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SCINTILLATORS EFFICIENCY

(e93050 - Hall A - TJNAF)

1 The triggers

Different kinds of triggers have been defined for the acquisition of the two high resolution spectrometers (HRS) of Hall A:

- the T1 and T3 triggers, that represent the single electron and hadron arm good events;
- the T5 trigger, that represents the coincidence between the two spectrometers;
- the T2 and T4 triggers, that represent the junk electron or hadron events; among the T2 and T4 triggers we can also find events that can be ascribed to an inefficiency of the scintillators that are in charge of the trigger;
- the T8 trigger, that is a random trigger.

The T1 (or T3) trigger is defined as the coincidence in time of at least one paddle in the S1 and one paddle in the S2 scintillator planes of the electron (hadron) arm when they are in a good geometrical configuration (S-ray) (fig. 1), i.e. when the two hit paddles are in the same position on the two planes or in an adjacent one:

$$\mathrm{T1}\ (\mathrm{T3}) = (\mathrm{S1} \bigcap \mathrm{S2})_{geom.\ coinc.} \qquad (1)$$

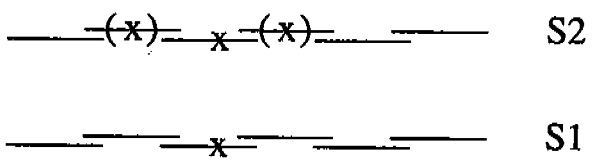

Figure 1: Geometrical configuration of a T1 (or T3) trigger

The good signal in the S1 (or S2) plane is defined as the coincidence between at least one left PM and its corresponding right PM (fig. 2):

$$\mathrm{S1}(i) = \mathrm{S1left}(i) \bigcap \mathrm{S1right}(i) \tag{2}$$

$$\mathrm{S2}(i) = \mathrm{S2left}(i) \bigcap \mathrm{S2right}(i) \tag{3}$$

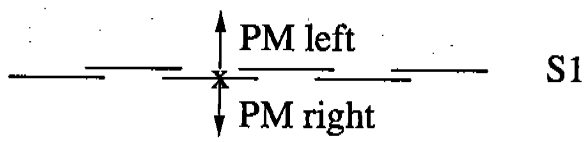

Figure 2: The coincidence left-right of the two PMs of the paddle i give a signal S1(i)

In addition to the paddle (or the paddles) that gave the S1 (or S2) good signal, i.e. a coincidence between a left PM and its corresponding right one, we can also find a certain number of paddles that gave a signal only on the left or on the right side (fig 3).

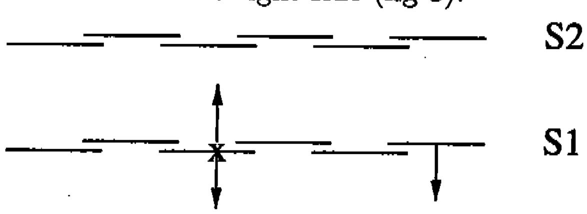

Figure 3: The left-right coincidence of the 3rd paddle gave a S1(3) signal; in addition the right PM of the 6th paddle gave a signal. In this case: hitpatl≠hitpatr (see after)

The T2 trigger (in the electron arm) is defined as the coincidence of a S1 signal with a Čerenkov signal, when the S2 one is missing (fig. 4(a)), or the coincidence of a S2 signal with the Čerenkov signal, when the S1 one is missing (fig. 4(b)), or as the time coincidence between a S1 and a S2 signals, that are not in good geometrical coincidence (fig. 4(c)) or as the geometrical coincidence between a S1 and a S2 signals that are not in good time coincidence (fig. 4(d)).

$$T2 = (S1 \bigcap \check{C})_{\bar{S2}} \bigcup (S2 \bigcap \check{C})_{\bar{S1}} \bigcup (S1 \bigcap S2)_{bad\ geom} \bigcup (S1 \bigcap S2)_{bad\ time} \tag{4}$$

In the figure the single arrows in parenthesis shows the noise that can be superposed to the good S1 or S2 signals, due to a signal in a single left PM or in a single right PM. We will examine later the relative weights of the different contributions.

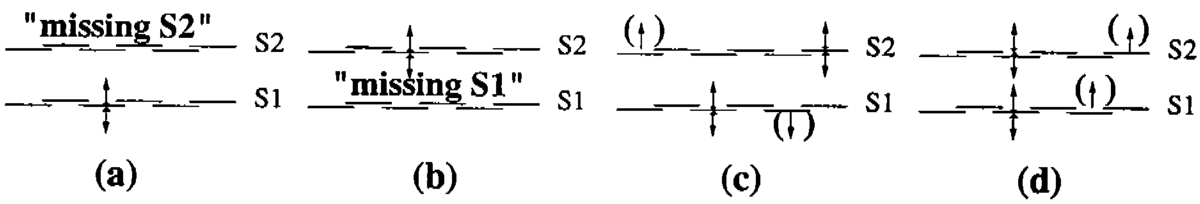

Figure 4: T2 triggers: (a) $(S1)_{\bar{S2}}$; (b) $(S2)_{\bar{S1}}$; (c) $(S1 \bigcap S2)_{bad\ geom}$; (d) $(S1 \bigcap S2)_{bad\ time}$

In a similar way we can define the T4 trigger on the hadron arm, with the only difference that no Čerenkov signal is requested:

$$T4 = (S1)_{\bar{S2}} \bigcup (S2)_{\bar{S1}} \bigcup (S1 \bigcap S2)_{bad\ geom} \bigcup (S1 \bigcap S2)_{bad\ time} \tag{5}$$

The T4 triggers are therefore less clean than the T2 ones as the selection criteria are less restrictive.

