ON ANALYSIS OF TOPOLOGICAL CROSS-SECTIONS IN $\bar{p}p$ INTERACTIONS AT 22.4 GeV/c

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(Presented by M. Suk)

In this report I present some results on the analysis of topological cross-sections in $\bar{p}p$ interactions at 22.4 GeV/c. The experimental details, cross-section estimates, and full analysis in the frame of the above collaboration are published elsewhere[1]).

In the course of scanning 20,000 bubble chamber pictures we have found 11,558 events of interactions of antiprotons with protons at the laboratory momentum p_{lab} = 22.4 GeV/c.

In Table 1 the number of events for different topologies as well as corresponding cross-sections are presented.

Table 1

No. of prongs	No. of events	Cross-section (mb) (normalized to 48.0 ± 0.5 mb) [2,3])
0	166 ± 17	0.65 ± 0.07
2	3863 ± 71	17.75 ± 0.80
2 inel.		8.81 ± 0.90
4	3599 ± 64	14.17 ± 0.32
6	2410 ± 52	9.45 ± 0.24
8	1080 ± 35	4.25 ± 0.15
10	361 ± 20	1.42 ± 0.80
12	62 ± 8	0.24 ± 0.03
14	16 ± 4	0.06 ± 0.02
16	1 ± 1	0.004 ± 0.004
Total	11558 ± 117	48.0 ± 0.5
Total inelastic		39.1 ± 0.8

A comparison with other experiments is given in Fig. 1 [4]).

Values of quantities frequently used in the analysis of multiplicity distributions are given in Table 2.

Table 2

$\langle n \rangle$	D	$\langle n \rangle/D$	c_2	c_3	c_4	f_2^-
4.69±0.05	2.3±0.06	2.04±0.05	1.24±0.01	1.8±0.03	2.94±0.08	-1.02±0.06

The energy dependence of the charged multiplicity is displayed and compared with the data of pp interactions in Fig. 2. For p_{lab} from 5 to 32 GeV/c the experimental points were fitted by $\langle n_{ch} \rangle = a + b \ln (s/s_0)$, where a = 0.69 ± 0.19, b = 1.05 ± 0.05, and $s_0 = 1 \text{ GeV}^2$.

The early scaling of $\langle n_{ch} \rangle/D$ for $\bar{p}p$ interactions[5] holds for our values given in Table 2. Figure 3 gives the $\langle n_{ch} \rangle/D$ values as a function of total centre-of-mass energy squared (s) for $\bar{p}p$ and pp interactions.

Normalized multiplicity distribution for inelastic $\bar{p}p$ interactions at 22.4 GeV/c is compared with high-energy pp data in Fig. 4 [6].

From our preliminary analysis we can summarize the following conclusions:

i) The inelastic topological cross-sections are in agreement with expected behaviour at higher energy.

ii) Average charged multiplicity at 22.4 GeV/c is $\langle n_{ch} \rangle = 4.69 \pm 0.05$. The $\langle n_{ch} \rangle/D = 2.04 \pm 0.05$ is comparable to the value of inelastic pp interactions at very high energies.

iii) The distribution of normalized multiplicity of inelastic $\bar{p}p$ interactions at our energy is comparable to that of inelastic pp interactions at very high energy.

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Figure captions

Fig. 1 : Topological cross-sections as a function of p_{lab}.

Fig. 2 : Average charged multiplicity as a function of centre-of-mass energy squared. The lines correspond to pp data and to fitted $\bar{p}p$ data with $p_{lab} > 5$ GeV/c.

Fig. 3 : Energy dependence of the ratio $\langle n_{ch} \rangle / D$ compared with pp interactions.

Fig. 4 : Distribution of normalized multiplicities for inelastic $\bar{p}p$ interactions at 22.4 GeV/c compared with a fitted pp data at very high energies (Ref. 6).

