E877 Note # HD-96/08/27

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Occupancy correction. Method # $n+1$. Version 2.

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ABSTRACT

As was pointed out by Roger Lacasse the weighting method for the occupancy correction described in my previous Note is impossible to apply for the real data, in the situation when there is no any information about the lost tracks. Here I discuss a similar method which takes this fact into account, and which, I believe, is more realistic in this sense.

The problem with the method described in the previous Note [1] is the following. The correction was based on the fact that the mean weight for each track equals to unity (see Eq.2 in [1], the notations are the same as in [1]):

$$\langle weight \rangle = e^{-\overline{n}} \sum_n p_n 2^n = 1, \tag{1}$$

where the weight was calculated using all other tracks (both survived as well as lost during minimum separation cut) in some window with width equal to minimum separation. Due to the fact that lost tracks are really lost (Roger is right) and one cannot use them to calculate the weight, the method would, in general, under-correct the data. In the limiting case when all tracks with the separation less than minimum one are totally lost, one can find only 0, 1, or maximum 2 tracks in the window used to calculate the weight, and the sum in Eq.1 has only three terms. In this case it is possible to find a proper coefficients in front of each term to get the sum *approximately* equal to unity for a reasonable region of possible $\overline{n}$. Then to use these coefficients to calculate the weight. In this Note I discuss a different approach. It is known that some tracks still survive being in the minimum separation region. I will use these tracks for the evaluation of the weight.

For the case of two track separated less than the drift chamber minimum separation I introduce three probabilities w_0 – the probability of two tracks being lost, w_1 – the probability when one track survives, and w_2 - when both tracks survive. Using these probabilities I can calculate the distribution in number of tracks found in the bin with width of two minimum separation (2 cm for DC2). Then I try to fit the real data using these probabilities and to extract w_0, w_1, and w_2. To calculate the distribution in number of tracks analytically appears to be difficult so I used Monte Carlo calculation. For the data (from '93 run) I used two bins located in different parts of DC2 with mean track occupancy approximately of 0.4 and 0.17. I calculated the χ^2 for different combinations of w_0 and w_1 (the overall normalization can be calculated analytically, and I also use that $w_2 = 1 - w_0 - w_1$). The results are shown in Fig. 1–4. One can see that there is no possibility for the unique determination of w_0 and w_1 due to deep and relatively flat valley in χ^2. The real detector simulation is needed for this case. But one should agree that the probability to loose both tracks (w_0) should be negligible. The problem of tracking is to *resolve* two close tracks. In this case from the Figs.1-4 one would conclude that $w_1 \approx 0.45$ and, correspondingly, $w_2 = 0.55$.

Then I use my Monte Carlo program described in [1]. I introduced the probability for one track being lost proportional to the separation. If two tracks are close in two chambers the probabilities multiply. The resulting distribution in separation between tracks in DC2 and DC3 are shown in Fig.5. Then in my calculation of weight I use only the tracks which “survived”.

At the beginning let us calculate the probability of track to be lost. That is the correction factor which one has to get back from weighting. This probability is:

$$p_{survive} = e^{-\overline{n}} \sum_n p_n (w_2 + w_1/2)^n = e^{-\overline{n}(1-w_2-w_1/2)} \tag{2}$$

For the calculation of proper weight one needs the distribution in number of tracks found in the minimum separation bin. As I mentioned above I could not derive an analytical expression for a such distribution in general case. Below I use the expressions in first order in occupancy for the distibution in number of tracks. The results I use in Monte Carlo for *realistic* occupancy and compare the “input” and “reconstructed” track distributions. In first order of occupancy the probabilities of different cases I write in the form:

$$e^{-\overline{n}}[\overline{n}(w0 + w1/2) + (1 + \overline{n}(w_1/2) + \overline{n} w_2], \tag{3}$$

where the first term corresponds to the case when the track under consideration is lost, second term corresponds to the case with the track being survived and when there is no other tracks within the minimum separation to it, and the last term corresponds to the case when there is one track extra in the bin. Our task is to find a weight which one should apply to the third term to compensate for the track lost due to the first term. Simple arithmetics shows that this weight is

$$weight = (1 - w_1/2)/w_2. \tag{4}$$

For example, the case of $w_1 = w_2 = 1/2$ (what is close to the real situation) gives the weight $weight = 1.5$. This weight has to be applied to track each time any other track is found in the vicinity of minimum separation. Adding of the second chamber (DC3) is strait-forward – one should keep multiplication of the weight for each track found close in the second chamber as well.

