The $\phi\phi$ and $\phi\phi\gamma$ preselections

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In this memo we present the selections to reduce the data sample collected at the χ_0 and at the $^1P_1$ energies for the search of the $\phi\phi$ and $\phi\phi\gamma$ decays. [1]

That's not properly a DST production, in fact the output data format will be the same of the raw data, we are doing only a filtred data set.

1 $\phi\phi$ Selection

The preselection for the $\phi\phi$ channel is composed by 7 simple cuts with high efficiency and good rejection factor.

- *nthlin*: we reject all the events with a number of θ lines less than 3 or greater than 5 (fig. 1).

- *nphlin*: we reject all the events with a number of ϕ lines less than 3 or greater than 5 (fig. 2).

- *nH2'*: the number of hits in H2' has to be between 2 and 5 (fig. 3).

- *H2' COPL*: the same requirement of H2 coplanarity but with the hodoscope H2'[1].

- *H2' LOGIC*: the same requirement of H2 logic with H2'[1].

- *nclust CCAL*: the number of clusters in the central calorimeter is required to be less than 8 and greater than 2 (fig. 4).

- *Čerenkov*: the normalized FERA signal of the Čerenkov has to be less than 6 phe (fig. 5 and 6).

[1] The $\phi\phi$ selection is only for the χ_0 data and the $\phi\phi\gamma$ selection only for the $^1p_1$.

2 $\phi\phi\gamma$ Selection

The kinematic of the $\phi\phi\gamma$ decays provides an important constraint to our selection, that is the dipendence of the photon energy from the polar angle according to the formula:

$$E_\gamma(\theta_{lab}) = \frac{E_{CM}^2 - M_{\eta_c}^2}{2E_{CM}\gamma(1-\beta\cos\theta)}$$

The cut on the photon energy has a high rejection factor and a good efficiency. Following are the 7 cuts of the selection:

- *nthlin*: we reject all the events with a number of θ lines less than 3 or greater than 5 (fig. 7).

- *nphlin*: we reject all the events with a number of ϕ lines less than 3 or greater than 5 (fig. 8).

- *nH2'*: the number of H2' hits has to be between 2 and 5 (fig. 9).

- *H2' COPL*: the same requirement of H2 coplanarity but with the hodoscope H2'[1].

- *H2' LOGIC*: the same requirement of H2 logic with H2'[1].

- *nclust CCAL*: the number of clusters in the central calorimeter is required to be less than 11 and greater than 2 (fig. 10).

- *photon*: the cut on the photon energy (fig. 11).

3 Efficiencies and Rejection factors

The efficiency of the two selection has been calculated with montecarlo (GEANT) events. The $\phi\phi$ selection has been tested on a sample of 25000 events at the χ_0 energy and the $\phi\phi\gamma$ selection on 25000 events at the $^1P_1$. The results are summarized in the table 1 .

For the rejection factor (table 3) we run the two selections on the raw data, looking also at the processing time per event [2]. The rejection power of each cut is reported in table 2.

[2] Note that the processing time is calculated running on a alphastaion 500 - Alpha 21164 - RAM 512 Mb

$\phi\phi$		$\phi\phi\gamma$	
cut	efficiency	cut	efficiency
nthlin	98.7	nthlin	98.9
nphlin	98.4	nphlin	98.3
nH2'	99.4	nH2'	99.4
H2' COPL	99.6	H2' COPL	98.9
H2' LOGIC	96.2	H2' LOGIC	96.5
nclust CCAL	91.4	nclust CCAL	98.7
Čerenkov	98.8	photon	91.0
Total efficiency	84.6	Total efficiency	83.6

Table 1: Efficiencies of the $\phi\phi$ and $\phi\phi\gamma$ selections from Monte Carlo.

