“Use of the old CHOD in the NA62 trigger”

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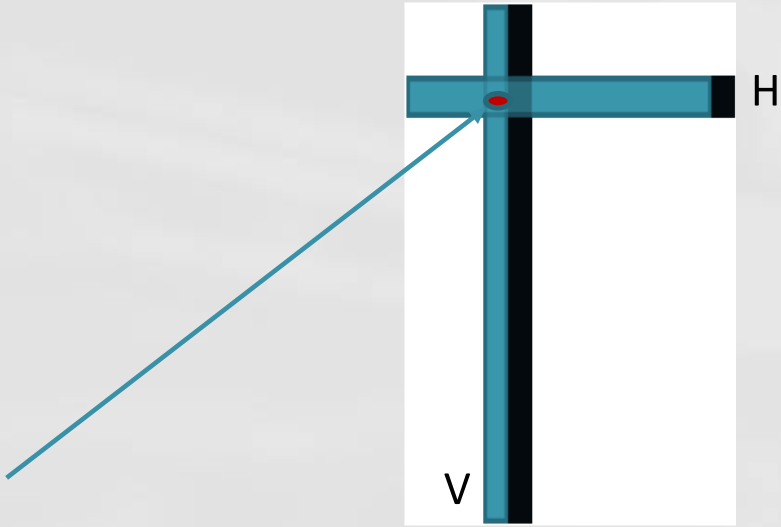
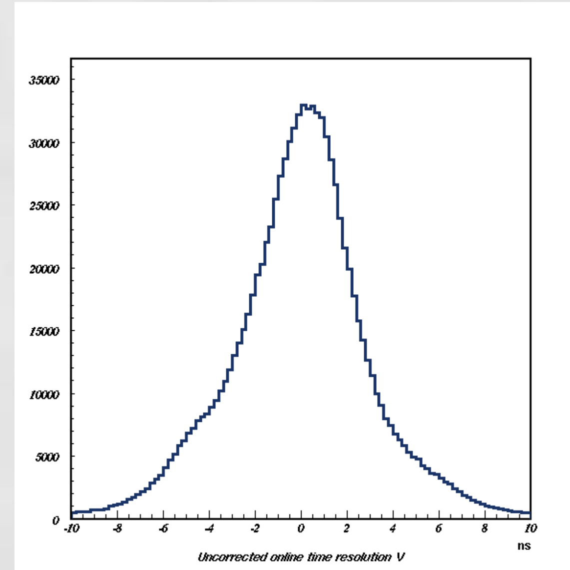
9.2.2011
TDAQ WG meeting

Online time correction

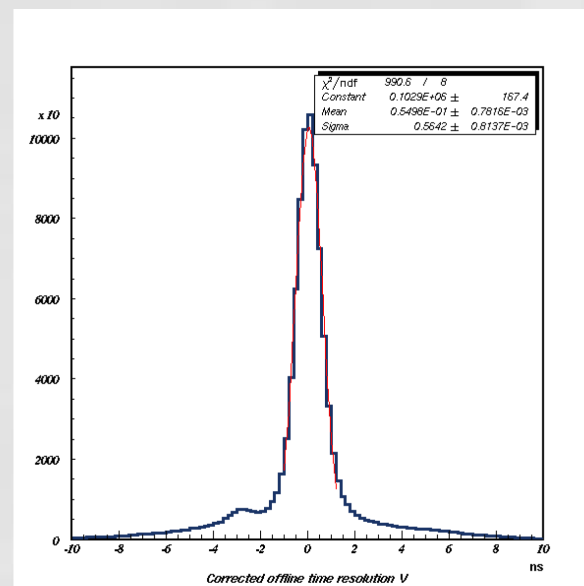




- The CHOD offline time resolution can be obtained online exploiting hit position defined with the crossing point of the two slabs in the two planes
- Compact routine chodcorr2000 (hodoscope time correction without DCH) adapted
- The quality of the procedure has been checked comparing with offline corrected data

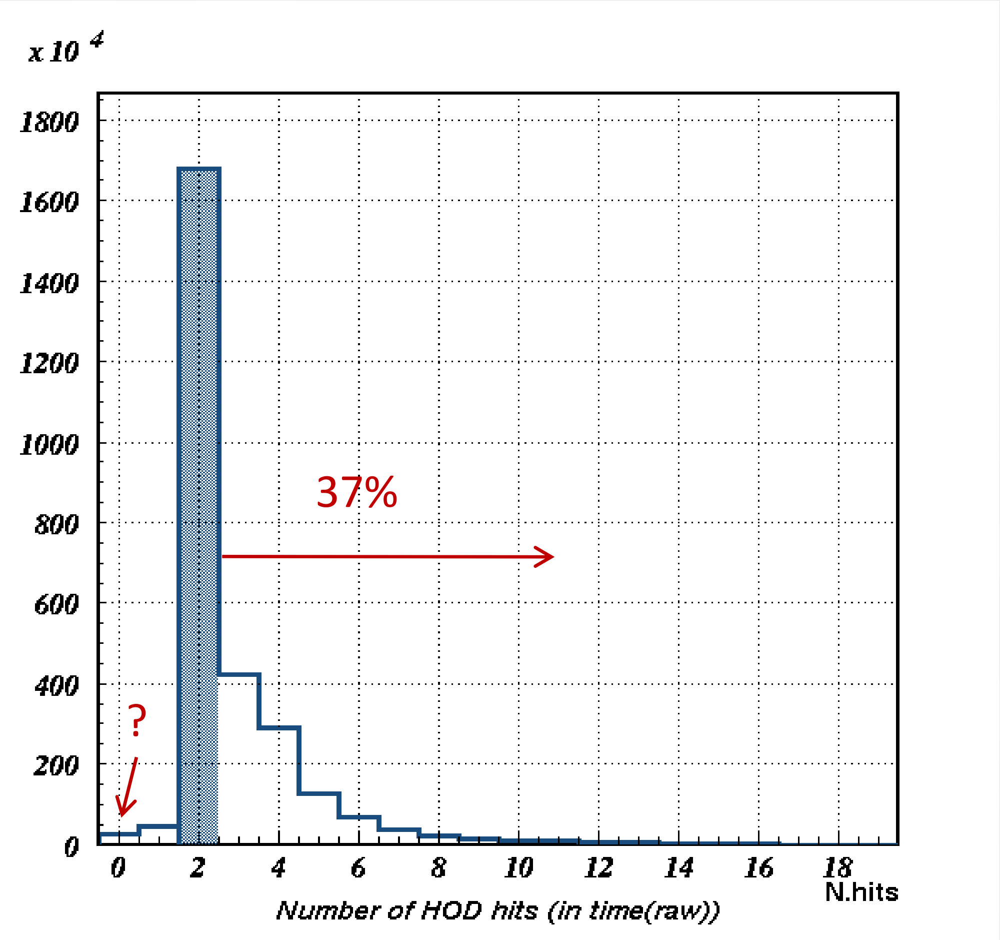
[see my talk in October TDAQ wg]

