Comparision of emulator and trigger data

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22 January 2008

RPC trigger emulator vs data - comparison (run 70036)

- Disagreement visible in 10% of events.
- In nearly all disagreeing events only eta value differs:

```
data:  0x47811f2a pt:0x1f phi:0x2a eta:0x01 qua:0 cha:-1 chav:1 fh:0 b
emul:  0x41bf1f2a pt:0x1f phi:0x2a eta:0x3f qua:0 cha:-1 chav:1 fh:0 b

data:  0x47803f2c pt:0x1f phi:0x2c eta:0x00 qua:1 cha:-1 chav:1 fh:0 b
emul:  0x41bf3f2c pt:0x1f phi:0x2c eta:0x3f qua:1 cha:-1 chav:1 fh:0 b
```

- Difference visible only for wheel 0. Eta values swapped: $0 \leftrightarrow -1$ $1 \leftrightarrow -1$ (eta:0x3f is -1)
- Difference identified as comming from change in CondFormats/RPCObjects during CMSSW_2_0 cycle ()

PAC definitions

Hardware (vhdl) description of PAC (PAttern Comparator, chip performing muon search) consists of two parts:

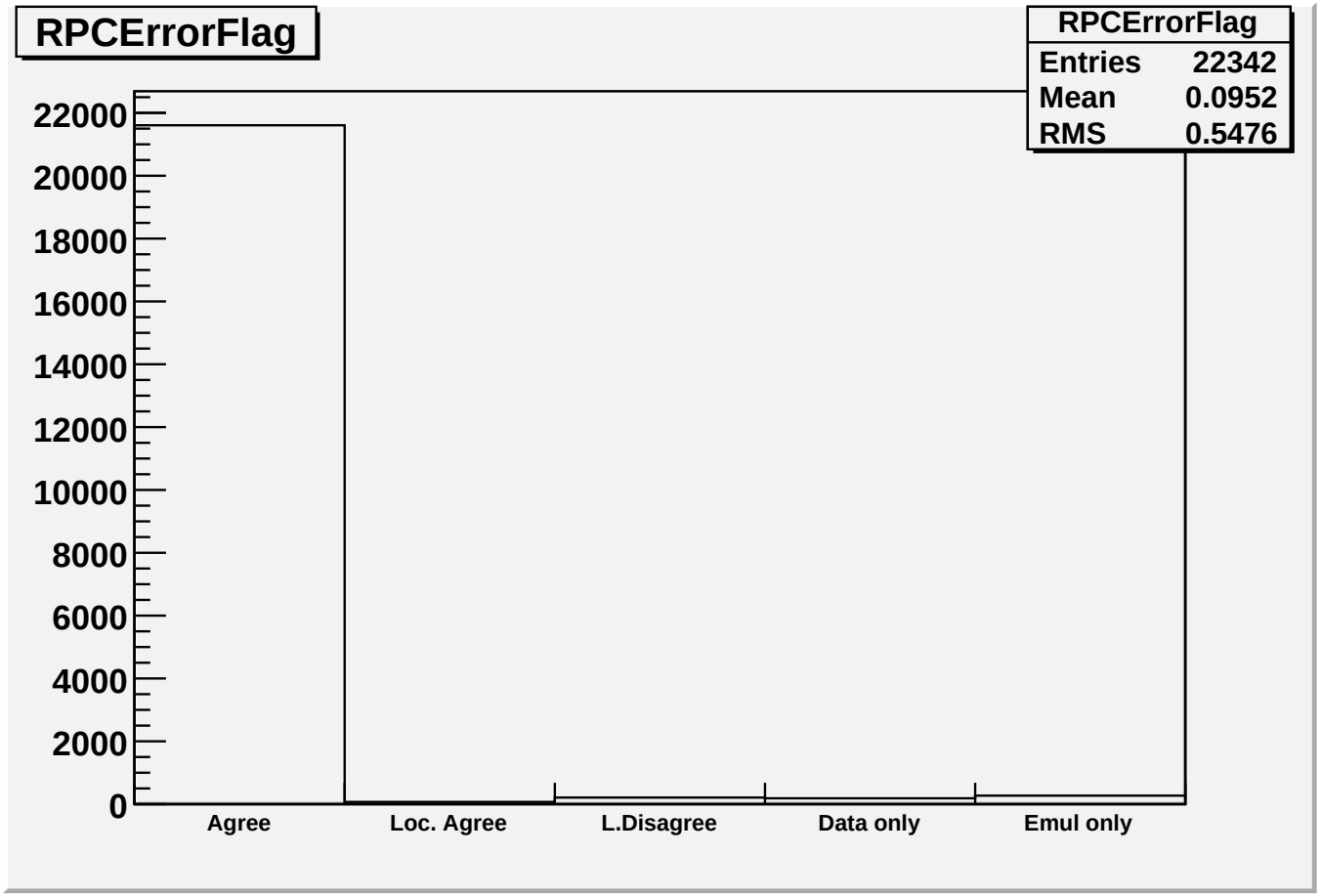
1. Logic cones definitions which depends on RPC geometry and raw2digi data
2. Patterns

