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THE DEPENDENCE OF THE CORRELATION STRENGTH ON AVERAGE TRANSVERSE MOMENTUM PER EVENT AND ON MULTIPLICITY[1]

UA1-MINIMUM BIAS-Collaboration

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An analysis using the UAI minimum bias data shows that the correlation strength ϕ_i is dependent on the average transverse momentum per event $\bar{p}_t$ and on multiplicity N. The enhancements of ϕ_i for high and low $\bar{p}_t$ events suggest at least two different physical components which cause the correlation. $\bar{p}_t$ may be a good quantity to distinguish soft and hard processes. A detailed comparison of a low $\bar{p}_t$ event sample with the Lund Monte Carlo Pythia 5.6 provides interesting insights into the reason of its failure.

1. Introduction

It has been shown by Białas and Peschanski [1] that factorial moments of the form:

$$F_i(\delta\eta) = \frac{1}{M}\sum_m \frac{< N_m(N_m-1)\cdots(N_m-i+1) >}{< N_m >^i} \tag{1}$$

or the correlation integrals [2]

$$C_i(\delta\eta) = \frac{\int_{\Omega_s} \Pi_k d\eta_k \rho_i(\eta_1,\cdots,\eta_i)}{\int_{\Omega_s} \Pi_k d\eta_k \rho_1(\eta_1)\cdots\rho_1(\eta_i)} \tag{2}$$

(averaged over M pseudorapidity intervals of binwidth $\delta\eta$ or integration domains Ω_s, respectively) extract the non-statistical (dynamical) fluctuations in contrast to the statistical bin to bin fluctuations. If such dynamic fluctuations do exist at all scales in multiparticle production, then as $\delta\eta \to 0$, factorial moments obey a power law as:

$$F_i(\delta\eta)\,\alpha\,(\frac{1}{\delta\eta})^{\phi_i} \tag{3}$$

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where ϕ_i is called intermittency degree [1] or correlation strength respectively. Positive intermittency exponents ($\phi_i > 0.$) have been obtained in the range of scales from $\delta\eta = 1.0$ to $\delta\eta = 0.1$ by many high energy e^+e^-, lepton-nucleus, hadron-hadron, hadron-nucleus, and nucleus-nucleus collision experiments [3].

Eqn. (3) however fails to describe the factorial moments $F_i(\delta\eta)$ in a larger range of scales which is extended to the whole η interval under consideration. This non-linearity of $\log F_i(\delta\eta)$ with respect to $\log \delta\eta$ in the one-dimensional phase space volume $\Delta\eta$ was argued [4] to be the natural consequence of intermittency occuring in higher dimensional phase space. Fig.1 shows that this is indeed the case, as $\log K_2$ (approximately the second order cumulant obtained from $\sqrt{s} = 630$ GeV UA1 minimum bias data) is a linear function of ${}_2\log(1/l)$ over the whole range, where l is the 3-dimensional variable $l = \sqrt{\delta\eta^2 + \delta\varphi^2 + \delta(\ln p_t)^2}$. It is still not clearly understood which physical mechanisms at the hadron and parton levels are responsible for the intermittency phenomenon, especially for soft collisions, although Bose-Einstein correlations, resonance production and parton cascading are believed to contribute to it. It has indeed been shown recently, that like sign particle correlations contribute substantially in small three dimensional phase space bins [6]-[8]. As a further step in these investigations, we studied the correlation strength not only as a function of the charged particle multiplicity per event, but in particular also of the average transverse momentum per event [9] defined as:

$$\bar{p}_t = \frac{\sum_i^N p_{ti}}{N} \tag{4}$$

where N is the multiplicity of final state charged particles and p_{ti} the transverse momentum of the ith charged particle. The variable $\bar{p}_t$ characterizes an event as a whole. Low $\bar{p}_t$ events are very soft by definition. High $\bar{p}_t$ events contain particles with significantly higher transverse momenta from hard scattering subprocesses. Event selection based on $\bar{p}_t$ is qualitatively different from a selection based on the transverse momentum of single tracks.

The aim of this paper is to make a detailed comparison of the correlation strength between the experimental data and the Lund Monte Carlo Pythia 5.6 [10]. Although resonance and jet production, the Bose-Einstein effect and kinematical constraints are incorporated into the minimum bias event generator of this Monte Carlo program, the generated correlations are in strong disagreement with the measured ones particularly for soft reactions. This has been shown for low multiplicity samples in one and two dimensional analysis [11,16]. By selecting a low $\bar{p}_t$ event sample where these discrepancies are largest, and by studying them for like-sign and unlike-sign particles separately, we shall infer the origin of failure of the Monte Carlo model.

