CMS Muon Meeting

HLT DT Calibration

(on Data Challenge Dedicated Stream)

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Overview

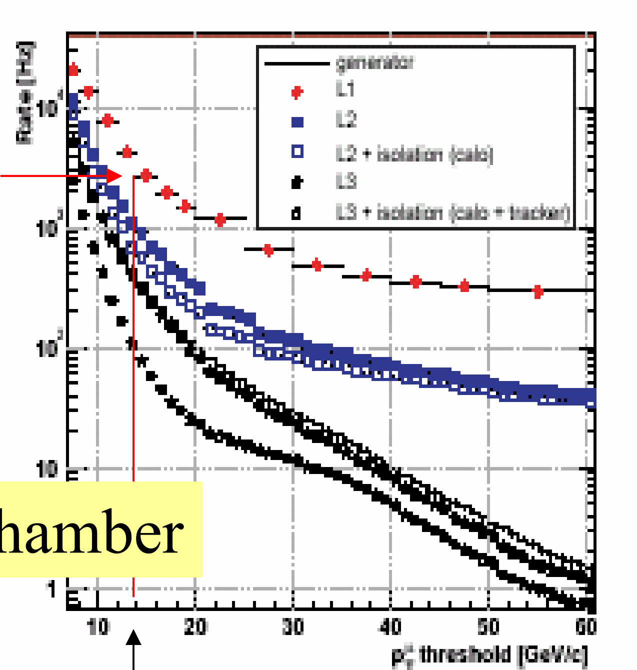
- Goal: develop the tools for HLT calibration for DTs in ORCA
  - Calibration algorithms + tools to handle/apply calibration constants
  - For the complete DT system
- Today's presentation: a preliminary exercise!
  - Playground to develop and understand the tools in ORCA
  - Not supposed to be realistic!
  - Current assumptions:
    - T_0 known from test pulses
    - Alignment known from optical measurements (decouple alignment and calibration for the time being)

DT Calibration

- TDC synchronization (T_0 pedestals)
  - Not considered here
- Determination of drift velocity
  - A) Using meantimers
  - B) Using residuals of reconstructed segments
- Available input:

low lumi:
2.7 KHz
L1 output
(1.3 KHz
in barrel)

20 Hz/chamber



single μ threshold

U.G., Calibration Workshop, 7/11/03

~minutes
to collect $O(10^3)$ segments/SL
(depending on available bandwidth)

Calibration in ORCA

- "DT calibration stream" (included in DC04 production)
  - Contains a copy of the DT digis for events with one reconstructed μ

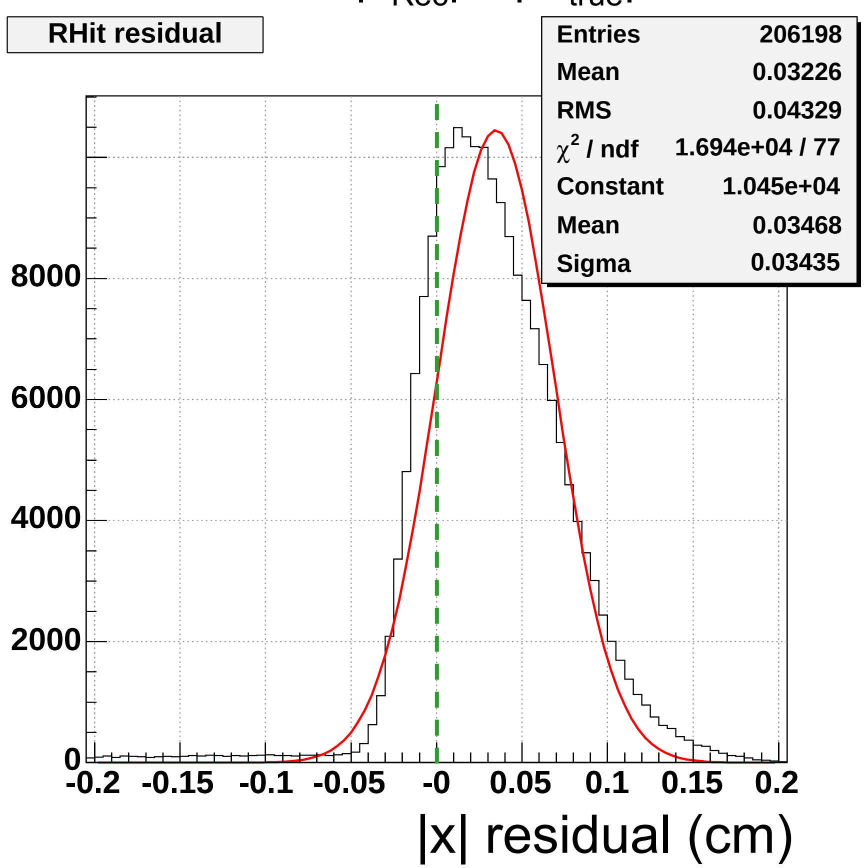
- Facilities implemented in ORCA:
  - Handling of per-wire digi offset
    - To allow per-wire T_0 subtraction
  - Handling of calibration constants
    - Interface to a "fake" condition database serving per-wire constants
  - RecHit reconstruction, different algorithms:
    - Using GARFIELD parametrization (CIEMAT)
      - Accounts for non-linearity and dependence on θ, **B**
    - Using constant v_d and σ (tunable on a per-wire basis)

