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M E M O R A N D U M

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From/De: F. Brasse, Coordinator of NA9

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Subject/: Status of NA9-Data Analysis and first preliminary uncorrected results.

It is the purpose of this report to inform you about the status of the NA9 data analysis, to demonstrate the potential of the experiment and to underline our requests for data taking in 1982 and later as presented in the note SPSC/81-84, SPSC/M-304. Some technical information is given in terms of data and their analysis for the question what has been achieved so far. Then some first preliminary and uncorrected results are presented. Finally our request for 1982 data taking as far as the vertex-system (streamer chamber) running is concerned is discussed.

1) Status of NA9-Data Analysis

From middle of August 81, when our data taking actually started, up to the end of Period 7 we have taken nearly 170K triggers on film, of which we expect about 20% to be genuine events, where a scattered muon fulfils the software trigger and can be combined with a measured primary muon to a vertex. It is foreseen in the long term to first reconstruct the scattered μ using the electronic information and pass only these genuine triggers to the streamer chamber analysis. Initially both analysis chains have been started in parallel to get quickly as much information as possible. Data from Period 6c had been selected for this. For completeness the whole experimental setup is shown in fig. 1.

On the streamer chamber side up to now 35K triggers have been scanned in total at the various laboratories outside CERN. About 48% were found to have

an interaction within the target. The other triggers are mainly upstream and downstream interactions and halo. From the good fraction 4K triggers have been measured. For a subsample of these events with a total of 7393 tracks, analysed at one institute, the distribution of the RMS residual per track is shown in fig. 2. To obtain the residual per track the fit of a track is projected back to film in all three views and compared then with all measured points. The mean RMS residual is already 6μ showing the good quality of pictures and of measuring.

About the same sample of raw triggers was sent through the analysis chain of the forward spectrometer which has been modified compared to NA2 for the existence of the vertex magnet field. Fig. 3 shows the distribution of vertices found from this analysis along the beam coordinate x. The region of the H_2-target is well separated from some other material sitting in the beam and acting as target, for instance a set of beam hodoscopes BHB, beam killers in the proportional chambers PV2 and windows and mirrors of Cerenkov counters C0 and C1. The contributions from these targets after the application of the software (= hardware) trigger are found to be 13%.

Streamer chamber and forward spectrometer track information are brought together in the final software package and are there completed by the information from the large angle track detectors PV1-3 and WV1-3. Fig. 4 shows the comparison between extrapolated streamer chamber tracks and track segments found in the chamber PV2 in the horizontal (y) and vertical (z) space coordinates perpendicular to the axis of the forward spectrometer. The displacements are very small, taking into account that no adjustment had yet been made between the coordinate systems of streamer chamber and forward spectrometer.

From the combined analyses on the test sample, where there was not complete overlap between events with film and all electronic data, 421 events with a total of 2817 tracks emerged to be used for a first look at physics variables. These events are also being used now to study the properties of the particle identification detectors and so test their software.

2) First Preliminary Results

As the acceptance for charged hadrons is nearly 100% of 4π and as no strong bias should be introduced by the software chain it is possible to look at physics distributions. However it must be understood that no corrections of any type have been made and that the distributions shown are not allowed to be quoted.

In fig. 5 the distribution of the 421 events across Q^2 and W^2 is given. It can be seen that most of the events are in the region $W^2 > 100$ GeV^2 ($\langle W^2 \rangle = 252$ GeV^2) showing the superiority over ν-experiments in the area of hadronic final states at SPS energies. In Q^2 even this sample goes beyond $Q^2 = 50$ GeV^2. The limitation at low Q^2 is imposed by the trigger cut on the scattered muon at 0.5° scattering angle.

The distribution of the multiplicity of charged hadrons per event is shown in fig. 6 with an average multiplicity of 6.7. Multiplicities up to 24 have been successfully measured. In principle with 100% acceptance for all charged hadrons only odd multiplicities are expected. The lower momentum cut on streamer chamber tracks is 100 MeV with a decreasing acceptance already above 100 MeV. Therefore especially not all slow protons are seen. Also electromagnetic pairs are not fully excluded. The average charge in this sample is 0.7.

The energy distribution of all charged hadrons can be compared with results from our NA2 experiments. This is done in fig. 7, where $\frac{1}{N_\mu} \cdot \frac{dN^{h^\pm}}{dz}$ is plotted as a function of $z = E_h/\nu$ and the NA2 results are represented by a line, adjusted to the data in CERN-EP/80-130. The agreement for $z > 0.2$ is very satisfactory. Most of the additional particles, seen in the vertex system, are in the region $z < 0.2$. This region is expanded in the corresponding distribution of the charged hadrons per event over x_F (fig. 8). The symbols with full lines are all charged hadrons reconstructed, whereas those with broken lines for $x_F > -0.1$ are seen at least by the streamer chamber. So the difference between the two symbols is only seen by the forward spectrometer. No tracks seen only by the large angle electronic chambers have been added . The x_F-distribution is remarkably symmetric to $x_F = 0$ within this statistic.

