PRS muon Meeting,

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Status report on DT hit reconstruction

Stefano Lacaprara, INFN and Universitá di Padova

Summary:

- algorithm description,
- result on single hit reco,
- result on segment reco,
- Conclusion and future plan;

Introduction:

- Goal: achieve an optimal reconstruction for DT hits and segments, both for position and error assignment.
- actual (now old) code based on a naive algorithm , not optimal position reconstruction, and very poor error assignment (nominal DT resolution).
- dedicated task force: 4 people, `me, Stefano V., Bart VdV., Giacomo B.` actively working on this item (according to time available),
- agreement on a new framework for segment reconstruction (described in PRS meeting 7/5/2002).
- focus on hits reconstruction (building block), position from digi time and error assignment,
- then (partially in parallel) improvement on segment building.

Improvement hit reconstruction:

- From digi we have RawTime, and wire ID: distance from wire is $X = VelDrift \times RawTime$
- further approximation: RawTime include TOF and propagation along wire, which should be subtracted.
  - ⋆ TOF included now is: (Real TOF)$-$(TOF for $p = \infty$), so already subtracted (in first approx) at digi level: what about real CMS raw-time? Can be subtracted in reconstruction once position (and particle momentum?) is known.
  - ⋆ propagation along wire can be subtracted once the position along the wire is known (as well as FE position).
- more important: drift velocity depends on θ and $B_{\perp}$
  - ⋆ Dependence can be studied in TB data, looking at Tmax/HalfCell, where Tmax is computed via mean timer technique.

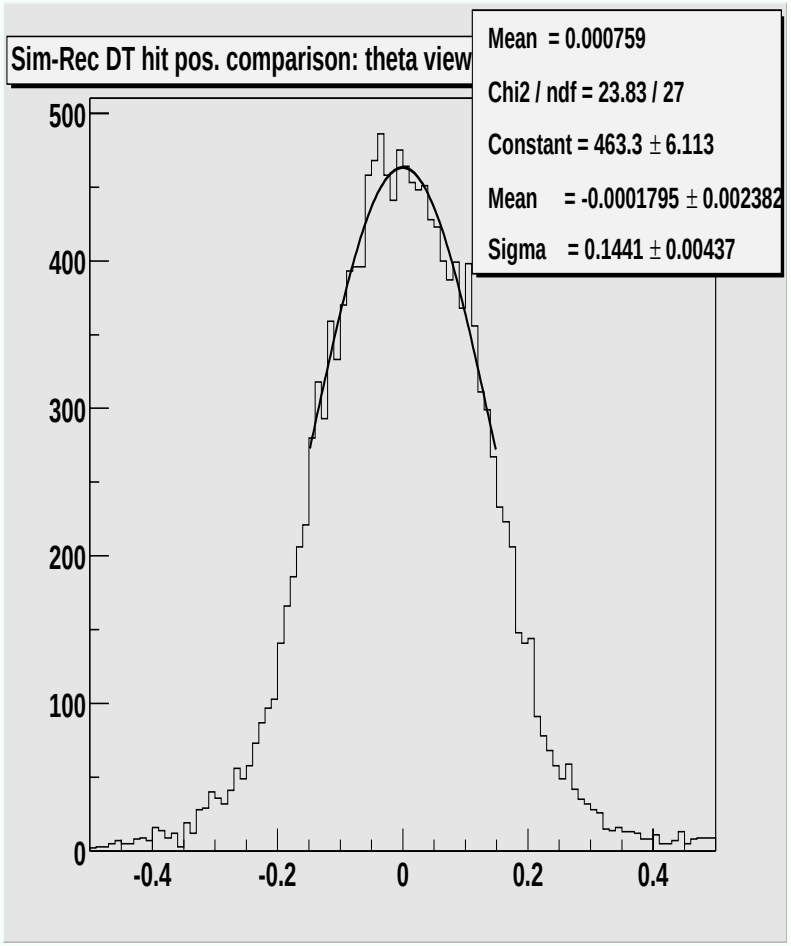
- ⋆ Using MC much easier, care to avoid cell with more than one simHit and SimHit which dies inside the cell (or cross the I): more complex situation, must check if the digitization algorithm works properly in these cases.

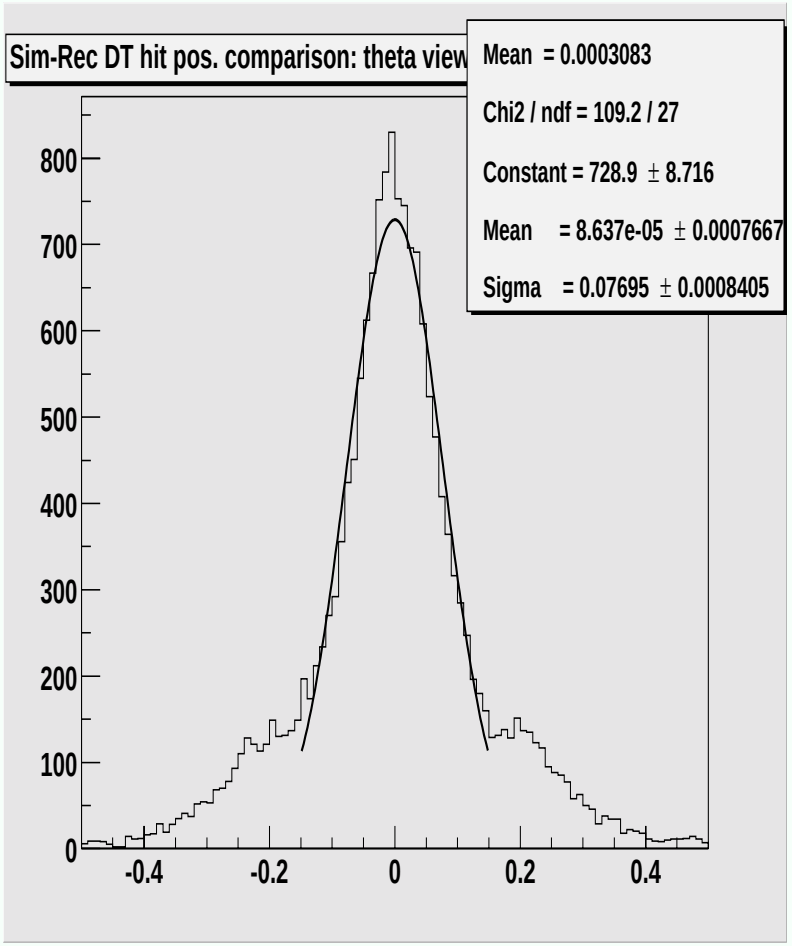
- Hit reconstruction is very sensitive to drift velocity, if Vd wrong by only 1%, then resolution for left/right half cell are displaced (double peek): same effect shown by Ugo on PRS meeting $4/6/2002$ on real data
- Time to drift relation studied in 3 different way: from TestBeam data, from MC and "inverting" digitisation algorithm via LUT table (S.V. and G.B.).
- Input parameters for the hit reco: position of the wire for $B_{\perp}$ and for θ (for Zed-R SL), center of the wire for subtracting propagation delay.
- Once better position and angle are available (from segment reco), use it to improve hits.

Improvement in segment reconstruction:

- $\rightsquigarrow$ First fit using "raw" hit reconstruction, linear fit use the errors assigned to each hits (no more hard-coded resolution $295\ \mu m$);
- $\rightsquigarrow$ Second iteration of fitting using the impact angle from the first fit to improve hit reconstruction;
- $\rightsquigarrow$ Third iteration using the $3D$ segment (if available) to get the global position of the hits, and improve hit reco by improved knowledge of $B_{\perp}$ and position along wire;
- $\rightsquigarrow$ correct using of hit errors to compute segments parameters and errors.

