First attempt of the DCH trigger efficiency evaluation in the all charged K_L K_S decay

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- Aims, requests, etc...
- Event selection
- The method
- Machine background
- First efficiency figures
- “To do” checklist

La Biodola 23−25 May 2001

Starting point

The standalone DC trigger efficiency in the channel $K_S K_L$ −> 4 charged is needed to enhance and/or cross check the ECAL efficiency. Any possible method should take into account that :

✔None (or little) Monte Carlo should be used

✔Machine background, electronic noise and all that must be taken into account from data itself (auto calibration)

➔Clipping to L2 trigger hits by super−layer structure must be considered

The approach used by now fulfill the first 2 conditions but does not yet take into account the last one −> more refinement coming...

Event selection

We restricted the analisys to a stable period of the DC trigger (Nov 00) , from run 16221 to run 16843 correspondig to ~ 7.8 pb^{-1} . The following samples were selected.

a)	$K_S \to \pi^+\pi^-$	$K_L \to$ crash (no frag.)	120361 ev
b)	$K_S \to \pi^0\pi^0$	$K_L \to \pi^+\pi^-,\pi\mu\nu,\pi e\nu$	112873 ev
c)	$K_S \to \pi^0\pi^0$	$K_L \to$ crash (no frag.)	73876 ev
d)	Neutral radiative phi decays (7 γ)		471174 ev
e)	$K_S \to \pi^+\pi^-$	$K_L \to \pi^+\pi^-,\pi\mu\nu,\pi e\nu$	376450 ev

In selecting sample a),b),c),e) the same cuts of KLOE memo 223 were used (with the software by T.Spataro, G.Cabibbo and M.Palutan).

In sample a) and c) care has been taken to select events with only a single high energy K_L cluster (“fragment”), to avoid track associated to the K_L interaction.

The d) events are from the corresponding radiative 7 photons files from the radiative group

The method : convolution and event selection

The L2 DC trigger (more stringent tha L1) fires when the DC hits counted by CAFFE board (“eq hits”) exceeds a threshold (i.e. 125 hits in Nov 2001)

We build the “true” distribution of trigger hits in 4 charged case from the distributions of the semi−charged events. These sample events has Ecal trigger efficiency (~1) −> true eq. hits distribution !

$K_S \to \pi^0\pi^0$ $K_L \to$ 2 charged $\to$ hit_{Lch}

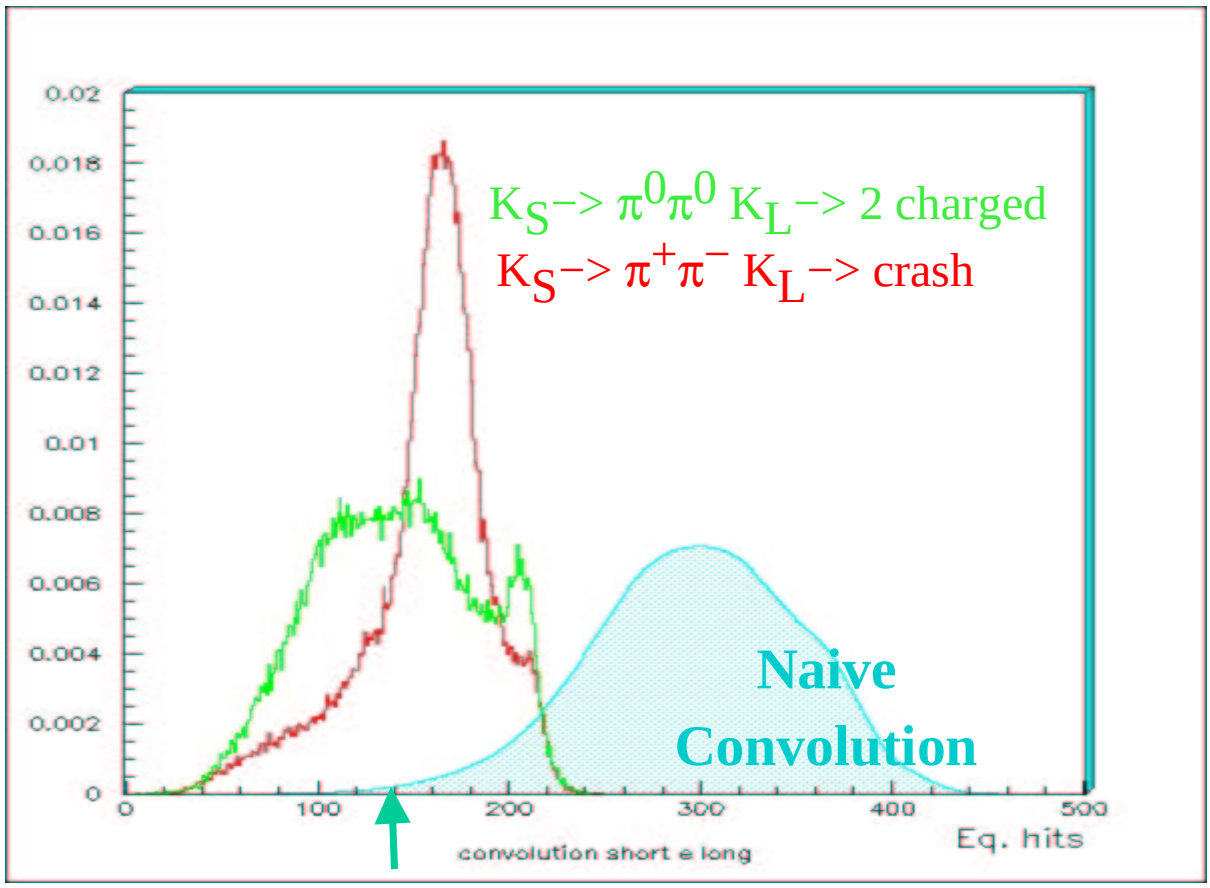
$K_S \to \pi^+\pi^-$ $K_L \to$ crash $\to$ hit_{Sch}