We present our measurement of factorial moment F_2 as a function of $\delta\eta$ (one-dimensional analysis) along with that of the correlation integral:

$$C_2(Q^2) = \frac{\int_0^{Q^2} \rho_2(Q^2)dQ^2}{\int_0^{Q^2} \rho_1 \otimes \rho_1(Q^2)dQ^2} \tag{5}$$

with

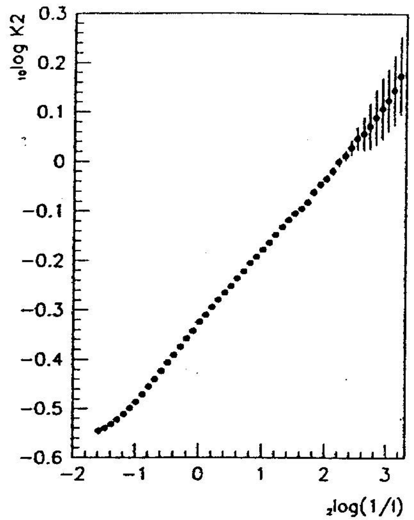

Figure 1. Three dimensional analysis with the correlation integral C_2 with respect to l, defined in the text. The region of analysis extends over 4 orders of magnitude of phase space volumes ($v = l^3$), namely from $v_1 = 27$ down to $v_2 = 0.001$. $K_2 = C_2 - 1.18$ has been estimated by performing the fit [5] $C_2 = a + bl^{-\phi}$ with $a = 1.18 \pm 0.09, b = 0.47 \pm 0.10, \phi = 0.49 \pm 0.10, \chi^2/NF = 22/47$. The errors are mainly due to systematic uncertainties.

$$\rho_2(Q^2) = \int d^3p_1 d^3p_2 \cdot \rho_2(p_1, p_2) \cdot \delta(Q^2 + (p_1 - p_2)^2),$$

$$\rho_1 \otimes \rho_1(Q^2) = \int d^3p_1 d^3p_2 \cdot \rho_1(p_1) \cdot \rho_1(p_2) \cdot \delta(Q^2 + (p_1 - p_2)^2)$$

defined in [12] and depending on Q^2, the 4-momentum difference of two particles (three-dimensional analysis), and use the intermittency exponents (slope parameters) ϕ_2 to characterize the correlation strength as exemplified by Figs. 2a and b. The bending of F_2 *vs.* $\delta\eta$ (Fig.2a) at $\delta\eta \approx 1$ requires to characterize the correlations in the one-dimensional $\delta\eta$ analysis by two slope parameters ϕ_2 in each of the ranges $0.1 \leq \delta\eta \leq 1.0$ and $1.0 \leq \delta\eta \leq 3.0$. As we are mainly interested in short range correlations, we do not concentrate on the numerical magnitude of the F_2 values themselves in this study.

2. Data Sample and Analysis Cuts

The present analysis is based on 159154 non-single-diffractive $\sqrt{s} = 630$ GeV events collected with a minimum bias trigger [13] in the UA1 1985 data taking run at the CERN proton-antiproton collider. Only charged tracks associated with the primary vertex reconstructed from the raw data of the central detector, with $p_t \geq$

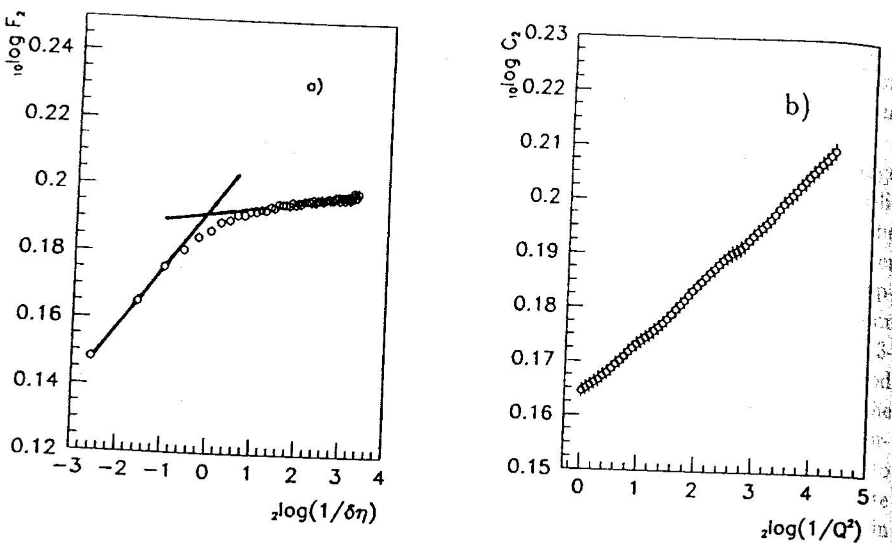

Figure 2. (a) Second order factorial moment F_2 *vs.* $\delta\eta$ (one-dimensional analysis) and (b) second order correlation integral C_2 *vs.* Q^2 (three-dimensional analysis), obtained from $\sqrt{s}$ = 630 GeV UA1 minimum bias events using all charged particles. In the case of the one-dimensional analysis, two slope parameters have been measured as indicated by the two straight lines.

