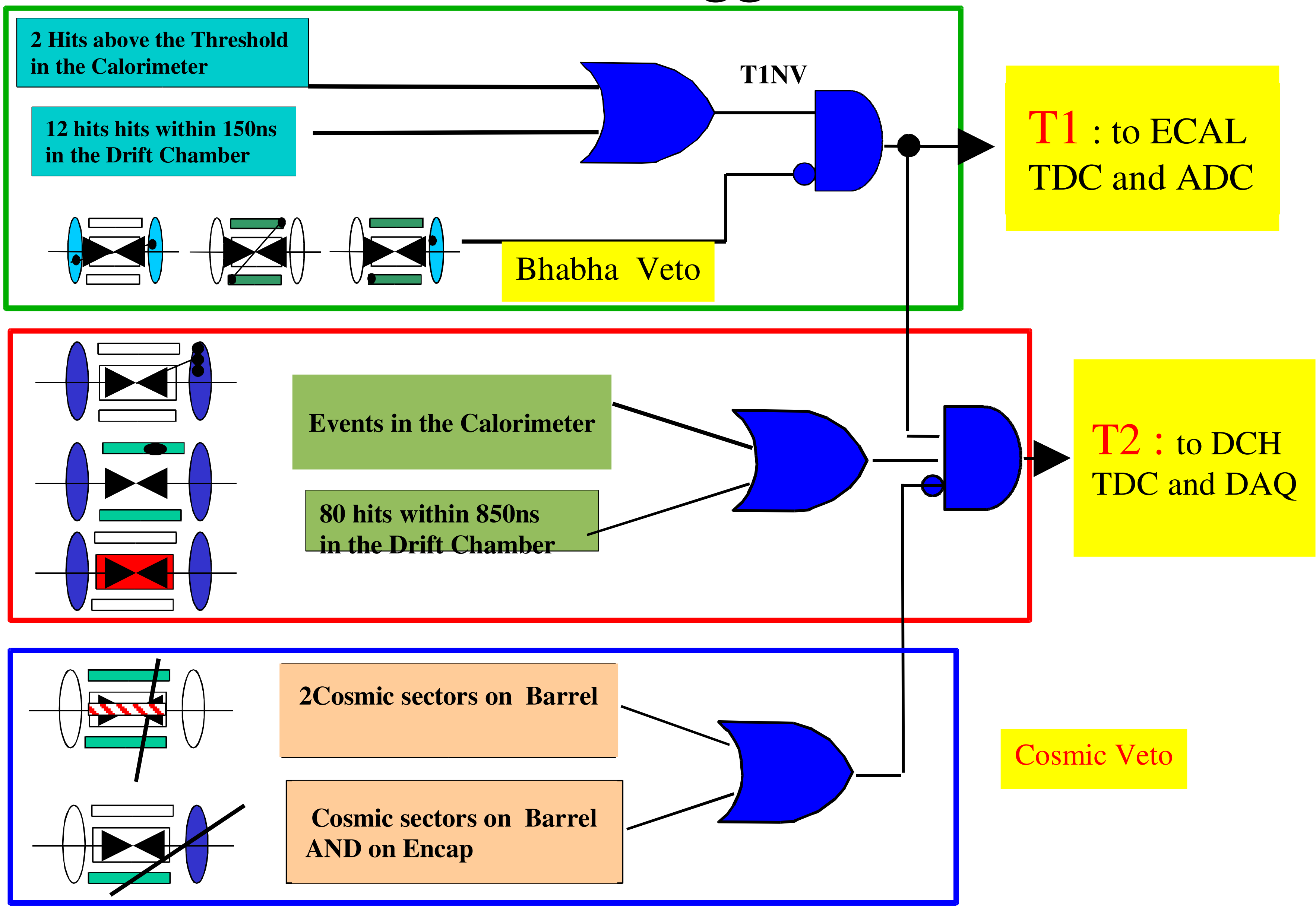
Trigger status report

- System status & configuration during summer 2000 data taking
- Monitoring tools and system stability
- First efficiency studies