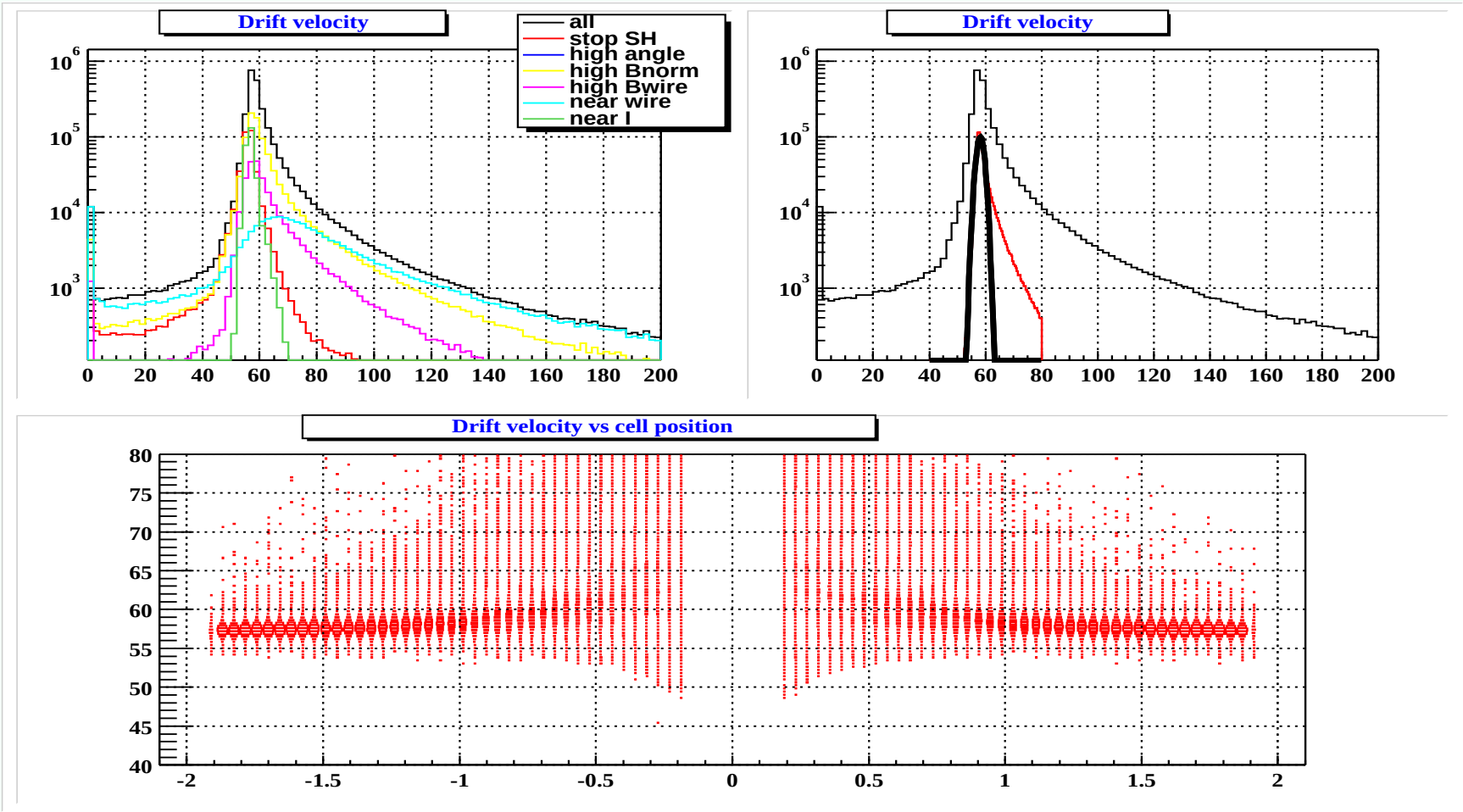
Look Up Table approach (Stefano V. and Giacomo B.):





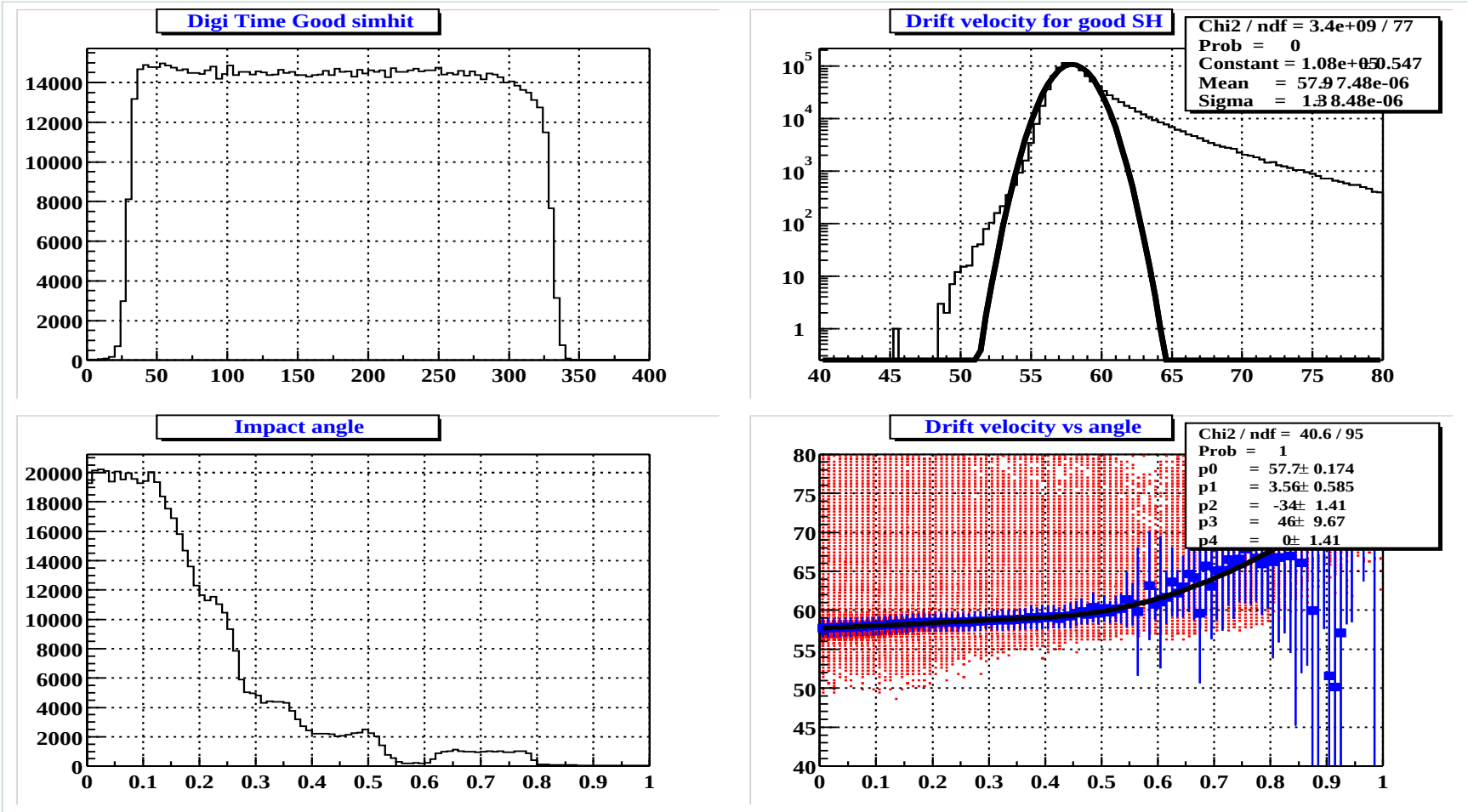
Evident improvement of reso distribution for most problematic chambers (wheel ± 2, Zed-R SL) not yet perfect

Drift velocity for “good” SimHits:



Problem for “problematic SimHits, excluded for the time being,
Vd asymmetric due to TOF subtraction

