Coincidence time optimization

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- Optimization goal

- Optimization steps

- Results for all kinematics

- List of encountered problems

Time optimization goal

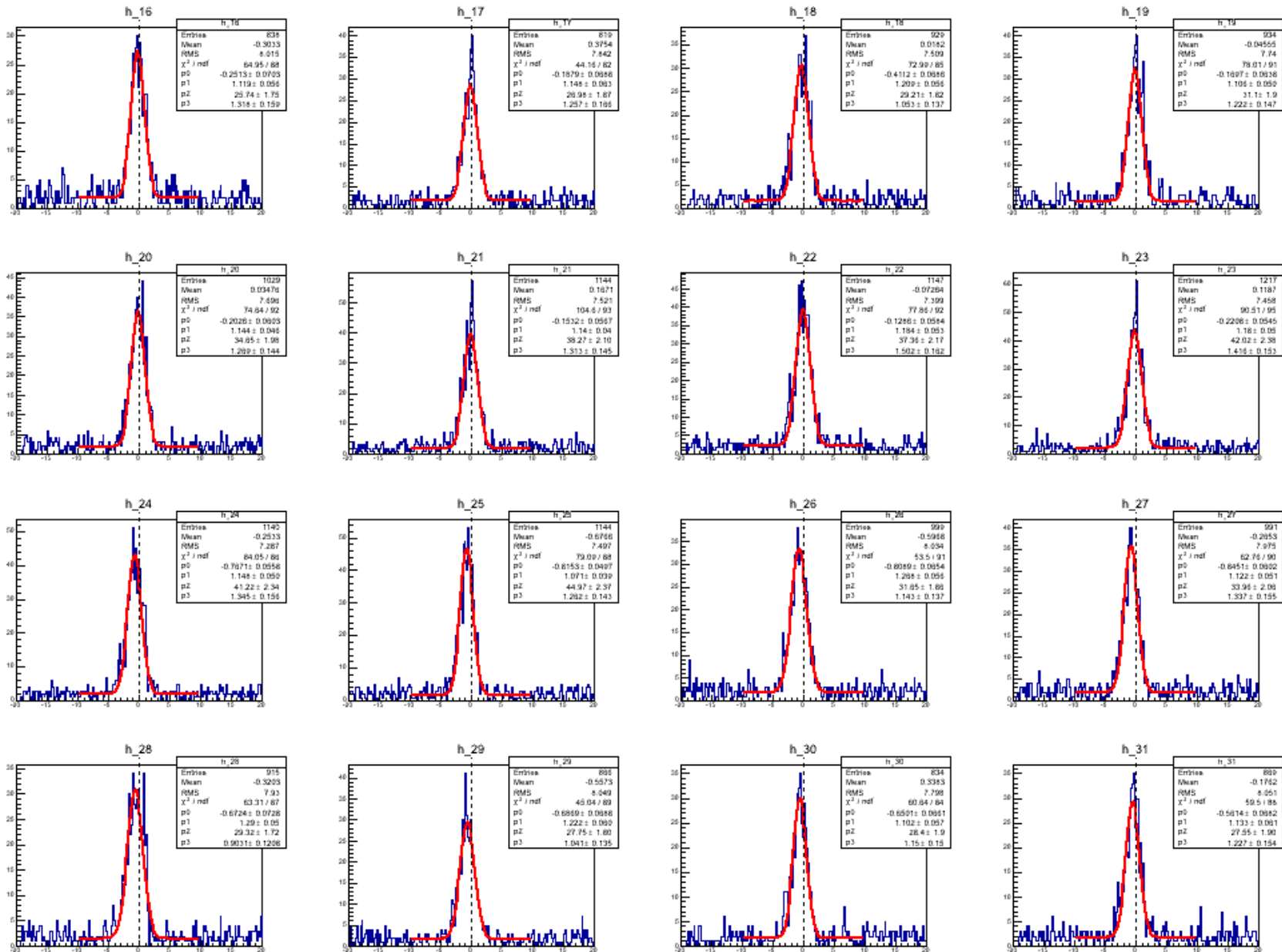Improve the coincidence time resolution allows :

- a reduction of the accidental events

- a better selection of blocks belonging to a given cluster which leads to :