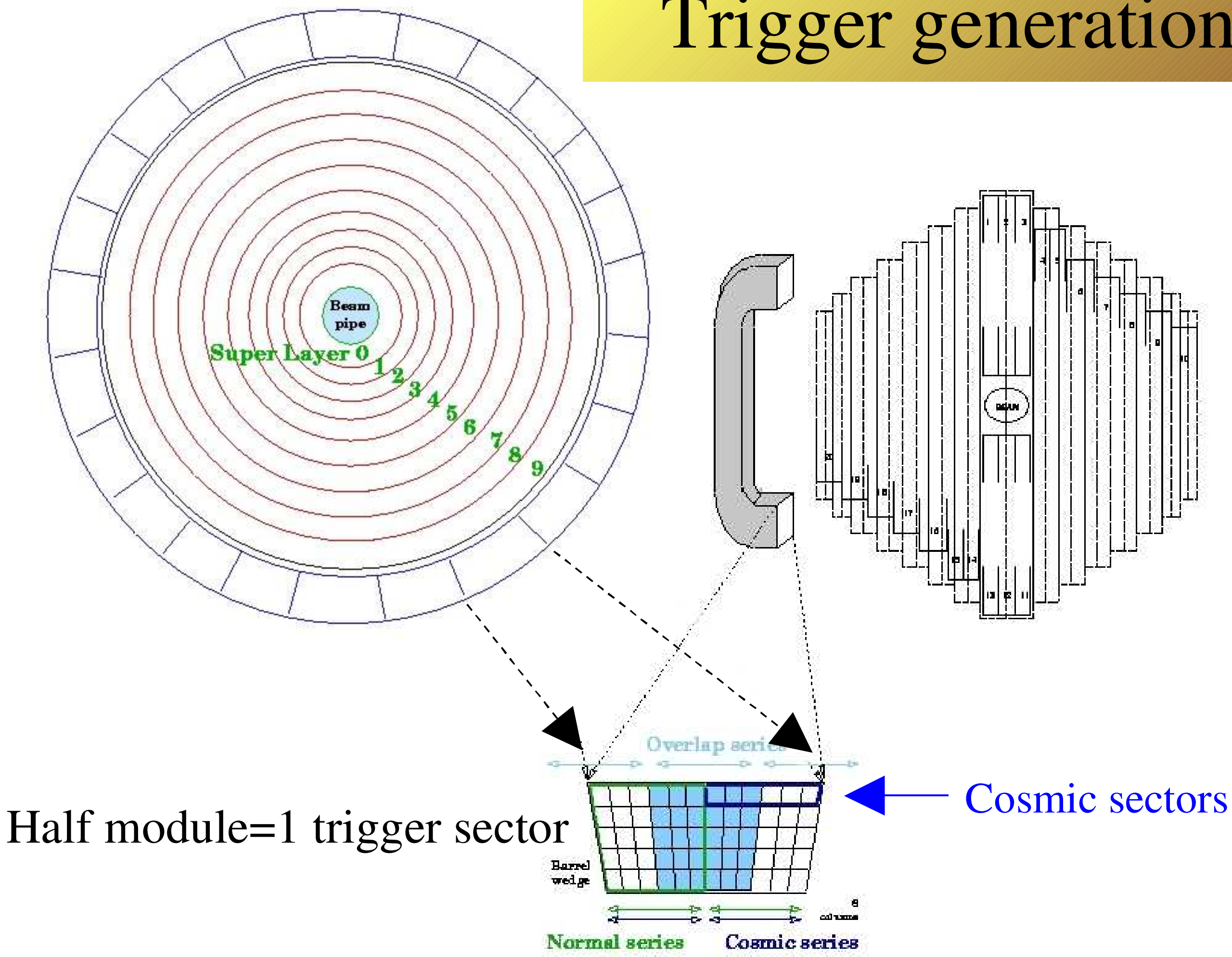
Vincenzo Patera LNF 12 oct 2000

Kloe Trigger



KLOE trigger group

Trigger generation

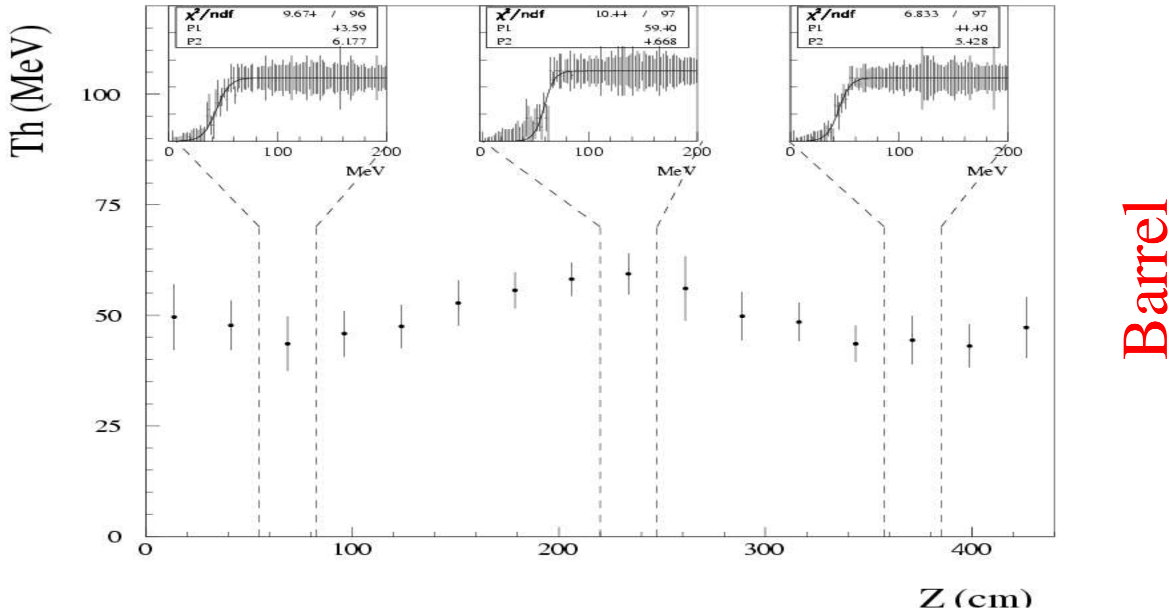


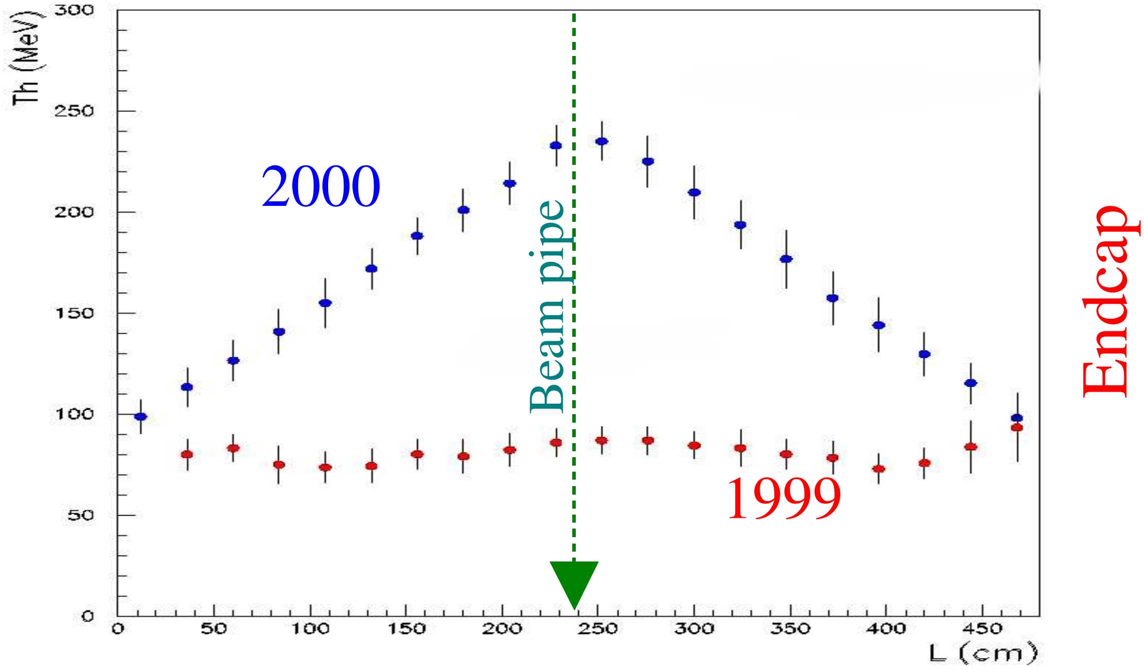
Each ECAL trigger sector gives 3 signal : LET ("low thr") and Bhabha ("high thr") from 30 EMC channels, cosmic signal from the 6 outer channels of the sector. –> topological trigger and vetoes