Finally we show the normalised distribution $\frac{1}{N_\mu} \cdot \frac{dN^h}{dp_T^2}$ over p_T^2 for all charged hadrons in fig. 9, where p_T is measured with respect to the direction of the virtual photon. The comparison again is made with NA2 results, which are represented by the curve and taken from DESY 81-063. Especially at low values of p_T^2 the NA9 values of dN^h/dp_T^2 per event are much above the NA2 data. This is to be expected from the contributions at $x_F \approx 0$ and $x_F < 0$, not measured in the forward spectrometer (cuts on NA2 data are $P_{lab} \geq 6$ GeV, $Q^2 > 3$ GeV^2, $100 < W^2 \leq 460$ GeV^2). At larger values of p_T^2 the two data sets are coming close to each other.

3) Conclusions for further Data Taking

We have shown that experiment and analysis of data are working. The potential in terms of good statistics at high values of W^2 and Q^2 can be estimated. The large statistic we are asking for will enable us to make detailed studies on the production of jets and on correlations between them (we have shown with NA2 data, that two jets in the forward direction exist at the level of $\sim$ 1%) including especially the target jet. Also to study the production of baryons with the very much extended particle identification in detail the large number of primary events is necessary. On the basis of the experience with scanning and measuring film from our data at the eight outside institutes the capacity of analysing film of the collaboration is indeed 100K good events per year. To be able to make use of this capacity over 1983, when the experiment with the polarised target is being planned to run, it is important also that the total of 200K good events is reached up to the end of data taking in 1982.

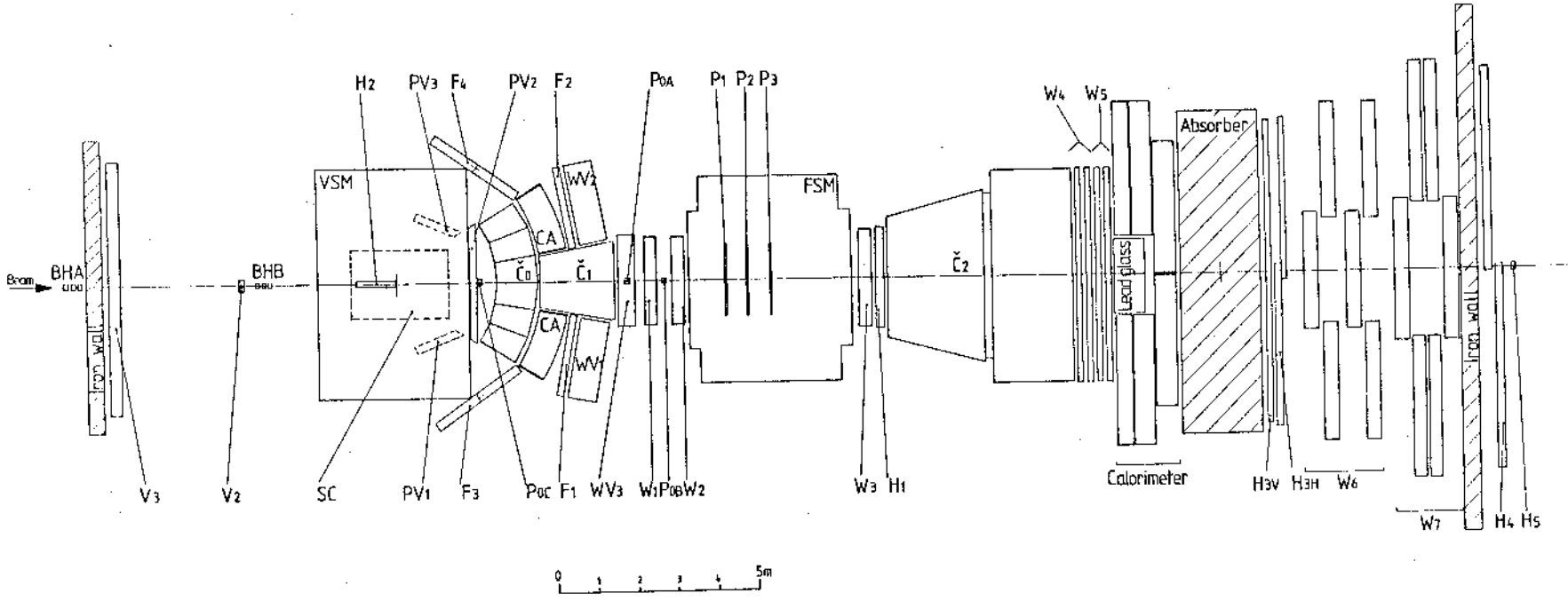

Beam
BHA
BHB
Iron wall
VSM
FSM
H2
PV3
F4
PV2
F2
POA
P1
P2
P3
W4
W5
Absorber
WV2
CA
Č0
Č1
Č2
CA
WV1
Lead glass
Calorimeter
V3
V2
SC
PV1
F3
POC
F1
WV3
W1
POB
W2
W3
H1
H3V
H3H
W6
W7
H4
H5
0
1
2
3
4
5m