  - a better energy resolution

  - a better reconstruction of the cluster position

➤ a better selection of DVCS events (especially n-DVCS events).
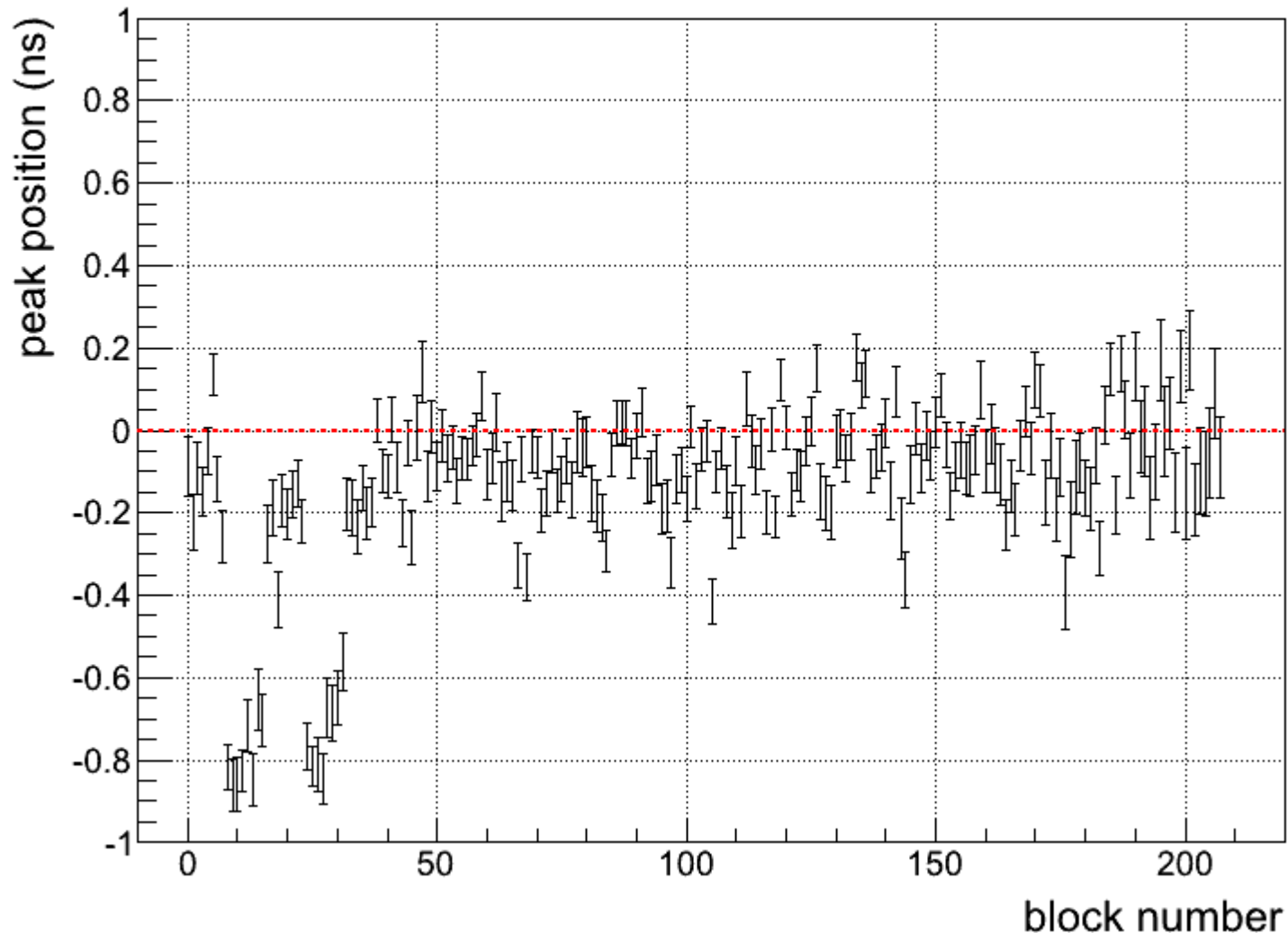
Optimization steps : initial spectrum
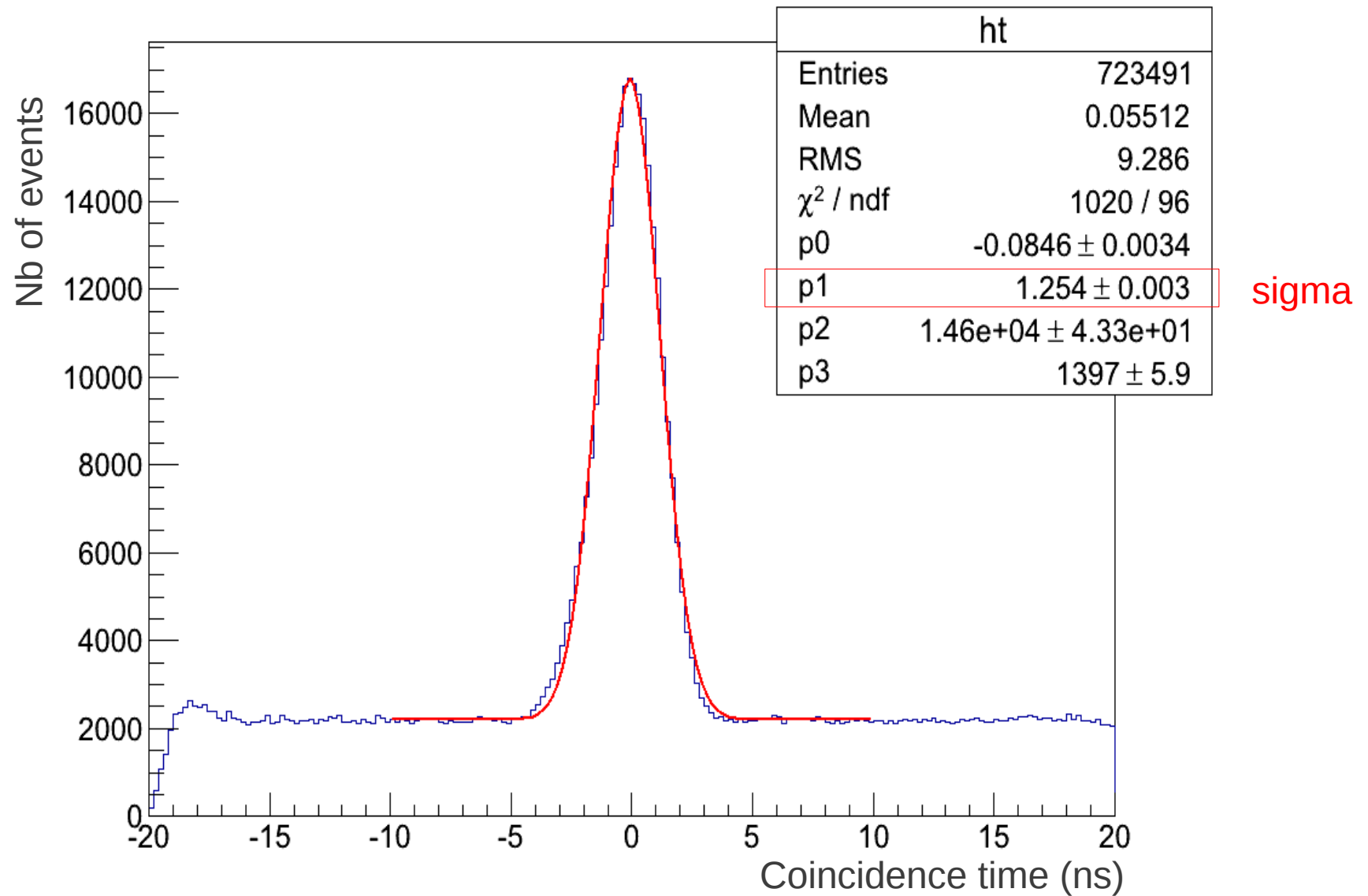
Initial coincidence time spectrum (run #9243) without any correction.

