Short note on the analysis of April T3 test run

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1 Introduction

The following report shortly summarizes the analysis of cosmic ray data taken in the late April 2001.

2 Setup

As the trigger we used the coincident signal from two scintilators, one placed in front of the drift chamber and second just behind the drift chamber. It allowed us to select "almost" particle horizontal tracks: The angle between T3 detector axis and the direction of selected tracks was about 15 degrees in the vertical plane and between +20 and -20 degrees in the horizontal plane. Fig. 1, top panel, shows measured inclusive hit distribution versus vertical (Y-view) direction and versus the plane position. Now, we select events according to the conditions:

(i) The number of hits in sub-module I and in sub-module III, (see Fig. 1) in Y-view is 3 ± 1.

(ii) The position of the cluster in Y-view is between 7 cm and 16 cm and between 15 cm and 26 cm for sub-module I and sub-module III, respectively (the reference frame is defined in such a way that the position of the lowest lying wire in Y-view is 1 cm, for the definition of clusters please refer to the analysis note #27).

The hits distribution for such selected events is shown in Fig. 1 (bottom panel). One can see that this simple conditions select the very pure sample of single track events. Fig. 2 refers to the same two samples of events, (top panel - all events, and bottom panel - single track events) but here we plotted the distribution of the measured hit multiplicity in each of the tree modules. One can clearly see, that for events selected according to **(i)** and **(ii)**, the hit multiplicity distribution is sharply pick around value 10 (each T3 module consist of 10 detection planes). For the run under consideration (run 3108, 13.5 hrs) the total number of collected tracks is about 130. All subsequent analysis will refer to this particular run.

3 Average performance

Gas mixture: 70 % Argon, 30 % C_4H_{10}, 2.8 % alcohol.
$HV_{diff} = 2150V$.
The extracted detection efficiency are 98 %, 94.5 % and 98 % for sub-module I, II and III, respectively. The noise level was about 0.2 noisy hits/event/module. See Fig. 3, and for better explanation analysis note #27.

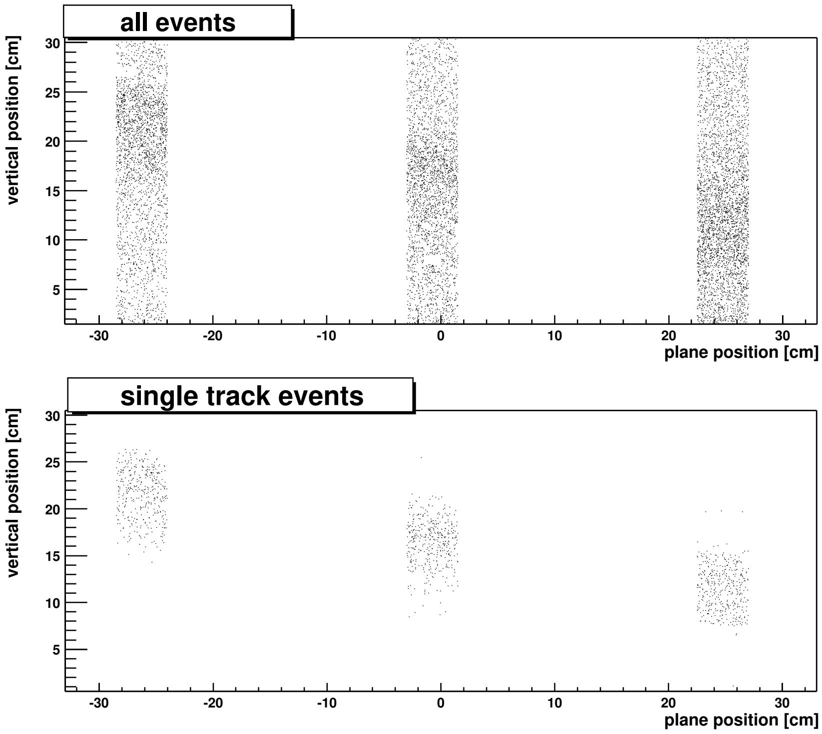

Figure 1: Inclusive number of hits measured in the Y-view, (top panel), and number of hits measured for selected single track events.

4 Calibration

The calibration of the drift distance was done according to the prescription given in the DC NIM paper in sec. V. C. (not published but it was distributed around collaboration). Here I would like to make some comments:

(i) The calibration method is valid for particles which tracks are perpendicular to the detection planes (= parallel to the detector axis).

(ii) Calibration should be done individually for each single drift cell particulary as the different channels might have different timing offsets.

(iii) Each cell should be uniformly illuminated (in fact it is enough when the particle rate versus transverse dimension of the cell is the linear function).

