Calibration for different trigger sources (DT,CSC,RPC)

PRELIMINAR RESULTS

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(with a big help from M. Dalla Valle)

DT Cosmic Analysis meeting (22 November 2006)
Goal

- MTCC phase 2: successful integration between different detectors (triggers synchronization)

  for the FIRST TIME we can study the dependence of the calibration parameters (ttrig, vdrift) on different trigger sources

  Do we need different calibration constants for different trigger sources?
  → (to guarantee the best segments reconstruction efficiency)

- NOTE: Different timing of cosmic muons with respect to pp muons:
  - bunched muons arrive to the DT station always at fixed time (=TOF) with respect to the BX time
  - cosmic muons have flat arrival time distribution: smearing of 25ns / \sqrt{12} on digi time
Event selection depending on the trigger source
Event filter on the trigger source

In order to divide the event sample on the trigger source basis, a new event filter has been developed and released.

EventFilter/DTRawToDigi/test/FilterByLTC

You need to specify in the cfg the trigger configuration you want:

1 = DT only
2 = CSC only
3 = RPC only
4 = DT && CSC
5 = DT && RPC
6 = CSC && RPC
7 = CSC && RPC && DT
8 = No DT
9 = No CSC
10 = No RPC
11 = DT inclusive
12 = CSC inclusive
13 = RPC inclusive
Events from MTCC phase 2

- Last runs: after all the reconfiguration of ROS/MC -> no (known) problem during data taking
  after all the re-synchronizations of different trigger sources

- Run 4398 (B=4T): CSC + RPC + DT
  - DT trigger: HH&HL, 3 sectors, MB1 masked
  - CSC trigger on single chamber
  - RPC trigger coincidence of 5/6 chambers

- Run 4333 (B off): CSC + RPC + DT
  - 60.6% 18.0% 14.2%

- Requested only ONE trigger source to study the trigger effect of each single detector

  (remaining 5% -10% mainly with DT&&RPC)
DT/RPC trigger window

To have a trigger you need **all your signals** (MB2*MB3 or 5 RPC coincidence) being in the same clock interval (i.e. assigned to the same BX)

but the signals are separated by the **muon TOF**

- **DT trigger** 3 ns of TOF between MB2 and MB3
  
  real trigger window ~ 25ns – 3ns = **22 ns**

- **RPC trigger** ~8 ns of TOF between 5 RPC chambers
  
  real trigger window ~ 25ns – 8ns = **17 ns**

**this can affect the RPC&&DT trigger efficiency**

**but it’s not enough to explain the observed values**

(LTC bug: busy of 1BX after a trigger, DT & RPC bit on) -> DT&&RPC trigger efficiency can be overestimated using LTC digi info
Time Box shape for different trigger sources
Time Boxes

- different rising edge
  (already seen in phase 1)
  studied in the next slides:
  \( t_{\text{trig}}, \sigma(t_{\text{trig}}) \)

- CSC distort time box
  due to big track angle?

plot with \( B=4T \) same behaviour
for \( B \) off (backup slides)
Request for CSC or DT triggered segment at big angle:
(only digi from recHits in 4D reco segments)

- same 3 peaks structure (like in simulated data)
- residual difference (bigger deep in CSC)
  - different angular distribution
  - effect of BX assignment in CSC triggered events
ttrig and $\sigma(t_{\text{trig}})$ dependence on the trigger source
New feature of TB fitter
G. Cerminara

In the calibration package the **CSC distort time boxes** cannot be automatically fitted: **finding the correct fit seed** is difficult.

