Results on

2003 Testbeam

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Overview

Study of trigger (BTI+TRACO) system response from the point of view of muon tracks detected in Drift Tubes Chamber (MB3)

- Chamber Performance

SL □ not affected by rotation (used as reference)

SL □1 & □2 behave similarly □ promediated for this presentation.

- Trigger response/efficiencies correlated with chamber info
  - Inclusive Muons
  - Dimuons
  - Ghosts triggers

Several incident beam angles analysed:

Negative: -30, -20, -10 degrees

Positive: 0, 5, 10, 15, 20, 25, 30, 35 degrees

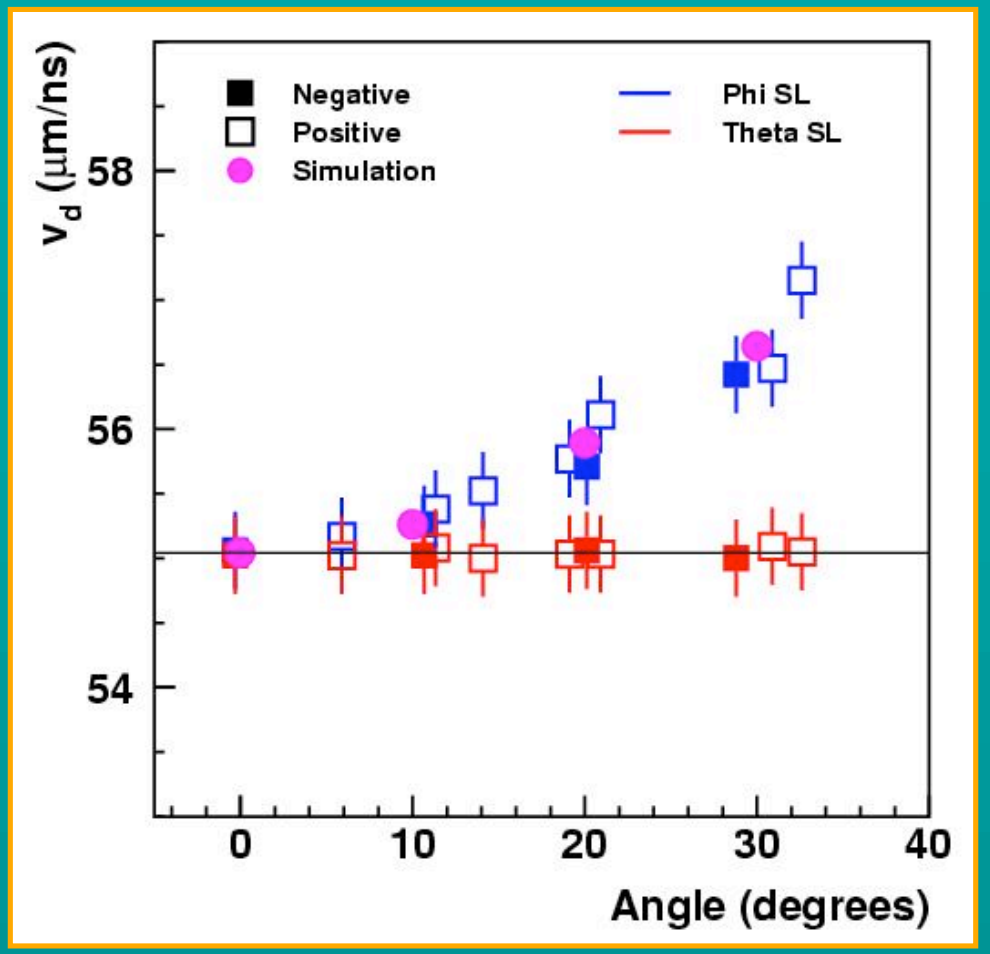
Trigger configuration:
STD-DEF

Drift Velocity

V_d (SL) = 55.0±0.3 m/ns at 0°

V_d (SL) increases with angle

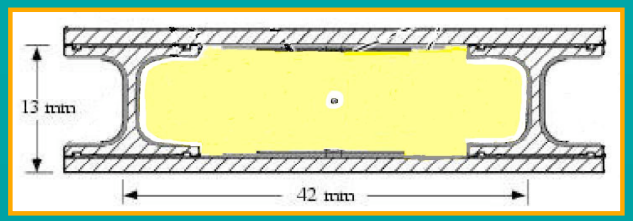
- No dependence on negative/positive angles
- Testbeam Simulation using MuBarDriftTimeParametrization.cc digitization package reproduces well data dependence with angle
- In the following, SL variables constant with angle



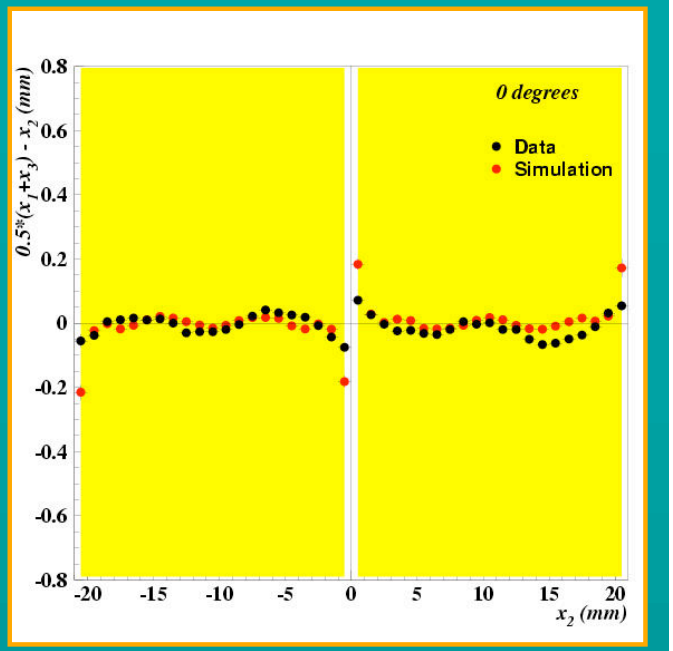
Computed in cell region where MeanTimers behave correctly (good pattern)

Check of testbeam simulation model

0 deg



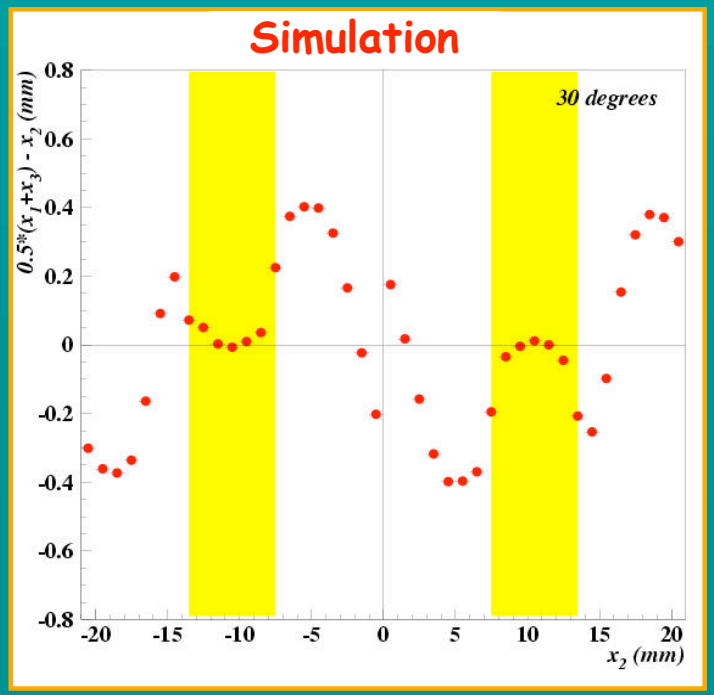
In a SL, the 4 layers
$G = (x_1+x_3)/2 - x_2$
G=0 is the calibration condition

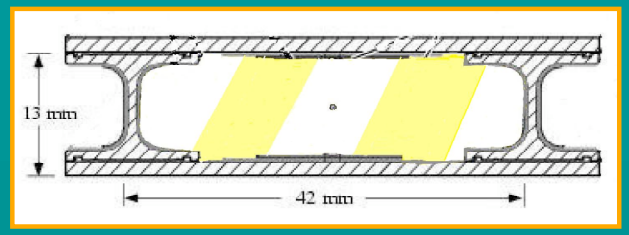


At 0°, G is below 50 μm in whole cell (except wire &Ibeams).
Simulation & data agree.

30 deg

What happens at a bigger angle?

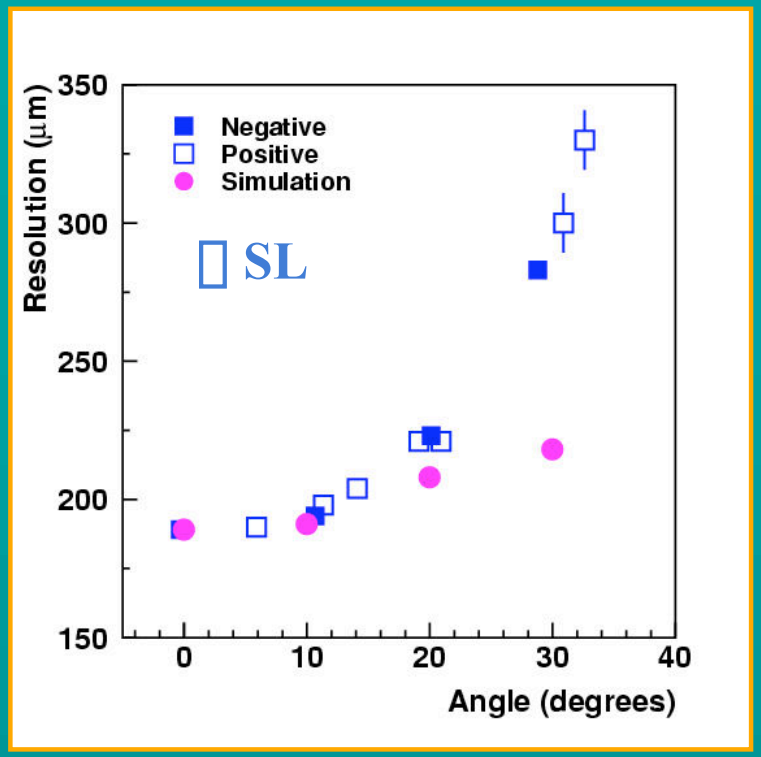


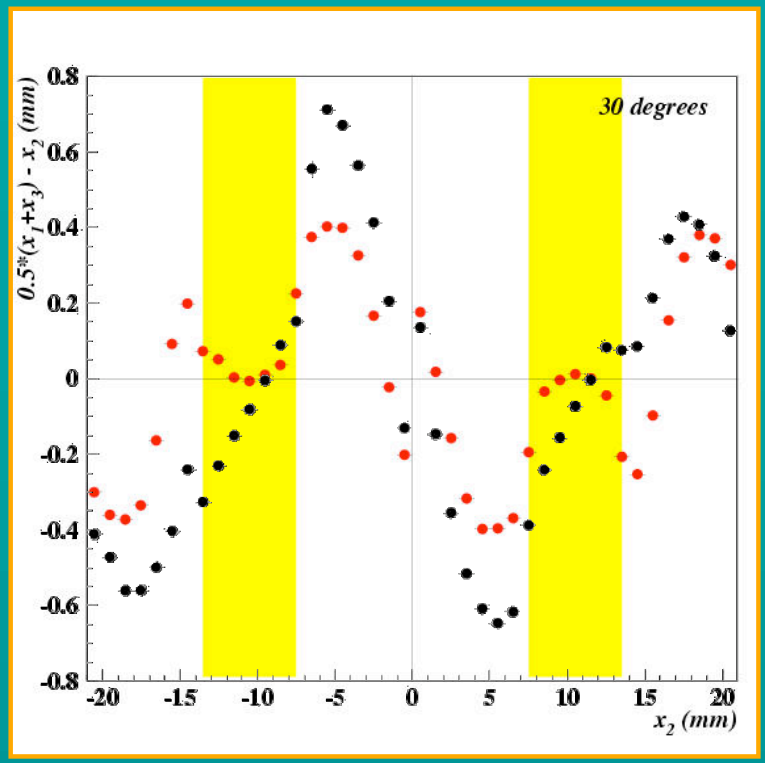


At 30° the correct TDC times pattern is fulfilled in a certain cell region, where G is still under 50 μm. Outside, residuals increase.