In Figs. 5–7 I show the results. The solid histogram is an “input”, the dashed histogram is the “observed” track distribution. Using filled circles I show the “reconstructed” distribution using weight calculated in accordance with the procedure described above. What is important that for this weight calculation I use only “observed” tracks.

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[1] S. Voloshin, E877 Note # HD-96/08/15.

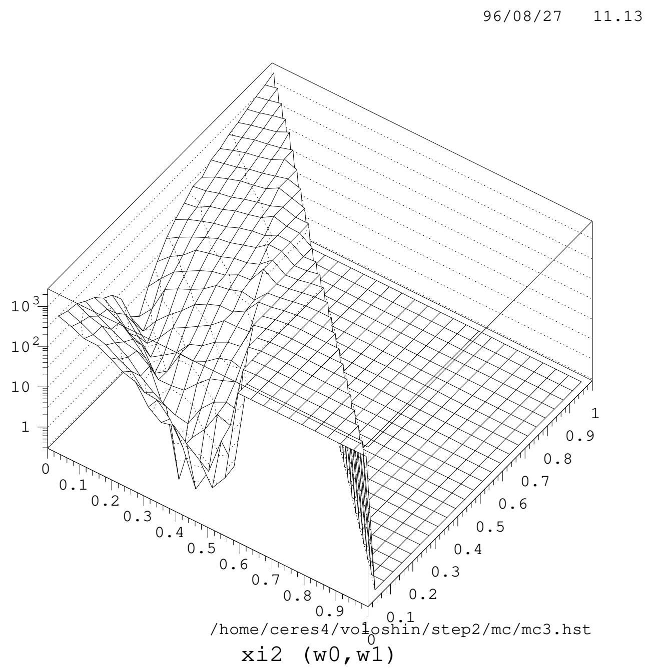

FIG. 1. χ^2 as a function of w_0 and w_1. Mean occupancy about 0.4.

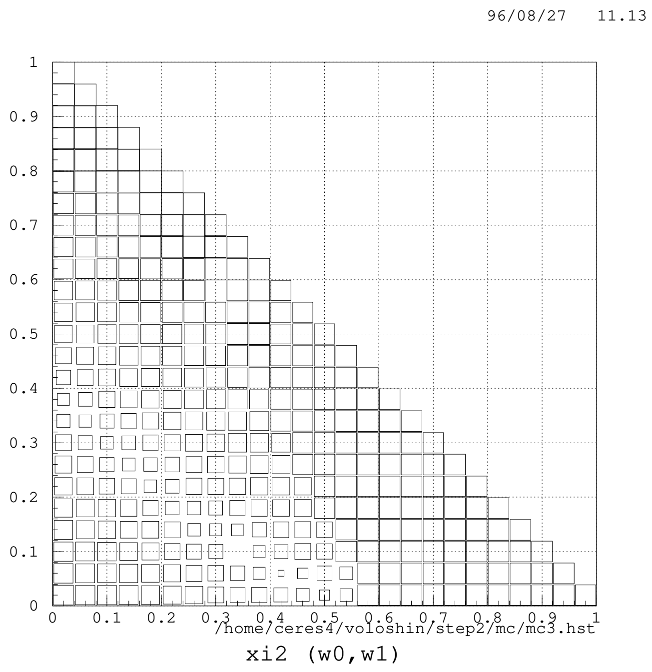

FIG. 2. The same as Fig. 1

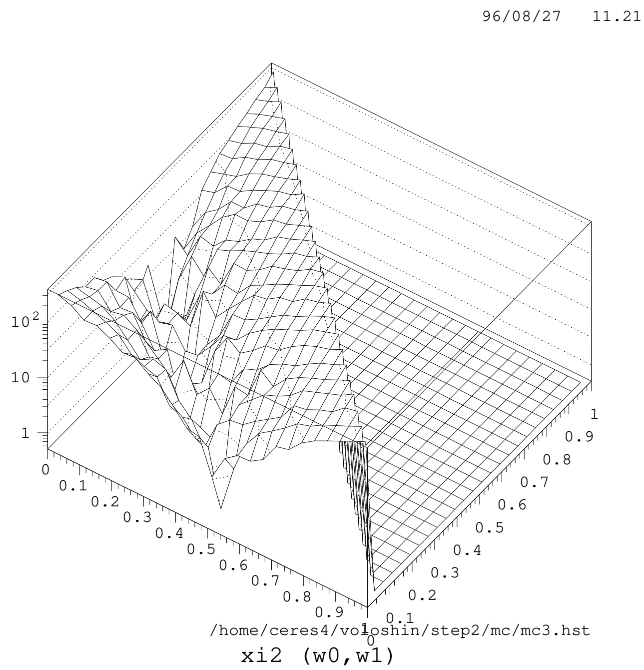

FIG. 3. χ^2 as a function of w_0 and w_1. Mean occupancy about 0.17.

