Muon DT Meeting

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TB2003 data analysis

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Summary

- TDC-TRACO matching: bug fix & resolution
- Data - simulation comparison
- Efficiency
- Ghosts:
  - ⇝ Out of time
  - ⇝ On time

Data Sample

- 40MHz bunched beam
- Several angles up to 45°
- Several BTI-TRACO-TS configurations
- 50000 events per run analyzed

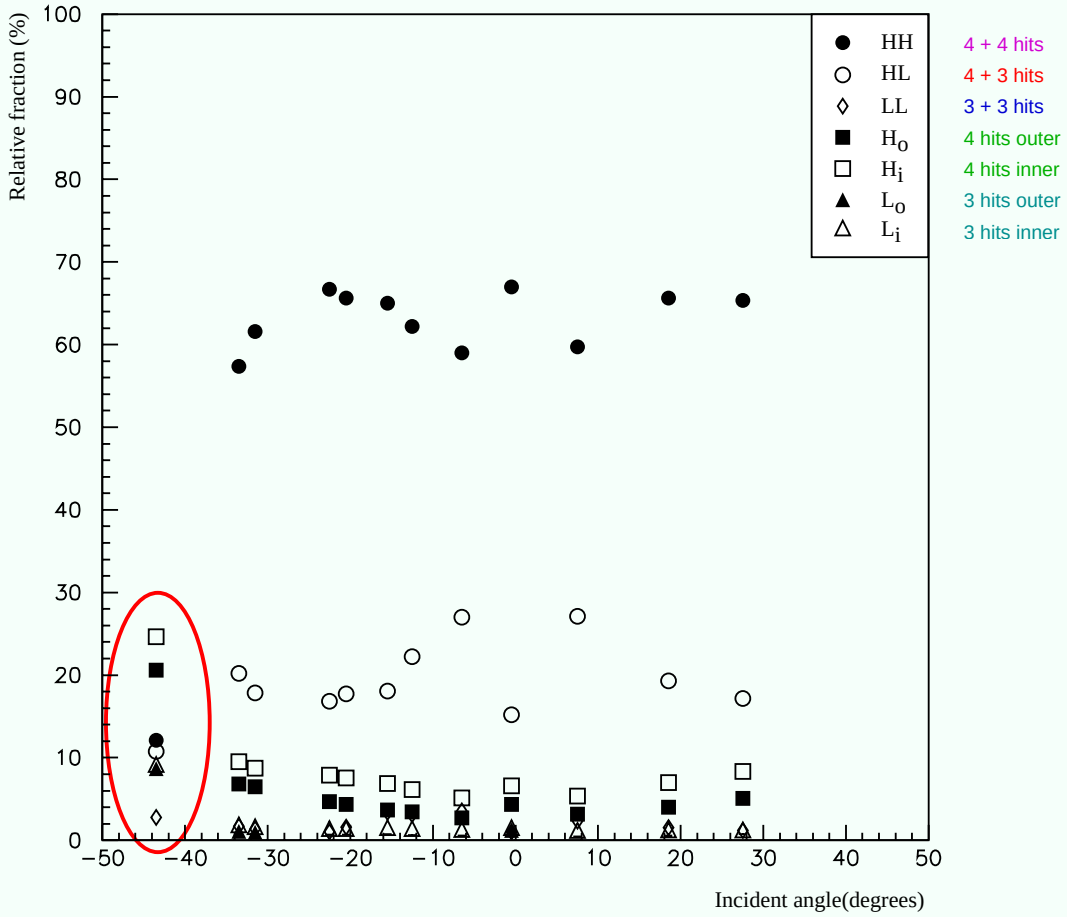
Selection cuts:

- scintillator trigger within 2ns
- at least 2 cells hit in beam region
- less than 3 hits outside time range -400ns $<$ t_0 $<$ 800 ns

In addition, to select single muon events:

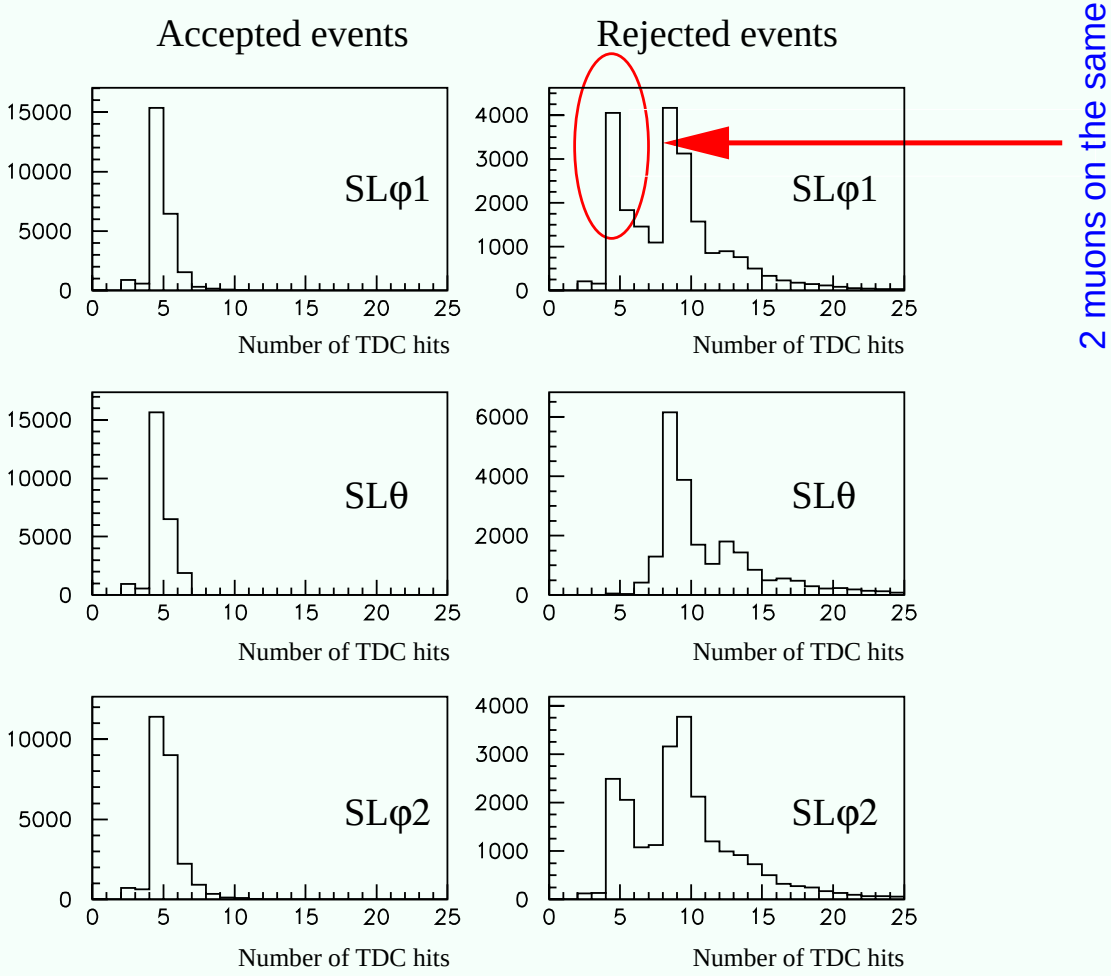
- less than 7 hits in at least one SL ϕ
- less than 7 hits in SL θ

