Beamspot inclusion and millepede adjustments - 1

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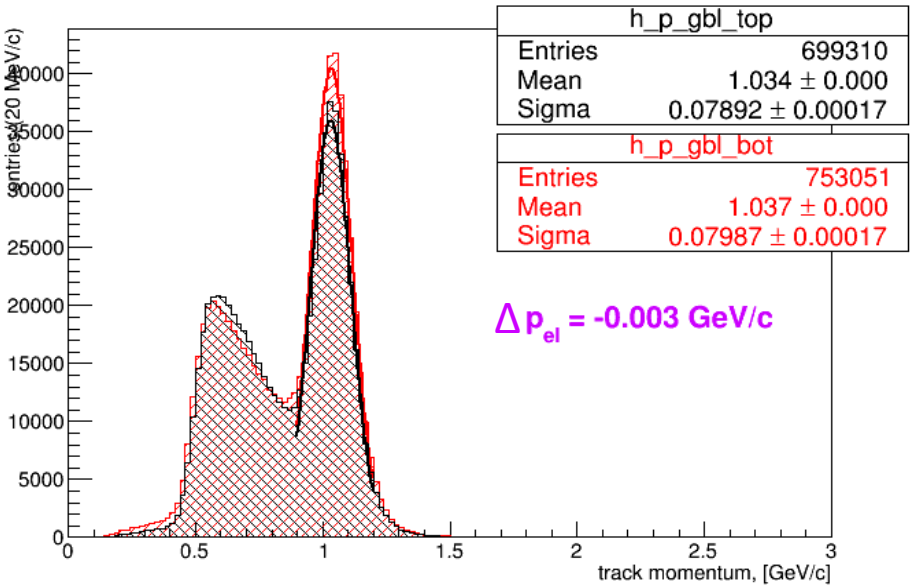
Jan 23, 2017

Present situation and procedure

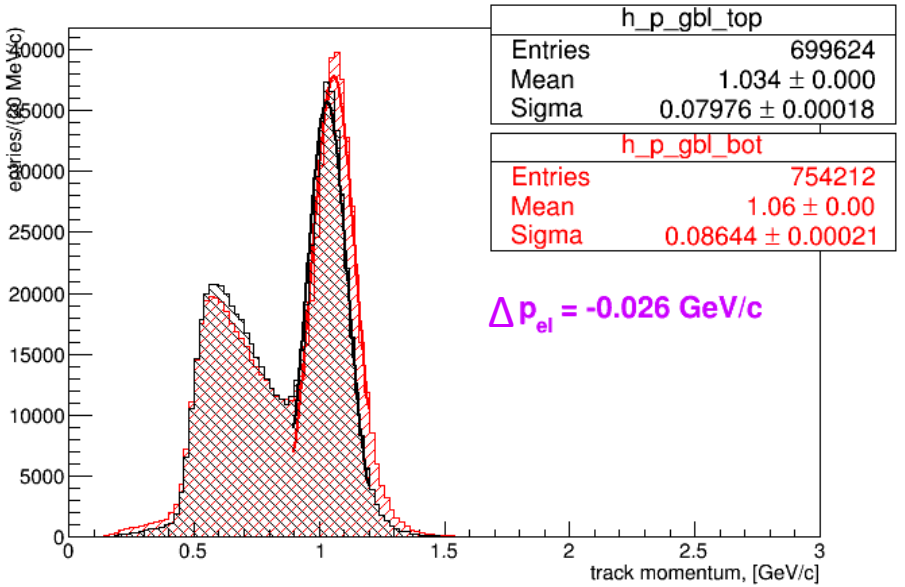
- Found a good geometry which provides acceptable residuals for both curved and straight tracks
  - Recall: this does not happen with the current geometry!
- Good agreement between momentum spectra for top and bottom
- Bad agreement between top and bottom impact parameters (d_0, z_0) and coordinates (x_T, y_T) @ z=0 (assumed as origin point of the helix in the curvilinear reference system)
- Problem: how to improve the impact parameter agreement without spoiling (or, if possible, improving) the current alignment quality?

- 2 steps procedure:
  1. Deduce the beamspot position from the experimental distributions, insert it as extra point in the reconstruction, check improvement, repeat until reasonable convergence
  2. Run millepede over reconstructed tracks with additional beamspot point, and produce a modified alignment taking into account the new point coordinates (which are allowed to be floated), check improvement, provide the reconstruction with the new information, repeat 1 (attention to the differen reference systems!)