Fig. 1

OXFORD PEPR

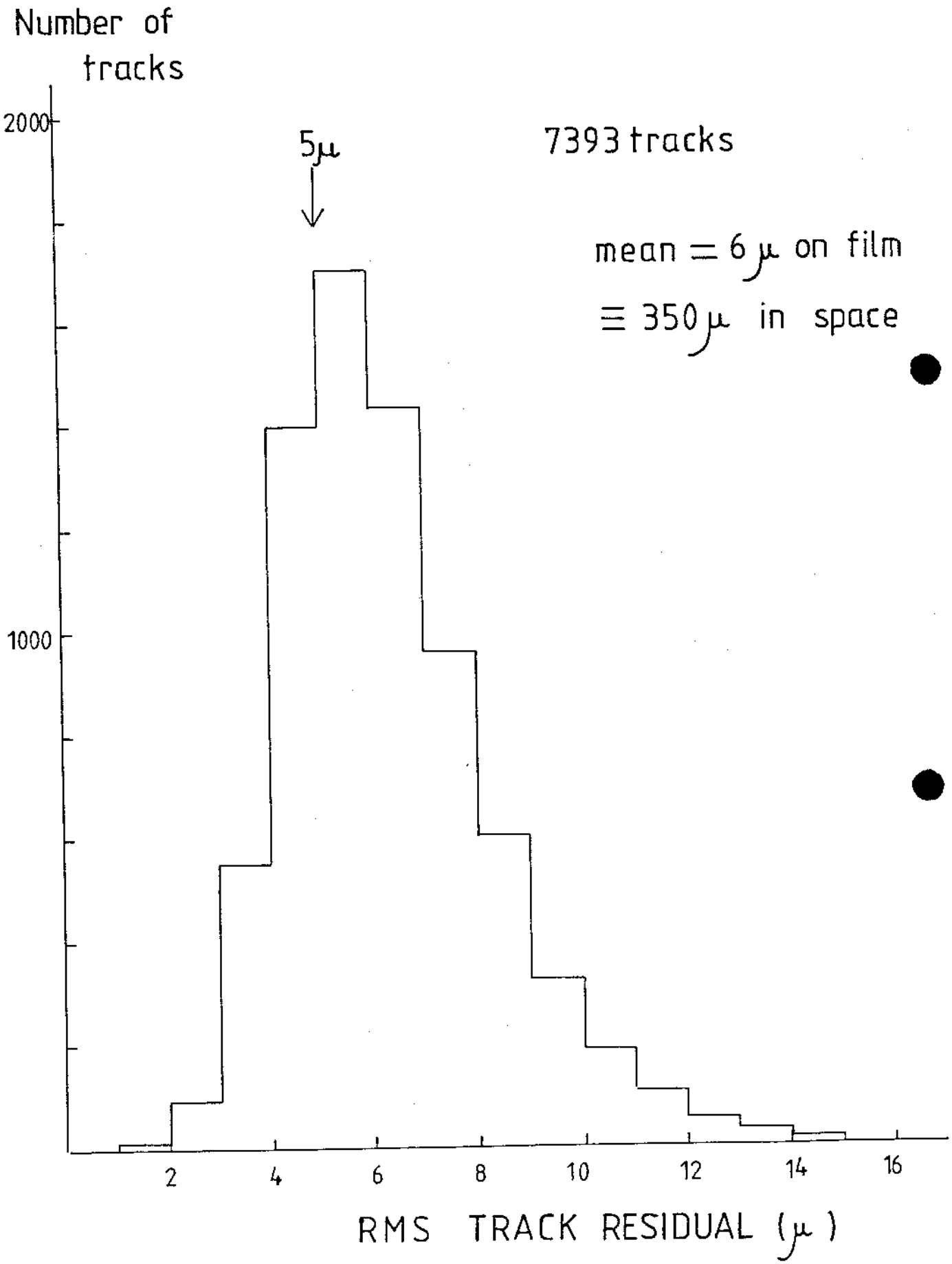


Fig. 2

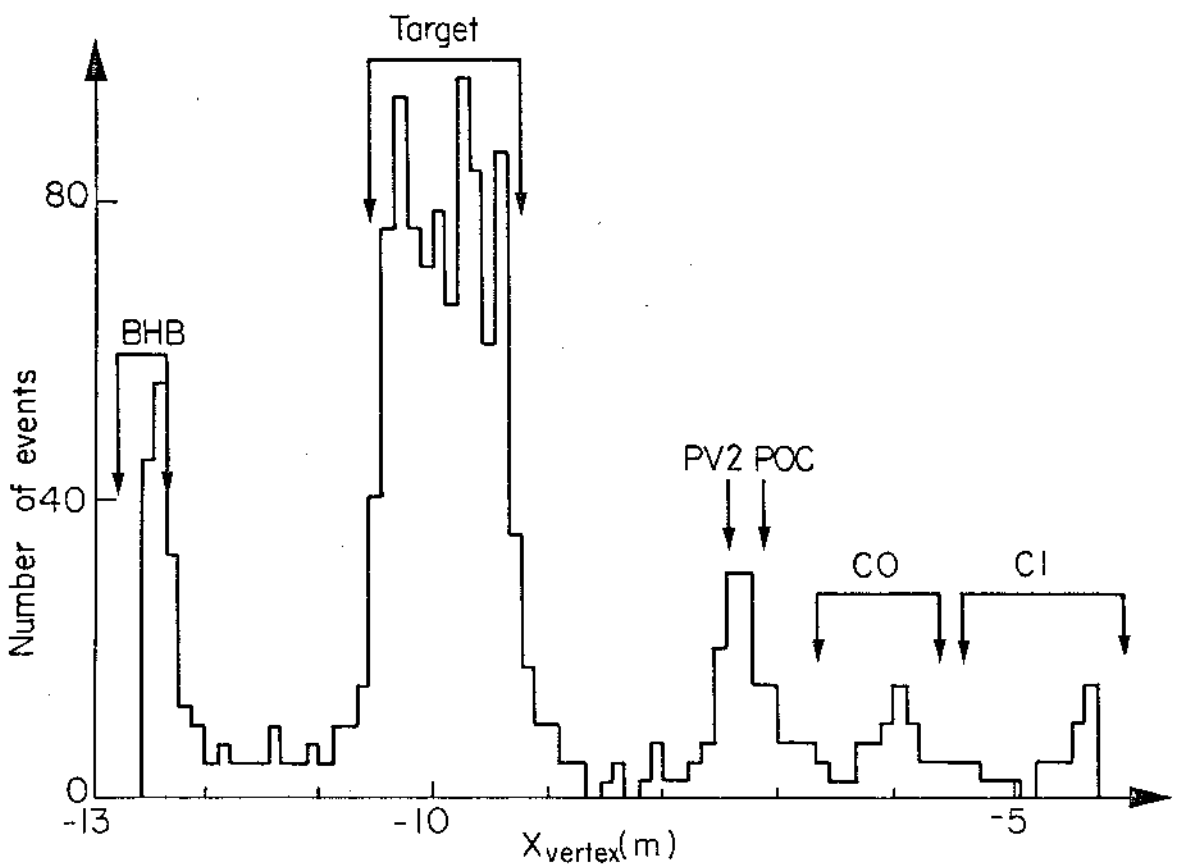
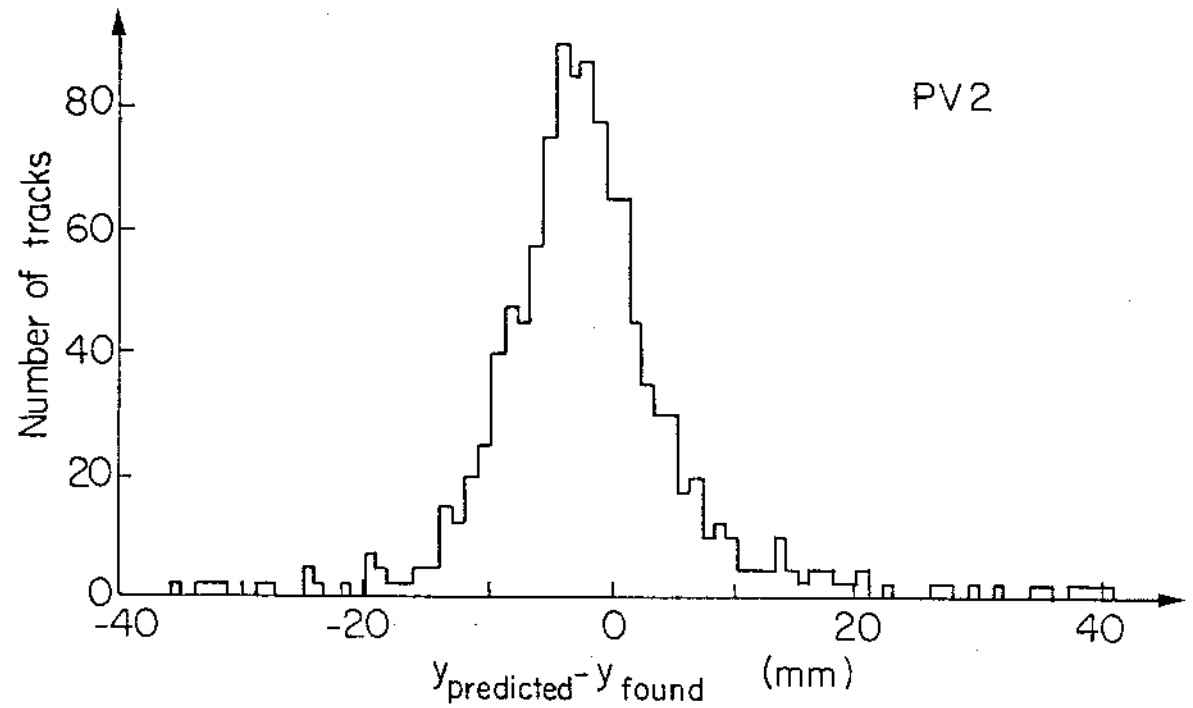


Fig. 3 - Distribution of the x-coordinate of the vertices reconstructed from the beam track and the scattered muon.