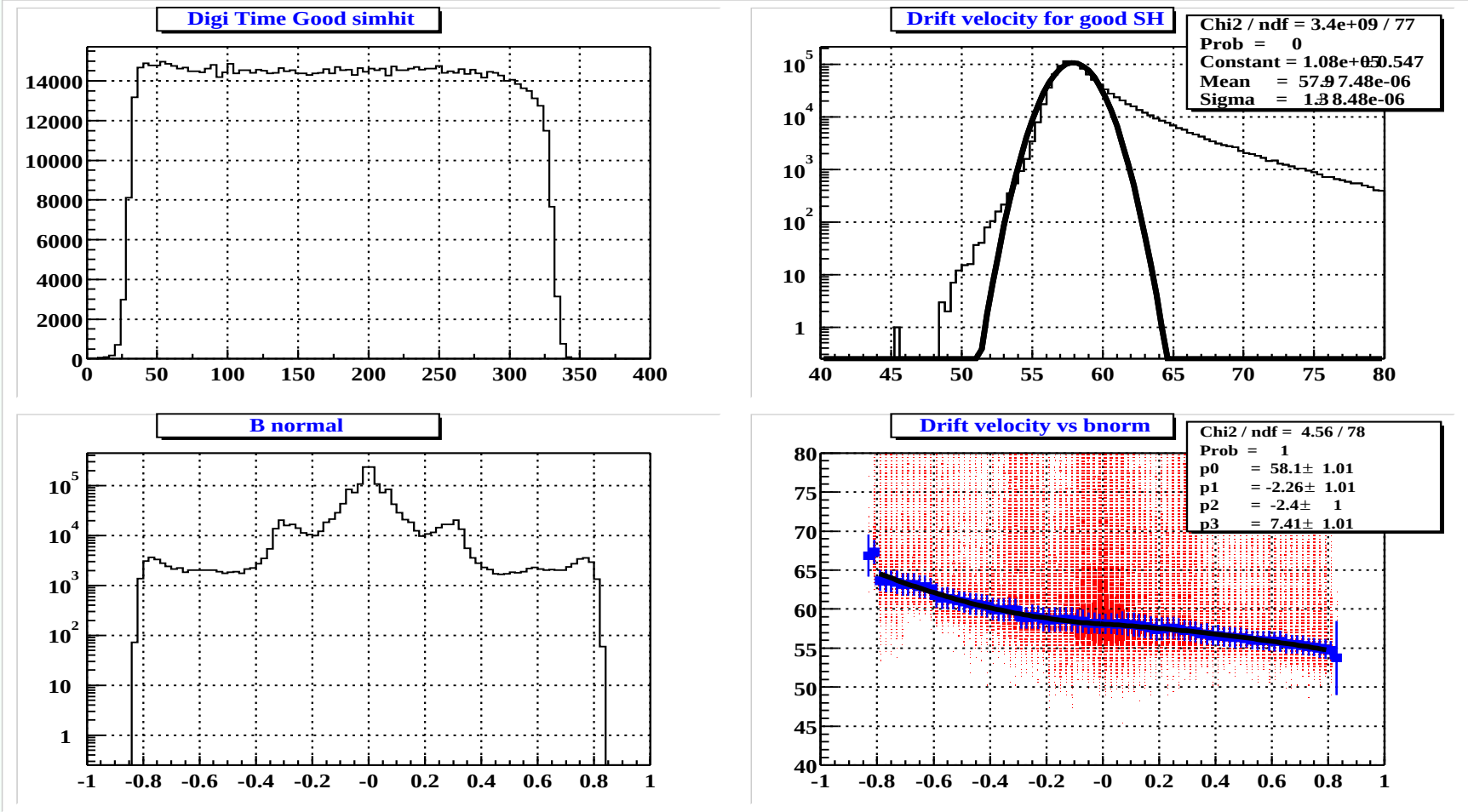
Drift velocity vs impact angle ($B \perp = 0$):



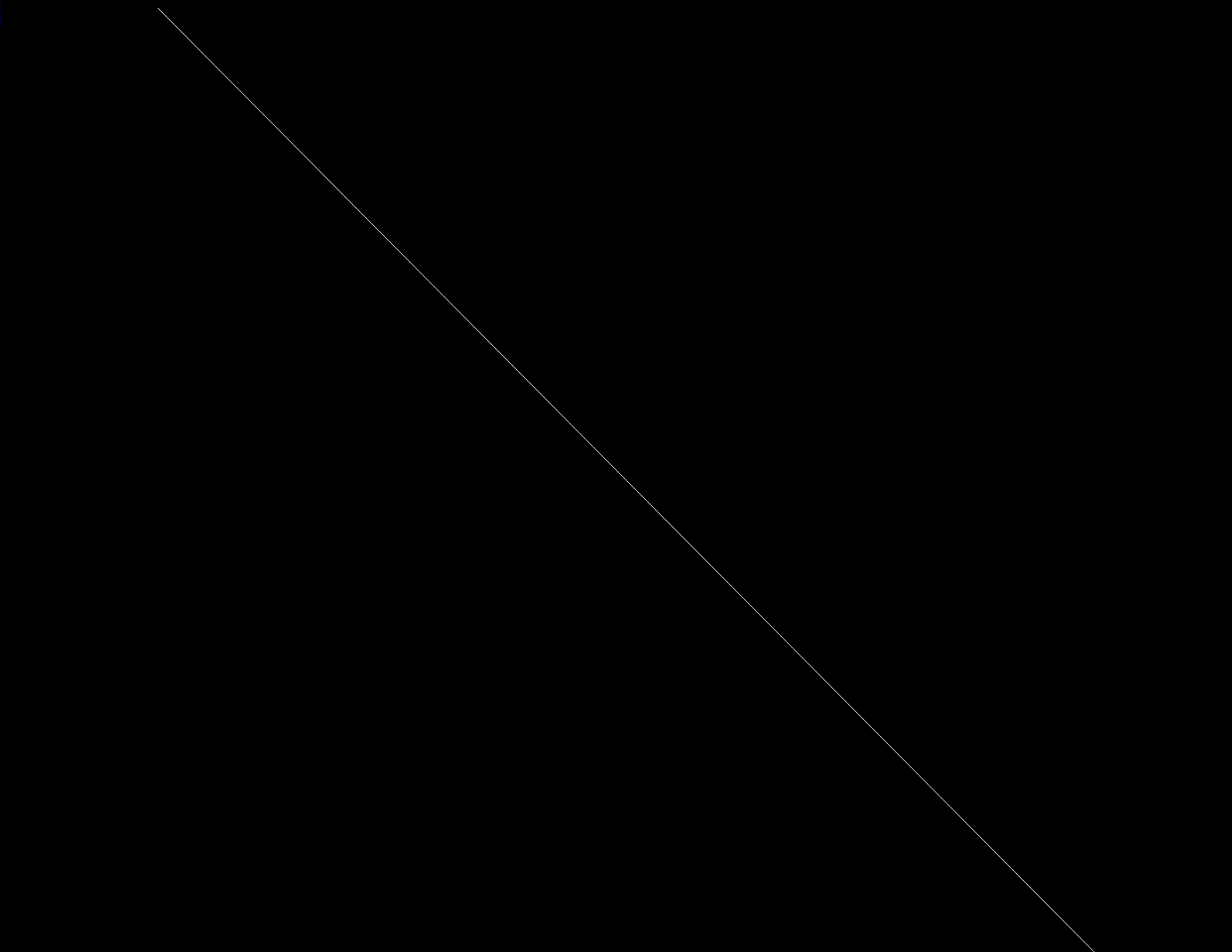
Vd variation for large angle (wheel ± 2) is huge!!