$\phi\phi$ run 5536		$\phi\phi\gamma$ run 5695	
cut	rejection	cut	rejection
nthlin	1.28	nthlin	1.30
nphlin	1.33	nphlin	1.37
nH2'	1.29	nH2'	1.21
H2' COPL	1.05	H2' COPL	1.06
H2' LOGIC	3.20	H2' LOGIC	1.82
nclust CCAL	1.35	nclust CCAL	1.09
Čerenkov	1.30	photon	3.51
Total rejection	8.0	Total rejection	11.0

Table 2: Rejection factor of the single cuts for the two selections.

$\phi\phi$			$\phi\phi\gamma$		
run number	rejection factor	proc. time msec/event	run number	rejection factor	proc. time msec/event
5443	7.4	5.0	5695	11.0	4.9
5536	8.0	5.2	5721	11.0	4.9
5537	7.5	5.0	5734	11.2	4.9
5892	6.8	5.0	5765	11.5	4.9
5907	6.6	5.0	5783	9.5	4.8
5912	5.4	5.0	7036	10.3	4.9

Table 3: Total rejection factor of the two selections on raw data.

4 Offline

We use a couple of private routines different from the official Offline ones, these are:

- *PHIPAT.FOR:* our version has the condition of 2 on-time hodoscopes for the ϕ lines. It contains also a patch to run on SGI.

- *CLFIBE.FOR:* this version contains a patch to run on SGI.

Note that with those basic cuts the execution level of the *program trim* is only 10, that is very important in order to have a low processing time.

References

[1] W.Baldini et. al. *Nucl.Instrum. and Meth.*, **A449** 331-343, 2000

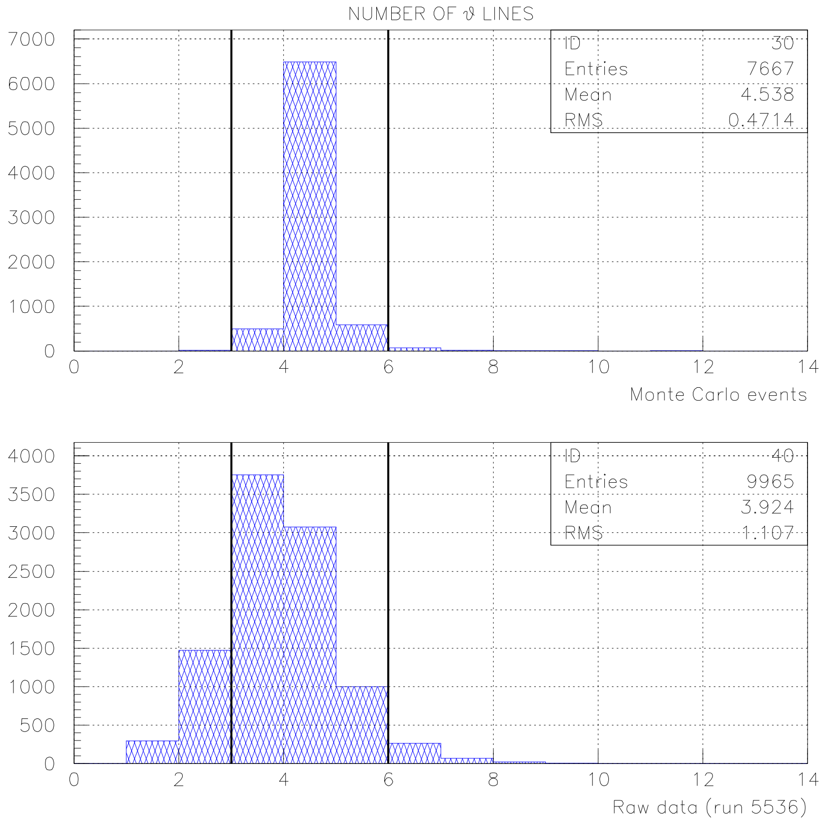

Figure 1: Number of θ lines from Monte Carlo (top) and from raw data (bottom). The two vertical lines define the limits of the cut.