GBL momentum: top vs bottom - start



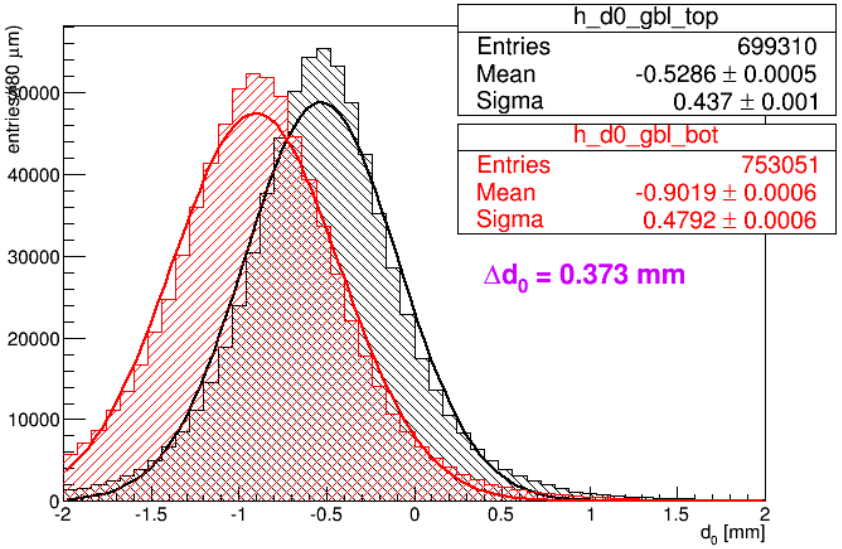
"current" alignment

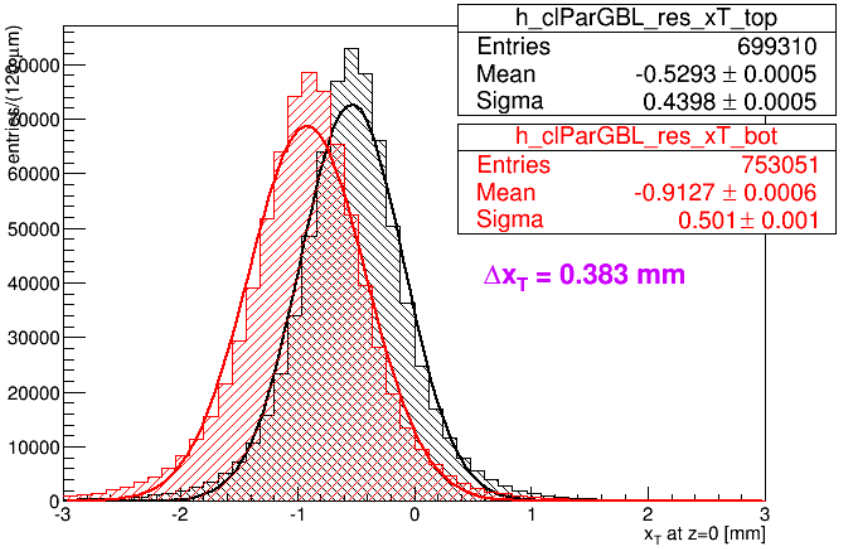


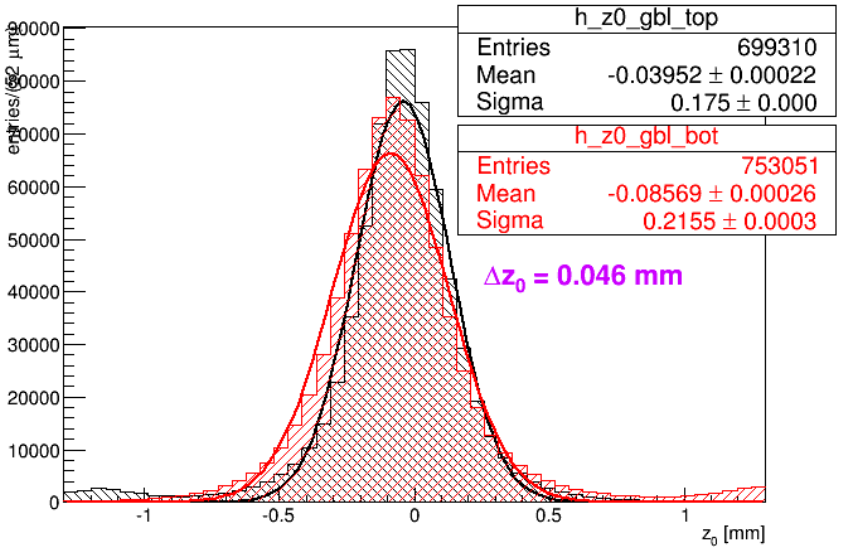
to be compared: momenta with best alignment on curved tracks + tweaks (latest excluded)

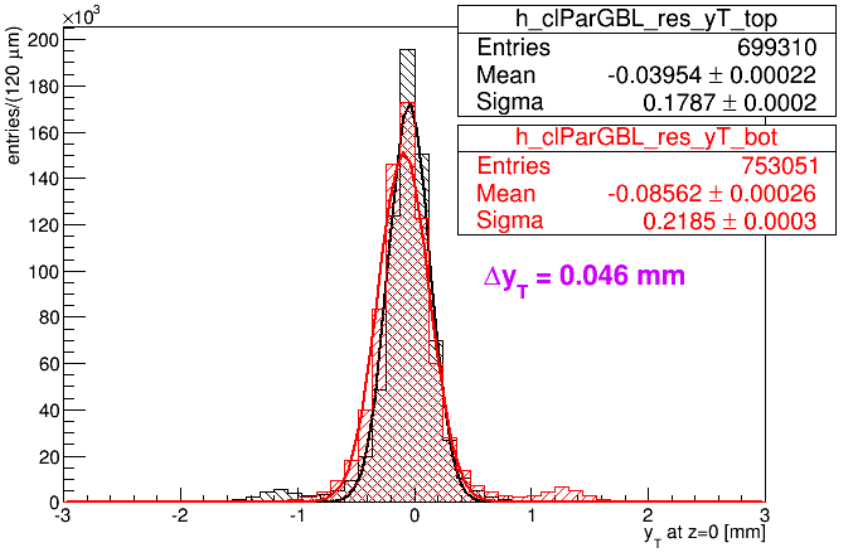
- **Systematic underestimation** wrt to beam energy nominal value (~ 20 MeV/c)
- Good agreement of mean values of elastic peaks for top and bottom tracks (no selections)