Trigger type fraction



fast drop at large angle

Single muon selection



Normal beam incidence

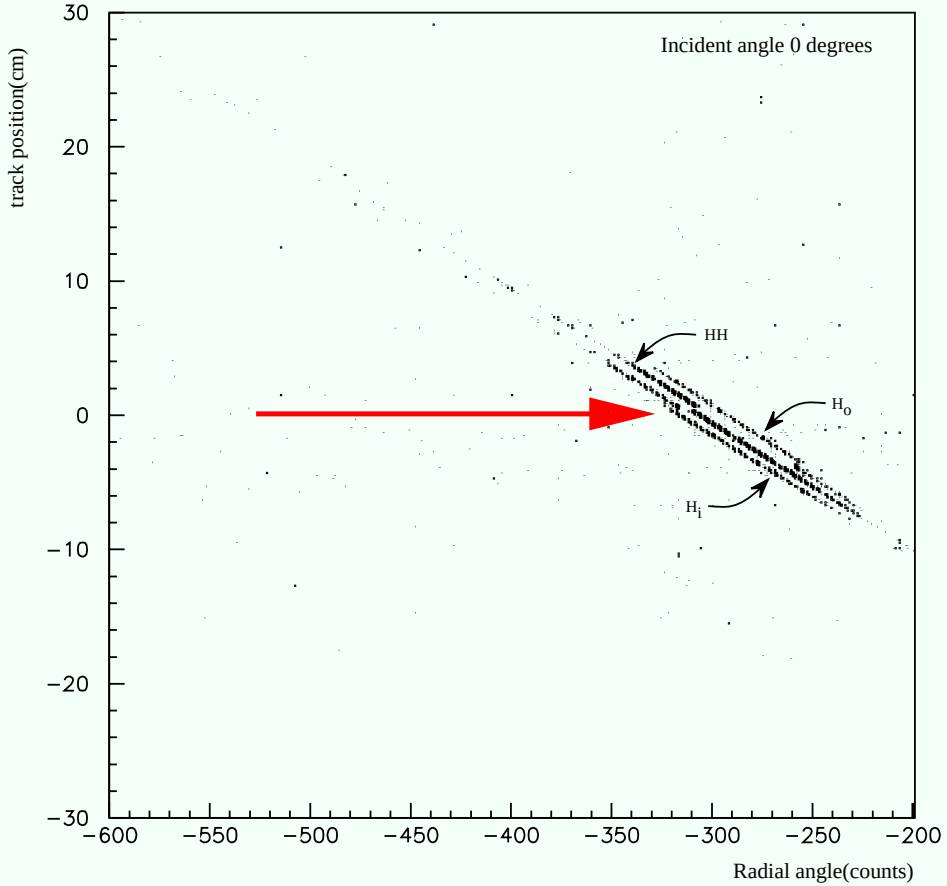
TDC-Traco matching

Tracks are reconstructed by

- ⇝ BTI-TRACO at trigger time
- ⇝ software (using TDC data) at analysis time

- Look for correlation
- Spot problems
- Reference and units transformation
- full comparison: resolution