1) if the 2 hit yelds were independent
2) if there were no bck hits in the DC
3) if there was no clipping in super layers then

$$Hit_{4ch} = hit_{Lch} + hit_{Sch}$$

The distribution of hit_{4ch} is would be given by the convolution of the dist of hit_{Lch} and hit_{Sch}

The method : convolution and background in DC



In both the semi charged events some background hits are present: in the convolution we count them twice!!! We must subtract the background... the true variable will be given by

$$Hit_{4ch} = hit_{Lch} + h\,it_{Sch} - hit_{bck}$$

The true distribution is the 3−fold convolution of the sum of the semi−charged events minus the background yeld to eq. Hits.

Background evaluation

Background contributions (machine bck,electronics noise, ..) must be estimated from data from..

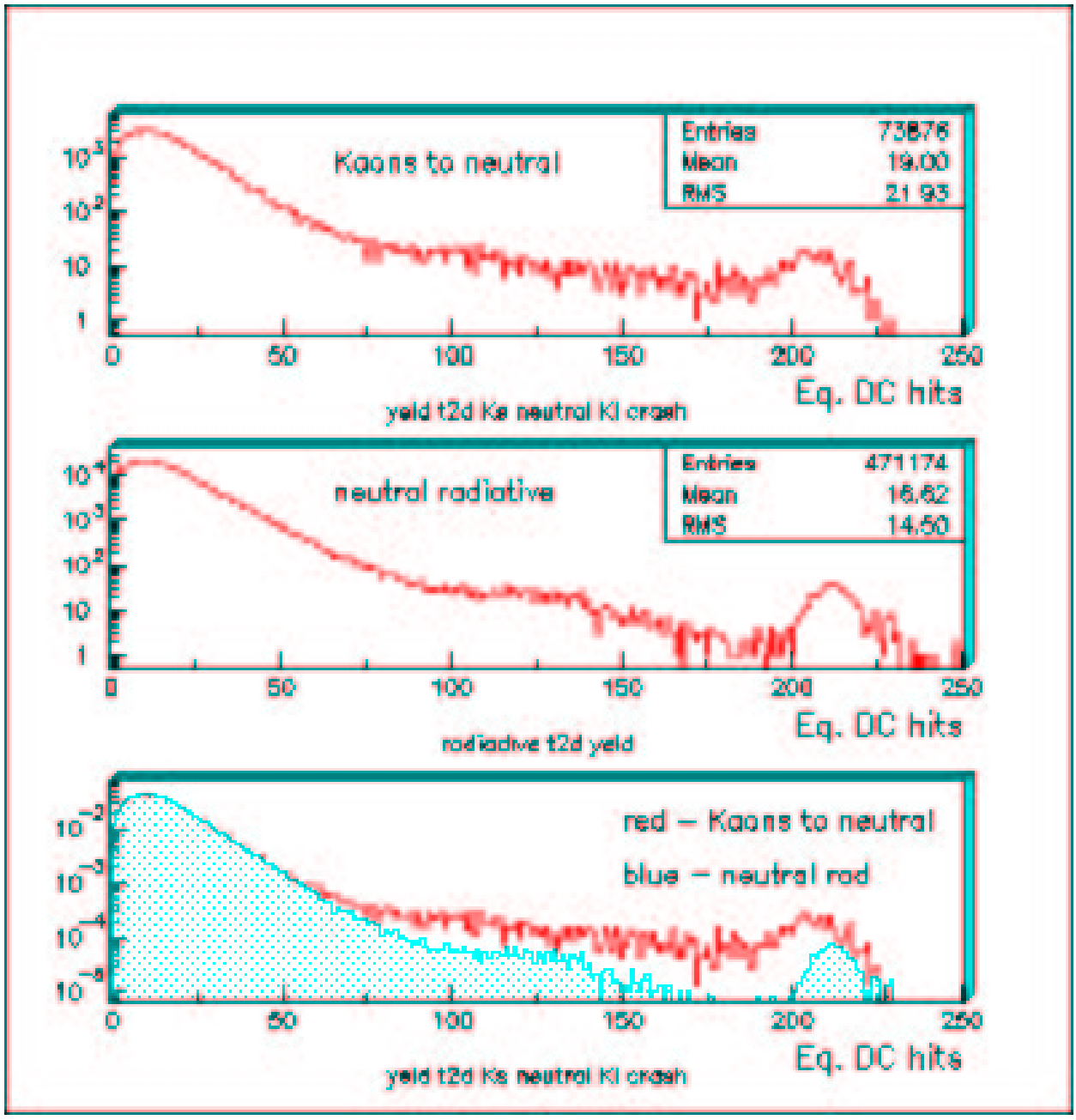
Radiative neutral events: very clean, fully ECAL triggered , but selected by EVCL with number of track=0 −> Lower bound to background !