0.15 GeV/c, $|\eta| < 3$, length $l \geq 30$ cm and good measurement quality have been used. The correction for acceptance loss has been evaluated by the Monte Carlo and amounts to 2% of the values of F_2 and C_2, but does not change the slopes. For details, see refs. [11],[13]-[15].

The measured distributions of average transverse momentum per event $\bar{p}_t$ and multiplicity N of our sample are shown in Figs. 3a and b, respectively. The $\bar{p}_t$ distribution (Fig. 3a) has a maximum at $\bar{p}_t = 0.5$ GeV/c and asymmetric tails in the regions $\bar{p}_t \leq 0.4$ GeV/c and $\bar{p}_t \geq 0.6$ GeV/c.

3. Results

3.1 The Dependence of ϕ_2 on $\bar{p}_t$ and on N in the One-Dimensional Analysis

The $\bar{p}_t$ dependence of the intermittency exponent ϕ_2 as obtained from each of the two scale regions $0.1 \leq \delta\eta \leq 1.0$ and $1.0 \leq \delta\eta \leq 3.0$, respectively (see Fig. 2a), is presented in Fig. 4 together with the corresponding values from Pythia 5.6 Monte Carlo. The experimental data show a remarkable decrease of ϕ_2 with increasing $\bar{p}_t$ and, after passing a minimum at $\bar{p}_t \approx 0.5$ GeV/c, a slight increase[3] at higher $\bar{p}_t$

[3] The increase effect is stronger for fixed multiplicity subsamples not shown in the present paper.

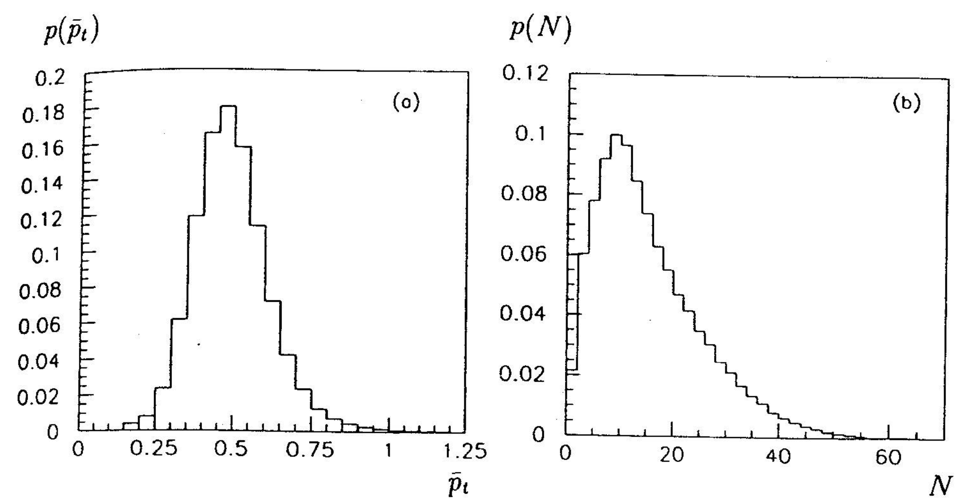

Figure 3. Probablity density distribution of (a) average transverse momentum per event $\bar{p}_t$, and of (b) charged multiplicity N for charged particles having $p_t \geq 0.15$ GeV/c and $-3. \leq \eta \leq 3.$

values. Lower $\bar{p}_t$ events correspond to soft processes while higher $\bar{p}_t$ events correspond to hard events with jet subprocesses both of them having higher slopes ϕ_2. The events with medium $\bar{p}_t$ value may contain both soft and hard components and, due to superposition, show the lowest slopes.

The multiplicity dependence of ϕ_2, given in Figs. 4b and d for comparison, corresponds to a similar result presented in ref. [11] for the interval $\eta = [-1.5, 1.5]$. In the context that ϕ_2 is monotonically decreasing with increasing charged multiplicity without showing an indication of a minimum, it was suprising that the $\bar{p}_t$ dependence of ϕ_2 appears to assume a minimum.

Fig. 4 also contains the results obtained from Monte Carlo events generated using Pythia 5.6 and subjected to the same selection criteria as the experimental data. The $\phi_2 - \bar{p}_t$ and $\phi_2 - N$ relationship appear to be in strong mutual disagreement[4] [11,16]: at low $\bar{p}_t$ and low multiplicity, the ϕ_2 values obtained from Monte Carlo events are generally suppressed compared to those obtained from the experimental data, whereas at large $\bar{p}_t$ and high multiplicity (especially for the scale range $1.0 \leq \delta\eta \leq 3.0$) they tend to become larger than the latter ones. It thus appears that the particle production mechanism contained in the minimum bias event generator in Pythia 5.6 is not sufficiently refined as to reproduce the observed correlation structure.