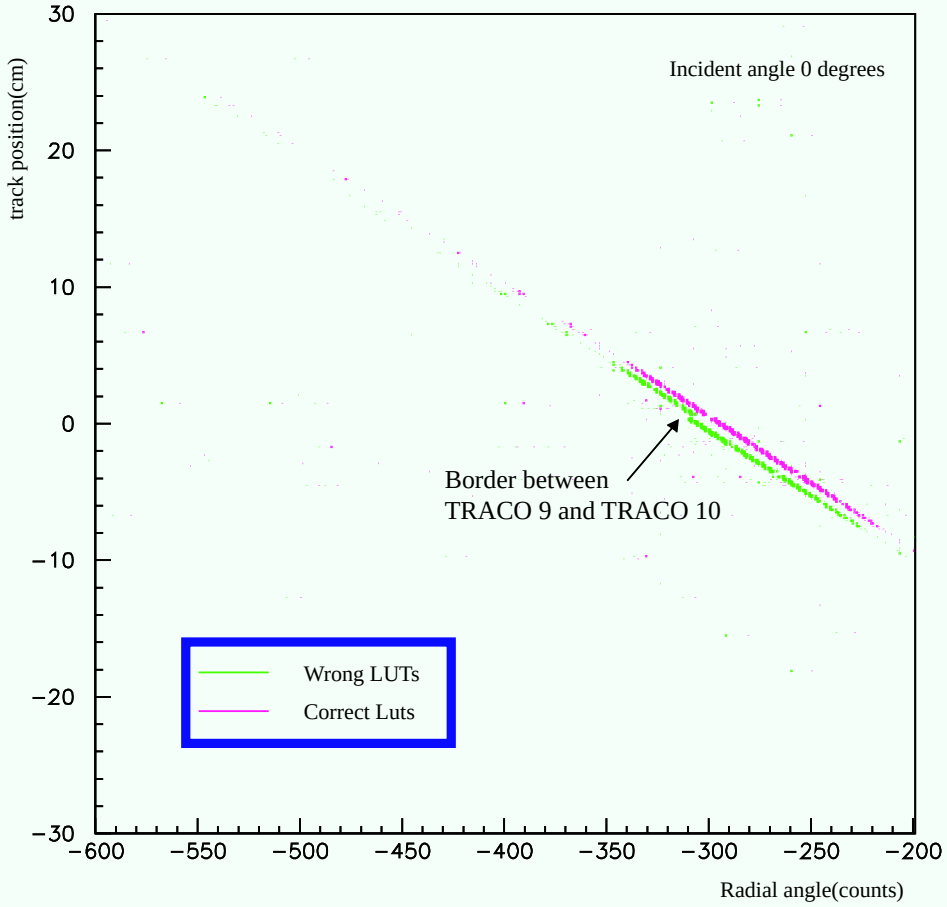
Correlation



Non overlapping lines

Non continuous lines

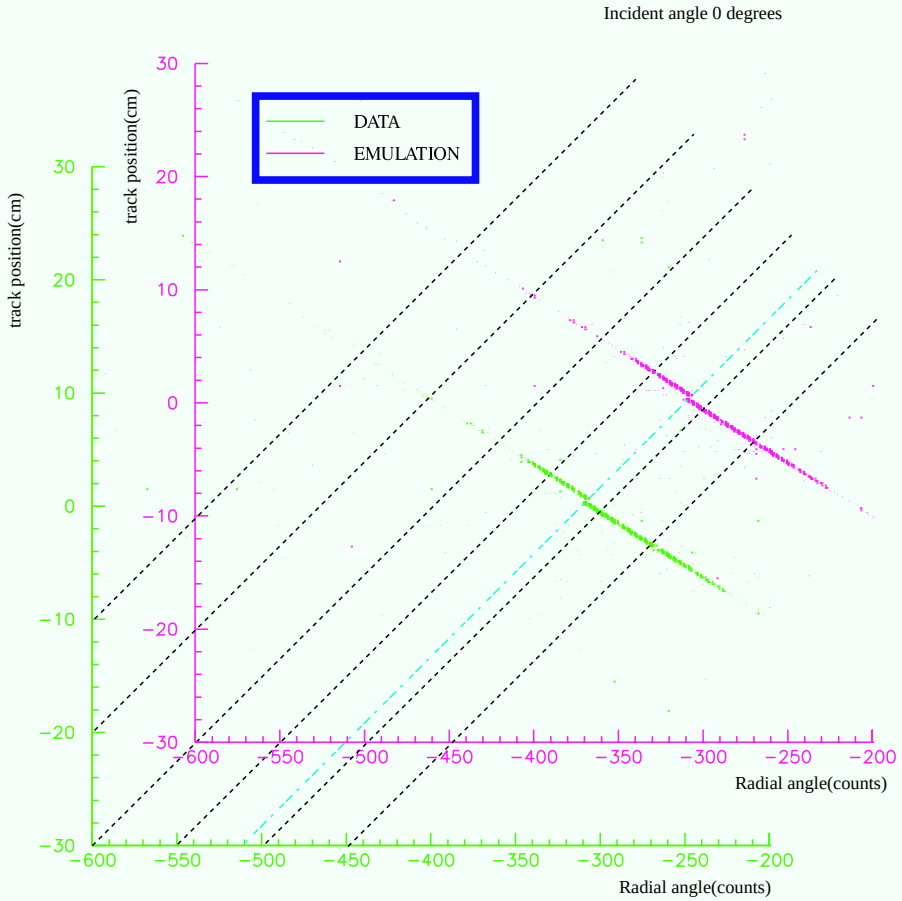
LUT effect



Bug in the TRACO LUT: drift velocity not coherent with BTI setting:

effect checked with simulation

Data-simulation comparison

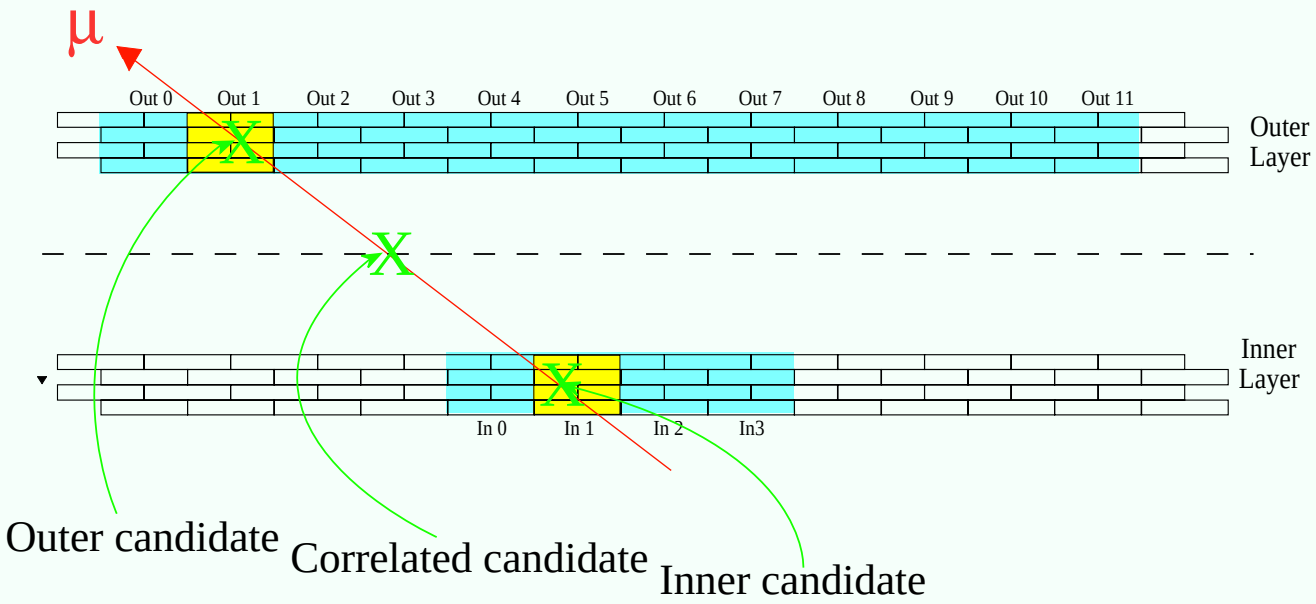


Simulation of trigger response from TDC output and comparison with data:

excellent overlap

Different angle handling

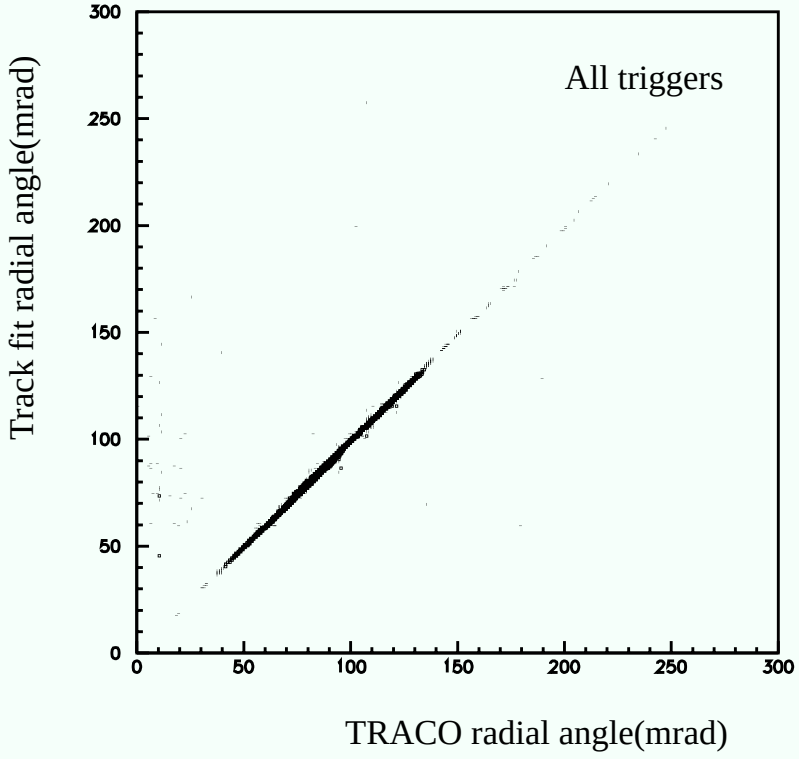
Data at different angles cannot be mixed when looking at simple correlation

