TRANSVERSE MOMENTA IN MINIMUM BIAS EVENTS AT COLLIDER ENERGIES

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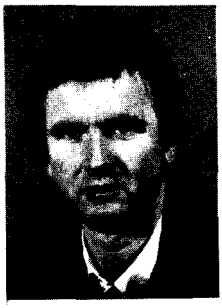

ABSTRACT

The origin of transverse momenta in minimum bias events is investigated within the framework of the Dual-Parton model. It is concluded that the scattering process at SPS-COLLIDER energies has to contain a substantial "semihard" component, which does not drastically affect the general event structure.

Yesterday you heard a talk about the dual parton model. The model explains essentially all features of highly inelastic processes, at least in an approximate way. To be specific, the model understands the limited charge transfer, the rise of the rapidity spectrum, various forms of long range correlations, the KNO scaling violation und the basic structure of diffractive events. In my talk I will address one particular aspect [1].

As you properly remember, the dual parton model assumed a factorization in the scattering between an initial process which is responsible for the production of strings and a final process which is responsible for their decay. The decay is parametrizised as in e^+e^- annihilation or lepto-production in a scaling region; the initial string production is described by one or more Pomeron-exchanges.

The initial exchange of one or more Pomerons involves only small transferred momenta and the dual parton model is therefore essentially a longitudinal model. It is well known that hard or semihard processes will play with increasing energy a more and more important role and it is interesting to investigate the actual situation with minimum bias events at collider energies in this regard.

How can one observe a small transverse momentum of the initial partons? Their effect on most quantities turns out to be minute, as long as one assumes that the transition happens continuously, i.e.if a soft Pomeron-exchange slowly obtains a semi-hard gluon-exchange like component without otherwise changing the topological structure (i.e. the number of strings). Even the expected rise in the global average transverse momentum is quite diluted as the momentum of the string end is usually shared among several final particles.

A quite sensitive observable for the transverse structure is the correlation between the average transverse momentum and the associated multiplicity[2]. If one selects events with an enhanced multiplicity in a certain rapidity interval, one typically chooses multi-Pomeron events i.e. events which contain more of the shorter additional strings. The partons entering the string on each side carry primordial p_t. This initial p_t will be less diluted in these shorter strings than in the longer initial strings. An enhancement of the multi-string contribution therefore means an increase in the average p_t.

To be quantitative about this effect we first need to estimate the actual value of the transverse momentum obtained in the soft multi-Pomeron process. The eikonal width of our Reggeon calculus parametrisation of the total cross sections translates approximately in a mean square value of a Gaussian distribution of 0.7 GeV^2. Can this value explain the data? For collider energies the situation is definite, the eikonal transverse momenta are not enough to produce a sufficiently strong increase of the semi-inclusive average transverse momenta. To get a satisfactory representation of the data one needs an extra contribution to the primordial transverse momentum of partons.

To estimate the size of such an extra semi-hard contribution we consider the following parametrization of the hard process: $\text{Prob}(p_t^2) = \text{const.} * (p_t^2 + (3.\text{GeV})^2)^{-2}$, and adjust the probability to have such a hard scattering to occur. Satisfactory fits are obtained, if 40% hard scattering was used for 64 GeV and 55% for 540 GeV. Especially for in multi-string events the actually obtainable transverse momentum is severely restricted by kinematic constaints and the final transverse momentum on the partons avarages only at 0.66 and 1.22 GeV. These values should not be taken too quantitatively as they depend on the details of the implementation. However, we tried many different implementations, no drastic effects could be obtained and the basic conclusion of a significant non soft component at SPS-COLLIDER energies is unavoidable.

To see if the semihard transverse momenta are reasonable in the framework of non-soft perturbative QCD, we borrowed the transverse momentum of semi-hard gluons calculated by **GRIBOV, LEVIN** and **RYSKIN** and obtain the fit given in the figure. Actually the calculation was before the considerably changed 84 data were available and the curve is therefore to a certain degree a **prediction.** It is obviously somewhat daring to combine both models[3] as the relation between sea quarks and gluons is not clarified, but the point that the required p_t actually follows quite reasonable expectations, is clearly demonstrated.

To put things together:

a) A careful analysis shows that at SPS energies the **minimum bias events are no longer soft by a significant amount.** However we found no drastic change in general structure of the events and except for very sensitive quantities like the considered correlation the required modification stays almost invisible.

b) Somehow the Pomerons start, with increasing energies , to look like semihard gluons and it would be nice **to obtain an better theoretical understanding about this transition.**

c) Obviously string ends will look like small jets and the model is therefore **consistent with the observation of mini-jets.** However mini-jet events do not play any special role and no clear cut seperation between hard and soft events is possible. If one would have a unbiased jet-trigger, triggering jetty events one would obtain multi-string events which contain typically large multiplicities. One could observe the inverse of the above correlation. As the UA1 mini-jet trigger actually also favors high multiplicities, it is not easy to isolate this dynamical correlation.

REFERENCES

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2) Piano Mortari (UA1-Collaboration), presentation at this conference.
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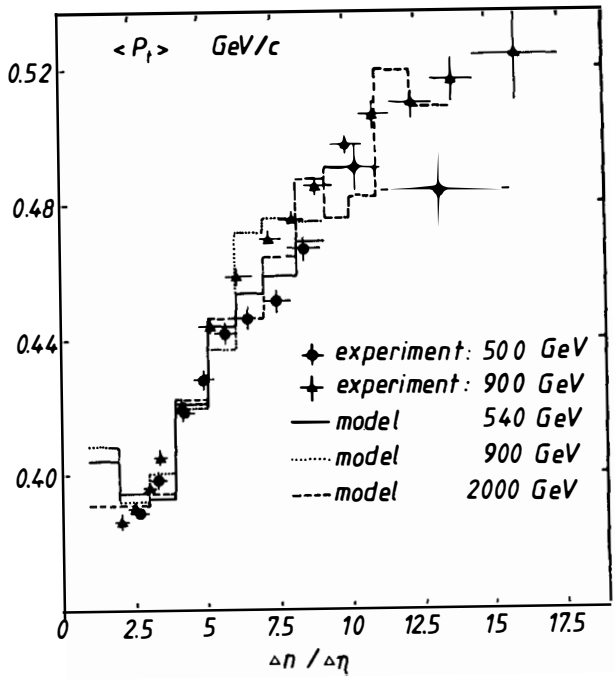

FIGURE