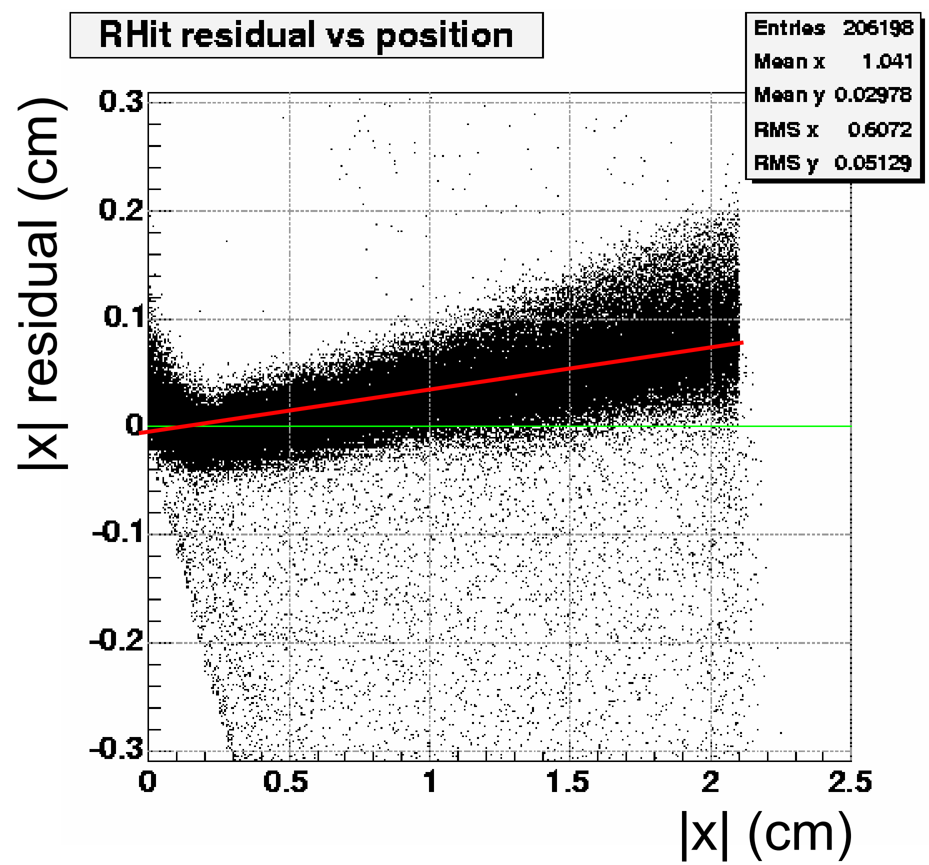
Example of Miscalibration

- Let's imagine a 3% v_d miscalibration

Rϕ RecHit Residual

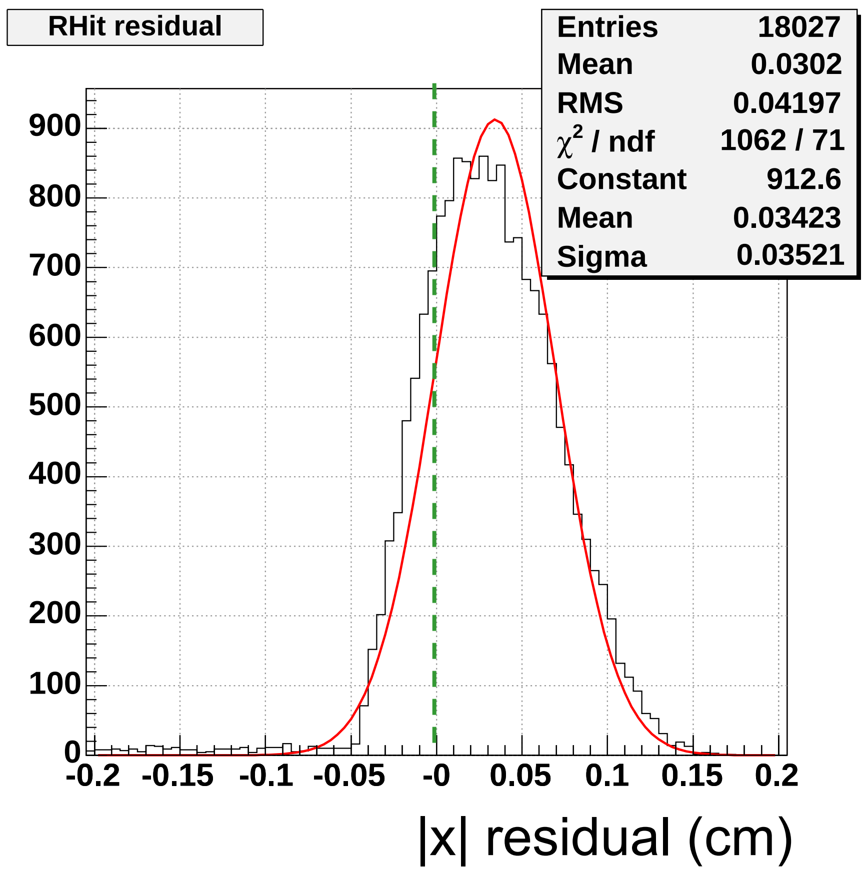
$\equiv |x_{Rec}| - |x^{\mu}_{true}|$