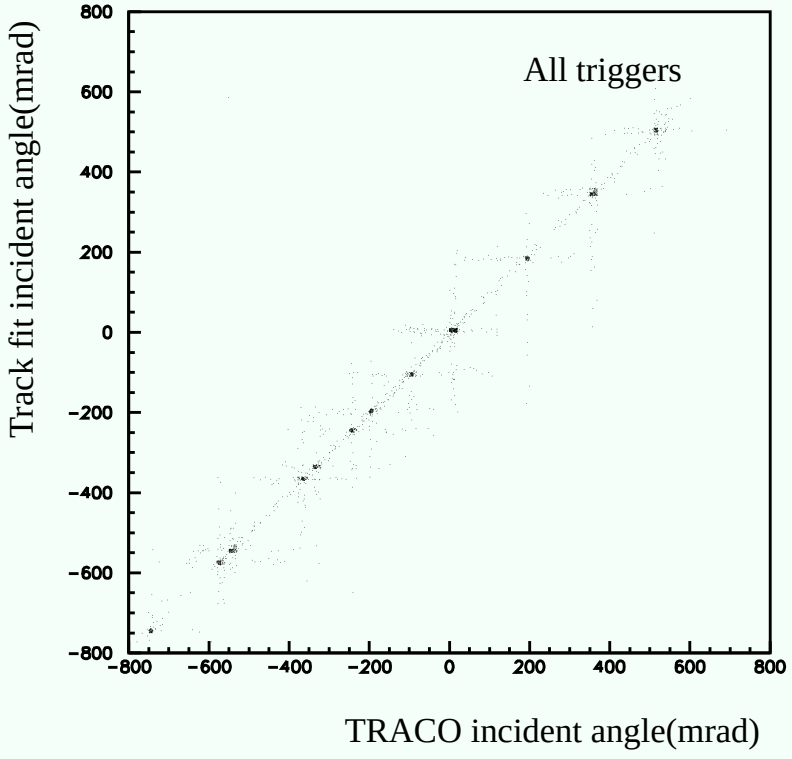


- TRACO Look Up Tables are computed in different positions depending on candidate quality
- Track fit from Drift times is always performed at chamber center
- LUTs and fit use different reference frames

⇒ Need extrapolation and frame conversion before comparison

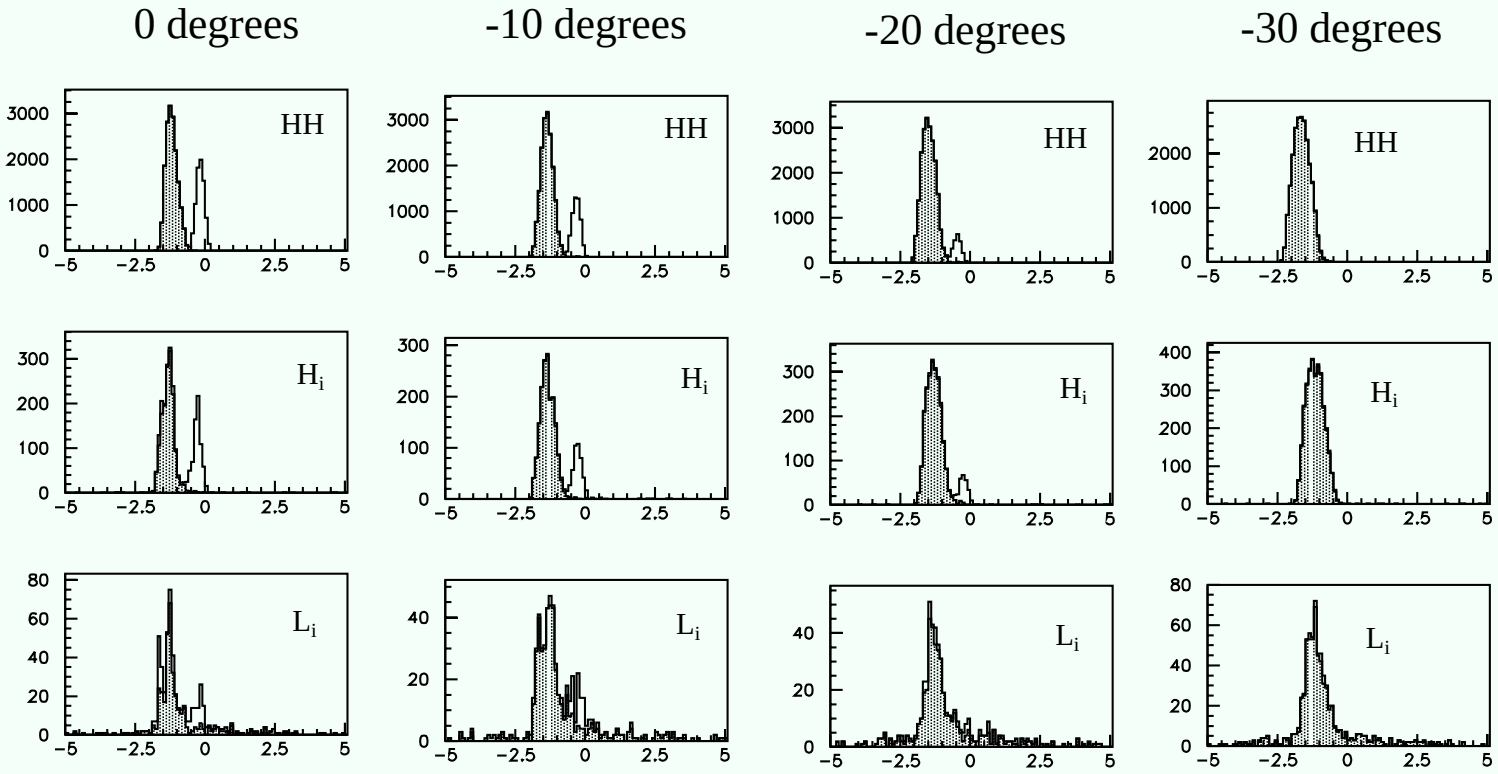
TDC fit - Traco comparison





After transformation trigger data and TDC fit show full agreement through all data samples

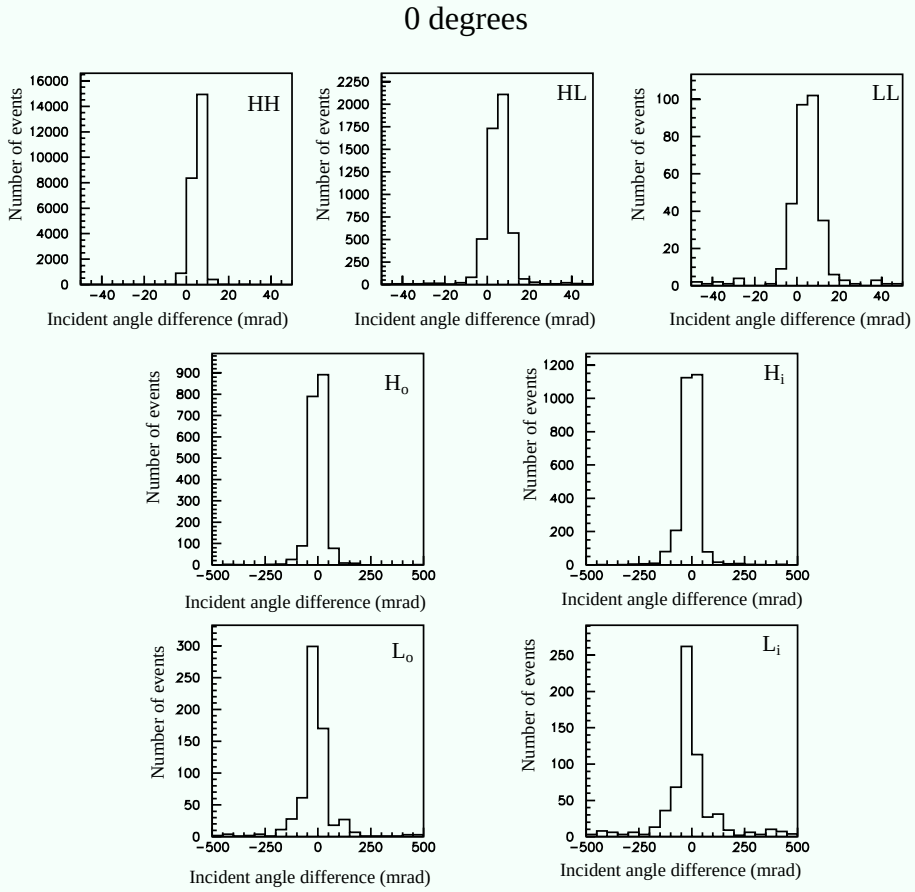
Radial angle resolution



Double peaks due to the LUT bug (TRACO 10 data shaded)

