$-system is discussed. New experimental data have come mainly from experiments performed at high energies by electronics technique [1-4] at Serpukhov, FNAL and ISR with high statistics.

The main features of nucleon diffraction dissociation $N \to N\pi$ observed at intermediate energies (< 30 GeV) are the following. The $(N\pi)^-$ system is preferably produced with low invariant mass. The energy dependence of the reaction is rather weak. The t-distribution shows diffraction - like behaviour ($\sim e^{Bt}$) with the slope B, which depends on the mass of the $(N\pi)^-$ -system. For the nucleon of the system, the cos θ_{GJ} distribution is strongly peaked towards cos θ_{GJ} =+1. Azimuthal φ_S and φ_t distributions are not uniform and hence are not in agreement with S- and t-channel helicity conservation.

1. Manifestation of Baryon-exchange Deck-effect

Fig. 1 shows the angular distribution over cos θ_{GJ} as obtained by Moscow-Karlsruhe-CERN Collaboration[1] in all experimental phase space (a) and under small M and $|t|$ restrictions (b). One can be sure that the influence of resonance production is considerably weakened by this restrictions.

Forward peak near cos $\theta_{GJ} \sim +1$ can be described as π-exchange Deck-effect (dotted). But quite pronounced backward peak near cos $\theta_{GJ} \sim -1$ is not consistent with π-exchange. This backward peak can be explained by a mechanism which is similar to the Deck one, but involving baryon exchanges instead of pion exchange[9] (solid).

In fig. 2, one can see that taking into account baryon-exchange Deck graphs' contributions

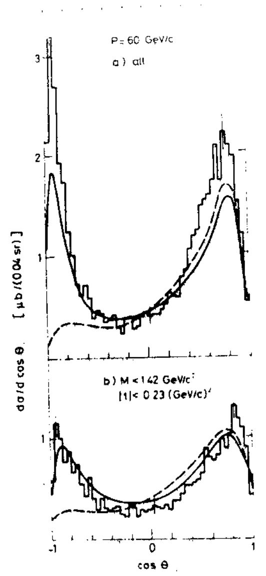

Fig. 1

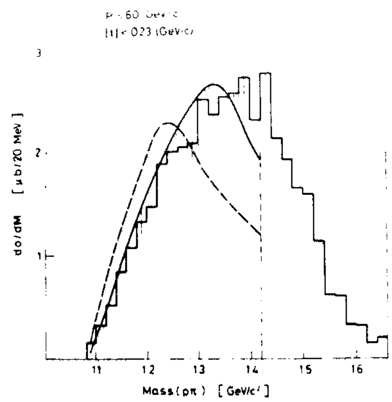

Fig. 2

improves mass spectrum description considerably (π -exchange Deck alone predicts too soft mass spectrum).

The backward peak near cos $\theta_{GJ} \sim -1$ at small M and $|t|$ was also clearly seen in FNAL/2/ and ISR/3/ experiments. Authors of/2/ compared φ_{GJ} -distributions at cos $\theta_{GJ} \sim +1$ and cos $\theta_{GJ} \sim -1$ with reggeized Deck model predictions (fig. 3). They consider the φ_{GJ}-distribution structure to be a manifestation of baryon-exchange Deck-effect.

So we have now at least three arguments for the existence of baryon-exchange Deck mechanism, i.e., backward peak at cos $\theta_{GJ} \sim -1$, mass spectra discription and φ_{GJ} structure.