$Vd(0) \approx 57.9\ \mu m/ns$ (old value $57.0\ \mu m/ns$)

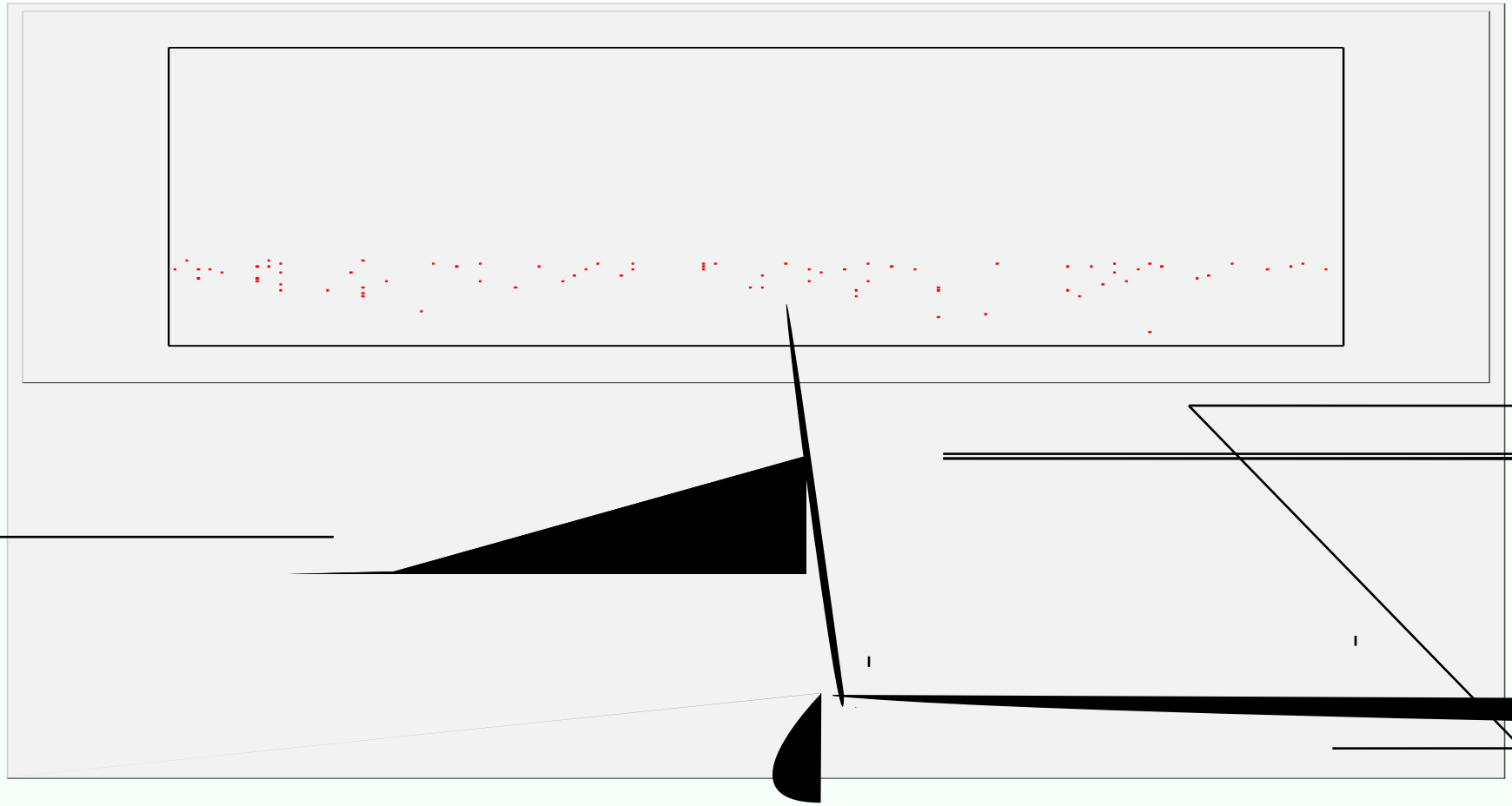
Drift velocity vs B field ($B_\perp$, $\theta = 0$)):



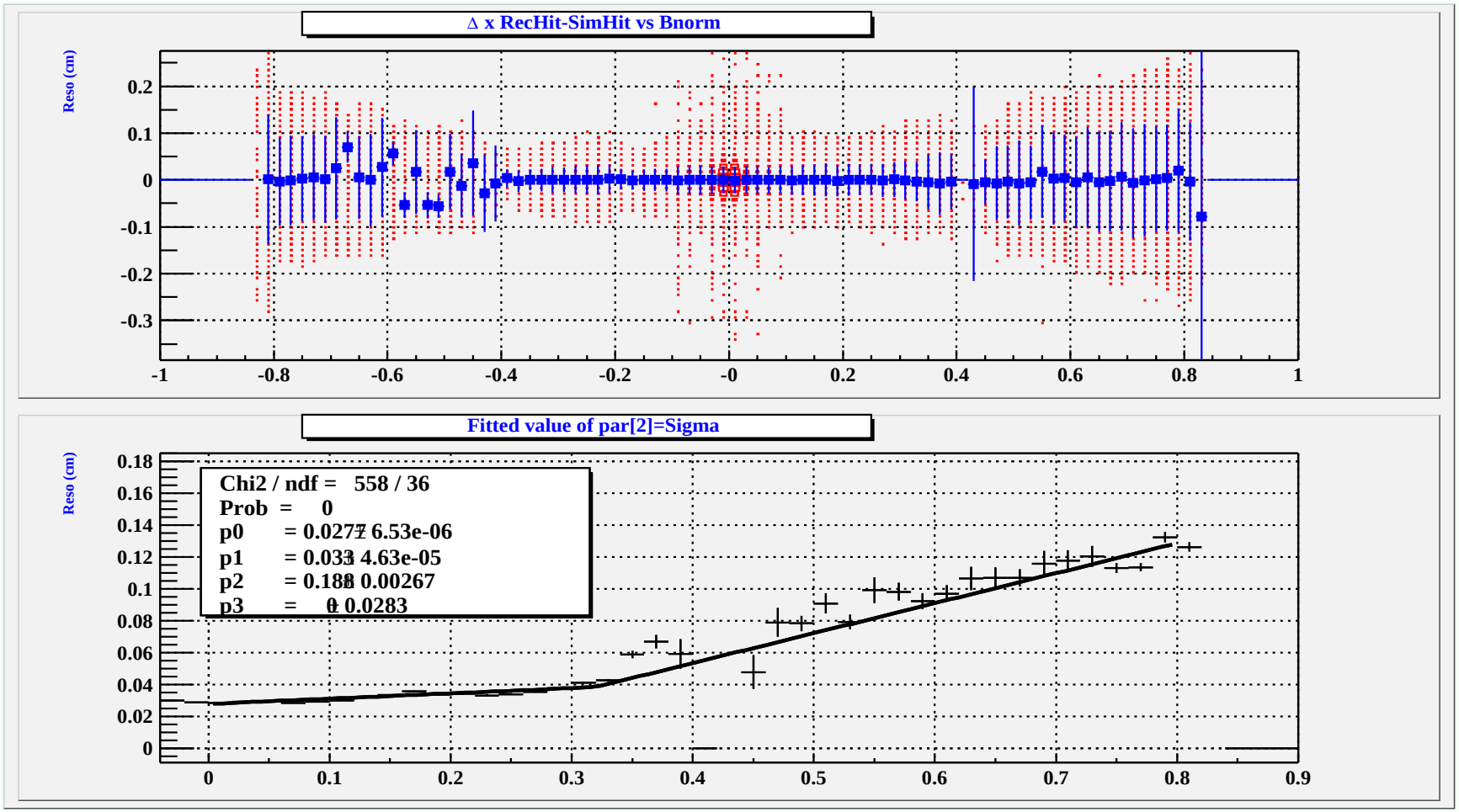
$B_\perp$ and not $|B_\perp|$ due to a bug in digitization



Hit resolution vs impact angle ($B_\perp \approx 0$)):

