"CHOD in L0 trigger"

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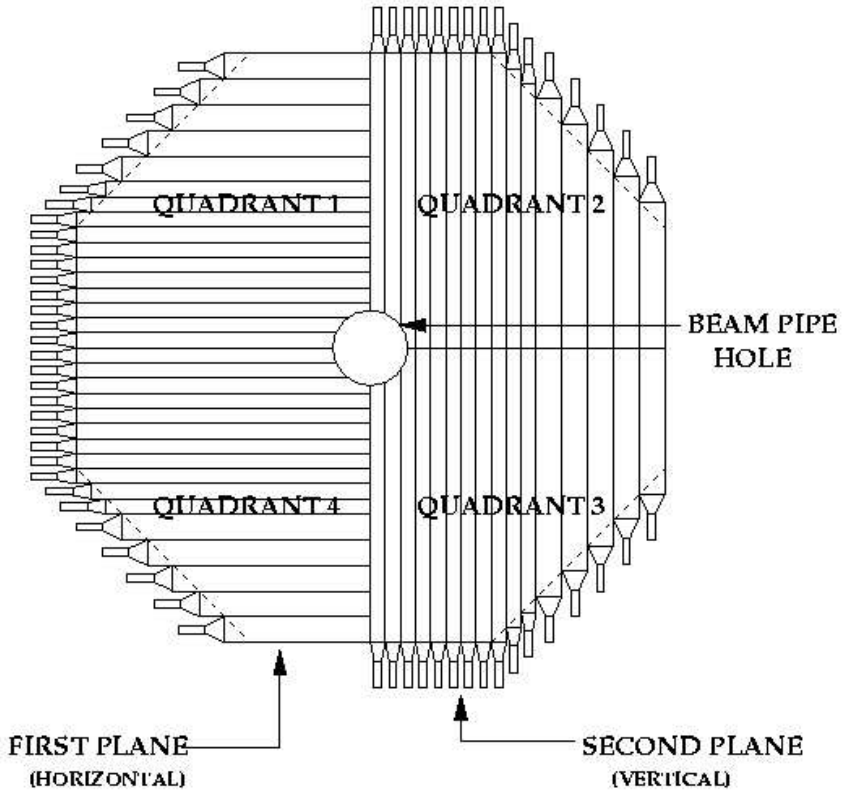
Introduction

- The old NA48 CHOD has been proposed as NA62 hodoscope to detect interactions in RICH mirrors and to partecipate to L0 trigger
- As positive time reference in the trigger, alternatively to the RICH, the time resolution has to be good enough: better than 1 ns!
- Usually the good time resolution (200 ps) in the CHOD is obtained by applying offline slewing and light propagation corrections, assuming the impact point of charged tracks extrapolated from DCH4
- we could do something to obtain a good time resolution without DCH information, in order to use the CHOD "online" ?

NA48 CHOD

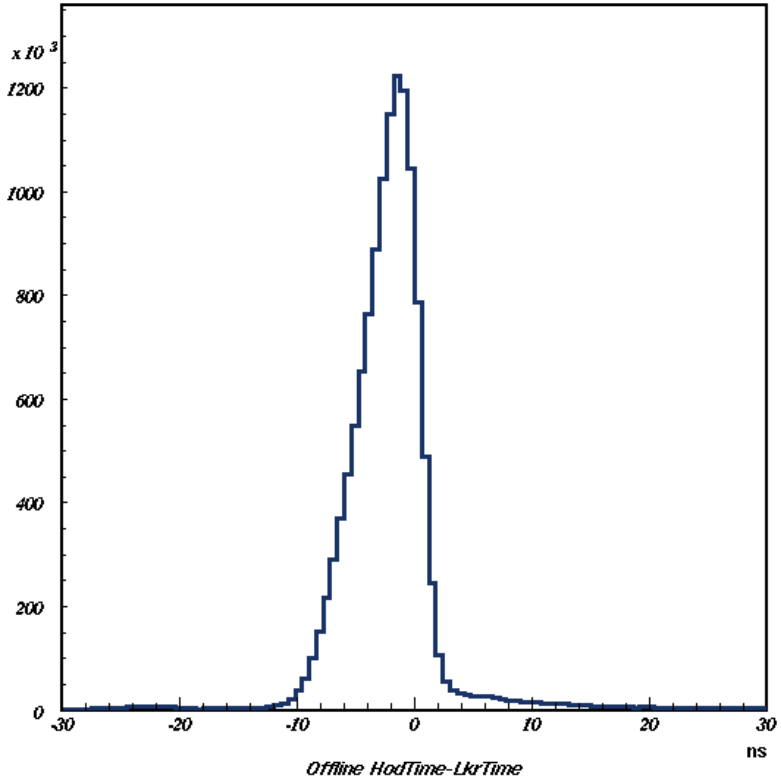


- The CHOD is composed by 128 scintillator's slabs, subdivided in 2 planes, with slabs oriented orthogonally (H and V)
- Each slab is 2 cm thick, 6.5 to 9.9 cm wide and 60 to 121 cm long

