INCLUSIVE CROSS SECTION RATIOS IN HIGH p_T PROTON-PROTON
SCATTERING AT ISR ENERGIES

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ABSTRACT

Ratios of inclusive cross sections $\sigma(\pi^+)/\sigma(\pi^+ + K^+ + p)$ and $\sigma(\pi^-)/\sigma(\pi^- + K^- + \bar{p})$ were measured for proton-proton interactions with a high p_T hadron in the final state around c.m.s. scattering angles $\theta \approx 10^\circ$, 20° and 45° at two ISR energies $\sqrt{s} = 31$ GeV and 62 GeV. Results are shown as functions of transverse and longitudinal momentum and are compared with parton model predictions. The different dependences of positive and negative pion fractions at $p_T \approx 2-3$ GeV/c on longitudinal momenta is similar to that observed in soft hadronic interactions at low values of p_T where the leading proton effect (diquark fragmentation) is known to contribute. The quantitative agreement of the data with diquark model predictions indicates the presence of diquark fragmentation also in high p_T jets.

1. INTRODUCTION

Hard scattering of elementary particles with production of high transverse momentum jets is one of the most important tests for parton models and Quantum Chromodynamics (QCD) [1]. Studies of leading particles in jets showed that knowledge of the particle identity directly gives information about the underlying parton scattering [2]. Identification of leading mesons in large p_T jets allowed the separation of gluon scattering from other high p_T processes [3]. The behaviour of leading baryons produced at high p_T showed new features unexplained within a standard parton model [4].

In this paper we present our analysis of high p_T processes at ISR energies, giving results on ratios of inclusive cross sections for negative and positive pions separately. In phase space regions limited by the geometric acceptance of Cherenkov counters the ratios are studied as functions of transverse momentum p_T , Feynman $x = 2p_L/\sqrt{s}$ and scattering angle θ . In comparison with previous measurements of particle ratios [5-6] this experiment extends the high statistics data to forward scattering angles ($\theta \approx 5-30^\circ$) and to higher transverse momenta. For completeness the previously published data at $\theta \approx 45^\circ$ are also shown [7].

The experiment is described in sect. 2. In sect. 3 the kinematic regions and statistics for data taken with the three triggers are presented. The results on pion ratios are shown in sect. 4 and compared with parton model calculations in sect. 5. A short summary and conclusions are given in sect. 6.

2. EXPERIMENT

The experiment was performed with the Split Field Magnet (SFM) Detector at the CERN Intersecting Storage Rings (ISR). The detector consists of a system of multiwire proportional chambers and an array of scintillation counters for time-of-flight measurements [7].

A three step trigger logic selects events with a high p_T track at a scattering angle $\theta \approx 10^\circ$, 20° or 45° . These tracks can be identified with

threshold Cherenkov counters filled with freon 114 at atmospheric pressure. The second Cherenkov counter at $\theta \approx 45^\circ$ was filled with freon 13 at 7.5 atm [4]. The configuration of the detector and the trigger telescopes are shown in fig. 1.

In this paper ratios of invariant cross sections for equally charged high transverse momentum particles are presented. These same-charge ratios are almost free of systematic errors since the geometric acceptance corrections cancel. The main corrections to the data come from inefficiencies in the Cherenkov counters. In the majority of the investigated kinematic regions the efficiency of the counters was high, on the level of 0.98-1.00 but in some border regions it dropped to ~ 0.80 . To correct the data the efficiency of the corresponding Cherenkov counter was calculated for each bin in an x versus p_T plot separately from the ADC spectra. In addition, for 20° data, particles identified as pions in the first Cherenkov counter were used to calculate the efficiency of the second counter. Comparison of the results given by the two methods showed good consistency of the data and allowed an estimate of the systematic errors.

The data were also corrected for decays in flight and for nuclear interactions of particles in the chambers of the trigger telescope. These corrections are typically 1-2% of the calculated ratios with a systematic uncertainty of 0.5%.