K_S−> $\pi^0\pi^0$ K_L −> crash events with only one K_L high energy cluster. Fully Ecal triggered but K_L hadronic interaction can give additional eq. Hits −> Upper bound to background!

Cosmic events with beam on and cosmics taken with beam off: clean, Ecal triggered but background is obtained as deconvolution of the two distribution, runs with beam on/off must be close in time... we gave up !

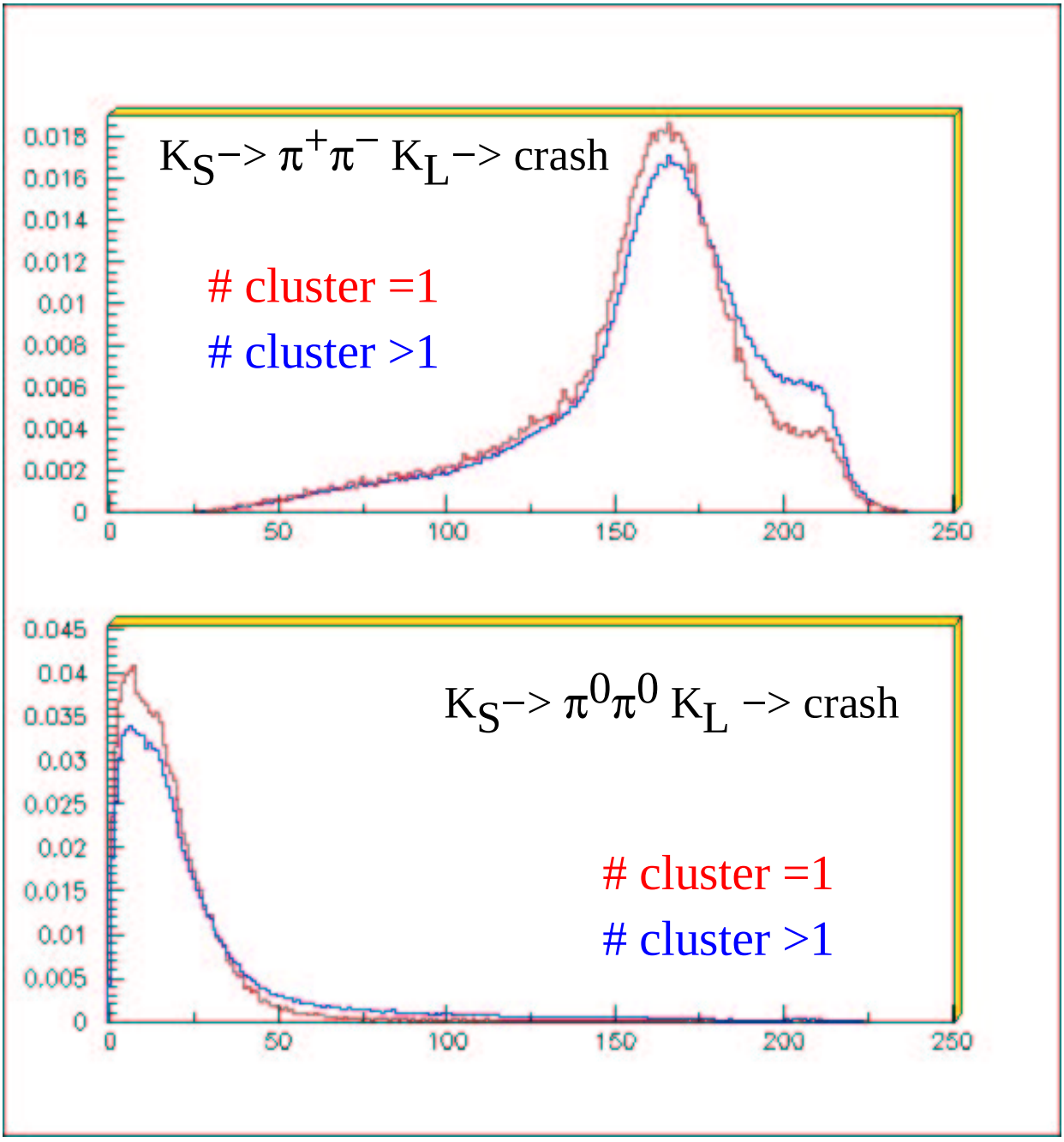
$\gamma\gamma$ events:... EASY AND CLEAN!

