

SVT Alignment

- Misalignment in simulated data
- First Millepede track-based alignment in Test run

Pelle

Testing misalignment in simulation

Prepare misalignment in simulation

- Shift chosen sensors by 100um
- Compare ideal and shifted

Simulation data

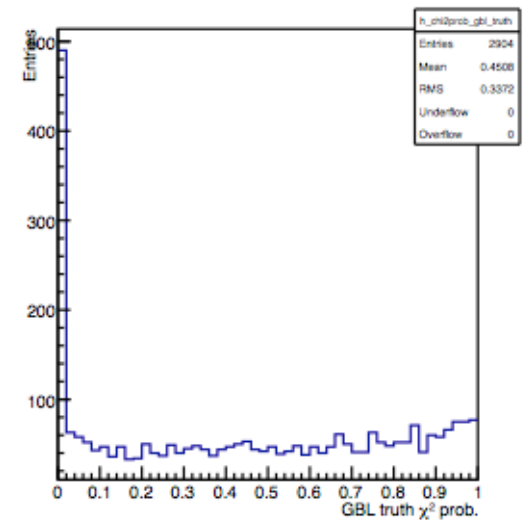
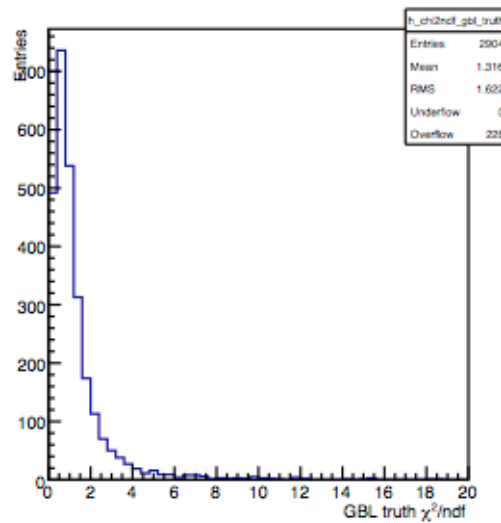
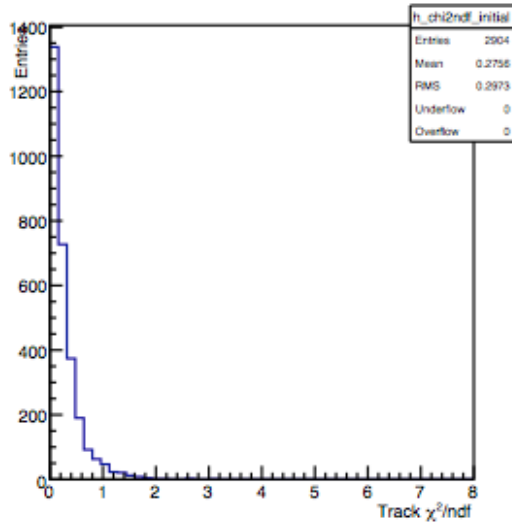
- EGS5 MC
- ~10k events, ~2k tracks (top & bottom)

Alignment procedure

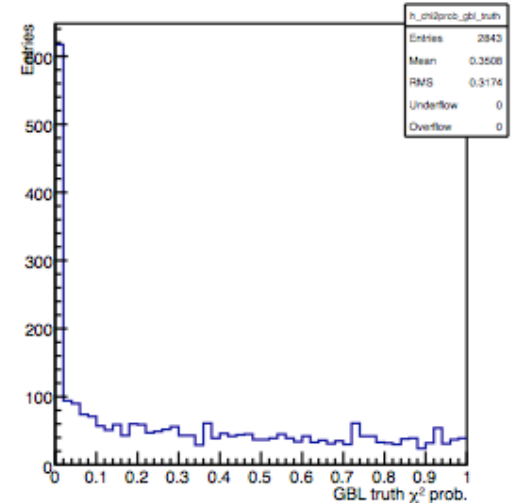
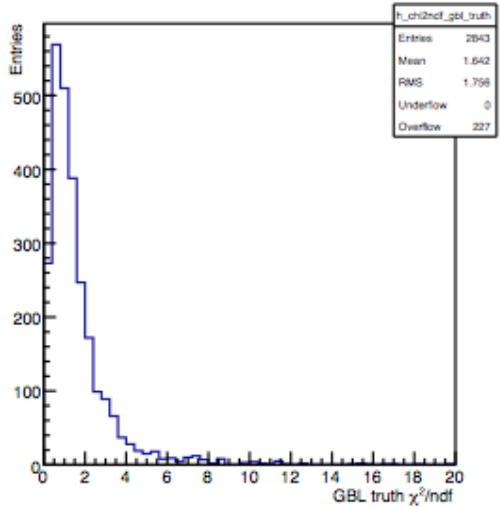
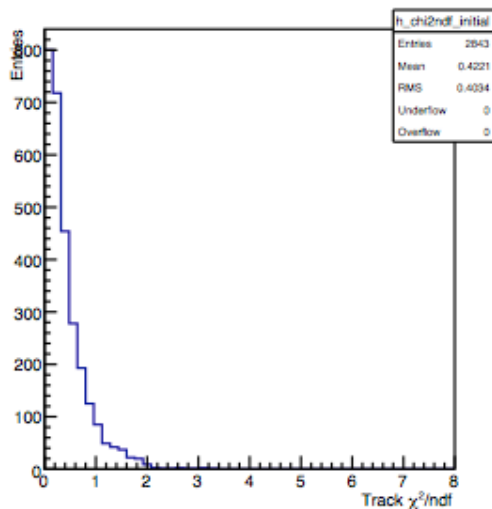
- Track-based alignment
- Refit tracks using GBL
- Global minimization with Millepede2

Testing misalignment in simulation

ideal



misal.



Chi2 increases (0.2->0.4) as expected...

Testing misalignment in simulation

Results show good agreement

Top	True 'y' shift	Fitted 'u' correction
L2 axial	0.1	0.098
L2 stereo	0.1	-0.098

'y' shift is close to 'u' shift
(~100mrad off for stereo sensor)

Proves that Millepede2 input are reasonable (for degrees of freedom tested here)

First Test run data alignment with Millepede

Data

- Run 1351, ~10k events, <2k tracks total (v8 geometry)
- ≥ 4 hits (L1 required to have hit: “357 strategy”)

Alignment setup

- Float L2 & L3 in *measured* direction (need ≥ 2 constraint to avoid offset weak mode)
- Align with GBL and Millepede2
- Geometry tools implemented to translate to compact description