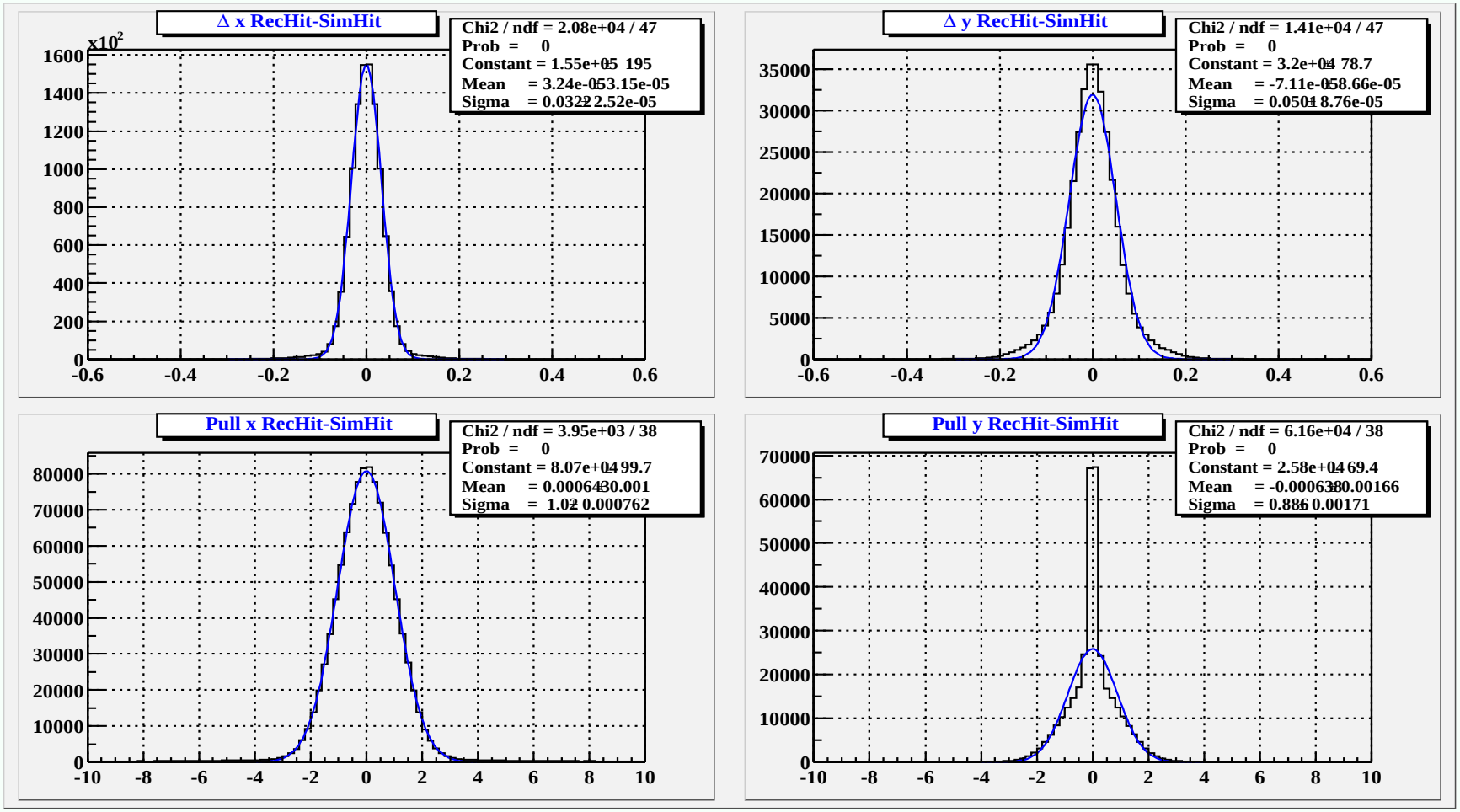


Hit resolution vs B field ($B_\perp$, $\theta = 0$)):



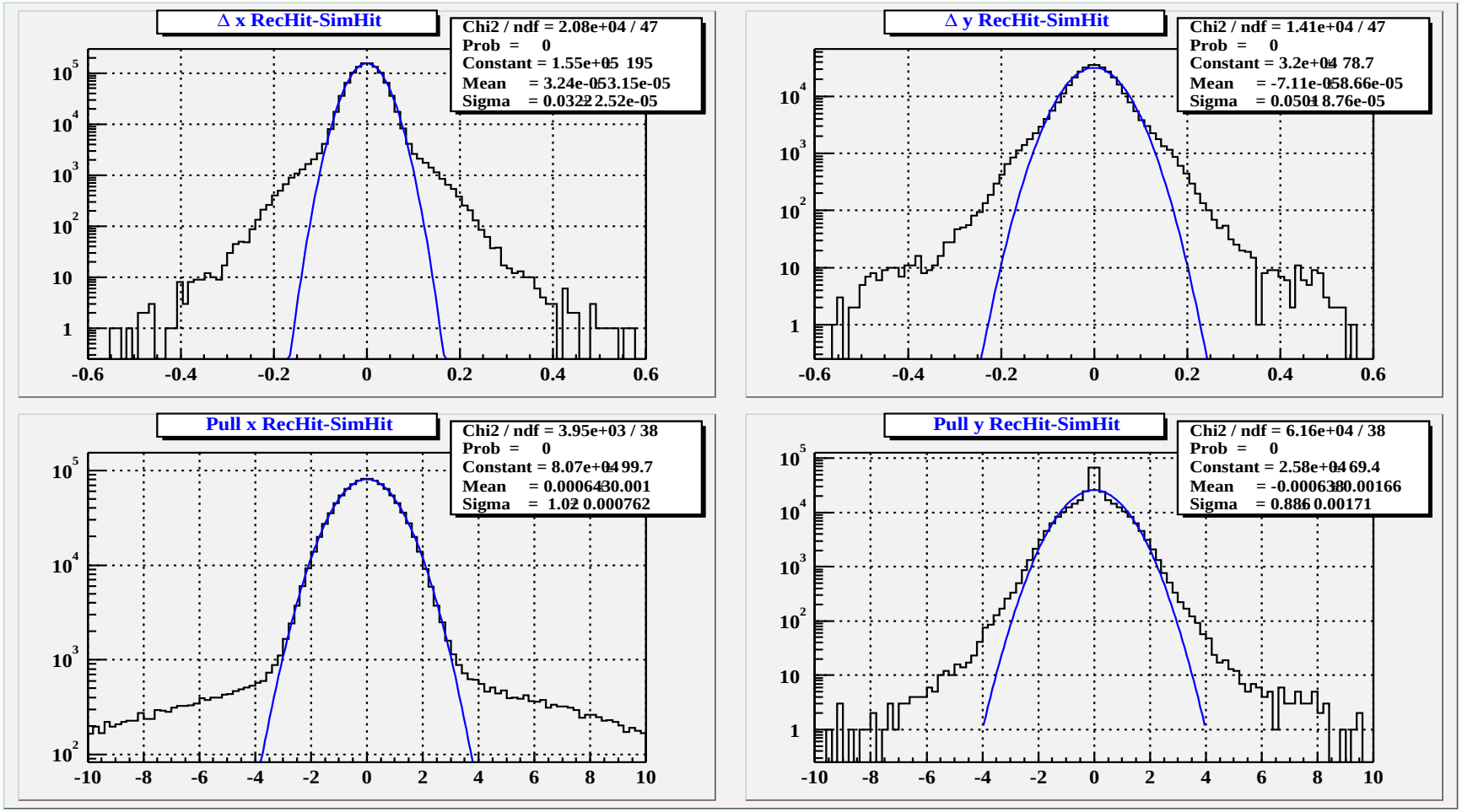
Resolution for $\theta \approx 0$, $B_\perp \approx 0$ is $\sigma \approx 280\ \mu m$.