impact parameters (after GBL) - start









Impact parameters – perigee reference system

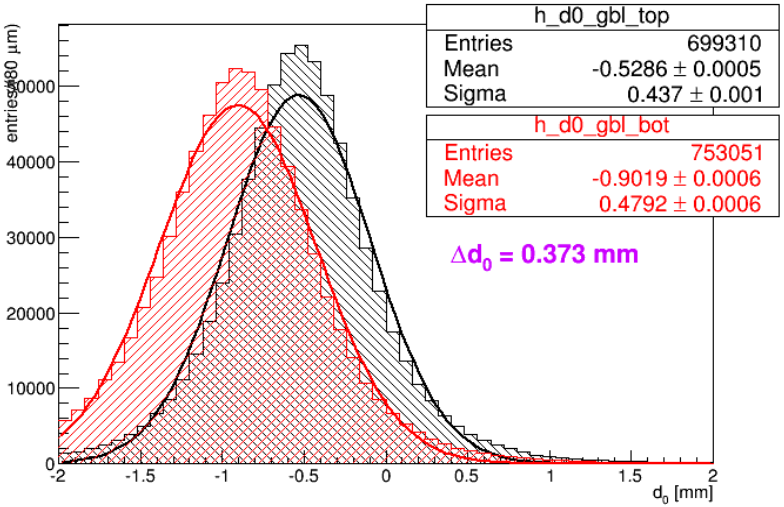
Track origin – curvilinear rs

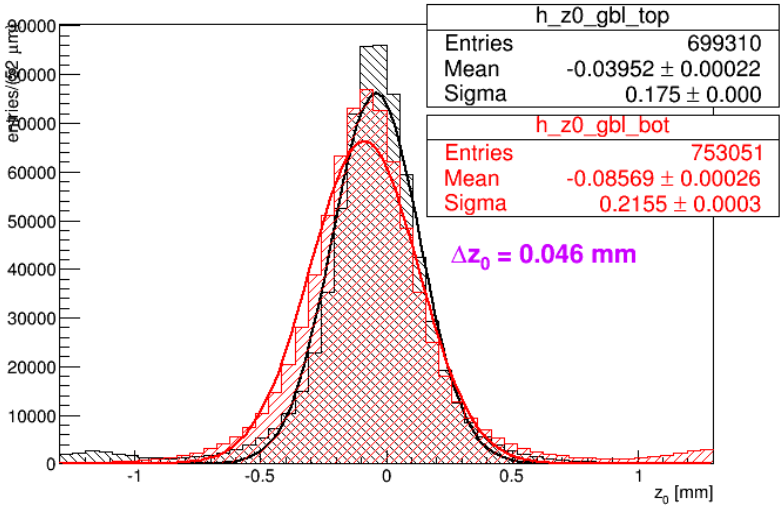
How to add the beamspot in the reconstruction

- Beamspot coordinates in the perigee reference system (0., d_0, z_0) inserted as xml parameters in the lcsim steering file
  - Taken as mean value of top/bottom impact parameters
  - Input beamspot coordinates: (x=0, y=d_0, z=z_0)
  - In the reconstructions these coordinates are converted to curvilinear coordinates of a point of the helix
- Beamspot width in y-z inserted as well
  - Taken as difference between top and bottom mean values

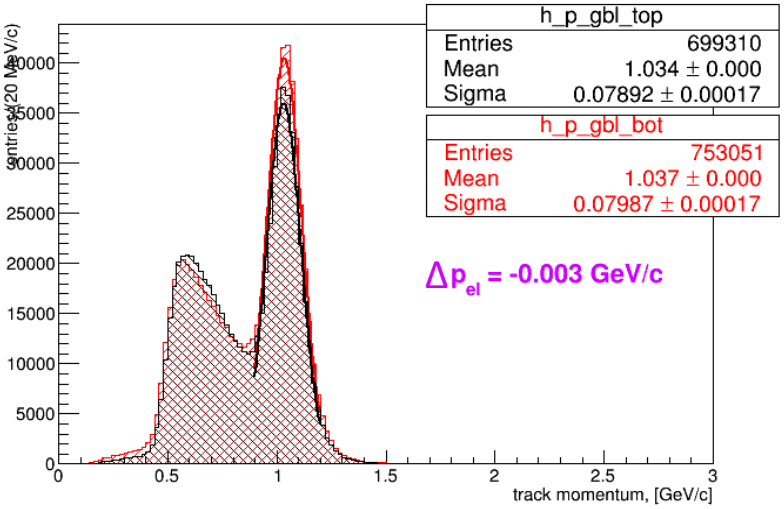
- Reconstruct data and perform quality check
  - Reconstruction efficiency (in some cases with large widths GBL fails)
  - Residuals/kinks stability/behavior
  - improvement of top/bottom agreement for impact parameters
    - Closer mean values
    - Narrower distributions
  - Calibration of elastic peak momentum for top/bottom
- Procedure available (at present) for curved tracks reconstruction only
- Some iterations needed (order 3-4)