Alignment

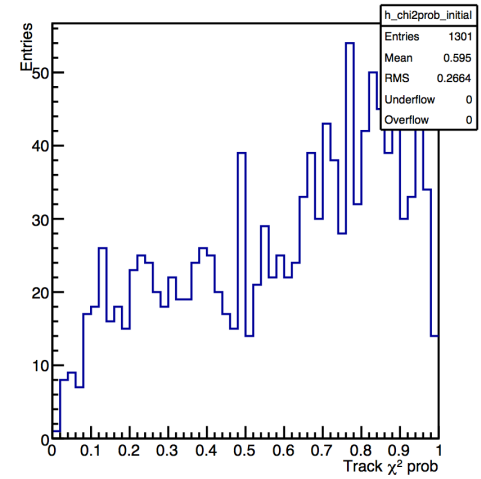
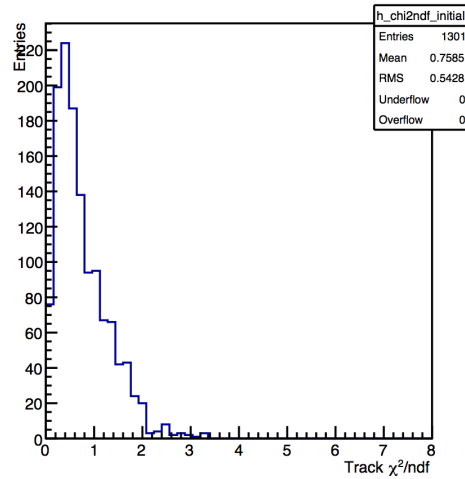
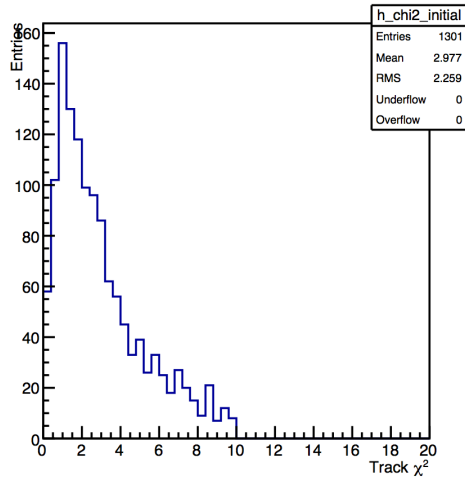
Top	u	x	y	z
L2 axial	-0.11297	~0	0.11	0.003
L2 stereo	0.15065	0.015	0.15	0.003
L3 axial	0.83E-01	~0	-0.082	-0.002
L3 stereo	-0.34E-01	-0.003	-0.034	-0.001

Bottom	u	x	y	z
L2 stereo	0.85	~0	-0.084	0.001
L2 axial	-0.62	~0	-0.061	0.001
L3 stereo	0.04	~0	-0.044	0.001
L3 axial	-0.03	~0	-0.032	0.001

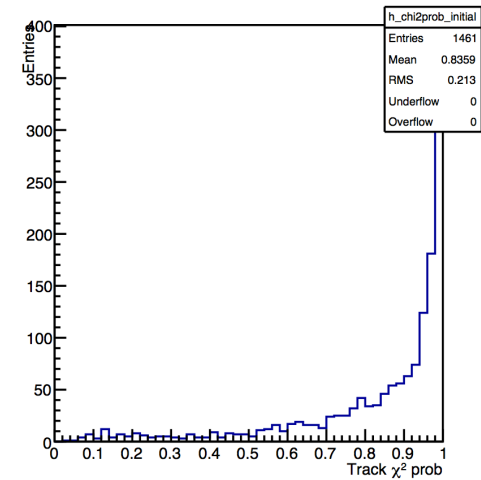
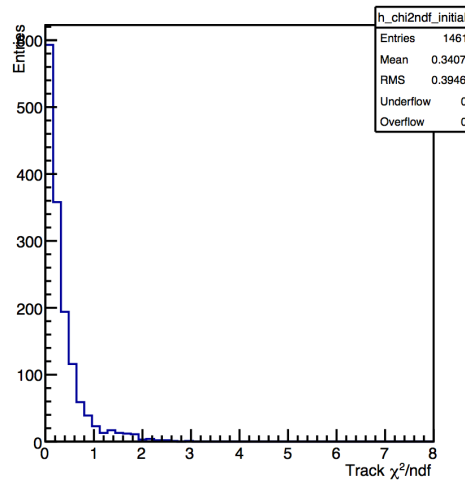
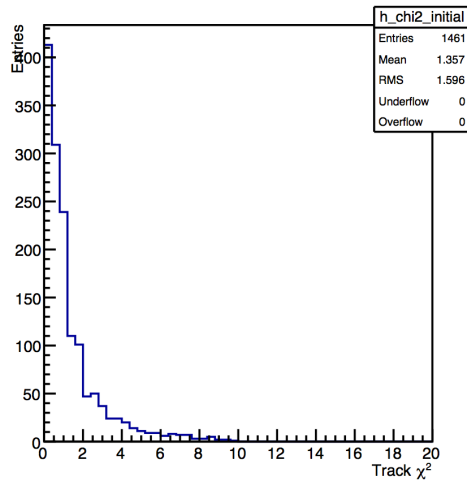
As expected stereo pair moves together
Corrections to survey constants of <0.1mm for both halves

Seed chi2 data top

v8



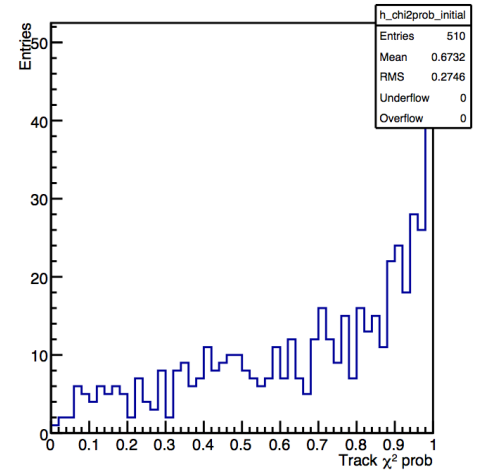
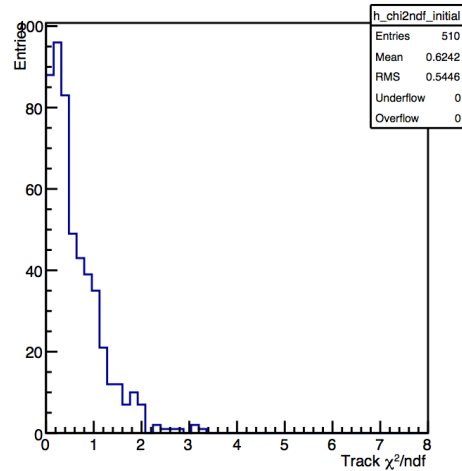
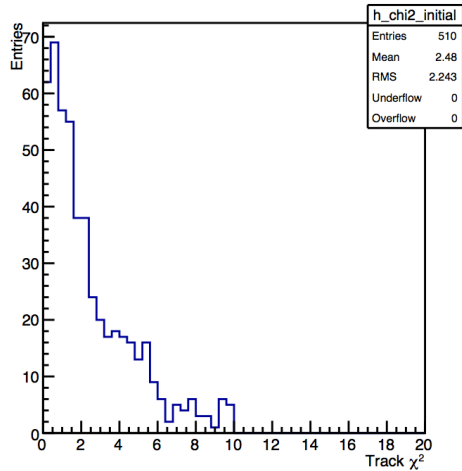
v8-4