1ˢᵗ correction : shift of the blocks
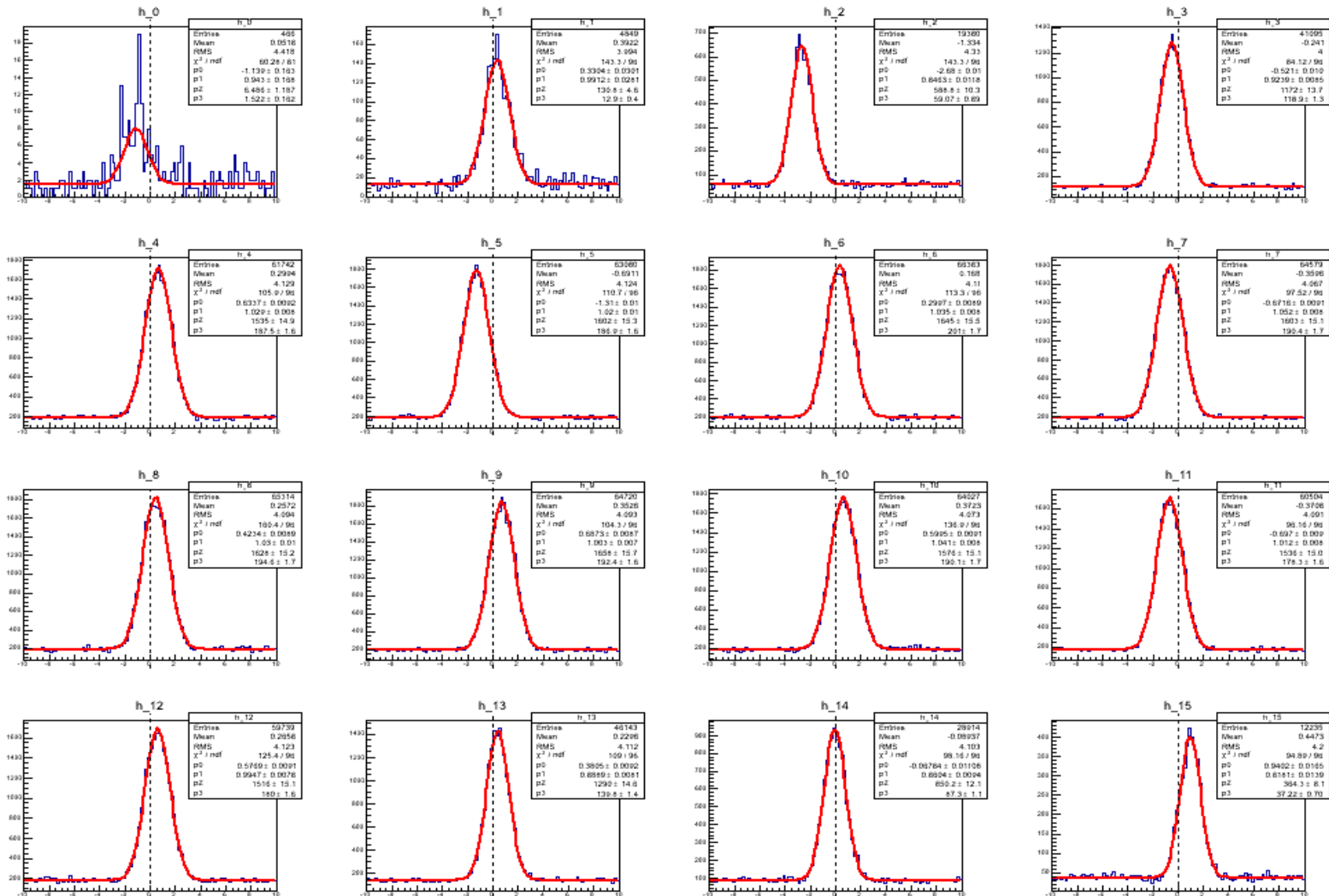
1ˢᵗ correction : shift of the blocks

The 1ˢᵗ correction : put the coincidence peak at zero for each block.

After this correction, the coincidence time resolution = **1.24 ns** (1.26 ns initially)
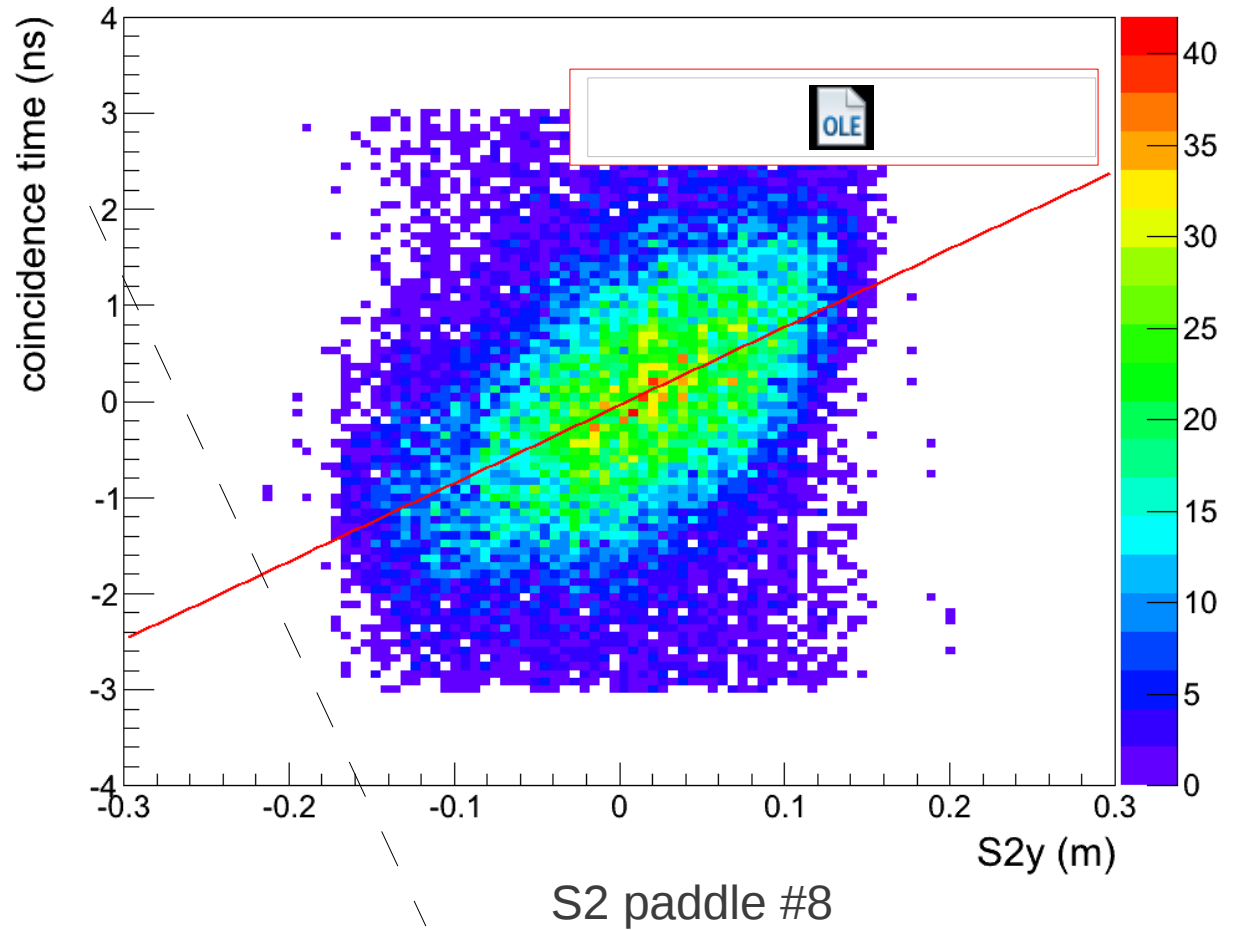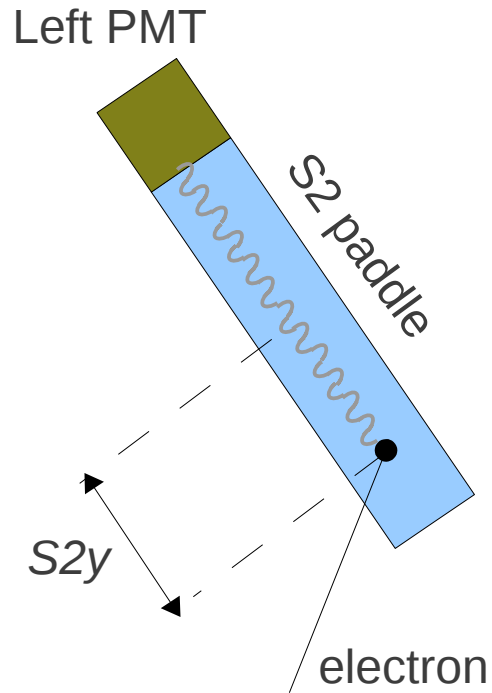
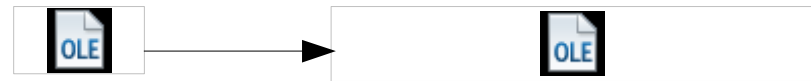# 2nd correction : shift of the S2 paddles