Resolution and pull for all chambers (any θ, $B_\perp$ Lin-scale:



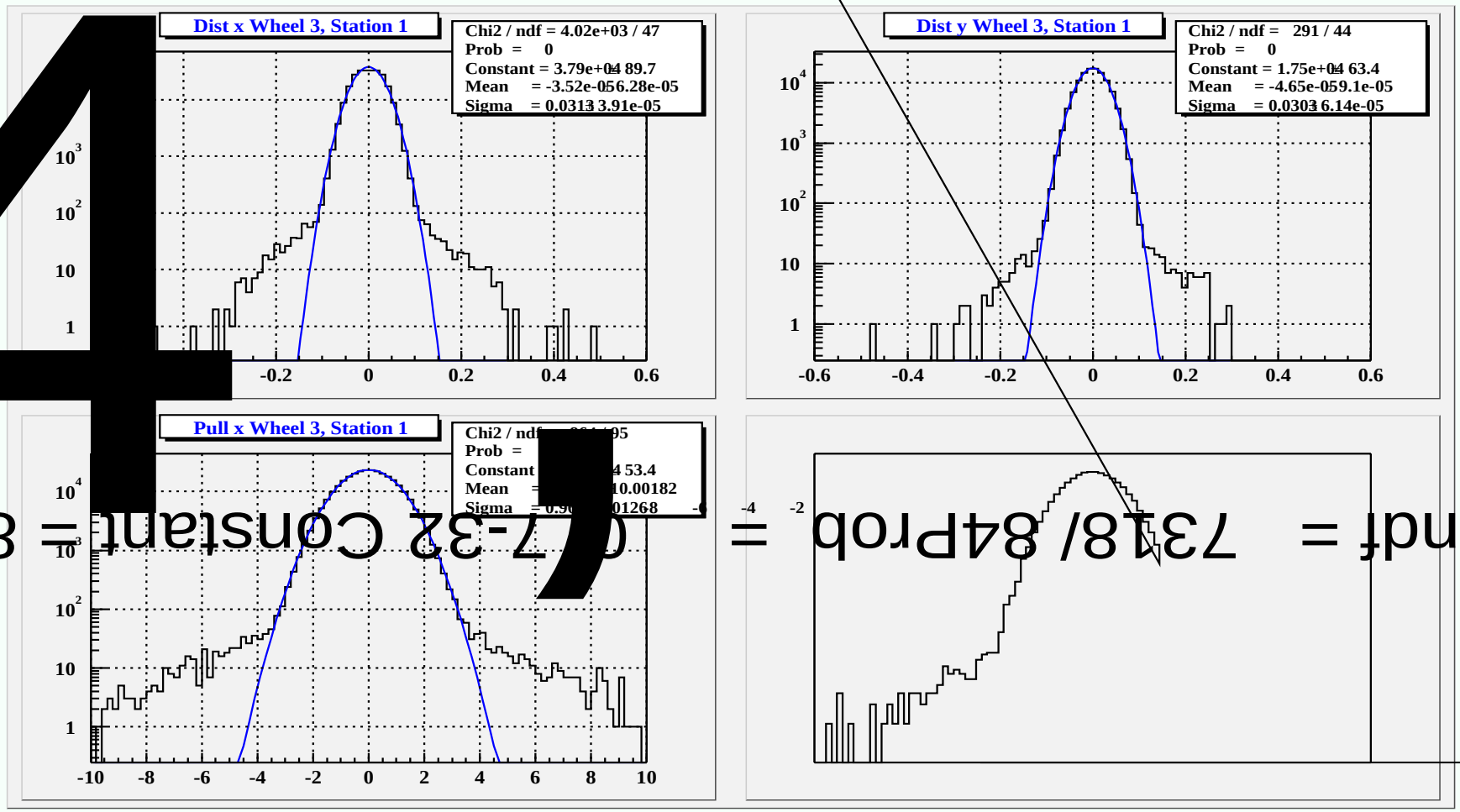
$\sigma(Pull) \approx 1.02$ for ϕ SL, $\sigma(Pull) \approx 0.88$ for ZED SL

Resolution and pull for all chambers (any θ, $B_\perp$ Log-scale:

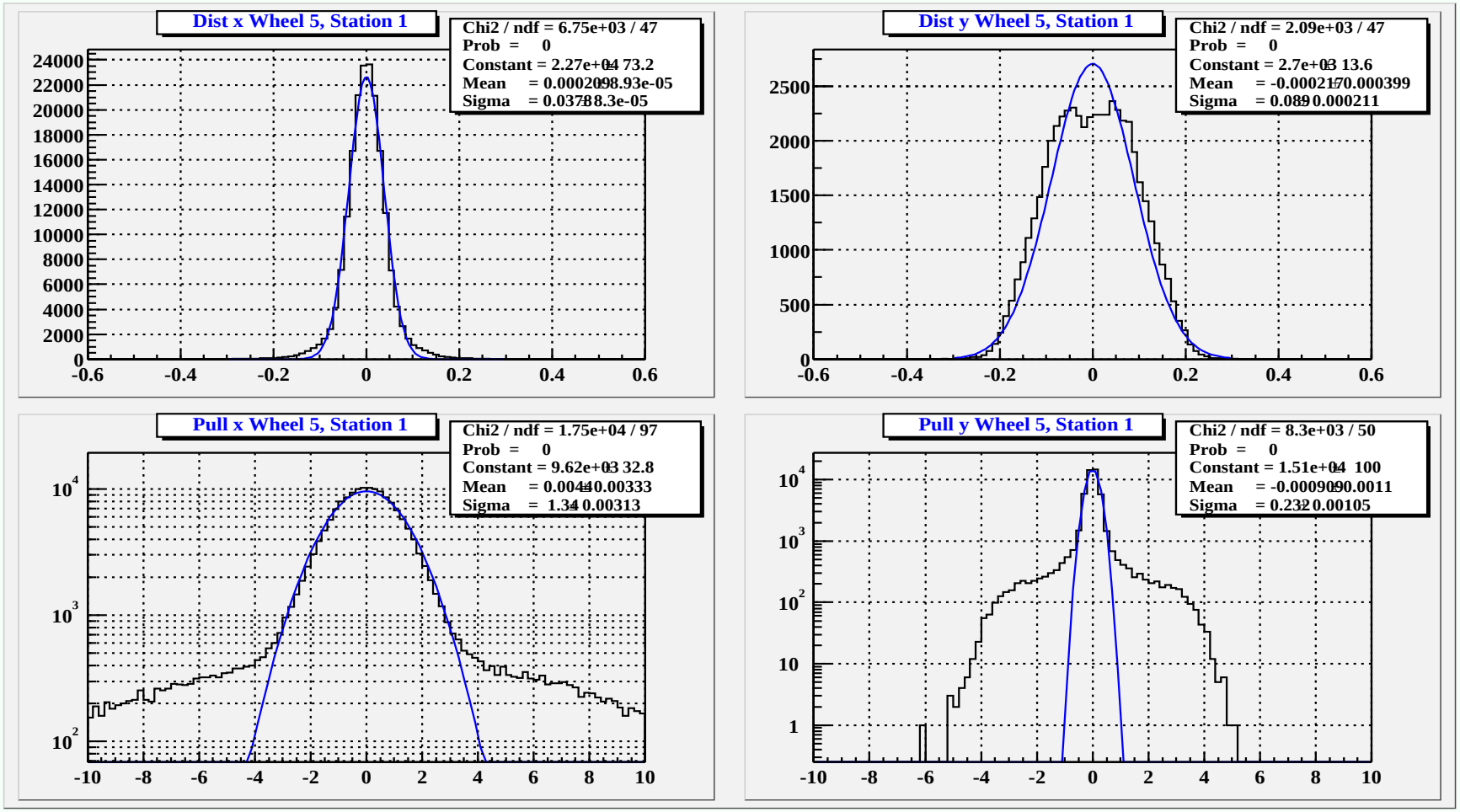


Large non gaussian tail also for ϕ SL, more problem for zed ones.