All this requirements are well fulfill for the RHIC collision tracks and rather not so well for the considering test measurements.

Summarizing: one can keep in mind that the calibration of the drift distance for the upcoming RHIC run data is expected to be significantly better than this presented here. The example of extracted calibration function is shown in Fig. 4.

5 Track reconstruction

The track reconstruction was performed using BrDCTrackingModule (brat version 1.16.5). Tracking was attended only for selected single track events. The example of one recon-

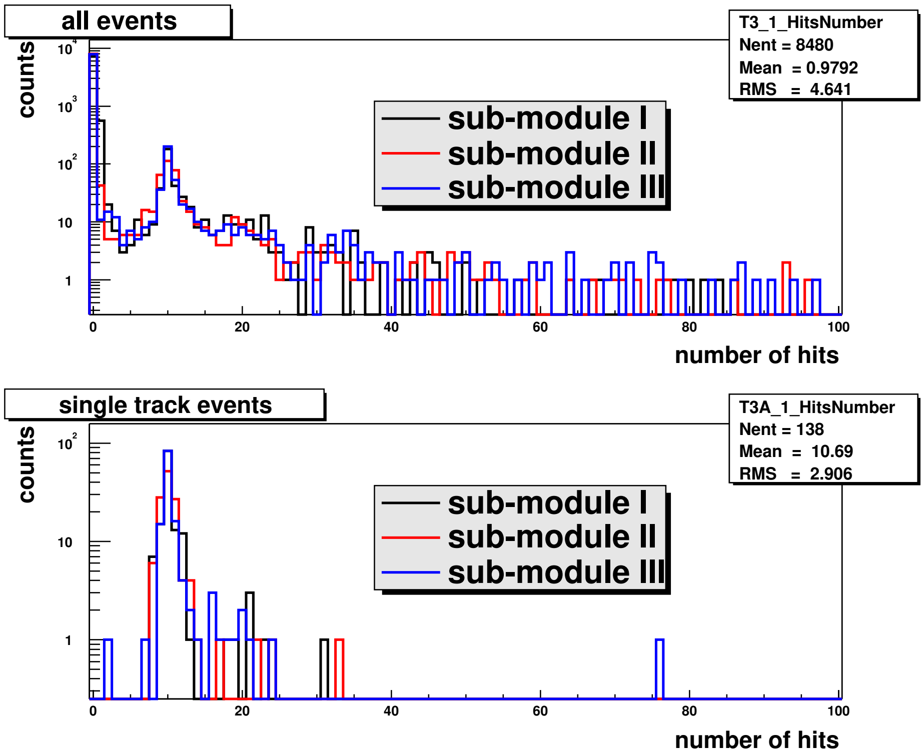

Figure 2: Multiplicity distribution of measured detector hits in a single event. Top and bottom panels refer to the same condition as described in Fig 1.

structed track (together with combined detector hits) is shown in Fig. 5. All reconstructed tracks for run 3108 are plotted in Fig. 6.

Fig. 7 presents the distribution of the distance between the reconstructed tracks and each of the associated primary detector hit (called deviation). This distribution directly refers to the achieved position resolution in the single detection plane. Fig. 7 (a) shows deviation distribution in the case when we impose condition that the number of missing associated combined hits should **not** exceed 1, 1 and 2 in view X, Y and UV (UV means U or V), respectively. Under this requirement the average number of primary detector hits associated to a given reconstructed track is about 25 (30 is the maximum number - number of detection planes in T3 detector) and the position resolution is about $\sigma = 218\mu m$.

Fig. 7 (b) shows the case when we impose condition that the number of missing associated combined hits should **not** exceed 1, 1 and 4 in view X, Y and UV, respectively. This requirement provide that the reconstructed tracks have on average about 20 associated primary detector hits and the deviation of the associated primary hits from the reconstructed tracks slight larger, $\sigma = 235\mu m$

The track reconstructed efficiency is 75 % and 90 % in case (a) and (b), respectively.

Comments:

The tracking code is optimized only for tracks perpendicular to the detection planes. Dealing with different track slopes it was necessary to be very tolerant imposing the criterion when combining hits to not loose the real hits, but on the other hand this tolerance creates a large number of “ghost” combined hits, that affects the tracking.