Considering the different shapes of the ϕ_2 dependence on large $\bar{p}_t$ and on large N, it is neccessary to establish how multiparticle production is interrelated in these

[4] There is a difference to the studies in ref. [11]: in this paper, we refer to a larger rapidity regions ($\eta = [-3, 3]$ instead of $\eta = [-1.5, 1.5]$) and to a more recent version of the Monte Carlo (Pythia 5.6 instead of Pythia 4.8). The improvements in Pythia 5.6 as compared to Pythia 4.8 did not diminish the difference to the data.

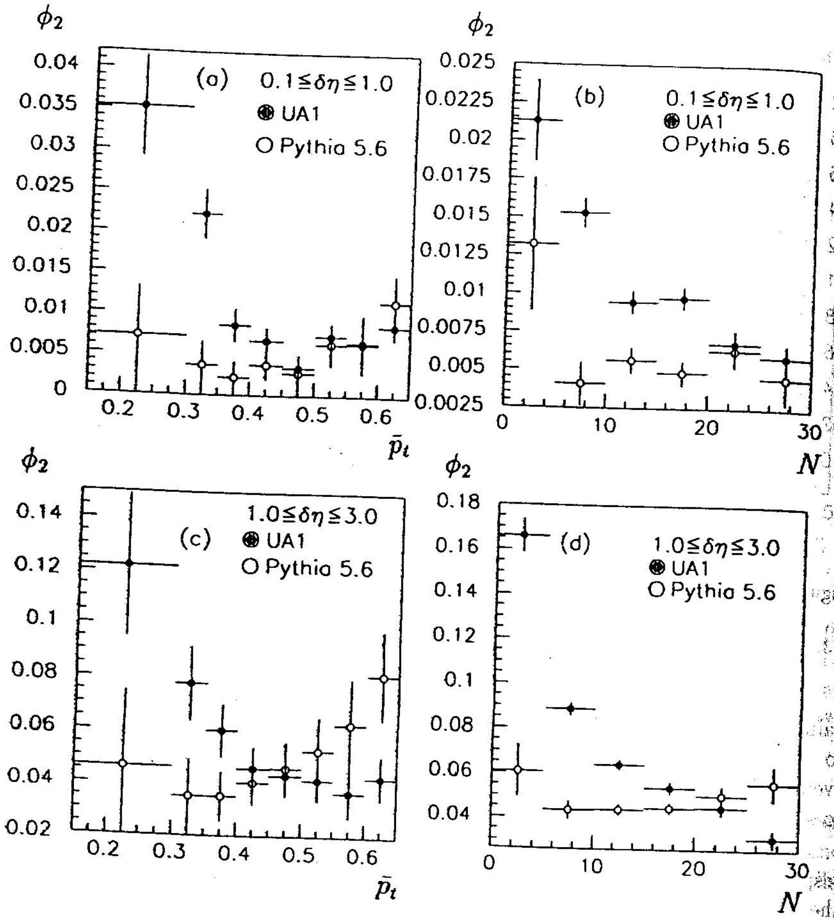

Figure 4. Dependence of the intermittency parameter ϕ_2 as obtained from each of the two scale regions $0.1 \leq \delta\eta \leq 1.0$ and $1.0 \leq \delta\eta \leq 3.0$, respectively, on the average transverse momentum per event $\bar{p}_t$ (a), (c) and the charged multiplicity (b) and (d). The experimental results from UA1 1985 minimum bias data (full circles) are compared with corresponding results from Pythia 5.6 Monte Carlo calculations (open circles)

two variables. Fig. 5 shows the frequency of the minimum bias events as a function of their respective average transverse momenta along with their charged multiplicity. It is conspicuous that very low multiplicity events have the largest spread in $\bar{p}_t$, and that the $\bar{p}_t$ spread seems to decrease considerable with increasing charged multiplicity. The population density in Fig. 5 moreover shows that $<\bar{p}_t>$, the sample average of average transverse momenta per event, rises weakly with increasing multiplicity. As it is well-known [11] that the intermittency parameters ϕ_i are much larger for low multiplicity events than for high multiplicities, we argue that the significiant tail of very low multiplicity events with large $\bar{p}_t$ causes also the rising tendency of ϕ_2 for

$\bar{p}_t > 0.55$ GeV/c.