If 1 or 2 is changed (Patterns, RPC geometry or raw to digi data) PACs must be recompiled. Changes done in CondFormats/RPCObjects (bug fix in the DBSpecToDetUnit) at the time weren't recognized as having impact on Logic Cones.

Previous analysis were done using early CMSSW_2_0_X versions (also when new CMSSW with changed RPCObjects was available). Therefore the difference wasn't visible

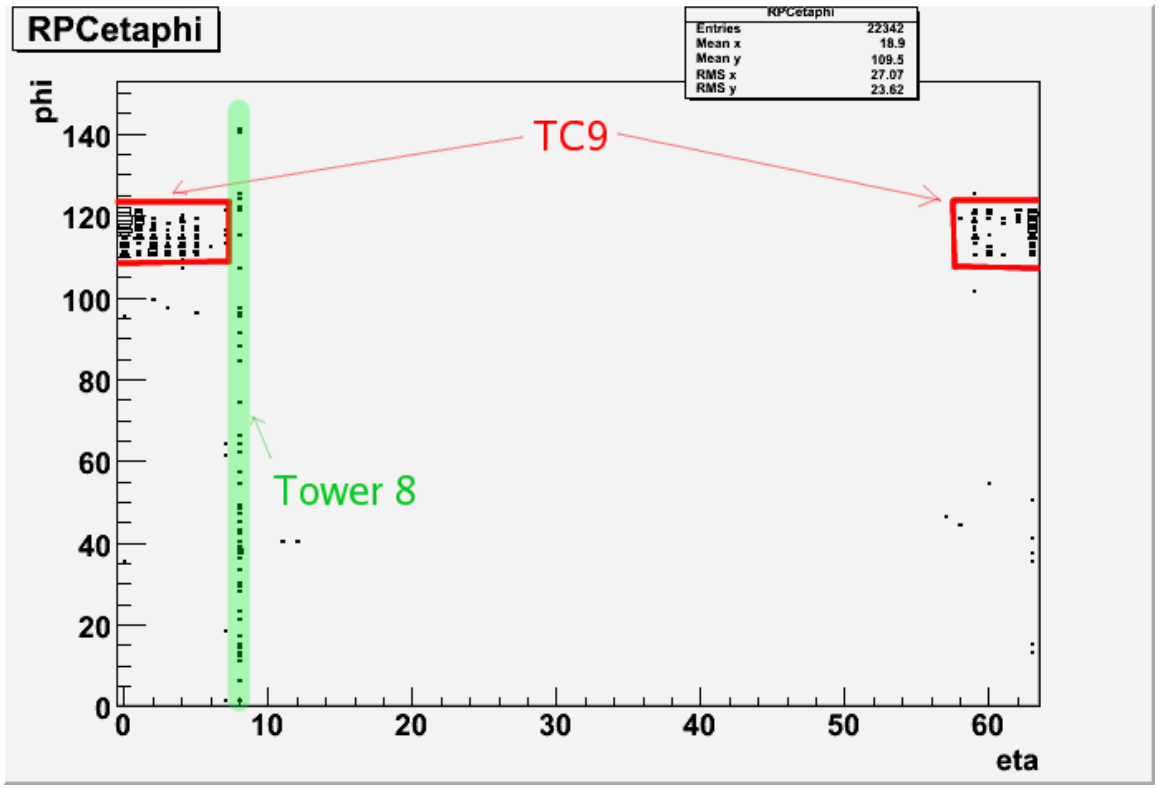
Simple text dump of logic cones will be sufficient to avoid such situation in the future

Data-emulator comparison - 98% agreement



After reverting DBSpecToDetUnit.cc to CMSSW_2_0_0 version data-emulator comparison is consistent in 98% of events.