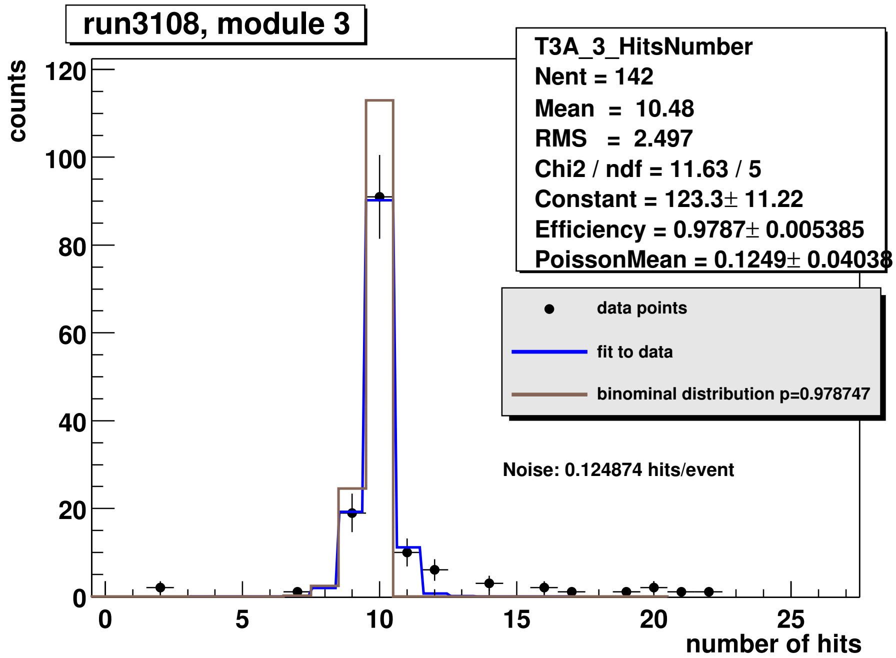

Figure 3: Hit distribution for selected events (black dots), blue colored histogram represents the fit to data points with convolution of binomial and Poisson distributions Brown colored histogram shows binomial distribution extracted from the fit. (see analysis note #27 for details)

For the presented analysis we did not use signals from detection plane T3-2-U1 and T3-2-U2 (broken fuse for the second one). Three, sixtin channel connectors was improperly plugged into TDC. This killed 3 channels of electronics in planes: T3-2-V2, T3-3-V2 and T3-2-X1. All the above problems has been fixed.

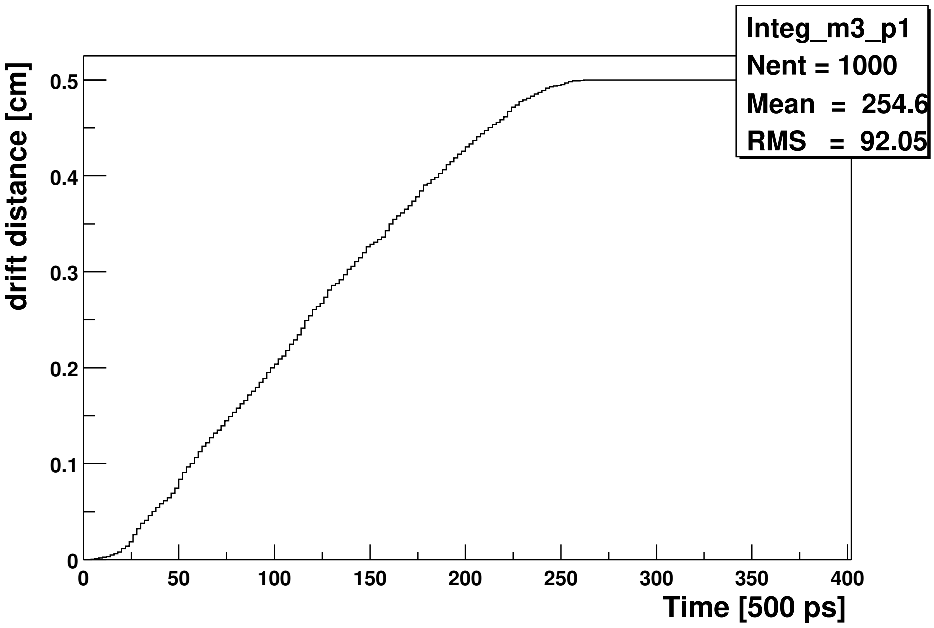

Figure 4: Calibration function for plane T3-3-X1. The shape of this function is not very smooth because the poor statistics.