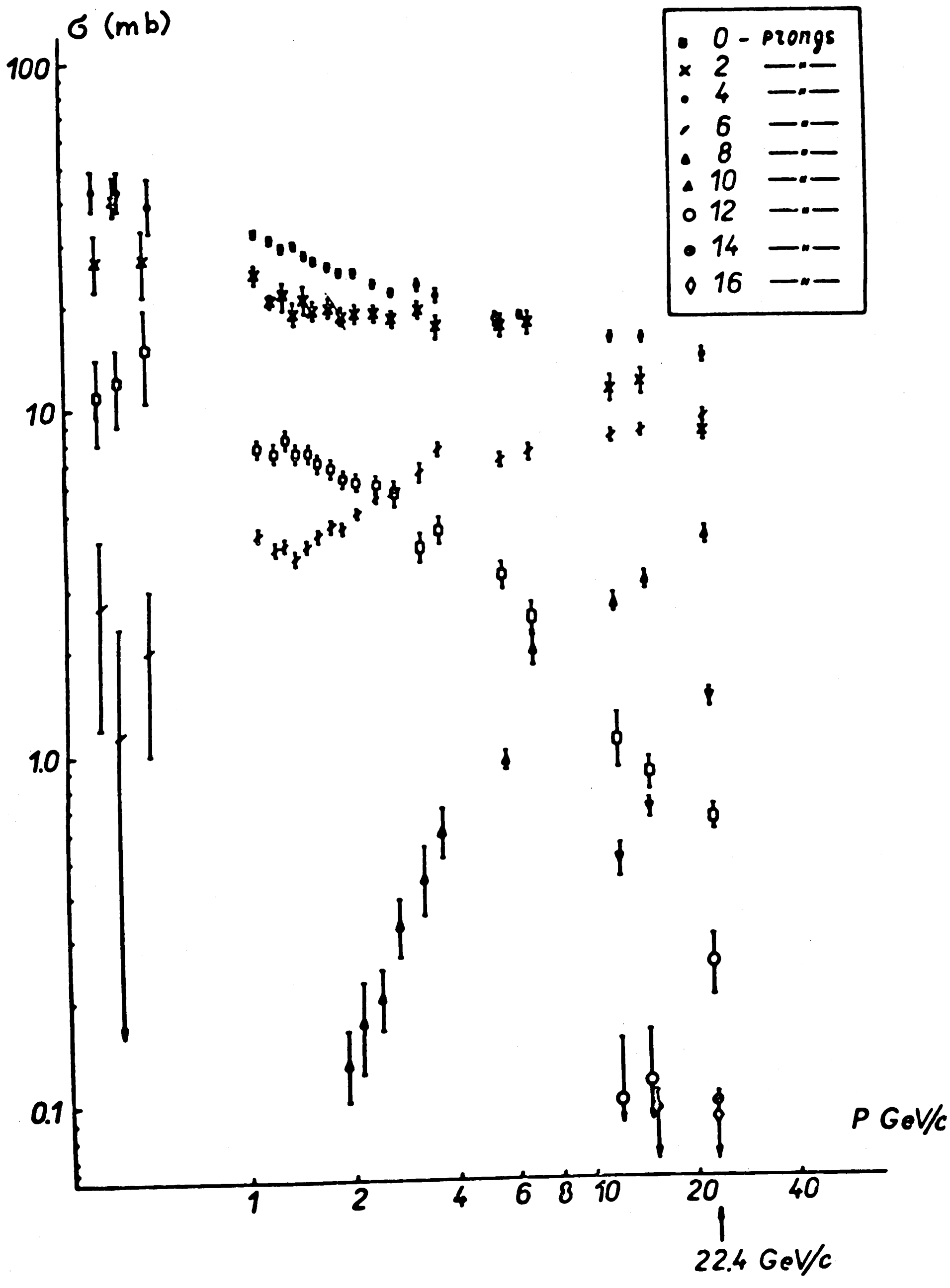
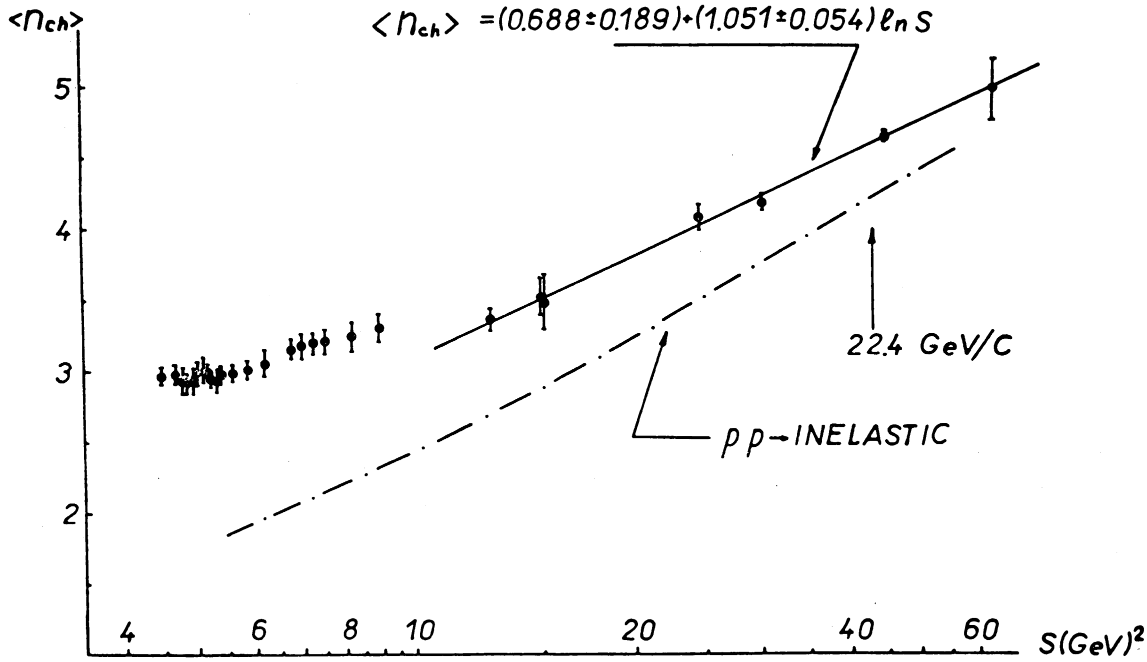