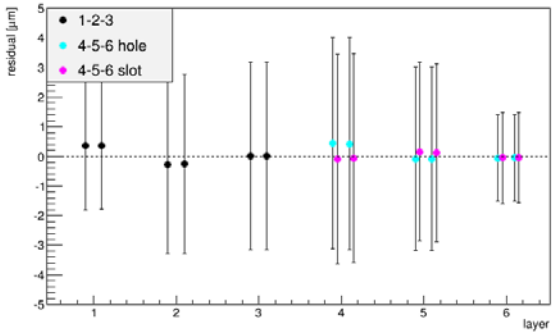
impact parameters (after GBL) – start

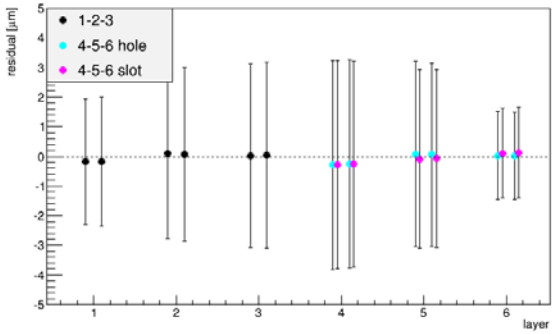




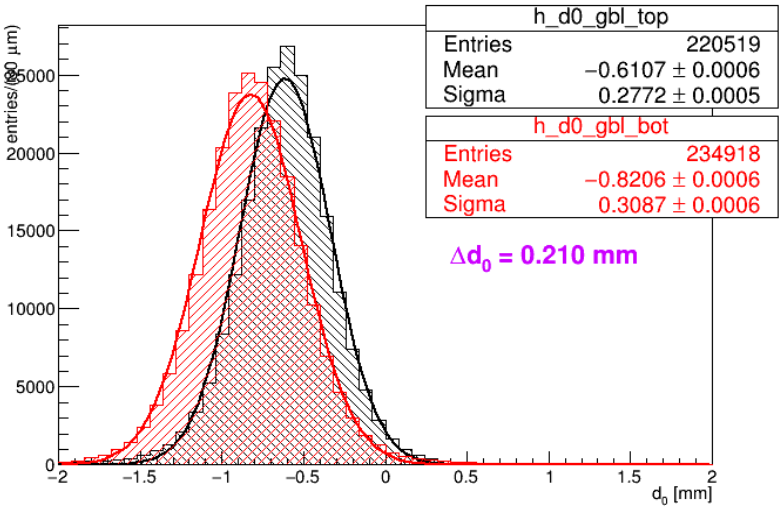
No beamspot

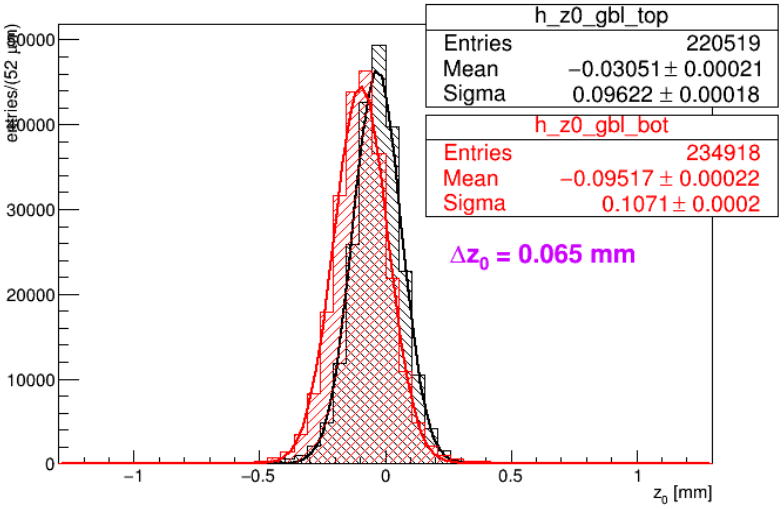




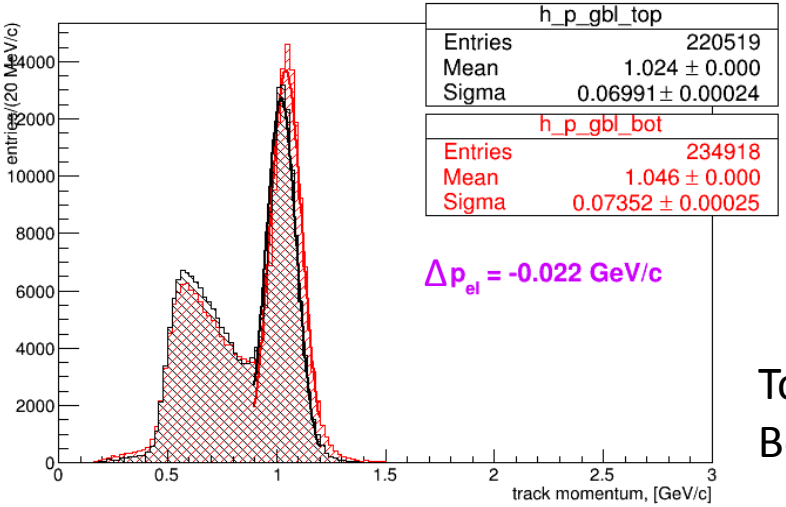


impact parameters (after GBL) – 1st iteration

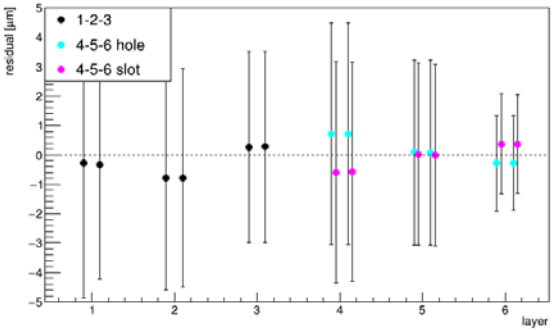