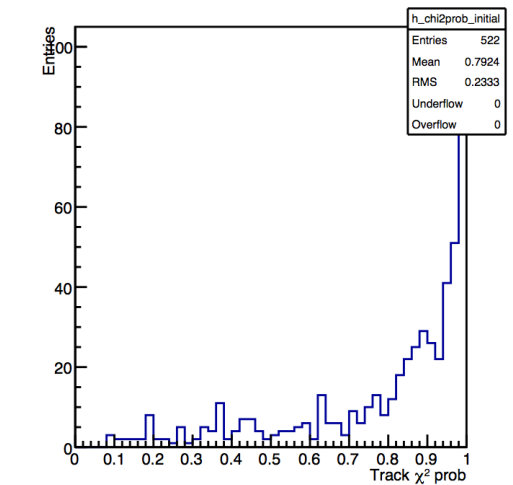
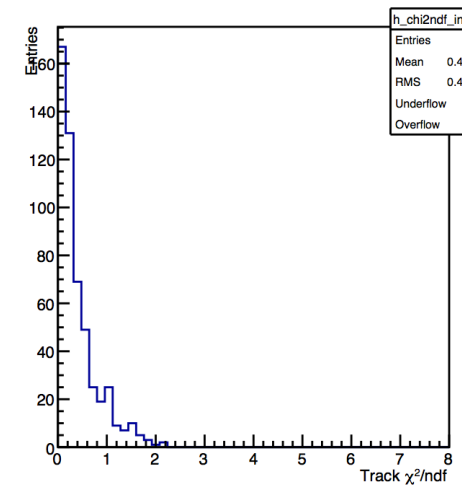
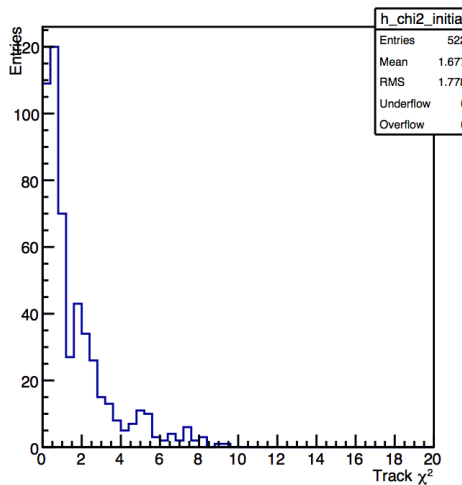
We're overestimating our errors in seedtracker

Seed chi2 data bottom

v8



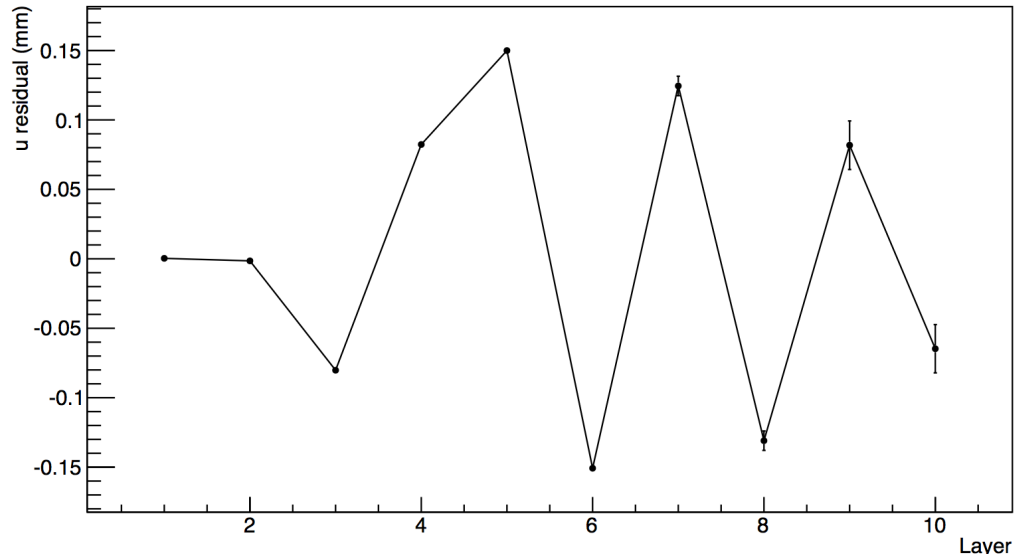
v8-4



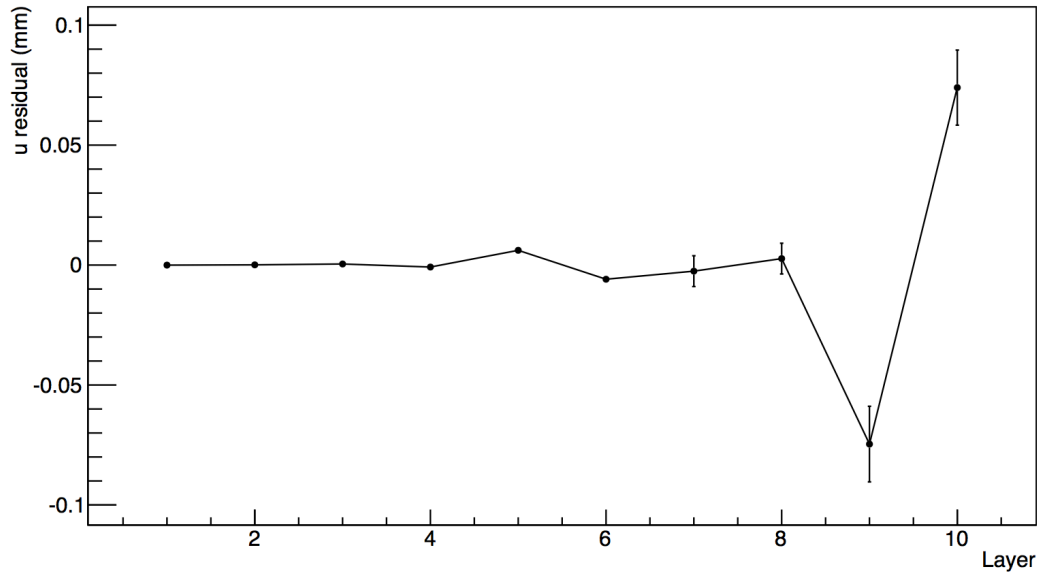
We're overestimating our errors in seedtracker