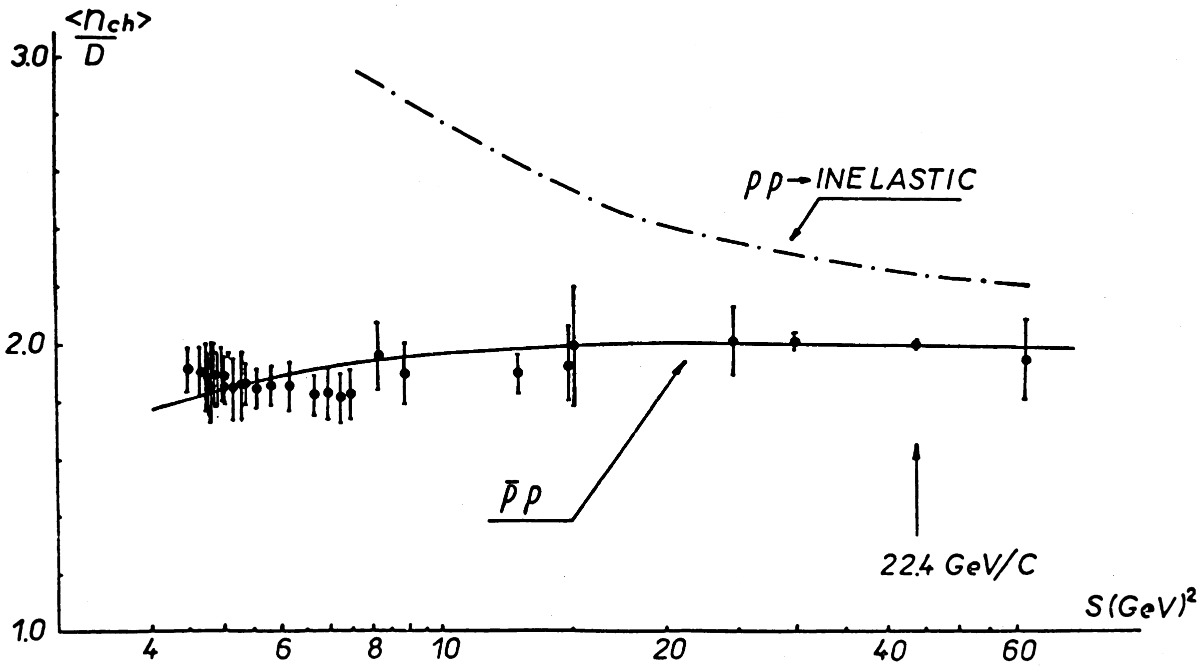