Background upper and lower bounds



But from these dist. DC L2 rate: 10 kHz for neutral decay of kaons and 1.8 kHz for rad: too high!

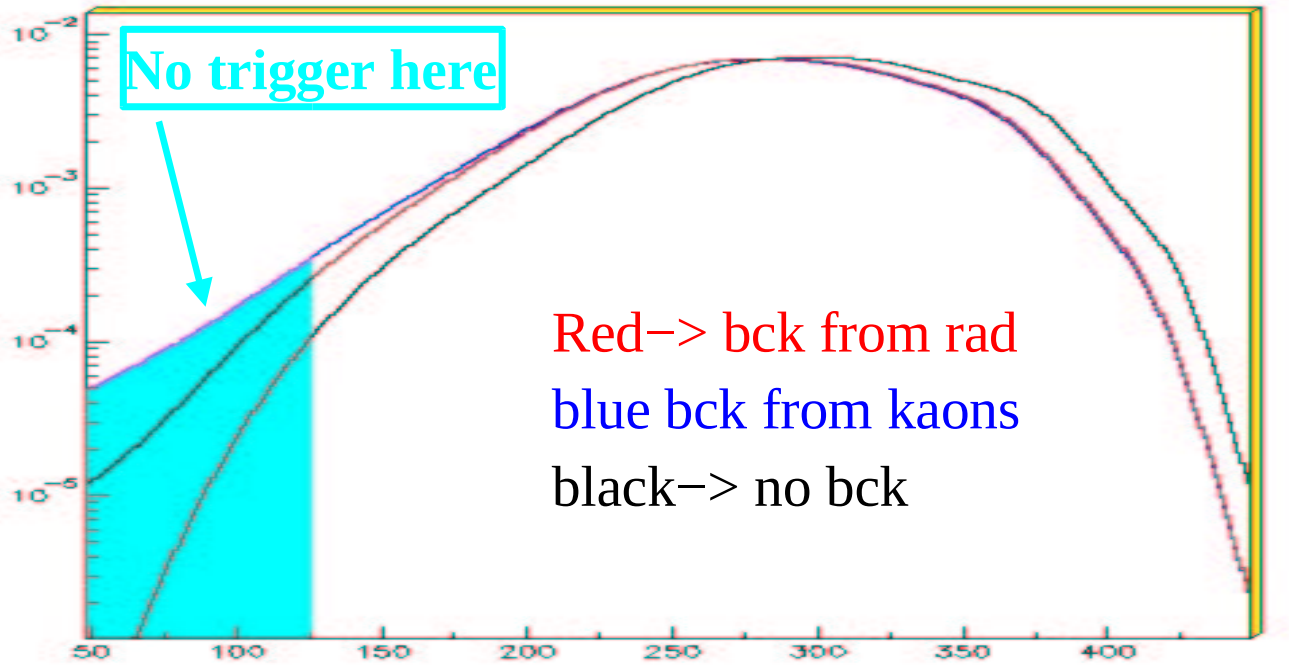
Event selection : K_L fragments versus DC hits



First indications

The introduction of the bck give us some confidence bands for the DC trigger efficiency:

NO CLIPPING CONSIDERED!



Efficiency computation gives a first crude estimate range –> $98.8\% < \text{eff}_{4ch} < 99.4\%$

As reference figures we report the values obtained by M.Palutan with the "DC versus ECAL " method on the summer 00 data:

$99.1\% < \text{eff}_{4ch} < 99.7\%$ where the eff. range here is due to variation during data taking .

Summary & comments

✔We are trying to develop a new approach for the DC trigger efficiency on the 4 charged decay of $K_L K_S$ using no MC

✔Background is evaluated and subtracted using the data itself.

✔The super layer clipping is yet to be considered to have any reliable number: the computed efficiency can easily change even if at threshold the events are less populated and clipping less severe.

✔A straightforward improvement of the method would be to feed the DC hit list of the semi−events into the trigger reconstruction: automatic care of the clipping.

✔Subtraction of the machine background could be done deleting hits from the event list according with the evaluated bck distribution

✔Work is just started, comments, advices and criticism are welcome....