- Each scintillator is readable from one side only
- In the NA48 era the signals were sent to PMBs for measuring time and pulse height

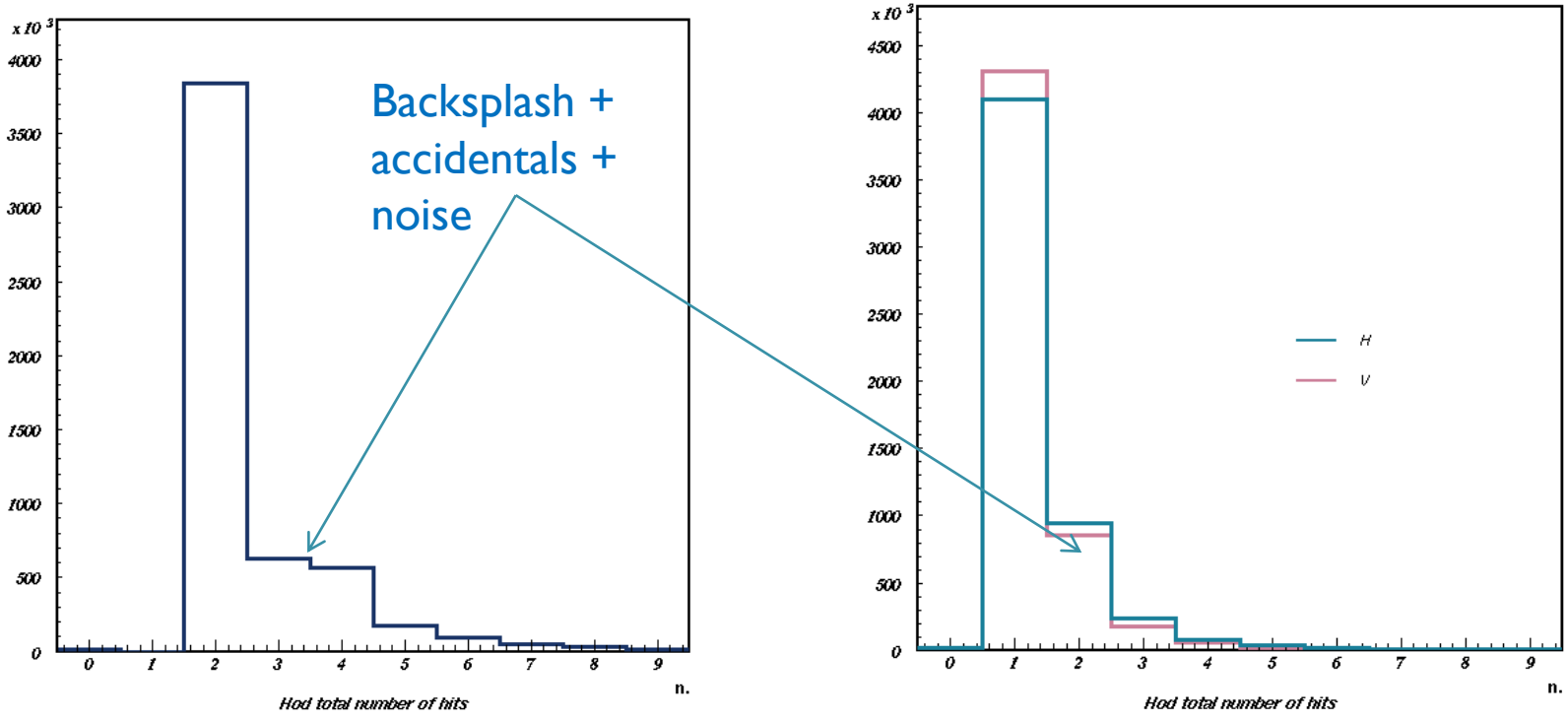
CHOD online time resolution

- 1700 burst in P5 (2007)
- Events with only 1 Track and only 1 Cluster
- Special structure (HODNEUT) in Compact: information from all CHOD hits (not only with associated tracks)