As we said before, only a certain number of the T2 and T4 triggers can be interpreted as good electron or hadron events that were missed because of an inefficiency of the scintillators, while the remaining part is just made of junk events and we must be able to separate them through suitable selection criteria. As a consequence of the definition of a good signal in S1 or S2 (2), we can say that one of the paddles of the S1 or S2 scintillator plane was inefficient when we are sure that **a particle traversed the paddle** and :

1. **neither the left PM nor the right one of the paddle gave a signal;**
2. **the left PM of the paddle gave a signal but the right did not;**
3. **the right PM of the paddle gave a signal but the left did not.**

The three situations explained before are resumed in figure 4(a) for S2 and 4(b) for S1. In any case we can not ascribe to inefficiency of the scintillators the situations shown in figure 4(c) or (d).

1.1 Some numbers

We want to give an idea of the order of magnitude of the different kind of events shown in figure 4. We will concentrate on events with at least one signal in all the four VDC planes, because this criterion will be chosen (as explained in section 3.1) to separate the events due to inefficiency. We also want to underline the effect of this selection on the different kind of triggers. The situation is totally different for the electron and for the hadron arm: for the electron arm, the raw value of the ratio T2/(T1+T5) is almost identical to the value obtained with the VDC selection; for the hadron arm the value of the ratio T4/(T3+T5) is strongly different with and without the selection. This means that T2 events are cleaner than the T4 ones due to the fact that on the electron arm the coincidence with the Čerenkov detector is requested in the trigger.

The case of the electron arm will be treated more in detail. Values refer to the run 1765 and are already multiplied by the prescale factors.

ELECTRON ARM (RUN 1765)

- total number of T1: <u>$105896310 \simeq 105.9 \cdot 10^6$</u>
- total number of T1 with at least one signal in all the four VDC planes: <u>$77805570 \simeq 77.8 \cdot 10^6$</u>
- total number of T5: <u>$578121 \simeq 0.6 \cdot 10^6$</u>
- total number of T5 with at least one signal in all the four VDC planes: <u>$423223 \simeq 0.4 \cdot 10^6$</u>
- total number of T2: <u>$4363865 \simeq 4.4 \cdot 10^6$</u>
- total number of T2 with at least one signal in all the four VDC planes: <u>$2314295 \simeq 2.3 \cdot 10^6$</u>

Without the VDC selection, the raw value of the ratio T2/(T1+T5) is 4%. This ratio reduces to approximatively 3% when the VDC selection is applied. This already gives us an order of magnitude of the inefficiency of the scintillators in the electron arm.

HADRON ARM (RUN 1765)

- total number of T3: <u>$55952550 \simeq 55.9 \cdot 10^6$</u>
- total number of T3 with at least one signal in all the four VDC planes: <u>$35531250 \simeq 35.5 \cdot 10^6$</u>
- total number of T5: <u>$578121 \simeq 0.6 \cdot 10^6$</u>
- total number of T5 with at least one signal in all the four VDC planes: <u>$362113 \simeq 0.4 \cdot 10^6$</u>
- total number of T4: <u>$16867170 \simeq 16.9 \cdot 10^6$</u>
- total number of T4 with at least one signal in all the four VDC planes: <u>$195750 \simeq 0.2 \cdot 10^6$</u>

Without the VDC selection, the raw value of the ratio T4/(T3+T5) is 30%. This ratio reduces to 0.5% when the VDC selection is applied and this is the order of magnitude of the inefficiency of the scintillators in the hadron arm. This gives us an idea of the importance of making good selections on the T4 events in order to calculate the correct efficiency.

ELECTRON ARM (RUN 1765)

The T2 events with at least one signal in all the four VDC planes (that is 2314295$\simeq$2.3$\cdot 10^6$) can be classified as follows (only most significant cases will be examined):

1. missing S1 and single hit on S2: <u>**591755**</u> (25% of the T2 with at least one signal in all the four VDC planes) that can be separated in the following classes:

   (a) no hit at all in S1: <u>**8835**</u> (only 1.5% of events with a single hit in S2 are due to total inefficiency of the S1 PMs)

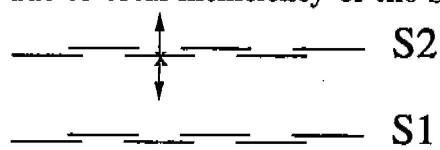

Figure 5: T2 trigger with a single hit in S2 and no hit in S1

   (b) no hit in any right PM and single hit in a left PM in S1: <u>**227430**</u> (38.5% of events due to the inefficiency of a right PM in S1 plane plus some noise)

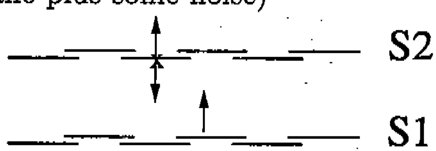

Figure 6: T2 trigger with a single hit in S2, no left PM hit and single right PM hit in S1