3. KINEMATIC REGIONS AND STATISTICS

The kinematic regions studied are determined by the fixed positions of the Cherenkov counters and therefore they cover slightly different regions of the phase space for the two studied energies. For three separate triggers the kinematic regions for positive and negative particles are shown in figs 2(a) and 2(b) for $\sqrt{s} = 62$ GeV and in figs 2(c) and 2(d) for $\sqrt{s} = 31$ GeV as functions of longitudinal (x) and transverse momentum. The data taken cover almost the full range of x at lower values of p_T and extend up to ~ 9.0 GeV/c in transverse momentum. However, the identification of pions was possible only for particles with a total laboratory momentum p_{lab} smaller than ~ 9.5 GeV/c due to the threshold for Cherenkov radiation of kaons. This diminishes the available x range, especially at the higher energy.

The statistics used for the present work consisted of 296 000 triggers at $\theta \approx 10^\circ$ and 1 050 000 triggers at $\theta \approx 20^\circ$ at $\sqrt{s} = 62$ GeV. For the lower energy the numbers of events are 152 000 and 262 000 respectively. The requirement of $p_{\text{lab}} < 9.5$ GeV/c reduces these numbers by 20-30%.

4. PION PRODUCTION

Pion ratios of inclusive cross sections, $R^+ = \sigma(\pi^+)/\sigma(\pi^+ + K^+ + p)$ and $R^- = \sigma(\pi^-)/\sigma(\pi^- + K^- + \bar{p})$, for proton-proton interactions at $\theta \approx 10^\circ$, 20° and 45° are shown in table 1 for $\sqrt{s} = 62$ GeV and in tables 2 and 3 for $\sqrt{s} = 31$ GeV as functions of x and p_T .

The p_T dependence of the data is illustrated in figs 3, 4 and 5 for different fixed values of x . For negative particles we observe: (i) a decrease of R^- with increasing p_T at lower values of p_T ; (ii) a broad minimum at $p_T \approx 2-3$ GeV/c, and (iii) a slow rise of R^- at higher transverse momenta. The same behaviour is observed for all x bins although the R^- values at a fixed p_T increase with increasing x . For positive particles R^+ rises monotonically with increasing transverse momentum, and again this kind of behaviour is observed for all x bins.

For $x = 0.1-0.2$ and $x = 0.2-0.3$ the data for the two energies are plotted in the same figures. Although the overlap regions of both sets of data are limited, we can conclude that the energy dependence of R^+ and R^- is rather small. For higher x ($x > 0.3$) the data were available only at lower energy due to the trigger acceptance limitations and no energy comparisons could be made.

Independent sets of data (three trigger regions at different θ values at two energies) give consistent results in the corresponding overlapping regions of p_T and x . This provides a further check of the proper treatment of the Cherenkov counters efficiencies and applied corrections.

The x dependences of R^+ and R^- at fixed values of p_T are illustrated in figs 6, 7 and 8. Independent of a chosen p_T value, the fraction of negative pions R^- is a steeply rising function of x . At $x = 0.5$ only a few percent of the cross section is left for heavier particles (K^- , $\bar{p}$) for all

values of p_T . The fraction of positive pions shows the opposite behaviour. Starting from $R^+ \approx 0.6$ at $x \approx 0$ it decreases with increasing x .

The dependence of R^+ and R^- on x , observed here at medium and high values of p_T , resembles closely the behaviour of positive and negative pion fractions at low transverse momenta. In the soft hadronic interactions this behaviour is generally understood as a reflection of the leading proton effect [8]. In the quark models of soft hadron scattering this effect is explained by the diquark content of the forward-backward jets in proton-proton collisions.

The experimental points at the two c.m.s. energies $\sqrt{s} = 31$ GeV and $\sqrt{s} = 62$ GeV, plotted in figs 6, 7 and 8, show the same dependence on x . In fig. 8 the results of this experiment are compared with the pion fractions obtained at $\sqrt{s} = 53$ GeV [6]. The comparison indicates again a negligible dependence of the measured pion fractions on the energy.

5. PARTON MODEL PREDICTIONS

The hard scattering of quarks and gluons was simulated by the Monte-Carlo program described in detail in ref. [9]. The program used the structure functions for protons from the CDHS Experiment data [10] and the Field-Feynman fragmentation functions for partons [11]. In the simulation no fragmentation of quarks and gluons to protons was attempted. The small contribution from this fragmentation was divided equally between pions and kaons. The process of diquark scattering was not included in this version of the simulation program.