Seed residuals top

v8



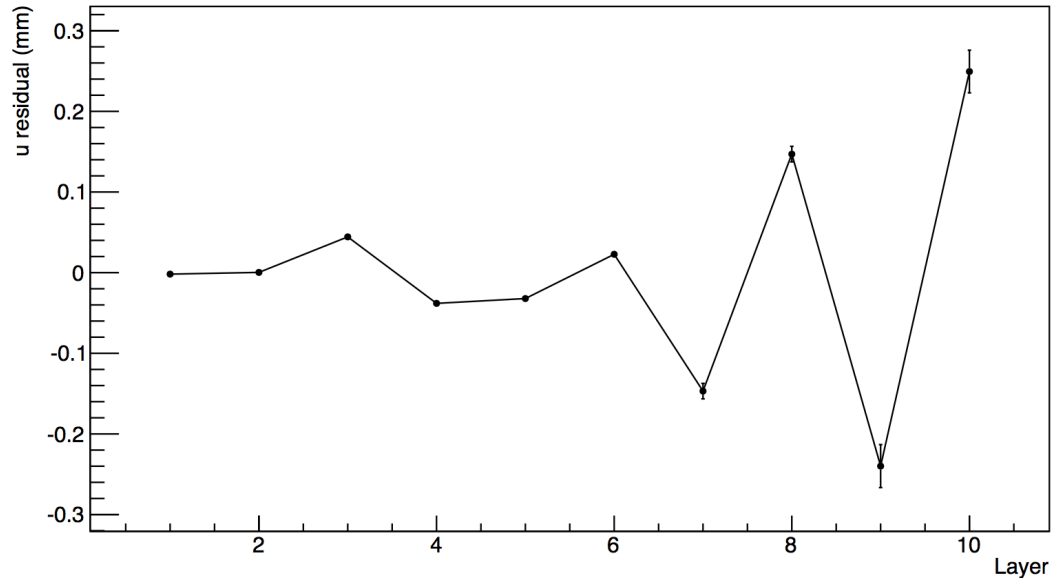
v8-4



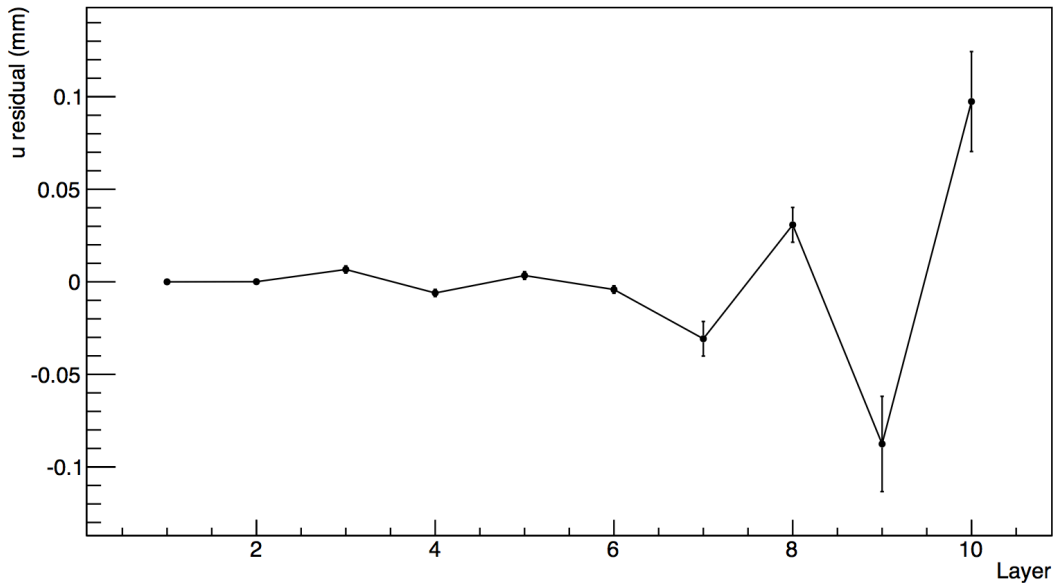
L1-4 residuals
all <10um

Seed residuals bottom

v8



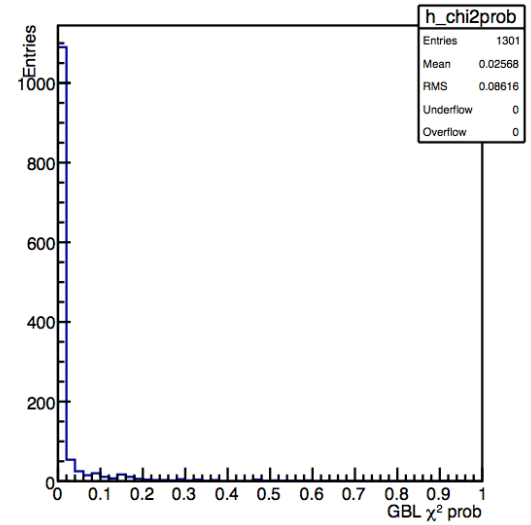
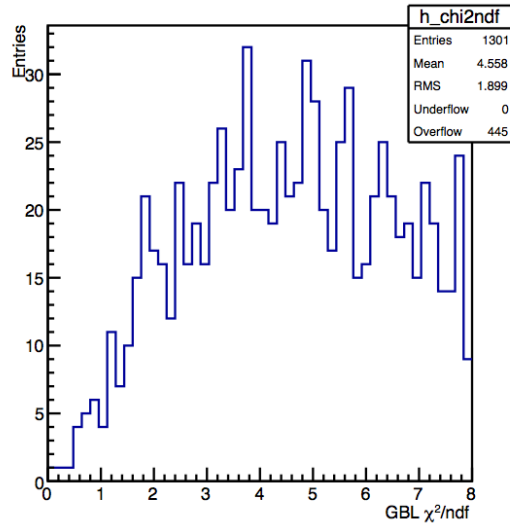
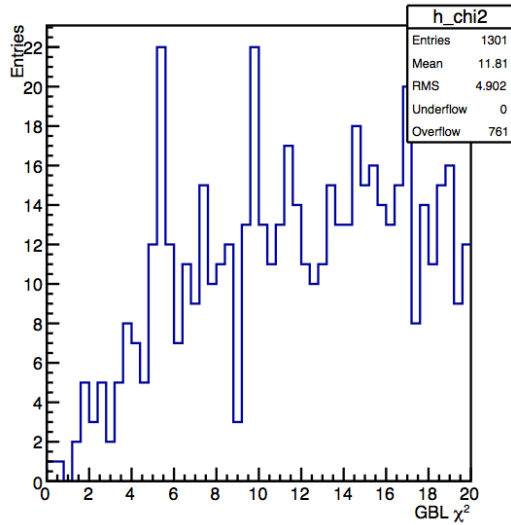
v8-4



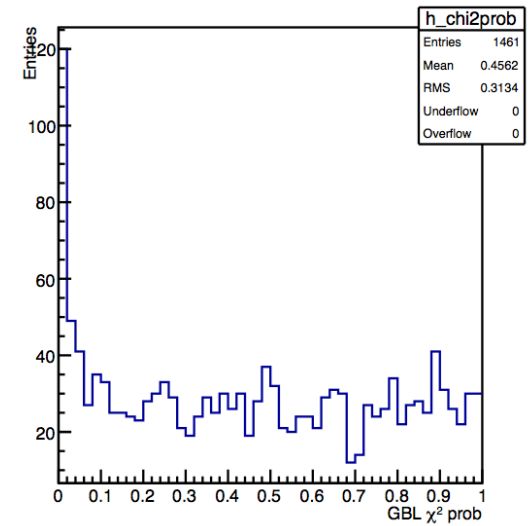
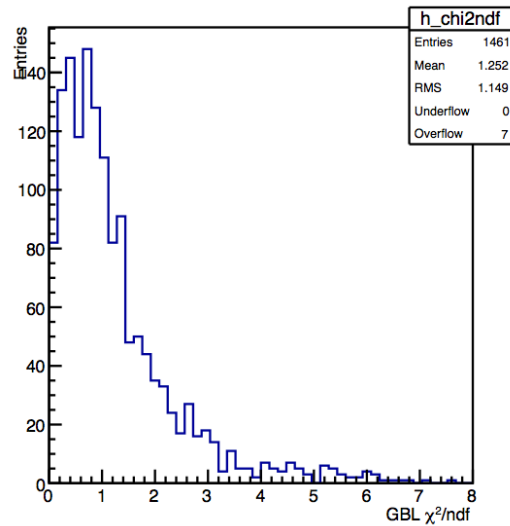
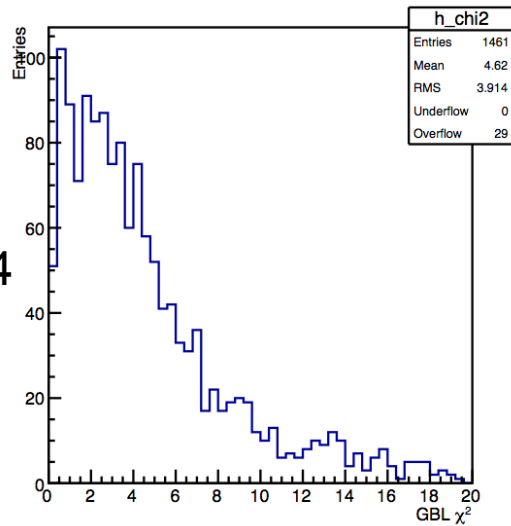
L1-3 residuals
all <10um
L4 <30um