Intrinsic Spatial Resolution

Mean Timers





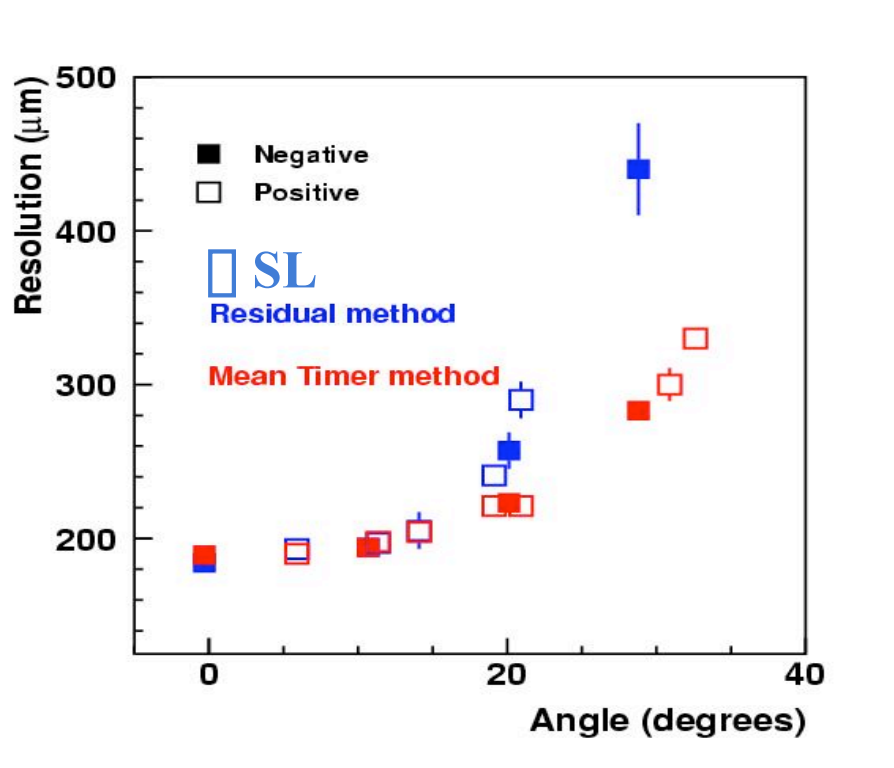
□(□ SL) = 187±2 □m at 0°

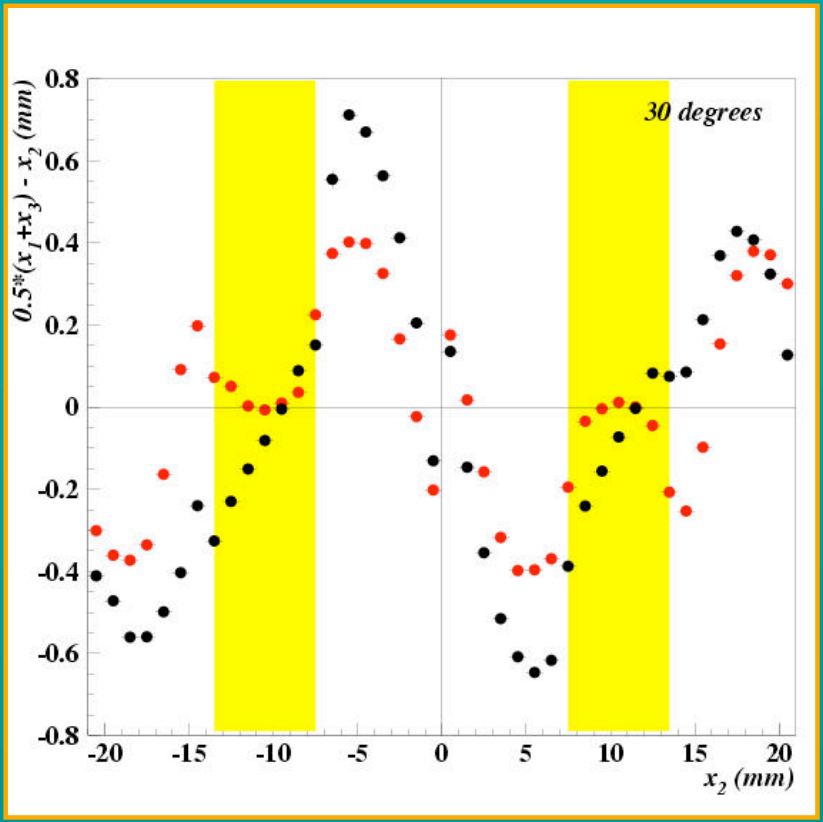
Both simulation and data worsen with increasing angle. At large angles data differs largely with simulation. Why?

In the cell region where simulation shows good calibration conditions, data presents a slope effect (under investigation) which broadens MT spectra (mean values at correct place)

Real Spatial Resolution

Residuals





σ(□ SL) = 193±4 □m at 0°

G values for cell regions outside good calibration zones may reach up to 700 □m, compared to MT resolution and to simulation predictions.

Cell regions used for Mean Timers

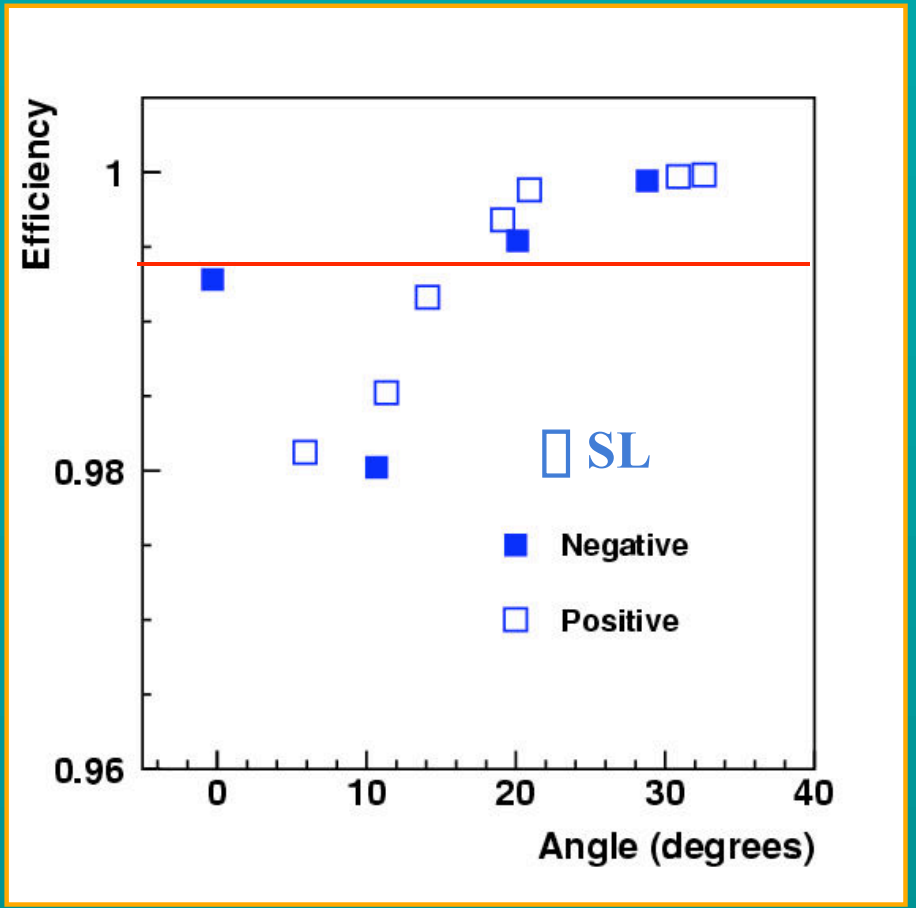
Residuals considered from whole cell

Superlayer Detection Efficiency

□(□ SL) = 99.4±0.1% at 0° (red line)

Geometrical inefficiency (I-beams) not excluded.

Efficiency increases with angle, except for the increase of number of 3-hits tracks when angle departs from 0 degrees (Ibeams effect)



Chamber Fraction of tracks with 3/4 hits per SL

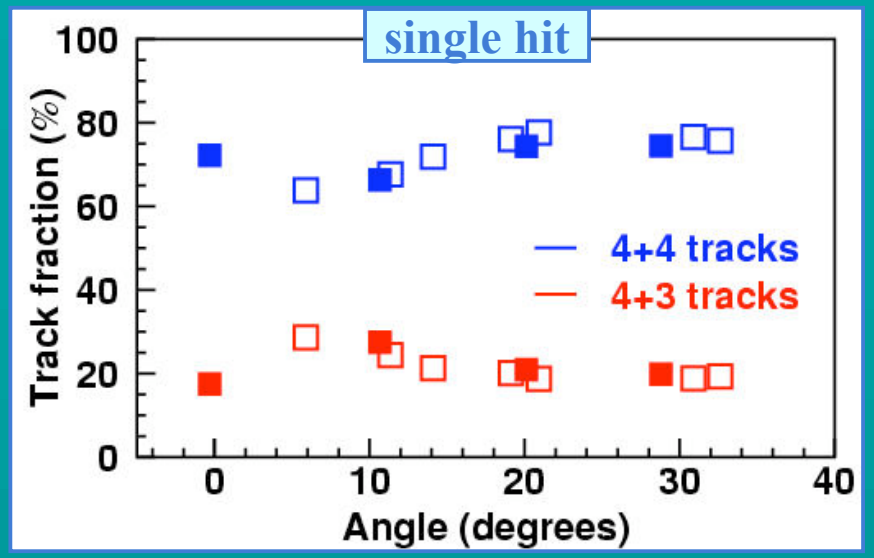
Select evts in chamber with 1fitted muon track/SL (single fit)

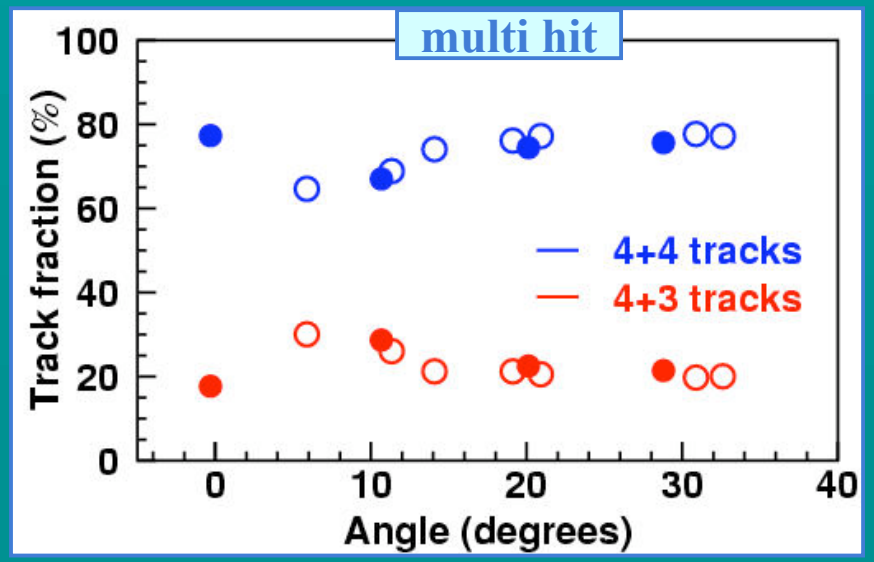
Classify according to 3-4 hits on each □1-□2 SL

4+4 | 3+4,4+3 | 4+0,0+4 | 3+3

Only 1 hit/cell (single hit)
Or multiple hits/cell (multi hit)

- Fraction of 4-hits tracks increases with angle, the 3-hits tracks decrease, in a complementary way.
- When departing from normal incidence number of 3-hits tracks increase considerably.
- Single & multi hit fractions behave similarly.