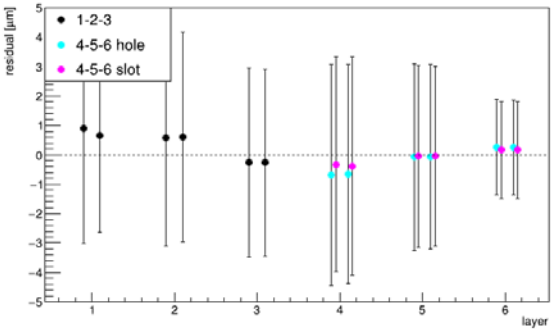


Input beamspot coordinates:
y = -0.717 mm , Δy = 0.373
z = -0.063 mm, Δz = 0.046



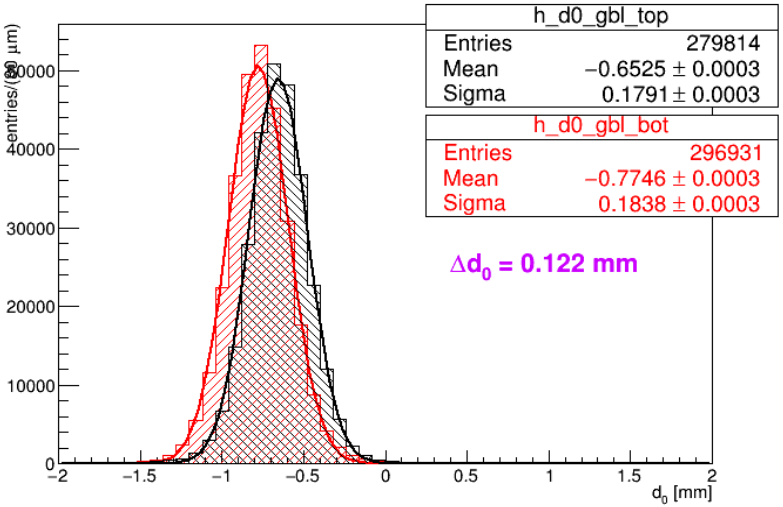
u-residuals slightly worsen
bottom is better

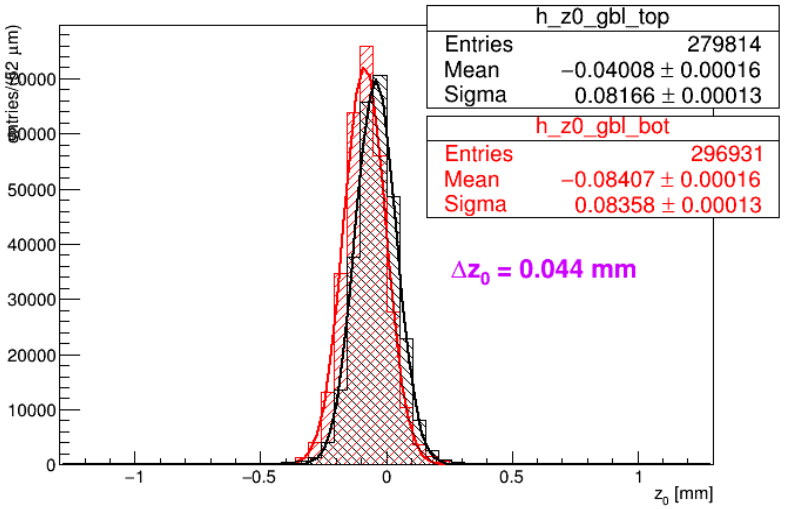




Top p_{el} decreases
Bottom p_{el} increases

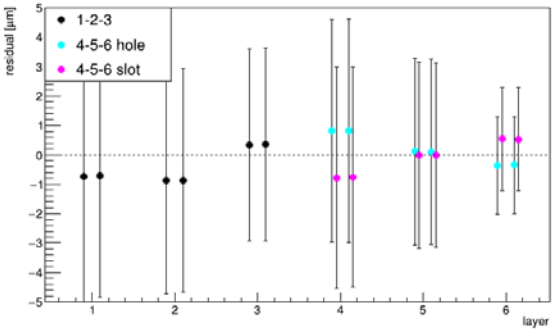
impact parameters (after GBL) – 2nd iteration