$\phi\phi$ SELECTION

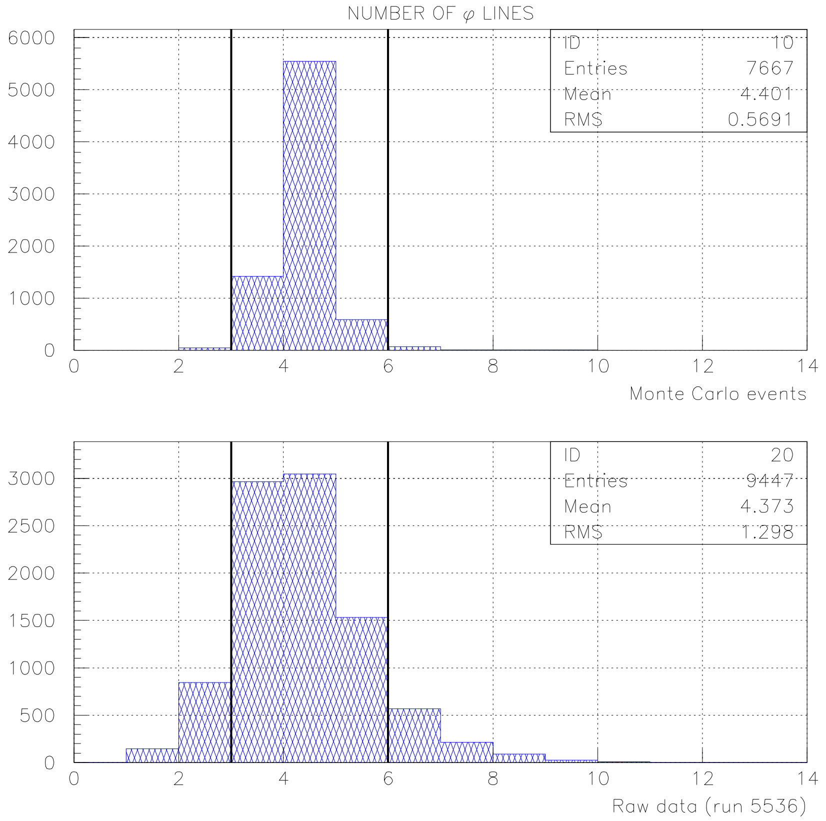

Figure 2: Number of φ lines from Monte Carlo (top) and from raw data (bottom).