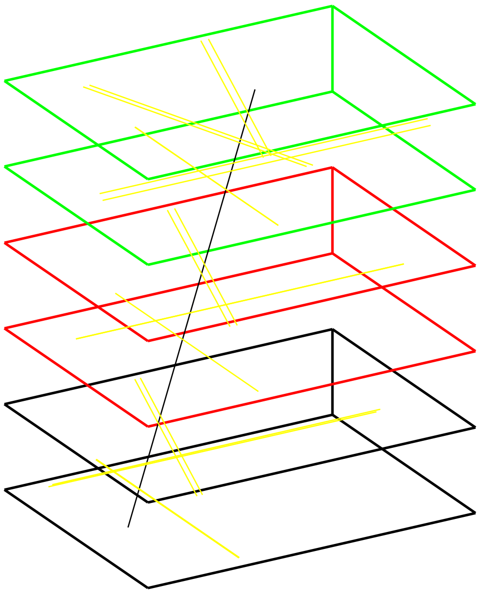

Figure 5: Reconstructed track - black line, and combined detector hits - yellow lines, for one selected event. The plotted shapes show the active volume of sub-module I (black shape), sub-module II (read shape) and sub-module III (green shape).

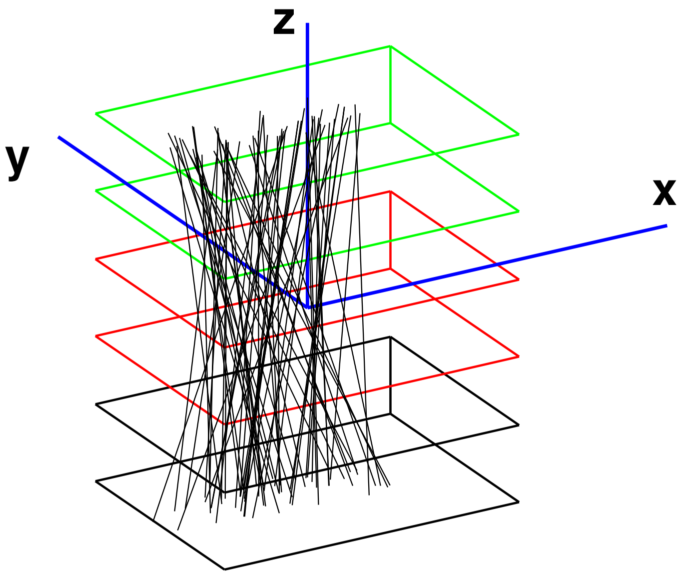

Figure 6: Reconstructed tracks collected in run 3108.

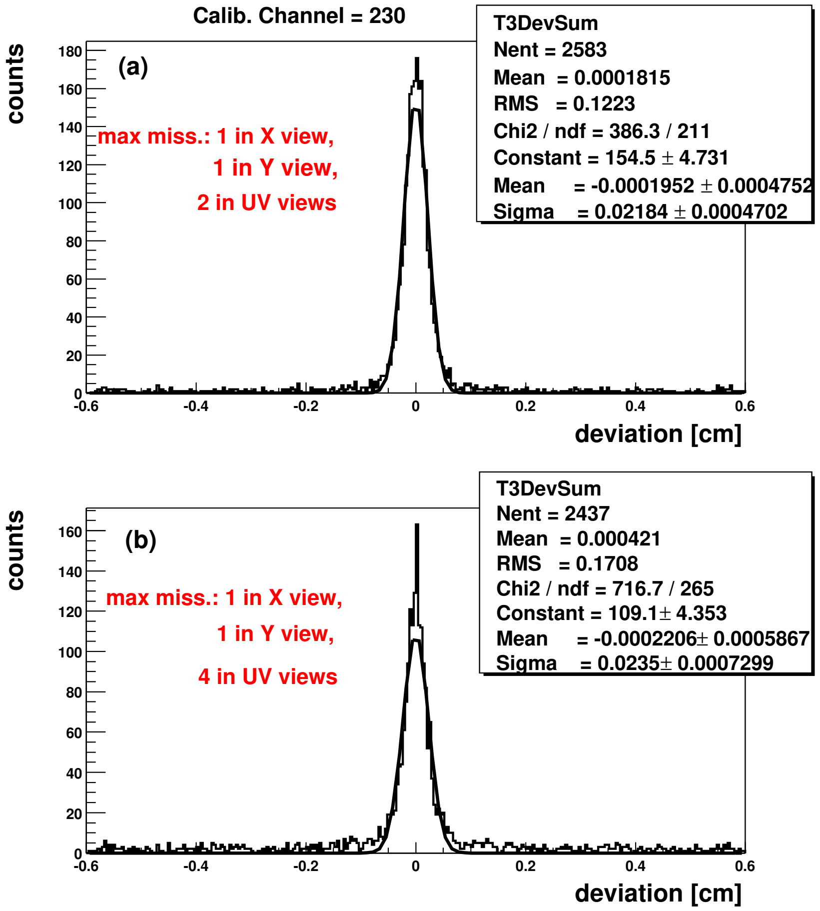

Figure 7: The distribution of the distance between reconstructed tracks and all associated primary detector hits. (a) and (b) refer to different requirements on the track quality (see text for more details).