[see my talk in Weekly meeting 13.1.2011]

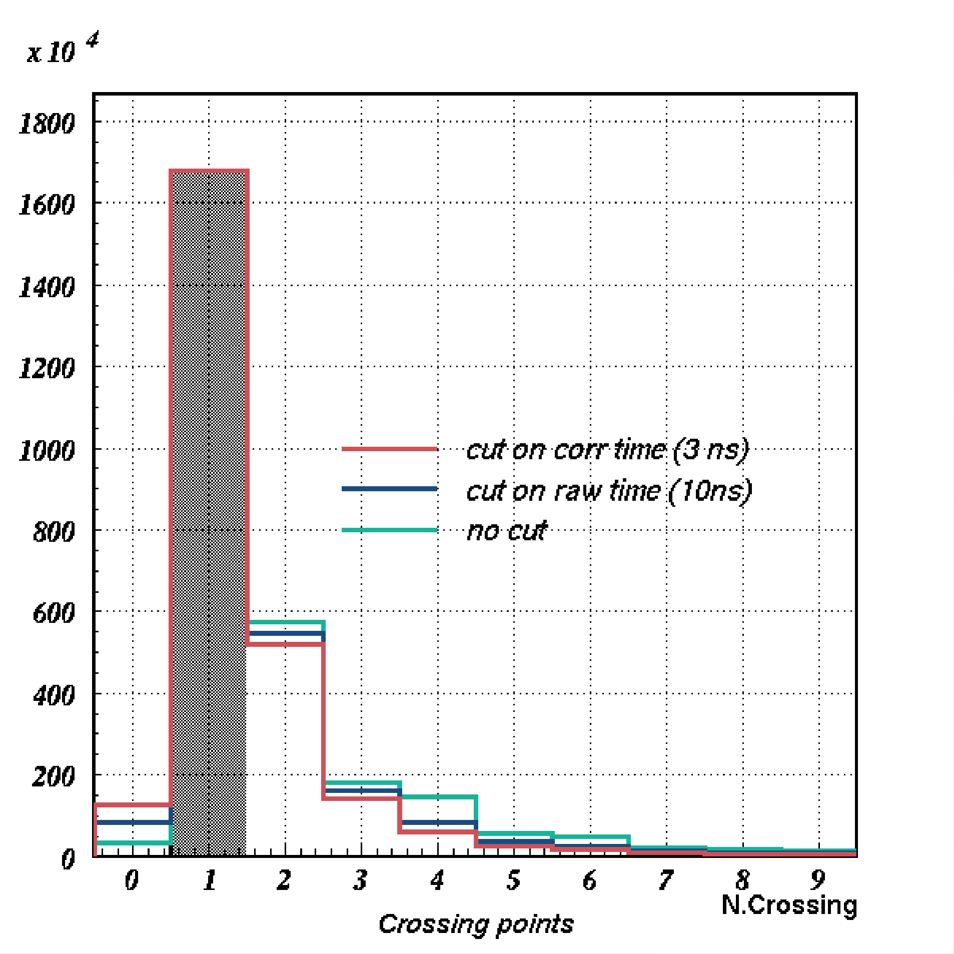


Extra hits

- To use the CHOD in the trigger, a good time resolution isn't the end of the story
- 37% of the events with 1 track has more than 2 hits in the CHOD (in time with the track)
- The extra hits can produce extra crossing points and, then, extra triggers
  - Extra rate, random veto if used against multi tracks events, errors in online time correction…