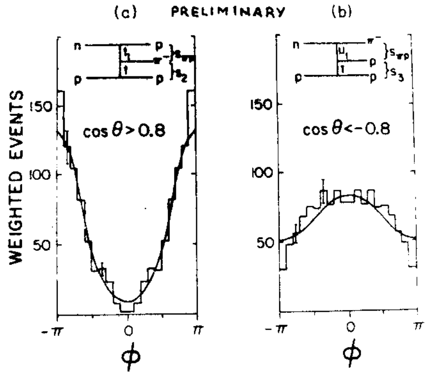

Fig. 3

2. t-distributions. Correlations

The appearence of the structure in $d\sigma/dt$ near $|t| \sim 0.2$ $(GeV/c)^2$ in DD-processes was recently discussed/2,3,9/. The new data have come from CHOV experiment/3/ at ISR the deep in t-distributions has been observed. Fig. 4 (b) shows that for the mass range 1.30-1.35 GeV the deep is most pronounced for the cos $\theta_{GJ} \sim 0$. Fig. 4 (a) presents the t-distributions for $-0.3 < \cos\theta_{GJ} < 0.3$ at different mass intervals. The deep is clearly seen for the masses M < 1.4 GeV and moves to higher $|t|$ values with mass increasing.

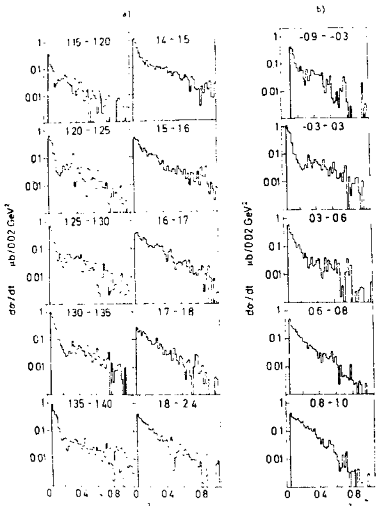

Fig.4

Deck-type model with absorption, perhaps, can interpret the appearence of this structure /9 and ref. therein/.

Collection of the data on mass-slope correlation is shown in fig. 5. One can see that in the momentum range 12-1000 GeV/c the shape of

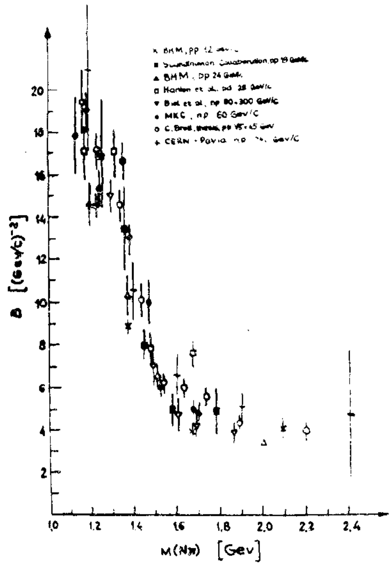

Fig. 5

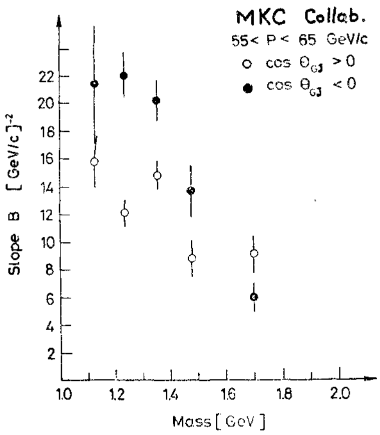

Fig. 6

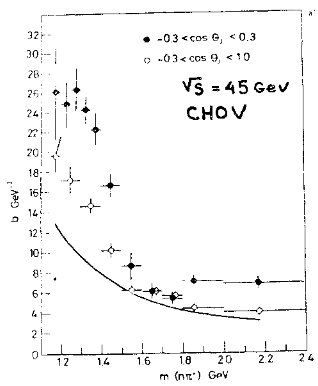

Fig. 7

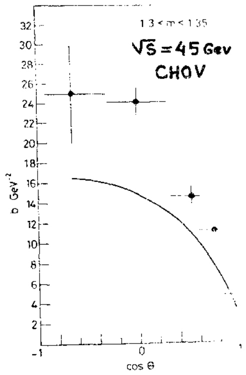

Fig. 8

the function is universal; at small masses the slope is about twice that of NN elastic one and for M≥1.6 GeV is about a factor of 2 less. At small masses(<1.3 GeV) there are some indications to increasing of the slope with the energy, but due to large experimental errors one can hardly say that the energy dependence of the slope in all mass intervals is different from that of elastic scattering. New experimental results[1,2,3] show the existence of the correlation between production and decay of $(N\pi)$ system (fig. 6-8). Theoretical description of the slopes is discussed in[9]. At least partially these correlations can be explained kinematically.