σ (mb)
100
10
1.0
0.1
0 - prongs
2
4
6
8
10
12
14
16
P GeV/c
1
2
4
6
8
10
20
40
22.4 GeV/c

Fig. 1



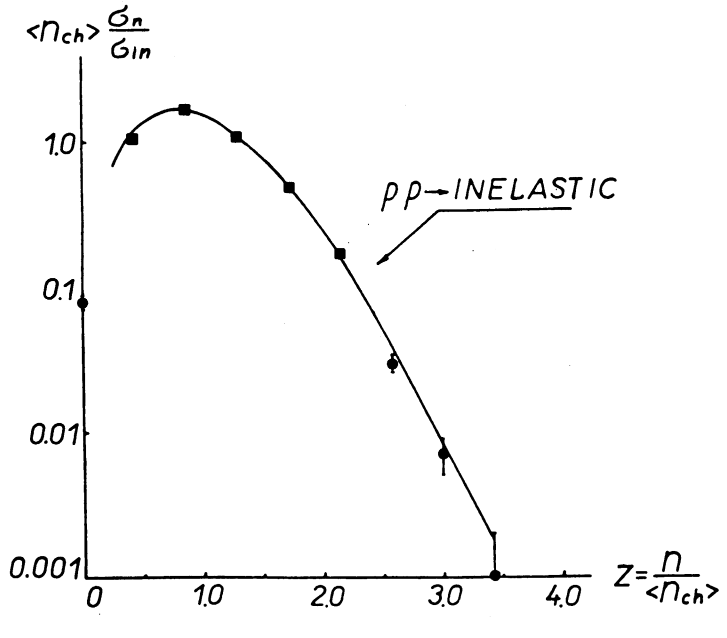
<nch>
<nch> =(0.688±0.189)+(1.051±0.054)ℓn S
5
4
3
2
22.4 GeV/C
pp→INELASTIC
4
6
8
10
20
40
60
S(GeV)²

Fig. 2



<nch>/D
3.0
2.0
1.0
pp→INELASTIC
p̄p
22.4 GeV/C
S(GeV)²
4
6
8
10
20
40
60

Fig. 3



$<n_{ch}> \frac{\sigma_n}{\sigma_{in}}$
1.0
0.1
0.01
0.001
0
1.0
2.0
3.0
4.0
$Z=\frac{n}{<n_{ch}>}$
pp→INELASTIC

Fig. 4

D I S C U S S I O N

- *Bartke:*

There are two components in $\bar{p}p$ interactions: the annihilations and inelastic reactions. How do you explain that -- as you have shown -- the multiplicity distribution for $\bar{p}p$ collisions is the same as for pp interactions?

- *Kitagaki:*

At 15 GeV/c the multiplicity distribution for $\bar{p}p$ interactions has the same shape as at 22.4 GeV/c.

- *Miettinen:*

The multiplicity distribution has two basic parameters, the $\langle n \rangle$ and D. Now the horizontal axis is scaled by $n/\langle n \rangle$, and thus $\langle n \rangle$ is out of the game. The width D of the low-energy $\bar{p}p$ -- and high-energy pp -- interactions is the same and, therefore, we have the same shape for the multiplicity distributions. This agreement is accidental. There is no physics in it.

- *Šimák:*

Yes, but what is surprising for me is such nice agreement of both distributions.