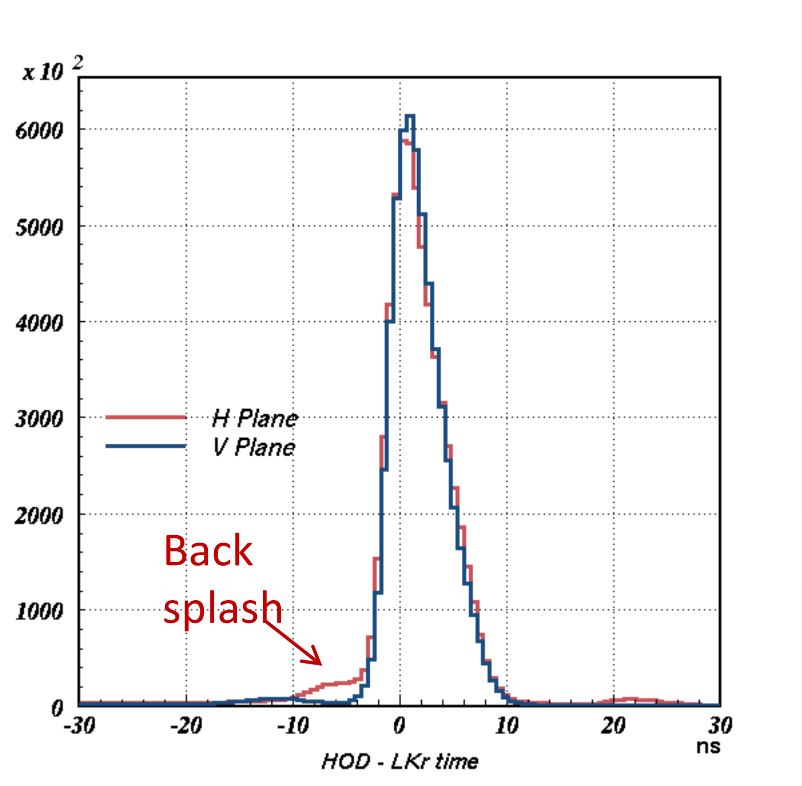


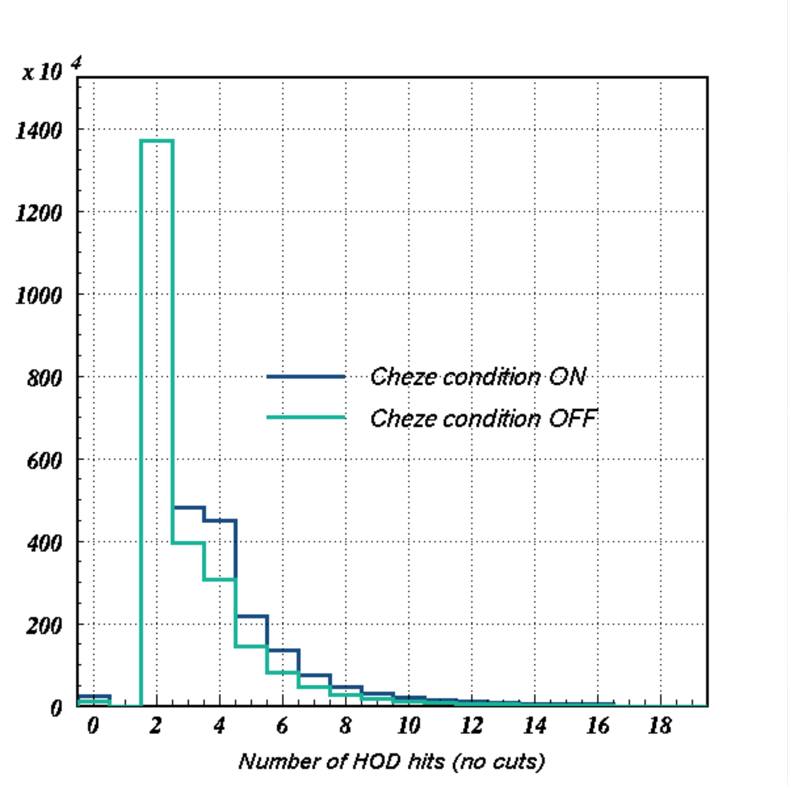
Crossing points



- A crossing point is defined if there is a spatial coincidence between H and V plane slabs
- Time coincidence between the two plane is required on raw and corr. time according to the resolution (10 and 3 ns)
- ~ 30% of 1 trk events has more than 1 crossing point

Extra hits sources

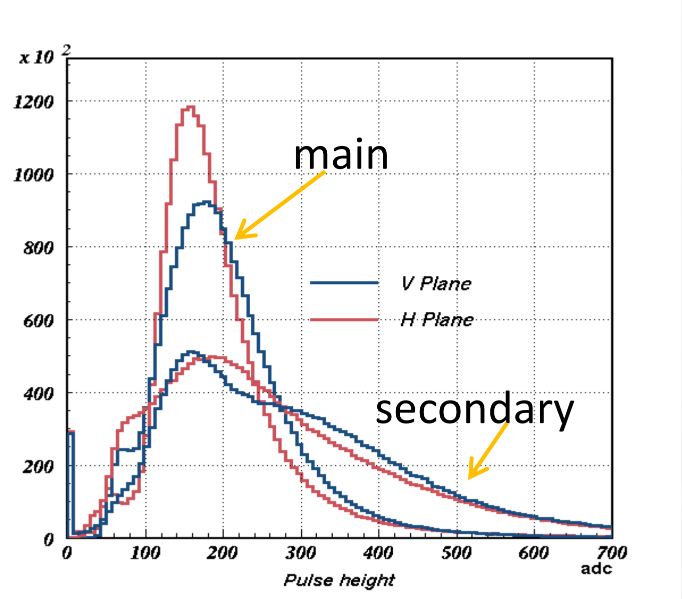


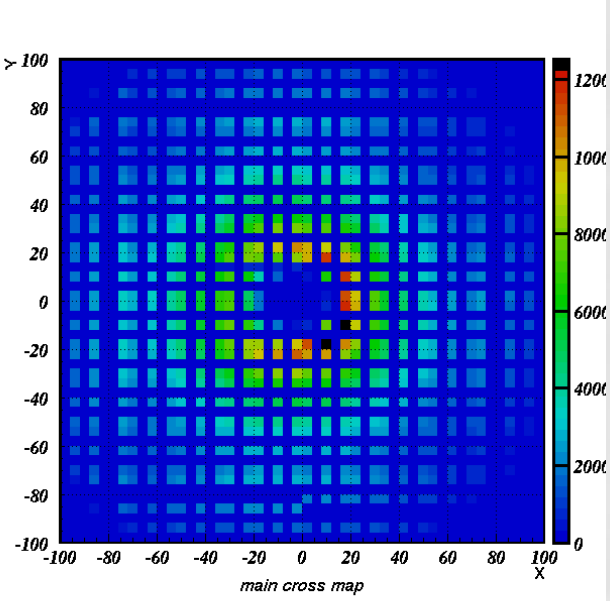


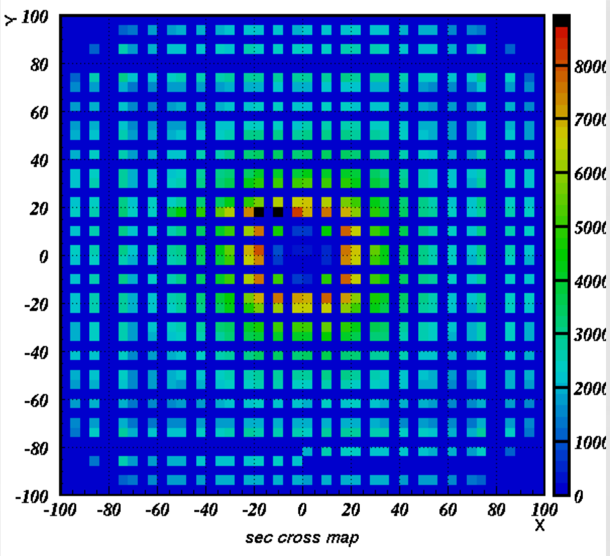
- Several sources investigated:
  - Backsplash: comparing the number of hits in H and V plane →very small contribution
  - Accidentals: comparing runs with and without Cheze condition → small contribution
  - Cross talk: studying the distance between the extrapolated track position and the extra hits → can't explain the excess

Extra hits sources

- In 2 crossing points bins, the “main” hit is defined as the hit corresponding to the track, the other is the secondary
- The pulse height distribution are quite different
- The main hit spatial distribution follow the positive charged particle deviation, while the secondary is flat