Ech super layer gives the istantaneous number of wires fired :
L1 trigger from total coincidence hits within 250 ns
L2 trigger from total number of hit integrated in a 1 μs time window

Ecal trigger thresholds

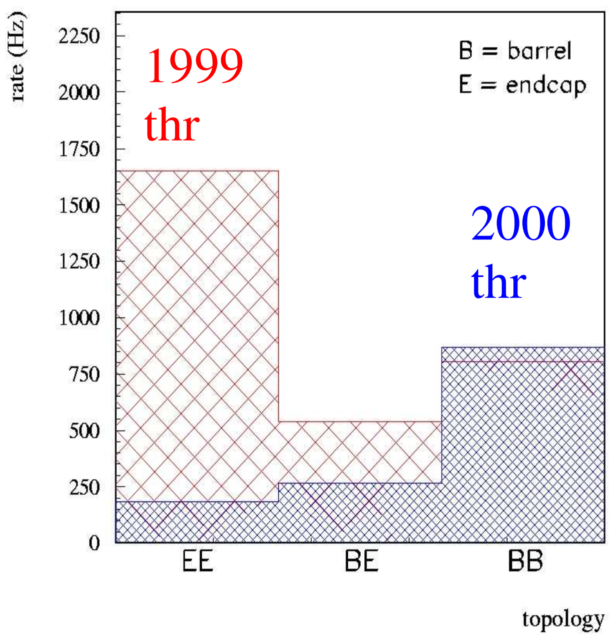
The endcap threshold has been unbalanced and raised to reject background from beam pipe region

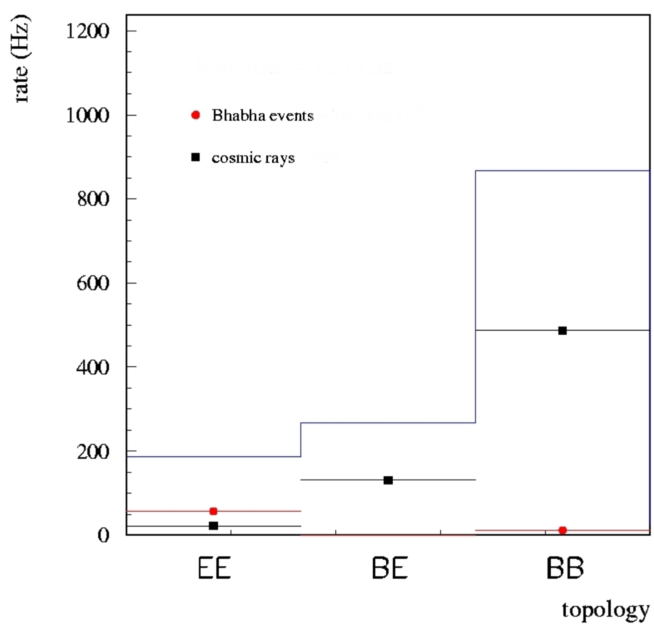




Ecal trigger thresholds vs background

- The 2000 thresholds get rid of a lot of Endcap–Endcap events
- At a beam condition of $I^{+} \sim I^{-} \sim 400$mA, $L \sim 10^{31}$cm^{-2}s^{-1} the Ecal trigger rate is ~ 1.3 kHz
- The Ecal trigger rate are due 50% to not rejected cosmic, 40% to machine background and 10% to Φ and Bhabha