   (c) no hit in any left PM and single hit in a right PM in S1: <u>**355490**</u> (60% of events due to the inefficiency of a left PM in S1 plane plus some noise)

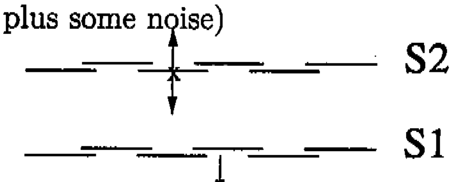

Figure 7: T2 trigger with a single hit in S2, no right PM hit and single left PM hit in S1

If we do not impose the single hit in the left PM in (b) and in the right PM in (c) we obtain: (b) <u>228475</u> events and (c) <u>357105</u> events (and a total of <u>585580</u>), that means that the noise contribution is negligeable.

2. missing S2 and single hit on S1: <u>1334085</u> (58% of the T2 with at least one signal in all the four VDC planes) that can be separated in the following classes:

   (a) no hit at all in S2: <u>0</u>

   (b) no hit in any right PM: <u>668610</u> (50.% of events due to the inefficiency of a right PM in S2 plane plus some noise)

   (c) no hit in any left PM: <u>665475</u> (50.% of events due to the inefficiency of a left PM in S2 plane plus some noise)

3. $(S1 \bigcup S2)_{badgeom.}$:

   (a) single hit in S1 and single hit in S2 not in geometrical coincidence: <u>4750</u> (0.2% of the T2 with at least one signal in all the four VDC planes)

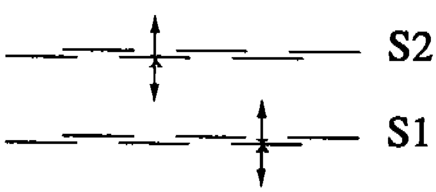

Figure 8: T2 trigger with single hit in S1 and single hit in S2 not in geometrical coincidence

4. $(\mathrm{S1} \bigcup \mathrm{S2})_{badtime}$:

(a) single hit in S1 and single hit in S2 in geometrical coincidence: **38855** (the rejection by the trigger must be due to a bad coincidence in time; 1.7% of the T2 with at least one signal in all the four VDC planes)

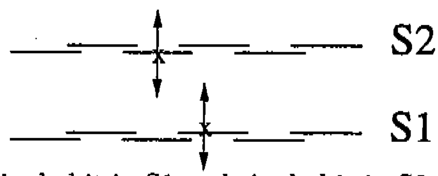

Figure 9: T2 trigger with single hit in S1 and single hit in S2 in geometrical coincidence

(b) single hit in S2 and double hit in S1, one of them in geometrical coincidence: **66975** (2.9% of the T2 with at least one signal in all the four VDC planes)

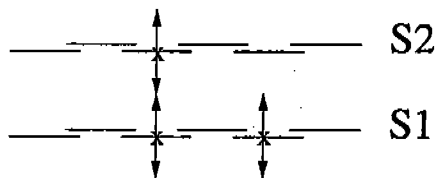

Figure 10: T2 trigger with single hit in S2 and double hit in S1, one in geometrical coincidence

(c) single hit in S1 and double hit in S2, one of them in geometrical coincidence: **74100** (3.2% of the T2 with at least one signal in all the four VDC planes)

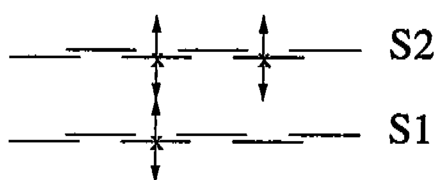

Figure 11: T2 trigger with single hit in S1 and double hit in S2, one in geometrical coincidence

(d) single hit in S2, one good hit in S1, plus a left or a right PM on S1: <u>15010</u> (0.6% of the T2 with at least one signal in all the four VDC planes)

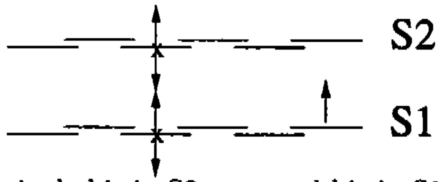

Figure 12: T2 trigger with single hit in S2,one good hit in S1 plus a left or a right PM on S1

(e) single hit in S1, one good hit in S2, plus a left or a right PM on S2: <u>21280</u> (0.9% of the T2 with at least one signal in all the four VDC planes)

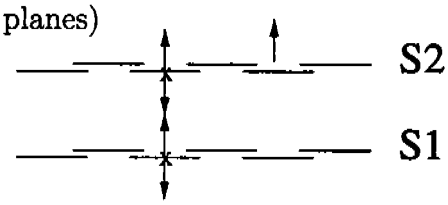

Figure 13: T2 trigger with single hit in S1,one good hit in S2 plus a left or a right PM on S2

Still 7% of T2 events are not included in all these cases, that are due to more complicate situations. From this list it is clear that it is important to find good selection criteria in order not to ascribe to scintillator inefficiency events coming from other sources.