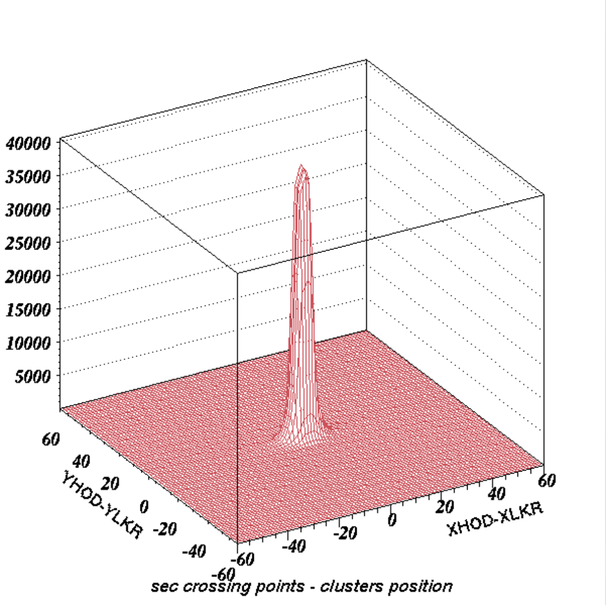


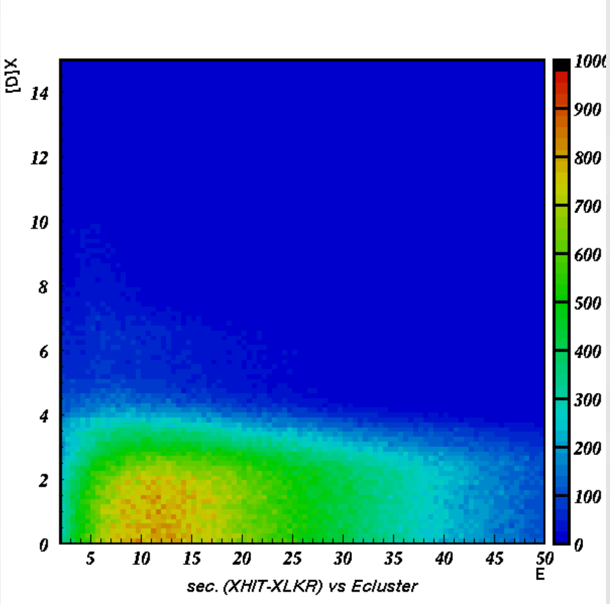




Extra hit sources

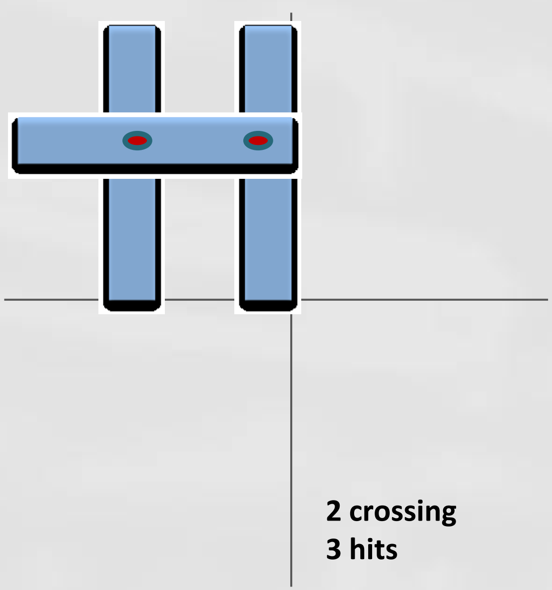
- The difference between CHOD hit and LKr cluster position shows that they are real particles
- Most probably they are conversions on the CHOD
- In the crossing point spatial resolution, there is no dependence of the Δx wrt the energy of the cluster (conversion after the magnet, probably in the CHOD itself)

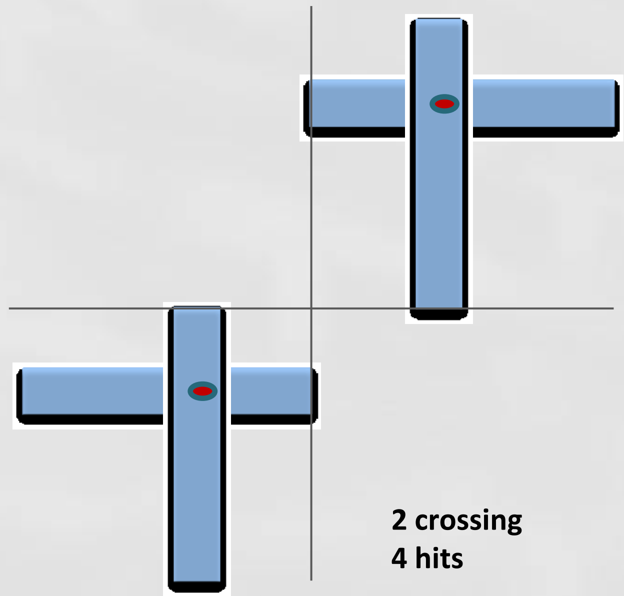


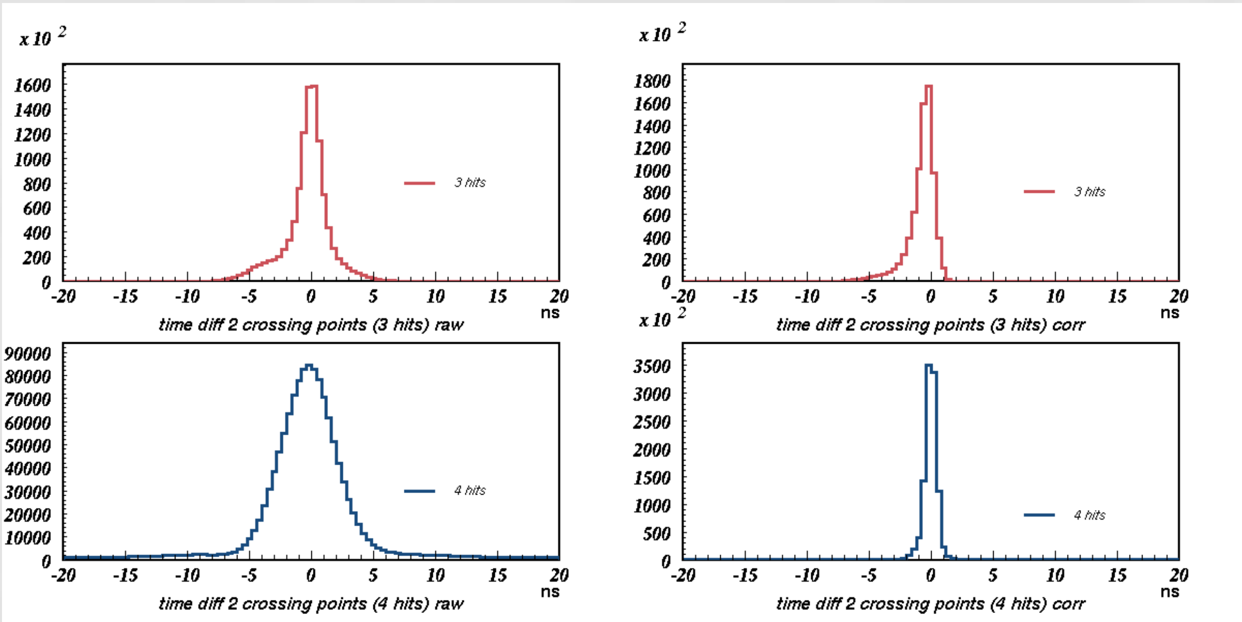


Time distribution for extra CP

- 2 crossing points events should be separated in two categories: 3 hits (34%) and 4 hits (66%)
- The time in both categories is well corrected by the online correction
- The flat background is negligible