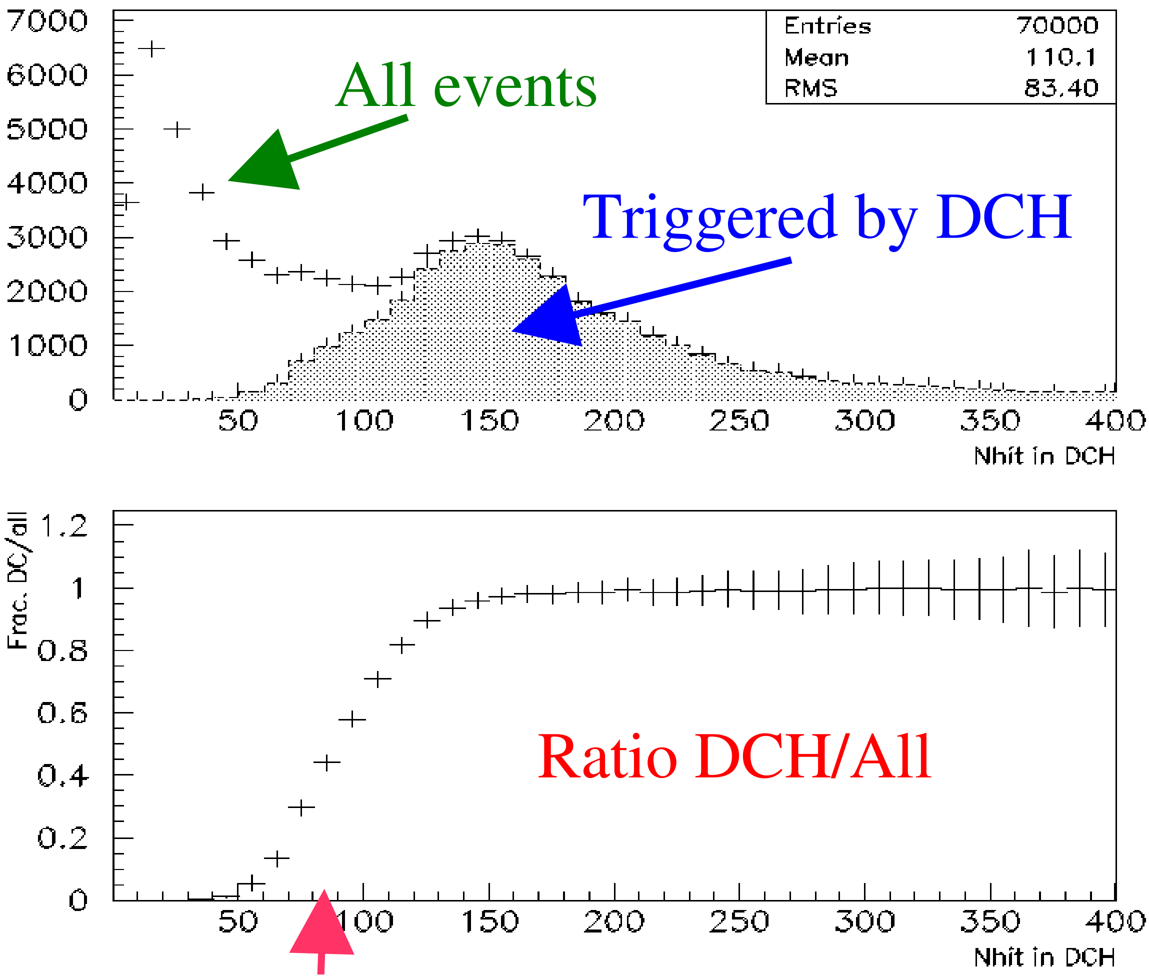




DCH trigger L2 threshold

The DCH L2 threshold now corresponds to ~ 80 total hits integrated in DCH. (On cosmic full efficiency at ~ 40 hits)

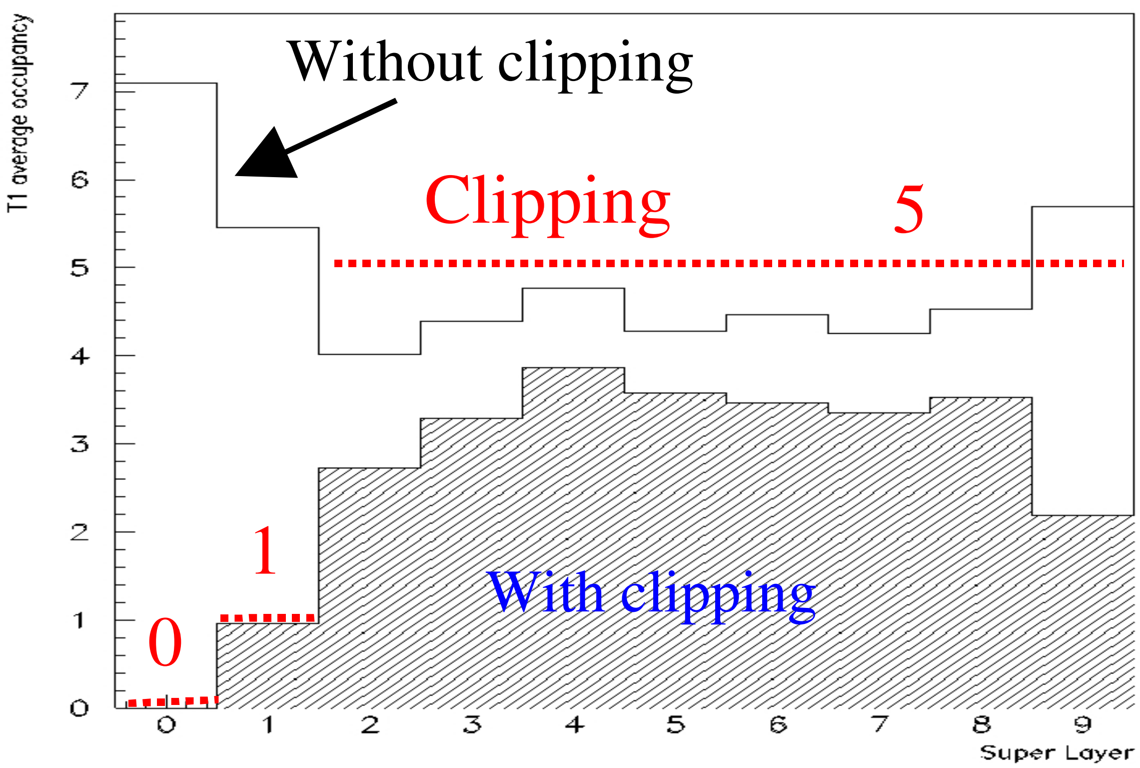
DCH hits distribution



DCH trigger setup

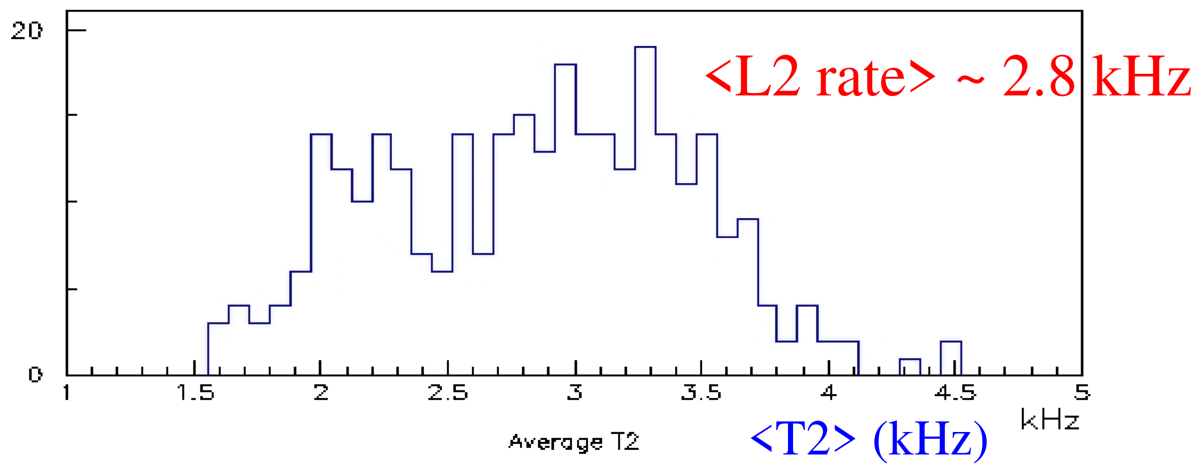
- Full hardware configuration. Tuning of the 2 level trigger system @summer 2000 data taking.
- Super layer clipping and L2 threshold optimization vs machine background
- Optimization of hot wires masking. Now from DB and run_control.