The 2nd correction : put the coincidence peak at zero for each S2 paddle.

After this correction, the coincidence time resolution = **0.99 ns** (1.24 ns before)

3rd correction : impact point in S2

Left PMT

S2 paddle

S2y

electron

coincidence time (ns)

S2y (m)

S2 paddle #8

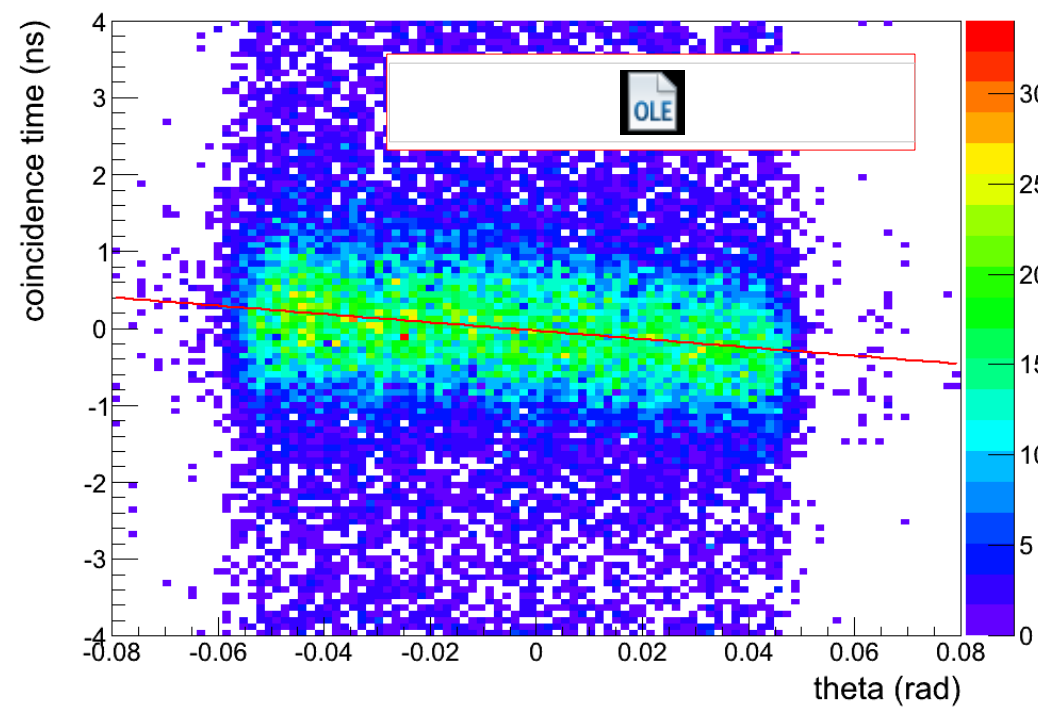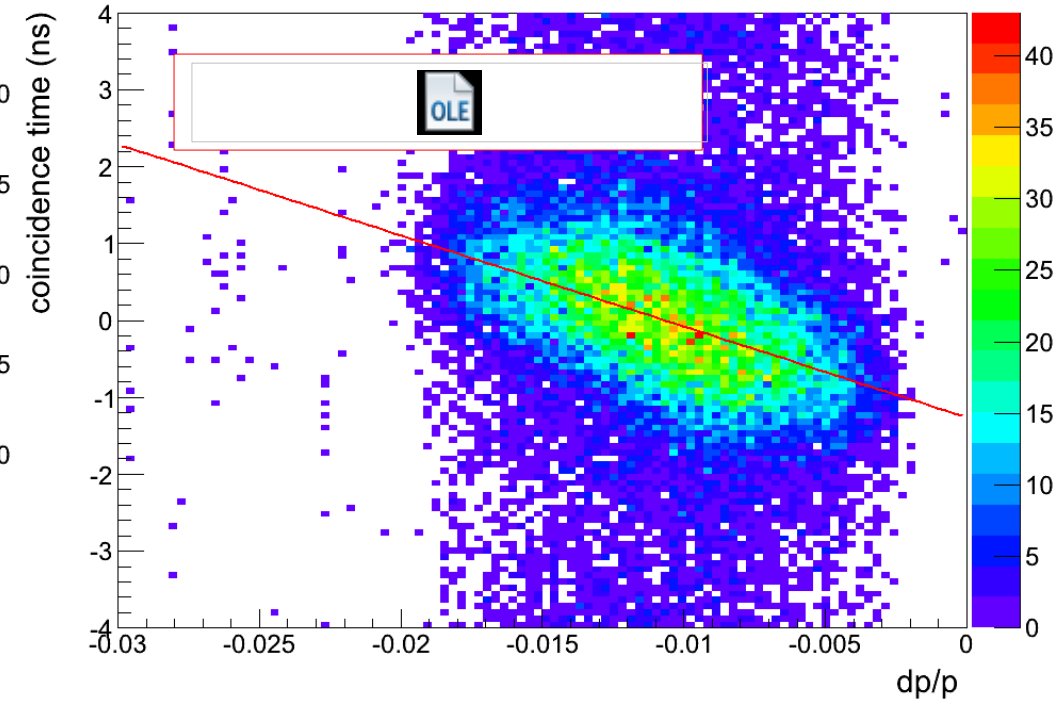The 3rd correction : for each S2 paddle i,