2 Some useful variables

It is necessary to remind here the meaning of the eight variables:

spec_e.s1.xdetgeom and spec_e.s1.ydetgeom
spec_e.s2.xdetgeom and spec_e.s2.ydetgeom
spec_h.s1.xdetgeom and spec_h.s1.ydetgeom
spec_h.s2.xdetgeom and spec_h.s2.ydetgeom

They represent the coordinates in the scintillator planes of the crossing of the VDC track with this plane. In few words, for a single hit (only one paddle hit) and for a well reconstructed track, the variable xdetgeom should correspond to the hit paddle.

Eight new variables were coded by Mark Jones inside ESPACE, from which we can deduce how many paddles were hit and which of them:

spec_e.s1.hitpatl and spec_e.s1.hitpatr
spec_e.s2.hitpatl and spec_e.s2.hitpatr
spec_h.s1.hitpatl and spec_h.s1.hitpatr
spec_h.s2.hitpatl and spec_h.s2.hitpatr

They are defined as follows:

hitpatl $= \sum_{i=1}^{6} 10 * 2^{(ipadleft(i)-1)}$

hitpatr $= \sum_{i=1}^{6} 10 * 2^{(ipadright(i)-1)}$

where: ipadleft(i)=i if the paddle was hit.

Ex.: single paddle (left or right):

i=1	hitpatl = 10 (or hitpatr=10)
i=2	hitpatl = 20
i=3	hitpatl = 40
i=4	hitpatl = 80
i=5	hitpatl = 160
i=6	hitpatl = 320

Ex.: two paddles (left or right):

i=1,2	hitpatl = 10 + 20 = 30
i=2,3	hitpatl = 20 + 40 = 60
i=3,4	hitpatl = 40 + 80 = 120
i=4,5	hitpatl = 80 + 160 = 240
i=5,6	hitpatl = 160 + 320 = 480

Warning! The left and the right side of a paddle are completely independent, i.e. you can have hitpatl≠hitpatr. For example, in figure 3, hitpatl=40 (3rd paddle left PM) while hitpatr=360 (3rd and 6th right PMs). For this reason in the following, when we will request a single hit in a scintillator plane, we will impose hitpatl=hitpatr, which will guarantee us that the same left and right PMs have given a signal.

3 Efficiency calculation

We will treat here the electron arm scintillator inefficiency, but the same treatment can be extended to the hadron arm.

3.1 Selection of good events

The basic idea is to identify, among the T2 triggers, the events that can be interpreted as inefficiencies of S1 or S2 planes. In order to do this, we have to impose some selection conditions, that should be severe enough as to allow to identify in a rather clear way a good track with a missing scintillator plane. The inefficiencies of the S1 and S2 scintillator planes can be defined as follows (g.t. = good track):

$$\epsilon_{S1} = \frac{\text{T2(g.t.} \bigcap \text{missing S1)}}{\text{T1(g.t.)} + \text{T5(g.t.)} + \text{T2(g.t.} \bigcap \text{missing S1)}} \tag{6}$$

$$\epsilon_{S2} = \frac{\text{T2(g.t.} \bigcap \text{missing S2)}}{\text{T1(g.t.)} + \text{T5(g.t.)} + \text{T2(g.t.} \bigcap \text{missing S2)}}$$

where:

- T2(g.t. $\bigcap$ missing S1 or S2) is the number of T2 triggers that have a good track, but the signal in S1 (or S2) is missing
- T1(g.t.) and T3(g.t.) are the number of T1 and T3 triggers that have a good track, defined with the same conditions as for T2

In the following, we will treat the inefficiency of the S1 plane, but the same reasonement can be extended to the S2 one.
The conditions that we impose to define a "good track" in (6) must be the same for the numerator and the denominator. We can choose the following conditions as good selection criteria for the calculation of S1 inefficiency (fig. 14):

1. **at least one signal in all the four VDC planes**
2. **a single hit (one paddle only) on the plane S2**

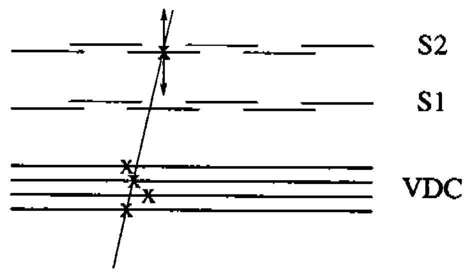

Figure 14: Criteria to select a "good track": 4 hit VDC chambers and a good S2 signal