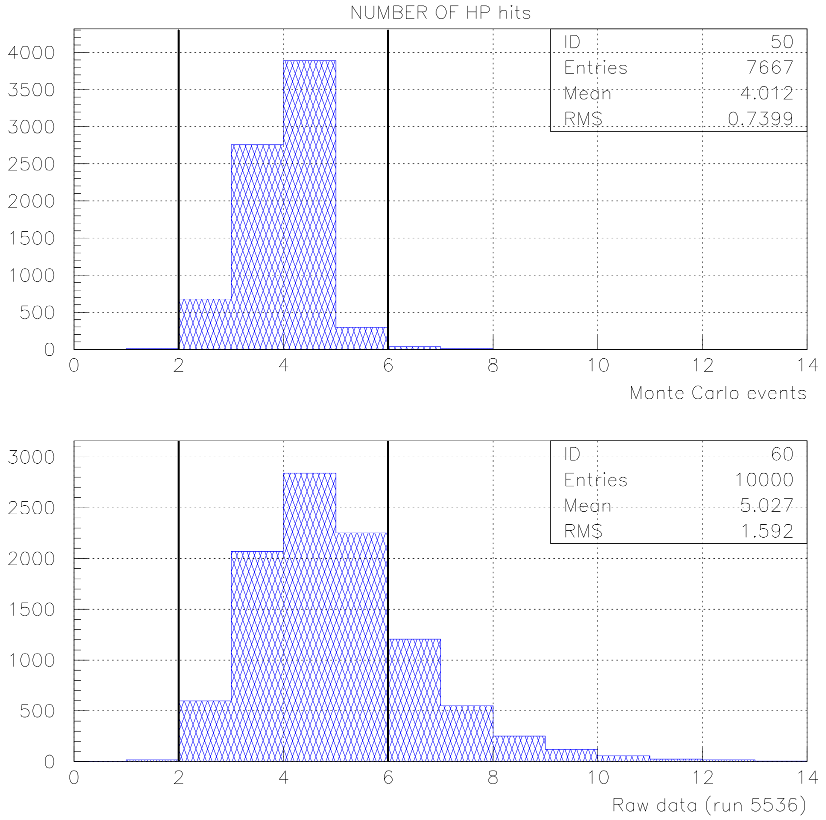

Figure 3: Number of hits in H2' from Monte Carlo (top) and from raw data (bottom). The two vertical lines define the limits of the cut.

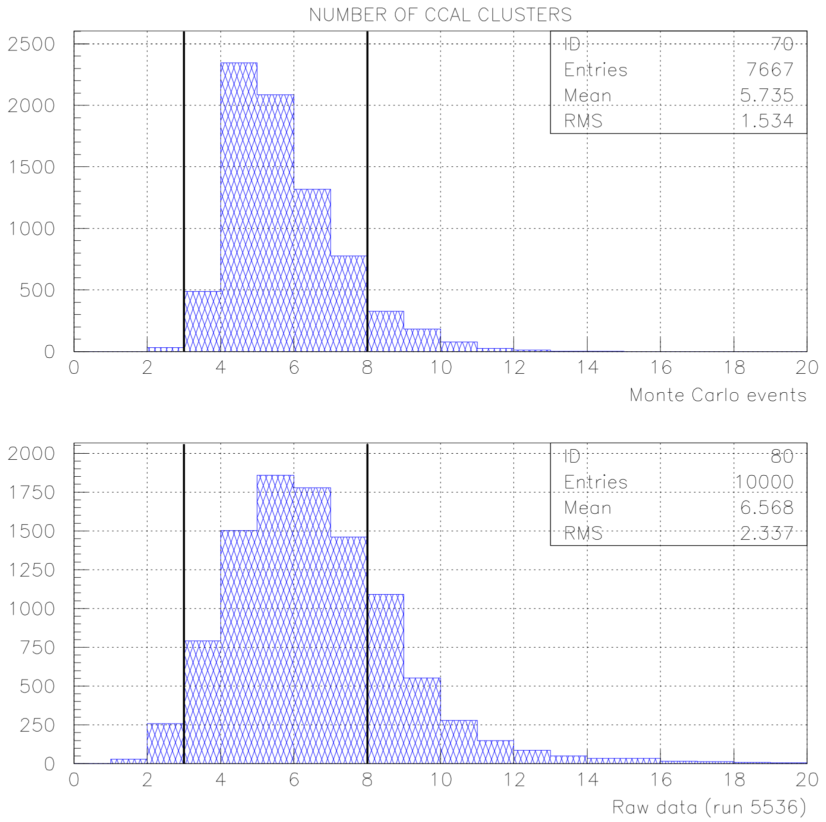

Figure 4: Number of clusters in CCAL from Monte Carlo (top) and from raw data (bottom).