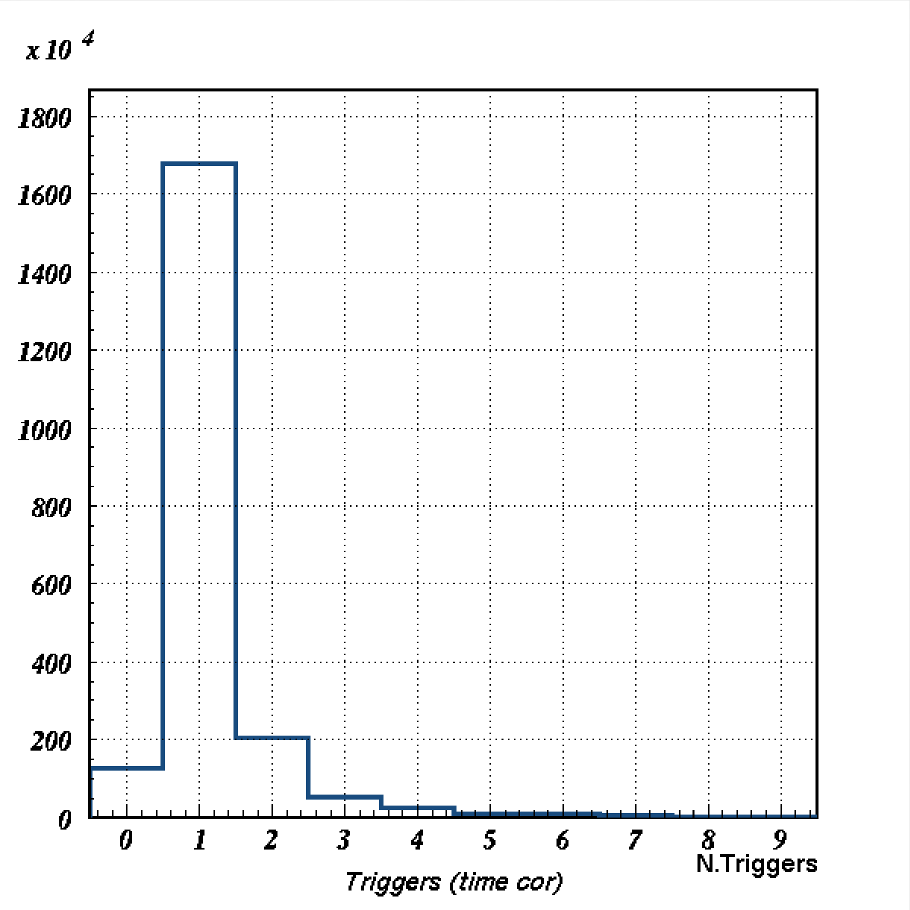






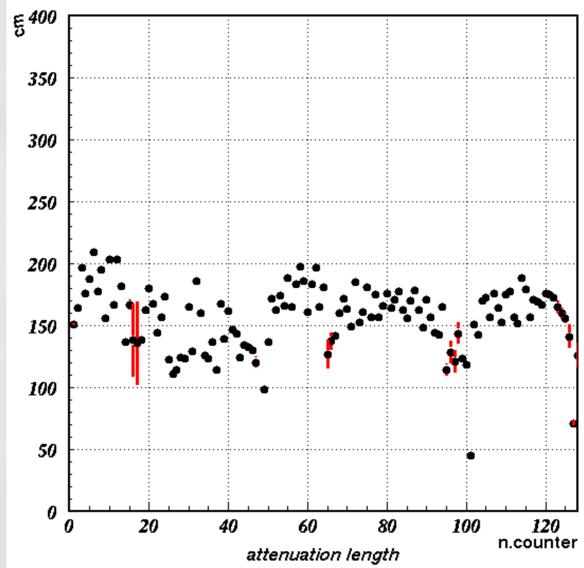
Number of triggers

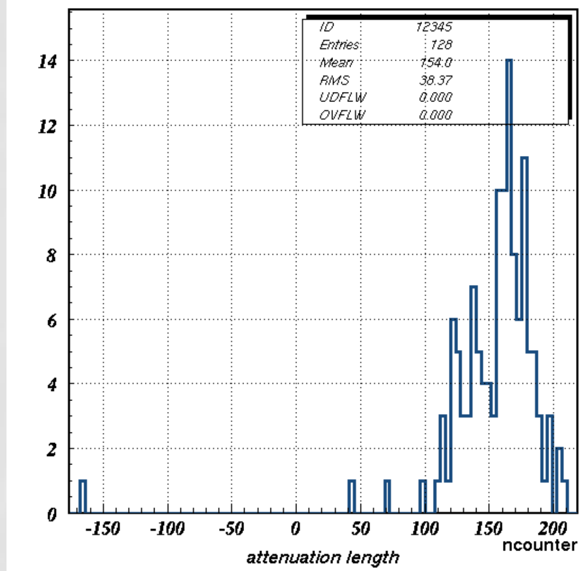
- Two "separated" trigger are defined if the crossing points are "far" in time (10 and 3 ns to be conservative)
- Good: Thanks to the "in time" behaviour of the extra crossing points, the extra rate is ~12%
- Bad: If we use the CHOD to cut on multiplicity there is a random veto of 30%