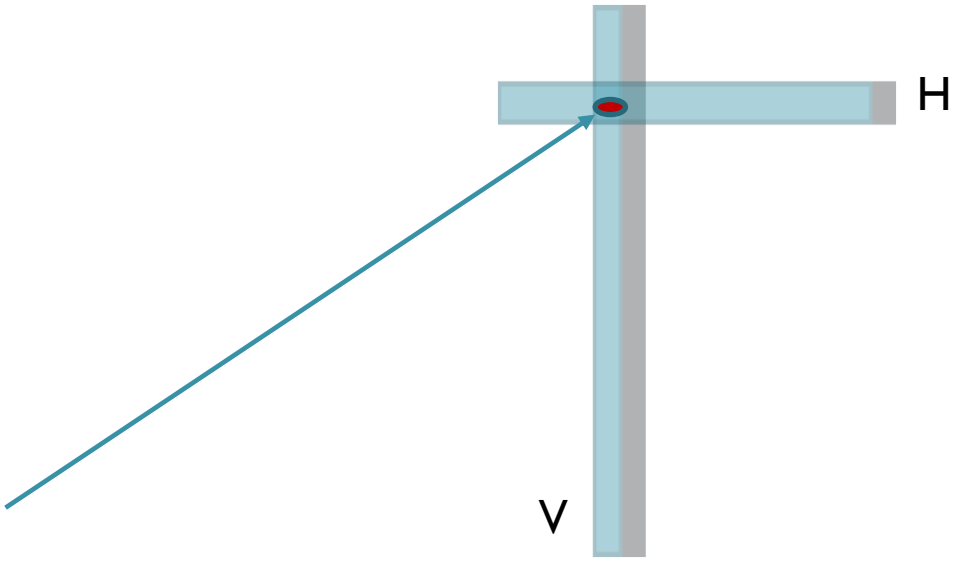
- Time difference between any CHOD hit and LKr cluster (both planes): wide not gaussian distribution!

