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Rates in the Veto system

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1 Introduction

A study of the hit rates due to showers in the veto systems has been made using particles simulated by Beam Geant and making their way to the different parts of the detector simulated by Detector Geant. The veto systems under study are the Beam Interaction Veto System (BIVS), the Vacuum Veto System (VVS) and the Forward Veto System(FVS).

2 The Beam Composition at the entrance of UMS

The Beam-Geant [1] has been used to generate the required 33 MHz of beam (10984 beam K^+ events) at the exit of the last beam magnet just upstream of the UMS system (z=-14m in Detector Geant). This has been achieved by generating separatly 3 files, with as input particles escapping the target: kaons, pions and protons in the "real life" proportions and creating as output the particles produced just upstream of the UMS system. The particle composition at that level is given in table 1. Those files are read at input of Detector-Geant with the full shower in the veto systems and provide the detector systems rates discussed below.

One notices that at the entrance of the UMS there is twice as much protons than pions. This is due to the fact that the protons being more massive than the pions, the difference in time of flight of protons having a different momentum within the momentum spread is significant, whereas two pions with that momentum gap have almost the same time of flight.

This results in a bigger proportion of pions than protons dumped into the beam dump.

Kaon Beam file part. content	π Beam file part. content	p Beam file part. content	Total
10894 K^+ 584 μ^+ 264 π^+ 334 γ 40 π^- 23 $e^\pm$	1875 μ^+ 710 π^+	1503 protons	10894 K^+ - 69% 2459 μ^+- 16% 974 π^+- 6% 1503 protons- 9%
			15830 charged (+) 334 γ 23 $e^\pm$ 40 π^-

Table 1: Beam composition just upstream of the UMS system

3 The Veto systems

1 - The Vacuum Veto System VVS:

The VVS [2] is made of 34 longitudinal sections each one containing 81 sandwiches of Lead/Scintillator (1mm/5mm). Each section is divided into 16 sectors in phi. In this study each sector has 3 PMT. Each PMT deals with 1/3 of the signal of the module, e.g. with the signal from 27 Scintillator tiles. In the experiment we are thincking to divide the light collection of each sector into two. Each one being collected by 2 interleaved PMT, one for the even slices one for the odd. This will allow to keep getting the information from any region even if one PMT dies. Therefore there will be 4 PMT per sector, being or'ed 2 by 2, in the spirit of "redundancy".

2 - The Beam Interaction Veto System BIVS:

We have subdivided BIVS into 10 longitudinal sections, made of 66 sandwiches of Lead/Scintillator each (the last one has 7 more sandwiches). Here too we use (1mm/5mm) Lead/Scintillator. Each section is divided into 8 sectors in phi with 3 PMT per sector.

3 - The Forward Veto System FVS:

The FVS [3] does not have the cylindrical symmetry of the BIVS or the VVS. It is a wall of radiators/scintillators located at the back of the Pion RICH with a hole to allow the non-interacting beam to go through. It collects the γ and the hadrons going forward in the lab system. Its dimension in the xy plane is 2.5 mx2.5m with a transverse segmentation of 5cm$\times$5cm into towers. It has 100 layers of Lead/Scintillator, each layer is (1mm/5mm) thick. The FVS depth is $\simeq$18 X0 deep. The main task of the Veto system is to veto backgrounds having photons. The main background of the kind comes from decay of the $\mathrm{K}^+ \rightarrow \pi^+\pi^0$ followed by the decay $\pi^0 \rightarrow \gamma\gamma$. This accounts for $\simeq$22of the K^+ decay. It has been shown [4] [?] that from kinematical considerations the γ produced and reaching the FVS are photons $\geq$1 GeV. The tower geometry will allow to separate photons from charged pions when both are going forward in the lab system.

4 Rates from the Kaon componant of the Beam

1 - VVS rates

We have measured the "OR" rate of hits per phototube, integrated over 33 MHz of beam and averaged over 16 wedges of the VVS. They have been reported in table 2 as a function of the detection energy threshold. We have run Geant with an energy cutoff 2MeV for leptons and 10 MeV for hadrons. In Figure 1, we give the number of non zero hits in the VVS for energy thresholds above 3MeV, 30 MeV, 60 MeV and 300 MeV. One can see that the shape of the distribution changes with increased threshold and most of the high numbers of hits events have disappeared above 30 MeV. The threshold for muons traversing a module is 30 MeV. This account also for drop in the number of hits versus threshold shown in Figure 2.

The rates in the VVS are reported in the table 2 below and shown in Figure 2.