After this correction, the coincidence time resolution = **0.82 ns** (0.99 ns before)
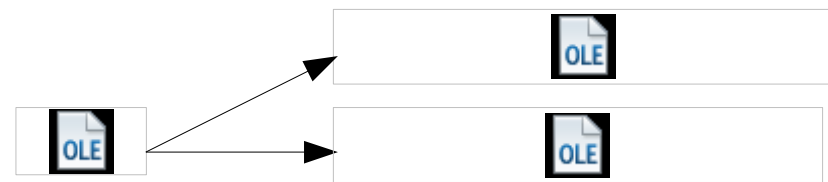
4ᵗʰ correction : electron trajectory length

S2 paddle #8

S2 paddle #8

The 4ᵗʰ correction : for each S2 paddle *i*,

After this correction, the coincidence time resolution = **0.68 ns** (0.82 ns before)

Eventual Corrections

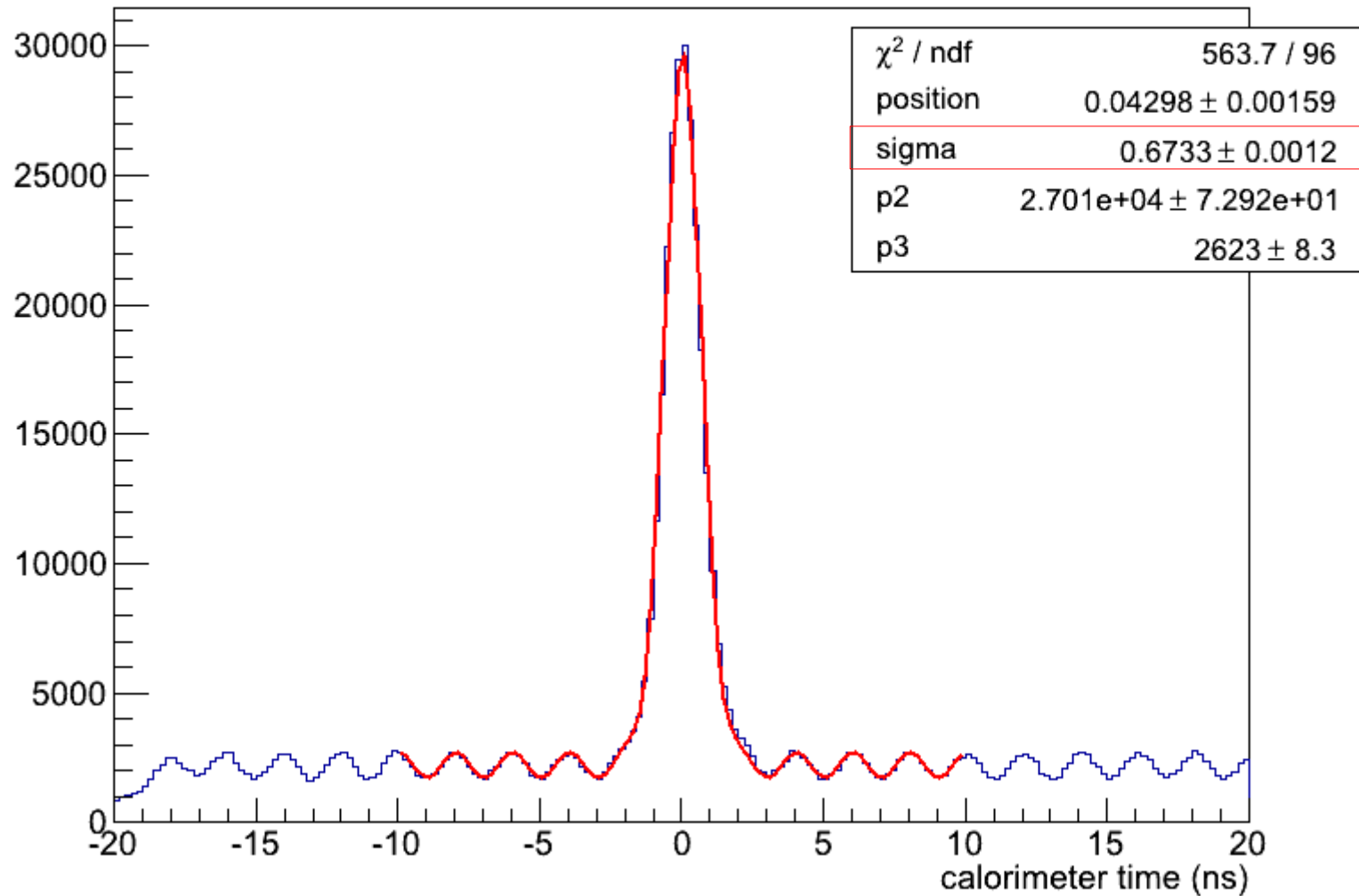- Correction as a function of ARS stop TDC (dt6 variable).

- Correction as a function of S2 TDC (L.s2.lt variable).

- Look to many other HRS and calorimeter variables but no significant correlation was seen.

- after all these corrections, a final check of the shift of the blocks (1st correction) is performed.

