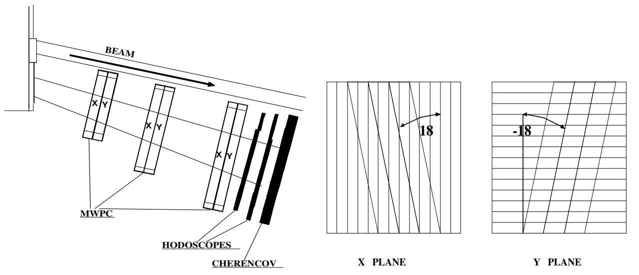
Determination of the ANKE forward detector MWPC efficiency

S.Dymov, V.Komarov[a], A.Petrus[a], S.Yaschenko

The three MWPCs of the ANKE forward detector (FD) provide the reconstruction of track and momentum of positively charged forward-emitted ejectiles in several experiments. The layout of the FD is shown in Fig. 1(a). Each of the chambers is made of two wire (X and Y) and two strip planes, the latter being inclined under $\pm 18^\circ$ to the vertical axis, and separated by a thin supporting film from the corresponding wire planes (see Fig. 1(b)). The wire planes have 1 mm step (wire distance), and the strip planes ≈ 3 mm.



(a) (b)

Fig. 1: Sketch of the ANKE forward detector and structure of the MWPC.

For processing experimental data with the aim to determine differential cross-sections and various polarization observables, it is necessary to know the efficiency of particle registration. The efficiency of proportional chambers demands a special investigation, in contrast to scintillation counters which usually have efficiency close to 100%. Furthermore, the efficiency could be inhomogeneous over the sensitive plane due to the non-standard construction, e.g. a weakly conducting supporting film, positioned between the wires and strips.

In this connection, a procedure to determinate the chamber efficiency is developed. A particle track is reconstructed using the information from the other wire/strip planes, and only events with one cluster per each plane are considered. The reconstructed tracks are checked for coincidence with the fired hodoscopes and must pass all background cuts. This allows one to uniquely reconstruct particle tracks as well as to circumvent complications caused by multi-track events and electronic noise. Then the crossing point of the track with the sensitive plane under study is determined and the presence of a hit wire (strip) is checked in the area around the crossing point. In order to determine the dependence of the chamber efficiency over area of the sensitive plane, the plane is divided into cells. If the crossing point of the track occurs inside a cell, the event is regarded as belonging to the cell. A typical efficiency distribution obtained by this method is shown in Fig. 2. Since the number of MWPC's used in data taking was different during different beam times, various combinations of wire and strip planes were used for building tracks. In one case all three MWPC's operated, and the wire planes of two of them could be used to estimate the efficiency of the third one. In the second case only two chambers operated, and one had to use also a strip plane for reconstruction. A similar situation occured when only the first MWPC and the Y plane of the second MWPC operated.

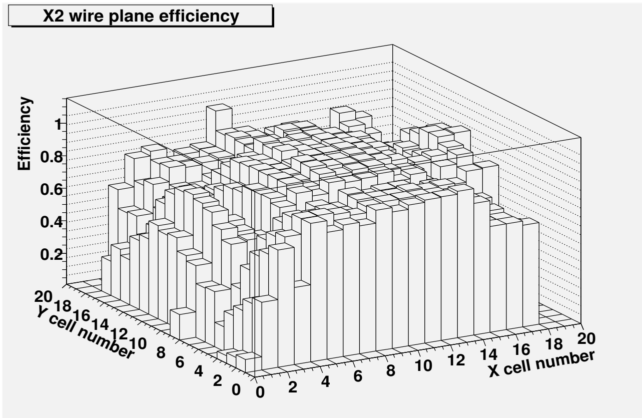


Fig. 2: Typical efficiency distribution over a wire plane.

These three situations lead to a significantly different spacial resolution of the reconstructed tracks and effectiveness of the track selection criteria. A comparison of the three methods on the same data has shown a rather good coincidence of the results for the efficiencies.

In order to check how well one can correct data for the MWPC inefficiency we compared model and experimental $pp \to pp$ angular distributions at $T_{beam} = 2.65$ GeV and a H_2 target, with one ejectile proton detected in FD. To obtain the model distribution we used the differential cross-section, calculated by SAID, and traced the particles through the setup with a GEANT-based program. The experimental events were selected from the momentum reconstructed distribution, in which this reaction yields a prominent peak at the proper position. The efficiency correction was done by assigning a weight for each event according to the coordinates of the track crossings with the MWPC's. In Fig. 3 distributions over the azimuthal angle are shown. The uncorrected experimental histogram is scaled by a factor 2.5 for better visual comparability.

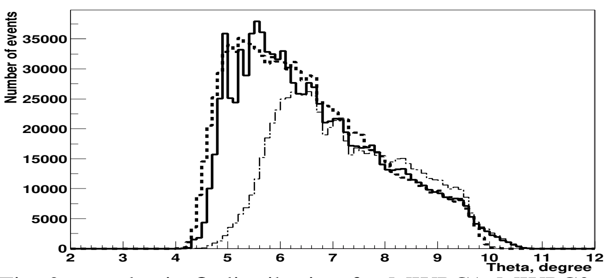


Fig. 3: pp-elastic Θ distribution for MWPC1–MWPC3: uncorrected (thin, dash-dotted), corrected (thick solid) experimental and model (thick dashed).

One can see that even in the chamber region with a strong efficiency drop (small Θ) the correction allows one to reproduce the expected shape. We also used the data with all three chambers in operation and found that the corrected results are in a good agreement for the cases when the tracks were reconstructed by MWPC1–MPWC2 and MWPC1–MWPC3 pairs.

This shows that the developed method can be used for effective reconstruction of experimental spectra.

[a] JINR, Dubna, Russia