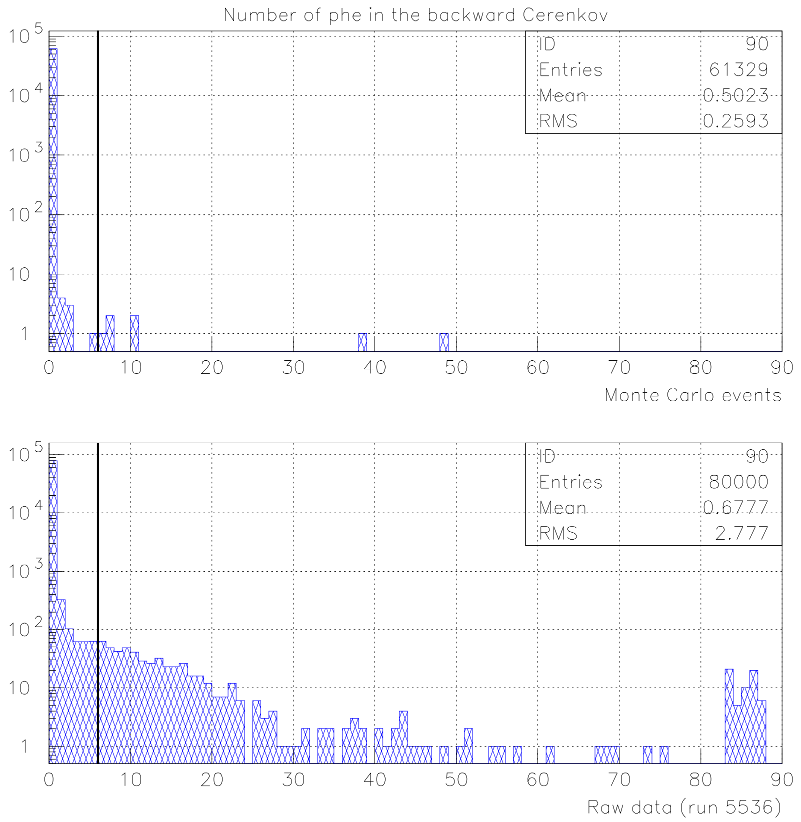

Figure 5: Number of phe in the backward Čerenkov from Monte Carlo (top) and from raw data (bottom). The vertical line define the limit of the cut.

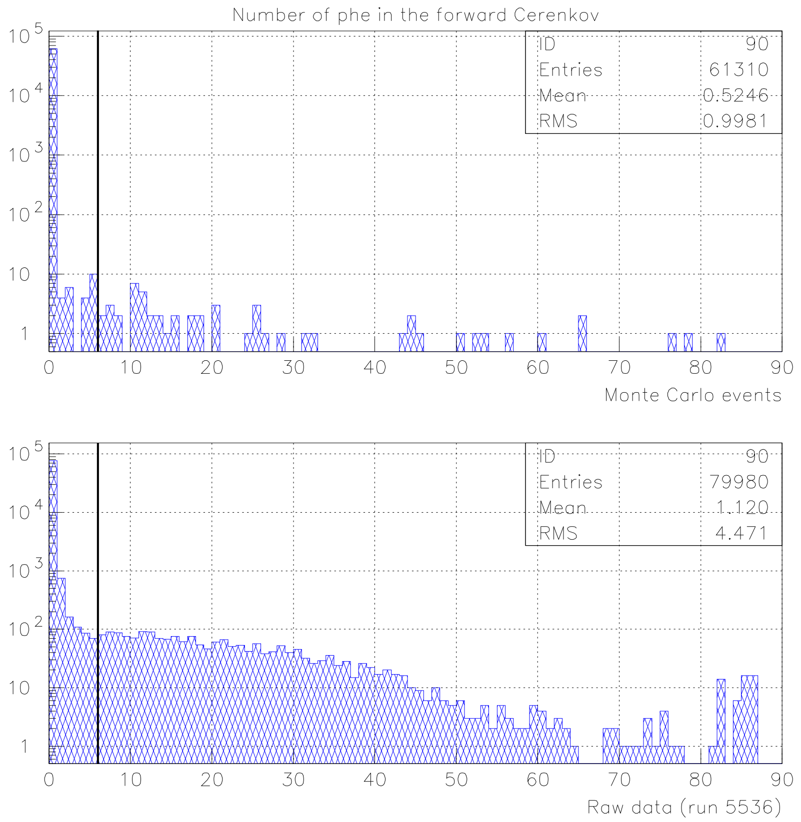

Figure 6: Number of phe in the forward Čerenkov from Monte Carlo (top) and from raw data (bottom).

