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CROSS-SECTIONS FOR DIFFRACTIVE CHARM PRODUCTION AT THE CERN ISR

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Abstract

Cross-sections are given for diffractive production of D, $\bar{D}$ and Λ_c in pp interactions at cm energy of 63 GeV. These results come from a study of the decay channels $K^-p\pi^+$ for Λ_c and $K^\pm\pi^\pm$ and $K^\pm\pi^\pm\pi^\pm$ for D and $\bar{D}$.

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We summarize here results on cross-sections for diffractive production of Λ_c^+ and D, $\bar{D}$ in pp interactions at cm energy of 63 GeV.[1] The Λ_c cross-section is based upon observation of the decay $\Lambda_c \to K^- p\ \pi^+$. Cross-section upper limits for D^0, $\bar{D}^0$, D^+ and D^- are derived from a study of the invariant mass spectra of $K^\pm\pi^\mp$ and $K^\pm\pi^\mp\pi^\mp$ systems.

The experimental setup, described in Ref. 1 was designed to trigger on the single diffraction dissociation process :

$$p + p \to X + p \qquad \ldots\ldots\ldots\ldots \quad (1)$$
$$\quad\ \lfloor\!\to \Lambda_c + D + \ldots\ldots$$
$$\quad\ \lfloor\!\to D + \bar{D} + \ldots\ldots$$

Cross-sections are evaluated for M_x, the mass of X, in the range 10 - 28 GeV/c^2. The lower limit for M_x was imposed by the trigger requirement that X decay into at least six charged particles. The upper bound for M_x corresponds to $x_p = 0.8$, ($M_x^2/s = 1-x_p$), where x_p is Feynman x for the outgoing proton in reaction (1) ; we arbitrarily fixed $x_p = 0.8$ as the limit for the diffraction dissociation process.

Details of data analysis are given in Ref. 1. Fig. 1 shows the invariant mass distribution for (a), (c) $K^- p\ \pi^+$ and (b), (d) $K^- p\ \pi^-$. The proton and K^--meson were Cerenkov identified in all events. The $K^- p\ \pi^+$ mass distribution in (a) has a 4.8 standard deviation peak at 2262 ± 10 MeV, interpreted as Λ_c^+ ; the error on the mass estimate includes systematic uncertainties. The corresponding Λ_c^+ cross-section is $\sigma.B(K^- p\ \pi^+) = 1.6 \pm 0.8\ \mu b$ for the Feynman x range $0.5 < x_{\Lambda_c} < 0.8$, (Table I). (This value is revised upward from the preliminary result in Ref. 1). The lower limit on x_{Λ_c} is due to detector acceptance. The absence of events above Feynman x of 0.8 is not related to acceptance but is probably associated with the trigger induced threshold of 10 GeV/c^2 for the mass of X in reaction (1).

For D-meson production the geometrical acceptance of the apparatus and the requirement that $K^\pm$ be Cerenkov identified[1)] limits the cross-section measurements to the Feynman x range $0.2 < x_D < 0.65$ for the $K\pi$ decay mode and to $0.2 < x_D < 0.45$ for the $K\pi\pi$ decay mode. Figure 2 shows the invariant mass distribution for $K^\pm\pi^\mp$ and $K^\pm\pi^\mp\pi^\mp$. No signals are evident in the D-meson mass region. The corresponding cross-section upper limits at 95% confidence level are given in Table I.

TABLE I

Cross-section estimates for Λ_c, D^0, $\bar{D}^0$, D^+ and D^- for the Feynman x range in column 3 (positive x only). Uncertainties in the decay branching ratio B have not been taken into account.

PARTICLE	DECAY MODE	X RANGE (ΔX)	$\frac{\Delta\sigma \cdot B}{(\mu b)}$	$\frac{B}{(\%)}$	$\frac{\Delta\sigma}{(mb)}$	$\frac{\Delta\sigma/\Delta x}{(mb)}$
Λ_c	$K^- p\ \pi$	0.5 - 0.8	1.6 ± 0.8	2.2 [2]	0.073 ± 0.036	0.24 ± 0.12
D^0	$K^-\pi$	0.2 - 0.65	$\leq$ 1.8	2.5 [3]	< 0.075	$\leq$ 0.16
$\bar{D}_0$	$K^+\pi$	0.2 - 0.65	$\leq$ 3.9	2.5	$\leq$ 0.16	$\leq$ 0.35
D^+	$K^-\pi^+\pi^+$	0.2 - 0.45	$\leq$ 3.4	4.6 [3]	$\leq$ 0.074	$\leq$ 0.30
D^-	$K^+\pi^-\pi^-$	0.2 - 0.45	$\leq$ 6.0	4.6	$\leq$ 0.13	$\leq$ 0.52

References

(1) K.L. Giboni et al., Phys. Lett. 85B (1979) 437.