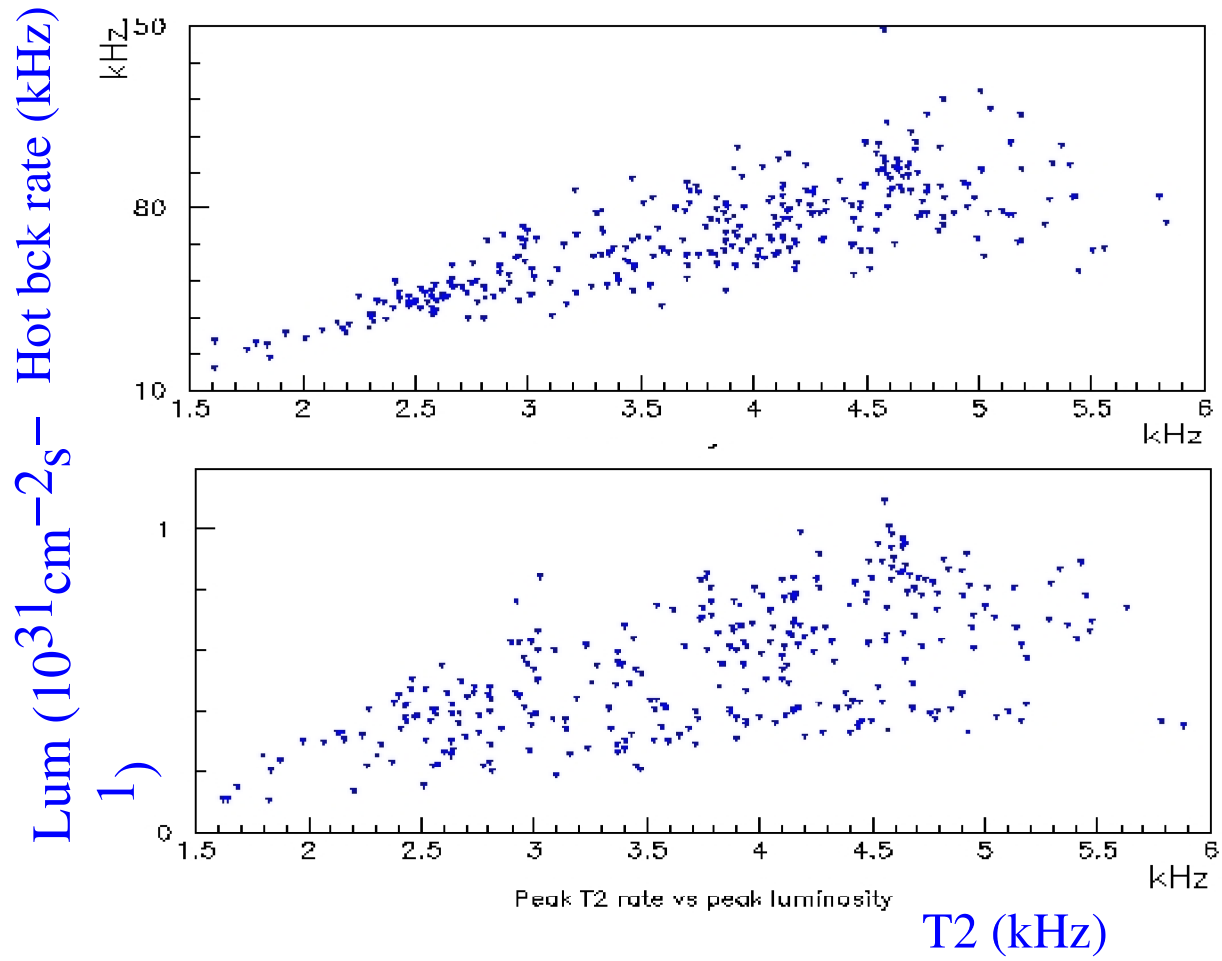
Super layer average occupancy



- During summer 2000 L2 rate changed accordingly to luminosity, machine background and DCH trigger optimization level.
- At present total T2 rate is ~ 2.8kHz @ L~$10^{31}cm^{-2}s^{-1}$ out of which 1.7 kHz ECAL, 1 kHz DCH. (0.4 kHz come from downscaled cosmic)

Average T2



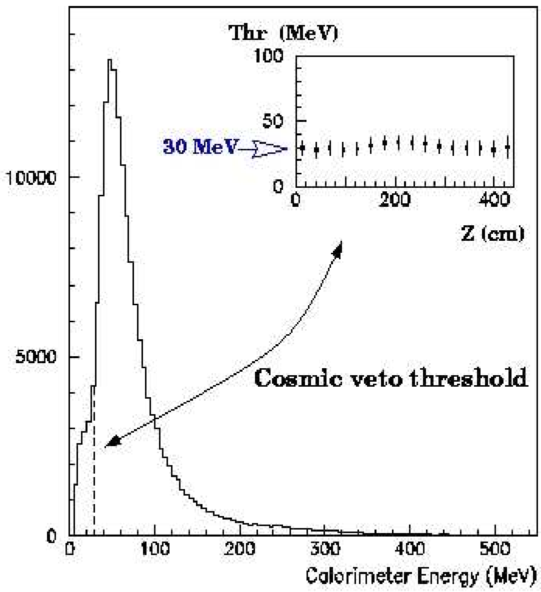


Trigger vs cosmic events

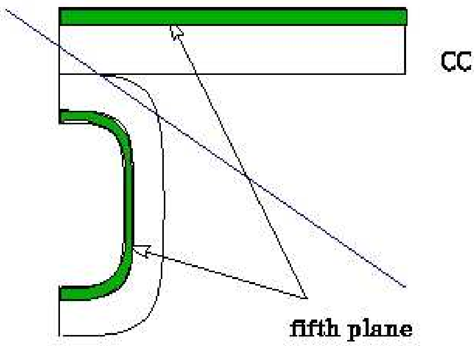
The unrejected rate of cosmic is~650 Hz, whose tracks are concentrated between barrel and endcap. For monitor and calibration purpose we add ~400 Hz of downscaled cosmic in the barrel

$$COSMIC\_VETO = B2C + B1C * (E1C + W1C)$$

$\rightarrow$ Efficiency $\sim$ 75% (2.7 kHz $\rightarrow$ 0.68 kHz)