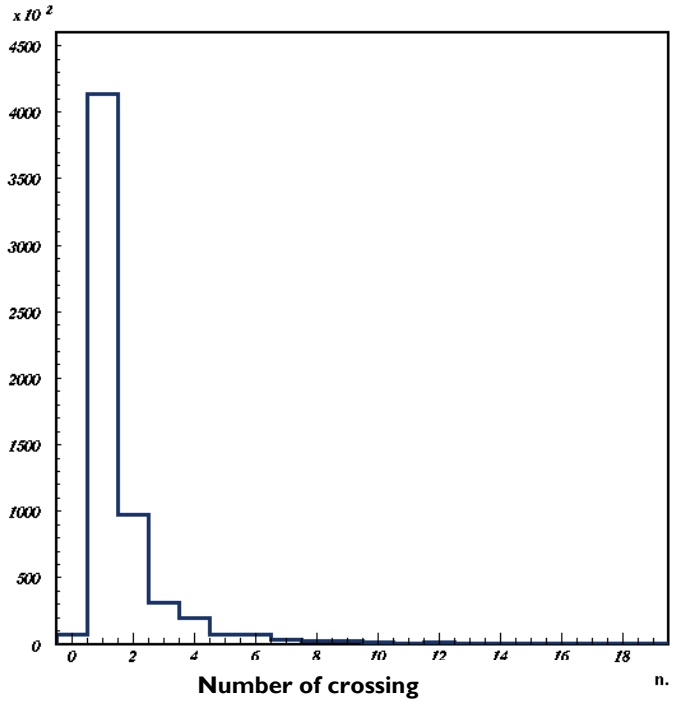
Hits on the CHOD



- About 20% of events have more than the correct number of hits

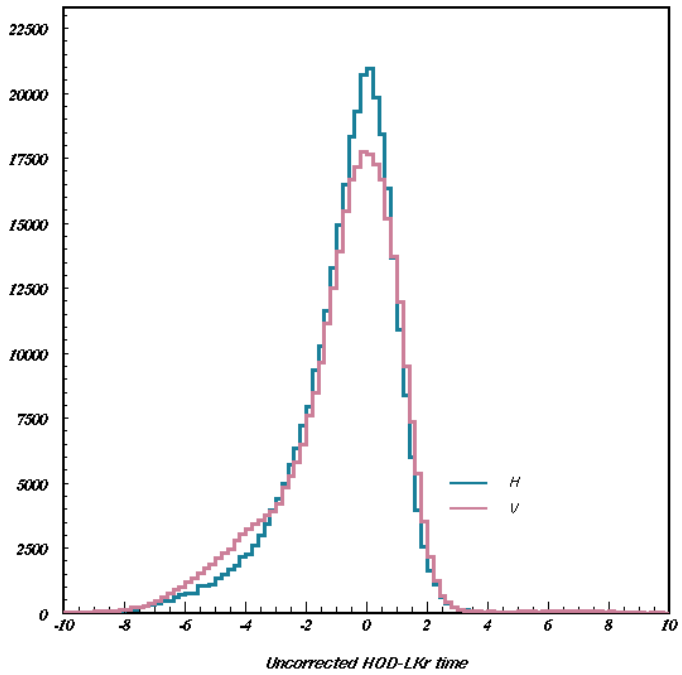
Correction without spectrometer

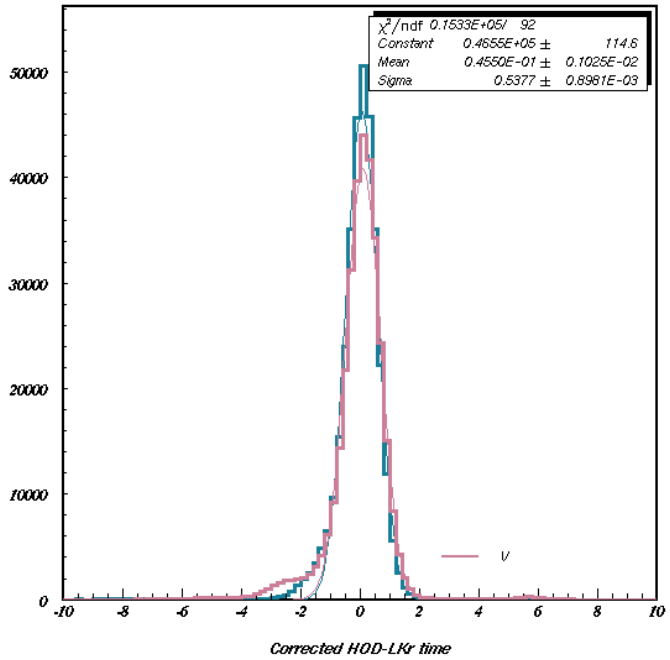




- Define the crossing point as the center of the square (or rectangle) obtained from the superposition of two slabs in opposite quadrants
- ~30% of 1 track events have more than 1 crossing point
- Use this point, instead of the extrapolated DCH point, to correct for slewing and propagation
- **Chodcorr2000** routine used: routine developed in 2000 to correct the CHOD time to reject charged events in neutral analysis without drift chambers