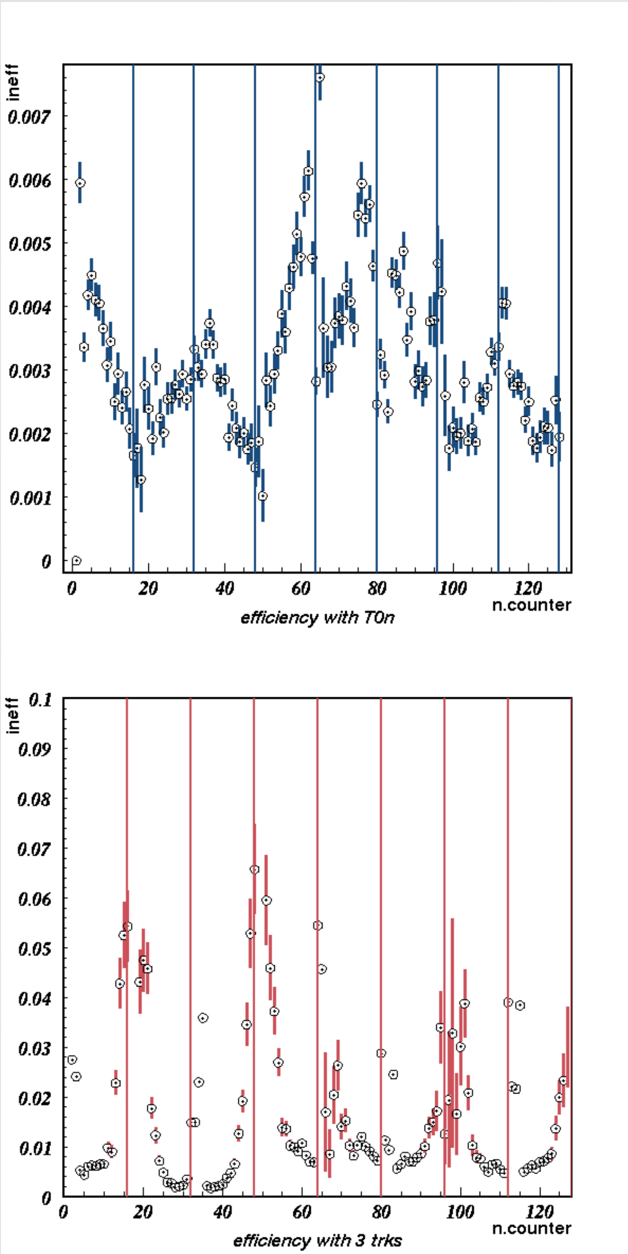
Attenuation length

- Attenuation length measured studying the pulse height as a function of the impact point position
- No selection on particle type
- 1 trk & 1 cluster & 2 CHOD hits associated with the tracks
- Factor 2 in degradation wrt the beginning
- Similar results in 2004 (Mauro R.) and in 2000 (Mauro P.)
- Some strange distribution for few counters
- Average 151.9±0.1 cm
- Roberto *(weekly 13.1.2011)* : 152.65 cm
- ~30 cm less wrt the 2004 result
- At least one critical slab: 37 H (the others "critical" are with small statistics)



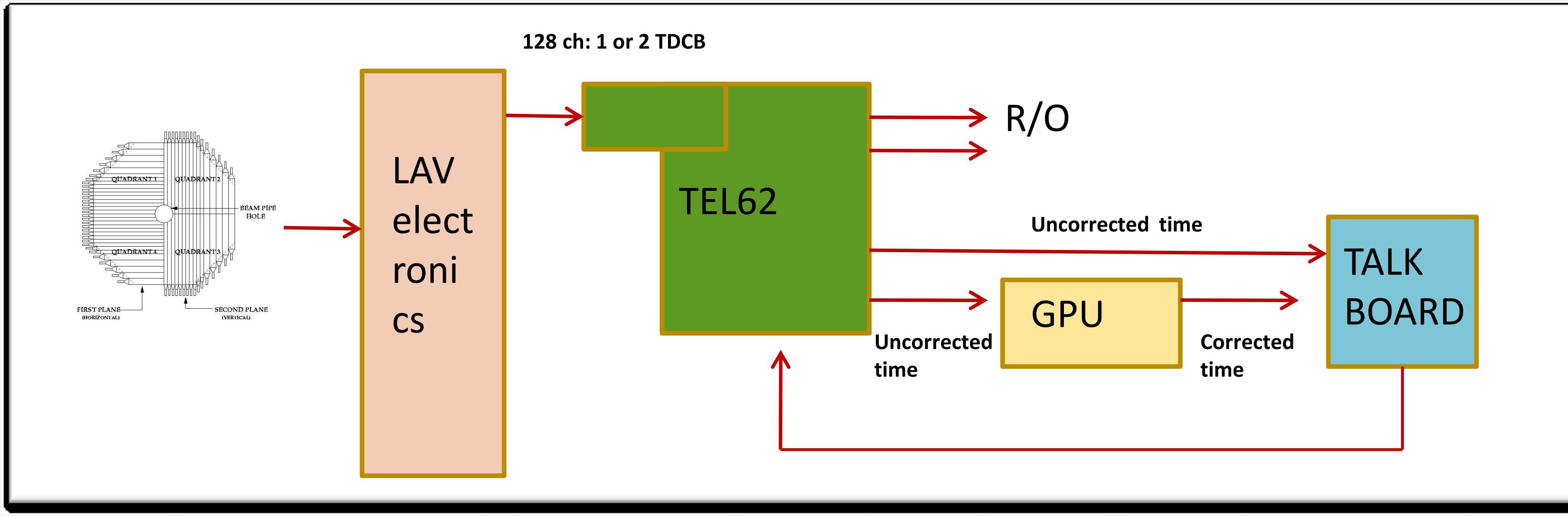


Efficiency



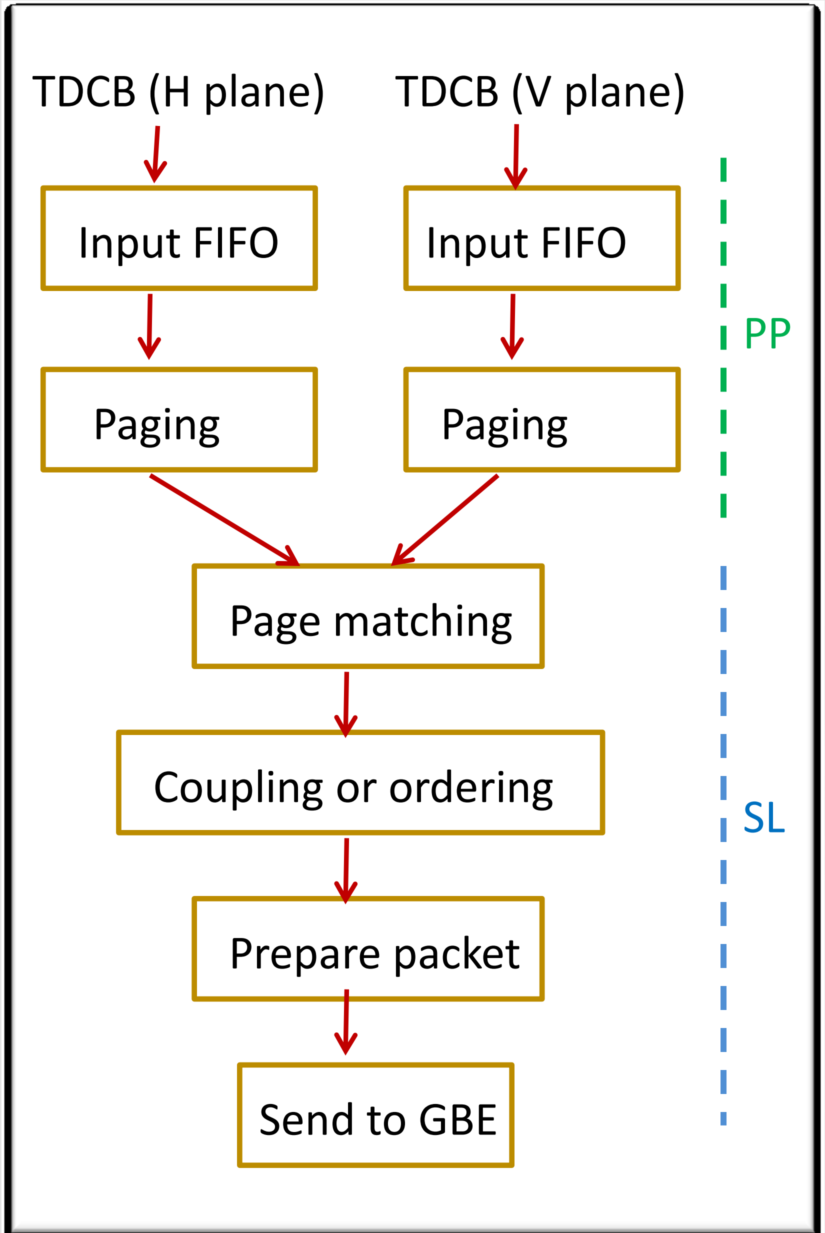
- The efficiency is checked in two ways:
  - T0N events
  - 3trk triggered by Q1
- The 3trk method is used to cross-check the low statistics and biassed T0N
  - The 3trk is more complex, effects of the procedure
  - Qualitative confirmation that the H plane is, in average, less efficient than the V plane.
- For the majority of the counters the inefficiency is less than 0.5%