- a new feature of the package allows **setting the fit seed by hand**
  
  - cd CalibMuon/DTCalibration/.test
  - root DTTimeBoxes.root
  - .x loadPlotter.r
  - plotter->setInteractiveFit(1)
  - plotter->plotTimeBox(1,1,10,1,"fit")
  - insert an estimate of ttrig
  - you can use the ttrig of near superlayers
  - the plot of the fitted TB is shown and the fit results are printed
  
- then you can modify the ttrig database using **DumpDBToFile.cfg** and **DumpFileToDB.cfg**

We are thinking how to improve the automatic search of the fit seed.
ttrig (DT vs CSC)

DT/CSC ttrig compatible in W2
• difference of some ns due to different track angle
• 3-5 ns of TOF

DT ttrig – CSC ttrig (ns)

plot with B = 4T, same behaviour for B off (back-up slides)
Events triggered from CSC

MB1 W1 Sec10
Time of Flight

\[ \theta = 0 \]

\[ 12 \text{ ns} \]
\[ 13-22 \text{ ns} \]
\[ -14 -22 \text{ ns} \]
\[ -15 \text{ ns} \]

\[ \mu (\theta<0) \]
\[ \mu (\theta>0) \]

\[ \text{ttrig DT - CSC} \]
SL1 - 3 ns
SL2 - 6 ns
SL3 - 3 ns

positive and negative differences due to TOF balanced
Events triggered from CSC

MB2 W1 Sec10
Time of Flight

\[ \theta = 0 \]

\[ \mu (\theta > 0) \]
\[ \mu (\theta < 0) \]

\[ t_{\text{trig}} \] differences compatible with TOF effect

| SL1 | 13 ns |
| SL2 | 21 ns |
| SL3 | 17 ns |

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Events triggered from CSC

MB3 W1 Sec10

Time of Flight

\[ \theta = 0 \]

\[ 17 \text{ ns} \]

\[ 15 - 25 \text{ ns} \]

\[ \mu (\theta > 0) \]

\[ \mu (\theta < 0) \]

\[ 15 - 25 \text{ ns} \]

\[ t_{\text{trig}} \text{ DT} - \text{CSC} \]

| SL1  | - 25 ns |
| SL2  | - 29 ns |
| SL3  | - 26 ns |

t_{\text{trig}} \text{ differences also bigger than the TOF}

MB4 W1 Sec10 / 14 have the same behaviour
Why the **trig difference not totally compatible with TOF effect?**

Probably interplay between:

- **pure TOF effect**
- **BX assignment effect**
  
  the BX assigned from the CSC trigger can be different from the BX of the muon arrival time at the DT (effect enhanced if the TOF increases)
ttrig (DT/RPC)

plot with B off, same behaviour for B=4T (back-up slides)

DT/RPC ttrig
difference < 5 ns:
• DT and RPC trigger
  some kind of track
• no TOF effect
\[ \sigma(t_{\text{trig}}) \] B off

\[ \sigma(t_{\text{trig}}) = \text{standard deviation of the gaussian used to fit the rising edge} \]

i.e. it measures how much the rising edge is steep

\[ \text{estimate of the digi time smearing for recHit near to the wire} \]

\[ \sigma(t_{\text{trig}}) \] CSC bigger because of big angle

you can’t know what electron arrives as first

\[ \sigma(t_{\text{trig}}) \] RPC smaller because of the very small trigger window

the smearing due to cosmic flat time distribution is proportional to the trigger window
Summary & TODO

- A deep look to the different trigger sources at MTCC
  - DT&&RPC trigger efficiency still to be completely understood

- Study of the Time Boxes at big angle
  - DT and CSC time boxes in reasonable agreement

- $t_{ttrig}$ & $\sigma(t_{ttrig})$ comparison for different trigger sources:
  - DT – CSC difference understood
  - DT – RPC very similar

- TODO: calibration of $v_{drift}$ → get the hit resolution
  - dependence on different trigger source
  - effect on hit resolution using the same $t_{ttrig}$ for all the trigger source
Back up slide
Time boxes comparison for different trigger sources (B off)

same behaviour with B = 4T (slide 7)
Ttrig comparison for different trigger sources

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\( \sigma(t\text{trig}) \) B=4T

![Graph showing the distribution of DT, CSC, and RPC signals with bins at 0, 2, 4, 6, 8, 10, 12, 14, 16, and 18 nanoseconds.]