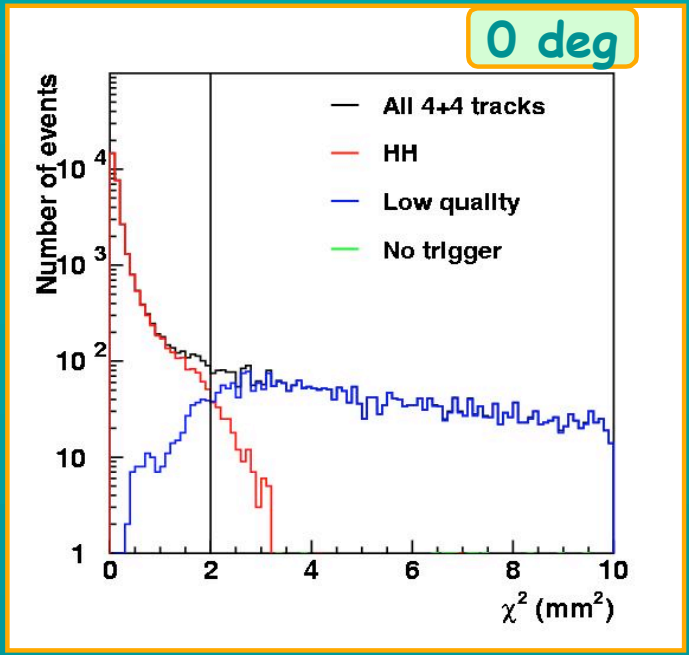


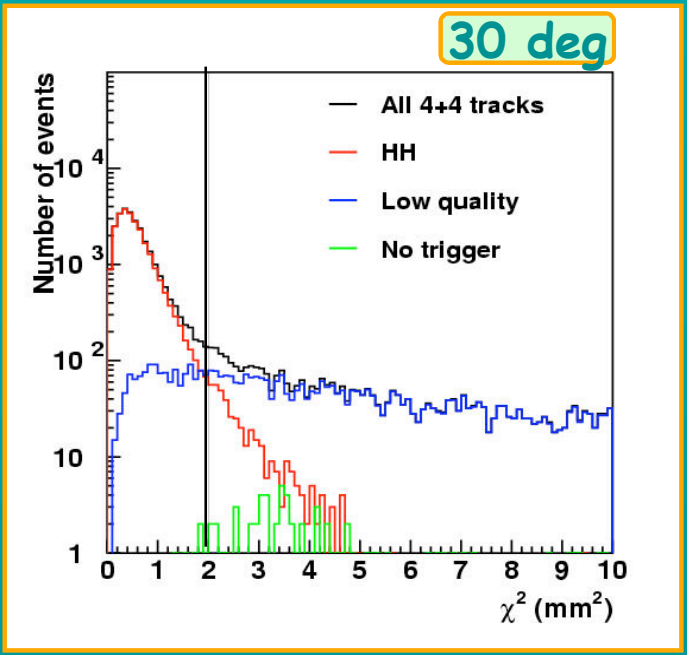
Trigger Efficiency obtained

with Muon Tracks from DT chambers

Fitted muon track quality

Require 1 muon/SL (single fit) and only 1hit/cell (single hit)





- Most HH triggers correspond to tracks with $\chi^2<2$
- At $\chi^2>2$ distribution is mostly populated by Low Quality triggers

Redefine quality of fitted muon track

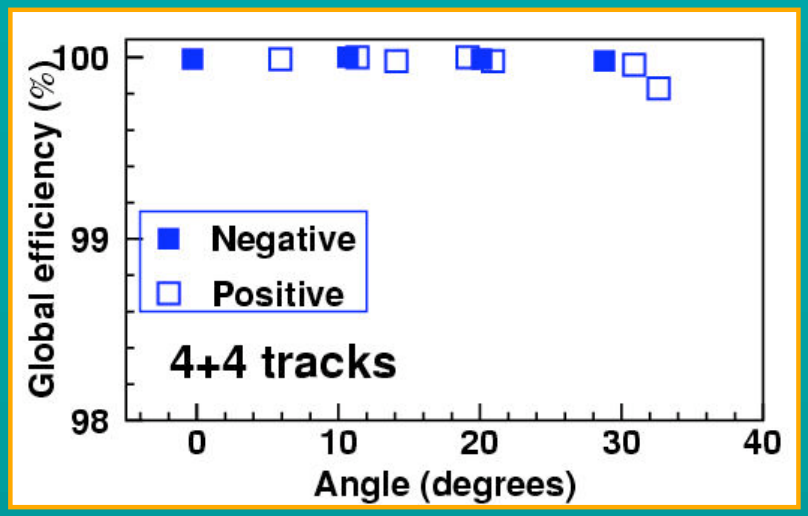
If track of 4-hits has $\chi^2>2$, the 'worst' hit is removed and track refitted with 3 hits.

Good quality track: 3/4-hit track with $\chi'^2<2$ → Link between HL trigger & good quality fitted muon track

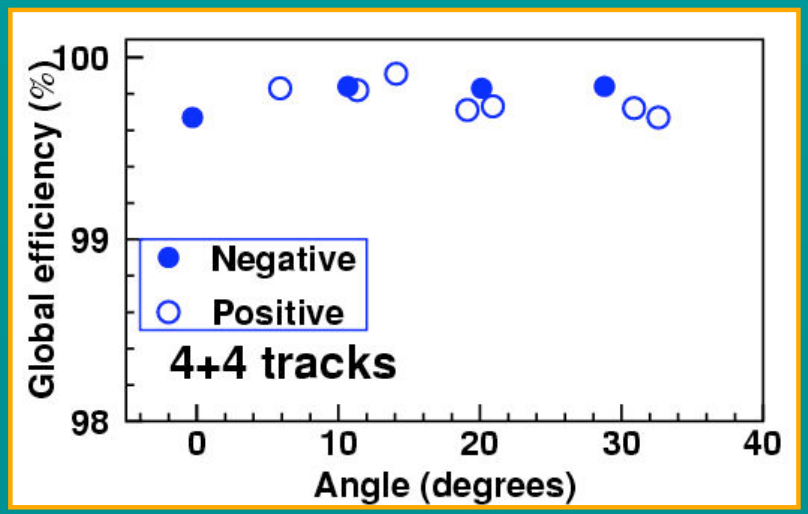
Trigger efficiency vs angle (4+4 tracks)

Expected trigger quality: HH

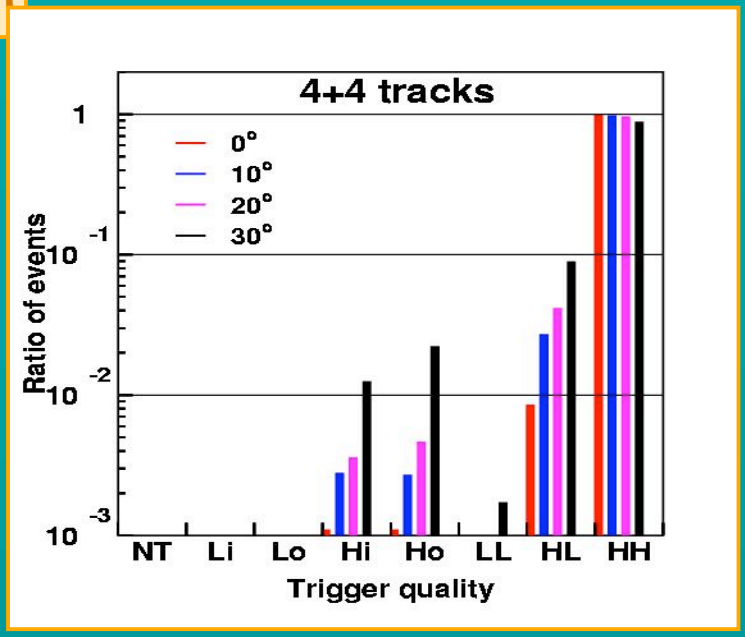
single hit

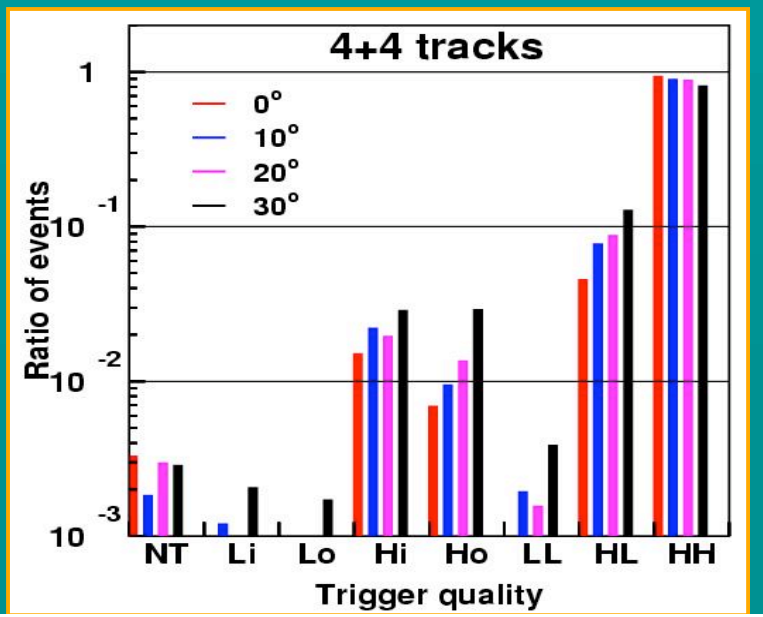


multi hit



Traco quality tracks

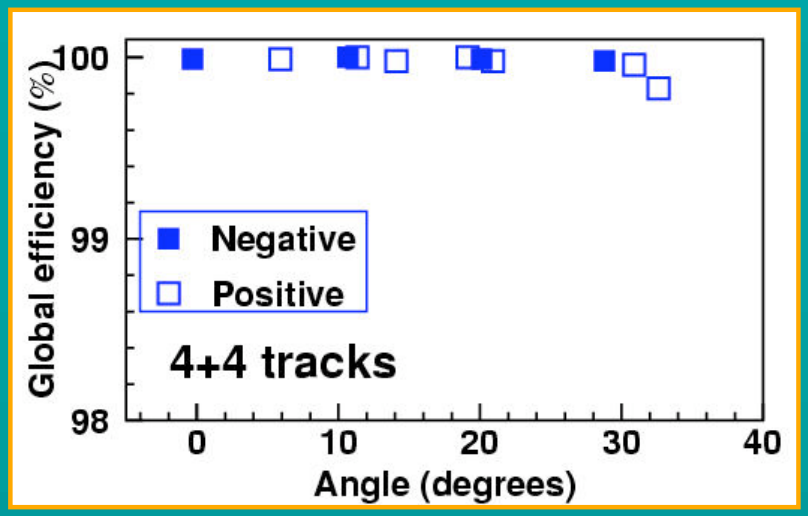


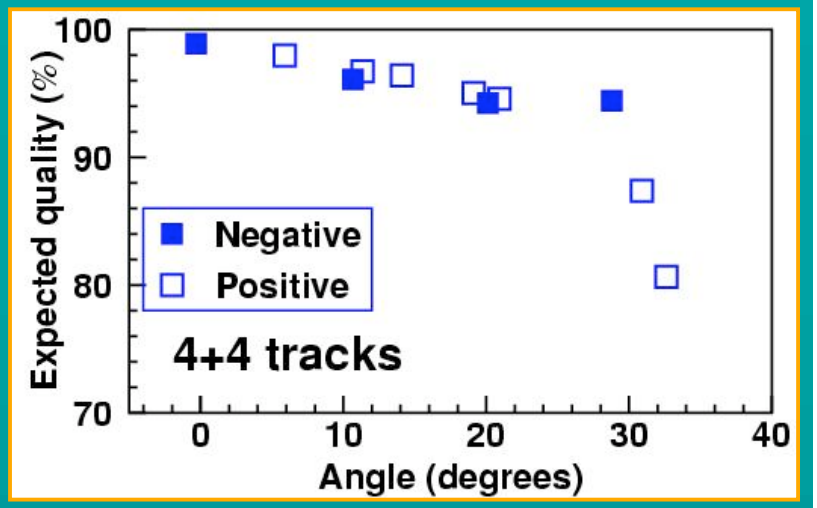


Trigger efficiency vs angle (4+4 tracks)