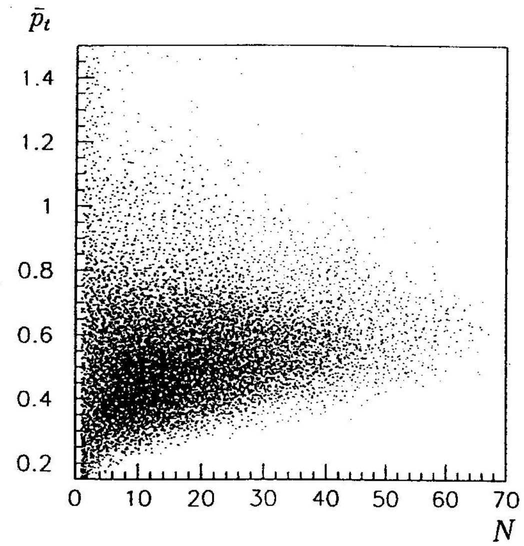

Figure 5: Distribution of $\sqrt{s} = 630$ GeV UA1 1985 minimum bias events average transverse momentum per event $\bar{p}_t$ versus charged multiplicity N.

3.2 The Dependence of ϕ_2 on $\bar{p}_t$ and on N in the Three-Dimensional Analysis

In the following we extend the one-dimensional analysis in terms of factorial moments as a function of $\delta\eta$ to a three-dimensional analysis in terms of the correlation integral, defined by Eqn. (5), as a function of Q^2. Small $Q^2 = -(p^{(i)} - p^{(j)})^2$ correspond to small three-dimensional phase space volumes of momentum differences. It has been shown in Ref. [11] and Fig. 2b, that the two particle correlation integral $C_2(Q^2)$ has very clearly the functional shape of a power law behaviour:

$$C_2(Q^2) = a(\frac{1}{Q^2})^{\phi_2} \tag{6}$$

Excluding the region of extremly small Q^2 which is affected by spurious losses, the interval $0.06 \leq Q^2 \leq 1.0$ $(GeV/c)^2$ has been chosen as scale range, from which the parameters ϕ_2 have been obtained by using Eqn. (6). This procedure has been performed for every subsample of events that have average transverse momentum per event $\bar{p}_t$ or charged multiplicity N within the horizontal bars shown in Figs. 6a and b respectively. The same analysis has been repeated on minimum bias events generated with Pythia 5.6 Monte Carlo. The experimental ϕ_2 dependences on $\bar{p}_t$ and on N as obtained from momentum differences of both like and unlike charge particle pairs entering Q^2 are collected in Figs. 6c and d.

Bearing in mind the strong decrease and subsequent slight increase of ϕ_2 with rising $\bar{p}_t$ as obtained from the one-dimensional analysis, the flatness of ϕ_2 followed bye the indication of an increase at large $\bar{p}_t$ values is striking in Fig. 6a. Likewise, the three-dimensional analysis yields a weaker decrease of ϕ_2 with rising multiplicity (Fig. 6b) than was found in the one-dimensional analysis (Fig. 4b). We argue that very small $\bar{p}_t$ events have in the limit of small pseudorapidity intervals, virtually all three track momentum components within small three-dimensional phase space volumes and therefore yield higher intermittency parameters ϕ_2. With rising $\bar{p}_t$, the tracks with pseudorapidity in small intervals remain however more and more separated in transverse momentum, thus yielding lower ϕ_2 values, especially for the bulk of events in the region around $<\bar{p}_t>$. As we have stated before, the seeming rise of ϕ_2 at still higher $\bar{p}_t$ may be attributed to the effect of low multiplicities having larger ϕ_2 (see Fig. 5). The three-dimensional analysis however ensures that no unaccounted separation of charged track paths in phase space is left when restricting Q^2 to small values. It can therefore be expected that ϕ_2, obtained from the three-dimensional analysis using the Q^2 variable , is not much affected by the decrease with rising $\bar{p}_t$ that resulted from the one-dimensional analysis.

The comparison of the $\phi_2$values derived from the experimental data with those obtained from minimum bias event generator using Pythia 5.6 Monte Carlo again leads to as pronounced discrepancies as we have observed before. In contrast to the flatness and the decrease of ϕ_2 with increasing $\bar{p}_t$ and N, respectively, the Monte Carlo yields a strong monotonic increase in both variables as is shown in Figs. 6a and b. This increase of ϕ_2 as obtained from Monte Carlo starts moreover with negative ϕ_2 values at the very lowest $\bar{p}_t$ and N and seems to indicate rather the vanishing of correlation with $Q^2 \to 0$ for events of these types. The Monte Carlo model thus appears to be missing an adequate non-cascade correlation generating mechanism for very soft and very low multiplicity events.