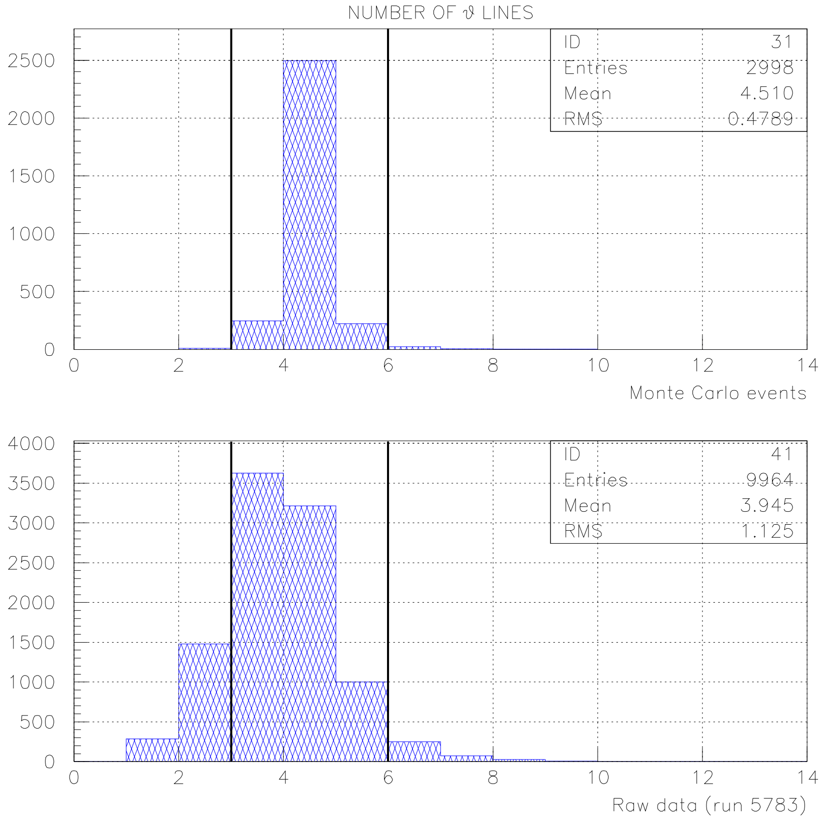

Figure 7: Number of θ lines from Monte Carlo (top) and from raw data (bottom). The two vertical lines define the limits of the cut.