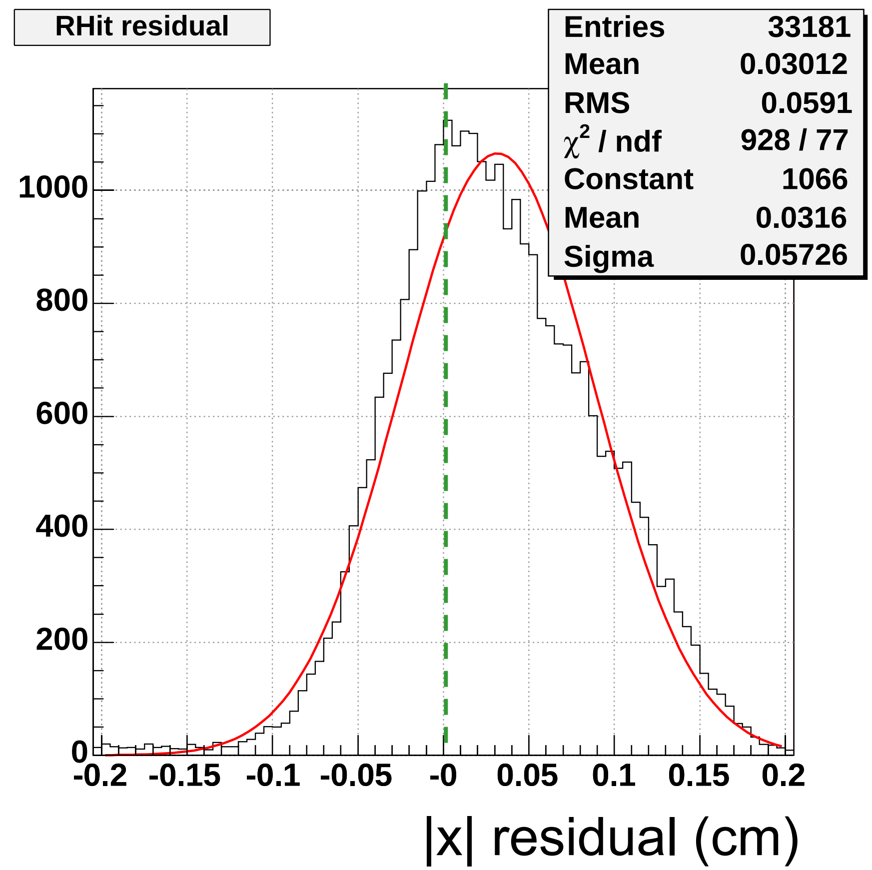


3% Miscalibration (cont.)

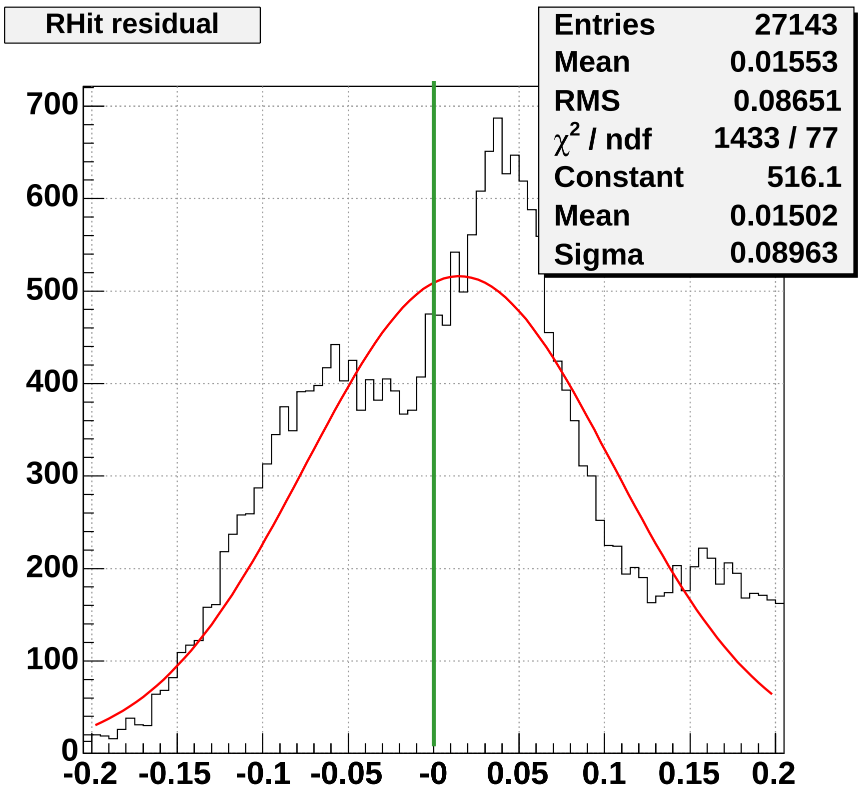
RZ,wheel 0



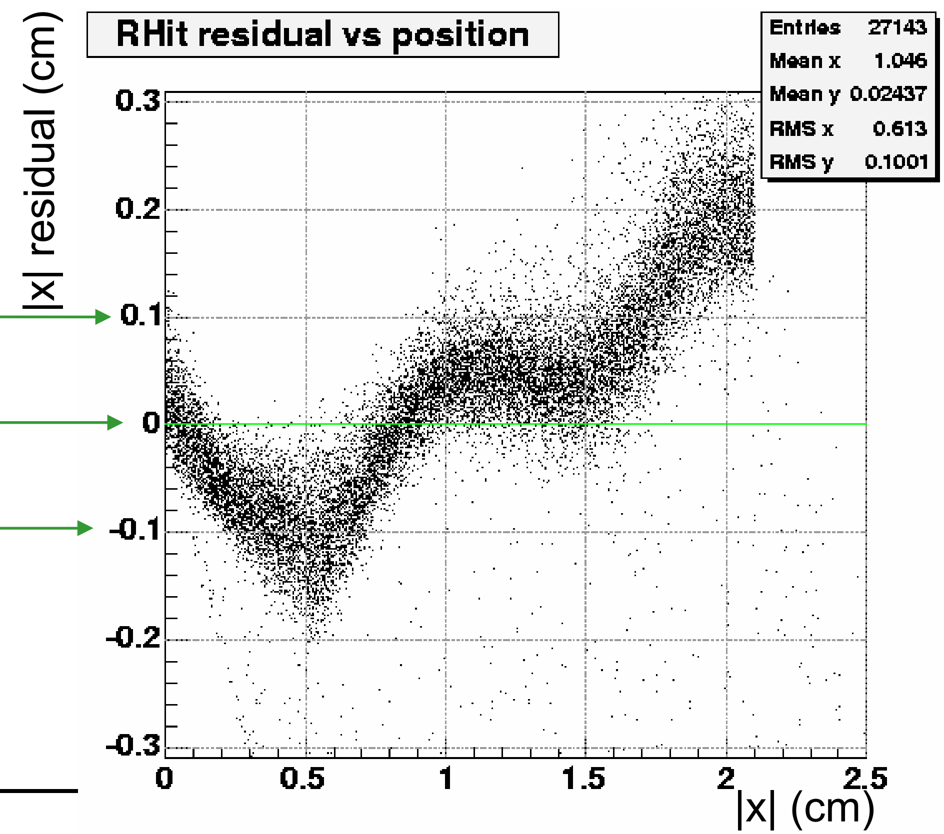
RZ, wheel ±1



Miscalibr. (cont.)