Old CHOD trigger & r/o in "early" runs



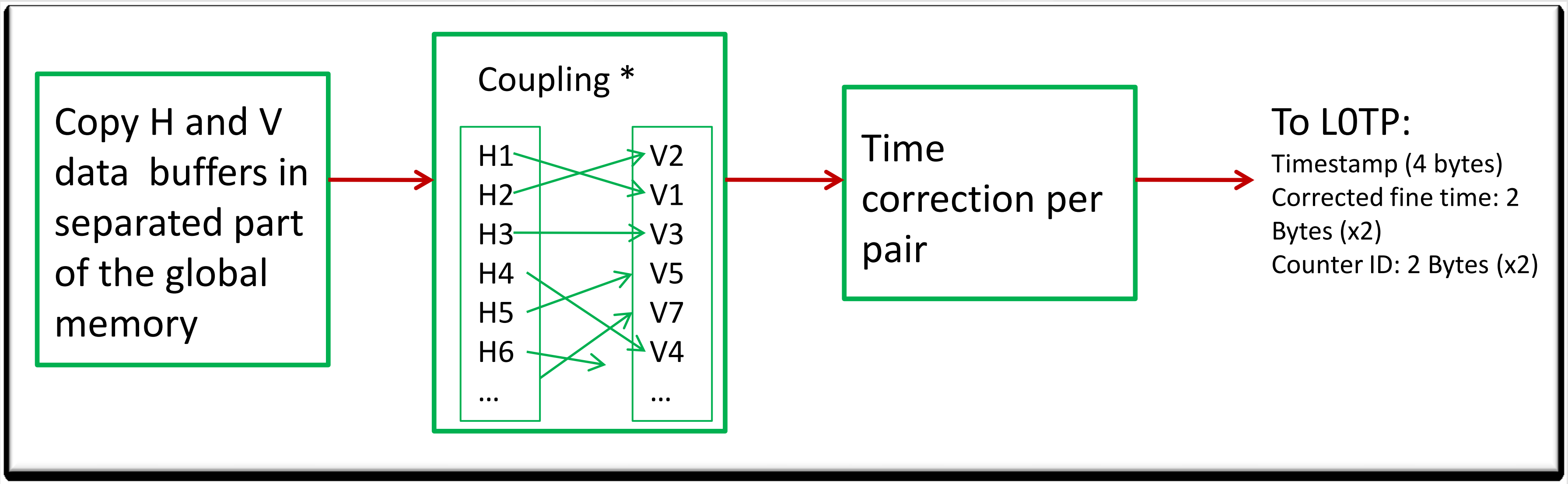
- The LAV electronics is proposed as front end
- 1 or 2 TDCB boards could be used to digitized the data
- Two links will be used for readout and two links for trigger
- The time correction should be, in principle, applied in the FPGA, but it's a very good opportunity to test the GPU implementation on a relatively simple system
- The TALK board should be used to produce the L0 trigger decision (communicated to all the detectors through LTU+TTCex)

GPU system



- Some kind of pre-processing should be done in the FPGA to use the GPUs
- Two options:
  - Coupling between H and V plane $\longrightarrow$ transfer to the GPU the pairs, to apply the online correction
  - Order in time the V and H hits to reduce the "sparsification" and the number of combination to find the right pair in the GPU

GPU system



- The parallelization in the GPU will be exploited to apply the online time correction at several hits in the same time
- If the coupling isn't done in the FPGA then several combination will be processed at the same time and the "best" will be choose at the end
- The coupling in the FPGA is preferred but imply a little more job in preparing the firmware (probably is a good excercice, opportunity to use the SRAM in the TDCB, etc..)

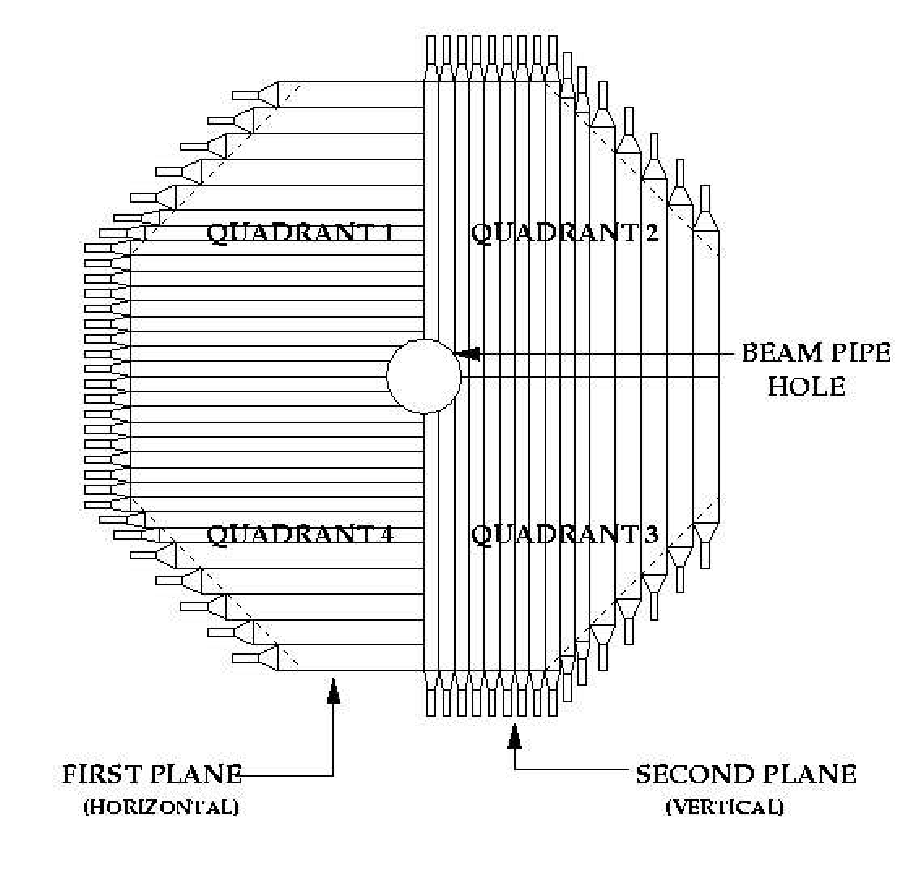
Conclusions (1)