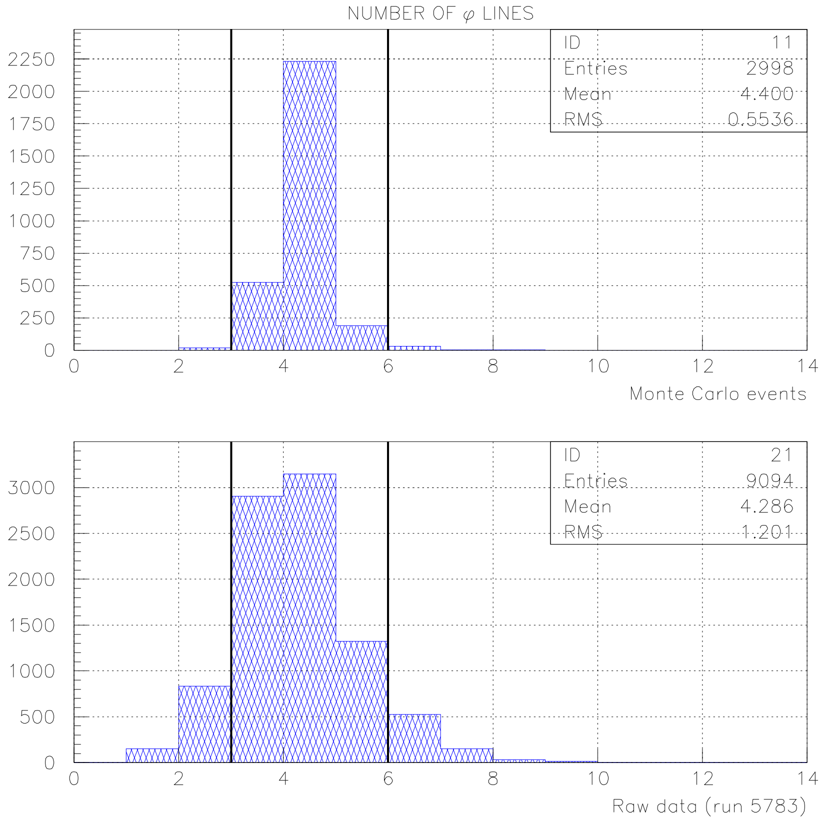

Figure 8: Number of φ lines from Monte Carlo (top) and from raw data (bottom).

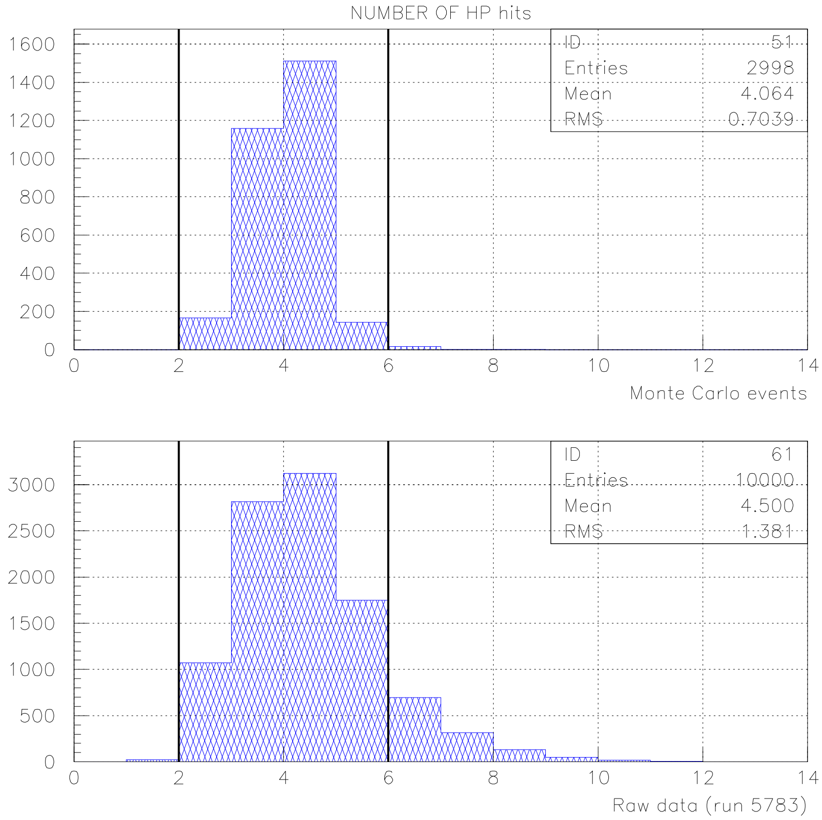

Figure 9: Number of hits in H2' from Monte Carlo (top) and from raw data (bottom). The two vertical lines define the limits of the cut.