RZ, wheel ±2 RecHit Res.

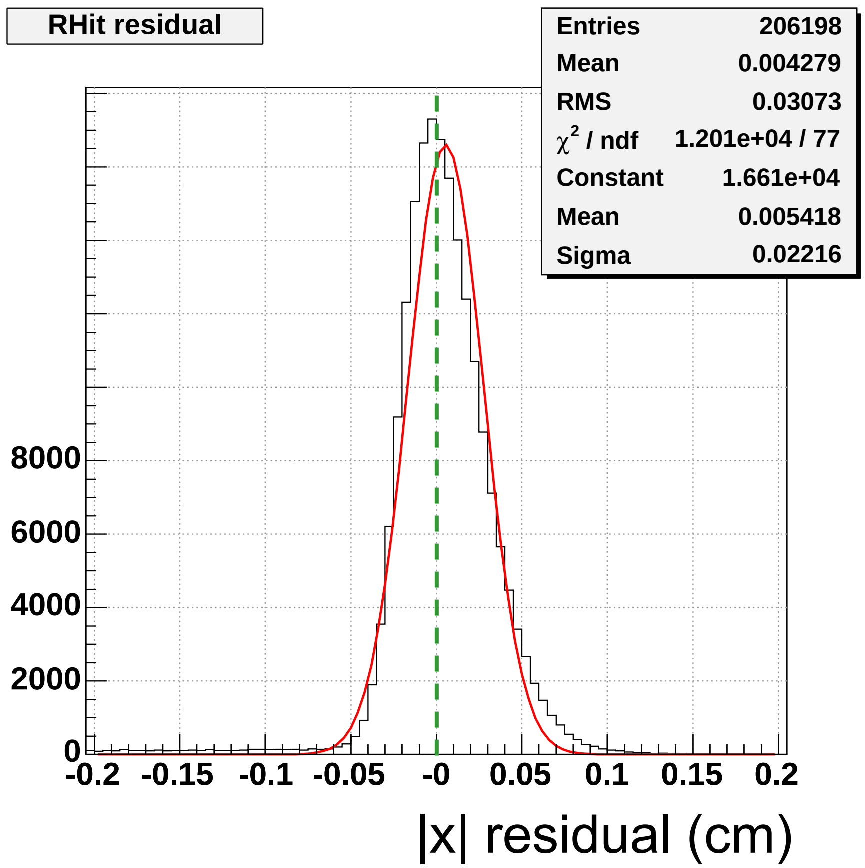


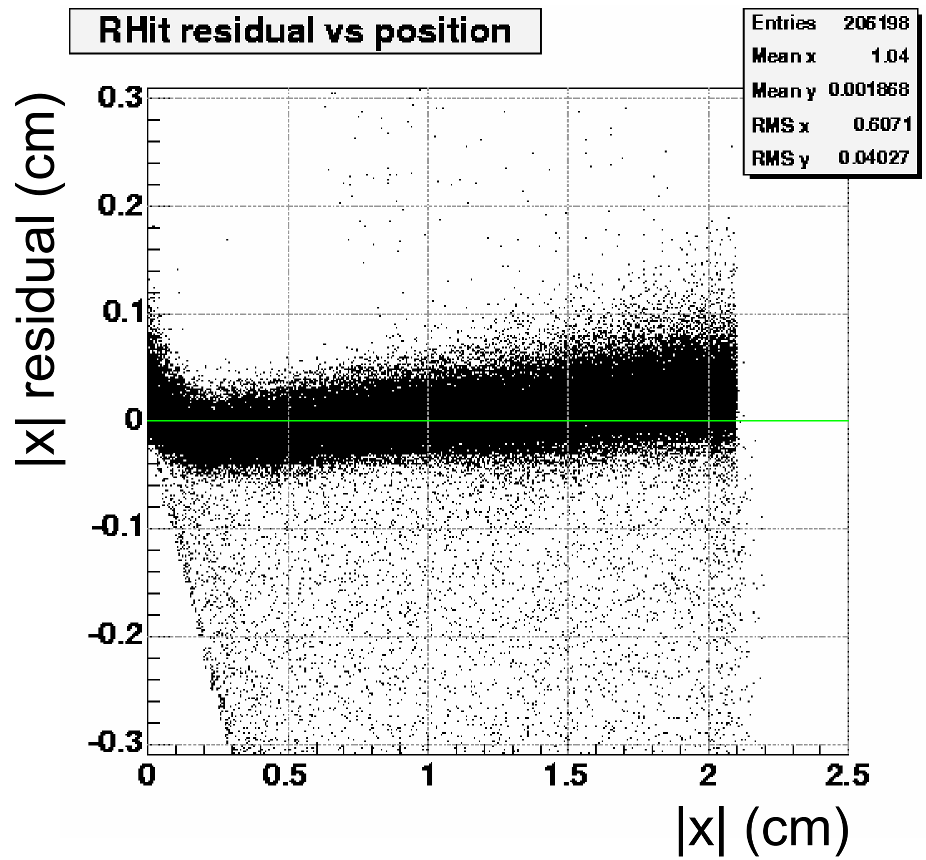
Calibration Exercise

- Starting from mis-calibrated constants, perform segment reconstruction
- Compute meantimers with SL granularity
- Get v_d and resolution
- Write calibration table (for the full detector)
- Use this table to check the residuals obtained on "calibrated" RecHit

