Efficiency of the Track Reconstruction from the COSY–11 Drift Chamber Signals

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In the COSY–11 experiment the trajectories of positively charged ejectiles, momentum analysed by the dipole magnetic field, are measured using multiwire drift chambers [1].

The efficiency of the track reconstruction from the drift chamber signals is a crucial factor for the determination of absolute cross sections of reactions under investigation. Since COSY–11 studies reactions of the type $pp \rightarrow pp\ Mesons$ and $pp \rightarrow pYK^{+}$ with at least two outgoing charged particles, it is particularly important to know the efficiency for the reconstruction of the tracks of two particles passing simultaneously through the detectors [2].

Specifically, the reconstruction algorithm has to evaluate which signal belongs to which track or to reject it as noise. The decision depends on the distance between a measured crossing point and a hypothetical track. The distance is measured in units of the position resolution of the drift chambers which typically amounts to $\sigma_{dc} = 0.03$ cm (standard deviation) and can be established from the data for each experimental run.

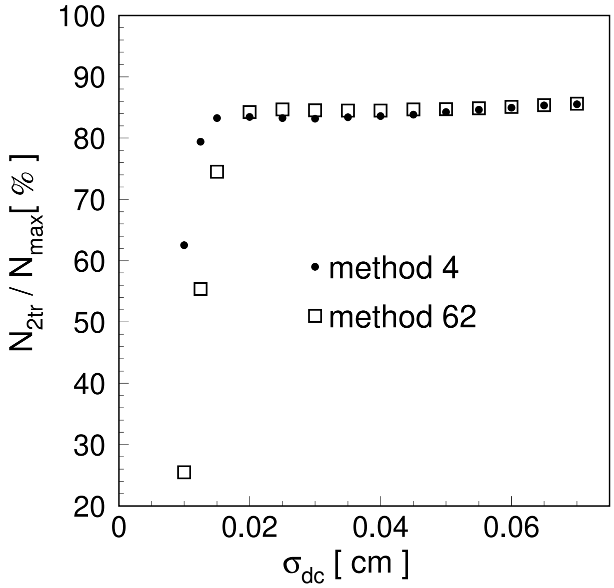

Figure 1: Efficiency for the two track reconstruction as a function of σ_{dc}.

Thus, σ_{dc} is one of the parameters which must be defined to perform the track reconstruction. Figure 1 shows the two track reconstruction efficiency as a function of σ_{dc} used for the reconstruction of simulated events. In this particular case $pp \rightarrow pp\eta'$ events were generated at a beam momentum of 3.240 GeV/c (threshold at 3.208 GeV/c). The hit points in the drift chambers were smeared out with $\sigma_{dc}^{simul} = 0.03$ cm. Next, the data were analysed for different σ_{dc} values as input for the reconstruction. The figure indicates that the efficiency increases rapidly at $\sigma_{dc} \approx 0.012$ cm and then saturates at $\sigma_{dc} \approx 0.015$ cm at a value of about 85%. On the other hand, the computing time grows exponentially with increasing σ_{dc}, as shown in Figure 2. In addition, both pictures compare two methods of reconstruction which differ slightly in the criteria used for the decision of assignment of a signal to the track.

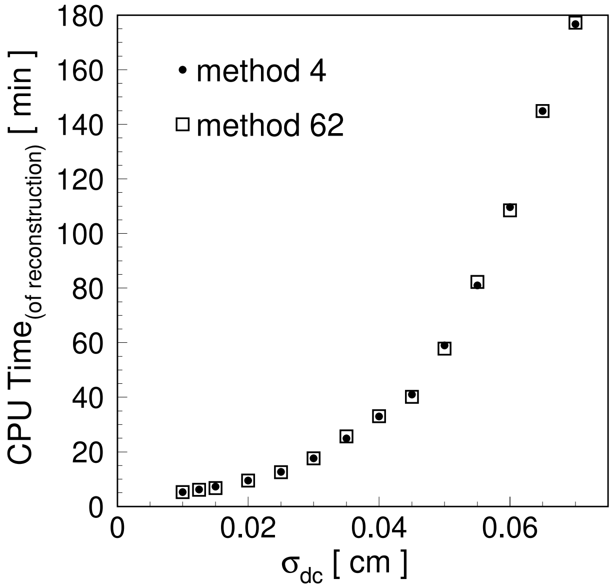

Figure 2: Real CPU time of reconstruction for $5\text{x}10^{5}$ events.

The performed analysis shows that: when taking σ_{dc} larger than the real one, the reconstruction efficiency increases by only a few per cent but simultaneously makes it much more time consuming. For example, σ_{dc} being assumed twice its real value results in 2% more reconstructed events but increases the needed CPU time by a factor of six.

References:

[1] S. Brauksiepe et al., Nucl. Instr. & Meth. A 376 (1996) 397

[2] P. Moskal et al., Annual Report 1997, IKP, Forschungszentrum Jülich, Jül-3505 (1998) 43

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