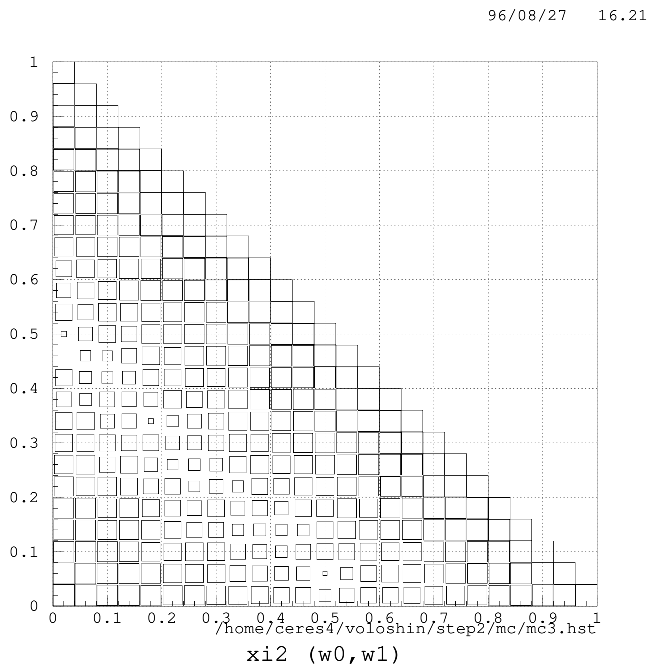

FIG. 4. The same as Fig. 3

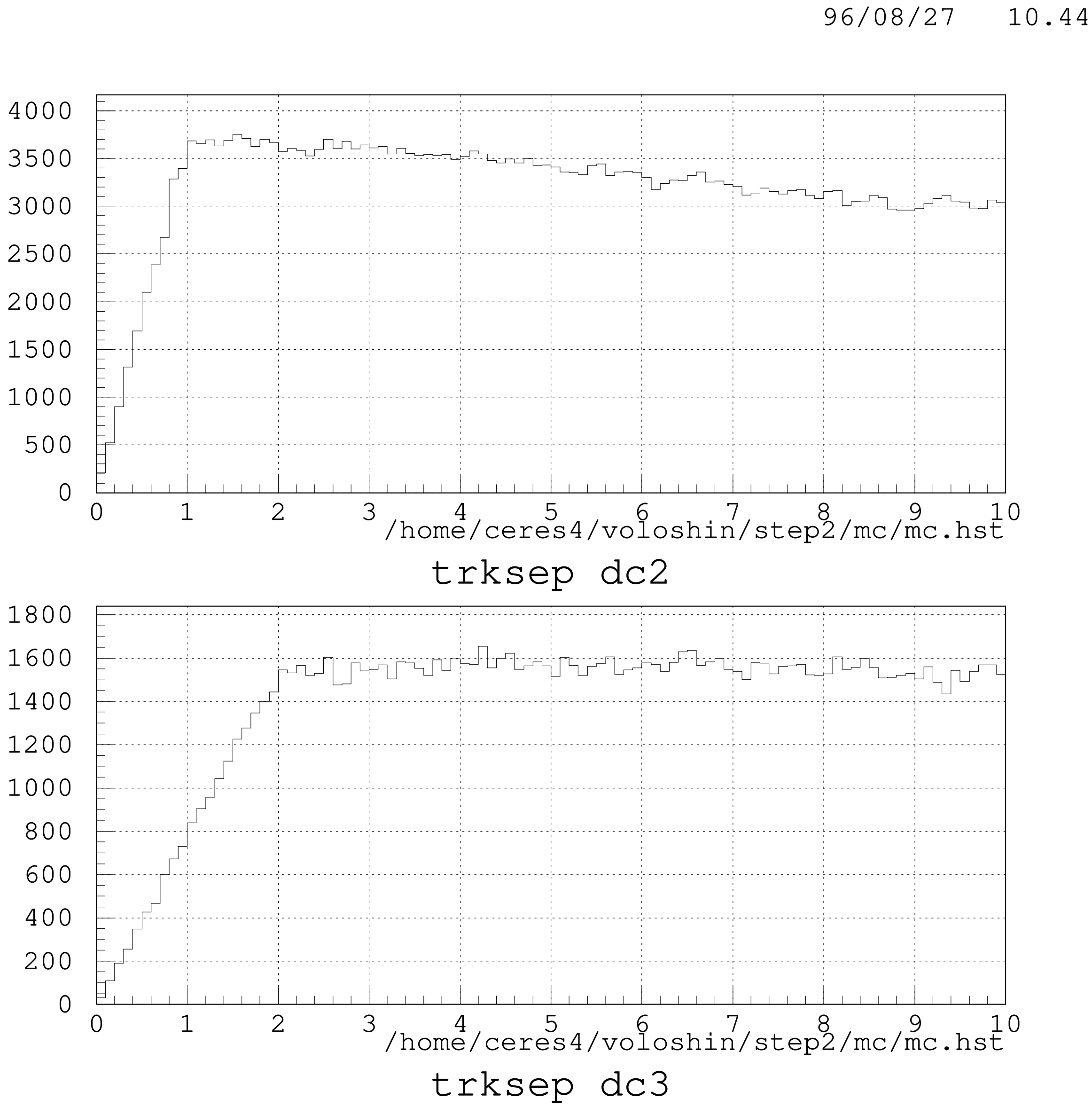

FIG. 5. The distribution in separation between tracks in DC2 and DC3.

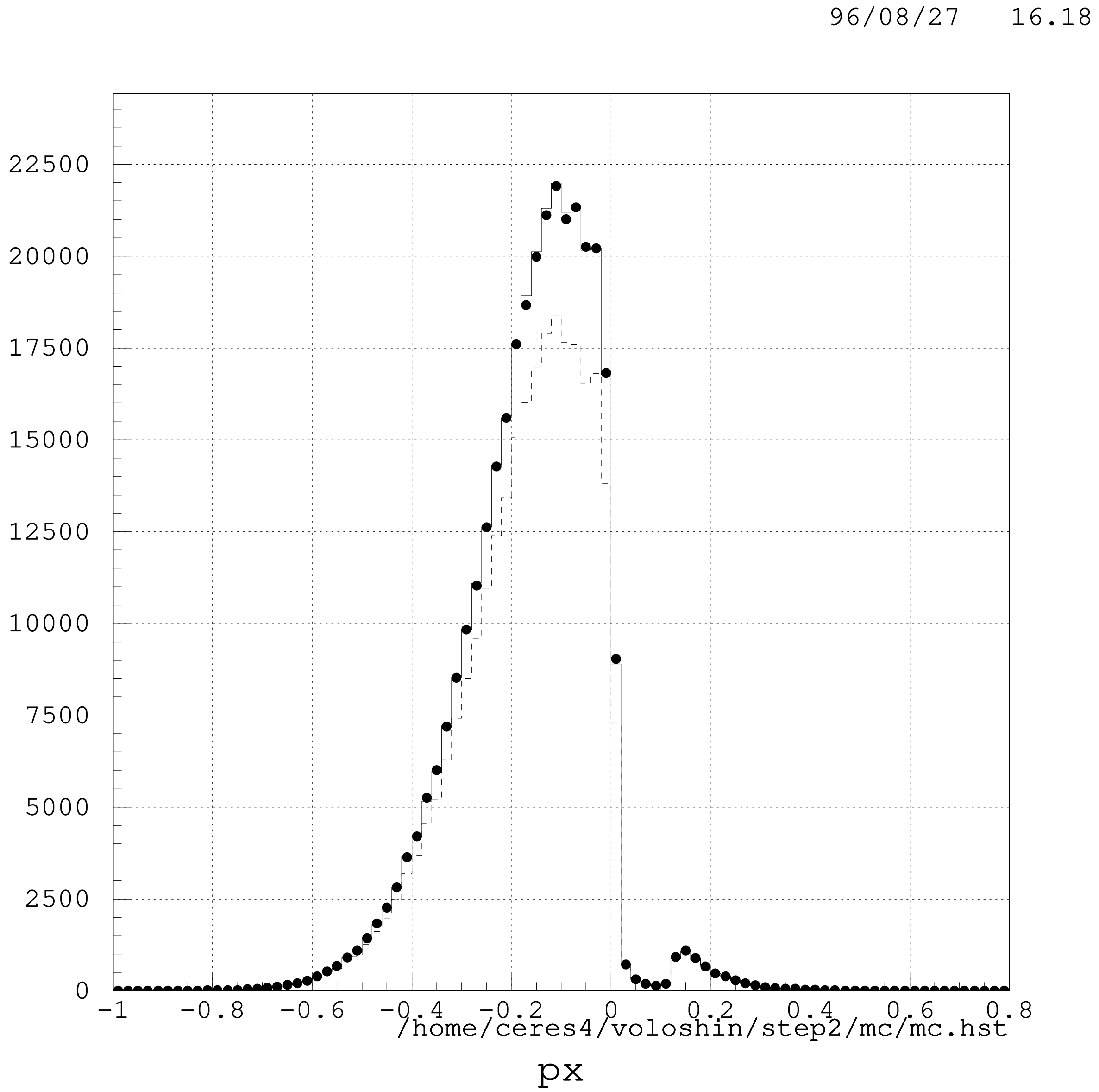

FIG. 6. Particle distribution in p_x. Solid histogram – input. Dashed histogram – the distribution after applying cuts on minimum separation in DC2 and DC3. Solid circles – the distribution, corrected using *weight* .