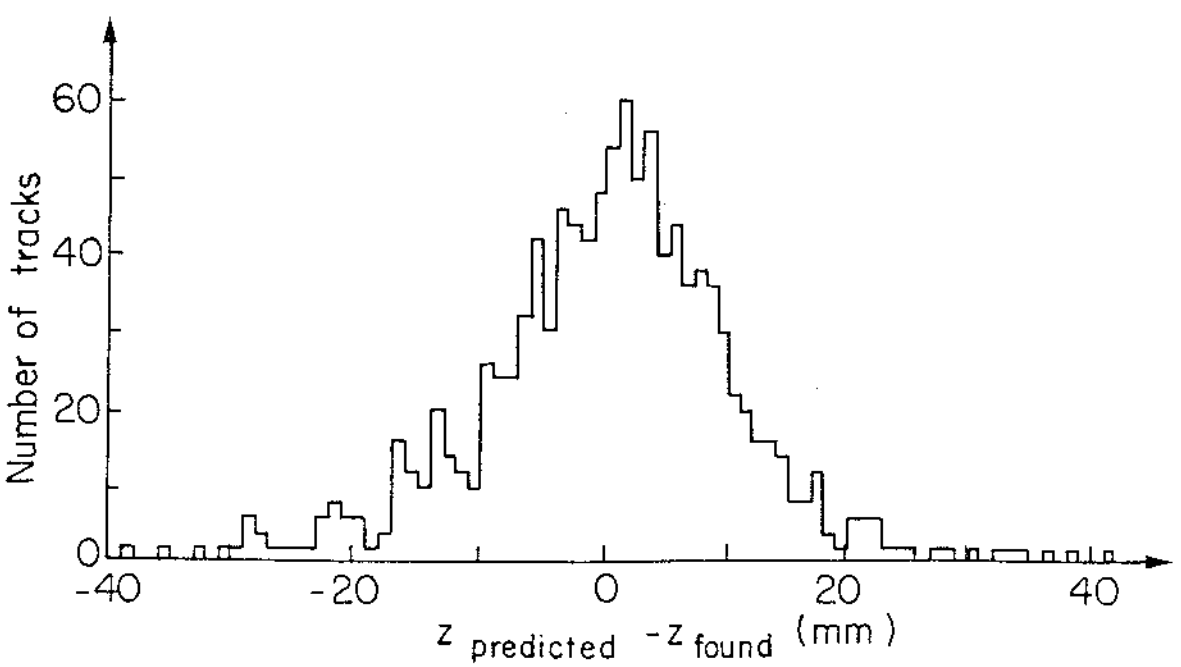


Fig. 4 - Distribution of the difference between the coordinates predicted by extrapolation of streamer chamber tracks and the coordinates of hits in PV2.

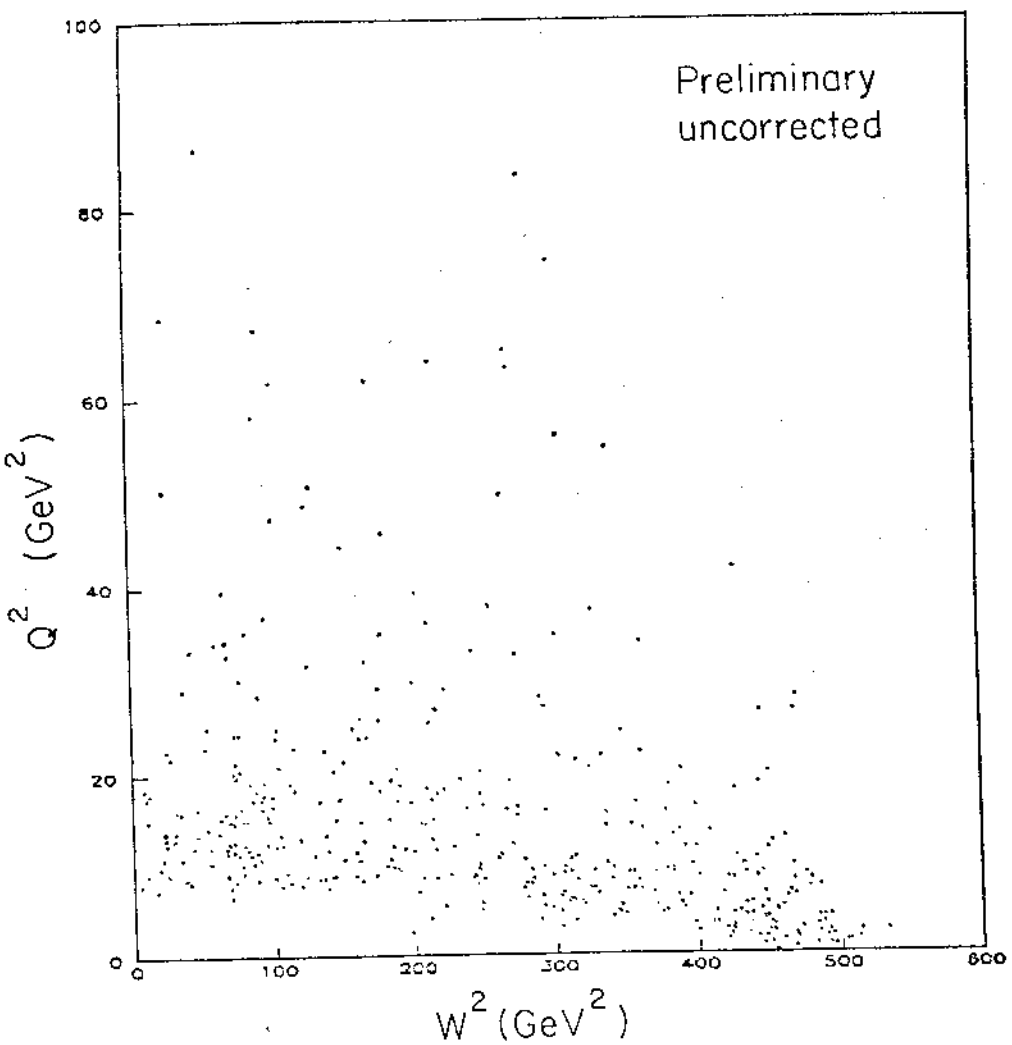

Preliminary
uncorrected
100
80
60
40
20
0
0
100
200
300
400
500
600
Q^2 (GeV^2)
W^2 (GeV^2)