Correction without spectrometer

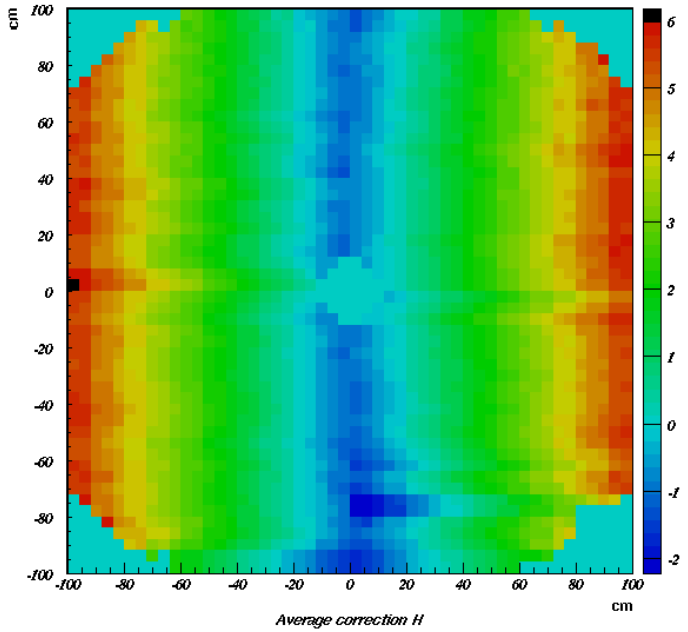


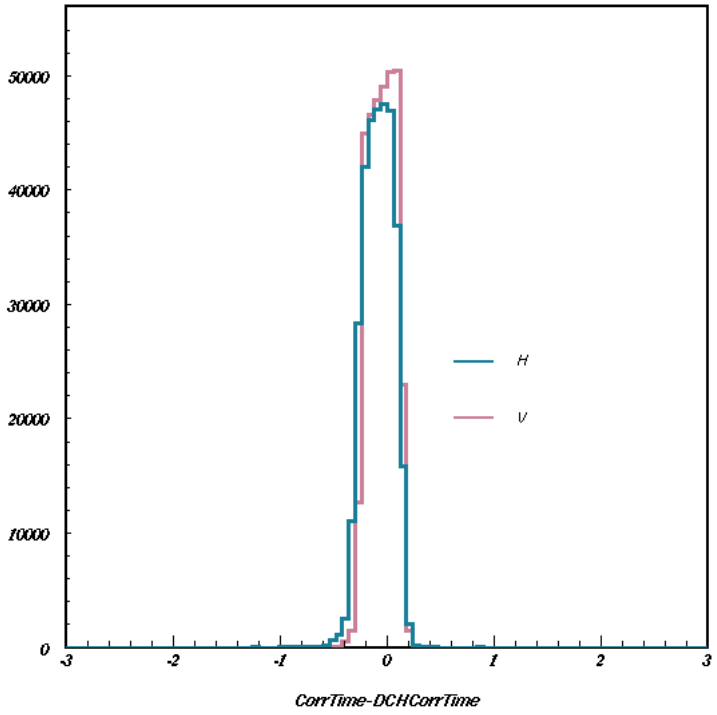


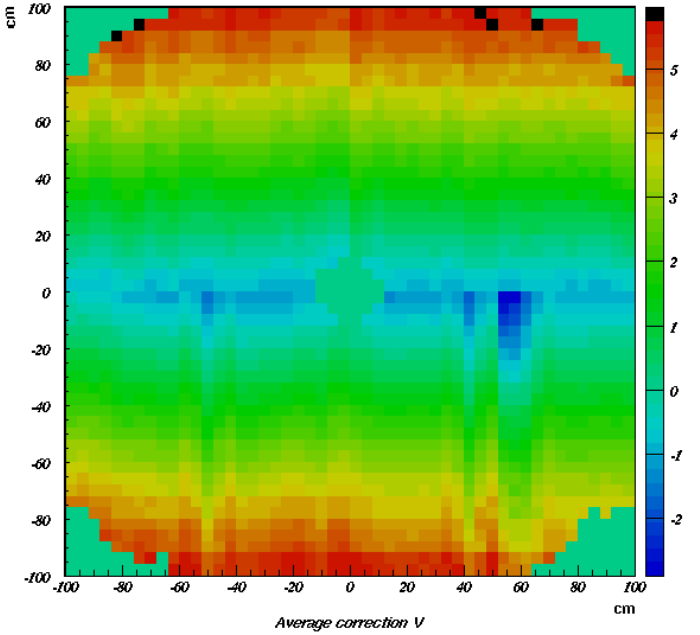
- **CHOD-LKr time**: the time resolution changes applying the correction with the crossing