Constant resolution at $\sim$ 250 μrad (compatible with 1 count)

Bending angle resolution



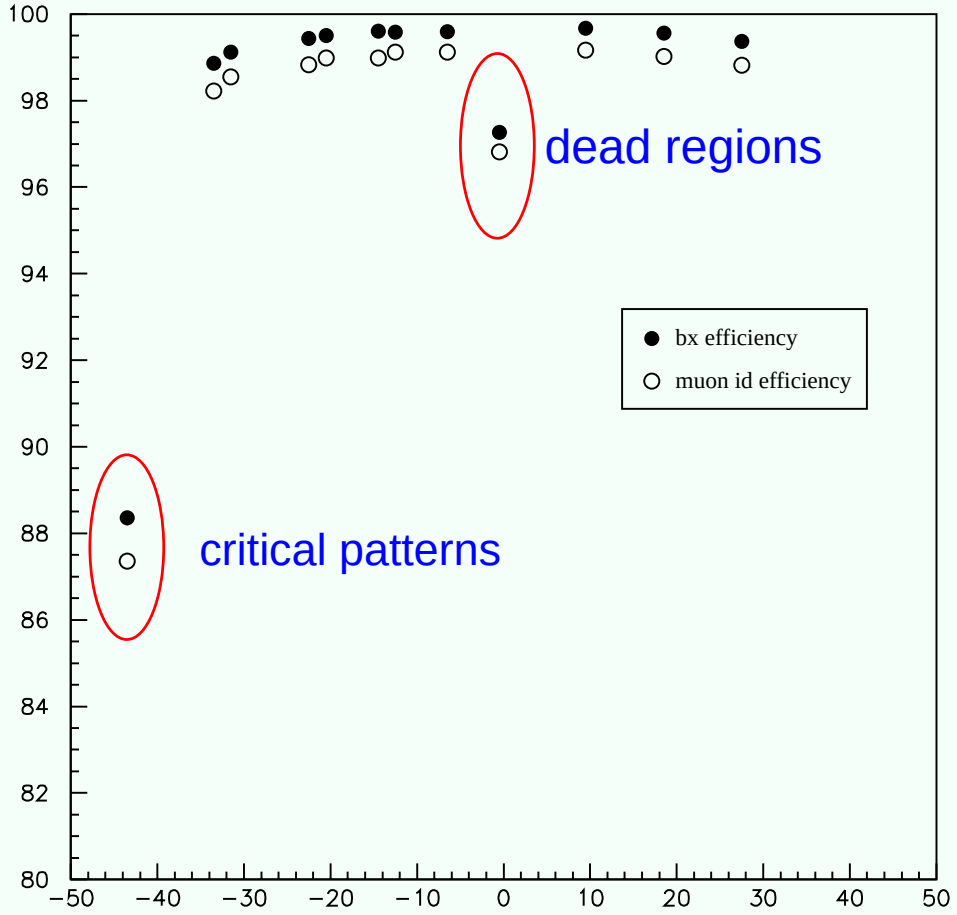
trigger type dependence: ∼ 5 mrad for correlated and ∼ 40 mrad for uncorrelated

Similar results obtained for other incidence angles

Efficiency

- Look for events with recorded trigger
  - ⇝ at correct time
  - ⇝ with correct track parameters
- see effect of incidence at:
  - ⇝ different angles
  - ⇝ different position

