# Alignment activities

- Alignment & Calibration in general (R. Mankel)
- GUI for MPS (millepede prduction system, L. A. Sanchez, A. Parenti)
- Millepede with MC beam halo events (A. Parenti)
- Millepede with MC cosmics (M. Prim, C. K.)

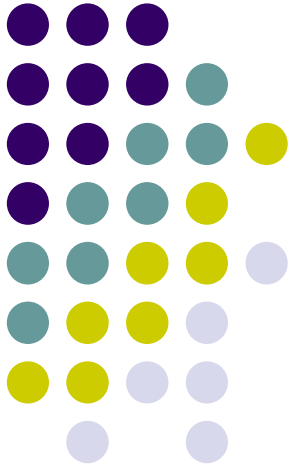
- Summer students: L. A. Sanchez, M. Prim
- New DESY fellow: Justyna Ukleija

# CMS Alignment & Calibration

Rainer Mankel

CMS-DESY Group Meeting

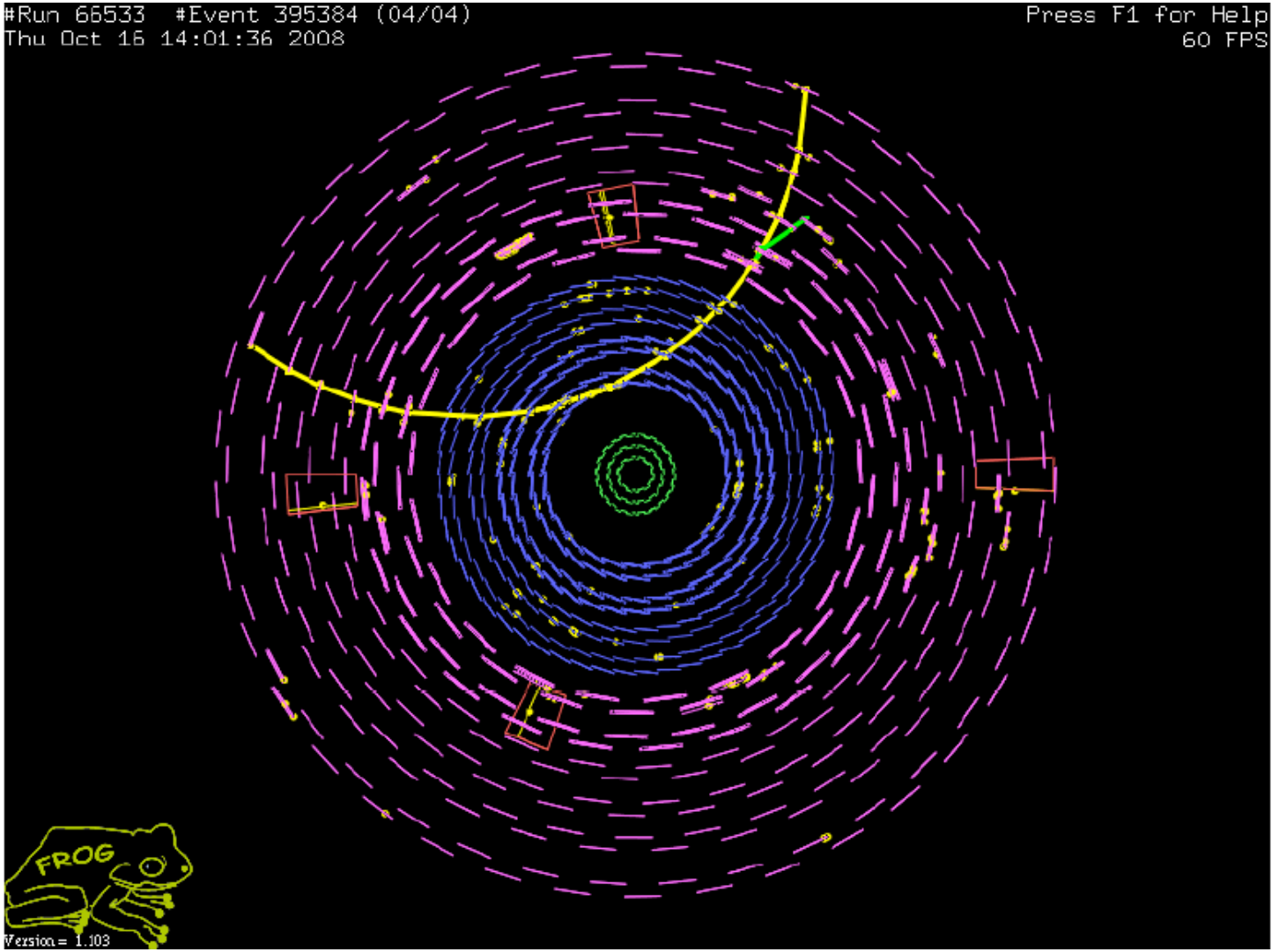