Calibration Results

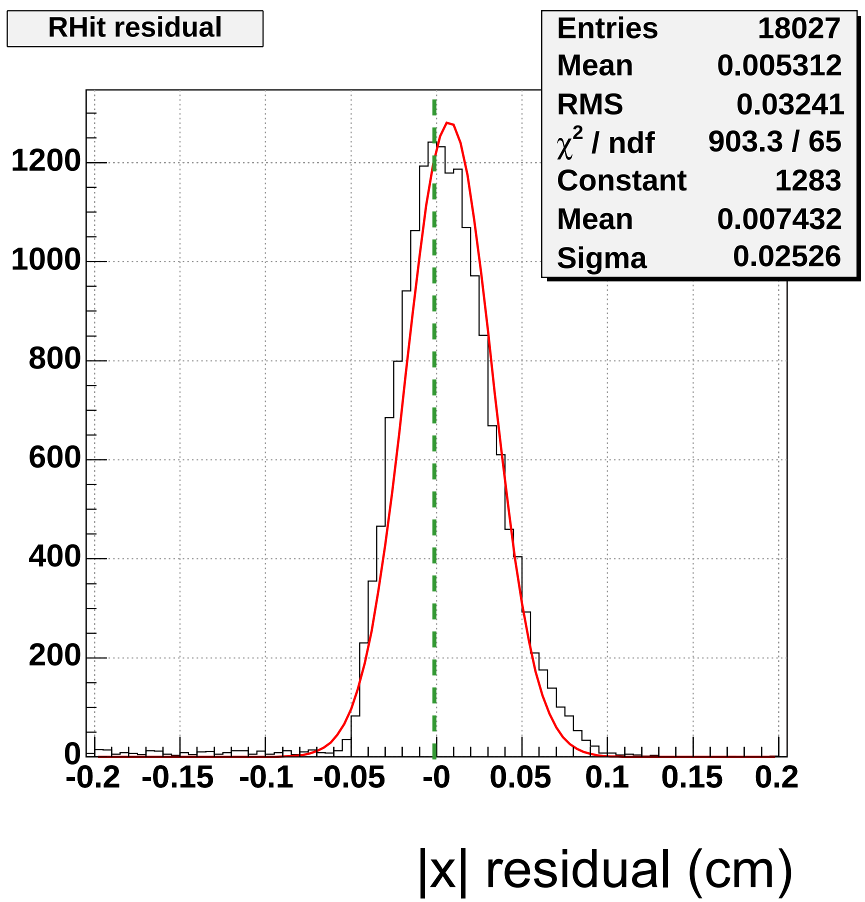
Rϕ RecHit Residual



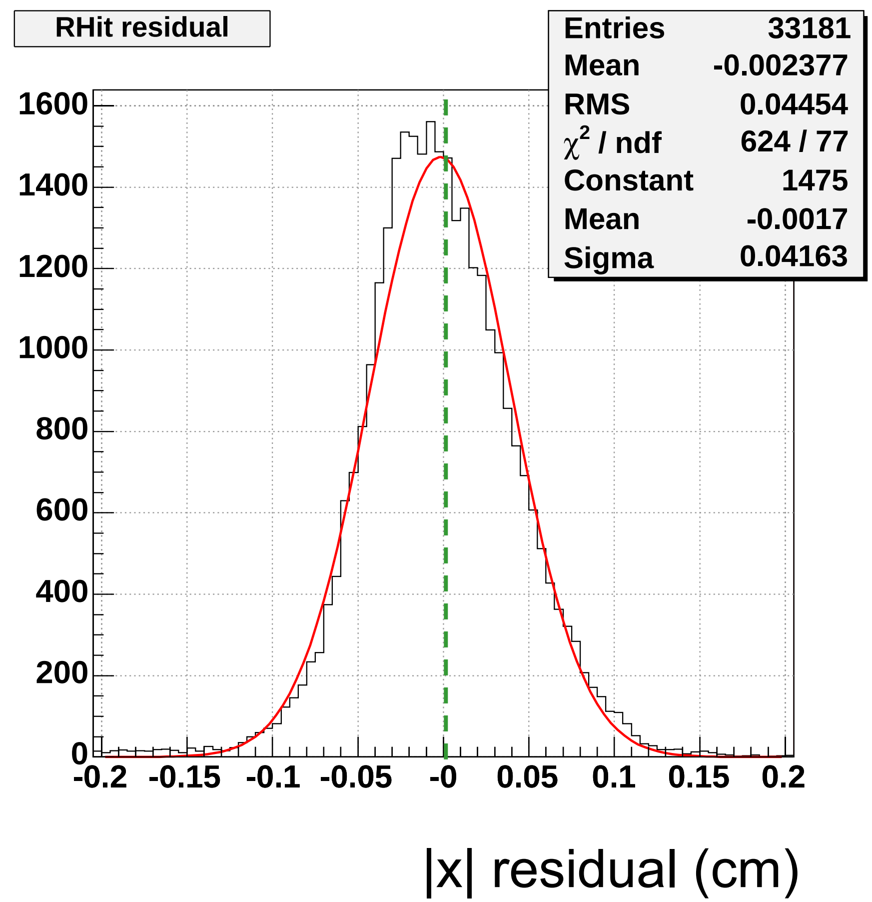


Calibration Results (II)