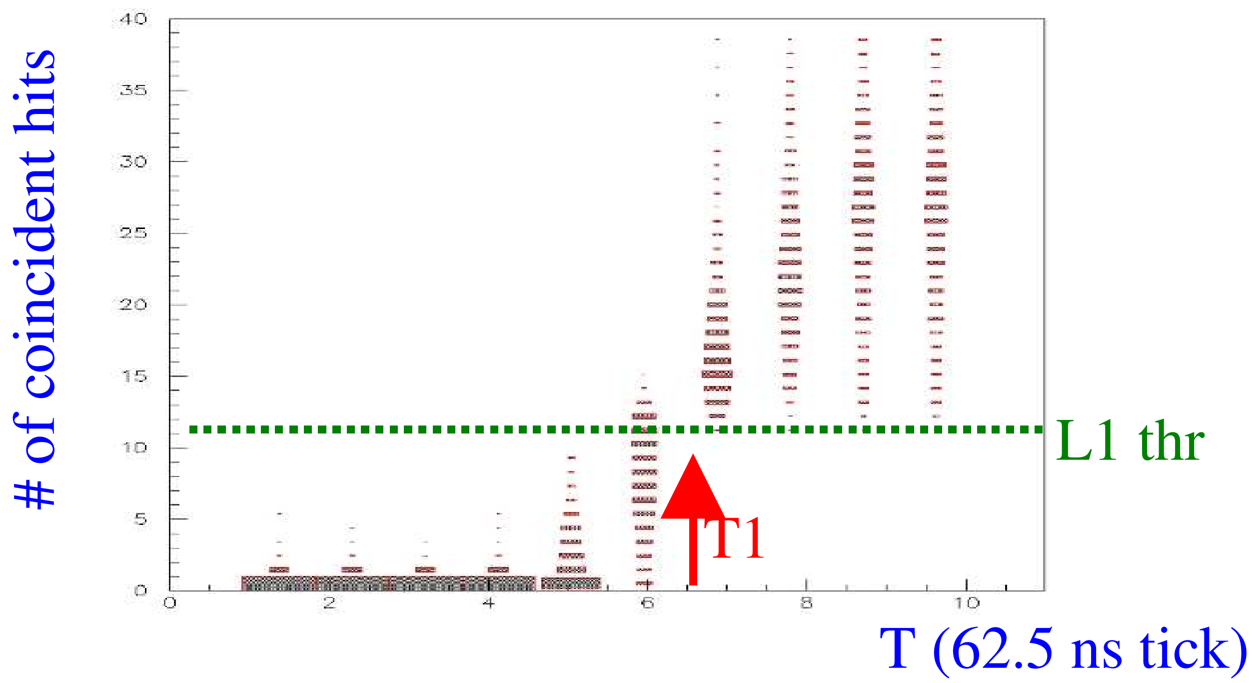


The ~25% cosmic veto inefficiency is dominated by the geometry of the apparatus

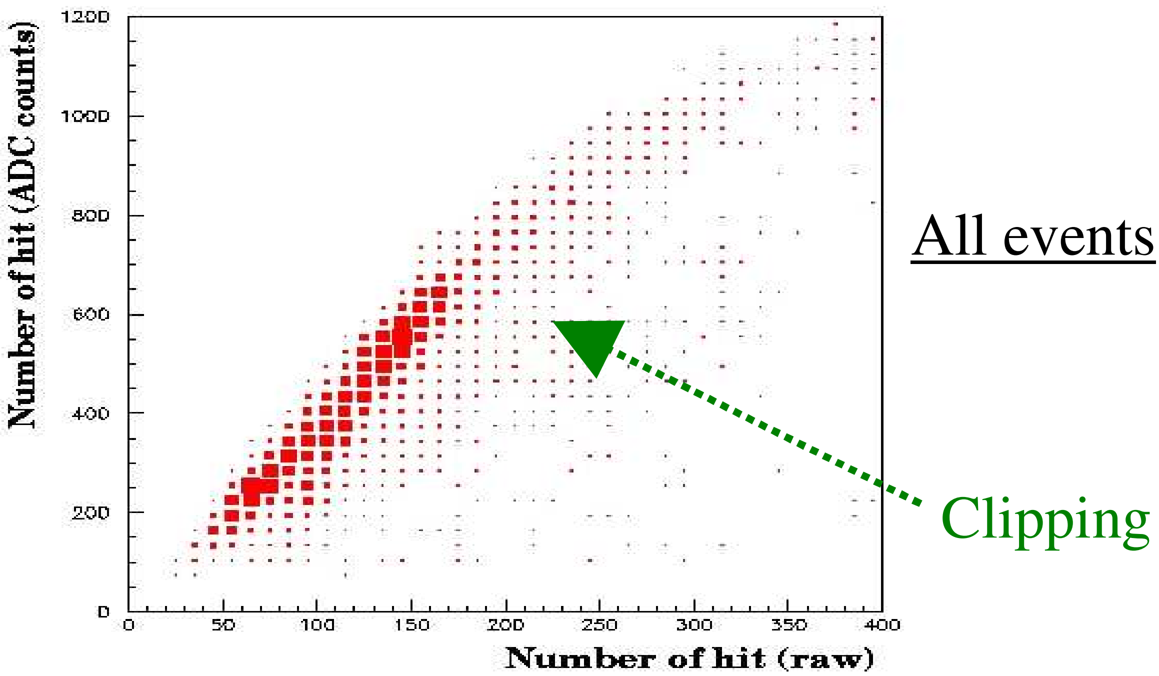


Hardware online monitoring

Super layer yeld vs time: L1 check



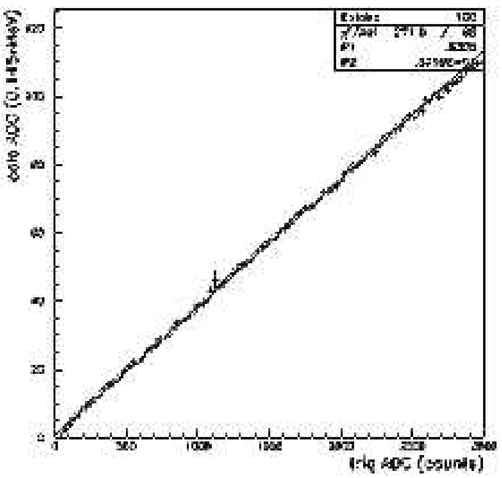
Super layer yeld sum vs total DCH hits: L2 check