29-Oct-2008



# General Situation: Two Main Lines of Development

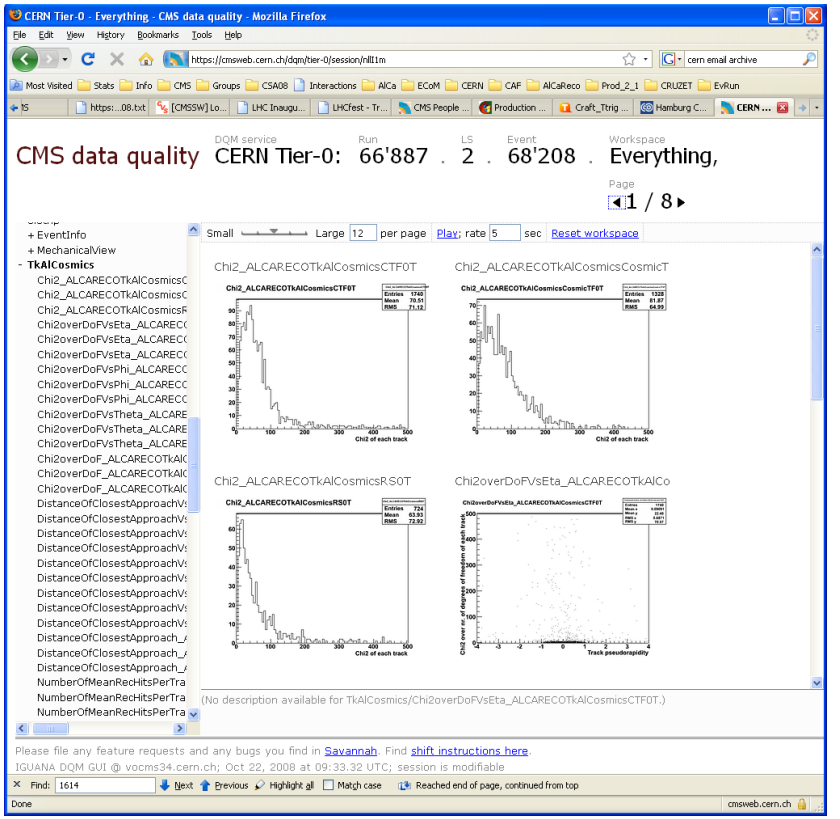
- Alignment with cosmic muons (Global Runs): CRAFT (Cosmic Run At ~Four Tesla)
  - first time data-taking with full magnetic field
  - started 11-Oct (full field since 14-Oct)
  - to continue until 11-Nov
- Preparation of collisions in 2009
  - cannot rely on experience from a few weeks of pilot run
  - need to prepare “cold” for LHC run next year