3. Mass spectra and cross sections

In fig. 9 the $(p\pi^-)$ mass distribution for $45 \le p_n \le 65$ GeV/c[1] is compared with the corresponding preliminary distribution from the FNAL experiment[2]. Both sets of data are absolutely normalized. The spectra turned out to be almost identical, apart from the mass region around 1.5 GeV.

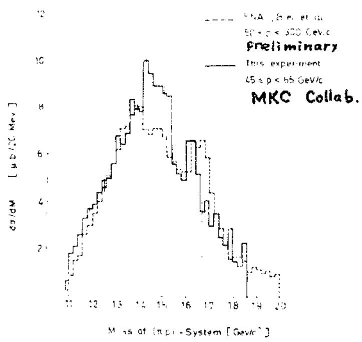

Fig. 9

Fig. 10 shows energy dependence of the cross sections integrated over two low mass intervals for $0.002 < |t| < 1.0$ $(GeV/c)^2$[1,2,7]. One can see that in the error bars low mass cross sections are energy independent.

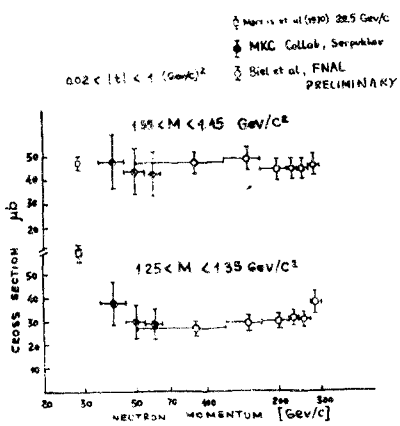

Fig. 10

Mass spectra for Serpukhov and ISR experiments are presented in fig. 11 under the same phase space distributions. All masses with the exception of the interval near $M \sim 1.5$ Gev display equal cross sections.

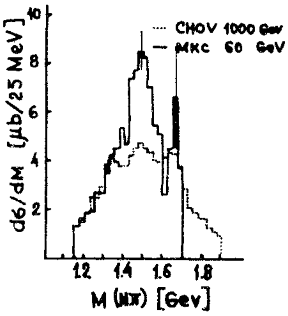

Fig. 11

If high energy diffraction dissociation is dominated by isospin I =0 exhange, cross section for the reactions $pp \to (n\pi^+)p$ and $np \to (p\pi^-)p$ should be equal (total DD pp cross sections have a trivial factor 2). Fig. 12 shows experimental data on total nucleon dissociation cross section in the momentum range from 7 to 1500 GeV/c/1-7/. At ISR energies np and pp channels have equal cross sections within the experimental errors. At the energies above Seprukhov range cross sections seem to be flattened.

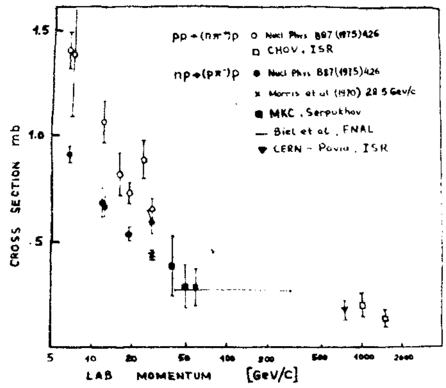

Fig. 12

I wish to thank Prof. V.A.Lyubimov and Dr. L.A.Ponomarev for useful discussions and some essential remarks.

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