The results of the model are shown in figs 9 and 10 where the pion fractions R^+ and R^- are plotted as functions of p_T at fixed values of θ for $\sqrt{s} = 62$ GeV and $\sqrt{s} = 31$ GeV respectively. The model describes reasonably well the negative pion ratios at both energies. The data in fig. 9 for $\theta = 18^\circ$ are fitted well and there is only a ten percent difference between the model predictions and the data for R^- shown in fig. 10 at $\theta = 14^\circ$. On the other hand, the positive pion ratios R^+ shown in fig. 10 are not described properly by the model. The discrepancy between the model and the data is increasing for smaller angles ($\theta = 20^\circ$) shown in fig. 10.

A similar discrepancy was observed previously for the complementary data on high p_T baryon production in proton-proton collisions [4]. Although the production of antiprotons was well described by the standard quark model, in the case of proton production this model failed to describe the magnitude and θ and p_T dependence of the proton relative yields. The contribution from diquark scattering [12] was proposed to explain the features of high p_T proton production [13]. The model applies to particles with $p_T > 2.5$ GeV/c. The predictions of this model for R^+ at $\sqrt{s} = 62$ GeV, $\theta = 26^\circ$ and at $\sqrt{s} = 31$ GeV, $\theta = 20^\circ$ are in good agreement with the high p_T end of the data shown in figs 9 and 10 respectively. About 90% of high p_T protons originate from diquark scattering in this phase space region. In the behaviour of pion fractions we see the reflection of this mechanism: the fast decrease of the positive pion fraction with increasing x due to the dominant fast proton production. We observe the increase of negative pion fraction where the diquark scattering cannot contribute.

6. CONCLUSIONS

The pion ratios were measured as functions of x and p_T in the forward region of proton-proton scattering at ISR energies. At fixed x and higher transverse momenta ($p_T > 2$ GeV/c) both negative and positive pion fractions increase slightly with p_T . There is a strong dependence of R^+ and R^- on a longitudinal momentum similar to that observed at low p_T pion production in "soft" proton-proton interactions: the positive pion fractions decrease with x and the negative pion contribution shows a strong increase with increasing x . In the studied region of transverse momenta $p_T \approx 1-3$ GeV/c the magnitude of R^+ decreases and that of R^- increases with longitudinal momentum. Their dependence on p_T is small. Similar properties of pion production at low and high p_T suggest a common origin of this behaviour: the fragmentation of diquarks with a substantial contribution of fast protons (leading proton effect) which suppresses the relative positive pion contribution at higher x . For negative particles this process is absent and pions dominate.

The predictions of the diquark model are in good agreement with the data at higher values of p_T . This indicates the presence of diquark fragmentation also in high p_T jets.

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REFERENCES

- [1] M. Jacob, Proceedings of 22nd International Conference on High Energy Physics, Leipzig (1984) 150.
- [2] A. Breakstone et al., Zeitschr. für Phys. C27 (1985) 205.
- [3] A. Breakstone et al., Phys. Lett. 135B (1984) 510.
- [4] A. Breakstone et al., Phys. Lett. 147B (1984) 237.
- [5] B. Alper et al., Nucl. Phys. B87 (1975) 19.
- [6] M. Della Negra et al., Phys. Lett. 59B (1975) 481.
- [7] D. Drijard et al., Nucl. Phys. B208 (1982) 1.
- [8] A. Breakstone et al., Phys. Lett. 132B (1983) 458;
J.L. Bailly et al., Zeitschr. für Phys. C31 (1986) 367.
- [9] T. Lohse, Diploma Thesis, University of Dortmund (1982).
- [10] H. Abramowicz et al., Zeitschr. für Phys. C12 (1982) 289.
- [11] R.P. Feynman, R.D. Field, Nucl. Phys. B136 (1978) 1.
- [12] S. Ekelin and S. Fredriksson, Phys. Lett. 149B (1984) 509.
- [13] A. Breakstone et al., Zeitschr. für Phys. C28 (1985) 335.