GBL chi2 top

v8

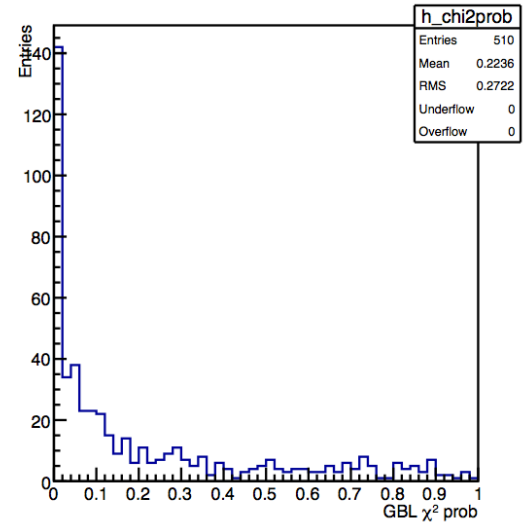
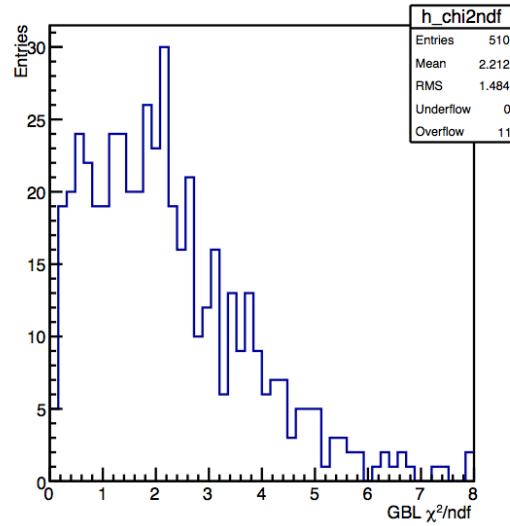
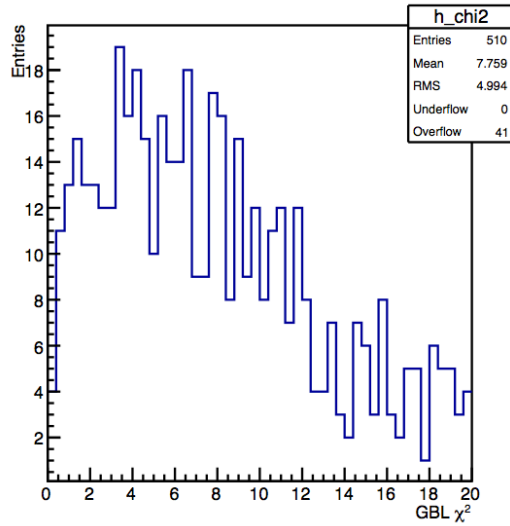


v8-4

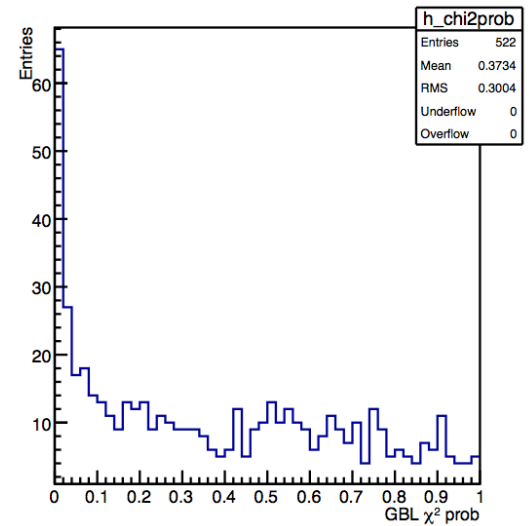
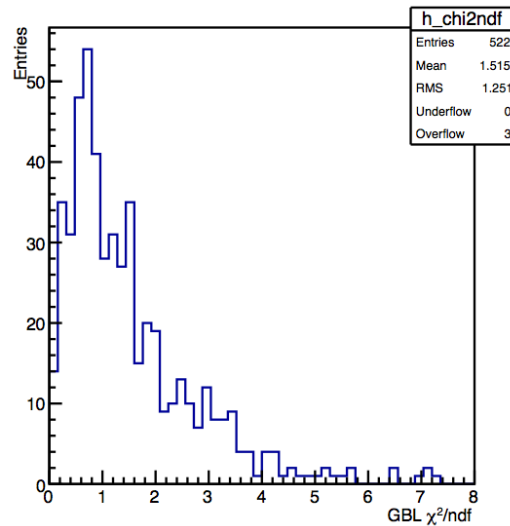
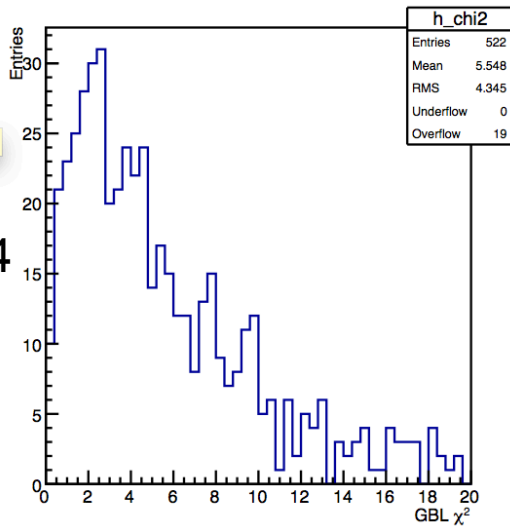