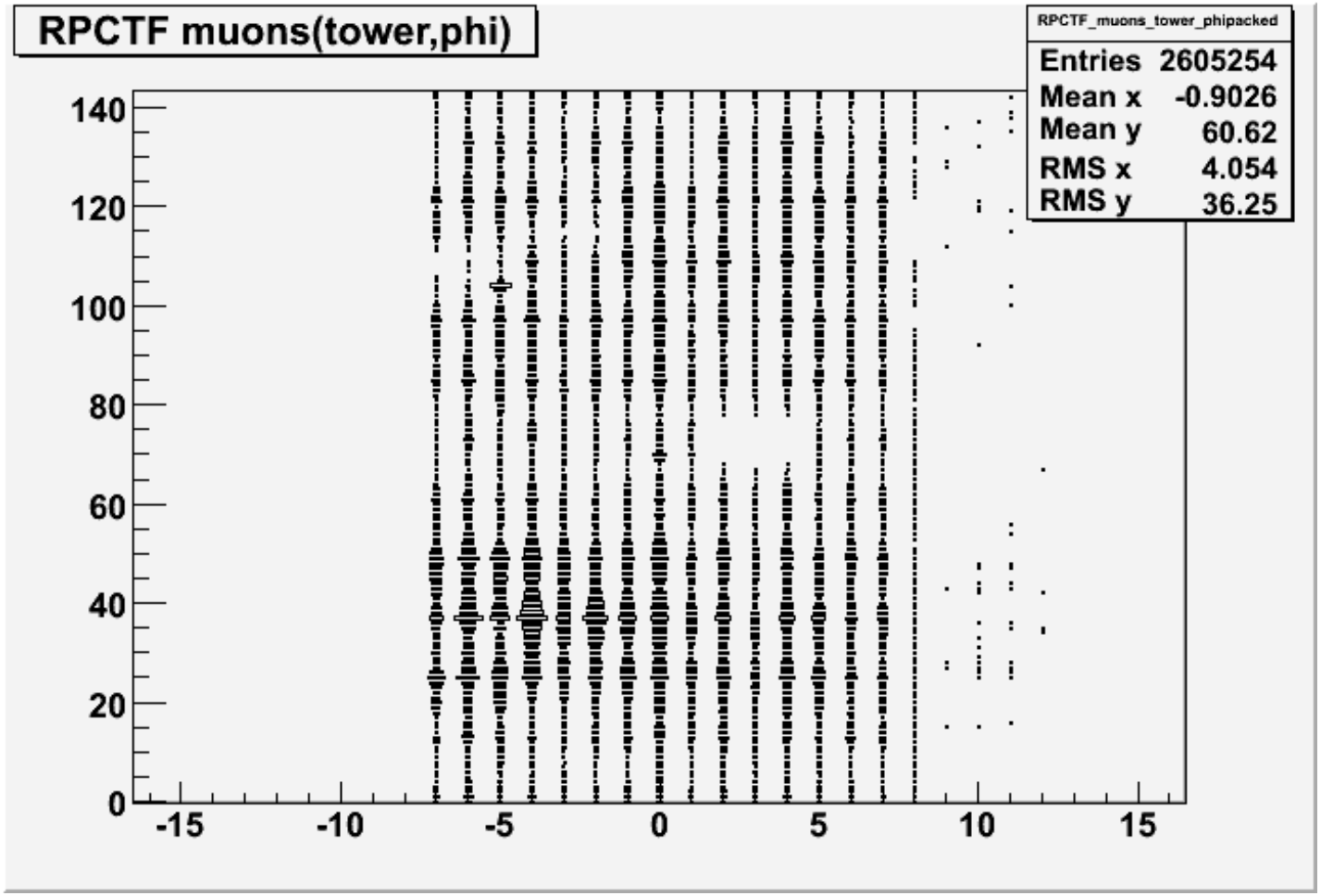
Data-emulator comparison - disagreements



Eta-phi distributions of disagreeing candidates (eta 63 is tower -1, eta 60 is tower -3)