RZ,wheel 0

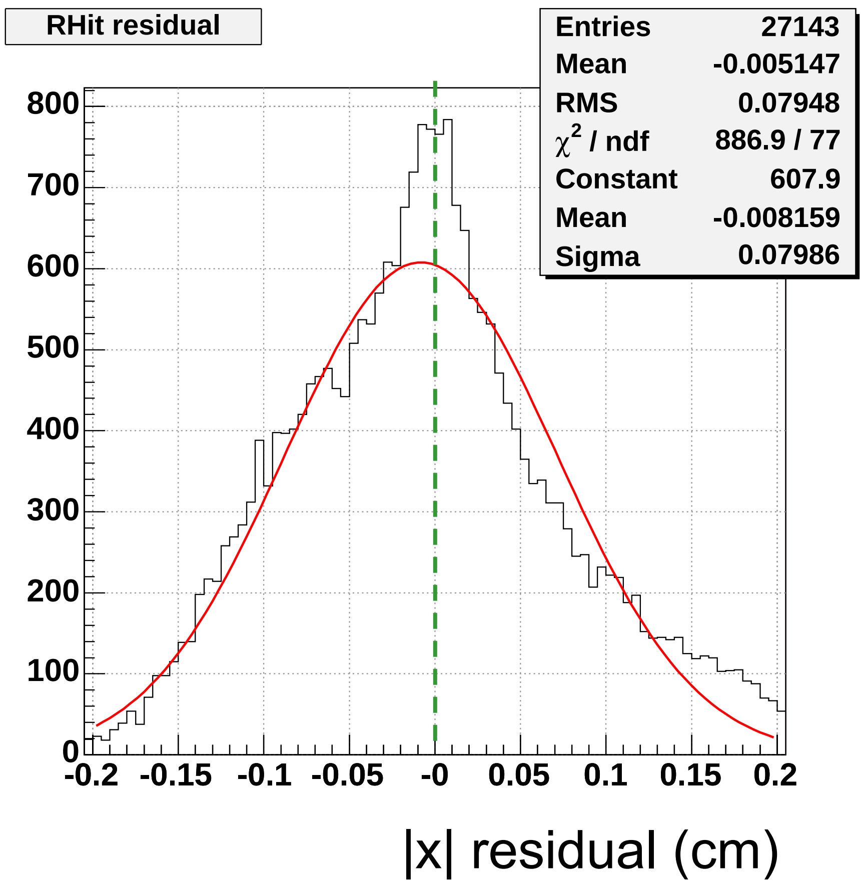


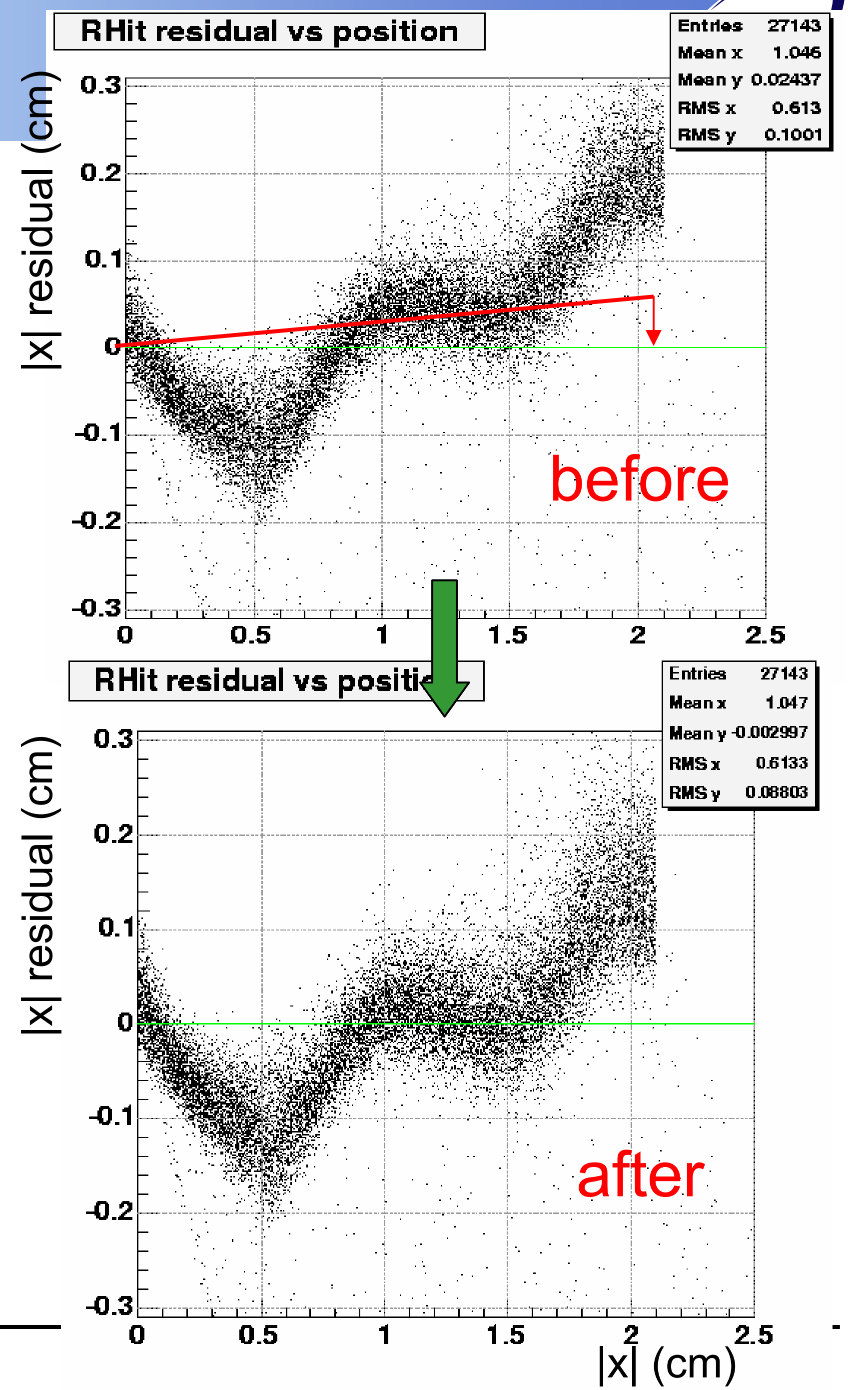
RZ, wheel ±1



Calibr. Results (III)

RZ, wheel ±2 RecHit Res.