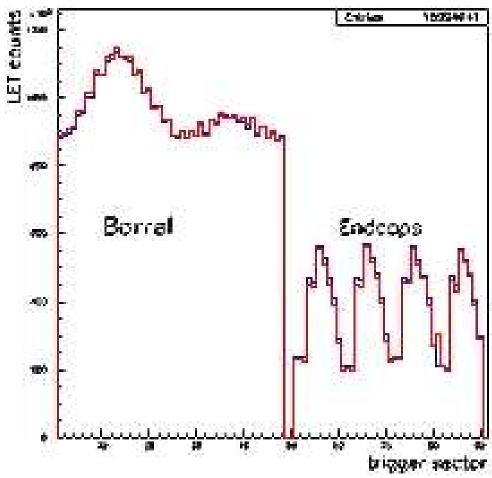


Online hardware monitoring

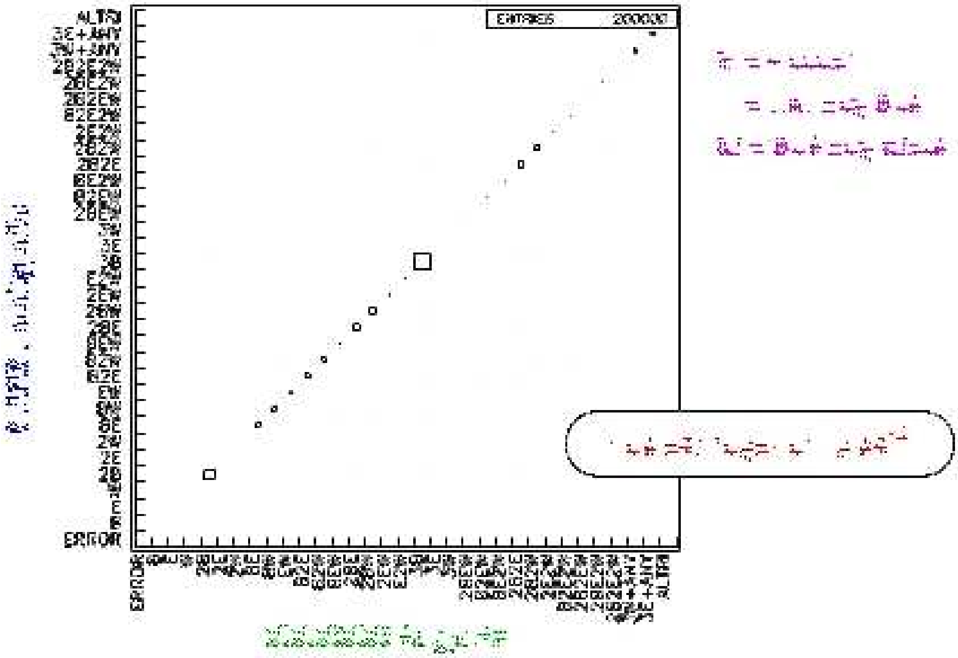
1) PIZZA sum stage:
calorimeter ADC signals versus the trigger ADC at DISH inputs

2) Trigger sector's hardware:
LET occupancy (blue) versus the illumination of calorimeter cells (red)





3) Consistency check on the multiplicity counting stage:
multiplicities at the TORTA input are correlated with the ones calculated starting from DISH outputs



Luminosity Monitor

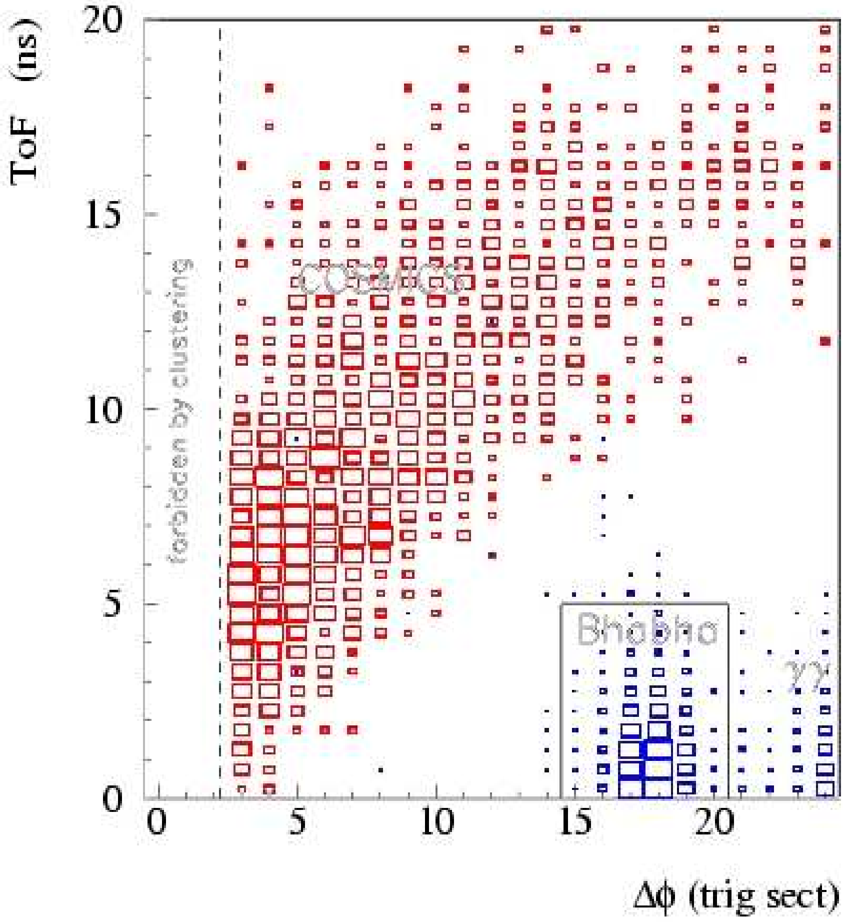
BHABHA SELECTION:

- ≥ 2 BBT sectors on the barrel (normal series);
- Angular distance: $112^{\circ} \leq \Delta\phi \leq 165^{\circ}$ ($15 \leq \Delta\phi \leq 22$, trig. sect.);
- Time of flight difference (Trigger TDC's): $\Delta t \leq 5$ ns.