# CRAFT: Tracker Cosmic



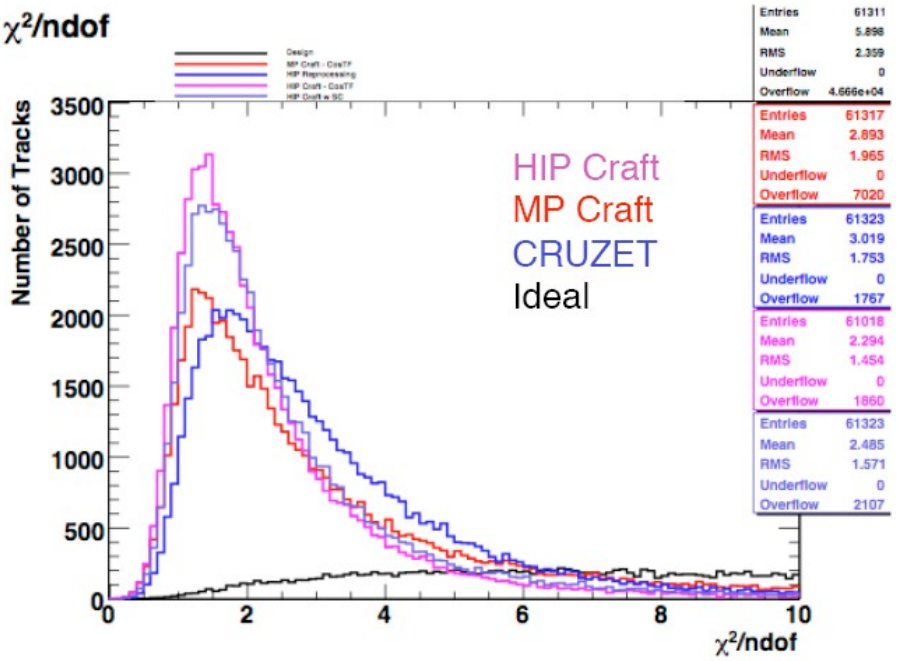
# CRAFT Alignment/Calibration Workflow

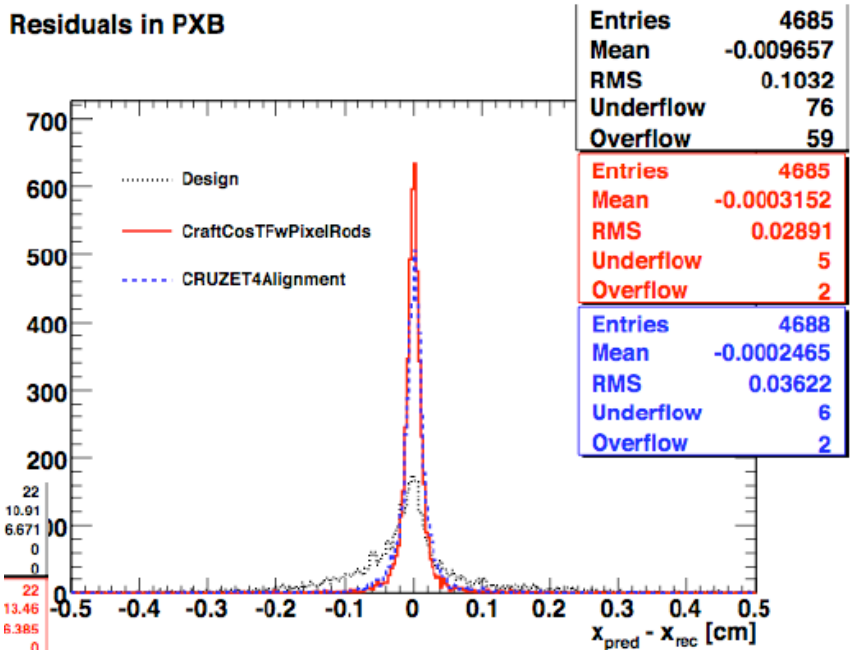
- Commissioning automated production of AlCaReco streams which form basis of CMS alignment & calibration
- Nine AlCaReco streams in prompt production:
  - HCalCalDijets (/Calo dataset only)
  - HCalCalHOCosmics
  - TkAlCosmics0T
  - TkAlCosmicsHLT
  - MuAlStandAloneCosmics
  - MuAlGlobalCosmics
  - MuAlBeamHaloOverlaps
  - RpcCalHLT
  - MuAlCalIsolatedMu
- For the first time, successfully using trigger bit selection on real data
  - good communication with trigger group essential
- Also offline DQM performed on AlCaReco workflows (TkCosmics)
- Weekly constants sign-off meeting (Wed mornings, 9:00)



