Space-Point Determination in the NA49 Vertex TPCs

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The first stage of particle tracking in the NA49 Time Projection Chambers is the determination of space-points within each detector volume. This process of "cluster finding" connects neighboring pixels (pad-time bins) with ADC values larger than some threshold value. From the charge distributions within these pre-clusters, one or more clusters are formed and assigned x-y positions used as space-points in the track reconstruction software. Efficient track-finding is dependent on the input of accurate space-points and their uncertainties as provided by the cluster-finding software.

The cluster-finding software previously used in NA49 reconstruction code identified clusters from projected charge distributions in the time (y) and pad (x) directions (1D X 1D). During the past year, this code was replaced by one that finds clusters directly in the 2D pad-plane.

The utility of the 2D approach was first illustrated in the upstream TPC, VTPC1, where the pad-layout design was optimized for the NA49 central Pb+Pb data using Monte Carlo studies of expected track populations[1]. Characteristics of the 2D shape of contiguous pixel hits (pre-clusters) were found to be associated with trajectories crossing the pad-planes at near optimal angles[2]. Such "golden" pre-clusters are processed quickly into final clusters. The x-z projection (in a $5cm$ vertical slice) of golden pre-clusters is shown in Fig. 1a in which complete particle trajectories are clearly visible. The golden pre-clusters represent $\geq$50% of all pre-clusters extracted from the raw data and about 85% of these are eventually included in tracks.

Again using only 2D-shape characteristics, the remaining (non-noise) pre-clusters are classified as either from merged hits or large-angle hits. Those likely being due to a merging of multiple clusters are split, if possible, into more than one space-point. Those pre-clusters that are characteristic of being from trajectories at large angles to the pad direction can be handled differently in the track-finding code. A plot of x-z positions for these last two categories is shown in Fig. 1b. The merged-type pre-clusters (filled circles) coincide with the high track density region near the beam-gap while those associated with large crossings angles (open circles) show the patterns of such trajectories. This information, obtained solely from pre-cluster characteristics, provides position or dispersion detail that is useful to the track-finding code.

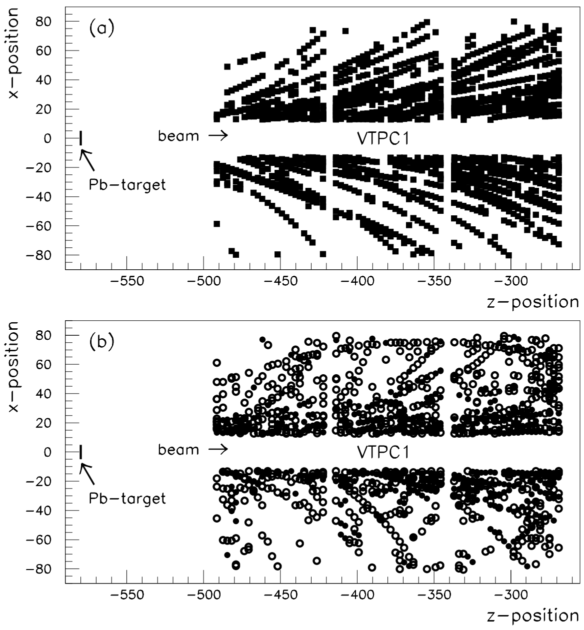

Figure 1: Positions of pre-clusters in NA49-VTPC1. Panel (a) shows only "golden" clusters. Panel (b) contains both likely merged (filled circles) pre-clusters and those likely from large-angle tracks (open circles).

References

[1] H. Appelshauser, NA49 Internal Report, (1995)

[2] T. Trainor, NA49 Internal Report (1996)