All these corrections will not improve the time resolution by more than 1%

Final coincidence time spectrum

ene > 0.1 GeV

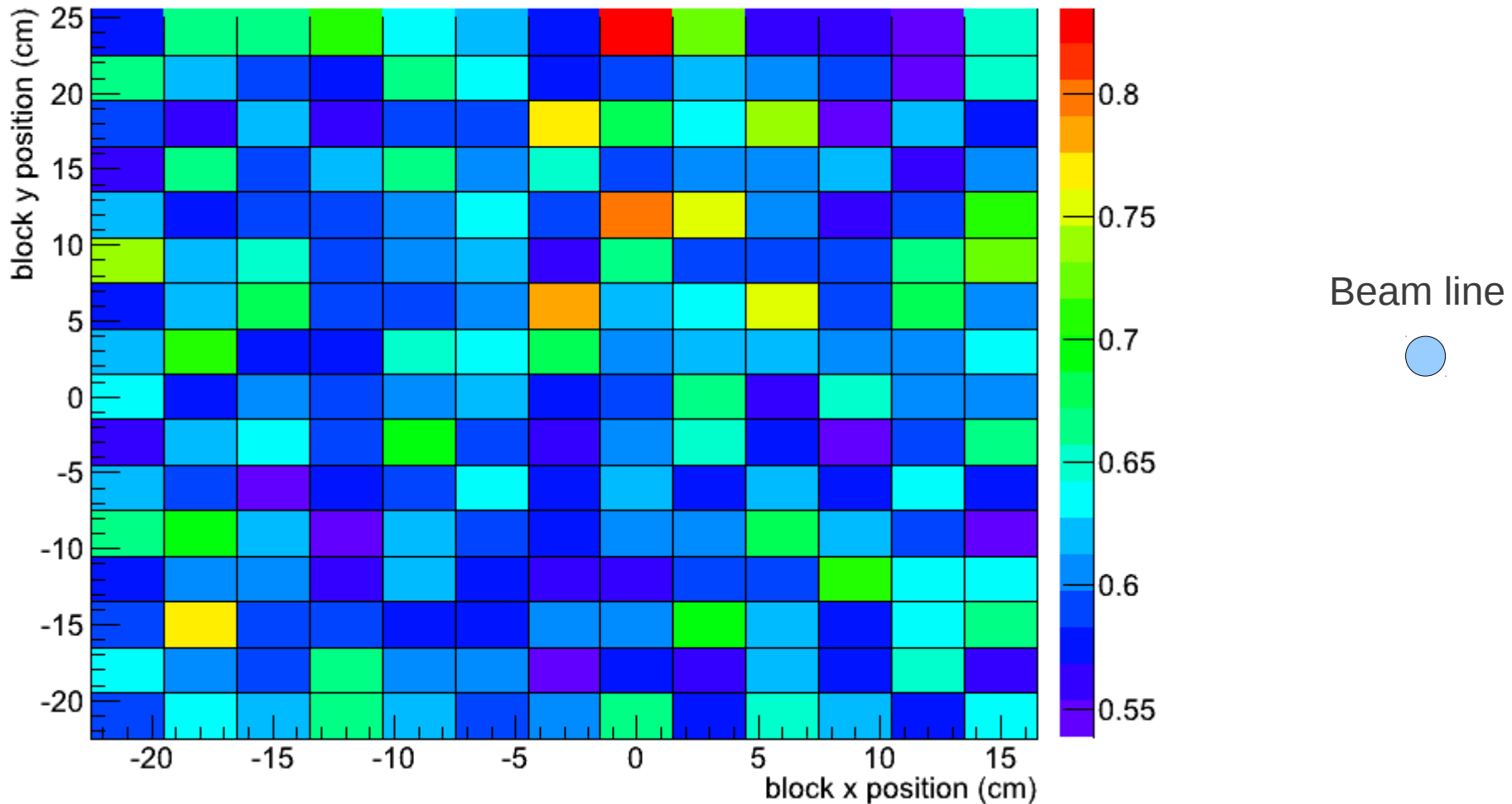| χ^2 / ndf	563.7 / 96
position	0.04298 ± 0.00159
sigma	0.6733 ± 0.0012
p2	$2.701e+04 \pm 7.292e+01$
p3	2623 ± 8.3

calorimeter time (ns)

- time resolution for pulses **> 0.1 GeV** = **0.67 ns**
- time resolution for pulses **> 0.5 GeV** = **0.59 ns**
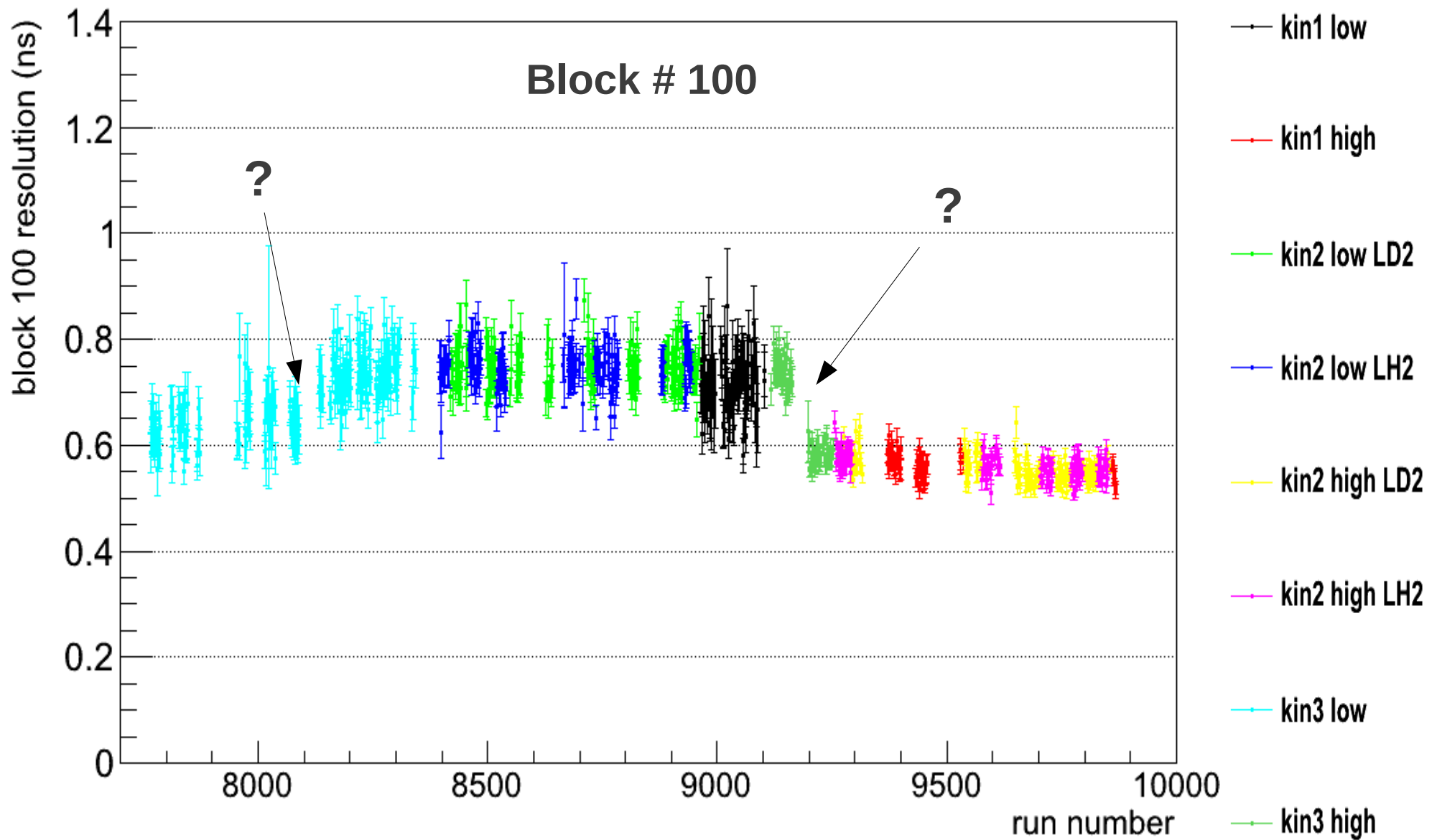- time resolution for pulses **> 1.0 GeV** = **0.57 ns**