PERFORMACES:

- High rate capability (up to 5 kHz);
- $\mathcal{L}_{TRIG} - \mathcal{L}_{OFFLINE} \sim 10\%$;
- Rejection power on cosmics $> 10^5$ (~ 4 mHz residual rate);
- Machine background contamination $\lesssim 5\%$.

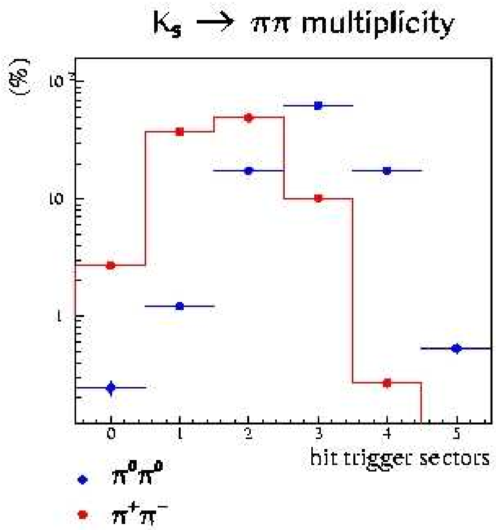
Trigger Bhabha selection

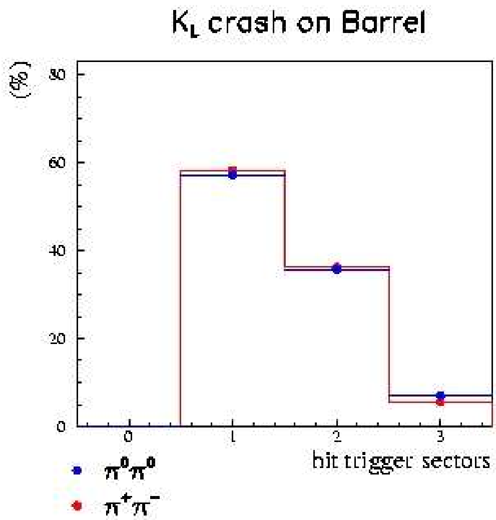


Trigger efficiency on $\mathrm{K_S}$ decays

$\mathrm{K_S} \to \pi\pi$ events are tagged by a $\mathrm{K_L}$ interacting in the calorimeter barrel with E > 100 MeV.
$\mathrm{K_L}$ fires at least 1 sector, the trigger efficiency is therefore (2 sectors required !):

$$\varepsilon(\mathrm{K_S} \to \pi\pi, \mathrm{K_L}\mathrm{crash}) = 1 - \mathrm{P_L}(1) \cdot \mathrm{P_S}(0)$$





The following efficiencies have been measured for $\mathrm{K_L}$ and $\mathrm{K_S}$:

$\mathrm{P_S}(0) = 0.24 \pm 0.03\%$ $(\pi^0\pi^0)$
$\mathrm{P_S}(0) = 2.69 \pm 0.07$ % $(\pi^+\pi^-)$

$\mathrm{P_L}(1) = 55.0 \pm 0.3$ %

As a result:

- $\epsilon_{trig} = (99.87 \pm 0.02)$ % for $\pi^0\pi^0$
- $\epsilon_{trig} = (98.52 \pm 0.04)$ % for $\pi^+\pi^-$

Trigger efficiency on $\mathrm{K_L}$ decays

- The probability $P(i)$ of having " i " sectors fired ($i = 0, 1, 2$) on each subdetector (B = barrel, W = endcap west, E = endcap east) is:

$$P(0) = S(0)L(0);\ P(1) = S(0)L(1) + S(1)L(0), ...$$

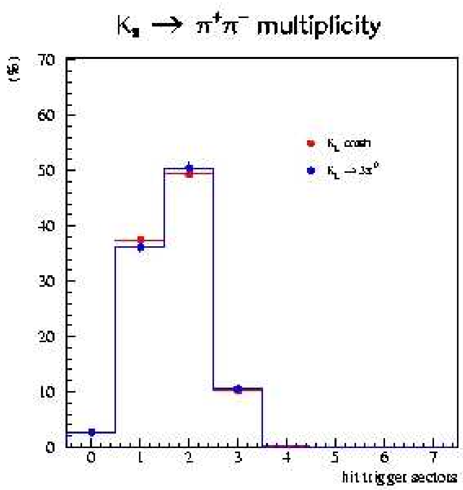
  where $S(i)$ and $L(i)$ are extracted from the "unbiased" multiplicity distributions of $\mathrm{K_S}$ and $\mathrm{K_L}$

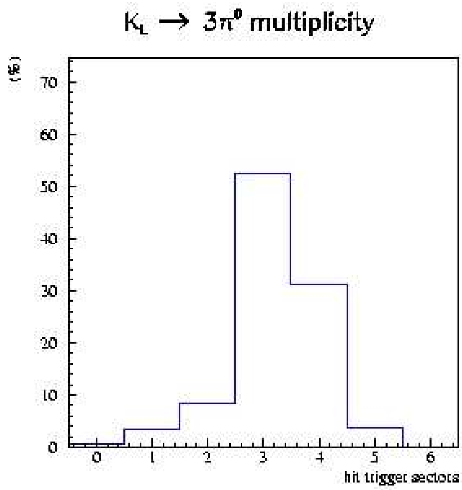
- The fraction of lost events 1 - ϵ_{trig} is:

$$B(0)W(0)E(0) +$$
$$B(1)W(0)E(0) + B(0)W(1)E(0) + B(0)W(0)E(1)$$

For $\mathrm{K_L} \to 3\pi^0$ (tagged by $\mathrm{K_S} \to \pi^+\pi^-$)

$$\epsilon_{trig} = 99.0 \pm 0.5\%$$





Conclusions

Ecal trigger very stable during the 2000 data taking

DCH trigger commisioned

First addressing of absolute trigger efficiency

Trigger thresholds hardened with respect to 1999 to deal with higher background