- ~37% of the 1 trk events has on time extra activity on the CHOD
- ~30% of the 1 trk events presents more than 1 crossing point
- The extra activity is mainly due to gamma conversions in the CHOD.
- The extra crossing points are time correlated with main crossing points (either in the case of sharing of one slab or in case of separated slabs)
- The time resolution isn’t affected by the extra crossing points and the rate trigger (of the positive signal) will increase by ~10%
- The CHOD can’t be used as veto for two tracks (30% inefficiency on single track)
- The attenuation length of the scintillators is compatible with the one measured in 2004 and 2000, but lower with respect to the initial value: average 1.52 m (30 cm less than in 2004)

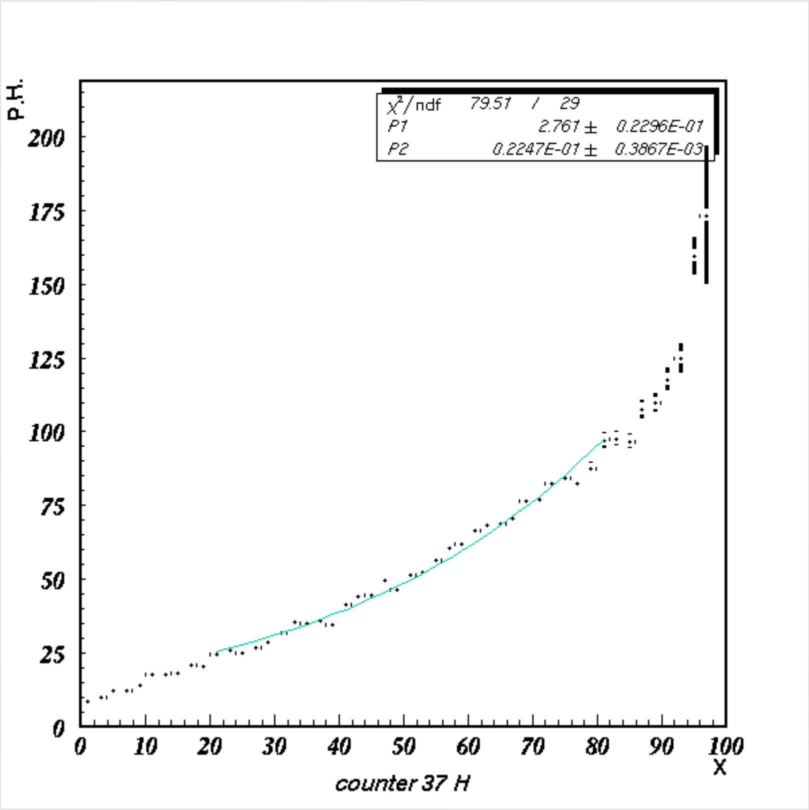
Conclusions (2)

- The CHOD efficiency is studied using T0N and 3trk samples to avoid bias from Q1: the inefficiency is lower than 0.5% for most of the slabs and the H plane is, in average, less efficient
- The R/O for the “early” runs should be based on LAV FEE (or RICH FEE), TDCB, TEL62 ,TALK BOARD and LTU+TTCex
- The online time correction will be applied using a GPU system in order to test the idea in a real environment (a standard trigger primitive line is foreseen as backup solution)
- The data from the TEL62 need to be “formatted” in order to optimized the GPU processing

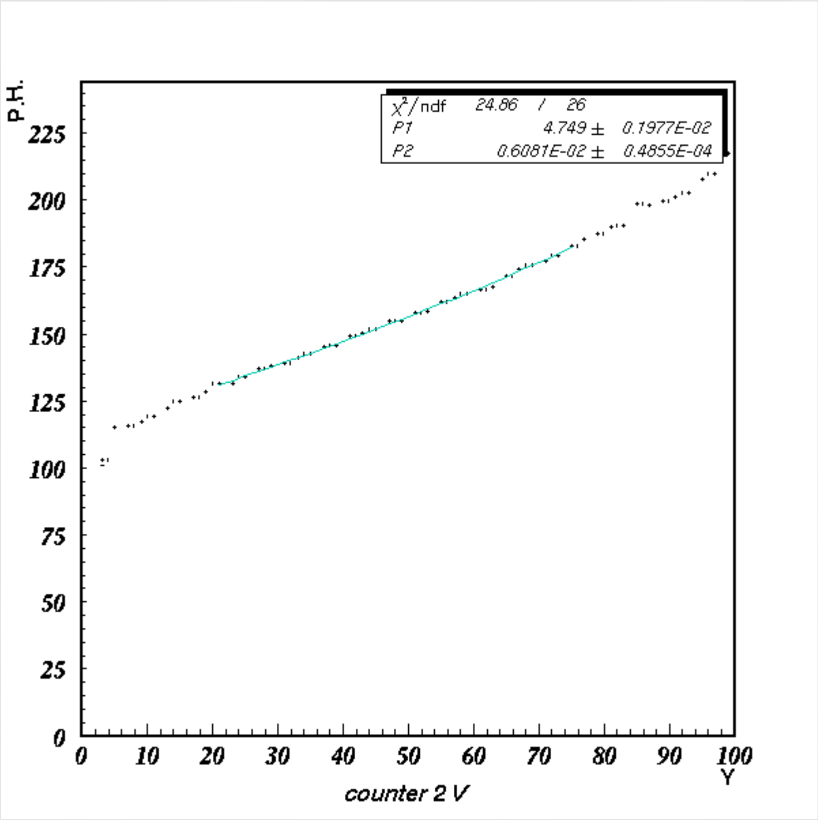
Spare


QUADRANT 1
QUADRANT 2
BEAM PIPE
HOLE
QUADRANT 4
QUADRANT 3
FIRST PLANE
(HORIZONTAL)
SECOND PLANE
(VERTICAL)

Spare



P.H.
χ^2/ndf 79.51 / 29
P1 2.761 ± 0.2296E-01
P2 0.2247E-01 ± 0.3867E-03
0 25 50 75 100 125 150 175 200
0 10 20 30 40 50 60 70 80 90 100
X
counter 37 H



P.H.
χ^2/ndf 24.86 / 26
P1 4.749 ± 0.1977E-02
P2 0.6081E-02 ± 0.4855E-04
0 25 50 75 100 125 150 175 200 225
0 10 20 30 40 50 60 70 80 90 100
Y
counter 2 V