Performance of Amadeus and S1 for Identification of two Particles with Small Relative Distance.

U.Seddik[1] P.Moskal [2], for the COSY - 11 Collaboration

Two planar drift chambers (DC) [1] with position resolution of 250 μm are used in the COSY-11 experiment to measure trajectories of both protons and positively charged mesons. Here, the performance of the S1 (start) and S3 (stop) scintillation detectors is investigated to identify two charged particles with small relative distance, where the DC cannot resolve the two tracks.

The data measured at the beam momentum p_b=3.321 GeV/c were analysed for one track events (OTE) and two track events (TTE). Figure 1(a,b) shows the energy loss (dE/dx) spectra of one and two particles crossing S3. Similar spectra were also obtained for the S1 detector. The histogram of energy loss signals of figure 1(a) normalized to unity is equivalent to the probability density distribution $g_1^{S3}(\Delta E)$ that the S3 detector registered OTE. Using the same normalization the distribution of figure 1(b) is equivelent to the probability density distribution $g_2^{S3}(\Delta E)$ that the S3 registered TTE. Similarly, the functions $g_1^{S1}(\Delta E)$ and $g_2^{S1}(\Delta E)$ were extracted for the S1 detector.

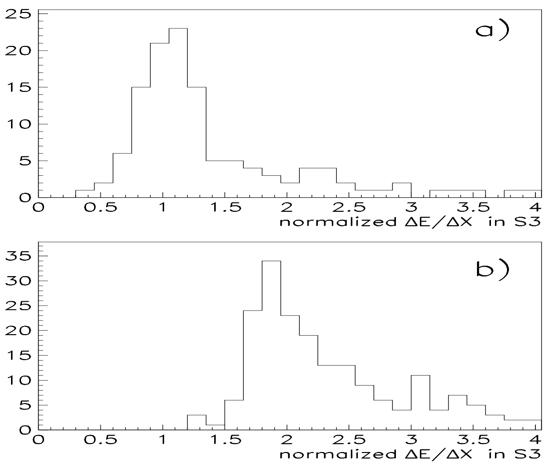

Figure 1: Energy loss spectrum for one particle (a) and two particles (b) crossing S3.

In order to identify the type of event the $Neyman-Pearson$ test will be used [2]. Thus, we define a probability ratio (α) given by

$$\alpha \quad = \quad W^{TTE}/W^{OTE} = \frac{g_2^{S1}(\Delta E1).g_2^{S3}(\Delta E3)}{g_1^{S1}(\Delta E1).g_1^{S3}(\Delta E3)}$$

If α is larger than a certain α_o value the signal will be denoted to be a TTE. Among the selected TTE events there is an impurity coming from OTE with:
$Impurity = \int W^{OTE}\Theta(\alpha - \alpha_0)dE_{S1}dE_{S3}$
where Θ is the Heaviside function. At the same time the probability that signals which are in reality TTE but are not recognized as such is given as:
$Loss = \int W^{TTE}\Theta(\alpha_0 - \alpha)dE_{S1}dE_{S3}$
Figure 2 shows the loss (level of significance) and the impurity change with α_o parameter. As an example, for α_o =4 about 8% of TTE are lost but at the same time only about 2% of OTE are accepted as impurity according to our test. Further, figure 3 shows the area of the energy loss in S1 and S3 which is covered by TTE at α_o =4 .

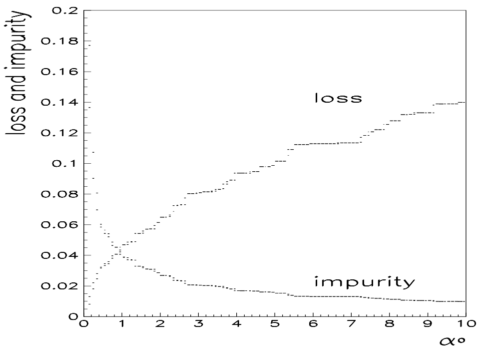

Figure 2: Loss and impurity change versus α_o parameter

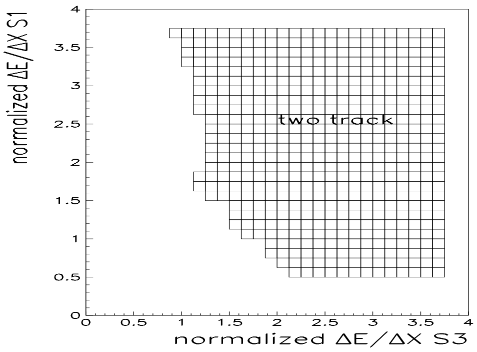

Figure 3: Area of two track events at α_o =4

[1] NRC, Atomic Energy Authority, Cairo, Egypt
[2] Institute of Physics, Jagellonian University, Cracow, Poland

References

[1] B. Gugulski et al., Report KFA-IKP(I)-1992-3.

[2] W.T.Eadie, D.Drijard, F.E.James, M.Roos, B.Sadoulet *Statistical Methods in Experimental Physics*, North-Holland, 1971