Repeating the analysis described above for like sign and unlike sign pairs separately of the experimental data only, we obtain the $\bar{p}_t$ and N dependences of ϕ_2 shown in Figs. 6c and d, respectively. It is interesting to note that the $\bar{p}_t$ dependence of ϕ_2 for unlike sign pairs coincides in shape, though not quite in magnitude, with the corresponding Monte Carlo dependence shown in Fig. 6a. The like sign pairs however yield correlation strength values ϕ_2 that are considerably larger than those for unlike sign pairs, but decrease moderately with inreasing $\bar{p}_t$ and strongly with increasing N. Interpreting the like sign correlation as being the result of Bose-Einstein interference, we conclude that this is the dominant contribution underlying intermittency. From Fig. 6c, we may moreover infer that the Pythia 5.6 minimum bias event generating model is susceptible mainly to unlike sign correlations for $N \geq 10$, but not properly to the full strength of the like sign correlations effects and to charged multiplicities $N < 10$.

The origin of the decrease of ϕ_2 with increasing $\bar{p}_t$ and in particular with insreasing N for like sign pairs is not yet undrestood.

3.3 The Dependence of ϕ_2 on Single Particle $\bar{p}_t$ in Three-Dimensional Analysis

In comparison with the $\bar{p}_t$ dependence of ϕ_2 discussed in Section 3.2, we now show

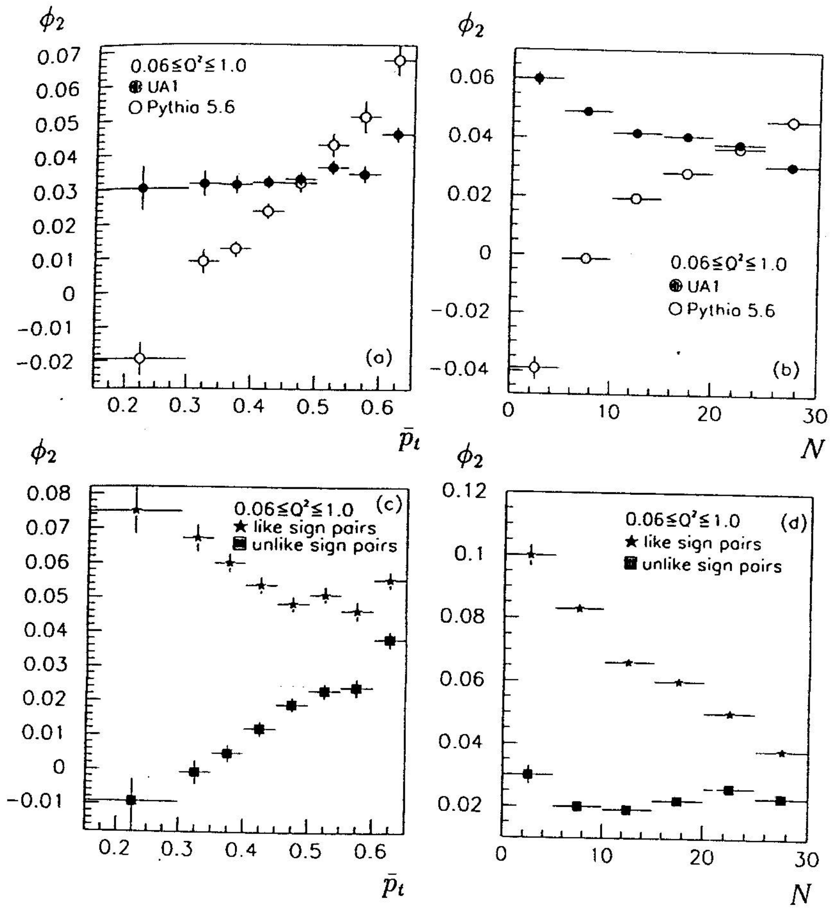

Figure 6. Dependence on $\bar{p}_t$ and N of the intermittency parameter ϕ_2 obtained from Eqn. 6 for successive $\bar{p}_t$ and N intervals. The comparison of the ϕ_2 values of UA1 minimum bias events (full circles) of analogous Pythia 5.6 Monte Carlo events (open circles) is shown in (a) and (b). The corresponding experimental $\bar{p}_t$ and N dependencies of ϕ_2 for like sign pairs (full stars) and unlike sign pairs (full squares) are presented in (c) and (d), respectively.

in Fig. 7 the dependence of ϕ_2 on the transverse momentum of individual particles. The difference between the $\bar{p}_t$ and single track p_t dependences of ϕ_2 is that in the first case samples of events having $\bar{p}_t$ in particular intervals were selected and all their like and/or unlike sign pairs momenta used to calculate Q^2, whereas in the latter case only pairs of single track momenta with both p_t's in particular bins were taken to compute Q^2.