# CRAFT Alignment & Calibration

- Muon DT trigger timing constants already uploaded last week
- Tracker started with CRUZET-based alignment constants
  - first alignment trials with CRAFT data show already some improvement
  - problem studied over weekend:
    - CTF tracks have too few pixel hits
    - temporary solution: inflate alignment positioning errors (APE) in database
- Need more data



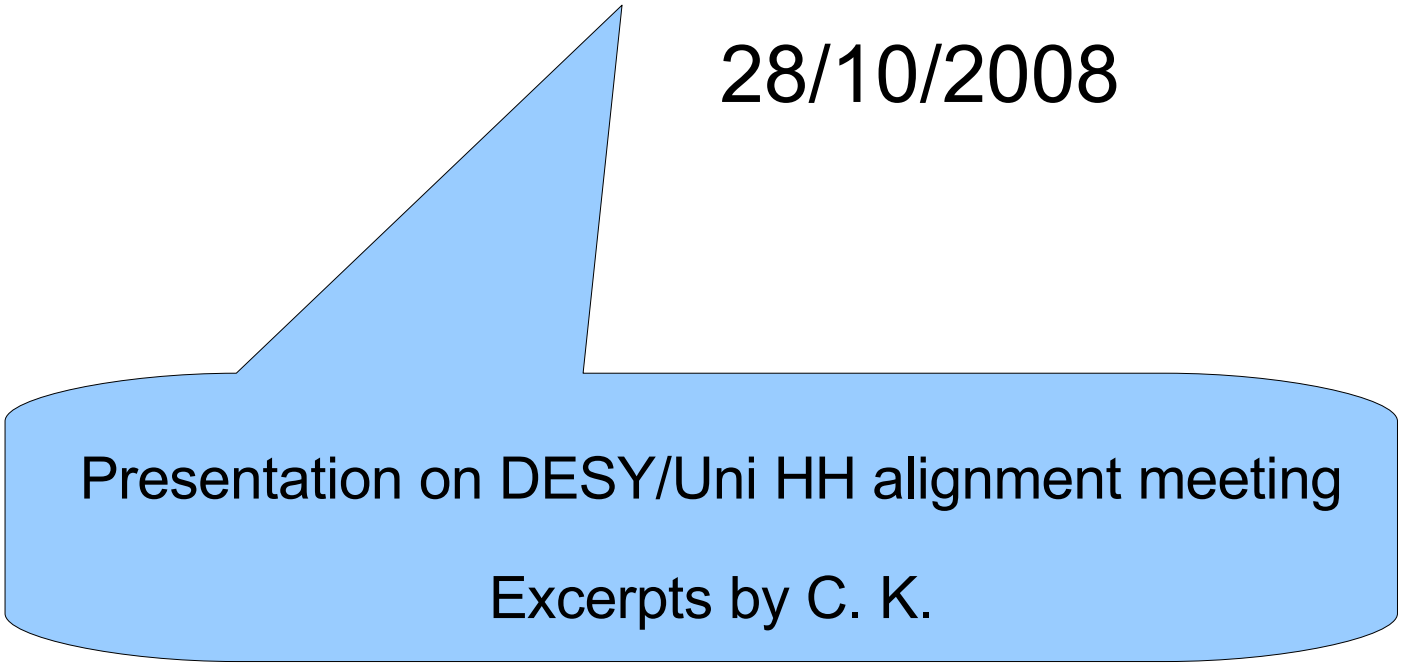
# Preparations for Collisions: Address Remaining Issues