(2) G.S. Abrams et al., Phys. Rev. Lett. 44 (1980) 10.

(3) Averaged from the compilation by G. Goldhaber and J. Wiss "Charmed Meson Production in e^+e^- Annihilation", LBL-10652, March 1980.

Figure Captions

Fig. 1. (a) $K^- p\ \pi^+$ and (b) $K^- p\ \pi^-$ invariant mass distributions for all events, (c) $K^- p\ \pi^+$ and (d) $K^- p\ \pi^-$ invariant mass distributions for events with $\geq$ 6 recosntructed trucks.

Fig. 2. Invariant mass distributions for (a) $K^-\pi^+$, (b) $K^+\pi^-$, (c) $K^-\pi^+\pi^+$ and (d) $K^+\pi^-\pi^-$.

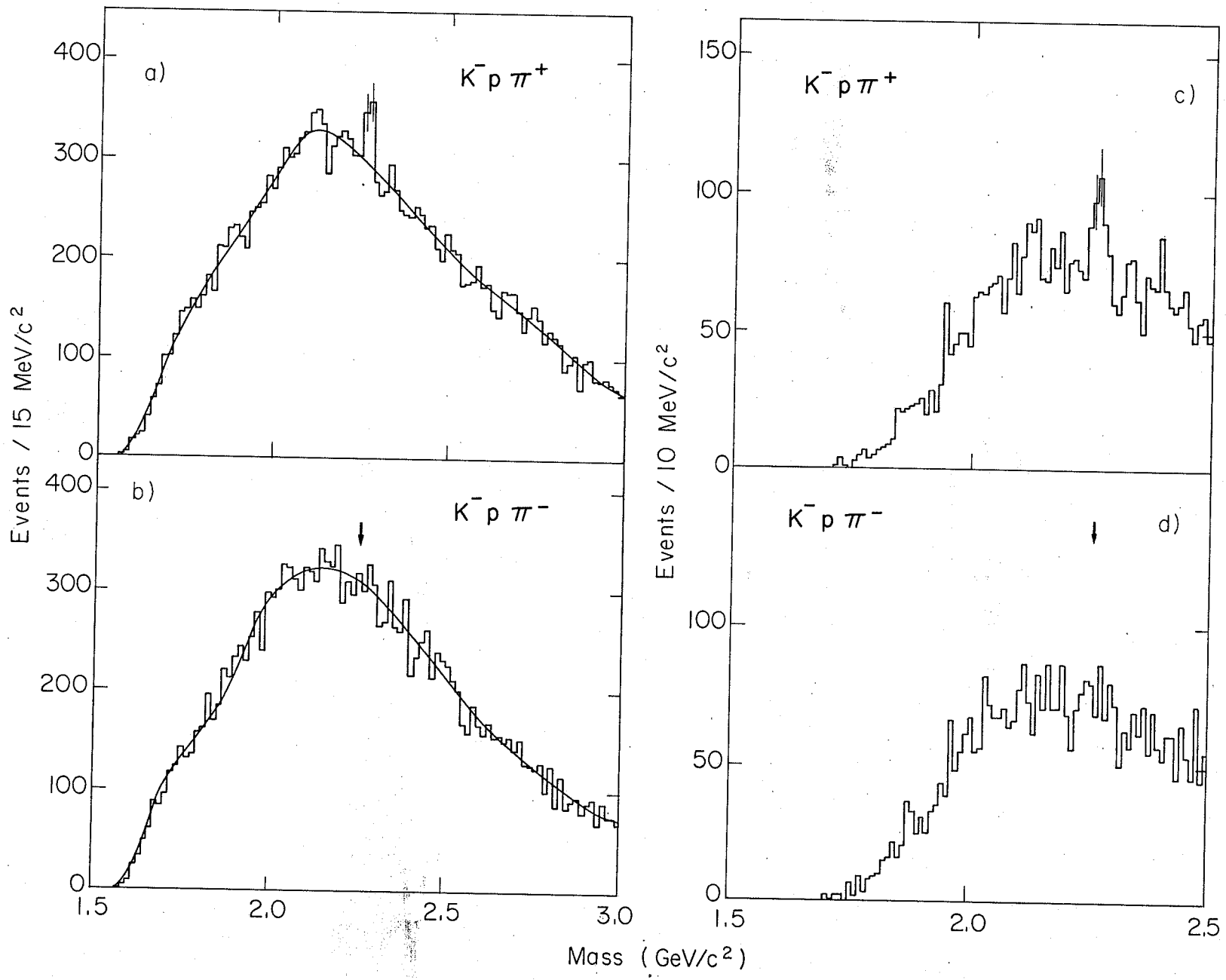
a)
$K^- p \pi^+$
b)
$K^- p \pi^-$
c)
$K^- p \pi^+$
d)
$K^- p \pi^-$
Events / 15 MeV/c²
Events / 10 MeV/c²
Mass (GeV/c²)
400
300
200
100
0
150
50
1.5
2.0
2.5
3.0