As like sign track pairs in the lowest p_t bin can also originate from higher $\bar{p}_t$ events, their ϕ_2 parameter is expected to be smaller than the ϕ_2 value derived from the corresponding $\bar{p}_t$ interval. Vice versa, higher p_t like sign track pairs being pre-

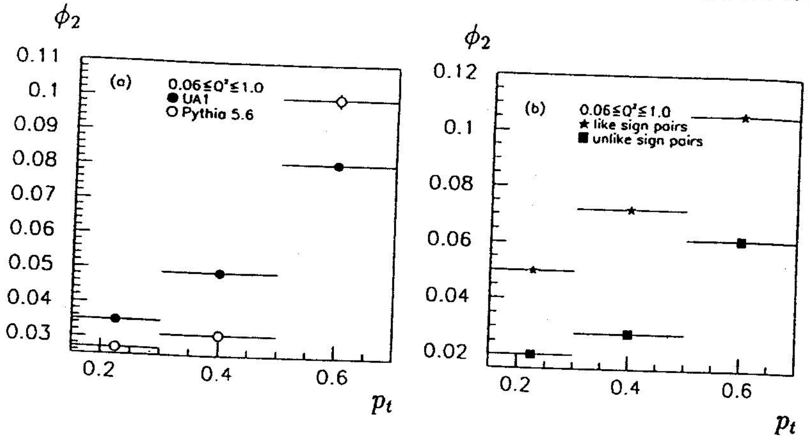

Figure 7. Dependence of the ϕ_2 parameter (three-dimensional analysis), obtained from the experimental data in the region $0.06 \le Q^2 \le 1.0 (GeV/c)^2$, on the transverse momentum p_t of individual charged particles that enter the Q^2 variable in all charged particle pairs (full circles) (a) in like sign pairs (full stars) and unlike sign pairs (open crosses) (b).

dominantly accompanied by lower p_t particles in lower $\bar{p}_t$ events which have larger ϕ_2 values, we anticipate that their ϕ_2 might become larger with increasing p_t than the ϕ_2 for corresponding $\bar{p}_t$. The ϕ_2 values for like sign pairs shown in Fig. 7b are rising with increasing p_t such that ϕ_2 at the lower end p_t is smaller than ϕ_2 at the lower end of $\bar{p}_t$ and larger at the upper ends.

As the events of the very soft type with $\bar{p}_t \le 0.35$ GeV/c are not likely to have additional tracks of large transverse momentum, we are led to argue from the Fig. 6c, that ϕ_2 is much influenced by the global event structure, i.e. whether events have additional larger p_t particles or not.

For unlike sign pairs, the comparison of Figs. 6c and 7b shows that ϕ_2 is rising with increasing p_t of individual particles as well as increasing $\bar{p}_t$. But the magnitude of the ϕ_2–p_t relationship is generally larger by about 0.03 than the ϕ_2– $\bar{p}_t$ values. Again, these two behaviours are consistent in the sense that unlike sign pairs of low p_t particles can originate from large $\bar{p}_t$ events which however have enhanced values of the ϕ_2 parameters. A tentative explanation of the increase of ϕ_2, i.e. of the strength of two-particle correlation, with increasing p_t might be that resonance production becomes more pronounced in relation to background at larger transverse momentum, as has been repeadly observed since many years. Additional correlations due to jet production might be another reason.

3.4 A Detailed Study of an Event Sample with $\bar{p}_t$< 35 GeV/c

In order to find the origin of the discrepancies between the experimental and Monte Carlo ϕ_2 values shown in section 3.1 and 3.2, we select in the following event samples with $\bar{p}_t < 0.35$ GeV/c both from the real events and from Pythia 5.6 events.

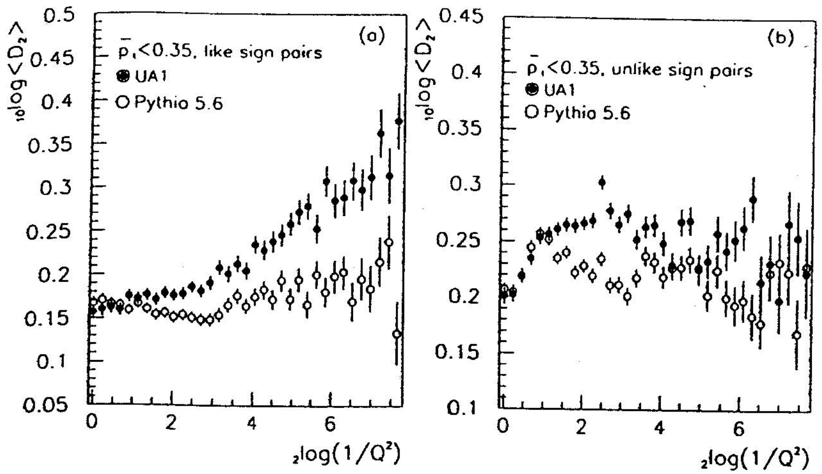

Figure 8. Dependence of the sample average of the differential correlation function $D_2(Q^2)$ (Eqn. 7) on $1/Q^2$ for $\sqrt{s} = 630$ GeV 1985 UA1 minimum bias data (full circles) and Pythia 5.6 generated Monte Carlo events (open circles) in the region of small transverse momentum per event $\bar{p}_t$< 0.35 GeV/c for like sign pairs (a) and unlike sign pairs (b).