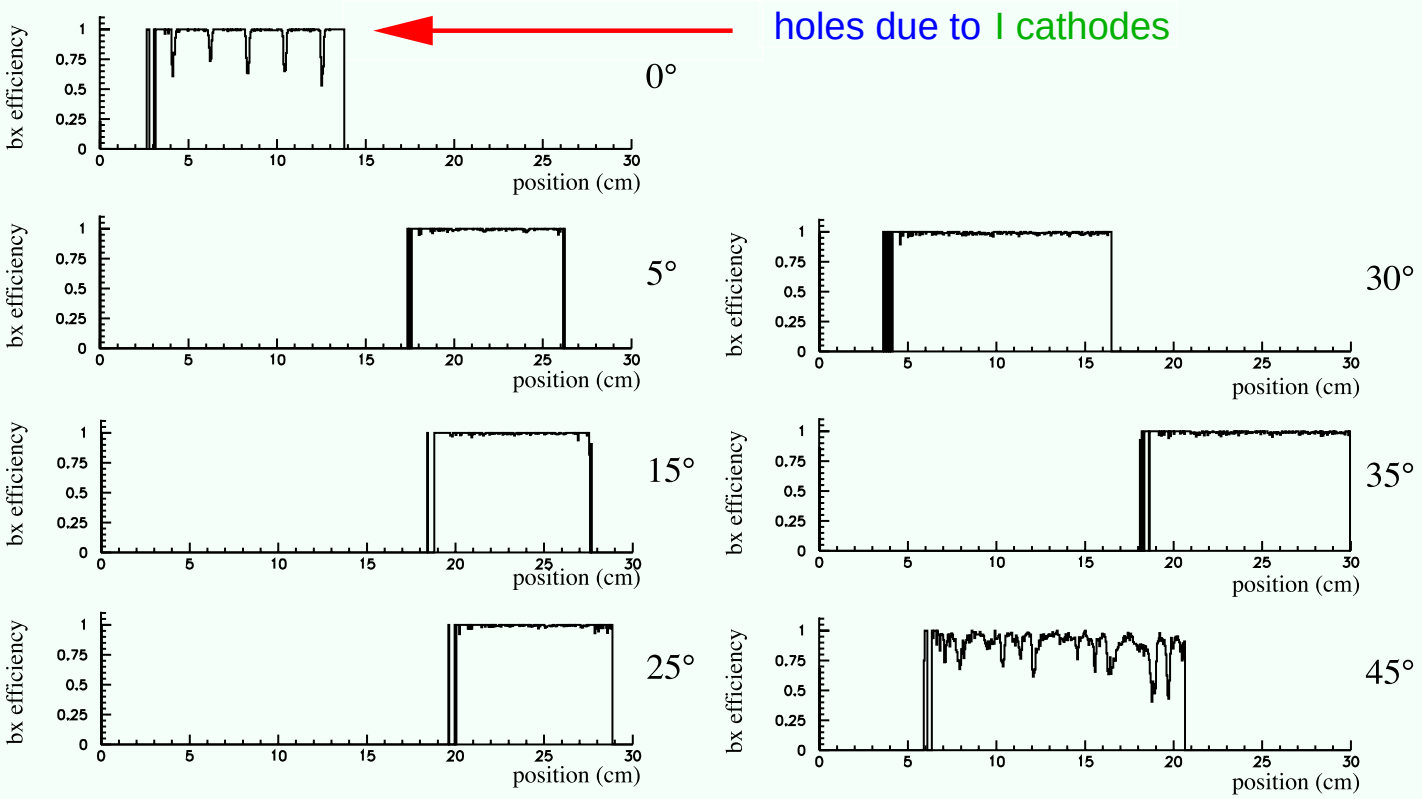
BX & mu identification efficiency



bx efficiency: given by any trigger at correct time

mu-id efficiency: given by a trigger with correct parameters

Efficiency vs. position



0°: cell dead regions line up

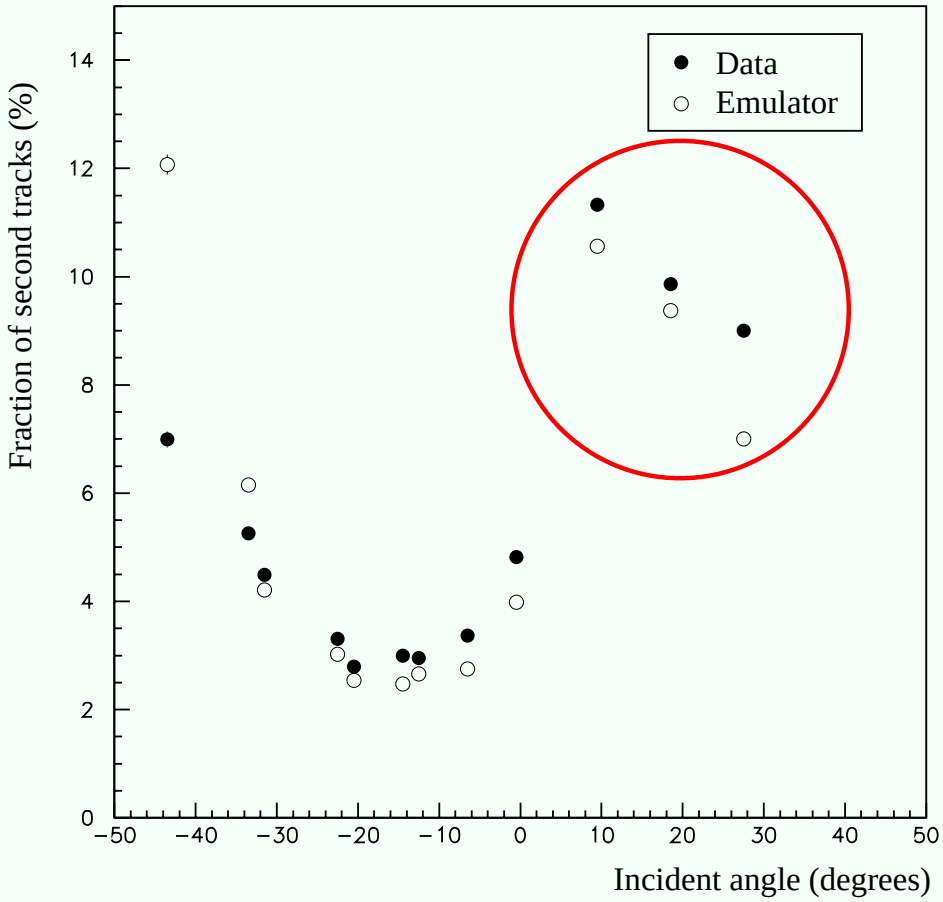
45°: time equations become quite complicated

other angles: efficiency is flat

Ghosts

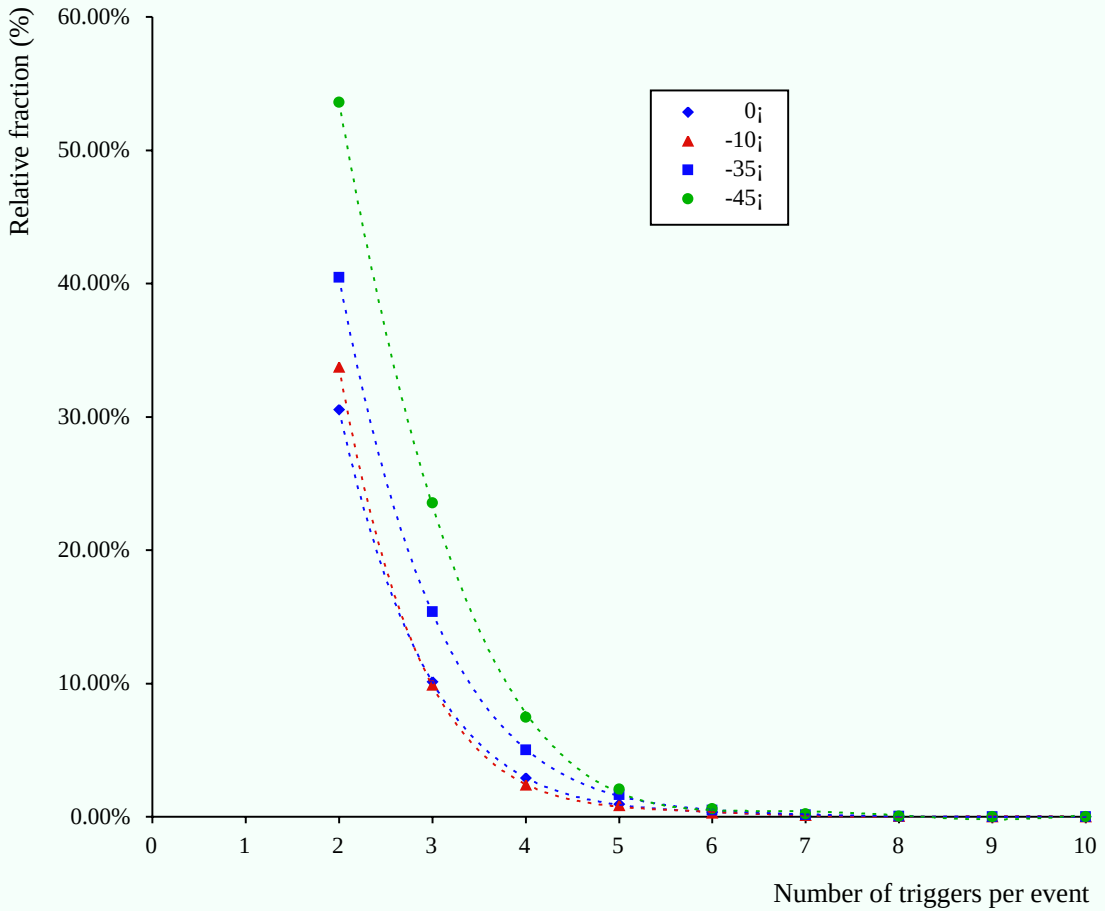
- On time: two tracks generated in the same slot due to
  - ⇝ TRACO superposition (same track copy)
  - ⇝ BTI superposition (low quality track)
- Out of time: fake alignment in nearby slots due to
  - ⇝ tolerances
  - ⇝ hit reflection
- Different configurations studied