TABLE CAPTIONS

Table 1 Ratios of inclusive cross sections $R^+ = \sigma(\pi^+)/\sigma(\pi^+ + K^+ + p)$ and $R^- = \sigma(\pi^-)/\sigma(\pi^- + K^- + \bar{p})$ in x - p_T bins for proton-proton scattering at $\sqrt{s} = 62$ GeV.

Table 2 Ratios of inclusive cross sections $R^+ = \sigma(\pi^+)/\sigma(\pi^+ + K^+ + p)$ in x - p_T bins for proton-proton scattering at $\sqrt{s} = 31$ GeV.

Table 3 Ratios of inclusive cross sections $R^- = \sigma(\pi^-)/\sigma(\pi^- + K^- + \bar{p})$ in x - p_T bins for proton-proton scattering at $\sqrt{s} = 31$ GeV.

TABLE 1

P_T [GeV/c]	x	Positives			Negatives		
		0.0-0.1	0.1-0.2	0.2-0.3	0.0-0.1	0.1-0.2	0.2-0.3
1.0-1.2		-	-	-	-	-	± 0.920 ± 0.016
1.2-1.4		-	-	-	-	± 0.701 ± 0.099	± 0.880 ± 0.014
1.4-1.6		± 0.632 ± 0.015	-	± 0.522 ± 0.065	± 0.707 ± 0.010	± 0.781 ± 0.007	± 0.820 ± 0.002
1.6-1.8		± 0.623 ± 0.007	-	± 0.485 ± 0.030	± 0.701 ± 0.006	± 0.780 ± 0.003	± 0.803 ± 0.001
1.8-2.0		± 0.599 ± 0.007	-	± 0.507 ± 0.016	± 0.687 ± 0.006	± 0.802 ± 0.017	± 0.794 ± 0.001
2.0-2.2		± 0.596 ± 0.007	± 0.524 ± 0.013	± 0.511 ± 0.008	± 0.678 ± 0.006	-	± 0.795 ± 0.001
2.2-2.4		± 0.597 ± 0.008	± 0.540 ± 0.003	± 0.520 ± 0.009	± 0.676 ± 0.007	-	± 0.802 ± 0.002
2.4-2.6		± 0.595 ± 0.009	± 0.540 ± 0.003	± 0.530 ± 0.008	± 0.687 ± 0.008	-	± 0.800 ± 0.003
2.6-2.8		± 0.579 ± 0.010	± 0.542 ± 0.004	± 0.535 ± 0.003	± 0.711 ± 0.010	-	± 0.824 ± 0.006
2.8-3.0		± 0.587 ± 0.010	± 0.550 ± 0.007	± 0.540 ± 0.003	± 0.696 ± 0.013	-	± 0.829 ± 0.086
3.0-3.2		± 0.602 ± 0.004	± 0.538 ± 0.026	± 0.548 ± 0.004	± 0.711 ± 0.004	-	-
3.2-3.4		± 0.606 ± 0.005	-	± 0.550 ± 0.006	± 0.711 ± 0.005	-	-
3.4-3.6		± 0.599 ± 0.005	-	± 0.572 ± 0.010	± 0.718 ± 0.006	-	-
3.6-3.8		± 0.608 ± 0.006	-	± 0.574 ± 0.025	± 0.727 ± 0.007	-	-
3.8-4.0		± 0.595 ± 0.008	-	-	± 0.735 ± 0.008	-	-
4.0-4.2		± 0.608 ± 0.005	-	-	-	± 0.728 ± 0.004	-
4.2-4.4		± 0.622 ± 0.005	-	-	-	± 0.751 ± 0.005	-
4.4-4.6		± 0.608 ± 0.006	-	-	-	± 0.751 ± 0.006	-
4.6-5.0		± 0.608 ± 0.006	-	-	-	± 0.771 ± 0.005	-
5.0-5.4		± 0.623 ± 0.008	-	-	-	± 0.778 ± 0.007	-
5.4-5.8		± 0.636 ± 0.011	-	-	-	± 0.801 ± 0.009	-
5.8-6.2		± 0.649 ± 0.011	-	-	-	± 0.801 ± 0.010	-
6.2-7.0		-	± 0.624 ± 0.017	-	-	± 0.852 ± 0.010	-
7.0-8.0		-	± 0.683 ± 0.020	-	-	± 0.863 ± 0.019	-
8.0-9.0		-	± 0.623 ± 0.040	-	-	± 0.906 ± 0.032	-