Resolution and pull for all chambers in wheel 0:

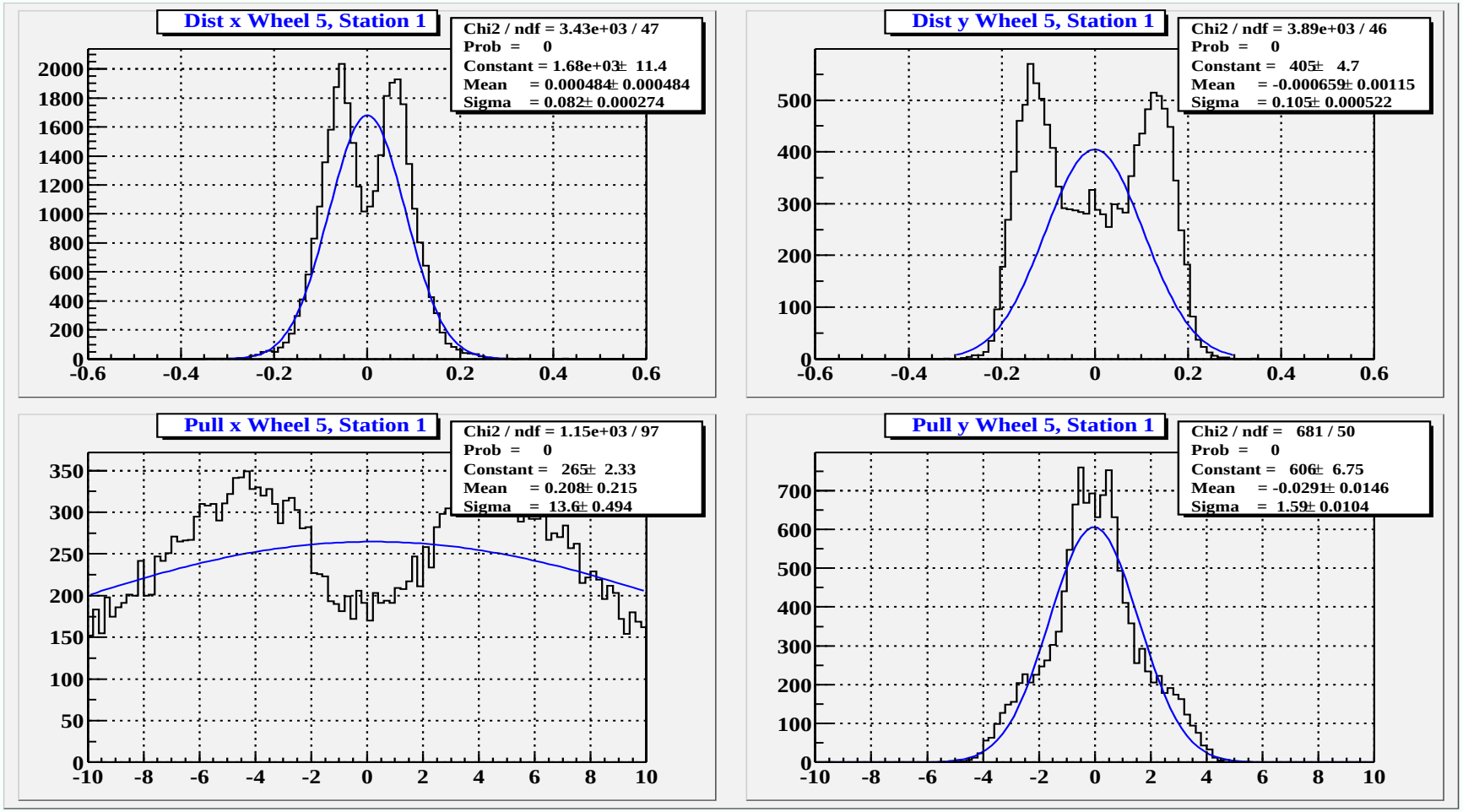


Resolution and pull for all chambers in wheel +2:



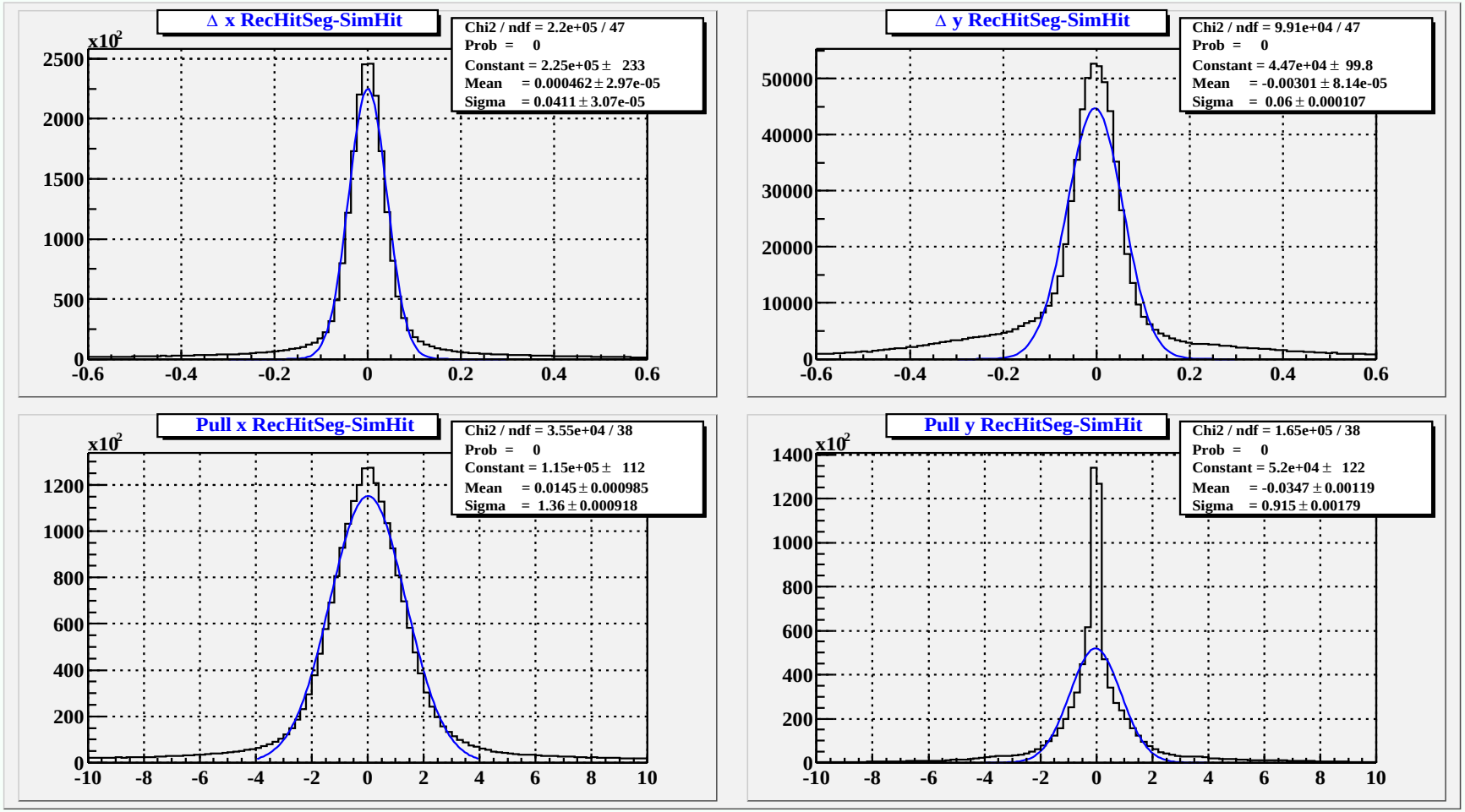
σ Pull (ϕ) Ok, resolution overestimated for zed!