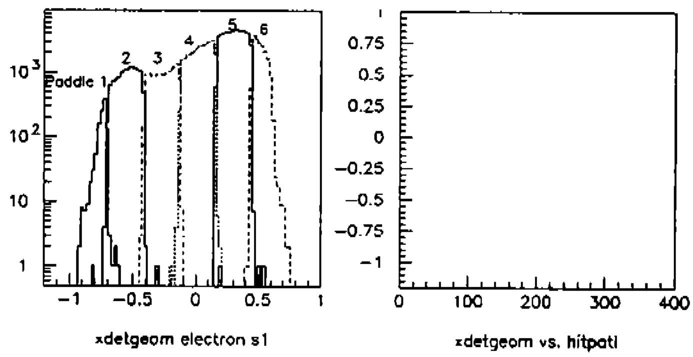

Figure 15: T1 triggers: see text for details

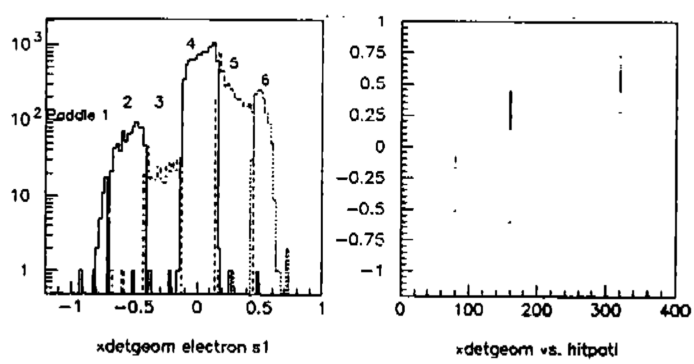

Figure 16: T2 triggers: see text for details

As no condition has been requested about the position of the four tracks in the VDC chamber, which would be rather complicate to be imposed, we would like to be sure that the track reconstructed by the VDCs well matches with the hit paddle. This is confirmed by figures 15, 16, 17 and 18 for the different type of triggers: on the left side of the pictures the distribution of xdetgeom, the position on the scintillator plane reconstructed by chambers, is shown: the hit paddle is clearly visible when we ask that all the four VDC planes have been hit; on the right side we can see the bi-plot of xdetgeom as a function of hitpatl (=hitpatr), that is related to the hit paddle (see section 2). We must keep in mind that the prescale factors are different for the different triggers: Ps=570 for the T1 triggers,Ps=95 for T2, Ps=150 for T3,Ps=270 for T4. We can immediately point out that the inefficiency is almost negligeable for the hadron arm scintillator planes.

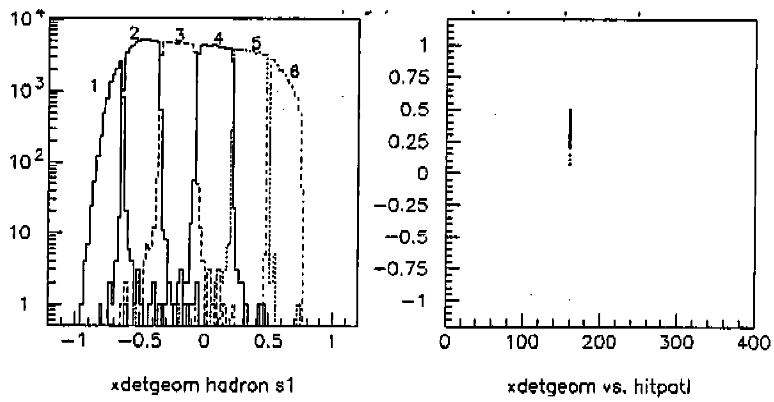

Figure 17: T3 triggers: see text for details

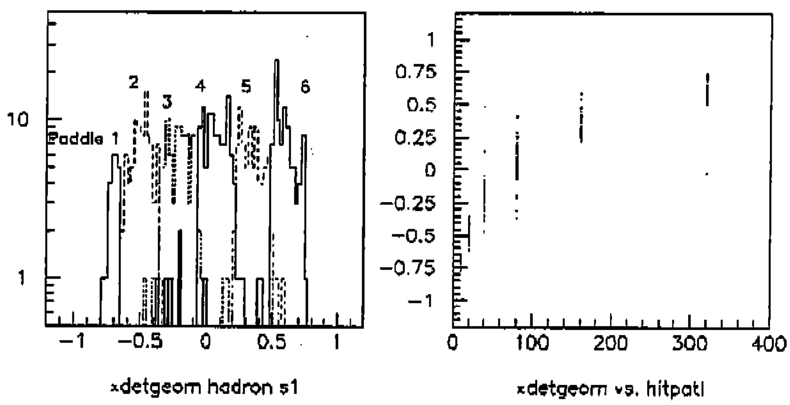

Figure 18: T4 triggers: see text for details

If we do not impose any additional condition over T1, T5 and T2 we will have:

- (A) = T2(single hit S2 $\bigcap$ 4 hit VDC)
- (B) = T2(single hit S1 $\bigcap$ 4 hit VDC)
- (C) = T1(single hit S2 $\bigcap$ 4 hit VDC)
- (D) = T1(single hit S1 $\bigcap$ 4 hit VDC)
- (E) = T5(single hit S2 $\bigcap$ 4 hit VDC)
- (F) = T5(single hit S1 $\bigcap$ 4 hit VDC)

The inefficiency of S1 is given by:

$$\epsilon_{S1} = \frac{\text{(A)} \times \text{PS(T2)}}{\text{(C)} \times \text{PS(T1)+(E)} \times \text{PS(T5)+(A)} \times \text{PS(T2)+(B)} \times \text{PS(T2)}} \tag{7}$$

and the inefficiency of S2:

$$\epsilon_{S2} = \frac{\text{(B)} \times \text{PS(T2)}}{\text{(D)} \times \text{PS(T1)+(F)} \times \text{PS(T5)+(A)} \times \text{PS(T2)+(B)} \times \text{PS(T2)}} \tag{8}$$

For our run:

- (A) = 7629   (B) = 15669
- (C) = 126551   (D) = 128489
- (E) = 391494   (F) = 398267

$$\epsilon_{S1} = \frac{724755}{74738874} = 0.97\% \tag{9}$$

$$\epsilon_{S2} = \frac{1488555}{75850307} = 1.96\% \tag{10}$$

We can otherwise add some more restrictive conditions on T1, T2 and T5, but being careful that they must be exactly equivalent in the three kind of triggers. For a T2 trigger we can impose that one of the following additional conditions on the plane S1 is realized:

(a) **no hit at all on the S1 plane** (fig. 19): it is the case of total inefficiency of S1

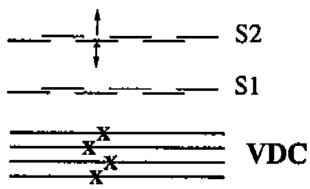

Figure 19: T2 trigger with 4 hit VDC, one single hit in S2 and no hit at all on S1

(b) **one single left PM hit in S1**: one contribution (b1) is due to a partial inefficiency of S1 on the right side (fig. 20 (1)) and another contribution (b2) is due to a total inefficiency of S1 mixed with some noise (fig. 20 (2))

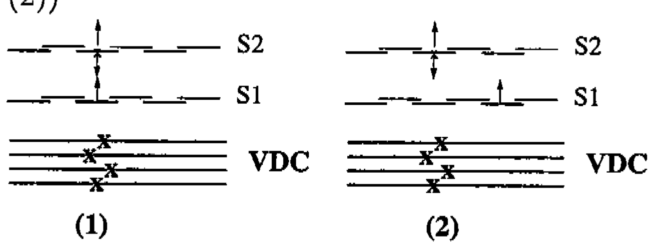

Figure 20: T2 trigger with 4 hit VDC, one single hit in S2 and one single left PM in S1

(c) **one single right PM hit in S1**: one contribution (c1) is due to a partial inefficiency of S1 on the left side (fig. 21 (1)) and another contribution (c2) is due to a total inefficiency of S1 mixed with some noise (fig. 21 (2))

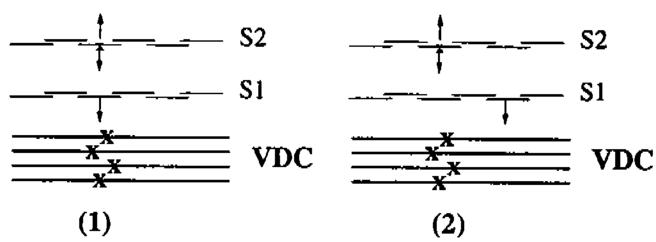

Figure 21: T2 trigger with 4 hit VDC, one single hit in S2 and one single right PM in S1

Three analogous situations can be easily found for the inefficiency of S2 when a single hit is present on S1:

(d) **no hit at all on the S2 plane** (total inefficiency of S2)

(e) **one single left PM hit in S2** (partial inefficiency of S2 on the right side plus total inefficiency of S2 mixed with some noise)

(f) **one single right PM hit in S2** (partial inefficiency of S2 on the left side plus total inefficiency of S2 mixed with some noise)

Let us now consider which conditions on T1 or T5 are equivalent to those requested for T2:

(g) **a single hit (one paddle only) on the S1 plane too** (figure 22): this condition can be considered equivalent to the situations (a), (b1) and (c1) (see figures 19, 20(1) and 21(1)).

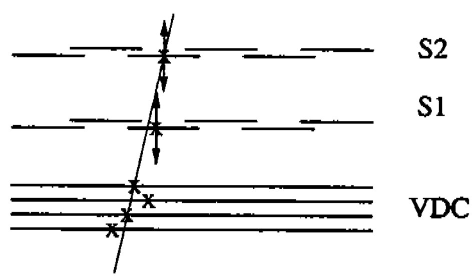

Figure 22: T1 or T5 triggers with 4 hit VDC chambers, a single hit in S1 and a single hit in S2

(h) a good signal on **S1 (coincidence left PM-right PM) plus a signal only in a left PM in S1** (figure 23): this condition can be considered equivalent to the situation (b2) (see figure 20(2)).

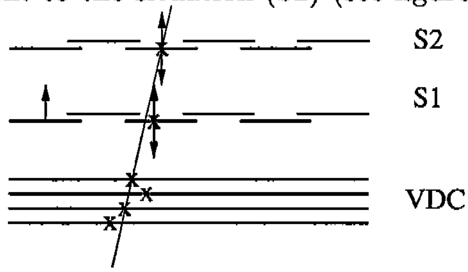

Figure 23: T1 or T5 triggers with 4 hit VDC chambers, a single hit in S2, a good hit in S1 plus a left PM hit in S1

(i) a good signal on **S1 (coincidence left PM-right PM) plus a signal only in a right PM in S1** (figure 24): this condition can be considered equivalent to the situation (b2) (see figure 21(2)).