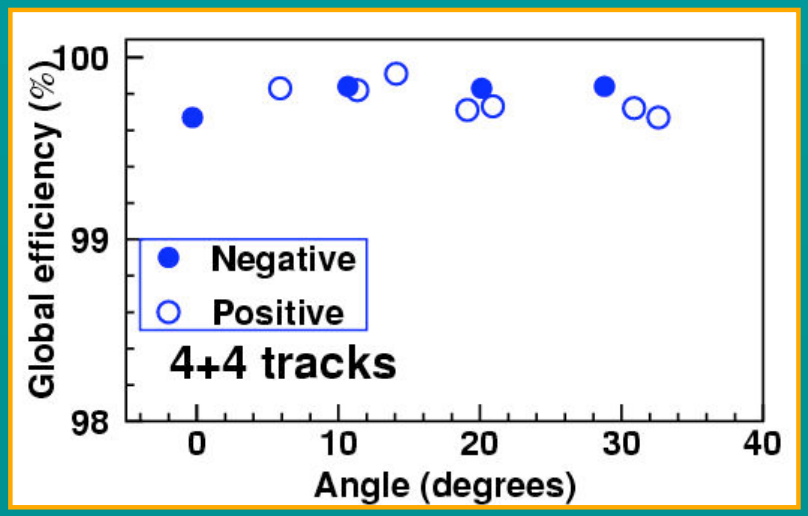
Expected trigger quality: HH

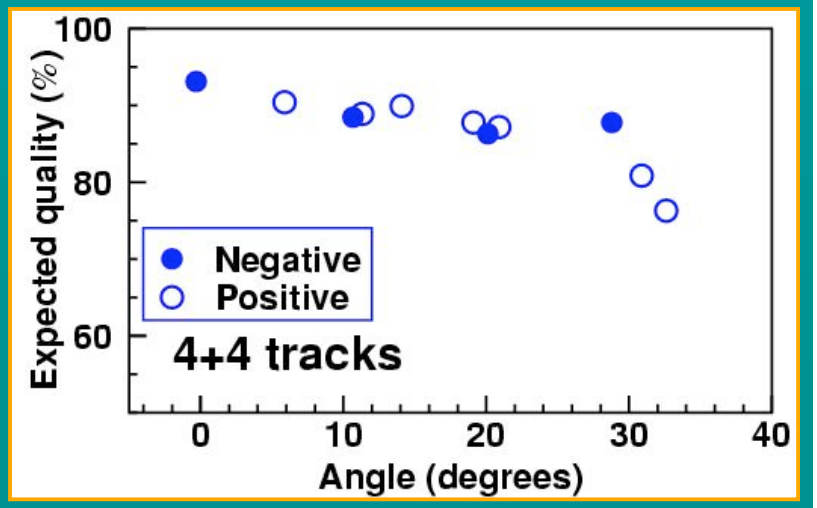
single hit





multi hit

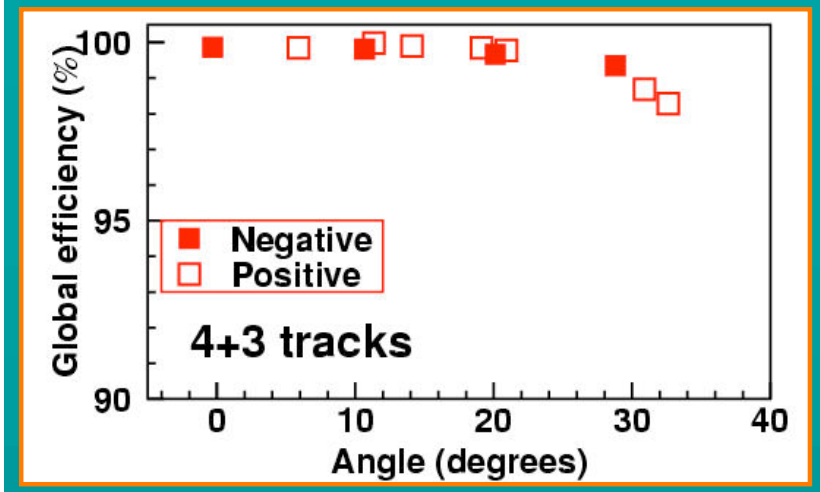




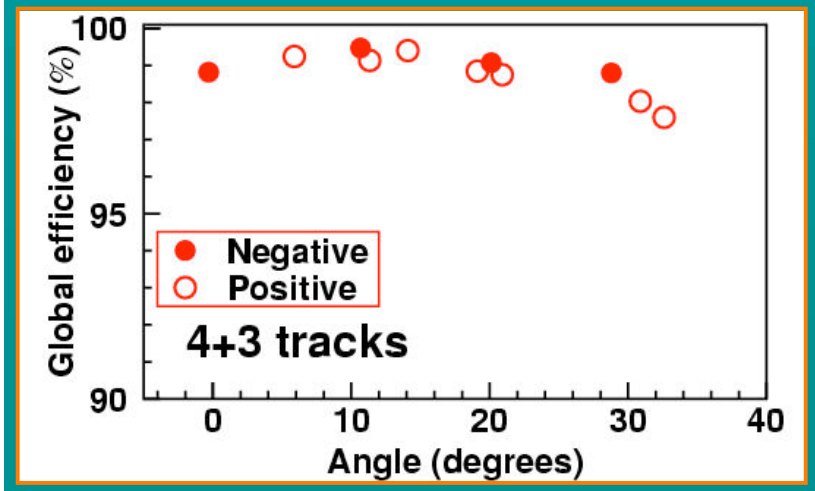
Trigger efficiency vs angle (4+3 tracks)

Expected trigger quality: HL

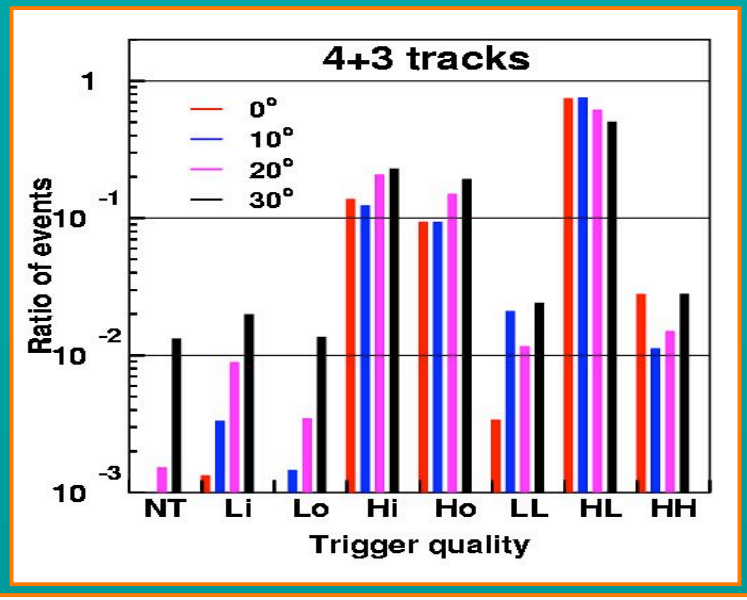
single hit

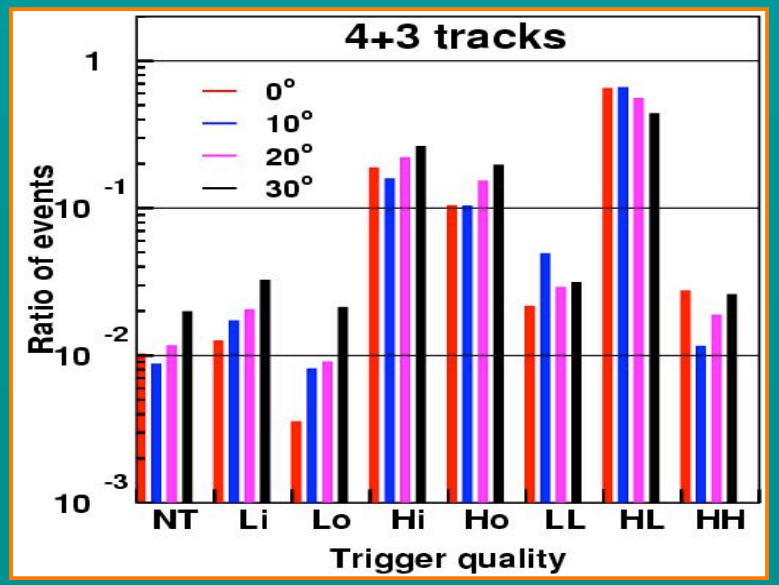


multi hit



Traco quality tracks

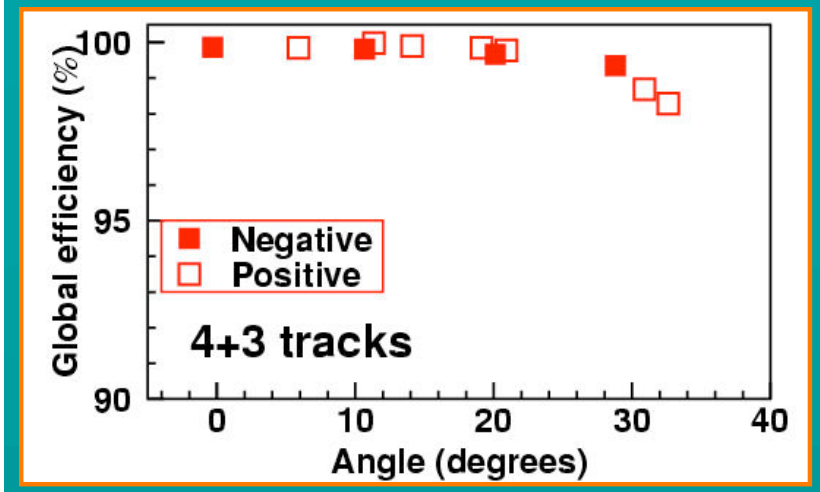


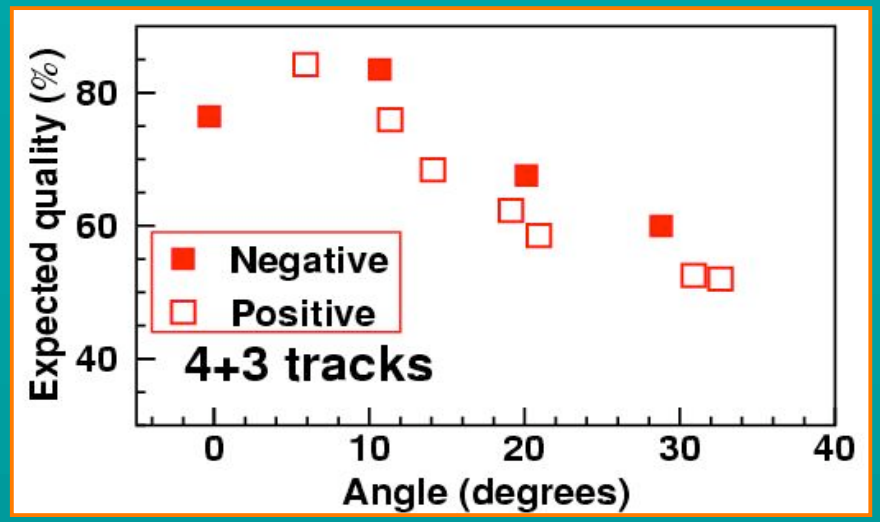


Trigger efficiency vs angle (4+3 tracks)