We present in Fig. 8 differential correlation functions

$$D_2(Q^2) = \frac{\int_{Q^2}^{Q^2+\delta Q^2} \rho_2(Q^2)dQ^2}{\int_{Q^2}^{Q^2+\delta Q^2} \rho_1 \otimes \rho_1(Q^2)dQ^2} \quad (7)$$

for like sign and unlike sign pairs separately. For like sign pairs the correlation function obtained from the real data shows a strong increase with decreasing Q^2 (Fig. 8a). This behaviour is similar to the observations derived from the whole data sample [6] and is usually attributed to the Bose-Einstein effect.[5] The unlike sign pairs (Fig. 8b) show on the other hand a general flattening off for Q^2 values smaller than the Q^2 at the ρ-resonance *i.e.* for $_2\log(1/Q^2) > 1.0$. In addition, structures are observed at $_2\log(1/Q^2) \simeq 2.5$, which can be attributed to pions from K_s^0 decays near the interaction vertex, and at $_2\log(1/Q^2) \simeq 4.5\,(M = \sqrt{Q^2+4m_\pi^2} \simeq 0.36 GeV/c^2)$, which might be due to reflections from η and η' decays [17]. The statistical errors are however large in this region.

The Pythia Monte Carlo has been tuned to reproduce correctly the single particle distributions and, with reasonable accuracy, also the overall multiplicity distribution. In order to eliminate residual discrepancies with the experimental data due to long range correlations, we have renormalized the F_2 value, obtained from Pythia 5.6 Monte Carlo events with $\bar{p}_t$< $0.35 GeV/c^2$ and particles in the reference interval $-3.0 \le \eta \le 3.0$, to the corresponding F_2 value determined from our data. Fig. 8 shows, that the origin of the discrepancy of the ϕ_2 values presented in sections 3.1 and 3.2 is due to an

[5]It is however not proven that this is the only origin of like sign pairs correlations

underestimation of short range correlations in Pythia 5.6 both for like sign and unli sign pairs. Especially in the like sign sample strong discrepancies between experim and Monte Carlo occur although the Bose-Einstein effect has been switched on in Monte Carlo with an exponential shape.

4. Conclusion

We have analysed the dependence of the two-particle correlation strength as gi by the intermittency parameter ϕ_2 on the average transverse momentum per ev $\bar{p}_t$, on the charged multiplicity N, and on the transverse momentum p_t of individ particles. A comparison has been made between the ϕ_2 parameters determined fro the second order factorial moment as a function of the bin-width of pseudorapidi intervals (one-dimensional analysis) and from the correlation integral as a function Q^2 being equivalent to a three-dimensional analysis. The three-dimensional analy has been performed separately for all charged, like sign and unlike sign particle pai Most of the results are compared with the predictions obtained from calculati using Pythia 5.6 Monte Carlo event generator.

We observe in the data sample:

- An enhancement of pseudorapidity correlations in the one-dimensional analy at low $\bar{p}_t$ and low N,
- an enhancement of three-dimensional (Q^2) correlations at low N,
- the indication of an increase of correlation both in pseudorapidity and in Q at high $\bar{p}_t$,
- and a strong increase of three-dimensional correlations with rising transve momenta p_t of indivual particles.

These observations indicate that different correlation producing mechanisms migh be responsible for events with small $\bar{p}_t$ and small N for events with large $\bar{p}_t$ or el large p_t particles. A detailed examination of a low $\bar{p}_t$ sample shows that both li sign and unlike sign particle correlations contribute to the observed strong sign there. The strong and steep like sign particle correlation function dominates at smal $Q^2 < 0.02\ (GeV/c)^2$.

In the case of unlike sign particle correlations we observe a signal from ρ and K decays and probably some reflections from η and η' decays on top of a smooth an flat correlation function.

The Monte Carlo Pythia 5.6 generally underestimates strongly the ϕ_2 values at lo $\bar{p}_t$ low N and overstimates them at high $\bar{p}_t$ or p_t and high N. In particular, it fails t reproduce both the like sign and unlike sign correlations in the low $\bar{p}_t$ sample. The observations suggest that the dynamical mechanisms which lead to correlations ar not sufficiently accounted for in the Phytia 5.6 Monte Carlo model of minimum bia event generator.

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