Additional systematic error: ± 0.020

TABLE 2

P_T [GeV/c]	x	0.1-0.2	0.2-0.3	0.3-0.4	0.4-0.5	0.5-0.6
1.0-1.2	-		0.468 ± 0.006	0.347 ± 0.002	0.251 ± 0.002	0.146 ± 0.020
1.2-1.4	0.509 ± 0.004		0.485 ± 0.006	0.410 ± 0.002	0.276 ± 0.002	0.180 ± 0.003
1.4-1.6	0.458 ± 0.014		0.437 ± 0.003	0.408 ± 0.004	0.335 ± 0.003	0.207 ± 0.003
1.6-1.8	0.578 ± 0.010		0.418 ± 0.004	0.378 ± 0.006	0.356 ± 0.005	0.272 ± 0.006
1.8-2.0	0.546 ± 0.012		0.398 ± 0.010	0.378 ± 0.006	0.340 ± 0.015	0.304 ± 0.010
2.0-2.2			0.475 ± 0.034	0.379 ± 0.009	0.340 ± 0.010	0.305 ± 0.018
2.2-2.4	0.581 ± 0.540		-	0.392 ± 0.016	0.325 ± 0.015	0.366 ± 0.078
2.4-2.6			-	0.404 ± 0.031	0.357 ± 0.022	0.322 ± 0.041
2.6-2.8	0.538 ± 0.026		-	-	0.398 ± 0.037	0.276 ± 0.049
2.8-3.0			-	-	0.402 ± 0.057	0.390 ± 0.081
3.0-3.2	-		0.581 ± 0.041	-	0.404 ± 0.097	-
3.2-3.4	-			-	-	-

Additional systematic error: ± 0.020

TABLE 3

P_T [GeV/c]	x	0.0-0.1	0.1-0.2	0.2-0.3	0.3-0.4	0.4-0.5	0.5-0.6	0.6-0.7
0.2-0.4	-	-	-	-	0.964 ± 0.032	-	-	-
0.4-0.6	-	-	-	0.954 ± 0.043	0.937 ± 0.014	0.962 ± 0.009	-	-
0.6-0.8	-	-	-	0.972 ± 0.011	0.914 ± 0.041	0.940 ± 0.003	0.972 ± 0.014	-
0.8-1.0	-	-	0.902 ± 0.030	0.876 ± 0.002	0.901 ± 0.003	0.928 ± 0.002	0.950 ± 0.004	-
1.0-1.2	-	-	-	0.866 ± 0.002	0.901 ± 0.013	0.900 ± 0.005	0.950 ± 0.003	0.952 ± 0.032
1.2-1.4	-	-	-	0.852 ± 0.003	0.872 ± 0.003	0.900 ± 0.009	0.747 ± 0.004	-
1.4-1.6	0.741 ± 0.011	-	-	0.858 ± 0.011	0.859 ± 0.003	0.891 ± 0.005	0.910 ± 0.011	-
1.6-1.8		-	-	-	0.852 ± 0.005	0.900 ± 0.007	0.918 ± 0.018	-
1.8-2.0	-	-	0.741 ± 0.011	-	0.856 ± 0.010	0.892 ± 0.009	0.946 ± 0.014	-
2.0-2.2	-	-	-	-	0.867 ± 0.034	0.894 ± 0.012	0.924 ± 0.018	-
2.2-2.4	-	-	0.746 ± 0.022	-	-	0.914 ± 0.019	0.956 ± 0.025	-
2.4-2.6	-	-	-	-	-	0.865 ± 0.041	0.875 ± 0.051	-
2.6-2.8	-	-	-	-	-	-	0.868 ± 0.065	-