Fig. 5

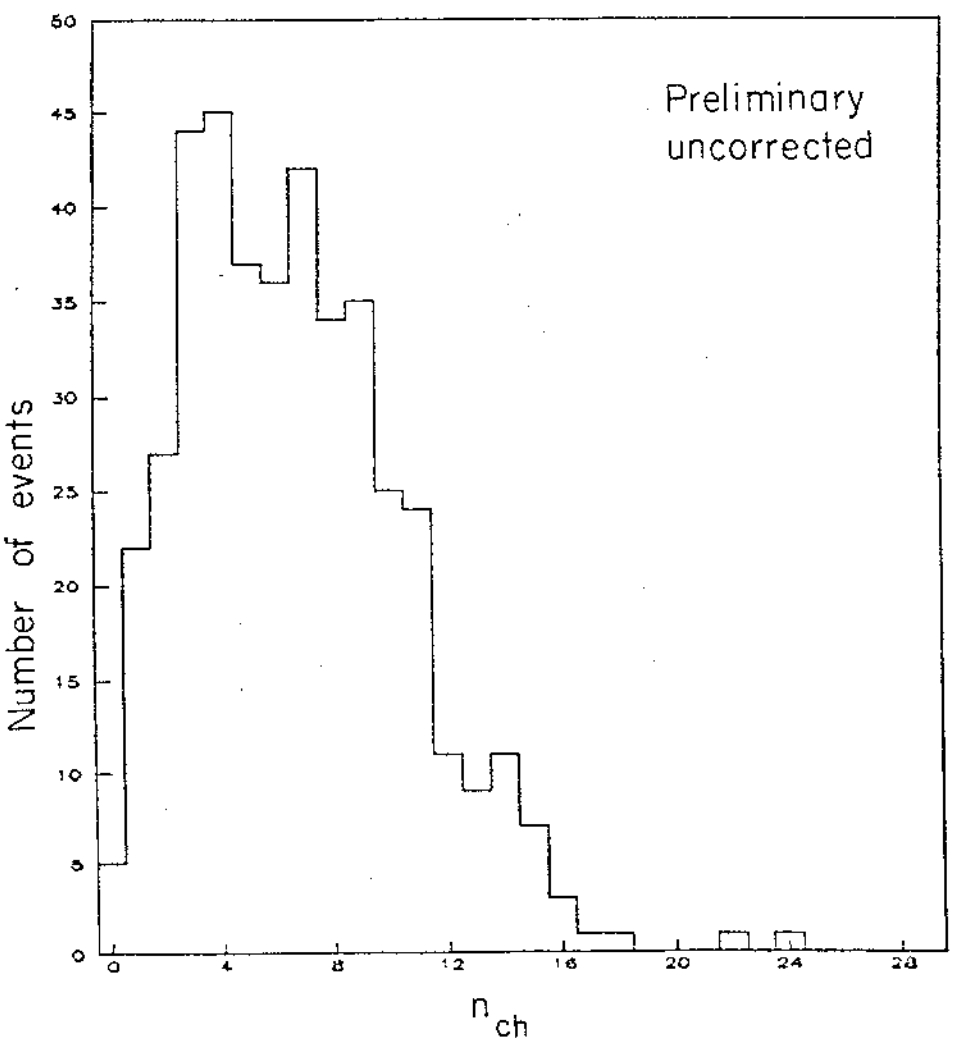


Fig. 6 - Multiplicity distribution of charged hadrons.