point from **3-4 ns** to **540 ps** (1 trk, 1 cluster, 1 electron, 2 chod, 2 chod_neut)

Checks

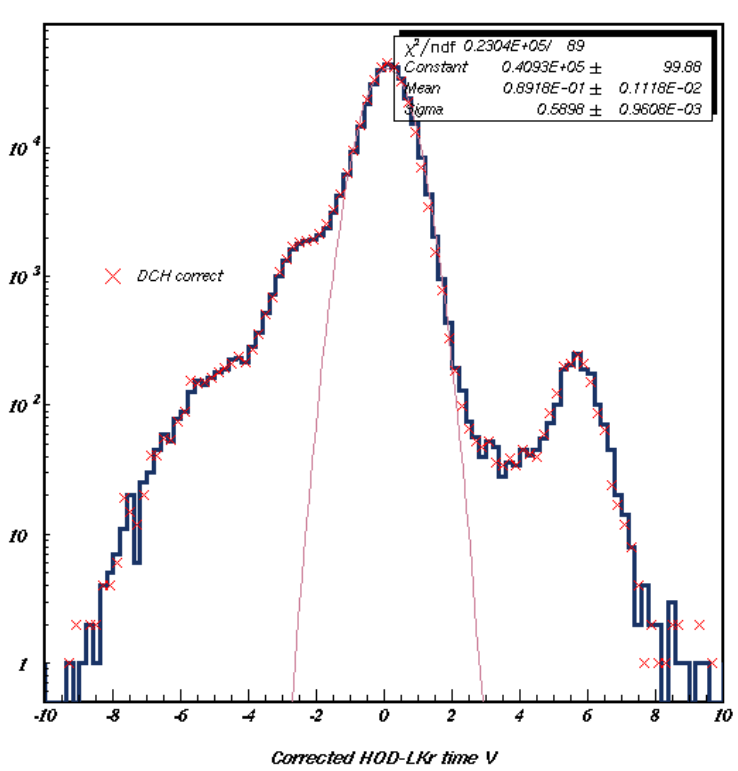
- Average correction as a function of the CHOD hit position
- Difference with the standard DCH procedure: ±200 ps