Plans

- Try residual method
  - Depends on quality of segment reconstruction
  - Easier to compute resolutions
- Optimize the granularity
  - Per SL is probably too coarse; per wire requires too much statistics
  - Define regions with “homogeneous” **B** field within SLs
  - May also separate regions along wires (e.g. last few cm)
    - Using 3D segments
    - Increases complexity of calibration tables
- Take incident angle into account
  - In each region, compute parameters for few θ bins
  - More statistics required
  - Starts being complex to produce and to use in reconstruction…
- Alternative approach: calibrate the DT parametrization!

RecHits from Parametrization

- How it works:
  - Based on the inverse function developed by J. Puerta and P. Garcia Abia:

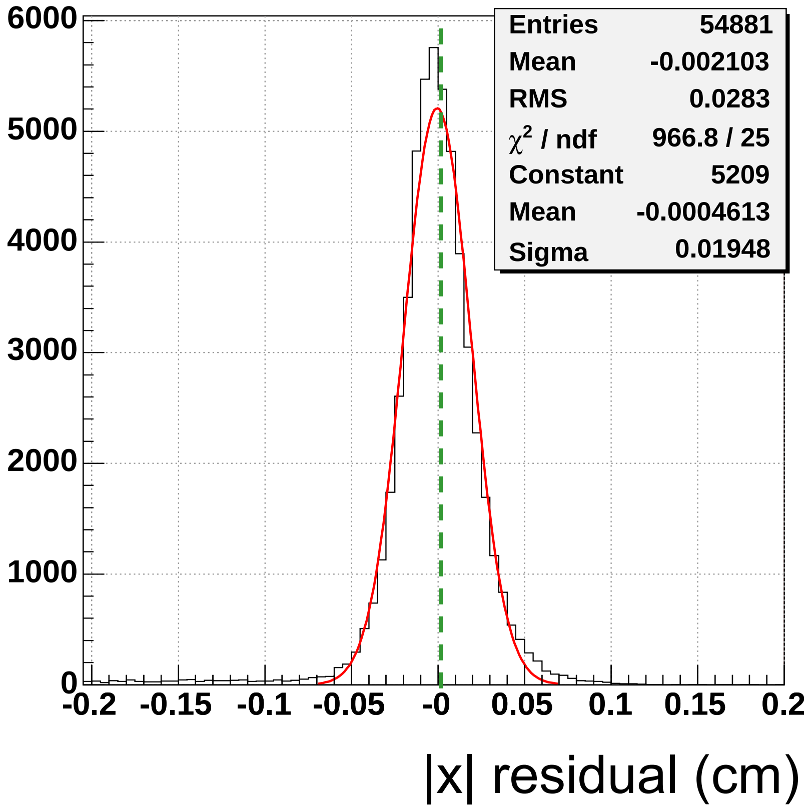
$$x = f^{-1}(t, \underbrace{\theta, B_{wire}, B_{norm}}_{\text{not known at the level of individual digi!}})$$

t = *peak* of (asymmetric) distribution
x = measured coordinate

- A 3-step procedure, while building segments
  - 1. coarse knowledge of θ, **B**
  - 2. θ from segment in SL
  - 3. **B** from 3D position of segment