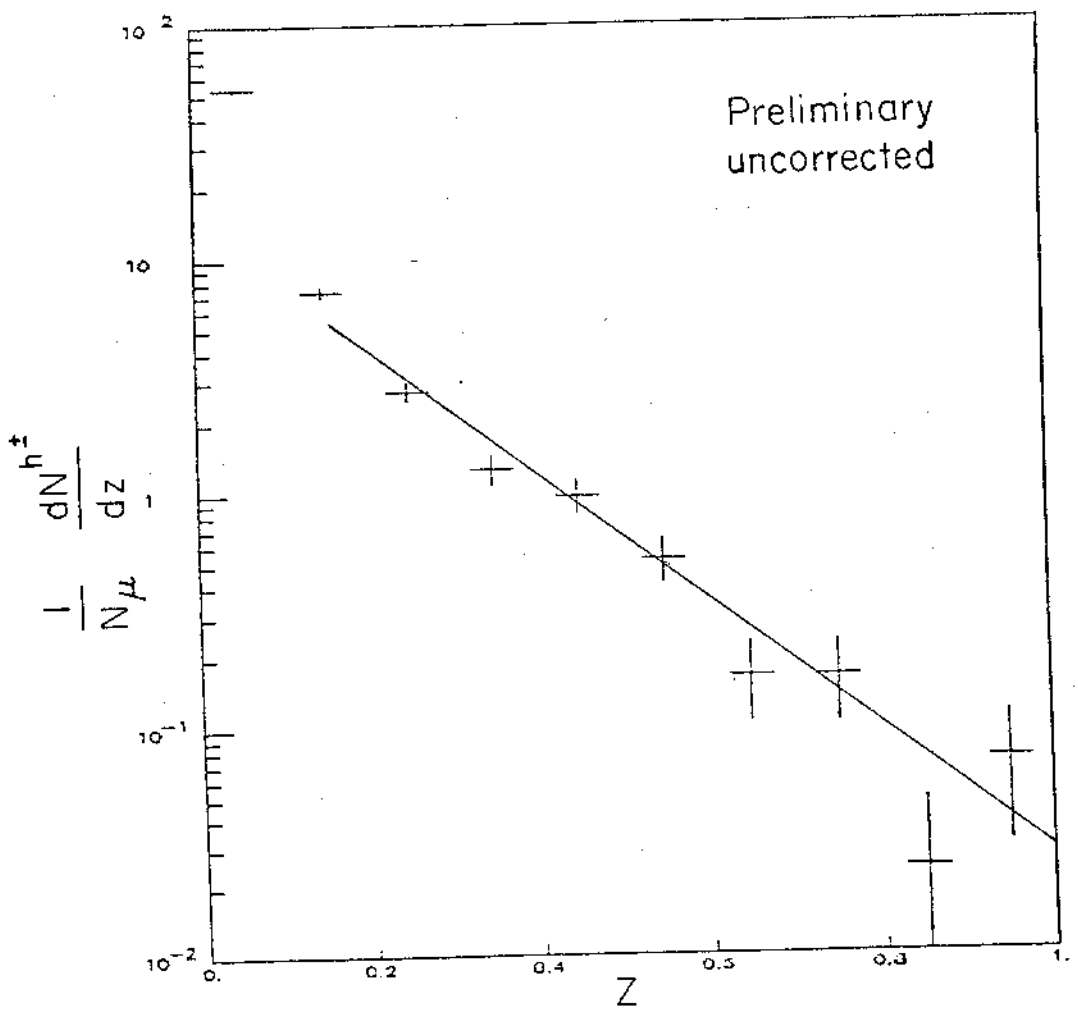


Fig. 7 - z-distribution of the differential multiplicity of charged hadrons. The line represents the data published by EMC (NA2).