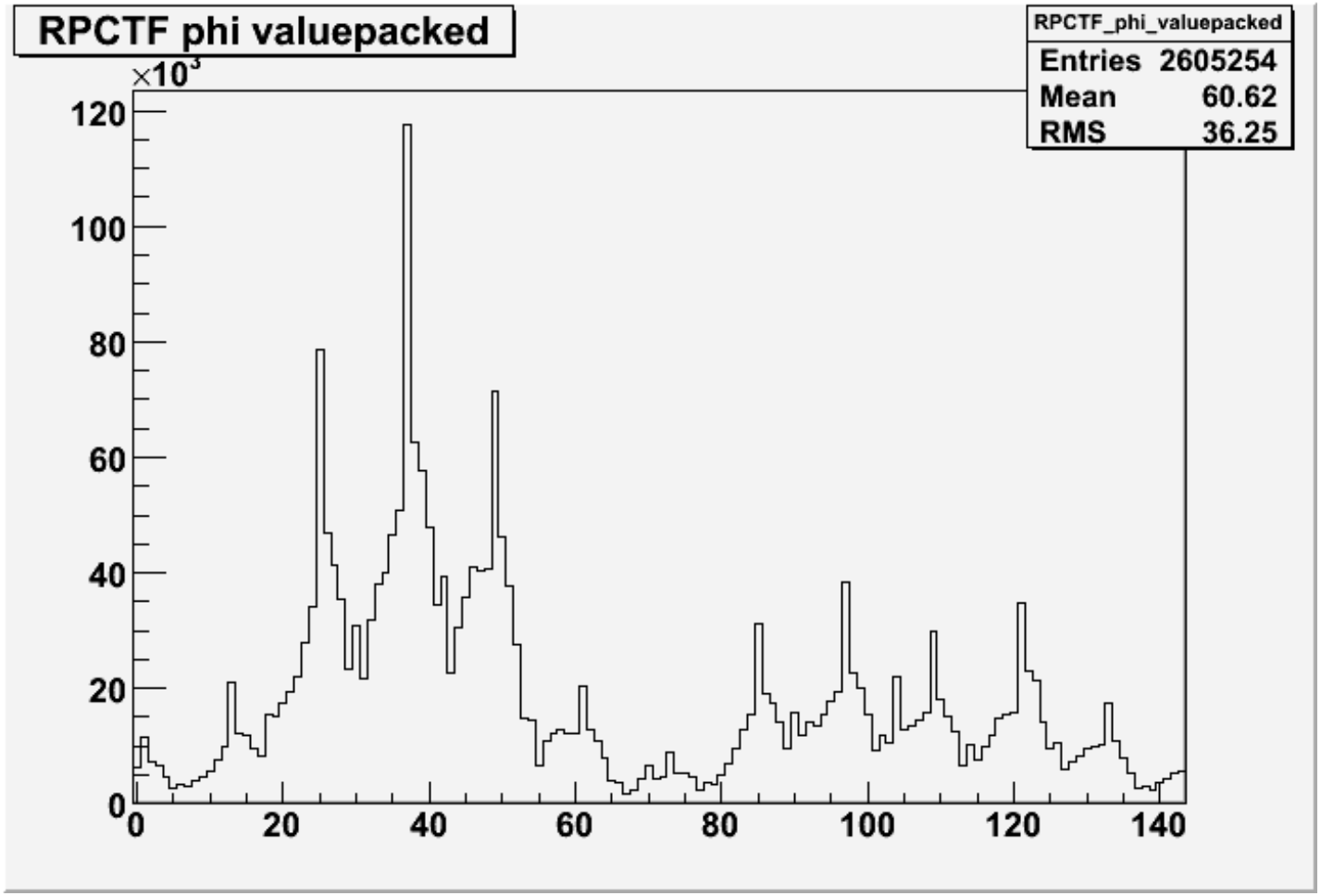
- Disagreement mostly visible for trigger crate 9. Probably due to transmission errors
- Some candidates with eta=8 also disagree (doesn't depend on phi, not yet understood).