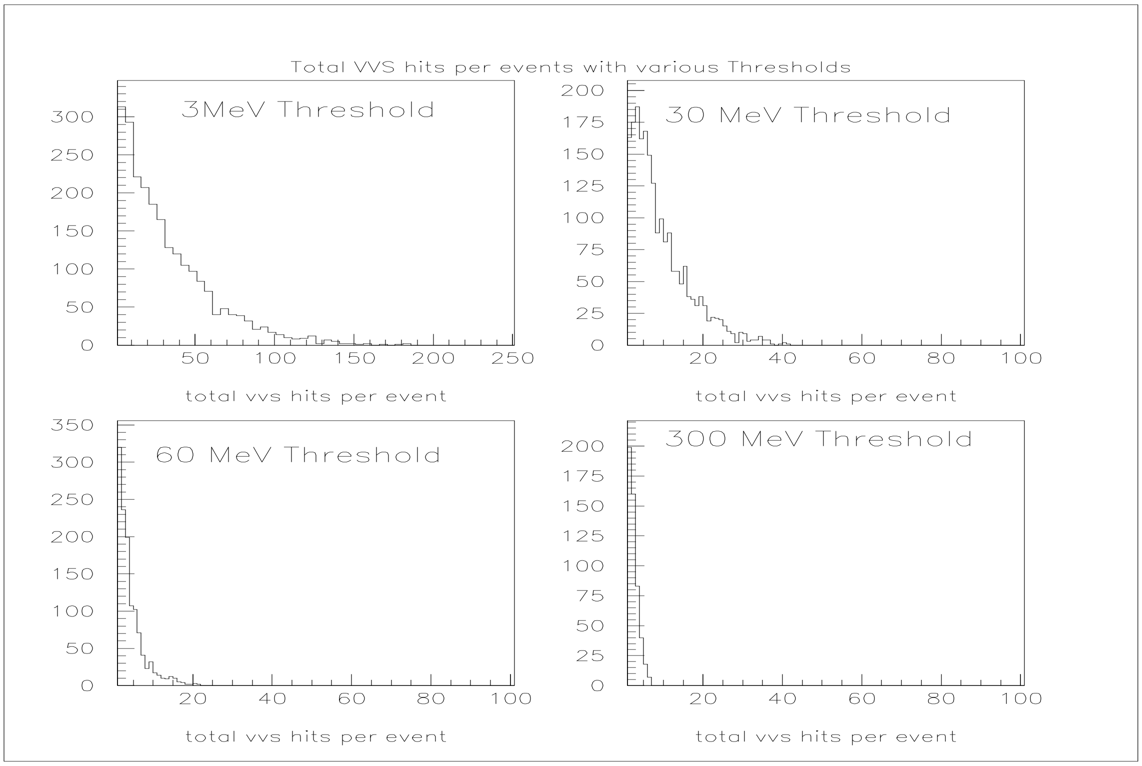

Figure 1: VVS hit rates with 4 different thresholds

2 - FVS rates

We have also reported the FVS results in a table 3 and the Figure 3.

One notices that the rates in FVS are systematically higher than in VVS, with a Maximum Rate per tube being almost one order of magnitude higher. By its location, rather far forward in the detector the FVS collects, high energy photons and hadrons which shower, e.g. the $\pi^+ \geq 14$ GeV (out cut) coming from the K^+ two body decays. A big part of the FVS signal is due to hadronic showers whereas the main component of the VVS showers is electro-magnetic. This account for the differences in rates.

Energy Threshold	Hit OR Rates MHz	Mean number of hits	Max Rates per tube
1MeV	7.24	38.29	0.302
3 MeV	7.04	32.73	0.239
6 MeV	6.86	28.14	0.185
10 MeV	6.72	25.46	0.164
20 MeV	6.54	23.05	0.130
30 MeV	6.22	9.21	0.059
60 MeV	3.69	3.94	0.022
100 MeV	2.69	3.56	0.018
200 MeV	1.96	3.00	0.013
300 MeV	1.54	2.59	0.009

Table 2: VVS K alone from a 33MHz beam generated by CKM Geant-Beam

Energy Threshold	Hit OR Rates MHz	Mean number of hits	Max Rates per tube
1MeV	10.85	28.11	1.399
3 MeV	10.47	21.94	1.154
6 MeV	10.19	16.91	0.908
10 MeV	10.07	11.46	0.727
20 MeV	9.97	7.65	0.530
30 MeV	9.90	6.42	0.433
60 MeV	9.48	4.36	0.312
100 MeV	6.70	3.78	0.221
200 MeV	3.86	3.16	0.127
300 MeV	3.50	2.63	0.094

Table 3: FVS - K alone from a 33MHz beam generated by CKM Geant-Beam

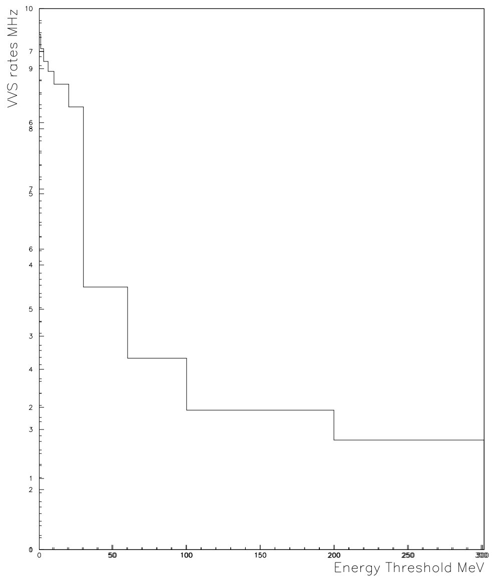

Figure 2: The VVS hit rates in MHz as a function of the Energy Threshold in MeV.