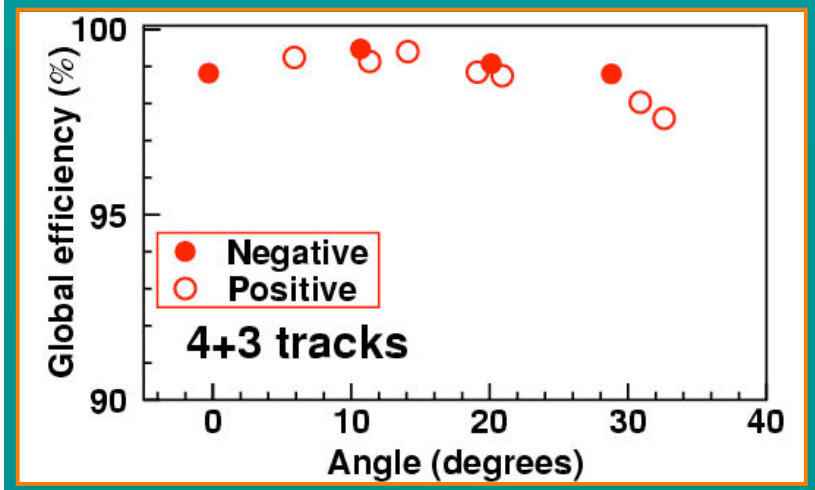
Expected trigger quality: HL

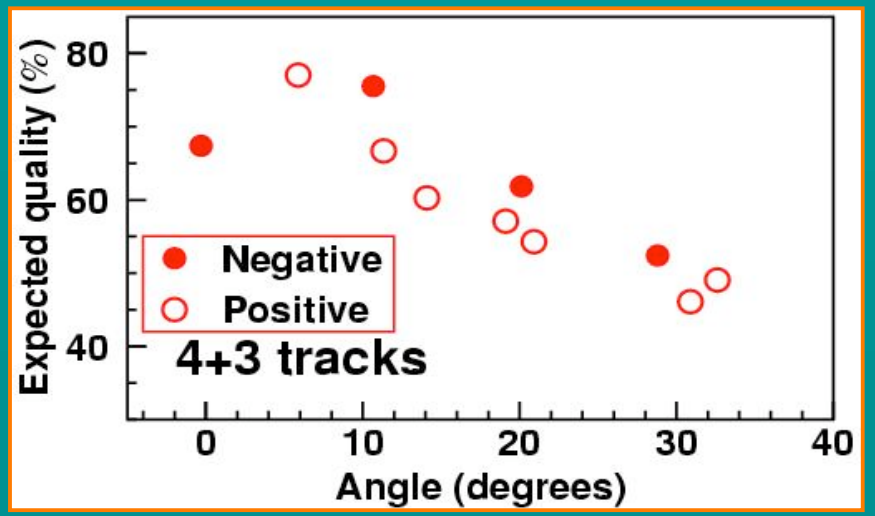
single hit





multi hit

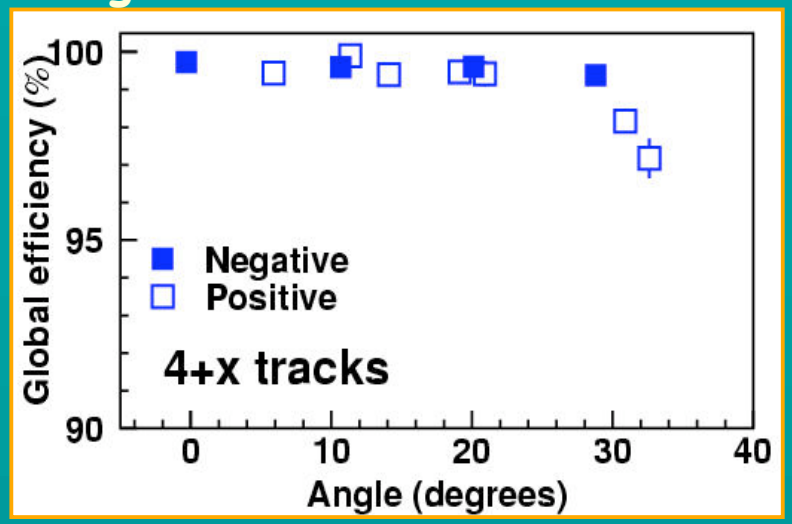




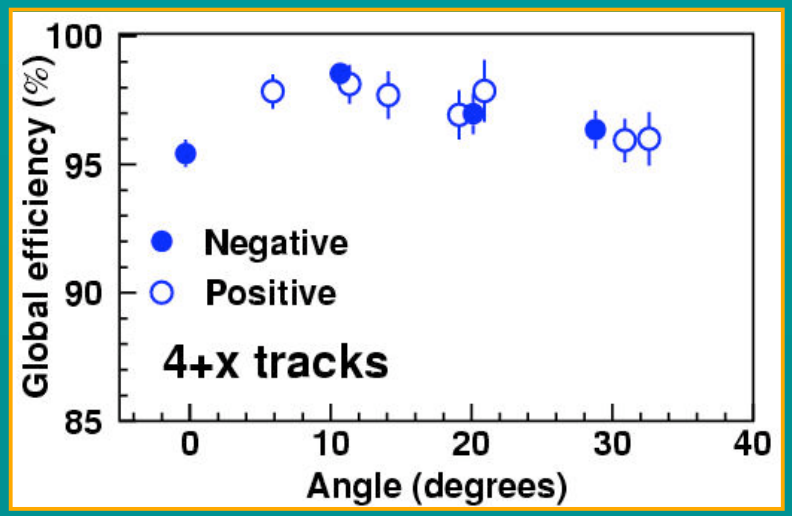
Trigger efficiency vs angle (4+0 tracks)

Expected trigger quality: HI-HO

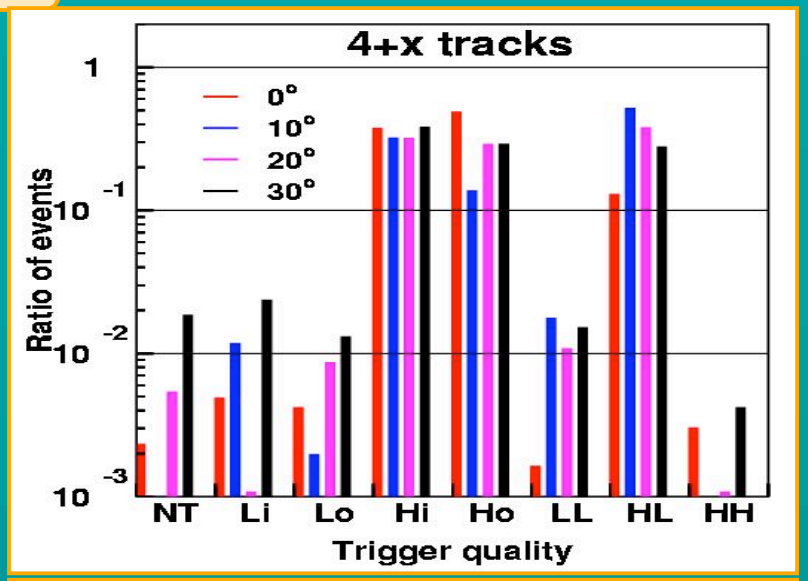
single hit

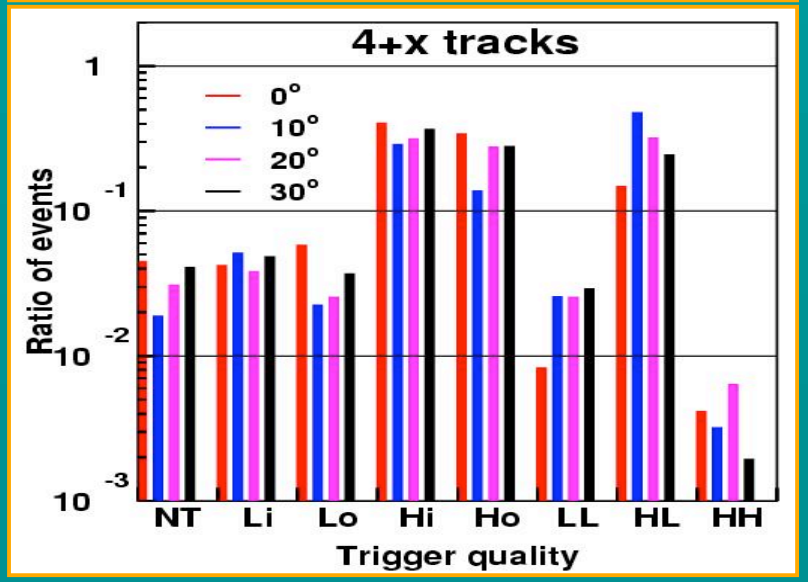


multi hit



Traco quality tracks

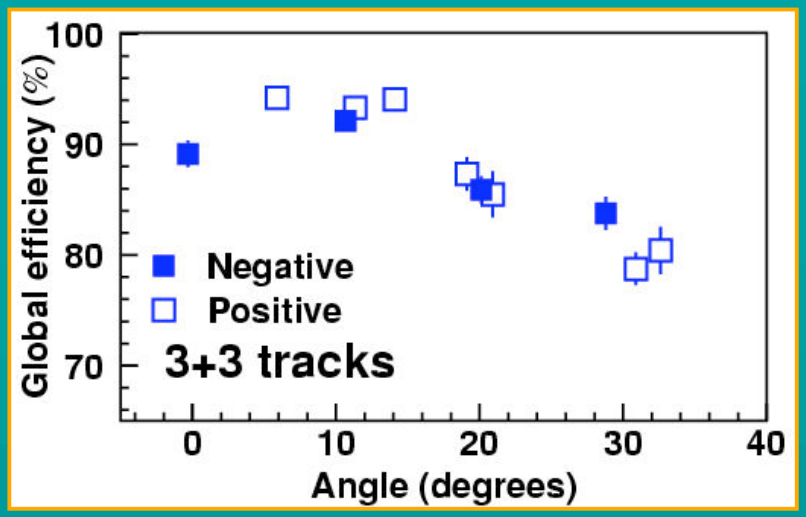


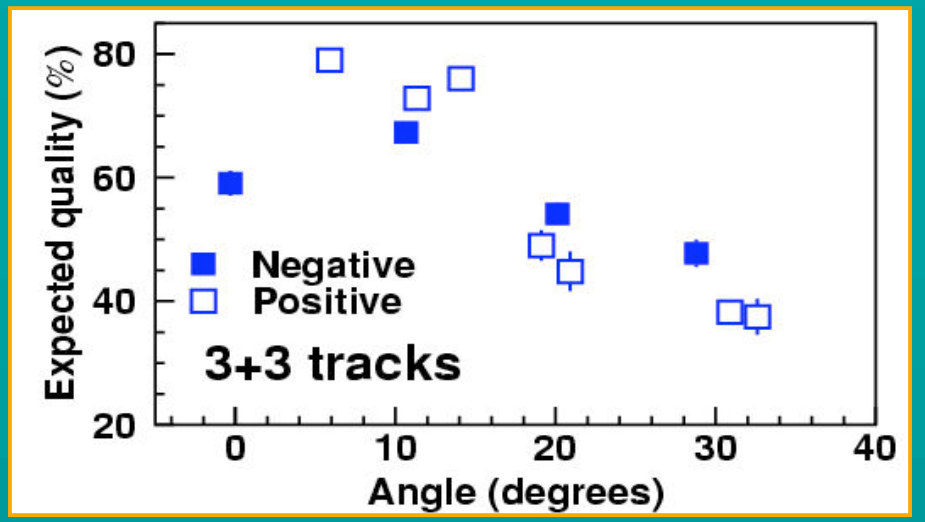


Trigger efficiency vs angle (3+3 tracks)