Trigger occupancy



- All (12) trigger crates giving the trigger (full ϕ coverage).
- Visible dead region around (phi,eta)$\sim$(70,3) due to chambers in wheel+1 sector 7 being off (see https://cmsdaq.cern.ch/elog/RPC/2191)

Trigger phi distribution



- No hot regions, periodic structure due to detector ϕ segmentation
- 12 peaks probably due to geometrical segmentation. Under investigation

Goals for CRAFT

Goals for CRAFT:

- Finish barrel hits synchronization
- Perform endcaps hits synchronization
- Firmware update (new FW with automatic optic synchronization)

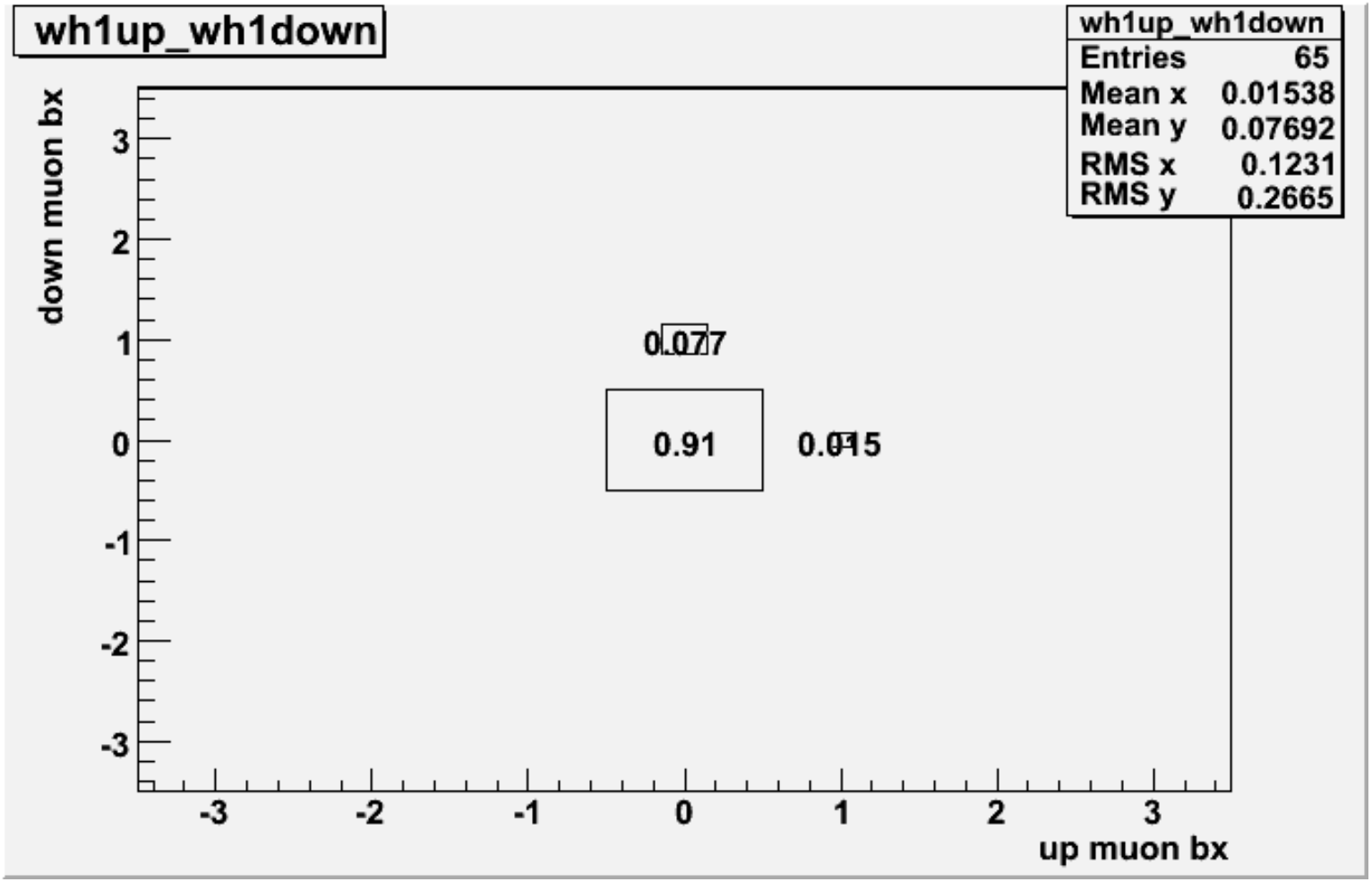
This goals weren't met due to coherent chamber noise appearance (when running with magnetic field) and problems with communicating with endcap (which is fixed now). Priority was given to noise studies

Muon hits synchronization between wheels

Method to check the synchronization:

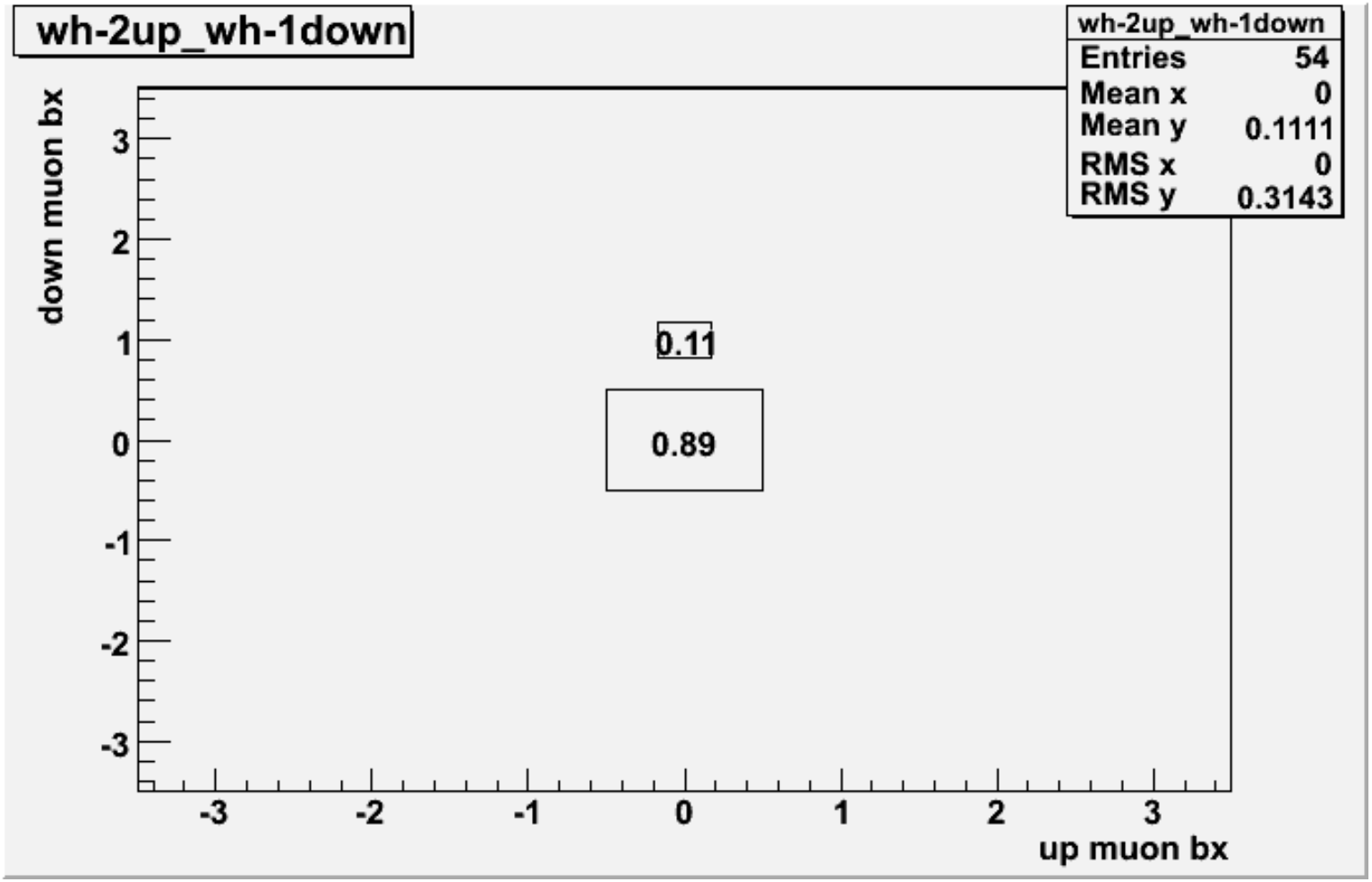
- Look for events with at least two muon candidates from RPC.
- First muon in up part of detector, second muon in down part of detecor
- Fill 2d histogram with BX of up and down muon candidates
- Histogram title says what is compared - **wh1up_wh0down** means that BX of RPC muon candidate comming from up part of wheel 1 is compared with BX of RPC muon candidate comming from down part of wheel 0