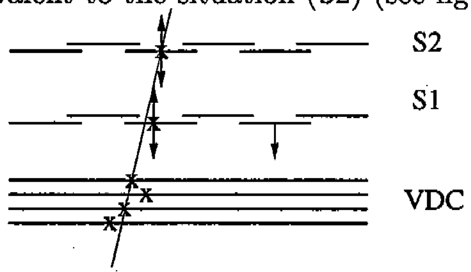

Figure 24: T1 or T5 triggers with 4 hit VDC chambers, a single hit in S2, a good hit in S1 plus a right PM hit in S1

And the three analogous for the inefficiency of S2 are found when there is a single hit on S1:

(l) = (g)

(m) **a good signal on S2 (coincidence left PM-right PM) plus a signal only in a left PM in S2**

(n) **a good signal on S2 (coincidence left PM-right PM) plus a signal only in a left PM in S2**

The inefficiency of S1 is therefore given by (I omit the prescalers for reason of simplicity):

$$\epsilon_{S1} = \frac{[(a)+(b)+(c)]}{T1[(g)+(h)+(i)] + T5[(g)+(h)+(i))] + [(a)+(b)+(c)]} \qquad (11)$$

and the inefficiency of S2:

$$\epsilon_{S2} = \frac{[(d)+(e)+(f)]}{T1[(l)+(m)+(n)] + T5[(l)+(m)+(n))] + [(d)+(e)+(f)]} \qquad (12)$$

For our run:

- (a) = 93 (b) = 2394 (c) = 3742
- (d) = 0 (e) = 7038 (f) = 7005
- (g) = 121556 (h) = 453 (i) = 472 for T1
- (l) = 121556 (m) = 700 (n) = 632 for T1
- (g) = 376297 (h) = 1404 (i) = 1381 for T5
- (l) = 376297 (m) = 2069 (n) = 2017 for T5

$$\epsilon_{S1} = \frac{591755}{72119092} = 0.82\% \qquad (13)$$

$$\epsilon_{S2} = \frac{1334085}{72352383} = 1.8\% \qquad (14)$$

The two different procedures seem to give the same results for the inefficiencies integrated all over the paddles. As the behaviour of the scintillators is very different from one paddle to another (see figures 15 and 16), it would be interesting to compare the two procedures for the calculation of the inefficiency of the single paddle or of steps of paddles.

3.2 The differential inefficiency

It has been necessary to divide the paddles into bins: the size of the bins has been chosen in order to have a constant inefficiency and enough statistics on each bin. For these reasons the size of the binning is different for the two arms (electron and hadron); for each arm, it is different from one scintillator plane to the other (S1 and S2); for each plane, it is different for the xdetgeom direction and for the ydetgeom one. We would like to remind that xdetgeom is the spatial coordinate related to the number of the hit paddle, while ydetgeom is the coordinate all along the paddle whose scintillation light is collected by two photomultipliers on the two sides of the paddle. We can therefore say that a different behaviour of the inefficiency as a function of xdetgeom is due to differences of the photomultipliers and of the scintillating material from one paddle to another, while variations along ydetgeom are due to the light propagation along the paddle and the collection at the two sides.

For the electron arm, we divided the S1 scintillators plane into 25 bins in xdetgeom and 6 bins in ydetgeom and the S2 scintillators plane into 29 bins in xdetgeom and 6 bins in ydetgeom. For this arm we should point out that, up to the run 1935, three paddles of the S2 plane (the second, the forth and the sixth one) had inefficiencies higher than the others. The value of these inefficiencies increased along the time. In figure 25, the inefficiencies of the electron arm for the S1 and S2 planes as a function of xdetgeom and integrated all over ydetgeom, are shown for run 1765: it can be seen that the second and sixth paddle have an inefficiency of the order of 1%, while the forth one has an inefficiency of 5%. In figure 26, the same plots are shown for the run 1926: the second and the sixth planes have now an inefficiency greater than 1%, while the inefficiency of the fourth paddle increased up 8%. Also on the other paddles the inefficiency increased, even if it is still lower than 1%.