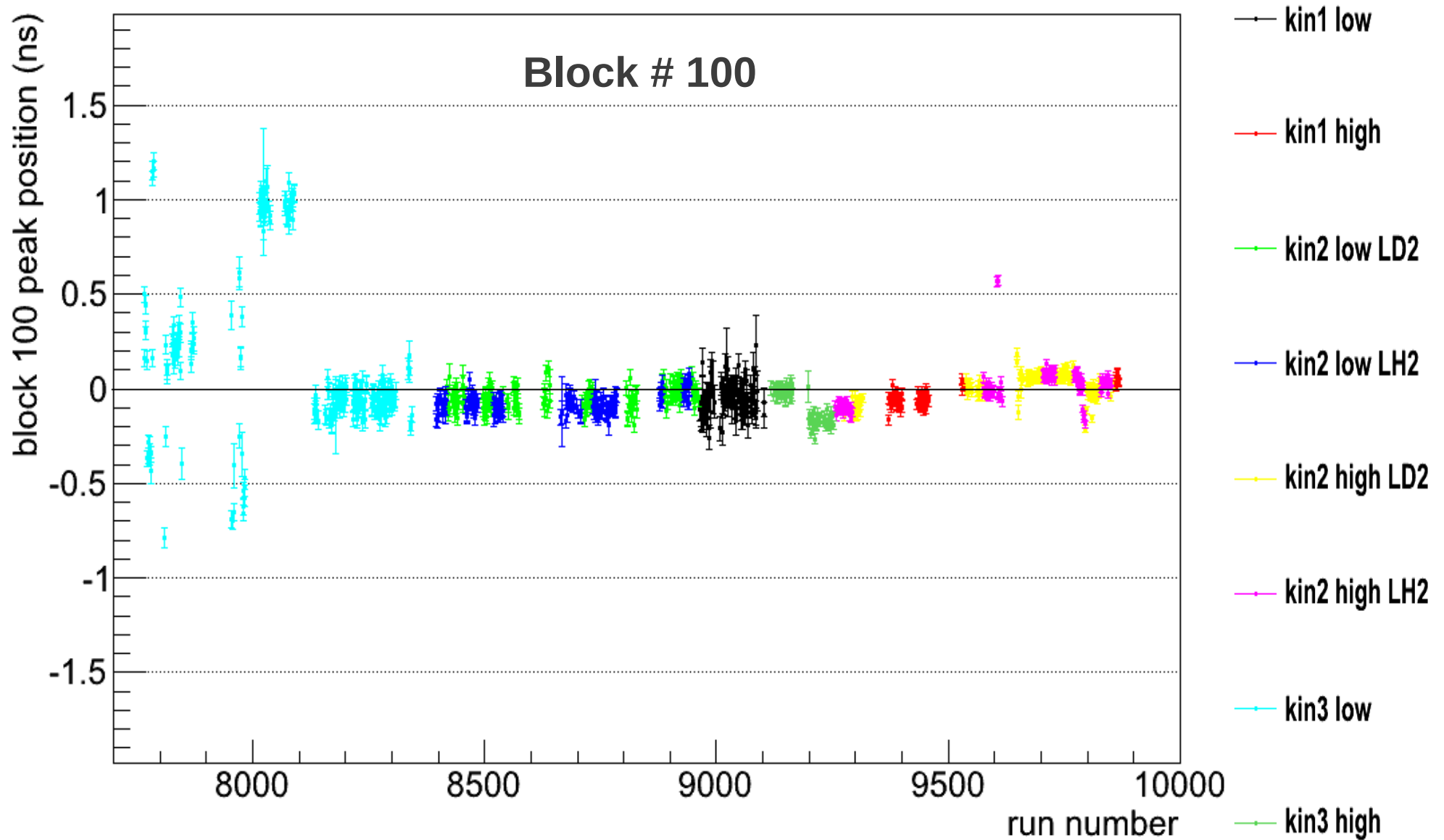run #9243 (kin3 high)

Time resolution for each block

- No clear correlation with the distance of the block to the beam line.

- The resolution seems to be correlated with the initial block quality (transparency loss measurements).

Results for all runs

Block # 100

Complete results (208 blocks) are in :
https://userweb.jlab.org/~mazouz/timing/showsig.ps.gz

Results for all runs

Block # 100

Complete results (208 blocks) are in :
https://userweb.jlab.org/~mazouz/timing/showcorr.ps.gz

Results for all runs
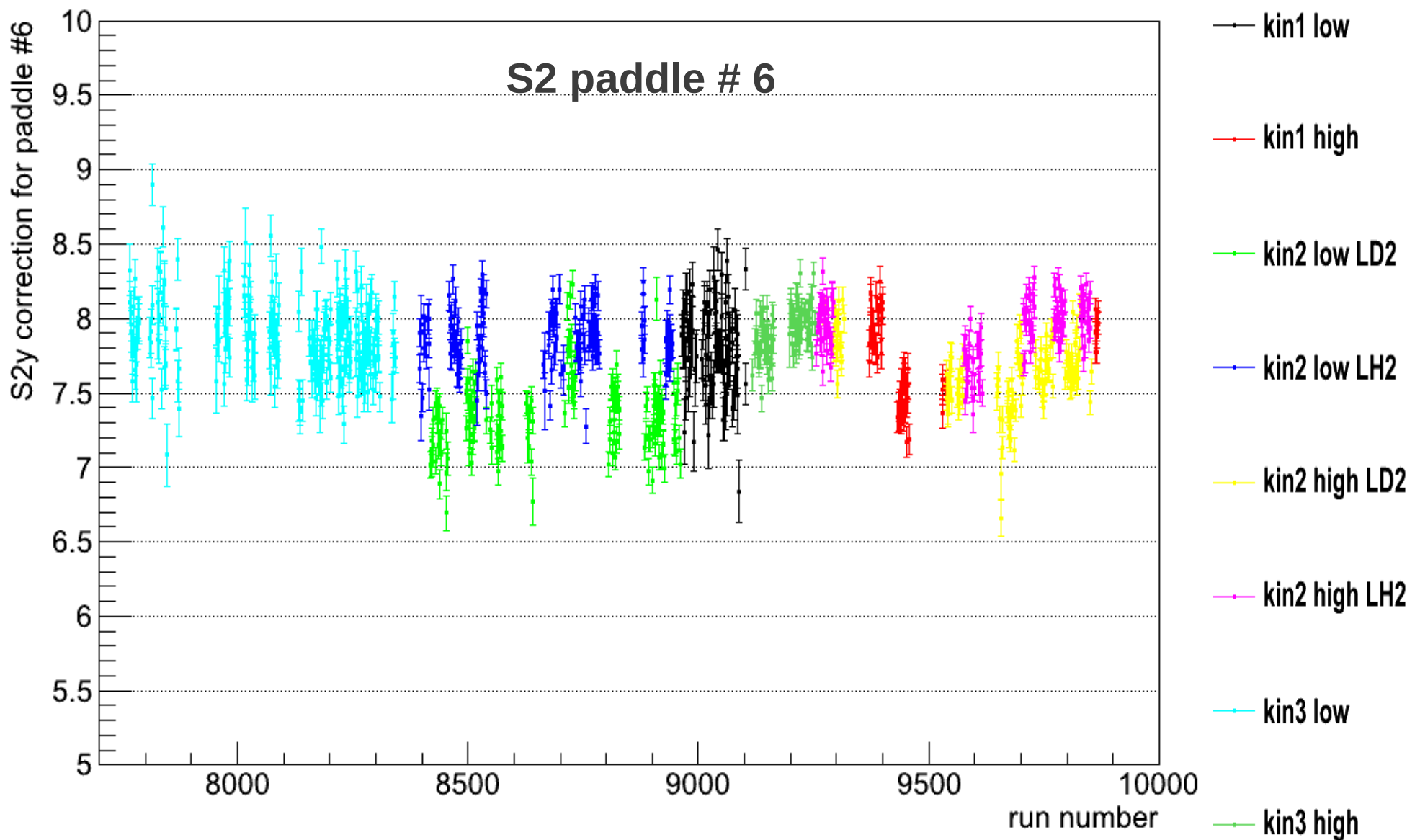
Complete results (all the corrections for the 16 S2 paddles) are in :
https://userweb.jlab.org/~mazouz/timing/showcorr.ps.gz