Second-track fraction



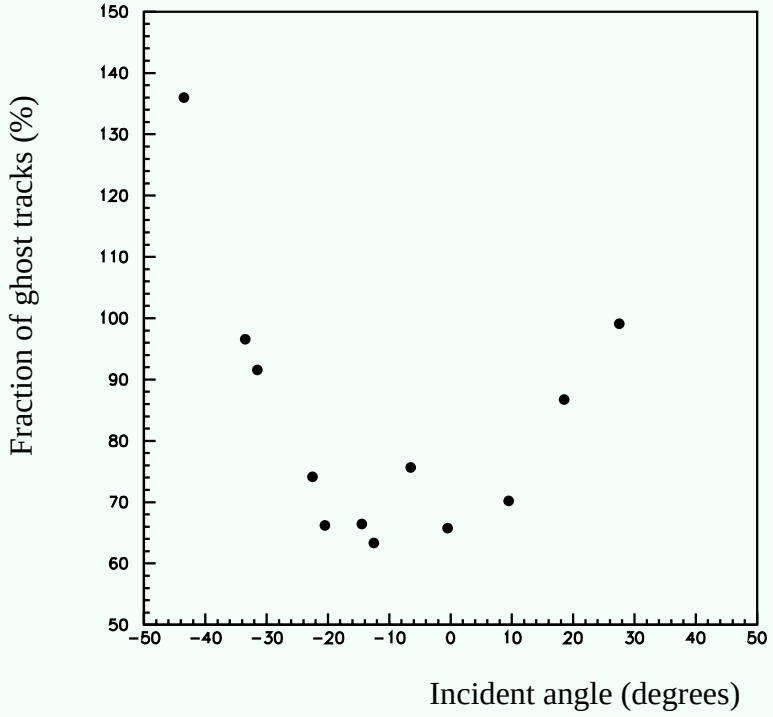
Excess of fake triggers at positive angles due to equation redundancies and noise hits: it may be removed by a redefinition, with an increase of low-quality trigger rate.