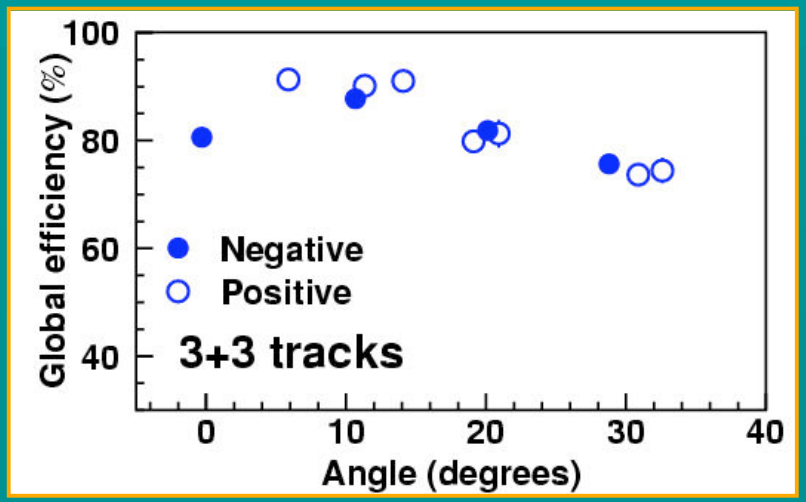
Expected trigger quality: LL

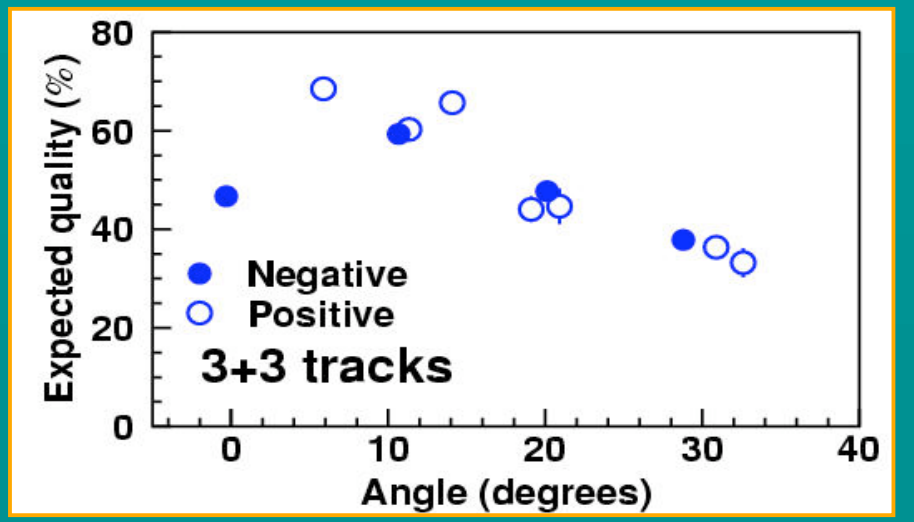
single hit





multi hit



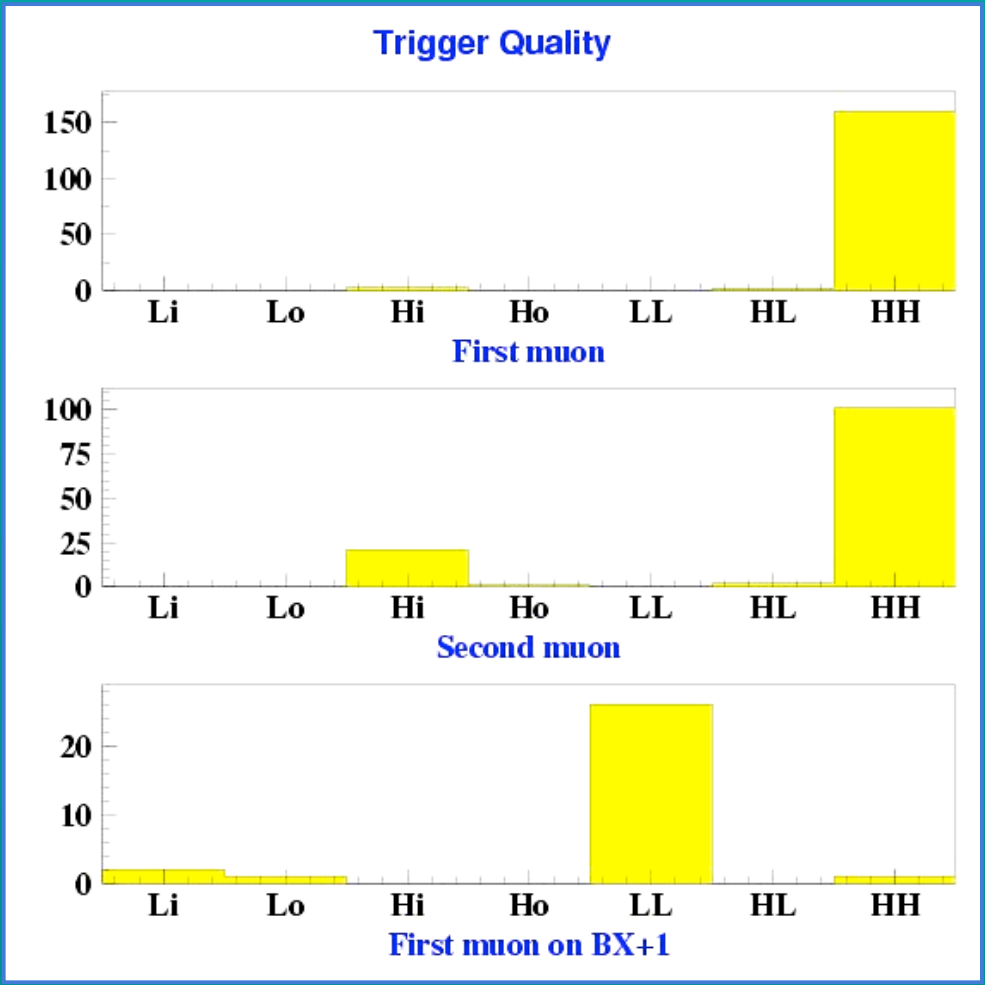


Trigger on dimuons

From the inclusive muons sample:

Select in chamber : 2 good muons (4+4, 4+4, χ^2<2) (no other extra)

Look at TRACO:



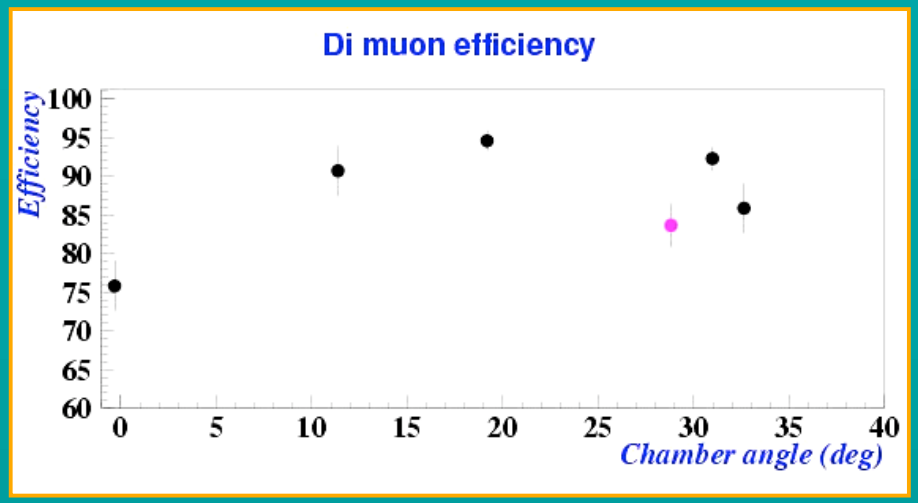
1. Trigger on first muon is HH (as expected)

2. There exists 1 muon at BX+1 slot, with dimuon control trigger bit on. Trigger quality is mostly HH

3. There are (18%) extra triggers with 1 muon at BX+1 slot, but with no dimuon trigger bit on (first muon from next BX) These are low quality triggers.

Trigger on dimuons

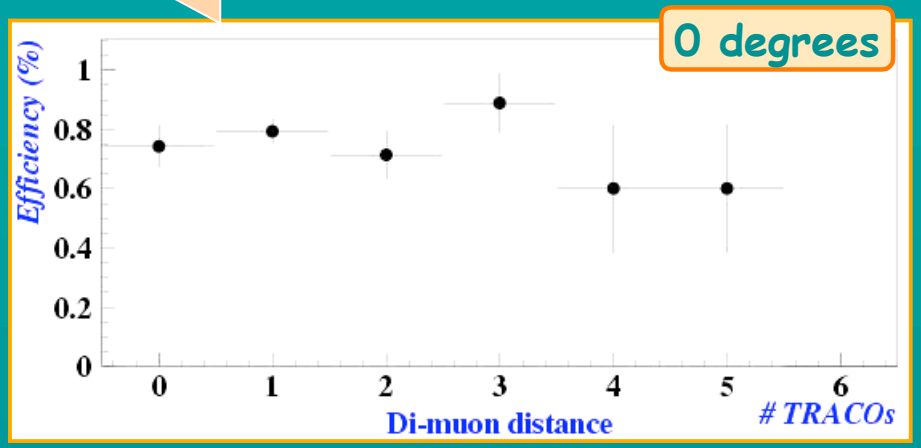
From the previous 1 & 2 triggers (good dimuon triggers)

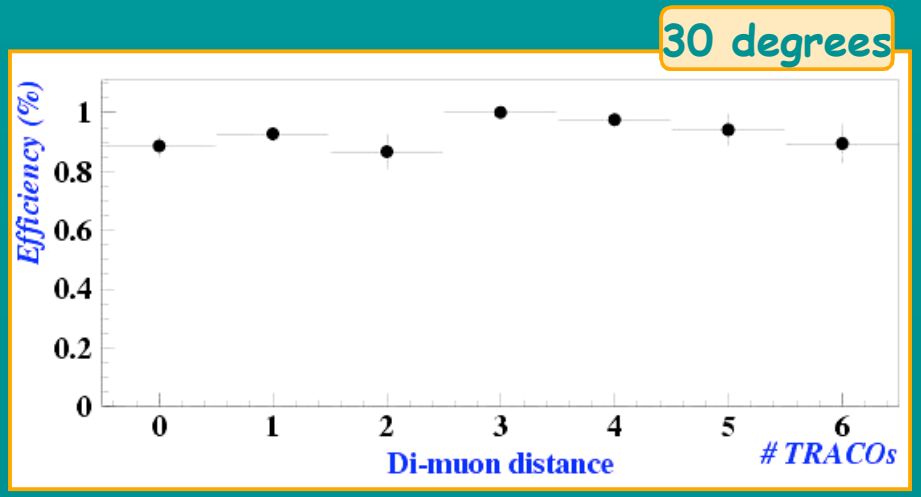


Trigger efficiency vs. angle

Trigger efficiency vs distance

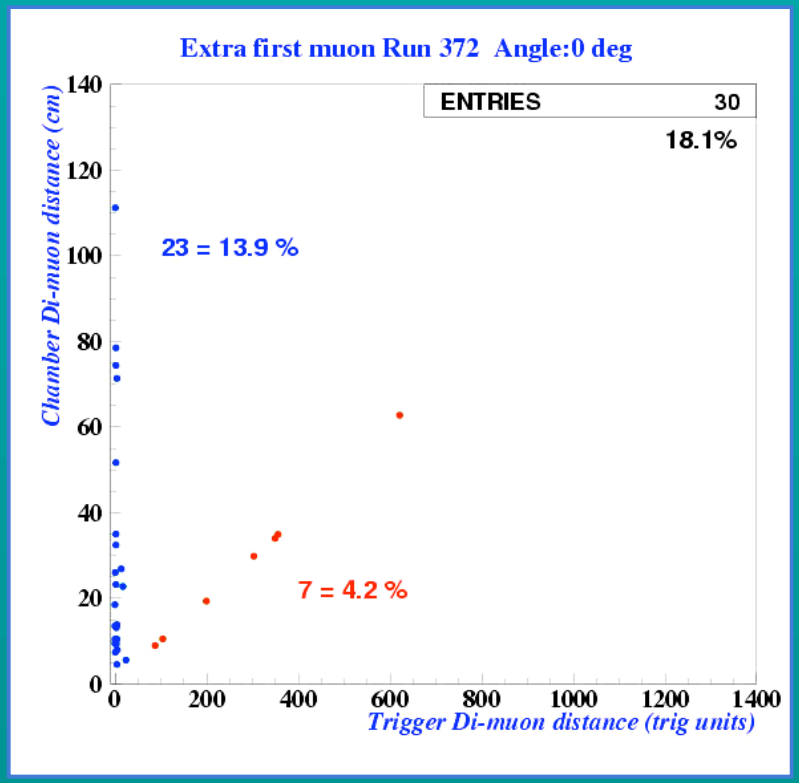
Distance is measured from #cell on □1, knowing correspondence with TRACO number, then difference in number of TRACOS