GBL chi2 bottom

v8

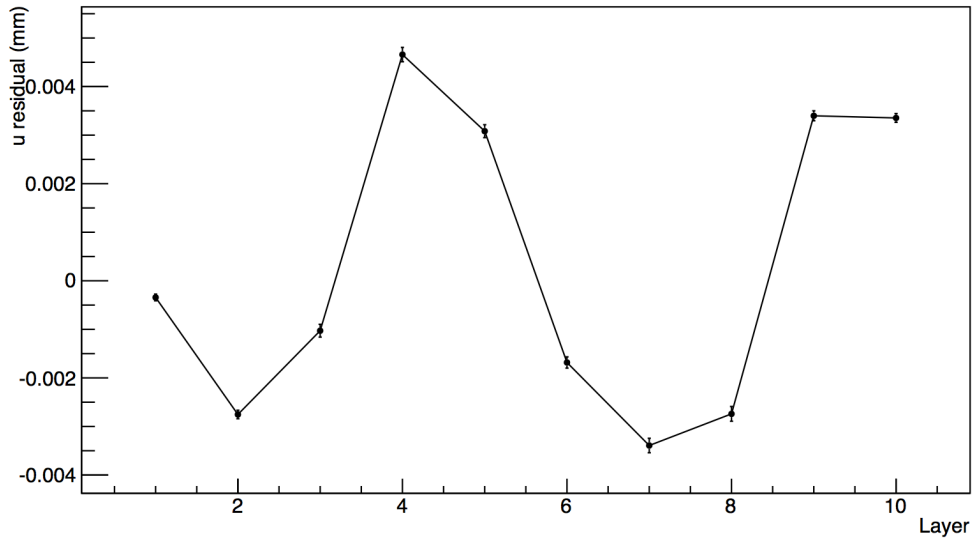


v8-4

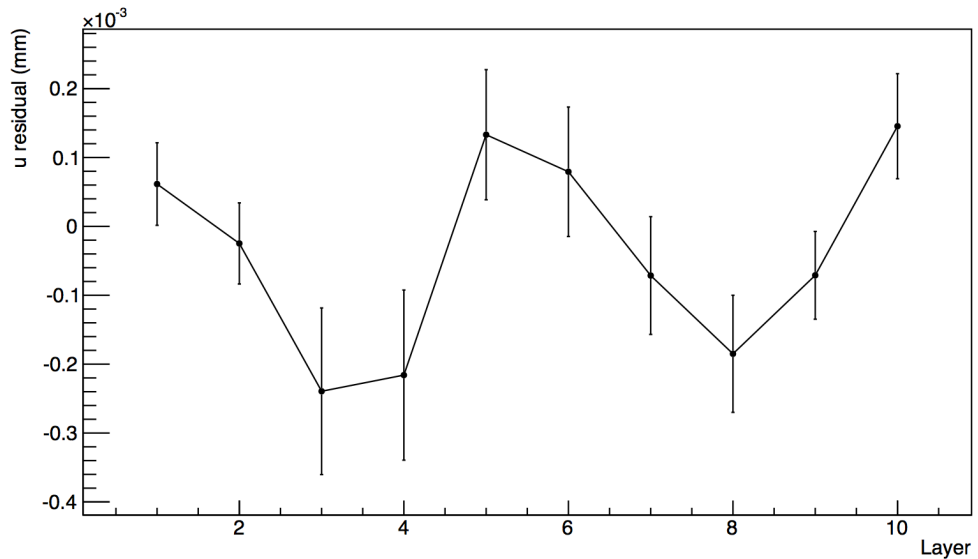


GBL residuals top

v8



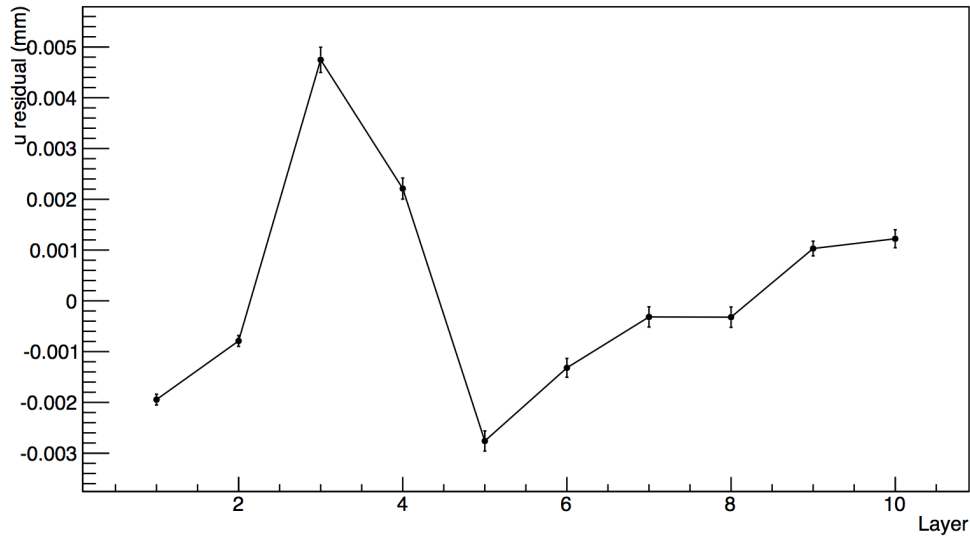
v8-4



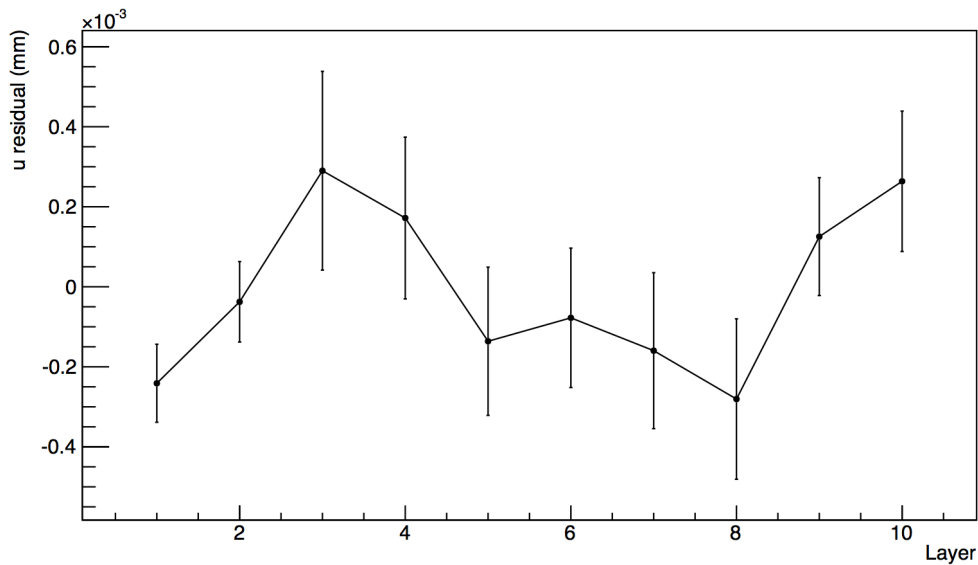
x10 improvement

GBL residuals bottom

v8



v8-4



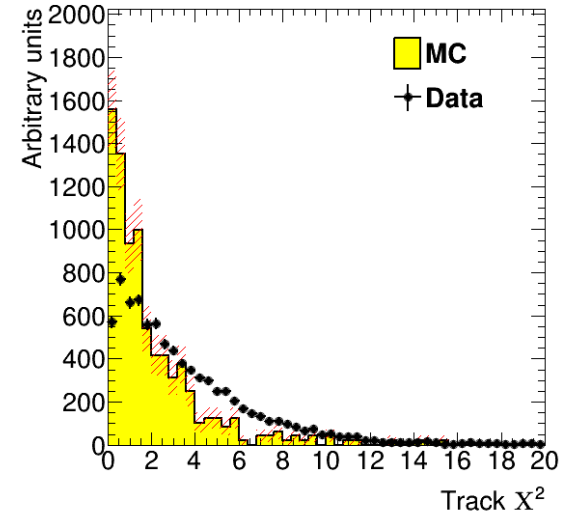
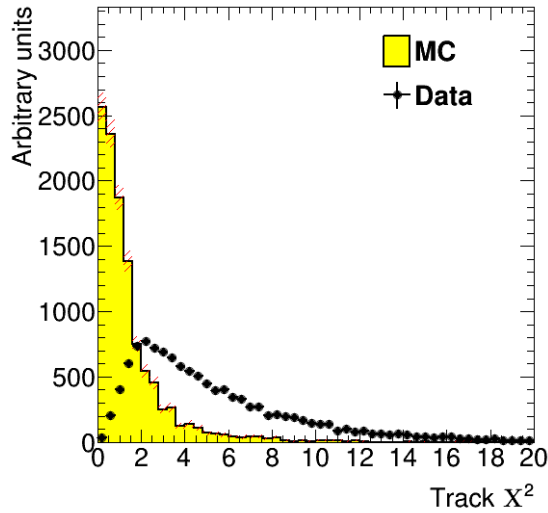
x10 improvement