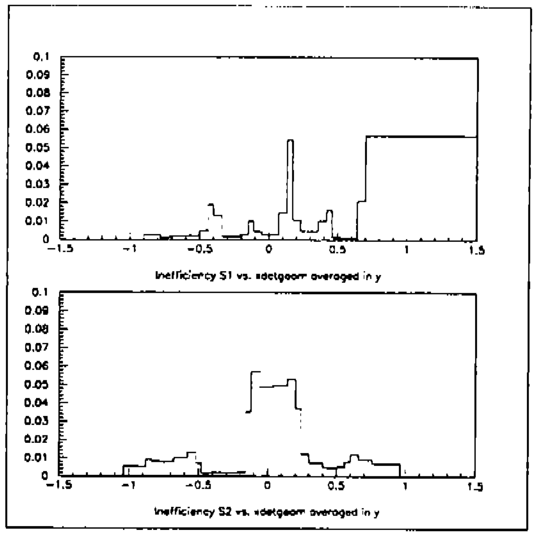

Figure 25: Run 1765 - Electron arm - S1 and S2 planes

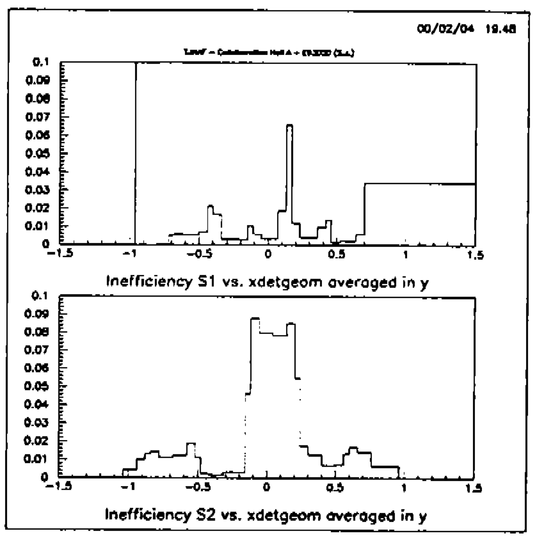

Figure 26: Run 1926 - Electron arm - S1 and S2 planes

After the run 1935, all photomultipliers were changed and the result is clearly visible in the fact that all electron arm inefficiencies went down essentially to zero, as it is shown in figure 27.
For the hadron arm, the situation is less critical, because the inefficiencies are almost negligeable all over the period of data taking. We divided the S1 scintillators plane into 25 bins in xdetgeom and 6 bins

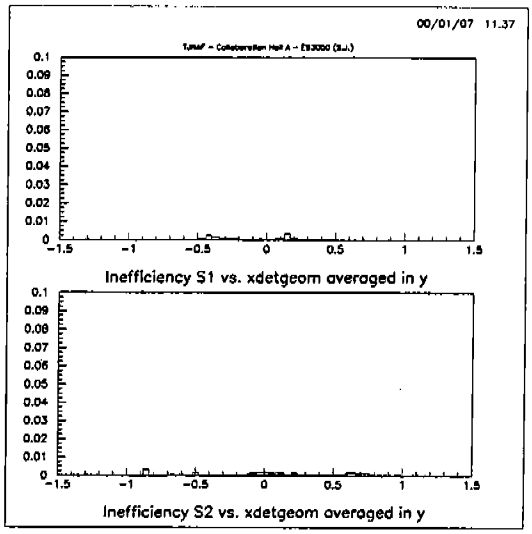

Figure 27: Run 2201 - Electron arm - S1 and S2 planes

in ydetgeom and the S2 scintillators plane into 29 bins in xdetgeom and 6 bins in ydetgeom.

In figure 28, the inefficiencies of the hadron arm are shown for S1 and S2 planes as a function of xdetgeom and integrated all over ydetgeom. They are lower than 0.2-0.3% during all the time.

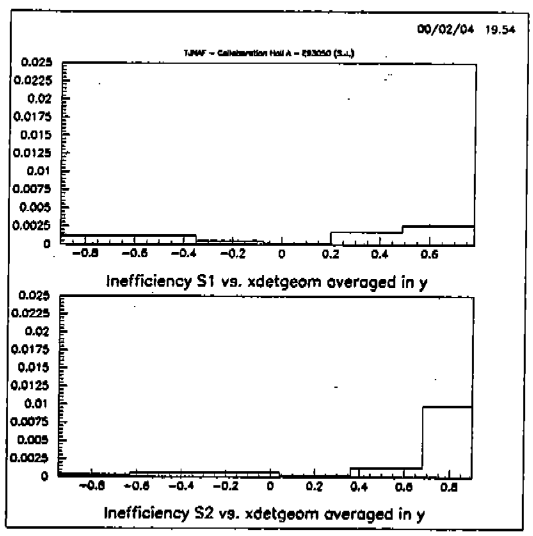

Figure 28: Run 1926 - Hadron arm - S1 and S2 planes

3.3 Application of the two procedures to the differential inefficiency

We applied the two different methods explained in section 3.1 to the calculation of the inefficiency on the bins in xdetgeom and ydetgeom, as said before.

In figure 29 the percentage difference between the inefficiencies calculated with the first and the second procedure is shown as a function of xdetgeom for the S1 and S2 planes of the electron arm.

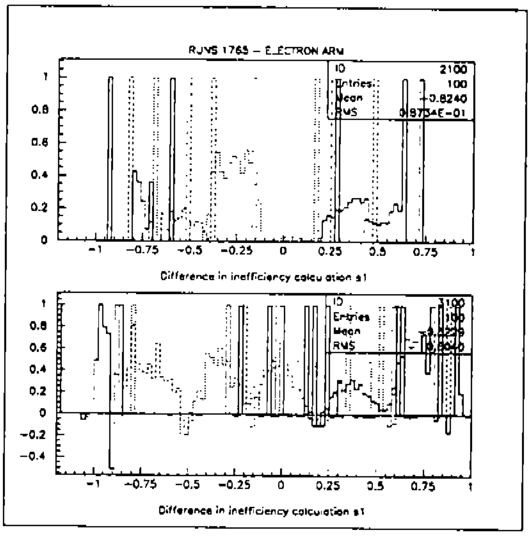

Figure 29: Difference between the inefficiency calculated by the two methods

It is clear that the second method, more restrictive than the first one in the selection criteria, allows the rejection of a certain number of events, that cannot be ascribed to scintillator inefficiency and that are taken into account by the first method. For this reason the difference between the first and the second procedure is almost always positive: with the first method we are considering as inefficiency sources events for which both planes gave a signal. The difference between the two methods, that was not visible on the results of the total inefficiency, is now clear on the differential inefficiency. For this reason we decided to choose the second method, with more restrictive conditions, because the selected events are cleaner than events selected by the first one.