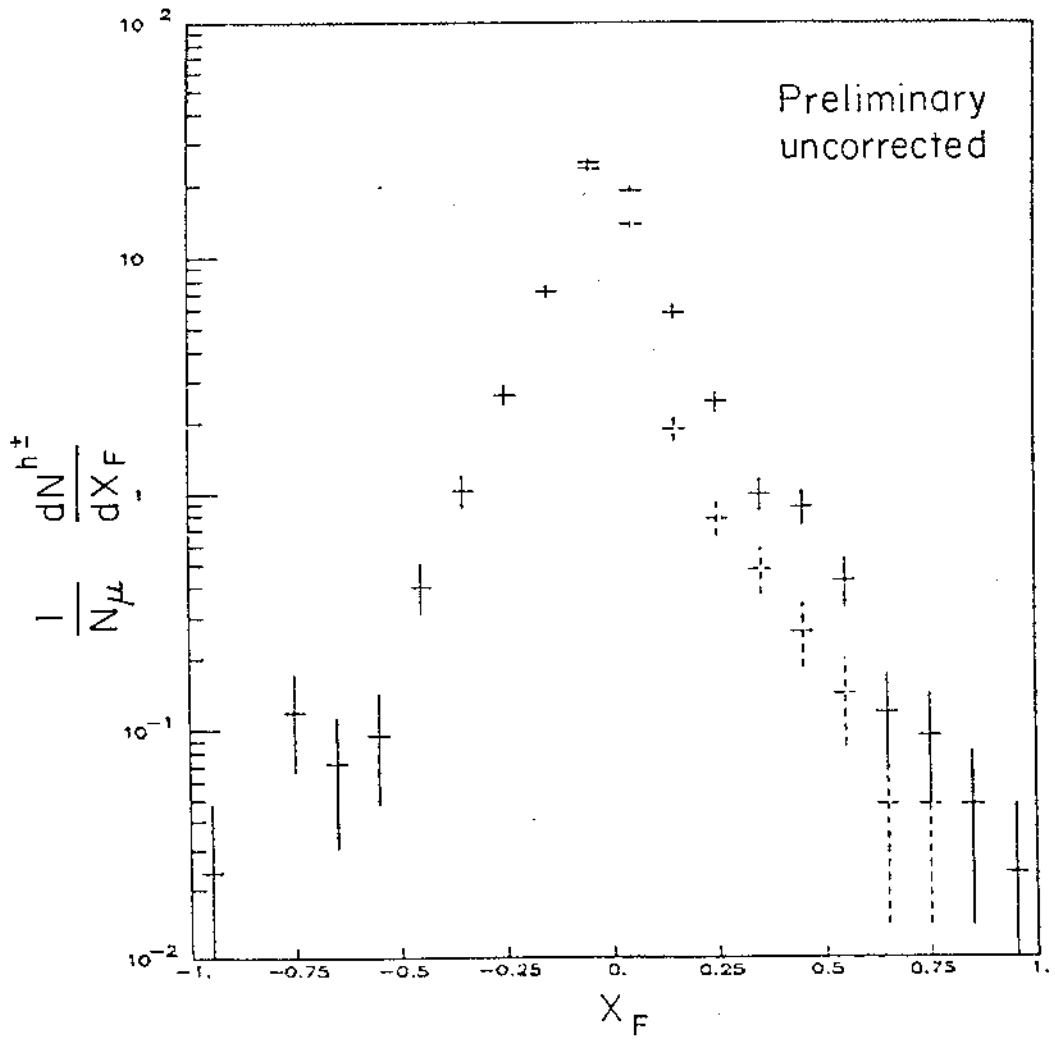


Fig. 8 - x_F-distribution of the differential multiplicity of charged hadrons. The dashed curves represent the hadrons measured in the streamer chamber. In the region $x_F < -0.1$ hadrons have only been reconstructed from streamer chamber measurements.

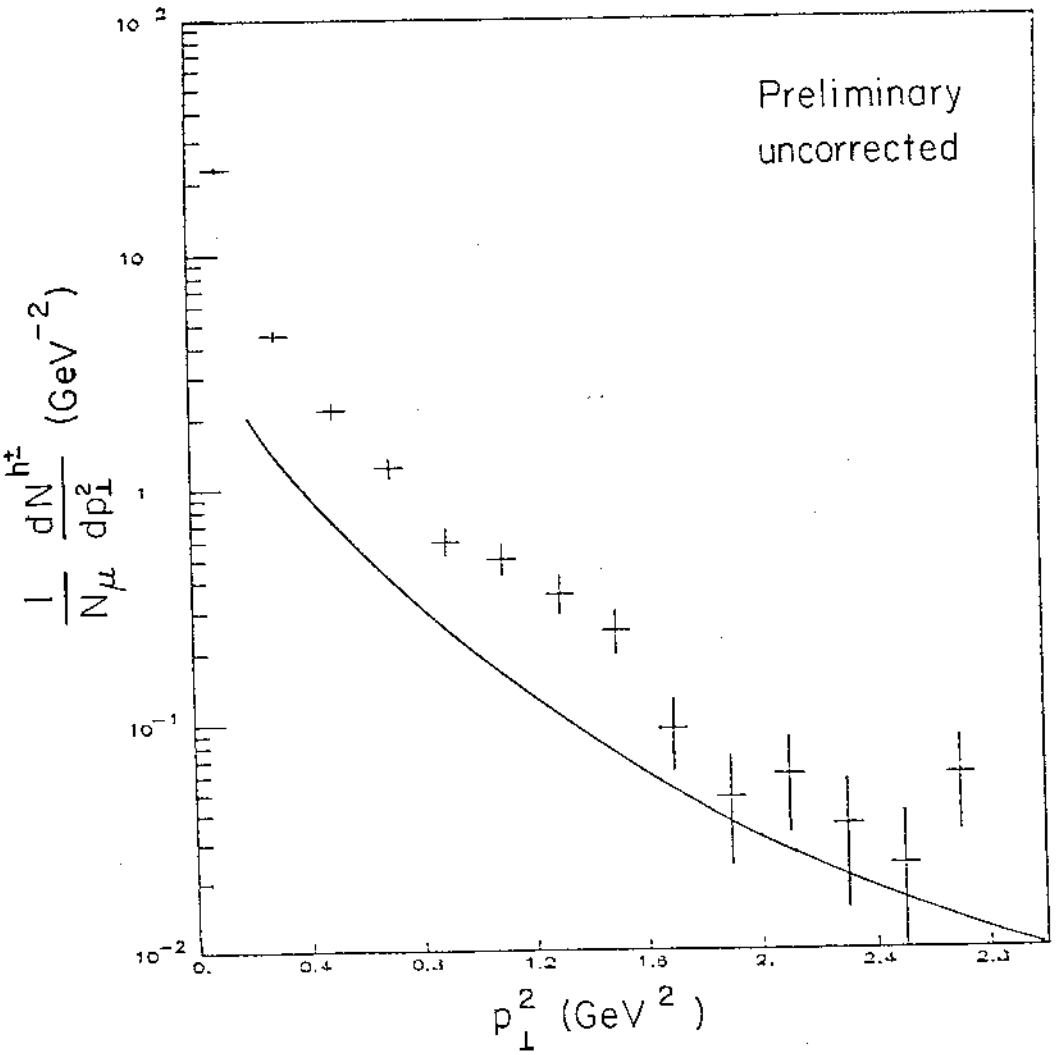


Fig. 9 - p_T^2-distribution of the differential multiplicity of charged hadrons. The line represents the data published by EMC (NA2) where only hadrons with momenta greater than 6 GeV have been used.