Chi2 data/MC

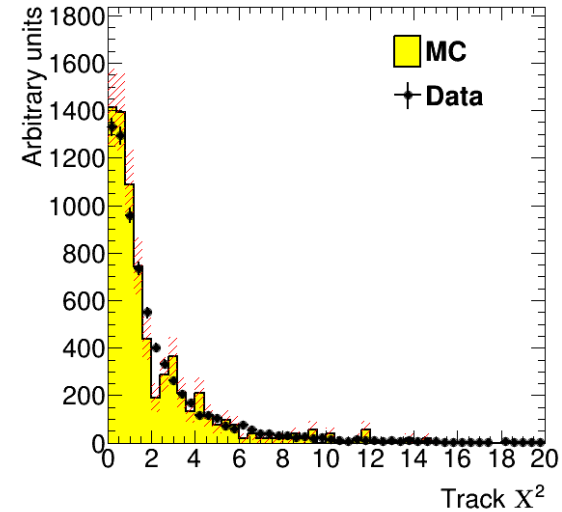
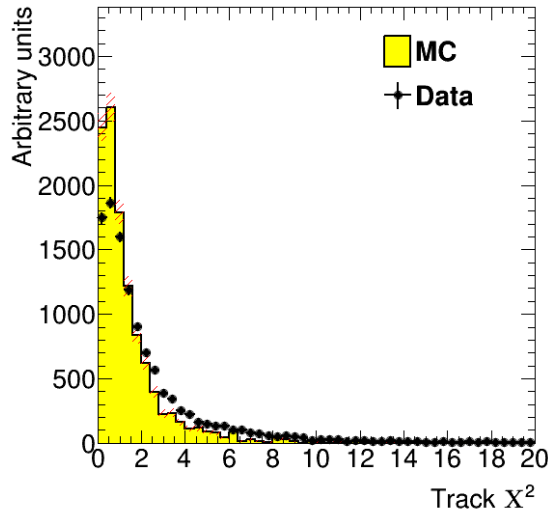
Top

bottom

v8



v8-4

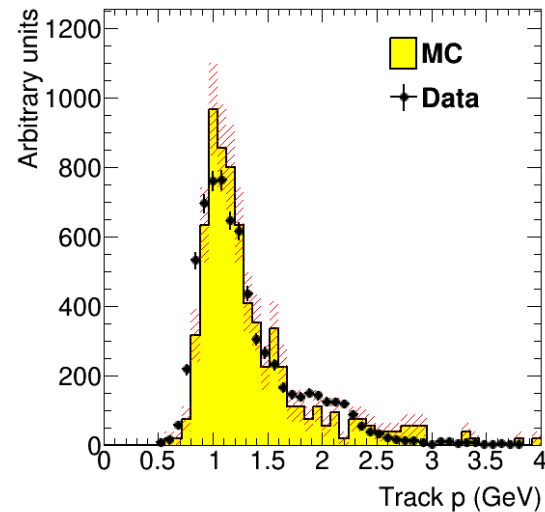
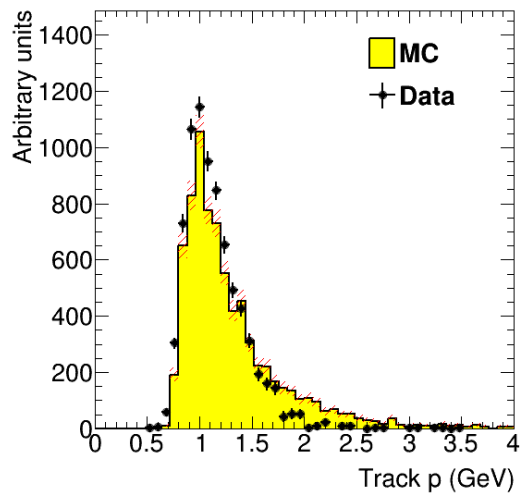


Track p data/MC

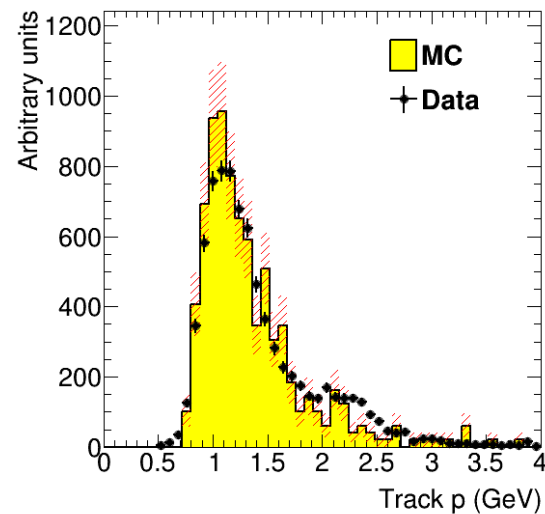
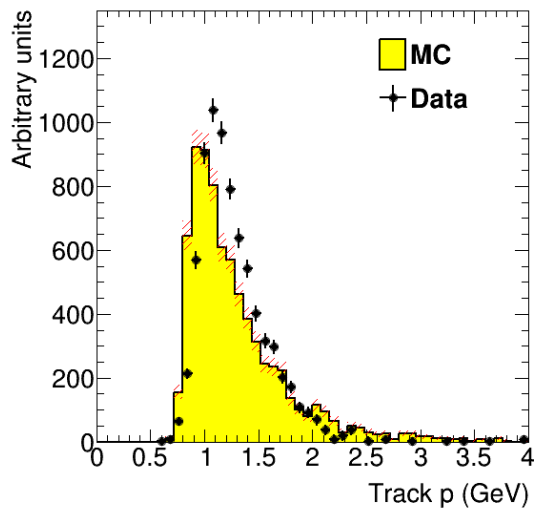
Top

bottom

v8



v8-4

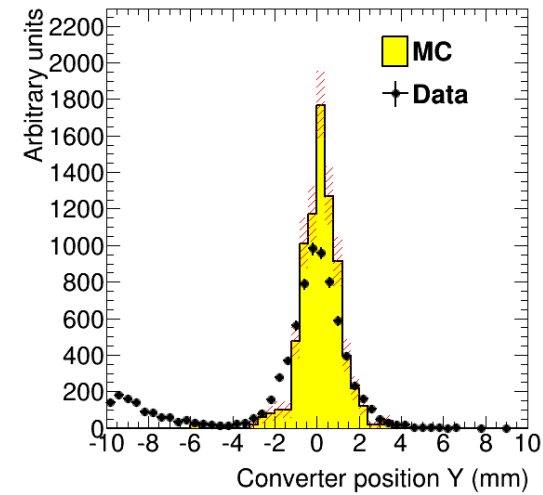
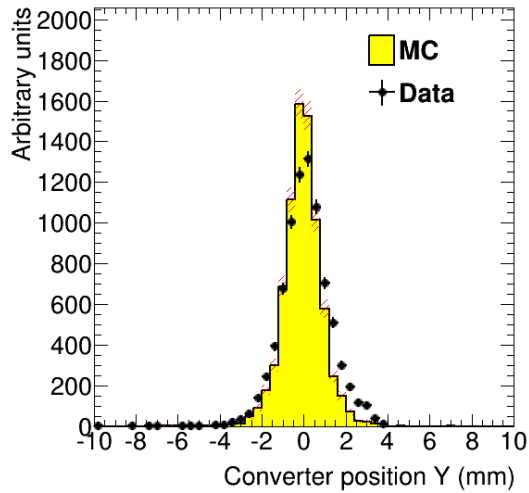