- Definition of Express Stream
  - converged yesterday on AlCa requirements
  - to be negotiated with trigger & physics
- Interface between trigger & alignment/calibration
  - last Friday, agreed on a database-driven solution to adapt trigger-bit filters of AlCaReco producers in view of fast-changing trigger menus
- Need to review data bandwidth budget for AlCa (P5→T0)
  - hardware alignment/calibration (ECAL+tracker laser, DT pulser, + …?)
  - four AlCaRaw streams (+ …?)
  - events with regular event content
- Finalize constants validation procedures
  - muon calibration, tracker alignment, RPC relatively advanced
  - aim for standardized path to CAF DQM server
- Automation of alignment & calibration workflows

# Alignment with Beam Halo

A. Parenti (DESY)

28/10/2008



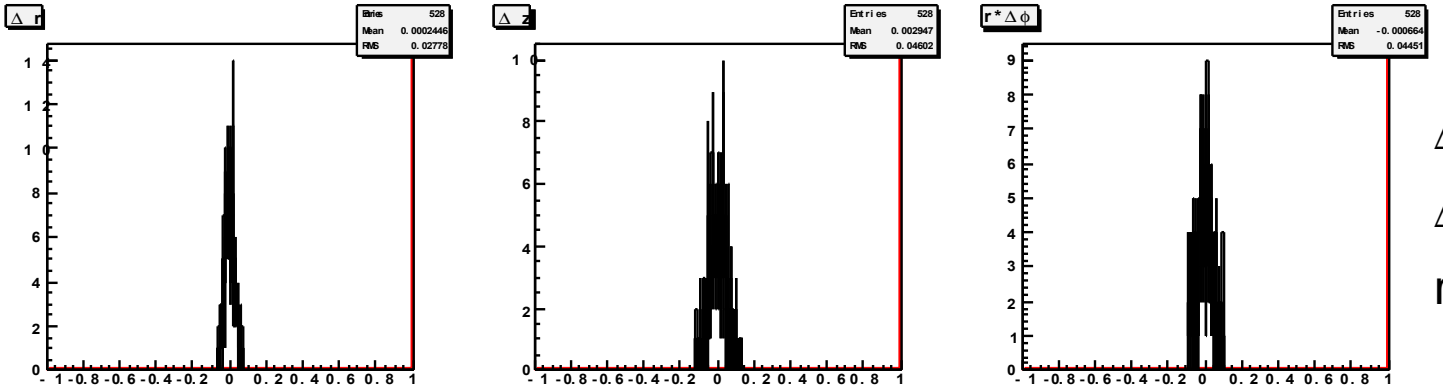
# Combined Alignment (1-2)

- CMSSW 2_0_12
- Samples:
  - CSA08 Minimum Bias (1PB_V2_RECO): 1M events
  - CSA08 Cosmics (1PB_V2_RECO): 3M events
  - CSA08 Beam Halo (STARTUP_V2): ~60k events
    - STARTUP_V2: same misalignment scenario as 1PB_V2_RECO
- Strategy:
  - align with cosmics and minimum bias
  - as above + beam halo (5x weight)
  - compare geometries

# Combined Alignment (5)

- TID. Comparison to ideal geometry (Subdet global displacements are subtracted):

Misaligned geometry:

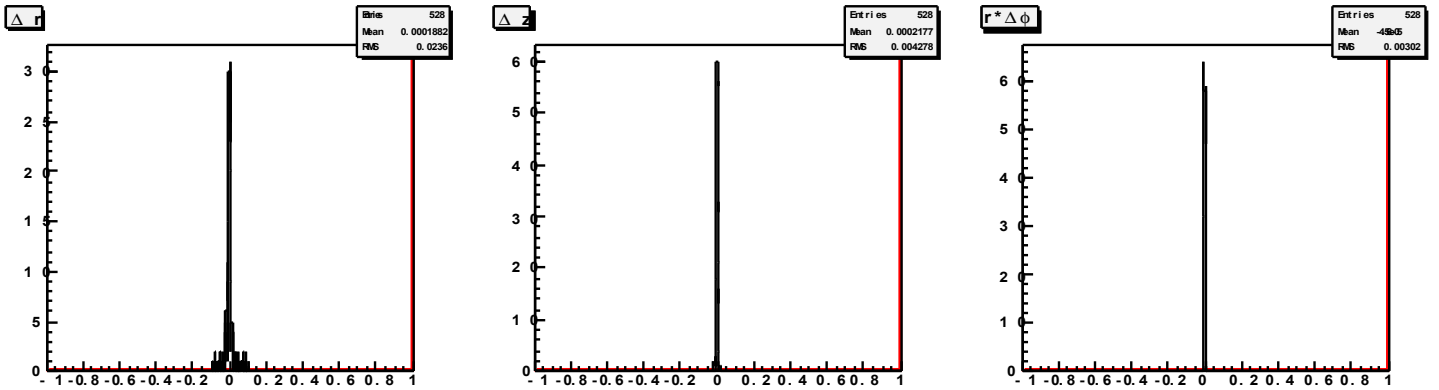



Δr=280 mμ

Δz=460mμ

rΔφ=450mμ

Aligned w/ MinBias+ Cosmics:




Δr=240 mμ

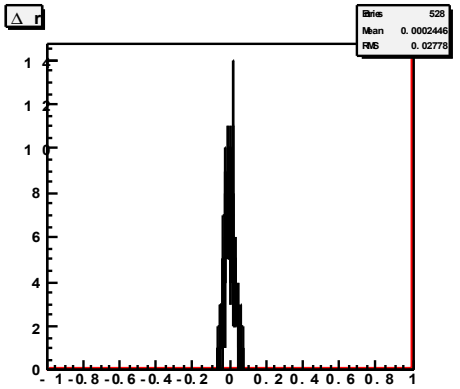
Δz=45mμ

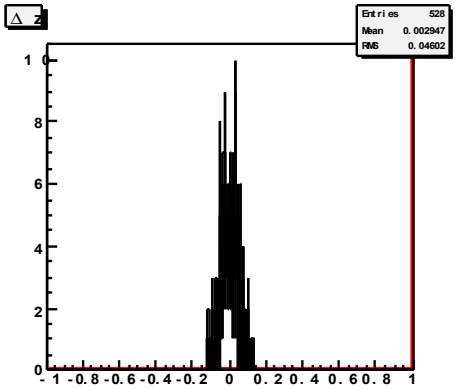
rΔφ=30mμ

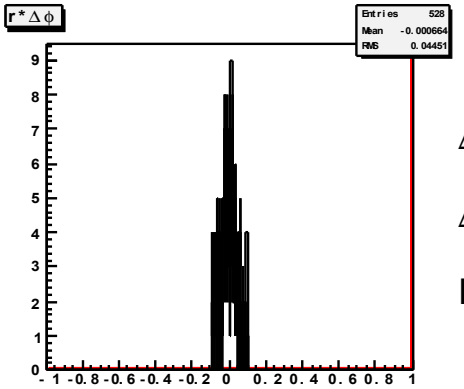
# Combined Alignment (6)

- TID. Comparison to ideal geometry (Subdet global displacements are subtracted):

Misaligned geometry:



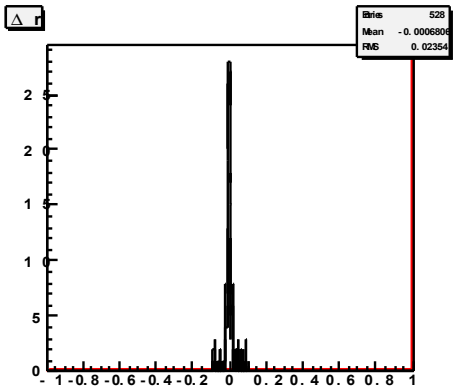



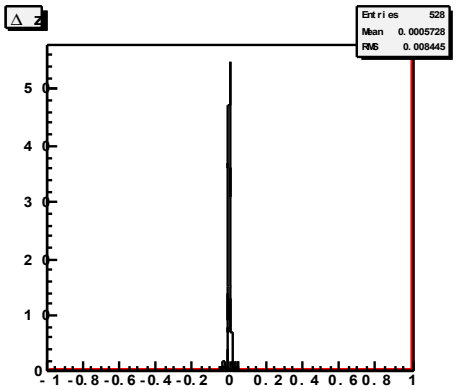

Δr=280 mμ

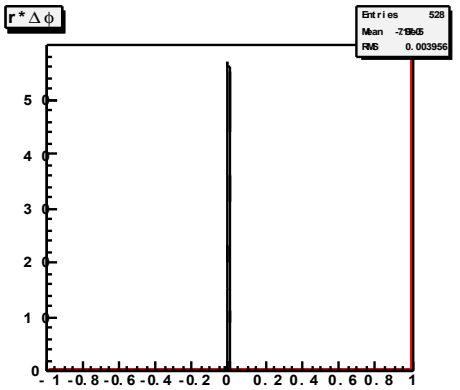
Δz=460mμ

rΔφ=450mμ

Aligned w/ MinBias+ Cosmics+ BeamHalo:




Δr=240 mμ

Δz=85mμ

rΔφ=40mμ

# Combined Alignment (7)

- Minimum bias and cosmics allow to align endcaps
  - noticeable improvement, especially in TID
- Beam halo tracks do not help:
  - Too many parameters and few beam halo tracks? Waiting for 21X production
  - Moreover there are few tracks connecting the two endcaps... (maybe due to the reconstruction)

# Status and Plans

- Use of beam halo events together with minimum bias and cosmics in a global alignment
  - minimum bias and cosmics improve detectors' alignment
  - only small changes adding beam halo too (maybe too few tracks?)
- Second attempt: beam halo standalone alignment of high-level structures in end-caps: ongoing

That's all.

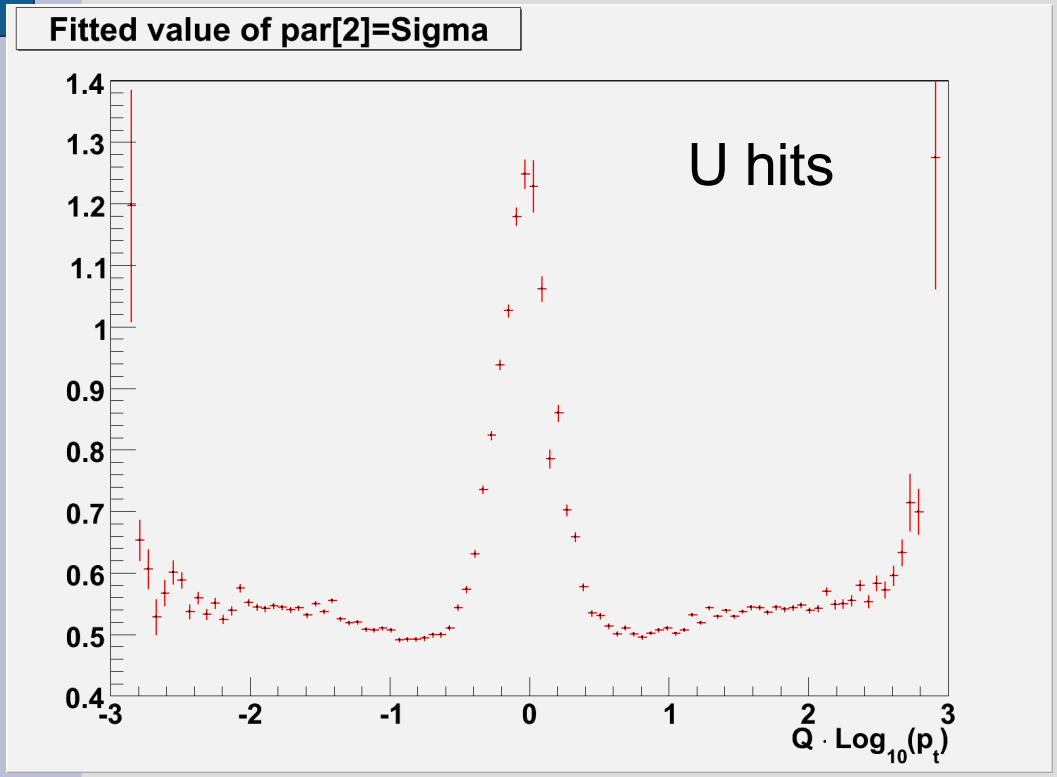
Thanks!