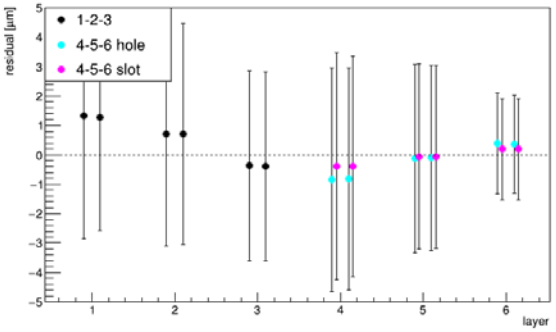


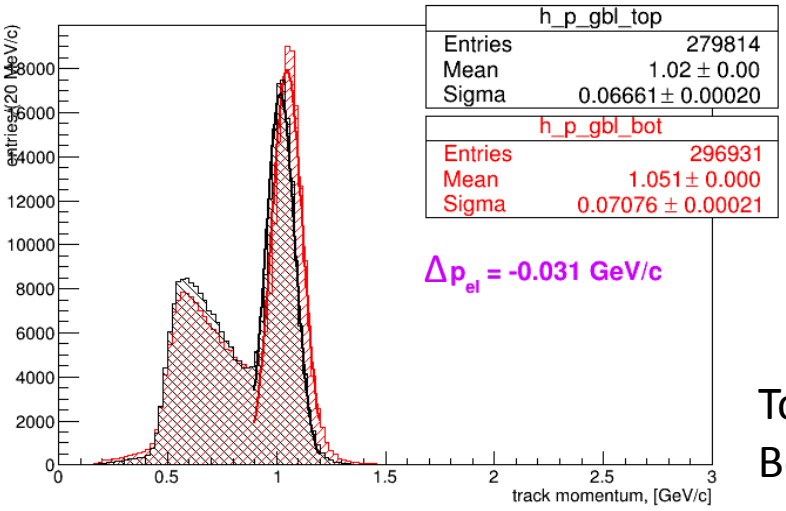


Input beamspot coordinates:
y = -0.716 mm , Δy = 0.210
z = -0.064 mm, Δz = 0.062

u-residuals slightly worsen

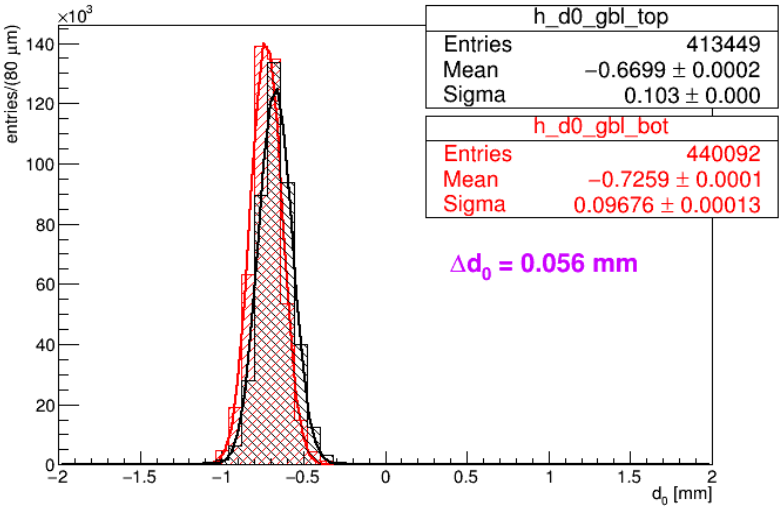


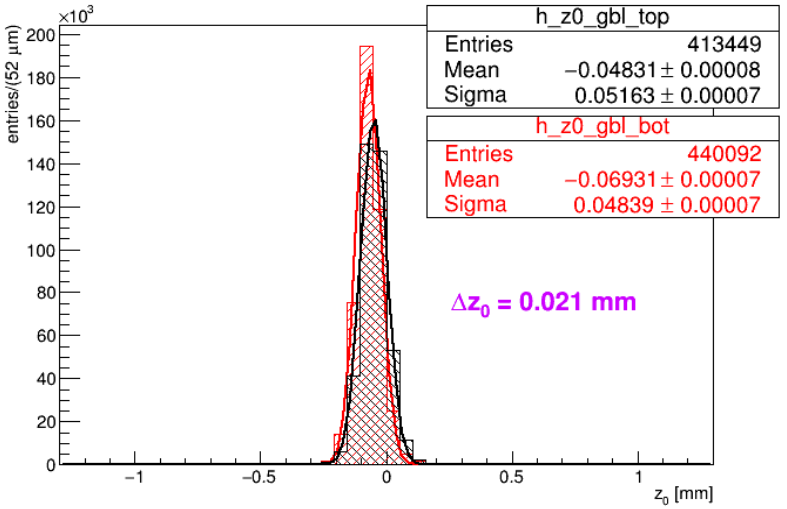




Top p_{el} decreases
Bottom p_{el} increases

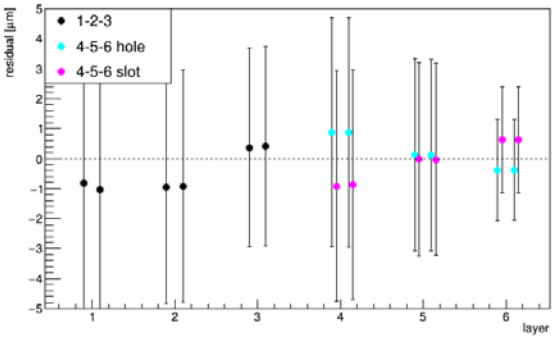
impact parameters (after GBL) – 3rd iteration