Vertical track position at converter data/MC

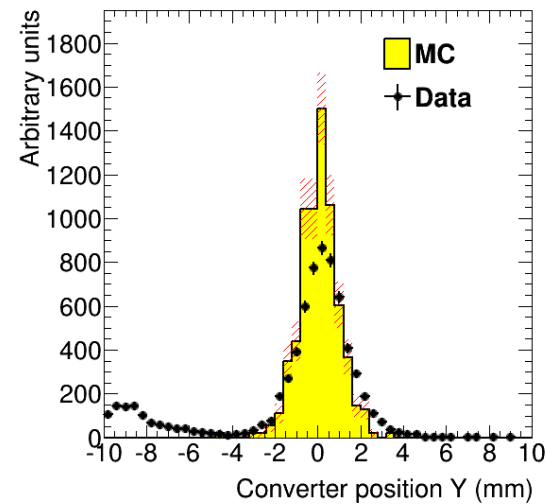
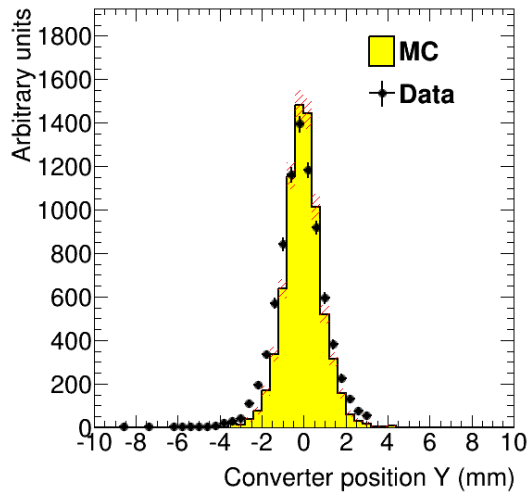
Top

bottom

v8



v8-4

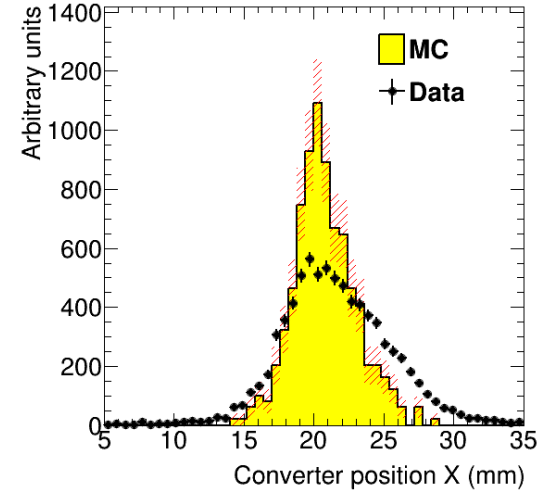
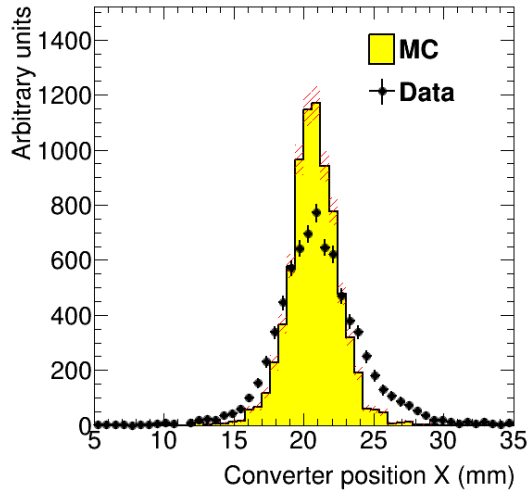


Horizontal track position at converter data/MC

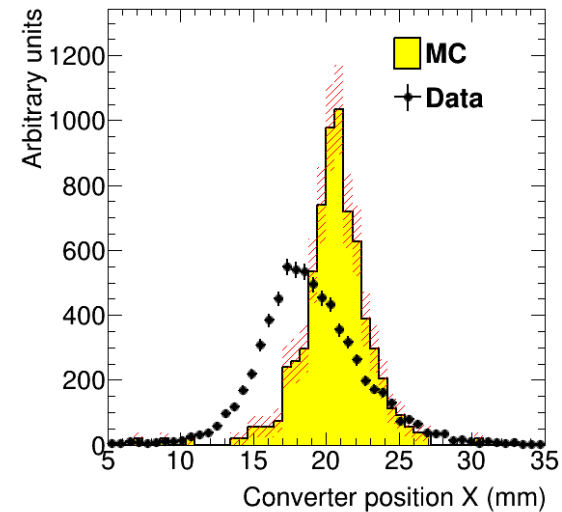
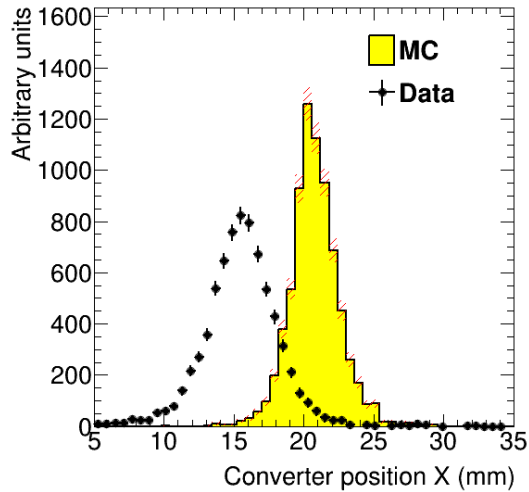
Top

bottom

v8



v8-4



Shift in bend-plane

First simple alignment with GBL+Millepede2 works*

- Test simulation misalignment
- Test run data with 2 layers floating in measurement direction

Observations

- Chi2 improves enormously for top and bottom half
- Residuals for L1-4 (rare with 5 hit tracks) are now within 5-10um
- Hit distributions doesn't change much
- Track momentum (p_z) is more off with correction in top
- Extrapolation in bend plane way off after correction; non-bend look ok

Don't expect perfection

- Floating two layers is not enough obviously; it's pretty stable though (see next)

Further quick studies

Iterate over different floating pairs

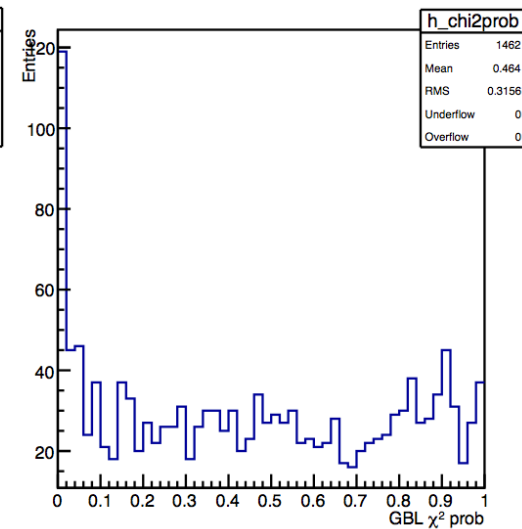
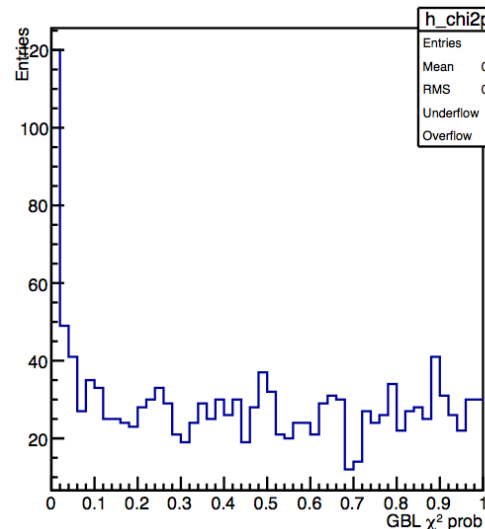
- No rotation allowed
- Stopped when changes were less than approx. 5 μ m (50) for L1-4 (L5)
- Looks stable with this track sample

Layer	Δy (L2,L3 float) [um]	Δ iteration [um]
1	-	+3
2	+130	-5
3	-50	-12
4	-	-4
5	-	+66

Not a huge change

- chi2 (both seed and GBL) almost identical
- L5 has low statistics

Increased statistics by x40 but no real change for L1-4



Next steps

Short-term improvements

- Play more with rotations (debug) and correlations
- Use more statistics to improve stability

Long-term improvements

- Super-structure alignment (module, support plate, etc.)
- New geometry implementation (ongoing)
- Simplified reconstruction (GBL in Java ongoing)
- Straight-through tracking and alignment

Keep using Test run as “test bed”

Help coming; Alessandra ramping up