Resolution and pull for all chambers in wheel +2, station 1 (most problematic!):



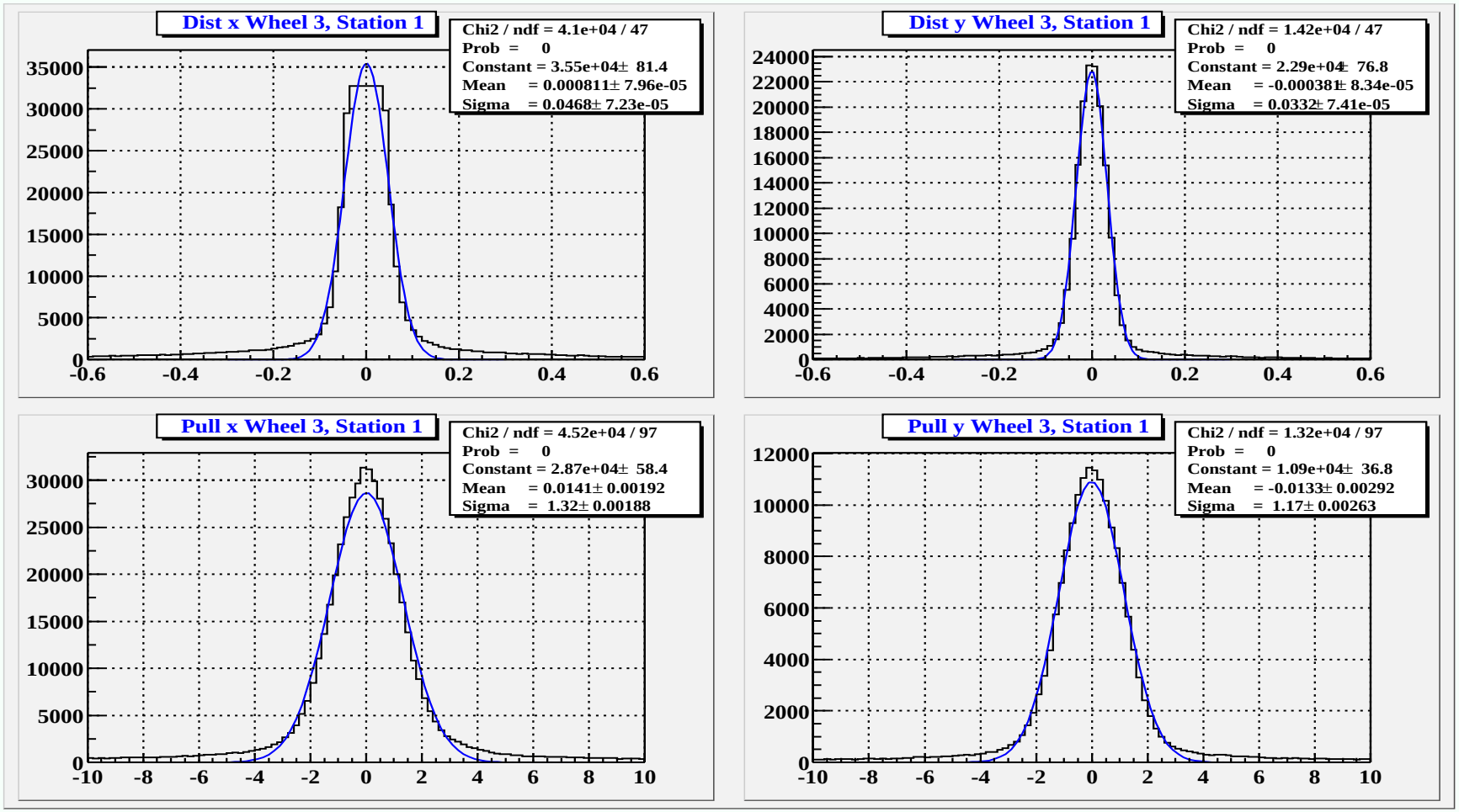
Disaster!!! Vd wrong (double peak in resolution), pull meaningless

Resolution and pull for all chambers for hits fitted in segments:



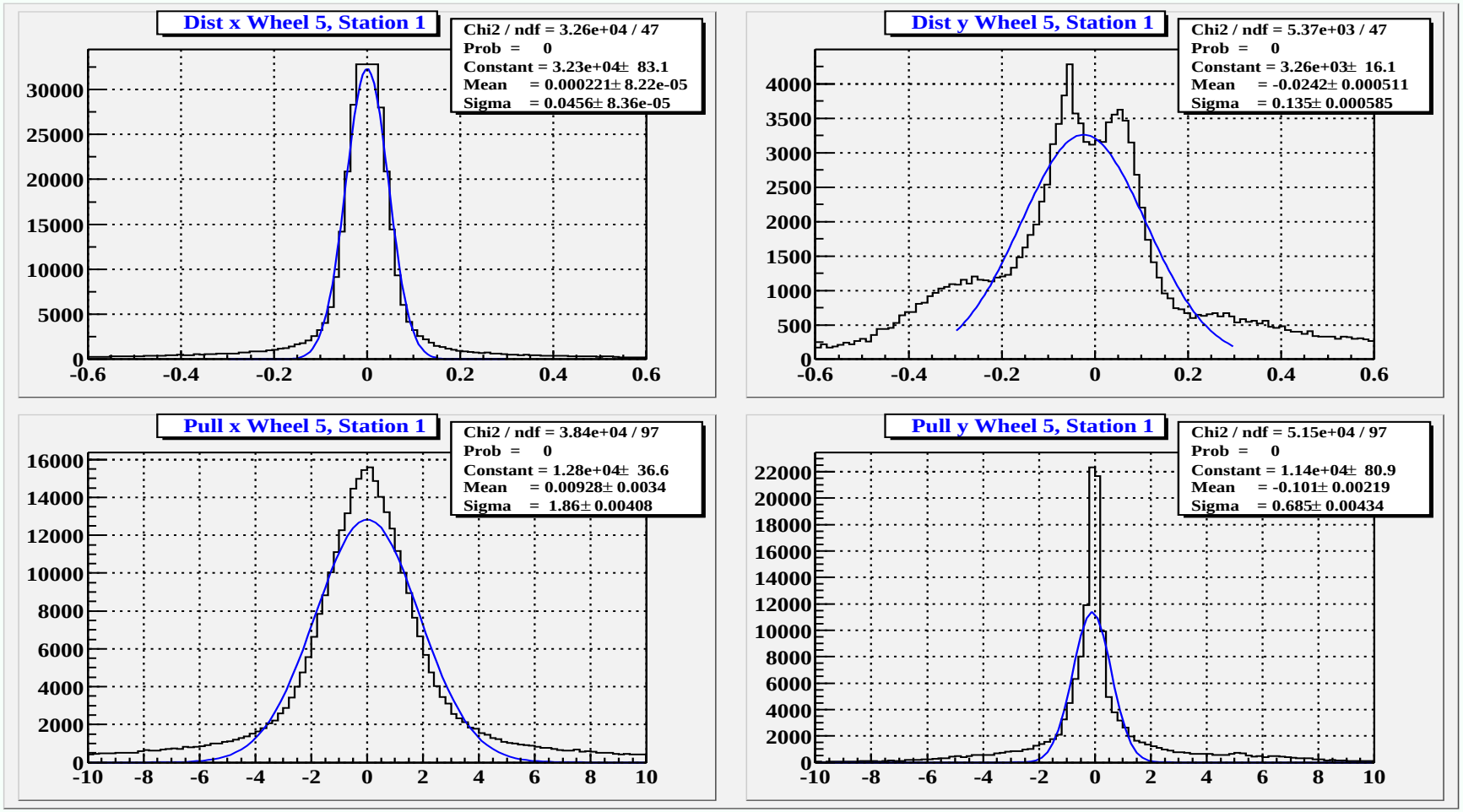
Worse than hit resolution...

Resolution and pull for all chambers in wheel 0 for hits fitted in segments:



"easy" chambers

Resolution and pull for all chambers in wheel 2 for hits fitted in segments:



lot of problems!!

Conclusion:

- ⇝ Work in progress!!!
- ⇝ New framework for optimized DT hit reconstruction available;
- ⇝ Use of tuned hit to build segments, 3 iteration of refitting to improve the hit definition (position and error) and improve the segments.
- ⇝ Drift velocity tuning is critical!! Try to use a method possible to use also for real chamber.
- ⇝ Once Vd tuned, can study resolution vs θ, $B_{\perp}$, in MC but also in real chamber (use 7 hits segment to study resolution of the 8^{th}).
- ⇝ $Vd(\theta, B_{\perp}) = Vd(\theta) \times Vd(B_{\perp})$??
- ⇝ Tuning of errors to be finalized;
- ⇝ Next: concentrate on local pattern reco.