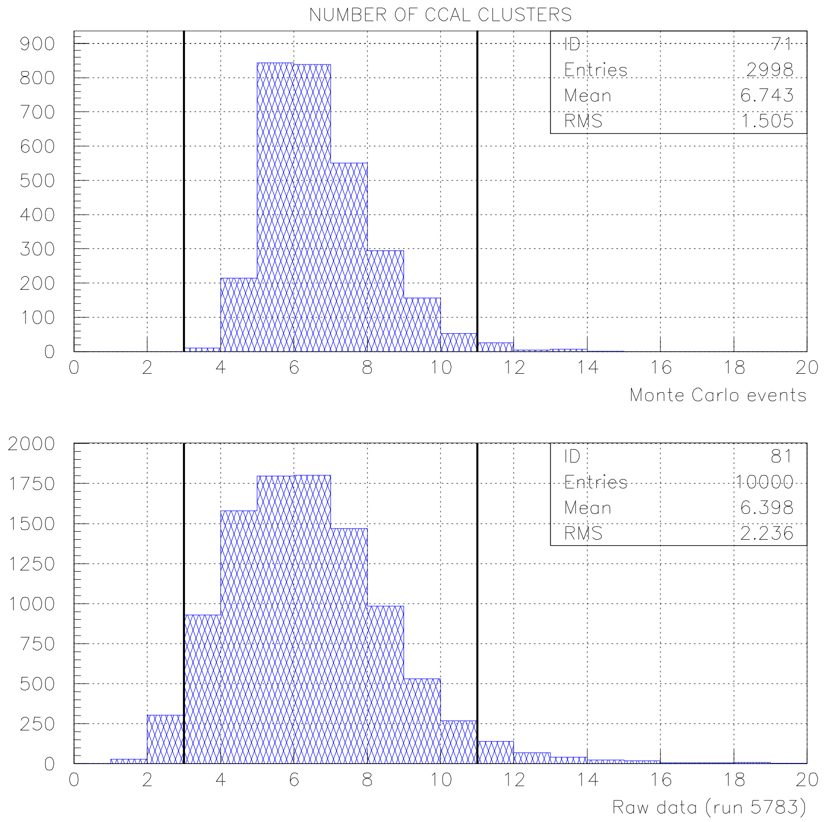

Figure 10: Number of clusters in CCAL from Monte Carlo (top) and from raw data (bottom).

$\phi\phi\gamma$ SELECTION

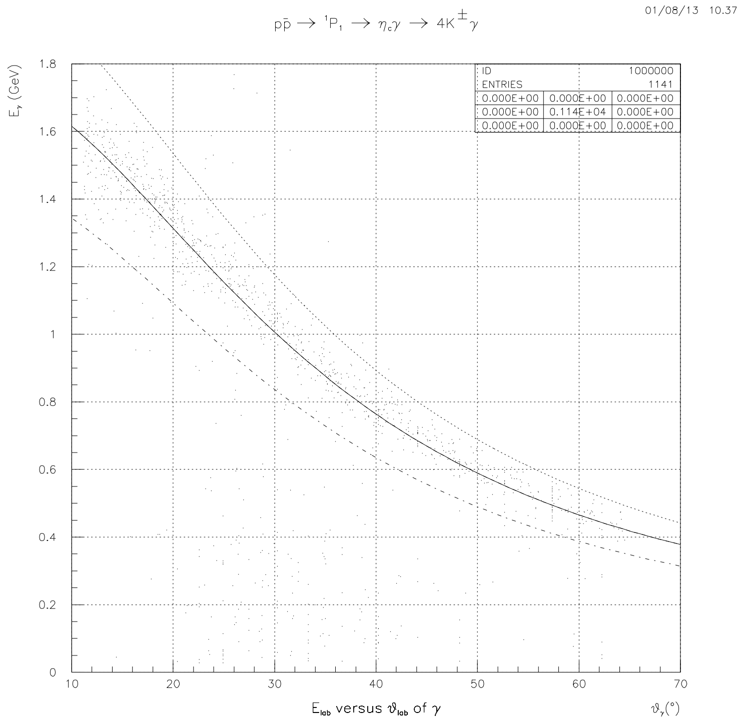

Figure 11: The energy of the photons as function of the polar angle for Monte Carlo events. The two dashed lines define the limits of the cut that is about at 3 σ from the theoretical value (solid line).