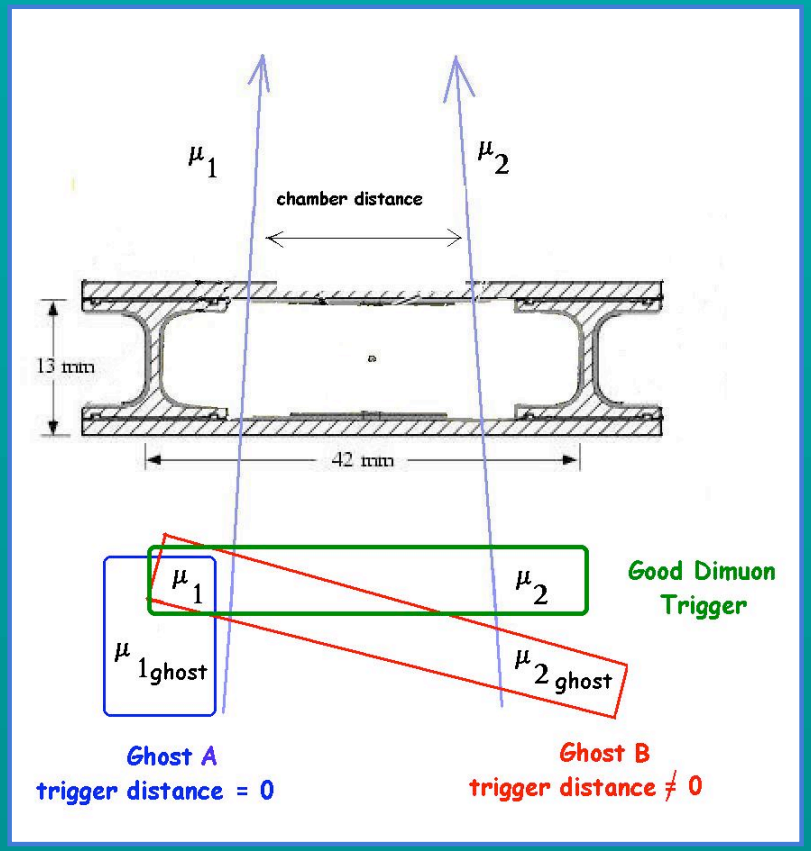




Trigger on dimuons

What are these cathegory 3 triggers? Look at distance between both muons in chamber and in trigger units



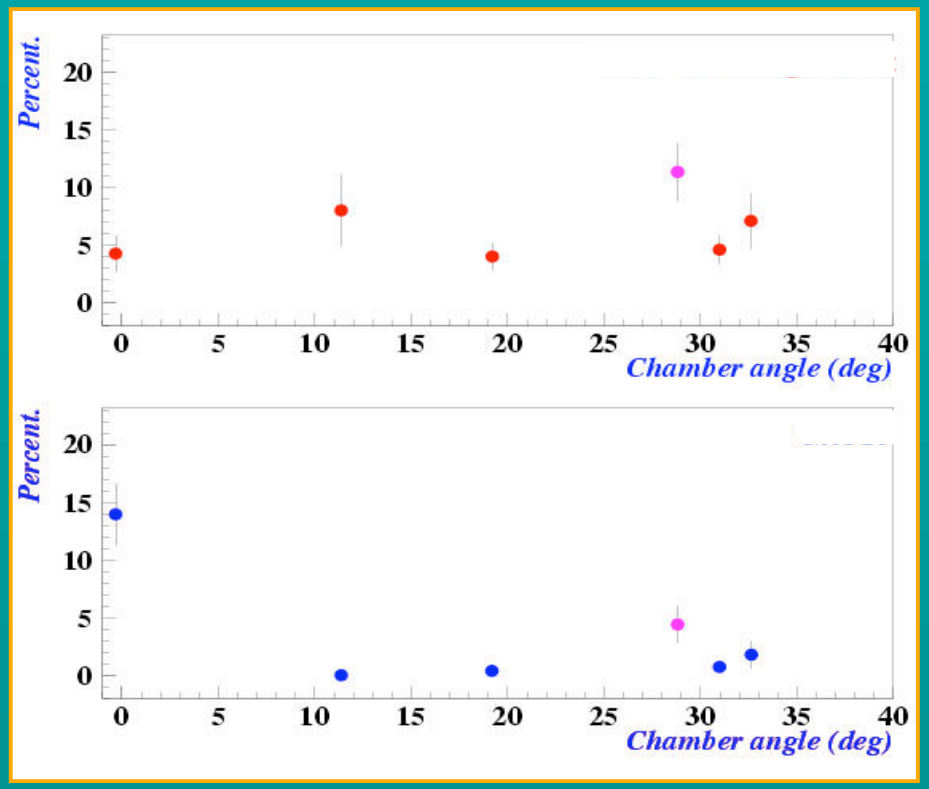


2 populations at 0°:

Type A: Trigger distance =0 (13.9%)
Type B: Trigger distance ≠ 0 (4.2%)

→ These extra triggers are Ghost triggers

Proportion of ghost triggers on dimuons vs. angle



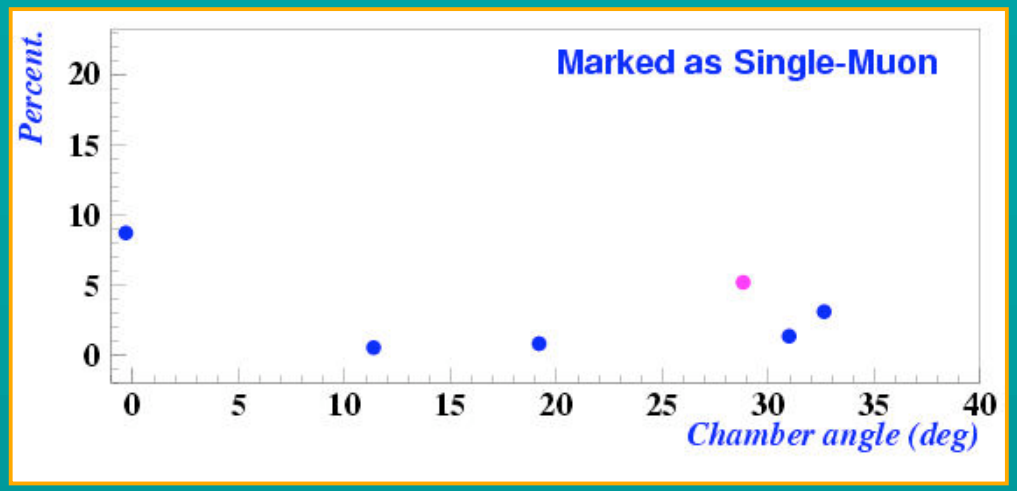
Type B triggers proportion stays constant (~5%) with angle

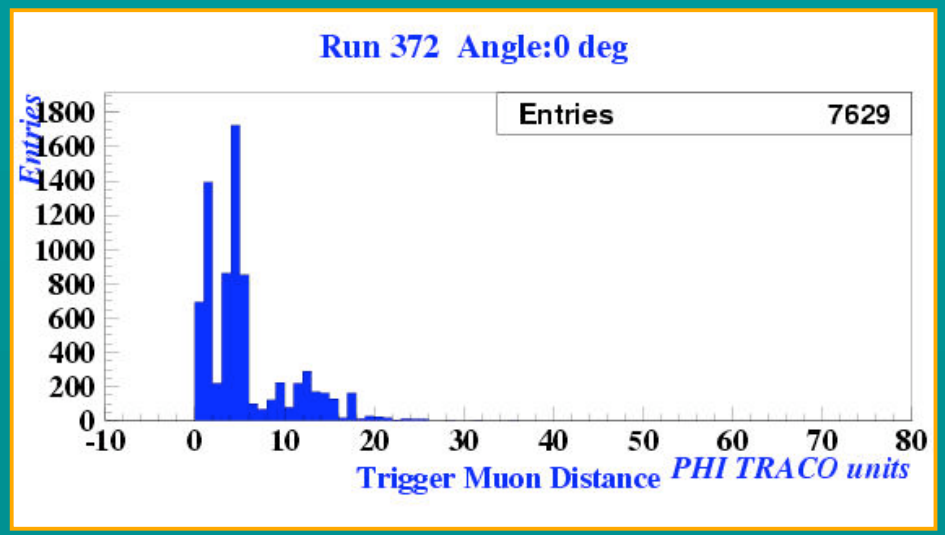
Type A triggers proportion decreases drastically with angle, from 13% at 0° down to 1% at 30°

Ghosts triggers type A (one muon and its own ghost) must be present in the inclusive muon sample as well.

Ghosts studies on inclusive muon sample

In the inclusive muon sample (4+4, χ^2<2, only 1 fitted muon) look at the BX+1 slot in trigger information: found triggers with no dimuon control trigger bit on (ctrl bit =0)



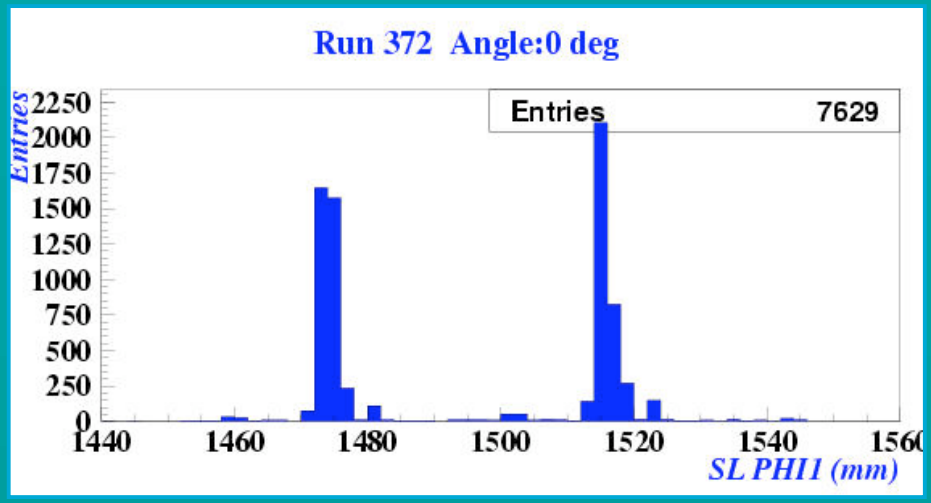


The behaviour is similar to the one in dimuon sample, 10% at 0°, decreasing at larger angles

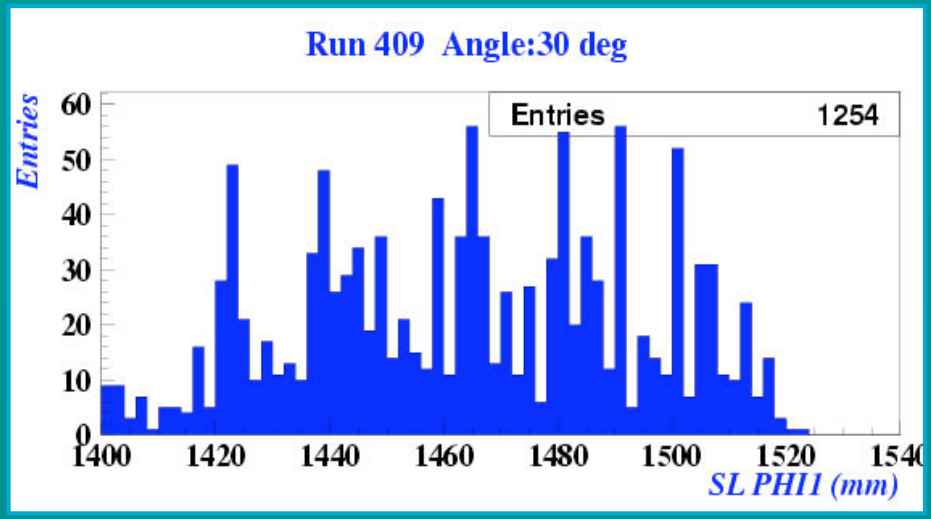
The difference in Phi TRACO units of distance show these are also ghost triggers.

