Determination of particles momenta from TOF measurements for ANKE*

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The aim of this work is to test the particle-momentum distribution in the side telescopes [1] of the ANKE spectrometer.
The momenta were calculated from the time-of-flight (TOF) information between the TOF-start and stop detectors[1] . Data were taken at proton beam energies 2.3 GeV. The value of the magnetic field in the spectrometer dipole D2 was 1.57 T.
Figure 1 shows the TOF spectrum between the start counter 15 and the stop counter 13. Most of the particles are pions (peak around channel 250) and protons (peak around channel 400) stemming from the target. Figure 1 shows the TOF spectrum without any cuts on scintillator or MWPC information.

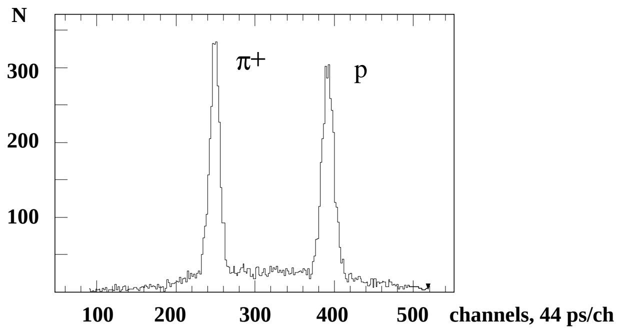

Figure 1: TOF spectrum between start counter 15 and stop counter 13.

All particles going through a certain start-stop combination have the same momentum [2]. This momentum can be calculated from the time difference between pion and proton peaks for each allowed start-stop combination [2].
Figure 2 represents the calculated momentum for all allowed start-counters and telescope 13. The same distributions were accordingly calculated for all other telescopes.

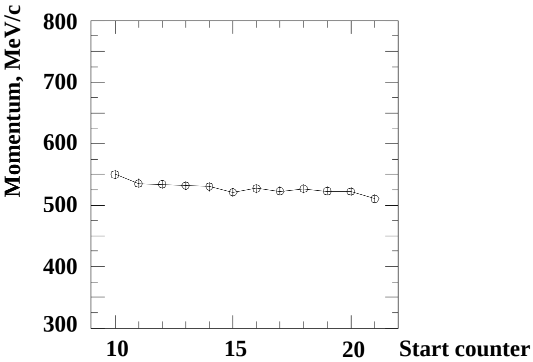

Figure 2: Distribution of particle momentum in telescope 13.

The errors are due to the inaccuracy of the proton- and pion-peak positions (±2 channels). This is equal to ±7 MeV/c for telescope 13. Since the telescopes are located along the focal surface of D2 the particle momenta in a certain telescope must be the same for all start counters. Some small divergence can be explaned by the ±3 % nonlinearity of bin width of TDC from mean value.
Figure 3 represents the comparison of the results of TOF method with ray-tracing calculations using GEANT [3].

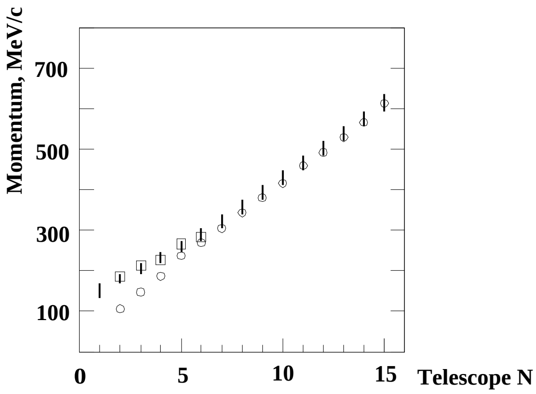

Figure 3: Comparison of the results of the TOF method with ray-tracing calculations. The vertical lines are the momentum ranges deduced from the GEANT simulations. The open symbols show the results obtained from the TOF spectra with (squares) and without (circles) corrections for energy losses.

The energy losses of particles in air and in the start counters decrease the momentum of particles in the first telescopes. Pion energy losses are small. They are less than 1 MeV for all telescopes. However, slow protons have quite big energy losses. After correcting for these energy losses the results of the TOF method coincide with the GEANT predictions.
Summarizing, the TOF method of momentum reconstruction confirms the GEANT predictions of particles momentum distribution in the telescopes.

References:

[1] M. Büscher et al., contribution to this Annual Report, p.

[2] M. Büscher et al., Annual Report 1998, IKP, Forschungszentrum Jülich, p. 12.

[3] M. Büscher et al. “Identification of K^+-mesons from subthreshold pA collisions with ANKE at COSY-Jülich”,**NIM** (in preparation).

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*Supported by grants RFFI99-02-18179a,DFG-443RUS-113,WTZ-RUS-99/684