Additional systematic error: ± 0.020

FIGURE CAPTIONS

- Fig. 1 Top view of the Split Field Magnet Detector. The three regions of triggers at the scattering angles $\theta \approx 10^\circ$, 20° and 45° and the corresponding Cherenkov counters are shown.
- Fig. 2 The kinematic regions accepted by the three triggers at $\theta \approx 10^\circ$, 20° and 45° in the reduced longitudinal (x) and transverse momentum plane:
- (a) positive particles at $\sqrt{s} = 62$ GeV,
 - (b) negative particles at $\sqrt{s} = 62$ GeV,
 - (c) positive particles at $\sqrt{s} = 31$ GeV,
 - (d) negative particles at $\sqrt{s} = 31$ GeV.
- Fig. 3 Pion ratios $R^+ = \sigma(\pi^+)/\sigma(\pi^+ + K^+ + p)$ and $R^- = \sigma(\pi^-)/\sigma(\pi^- + K^- + \bar{p})$ at fixed $x = 0.1-0.2$ and two c.m.s. energies $\sqrt{s} = 31$ GeV and $\sqrt{s} = 62$ GeV as functions of transverse momentum. The additional systematic error is ± 0.020 .
- Fig. 4 Pion ratios $R^+ = \sigma(\pi^+)/\sigma(\pi^+ + K^+ + p)$ and $R^- = \sigma(\pi^-)/\sigma(\pi^- + K^- + \bar{p})$ at fixed $x = 0.2-0.3$ and two c.m.s. energies $\sqrt{s} = 31$ GeV and $\sqrt{s} = 62$ GeV as functions of transverse momentum. The additional systematic error is ± 0.020 .
- Fig. 5 Pion ratios $R^+ = \sigma(\pi^+)/\sigma(\pi^+ + K^+ + p)$ and $R^- = \sigma(\pi^-)/\sigma(\pi^- + K^- + \bar{p})$ at fixed $x = 0.4-0.5$ and $\sqrt{s} = 31$ GeV as functions of transverse momentum. The additional systematic error is ± 0.020 .
- Fig. 6 Pion ratios $R^+ = \sigma(\pi^+)/\sigma(\pi^+ + K^+ + p)$ and $R^- = \sigma(\pi^-)/\sigma(\pi^- + K^- + \bar{p})$ at fixed $p_T = 2.1$ GeV/c and two c.m.s. energies $\sqrt{s} = 31$ GeV and $\sqrt{s} = 62$ GeV as functions of a reduced longitudinal momentum x .

FIGURE CAPTIONS

- Fig. 7 Pion ratios $R^+ = \sigma(\pi^+)/\sigma(\pi^+ + K^+ + p)$ and $R^- = \sigma(\pi^-)/\sigma(\pi^- + K^- + \bar{p})$ at fixed $p_T = 2.5$ GeV/c (R^-) and $p_T = 2.9$ GeV/c (R^+) and two c.m.s. energies $\sqrt{s} = 31$ GeV and $\sqrt{s} = 62$ GeV as functions of a reduced longitudinal momentum x .
- Fig. 8 Pion ratios $R^+ = \sigma(\pi^+)/\sigma(\pi^+ + K^+ + p)$ and $R^- = \sigma(\pi^-)/\sigma(\pi^- + K^- + \bar{p})$ at fixed $p_T = 1.3$ GeV/c (R^-) and $p_T = 1.5$ GeV/c (R^+) and two c.m.s. energies $\sqrt{s} = 31$ GeV and $\sqrt{s} = 62$ GeV as functions of a reduced longitudinal momentum x . The R^- data from the experiment [6] at $\sqrt{s} = 53$ GeV are shown for comparison.
- Fig. 9 Positive and negative pion fractions at $\sqrt{s} = 62$ GeV and a fixed scattering angle $\theta = 26^\circ$ for R^+ and $\theta = 18^\circ$ for R^- shown as functions of transverse momentum. The predictions of the parton models described in the text are also presented.
- Fig. 10 Positive and negative pion fractions at $\sqrt{s} = 31$ GeV and a fixed scattering angle $\theta = 20^\circ$ for R^+ and $\theta = 14^\circ$ for R^- shown as functions of transverse momentum. The predictions of the parton models described in the text are also presented.

SFM Detector (1983)

Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

Fig. 6

Fig. 7

Fig. 8

Fig. 9

Fig. 10