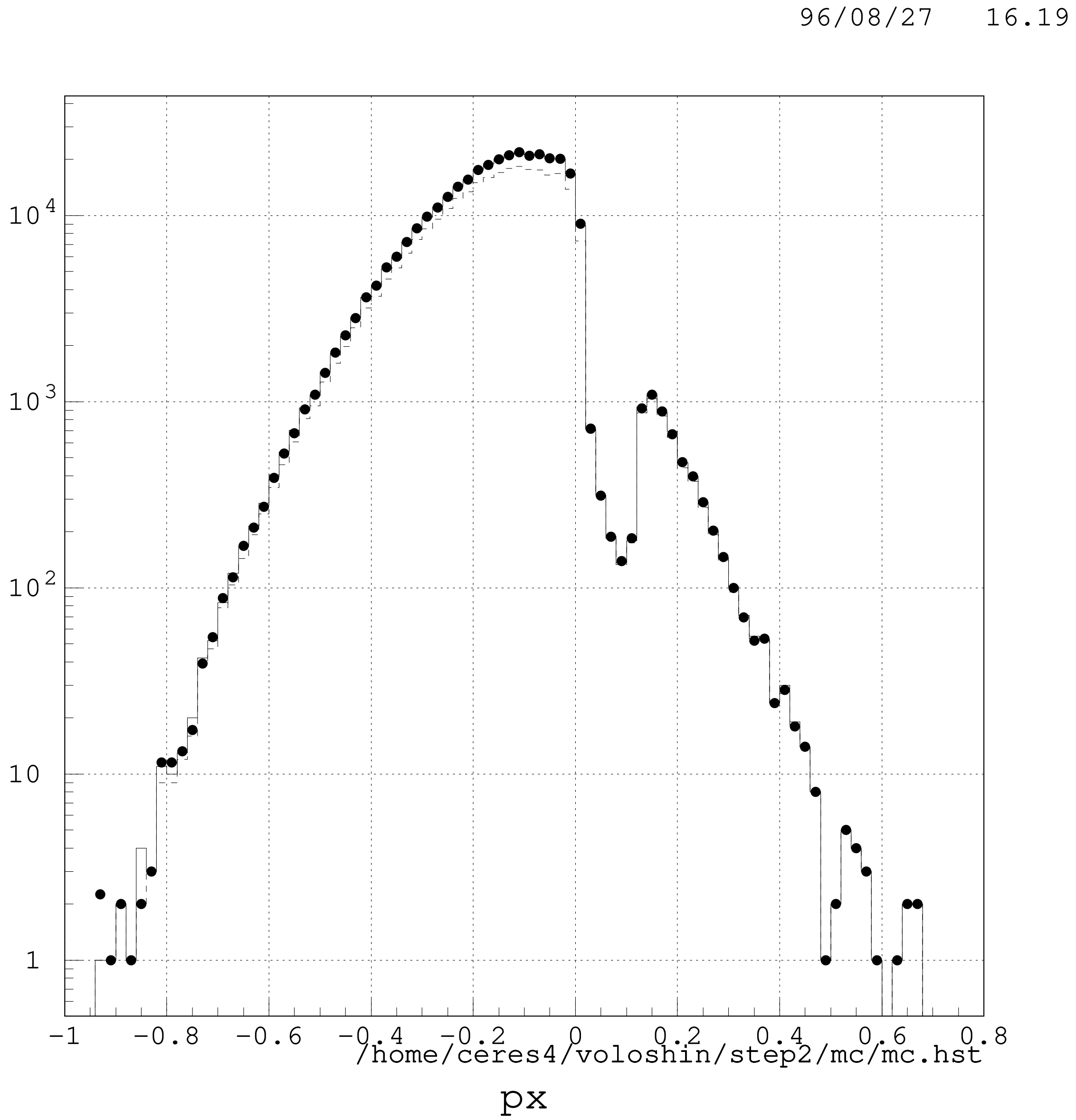

FIG. 7. The same as Figure 7 in log scale.