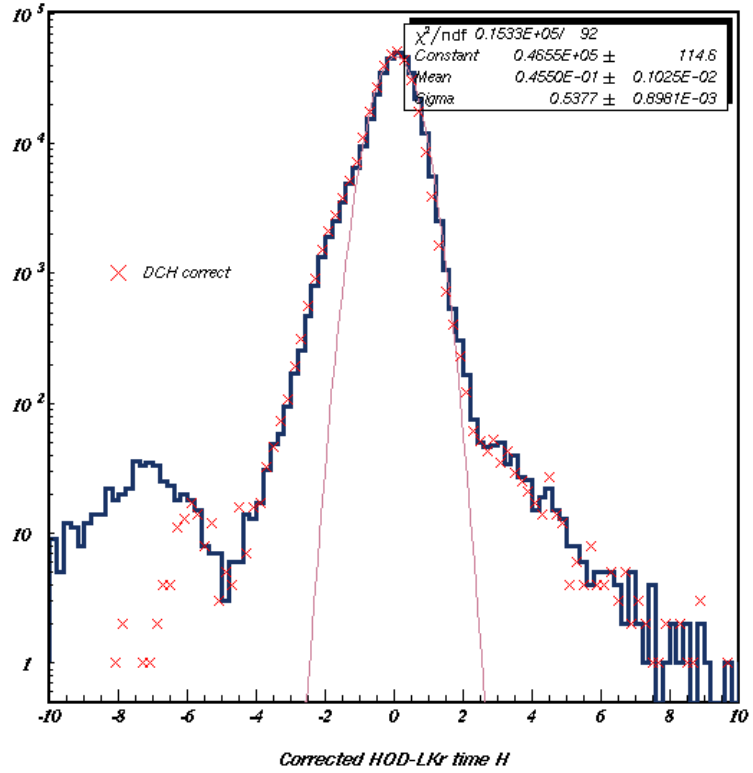






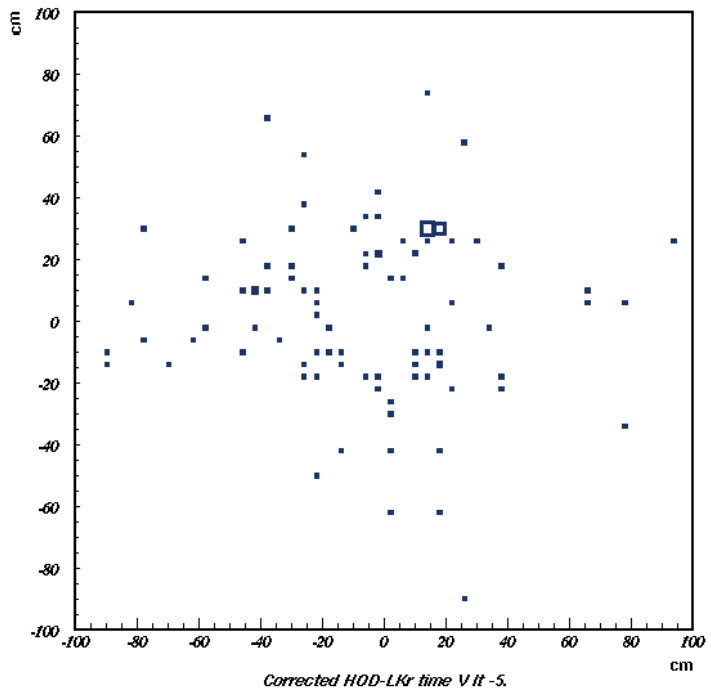
DCH corrected vs Self corrected

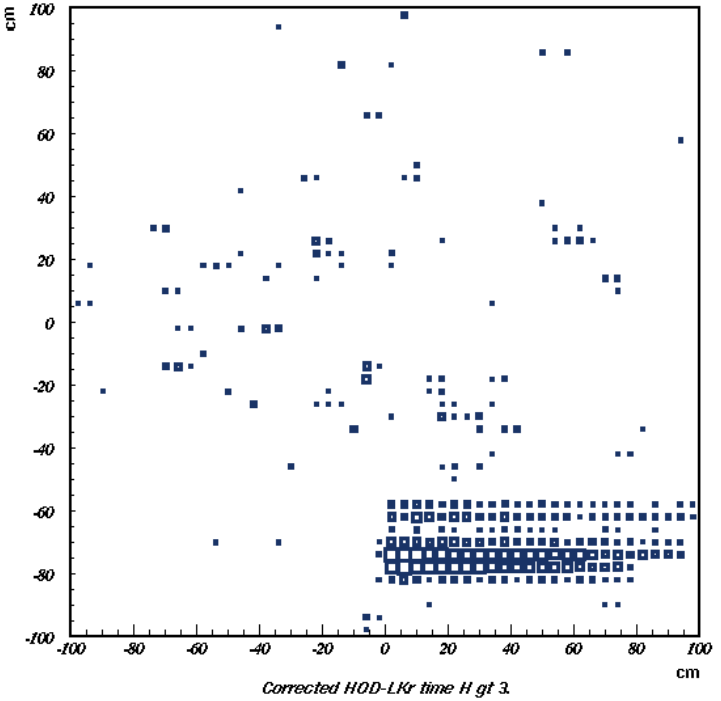




- In events with 1 Track, 1 Cluster, 2 CHOD hits, 2 CHODneut hits the shape of the corrected time with DCH is very well reproduced