Fig. 1

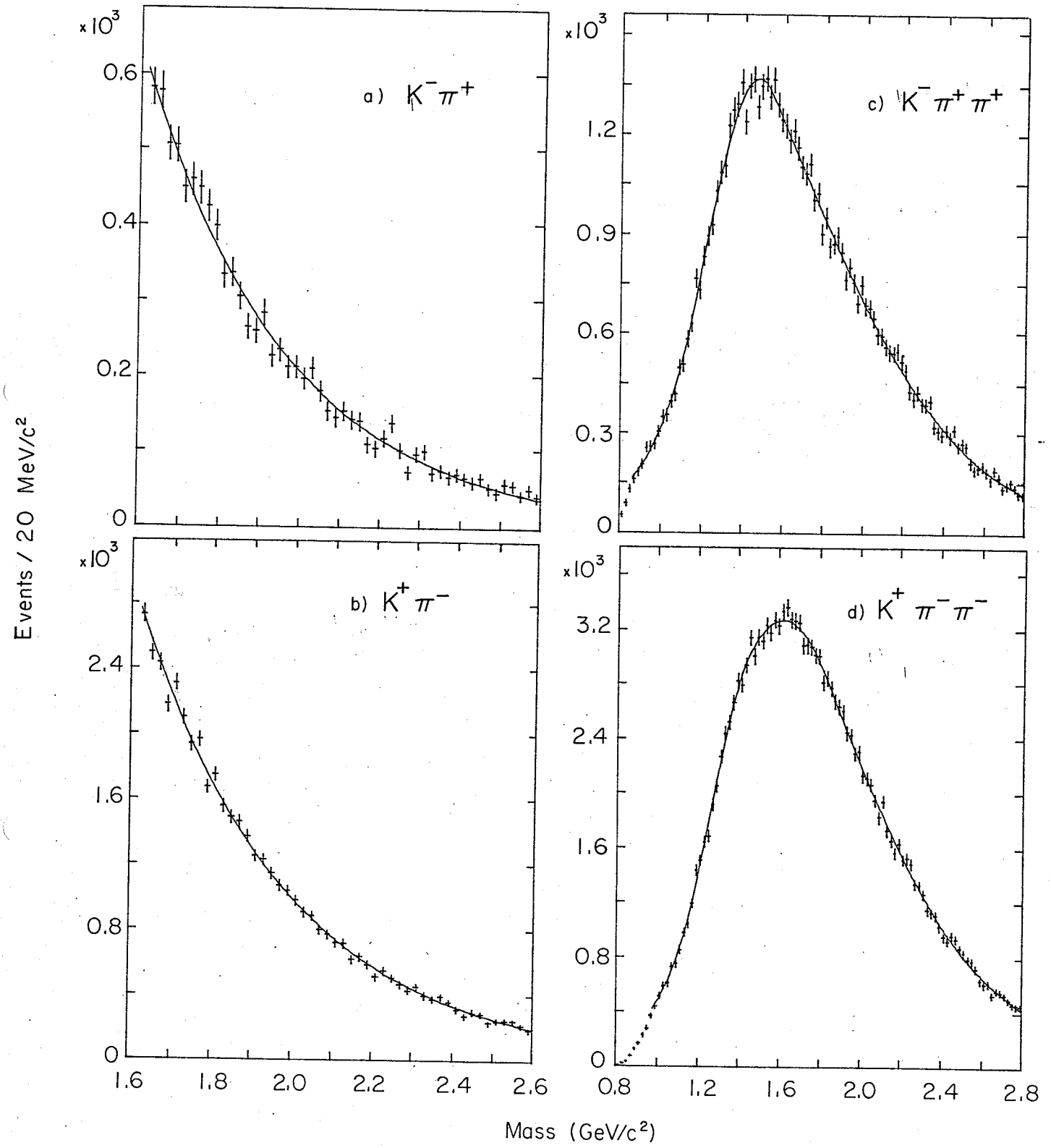

Fig.2