Muon hits synchronization between wheels



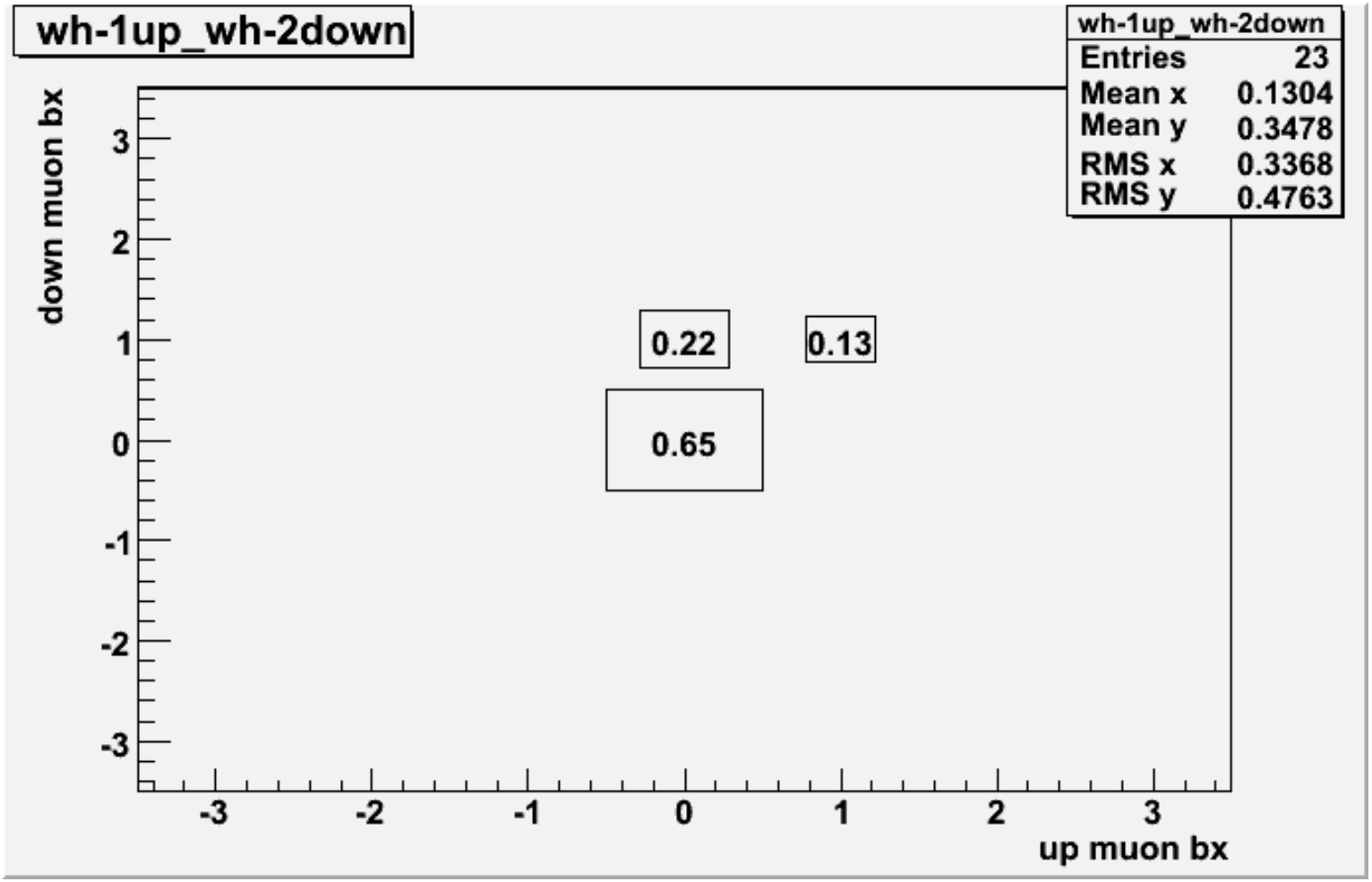
Example of good relative synchronization (up part of wheel1 vs down part of wheel1)

Muon hits synchronization between wheels



Example of good relative synchronization (up part of wheel-2 vs down part of wheel-1)

Muon hits synchronization between wheels



Example of relative synchronization that must be improved (up part of wheel-1 vs down part of wheel-2)

Summary

- All 12 crates giving trigger - full ϕ coverage
- Good data-emulator consistency