Run by run correction or average correction?
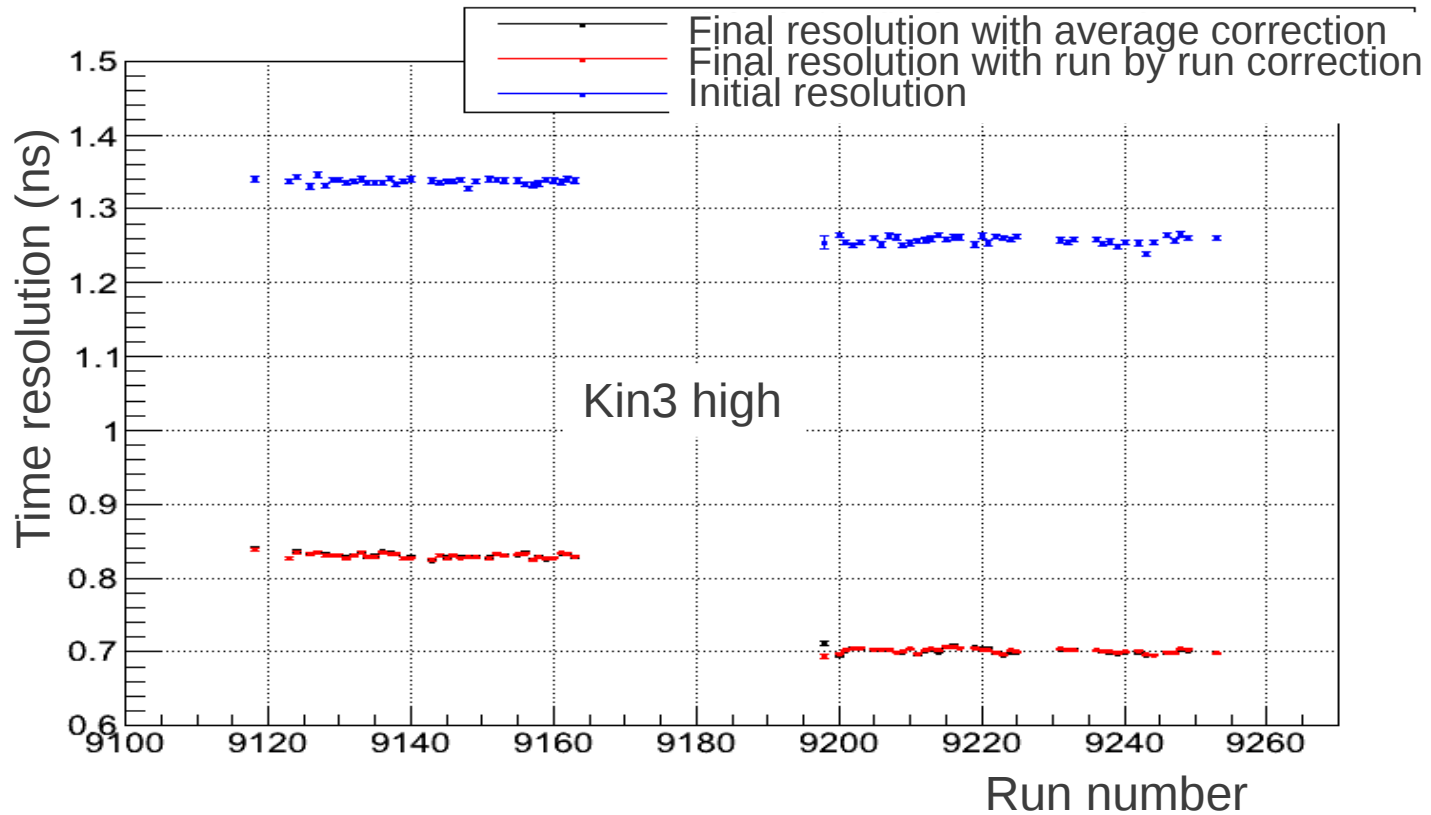
Taking the average correction values instead of run by run corrections will not improve significantly the final resolution.

Applying the average correction is not easy to do in practice because there were a lot of changes during the experiment.

Problems encountered during this analysis

All the analyzed runs are from Hisham run list:
See Elog entry : *https://hallaweb.jlab.org/dvcslog/DVCS2/**132***

- **run 8948** : very low statistics in block 201 relatively to its neighboring blocks
HV trip for this bloc. To be rejected from run list.

- **7765≤ runs ≤7786** (19 runs, 8% of kin3 low) : no signal in block 119
Bad cable between trigger and ARS for this block. To be rejected from run list ?

- **run 7809** : very high background in block 119
very high HV for this block. To be rejected from run list.

- **run 9745** : no coincidence peak in any block (only background).
Test run. To be rejected from run list.

- **run 7865** : very low statistics (~1000 events distributed to 208 blocks)
Junk run. To be rejected from run list.

- **run 7864** : no signal in block 84 and 192<=block<=207
LV cable disconnected. To be rejected from run list.