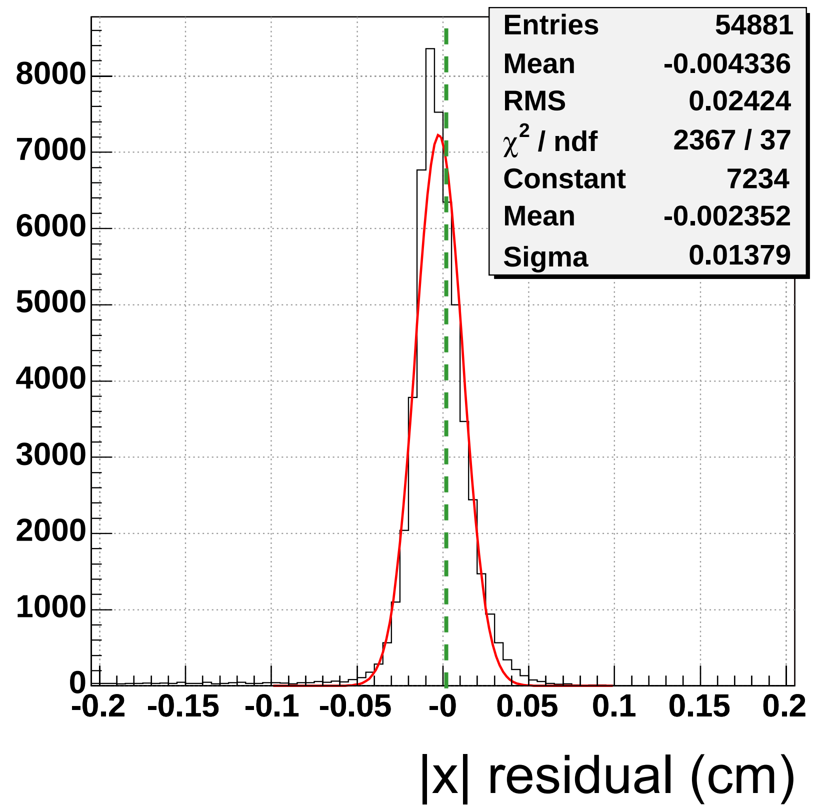
Residuals Rϕ layers

1. Stage



3. Stage

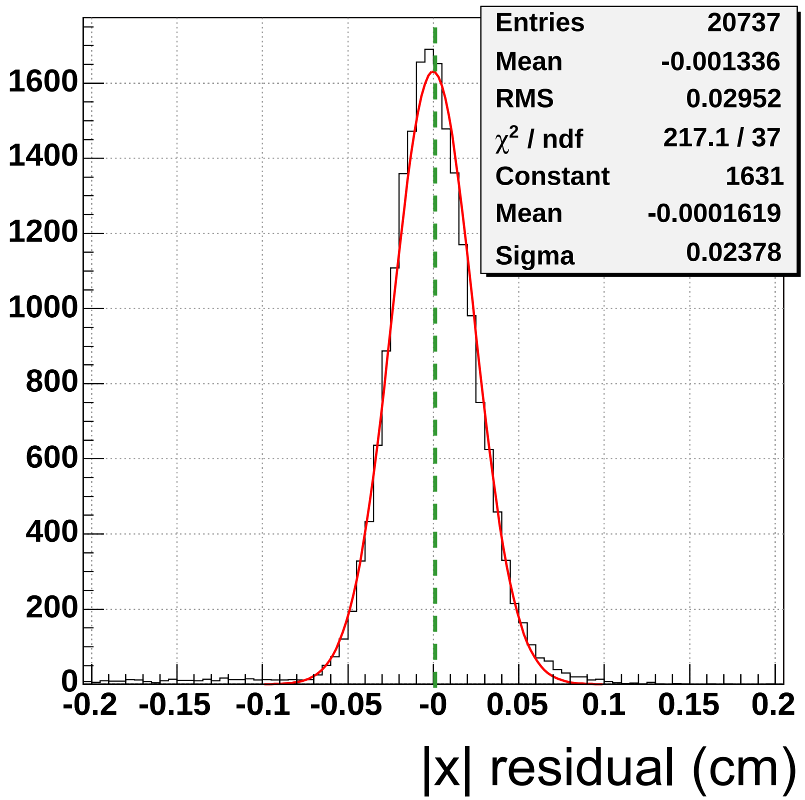
(Ideal case: perfect knowledge of θ, **B**)



- Resolution better than "meantimer resolution" since the cell non-linearity is taken into account!

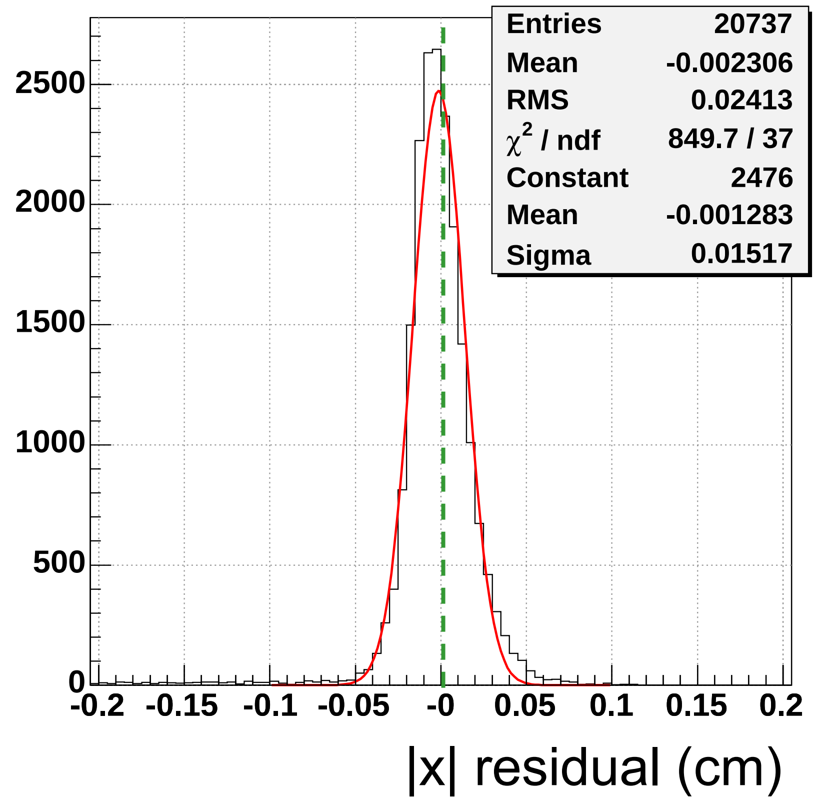
Residuals RZ layers

1. Stage



3. Stage

(Ideal case: perfect knowledge of q, **B**)



- Spread is larger than in Rϕ layers
  - larger angles, different field

Calibration of Parametrization

- Concept: add calibration parameters to the function
  - E.g. 2 multiplicative parameters, for the linear part and for the deviation from linearity:

$$x = f^{-1}(t, \theta, B_{wire}, B_{norm}, p_1, p_2)$$

  - Fit the additional parameters to the data
    - In principle, a simple least-squares fit
    - In practice could be implemented with a iterative filter
  - Advantages (providing it works!)
    - It will provide the best possible resolution, since non-linearity is taken into account
    - It will handle the dependency on θ, **B** with no need of complicated tools (i.e. partitioning in homogeneous B regions, computation and of calibration consts as a function of θ)

Conclusions

- First HLT calibration tools implemented in ORCA
- Prototype of a calibration job with meantimers
- Many ideas – in progress!
- Plans to test it on 2003 and hopefully 2004 test beam data!