Where are these fake triggers in the chamber?

Ghosts studies on inclusive muon sample



At 0° ghost proportion is large (10%) and concentrates in certain chamber regions.



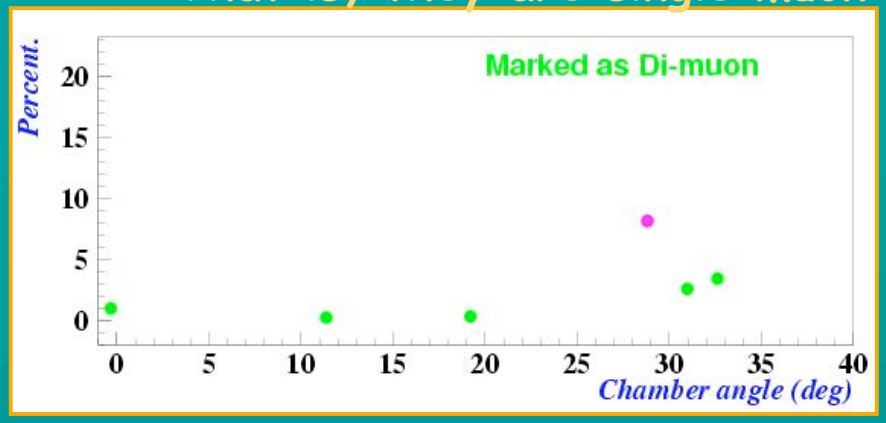
At bigger angles fake trigger proportion is very reduced and more distributed along the chamber (although some peak structure might still be seen).

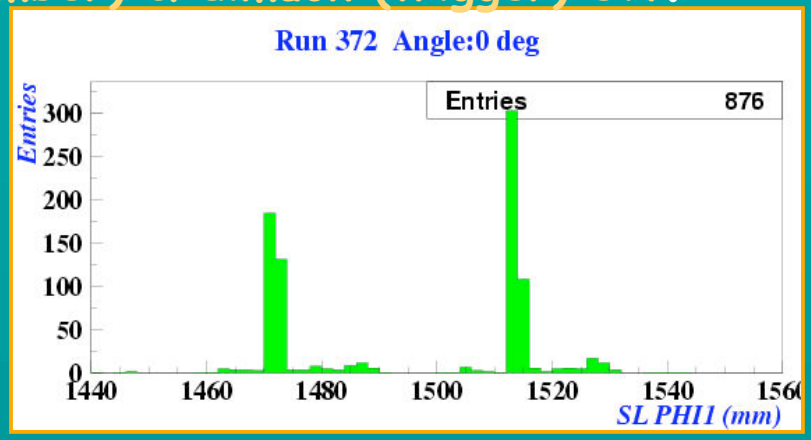
Ghosts studies on inclusive muon sample

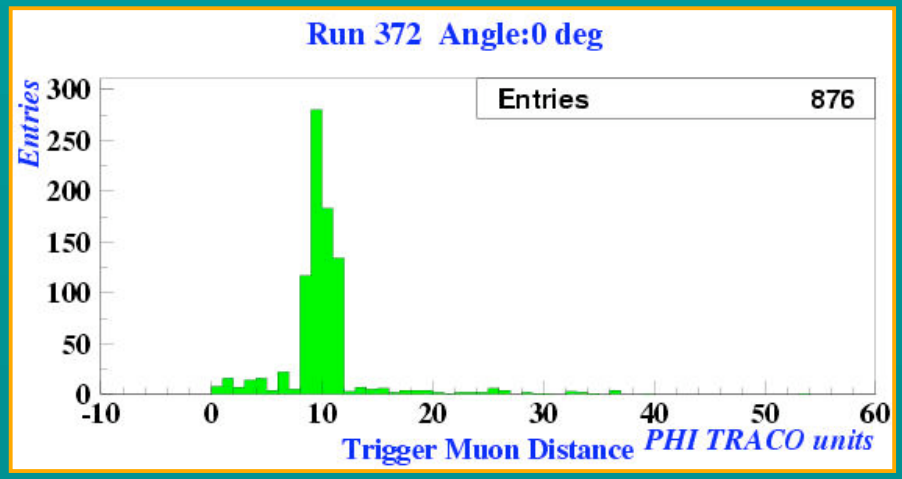
Still, a new cathegory of extra triggers in single muons sample appears.

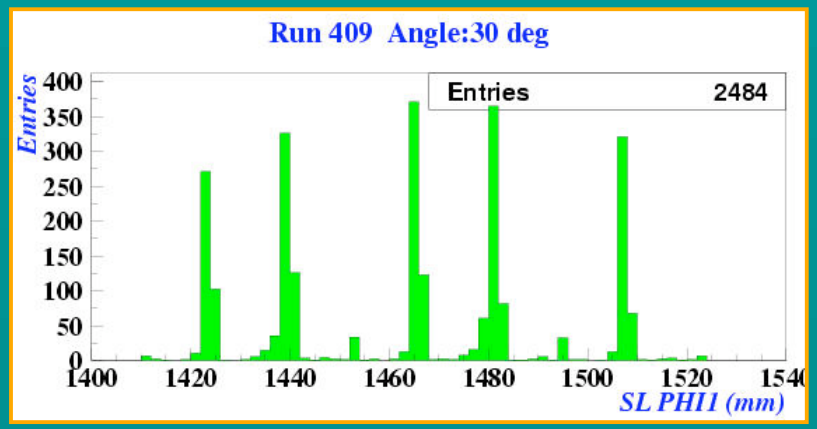
They have an extra muon in the BX+1 slot, with the dimuon trigger ctrl bit on.

That is, they are single muon (chamber) & dimuon (trigger) evt.







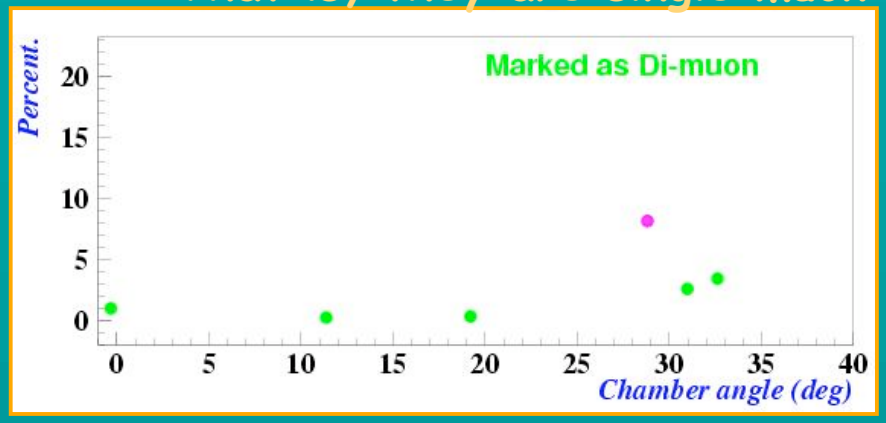


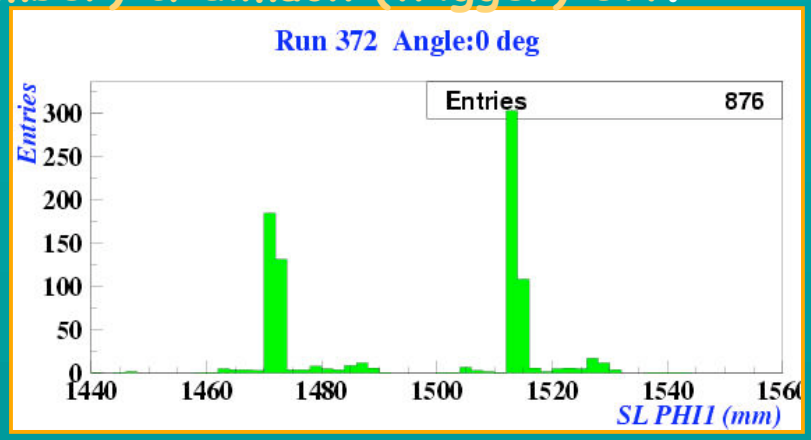
Ghosts studies on inclusive muon sample

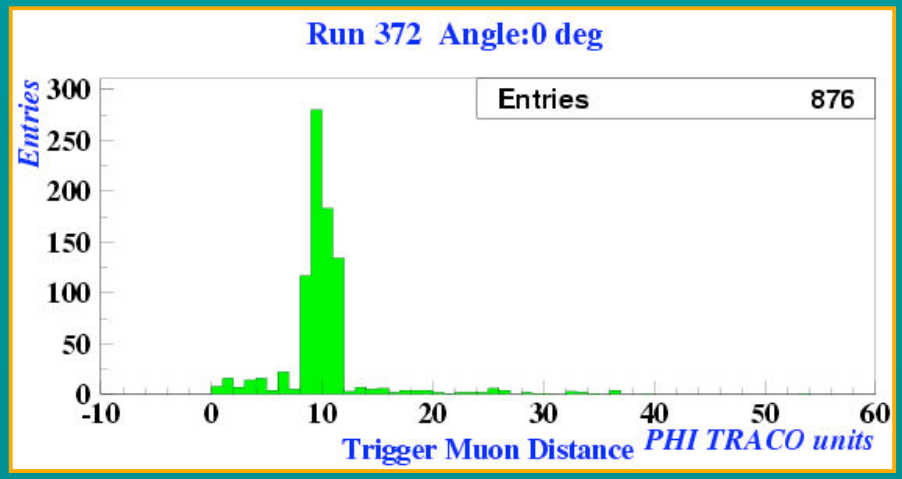
Still, a new cathegory of extra triggers in single muons sample appears.

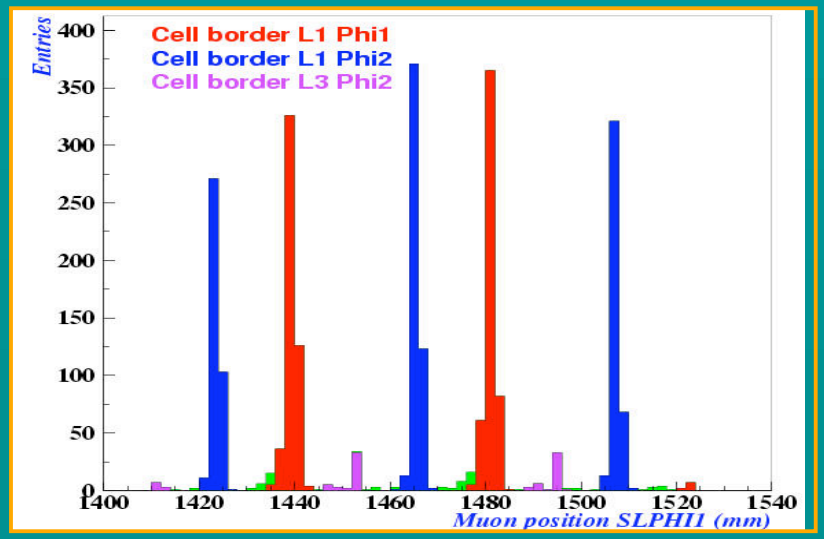
They have an extra muon in the BX+1 slot, with the dimuon trigger ctrl bit on.

That is, they are single muon (chamber) & dimuon (trigger) evt.









Summary

Good chamber and trigger (BTI & TRACO) performance, in general, and with good correlation between their info

Chamber

- Electrons drift velocity increases with angle
- Chamber resolution deteriorates for increases angles.
- SL detection efficiencies are in any angle over 98%

Trigger Server info

- Global trigger efficiencies over 99% for correlated HL tracks
- Quality of tracks decreases with angle,becoming low quality tracks cathegory more populated.
- Dimuons efficiency as a function of angle and distance.
- There is a ~18% ghost triggers at 0°, decreasing to around 5% proportions at larger angles.
- Ghost trigger studies on the single muon sample.