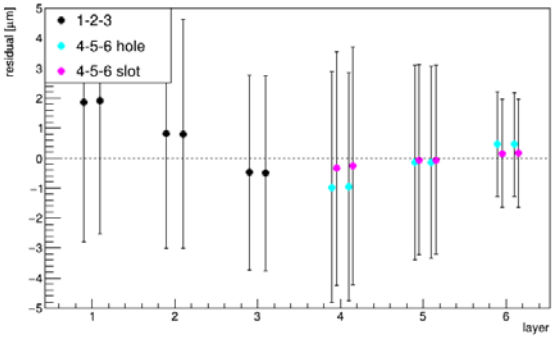


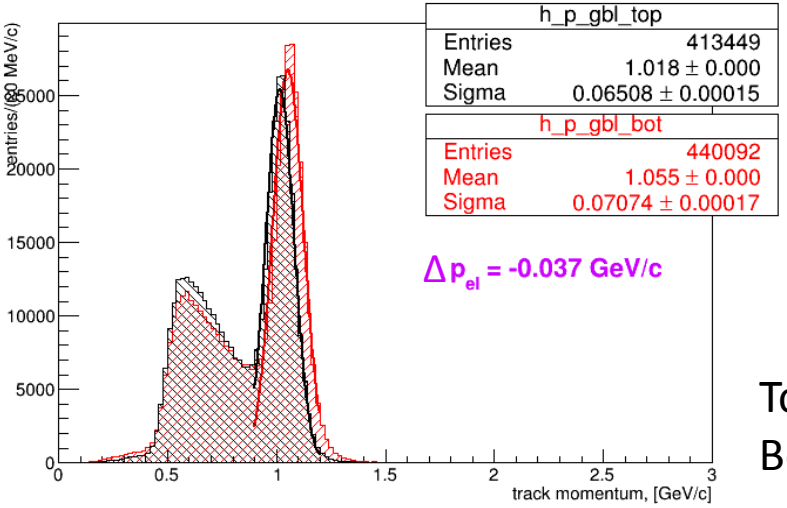


Input beamspot coordinates:
y = -0.699 mm , Δy = 0.122
z = -0.062 mm, Δz = 0.043

u-residuals worsen

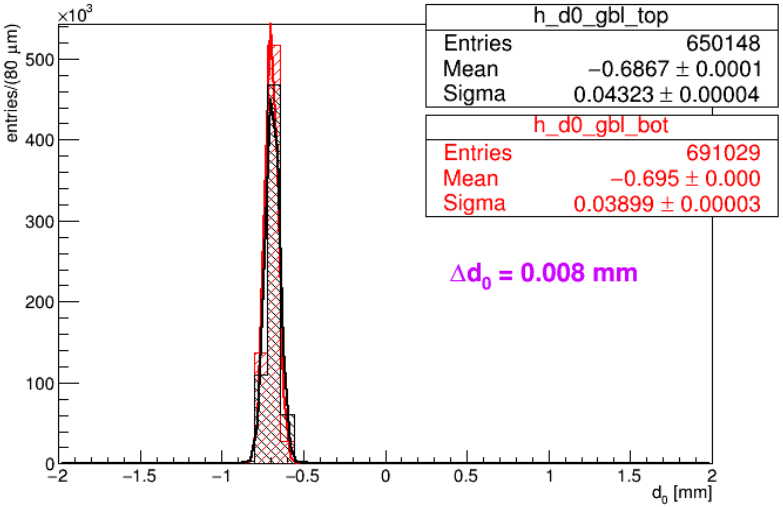


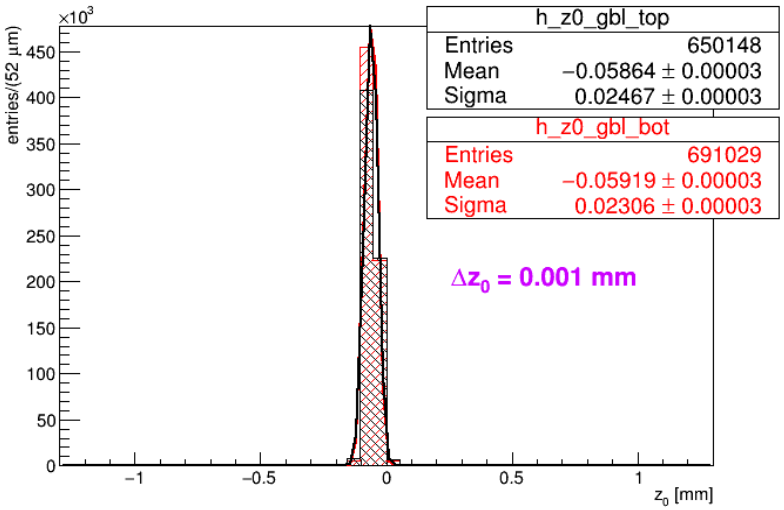




Top p_{el} decreases
Bottom p_{el} increases

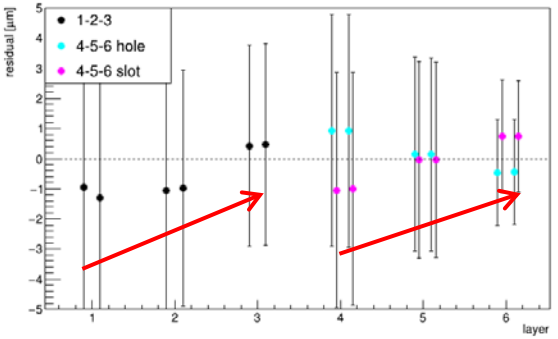
impact parameters (after GBL) – 4th iteration

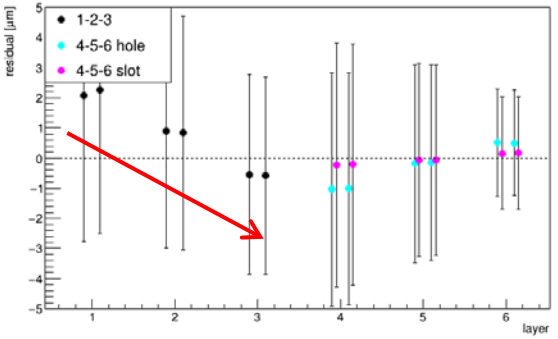


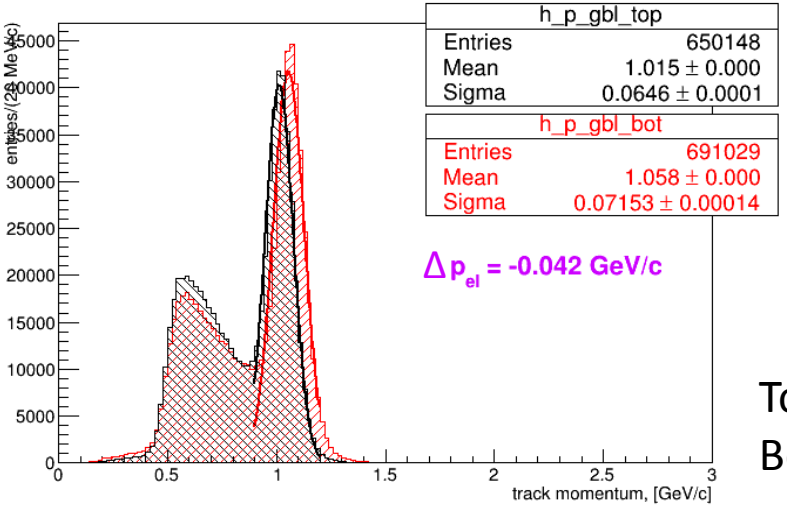


Input beamspot coordinates:
y = -0.696 mm , Δy = 0.059
z = -0.059 mm, Δz = 0.021

u-residuals worsen… more and more







Top p_{el} decreases
Bottom p_{el} increases

Summary: four beamspot iterations

	Iter 0	Iter1	Iter2	Iter3	iter4
<y> (mm)	**-0.717**	-0.716	-0.699	-0.696	**-0.691**
Δy (mm)	**0.373**	0.210	0.122	0.056	**0.082**
<z> (mm)	**-0.063**	-0.064	-0.062	-0.059	**-0.059**
Δz (mm)	**0.046**	0.062	0.043	0.021	**0.006**
<p> (GeV/c)	**1.034**	1.036	1.036	1.037	**1.037**
Δp (MeV/c)	**2.85**	-22	-30.5	-37.0	**-42.0**

- Top/bottom d_0 and z_0 impact parameter agreee
- Narrower width of the distributions
- Inserting the beamspot information IS NOT a weak constraint for aligment:
  - Residuals are in general worsening
  - The calibration of the elastic peak worsens as well
    - Improvement only for the bottom section
- Can a new MP alignment applied at this point provide a better adjustment?

Second step: adjust residuals

- The beamspot is intended as a new (fictitious) layer with given origin coordinates
  - 4 new (pseudo)sensors: top + bottom, axial+stereo
- Possibility to include millepede floats to adjust the origin coordinates for each sensor
  - 6 degrees of freedom for each sensor
  - Rotations are not meaningful (kept for code consistency)
  - To be constrained: bottom and top offsets must be the same to converge to the same point

- Same procedure
  - the GBL file must contain the coordinate of the beamspot as a new point for the track fit
  - no problem of principle to mix curved tracks including beamspot and straight tracks without it (could be interesting to implement it)

- Problem (working on): MP delivers offsets in the sensor reference system
  - How to translate them into the beamspot coordinates provided in the perigee frame?

- To be continued…