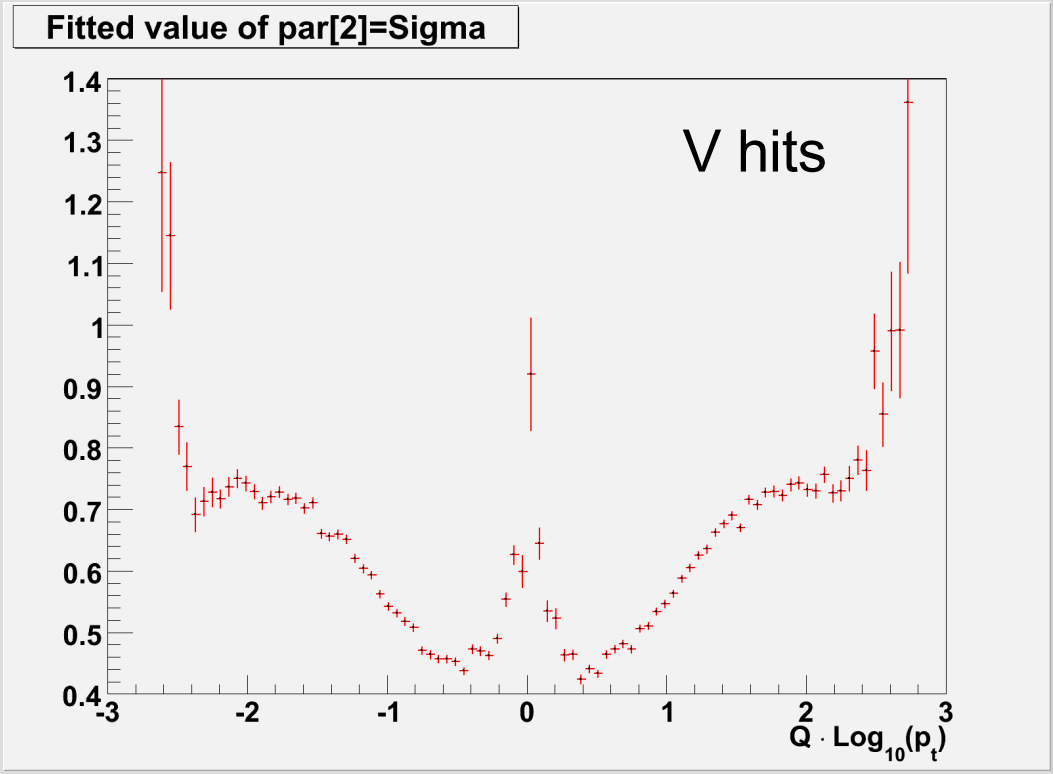
# Millepede with MC cosmics (1)

- Check quality of input to millepede
  - Expect unit width for ratio of hit residuals to errors
  - Residuals and errors from reference trajectory
  - Kalman filtered track is expanded at some point (first, last, center hit) into helix (+energy loss) as ref. traj.
  - Multiple scattering only accounted for by increase of (uncorrelated) hit errors, correlations are neglected
- Bad description of width of residuals leads to
  - Problems with outlier rejection
  - Potential large contribution of change of set of rejected tracks to variation of $\Sigma\chi^2$ $\Rightarrow$ bad convergence

# Millepede with MC cosmics (2)

- Look at simulated cosmics with ideal geometry
  - Barrel only, width of r/σ vs Q $\log_{10}(p_t)$ (M. Prim)
  - Not always gaussian distributions



# Millepede with MC cosmics (3)

- New track model for MP (G. Flucke)
  - Take residuals directly from KALMAN track
  - First tests are promising ($Z \rightarrow \mu\mu$, cosmics for 2_1_X not yet ready)
- Plan: compare track models for
  - MC cosmics with ideal geometry
  - MC cosmics with misalignment
  - CRAFT data