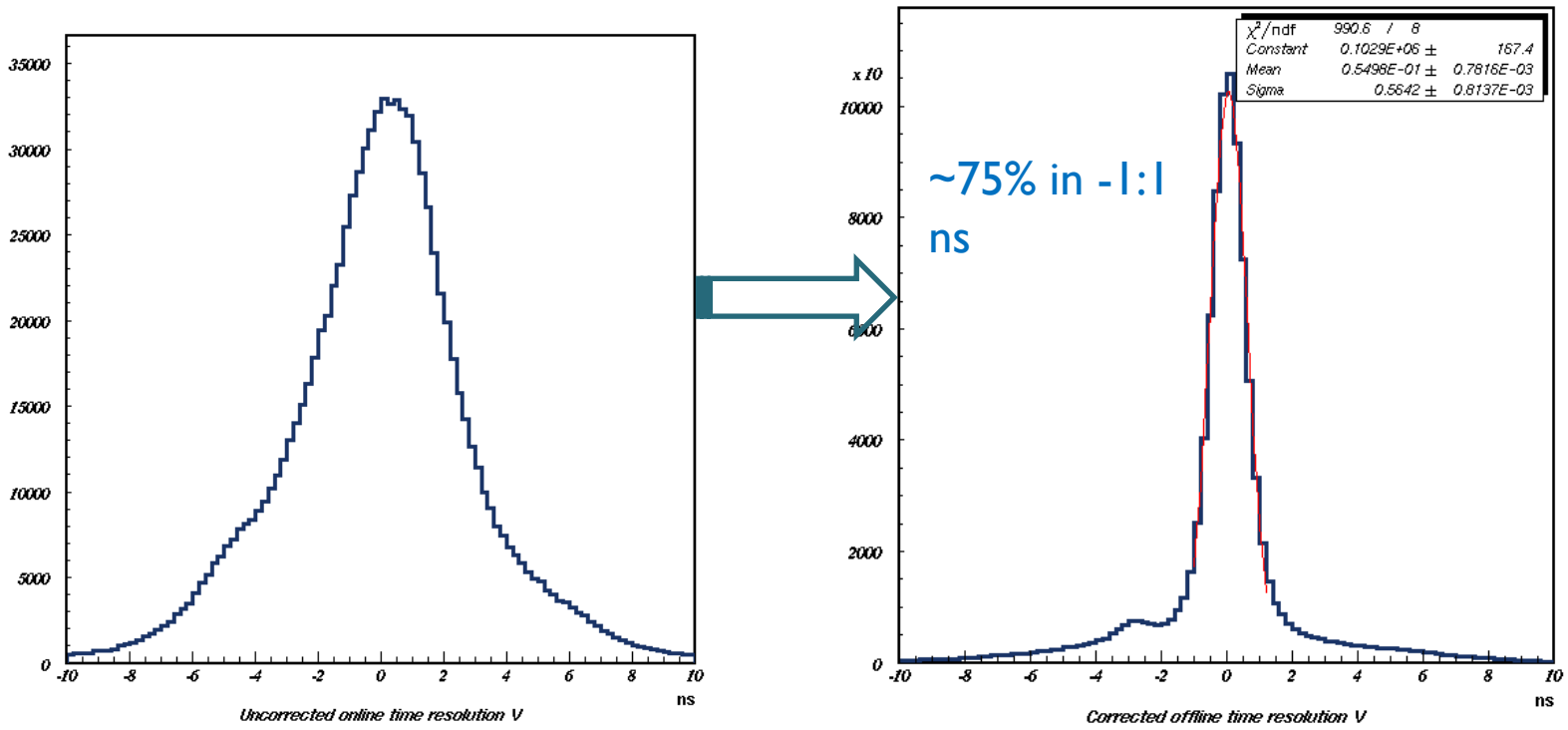
CHOD noise





- The "bumps" in the previous plots are localized in particular regions of the CHOD

Online resolution



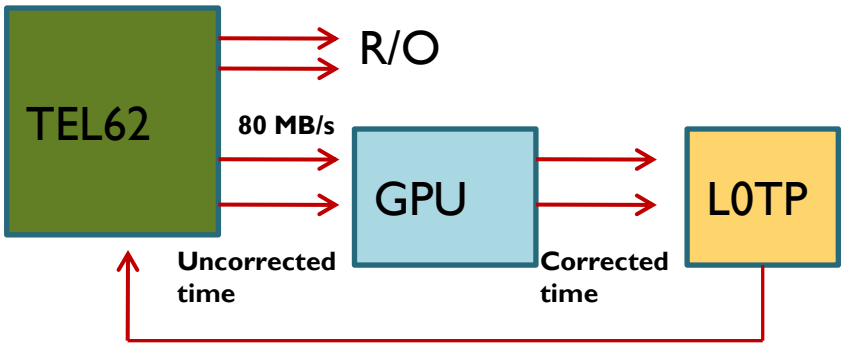
- The sigma for the CHOD-LKr time for all the events (1 trk with any number of Chod_neut hits) is ~550 ps
- It's very similar to the standard offline procedure: 200 ps resolution for CHOD time.

Possible TDCB-TEL62 implementation

- The CHOD will be read with 1 or 2 TDCB (128 channels)
- The time correction could be applied in the TEL62 FPGAs
- At the moment we need 896 numbers for the correction (1.8 kB of memory in the Stratix III isn't an issue)
- If we want to apply the online slewing correction we need a TOT technique to estimate the pulse height: the number of constants should change a little depending on the number of points used in the parametrization (the slewing is the less relevant part in the procedure…)
- Assuming no noise, a rate of 10 MHz is expected on the CHOD. This means that a firmware assuring a computing capability of 100 ns per event, has to be designed and a bandwidth of 80 MB/s should be reserved for trigger primitives (a factor 10 less for the readout of uncorrected data)
- In the synchronization run the CHOD will be the only positive L0 trigger detector: a good time resolution is required to test the entire system and the MUV3 in particular
- In the "real run" the CHOD, with good time resolution, could be employed as alternative trigger to check the RICH primitives generation efficiency.

Another possibility…

- Another possibility is to perform the corrections in the GPUs
- The TEL62 firmware would be very simple: just send out everything!



- A prototype could be tested in the synchronization run
- This should be very useful to continue the development on the GPU trigger

Conclusions

- The use of CHOD with good time resolution seams to be feasible, using online correction based on the intersection point between two slabs in opposite quadrants
- The efficiency is not 100%: further studies to quantify the losses!
- Time over Threshold could be used to measure the pulse height: the feasibility of this technique on the CHOD must be proven
- The online correction would be applied in the TEL62: some effort is required in designing the firmware!
- The GPUs approach offer a possibility to avoid too complicate firmware and to test a proto-GPU trigger system in the synchronization run!