3 - BIVS rates

One notices that Maximum rates per tube in the BIVS are very similar to those in the FVS and higher than for the VVS. Here too we are dealing with beam hadrons as well as with photons. In the table 4 below are represented the rates in BIVS

5 Rates from the pions and protons componants of the Beam

The study of the rates of πs and protons in the VVS and FVS have also been done for three energy threshold, 3 MeV, 30 MeV and 300MeV and are reported in a table 5 and table 6, together with the rates for the kaons with

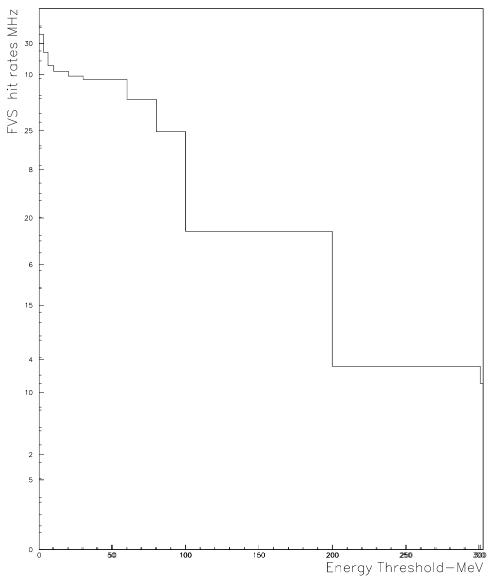

Figure 3: The VVS hit rates in MHz as a function of the Energy Threshold in MeV.

the same energy thresholds.

One notices that the K^+ provides the highest OR rates at all energy threshold, more than one order of magnitude higher than for the other particles.

For the FVS too the K^+ provides the highest OR rates up to 300 MeV energy threshold. At 300 MeV Threshold the OR rates provided by the π^+ are similar to those due to the K^+

6 Conclusion

The signal in VVS comes mostly from electro-magnetic showers and from the muon of the decay of the kaons and pions in the beam. The signal in BIVS comes mostly from hadronic showers with a non negligible electro-magnetic component as does FVS. As can be seen from the tables, a threshold of 10 MeV seems to be adequate for hadronic showers in FVS and BIVS and provides a reasonable rate per Photomultiplier. On the other hand in VVS

Energy Threshold	Hit OR Rates MHz	Mean number of hits	Max Rates per tube
1MeV	5.63	26.47	1.214
3 MeV	5.54	23.54	1.102
6 MeV	5.40	18.91	0.949
10 MeV	5.17	14.66	0.788
20 MeV	4.52	11.54	0.618
30 MeV	3.92	9.52	0.539
60 MeV	3.10	8.16	0.423
100 MeV	2.84	7.15	0.365
200 MeV	2.62	5.91	0.290
300 MeV	2.43	5.34	0.223

Table 4: BIVS - K alone from a 33MHz beam generated by CKM Geant-Beam

Energy Threshold	Hit OR Rates MHz	Beam file
3 MeV	0.093	protons
	0.064	π
	7.04	K
30 MeV	0.055	protons
	0.033	π
	6.22	K
300 MeV	0.024	protons
	0.003	π
	1.54	K

Table 5: VVS- rates comparison for 3 energy thresholds for the protons, π and K beam files from 33 MHz generated by Geant-Beam

Energy Threshold	Hit OR Rates MHz	Beam files
3 MeV	0.491	protons
	1.087	π
	10.47	K
30 MeV	0.403	protons
	1.015	π
	9.90	K
300 MeV	0.188	protons
	3.50	π
	3.50	K

Table 6: FVS - rates comparison for 3 energy thresholds for protons, π and K beam files from 33 MHz generated by Geant-Beam

which experiences mostly electro-magnetic showers a threshold of the order 1MeV seems more appropriate.

References

[1] Note CKM29-GEANT simulations of an RF separated beam; Coleman, Kobilarcik,Milstene; June 2000.

[2] Note CKM20- Study of the Vacuum Veto System; Milstene,Cooper; January 2000.

[3] Note CKM23- Study of the Forward Veto System; Milstene,Cooper; January 2000.

[4] Note CKM22-Pi0 Inefficiency Estimation; PS Cooper Feb 2000.
Note CKM25-A Photon Veto System for CKM; Cooper, Milstene, Ramberg, Tschirhart.

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