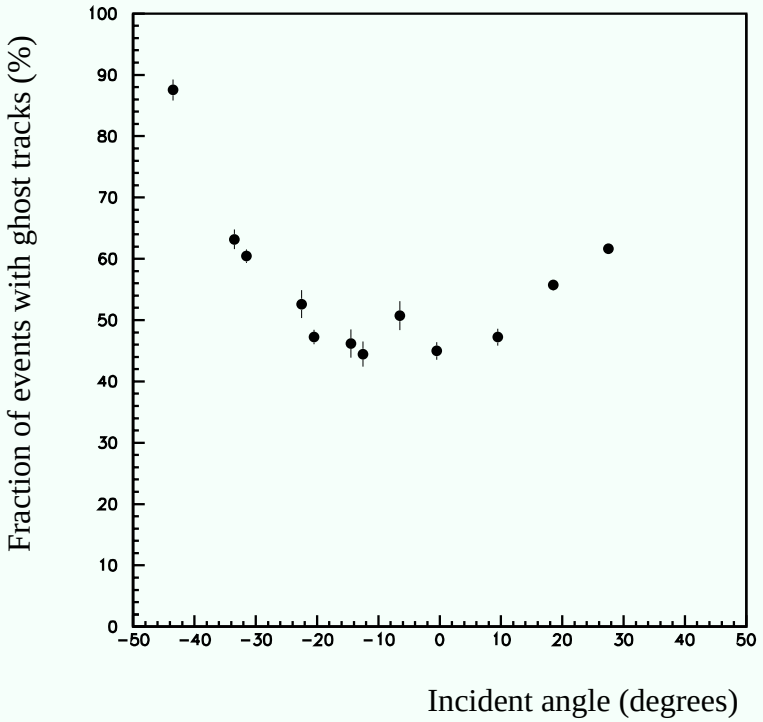
Out of time triggers



Increase with angle (more patterns for alignment), symmetric

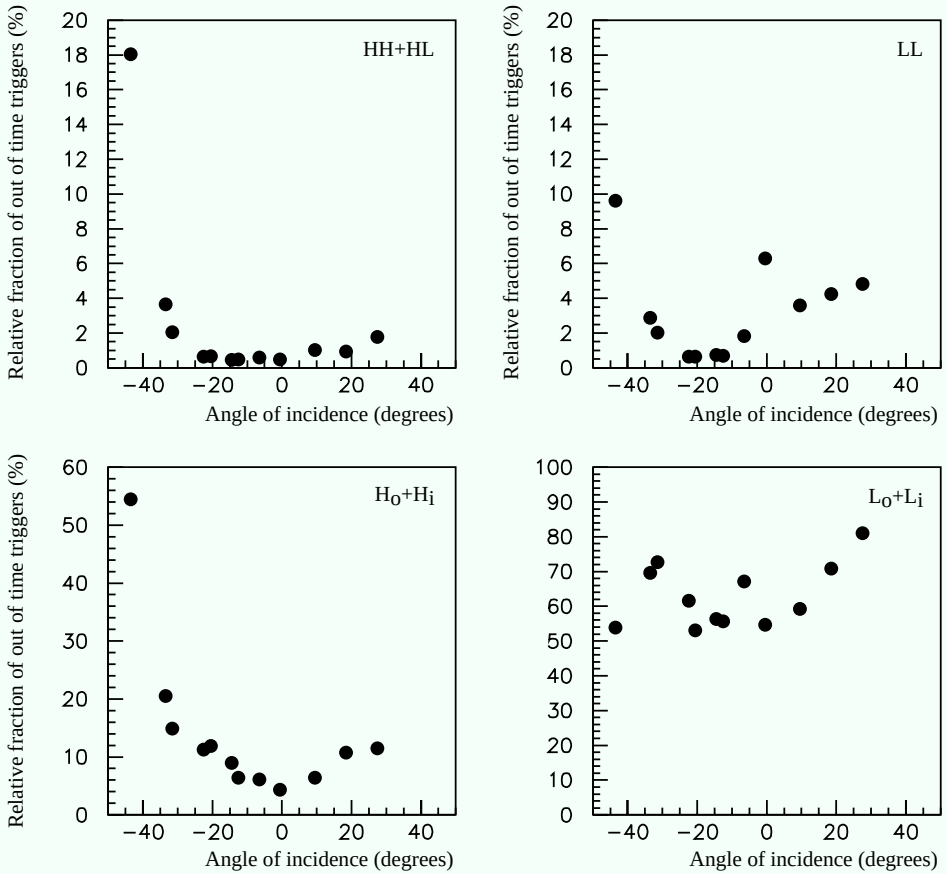
Out of time triggers





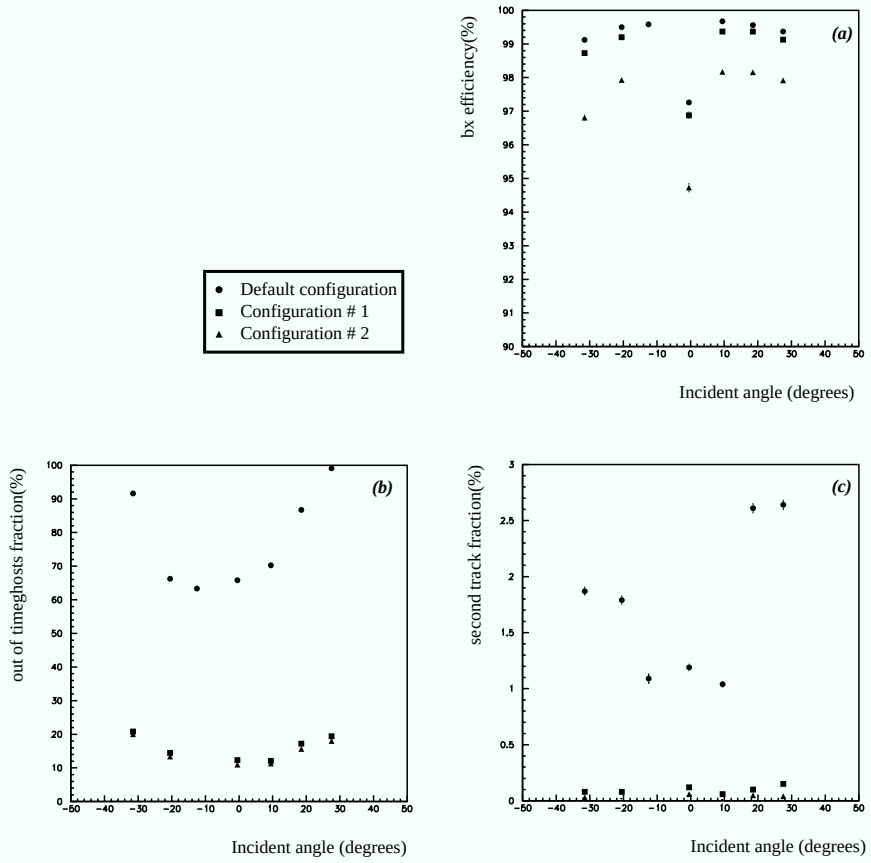
Average well below 100%

Out of time trigger type



Most out of time fake triggers are uncorrelated L-type: not used as track origin

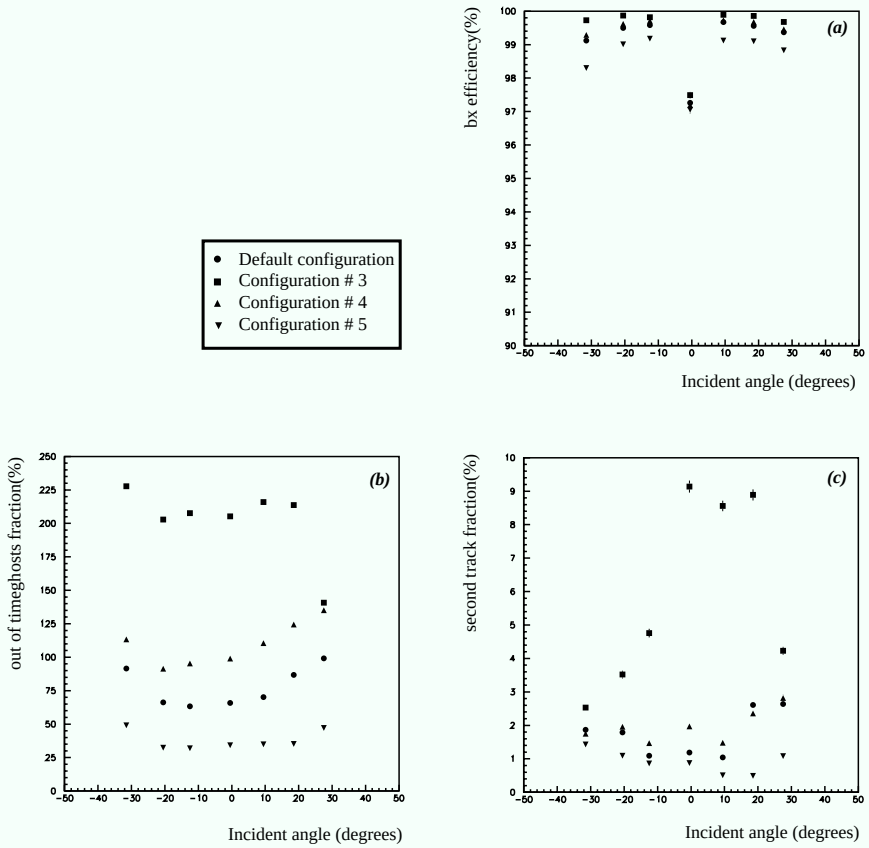
Theta trigger validation



Conf.1 (squares): L-trigger accepted if a H-trigger is present in Θ SL

Conf.2 (triangles): L-trigger refused

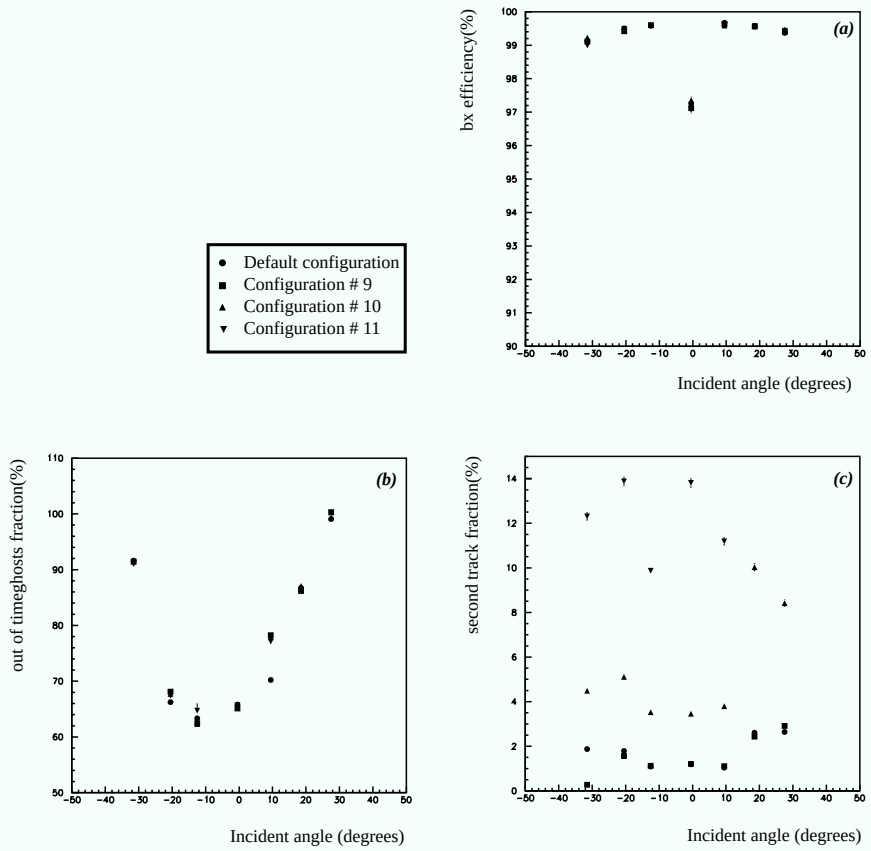
Low Trigger suppression



BTI LTS (circles): mandatory (too high noise otherwise)

TRACO LTS (downward triangles): applicable (small efficiency loss)

TS ghost suppression



Recover of H_i triggers if L trigger in following slot (squares): small effect

Ghost suppression disabled (triangles): unfeasible (much bigger noise)

Conclusions

- Results obtained on
  - ⇝ Resolution: at the expected level
  - ⇝ Efficiency: 98-99% in most regions
  - ⇝ Noise at acceptable level, space available for reduction
- Design choices validated
- trigger requirements are met

Acknowledgements

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+ all peoples being on shift during data acquisition