

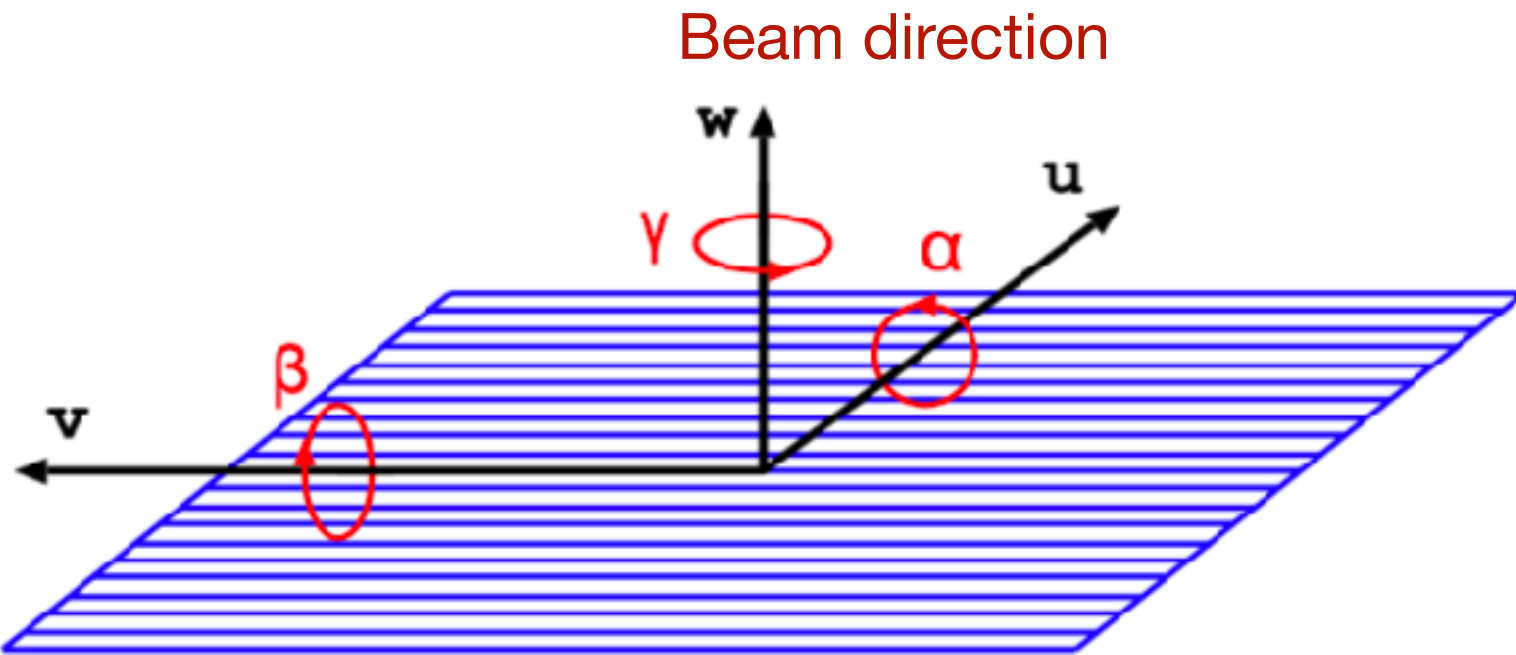
MOST2 offline tracking reconstruction and alignment

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Interface to Millepede

- using simulated data from G4
- interface to Millepede to solve the matrix, then get the corrected alignment parameters
- digitizing the simulation data, randomly change the ideal geometry



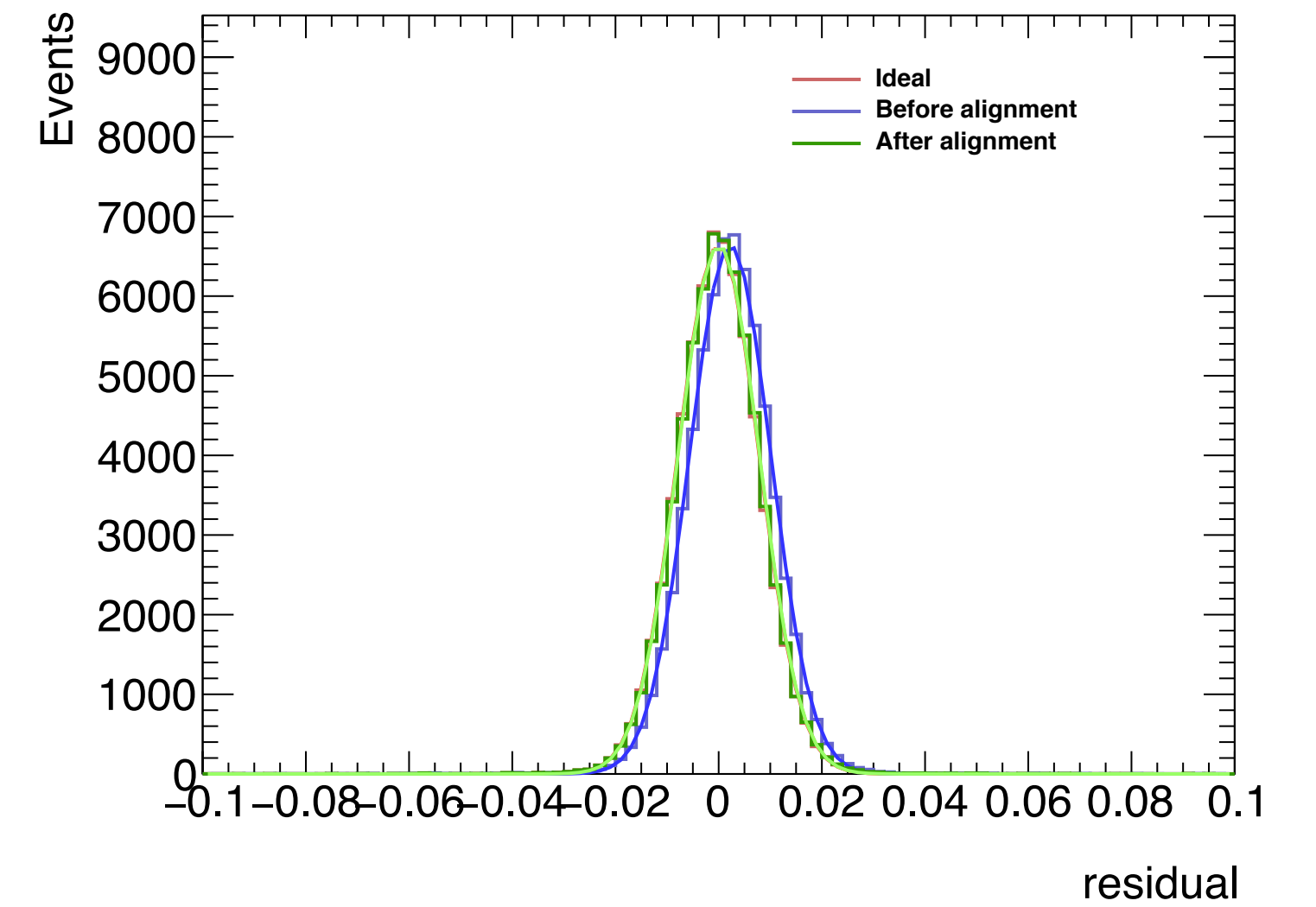
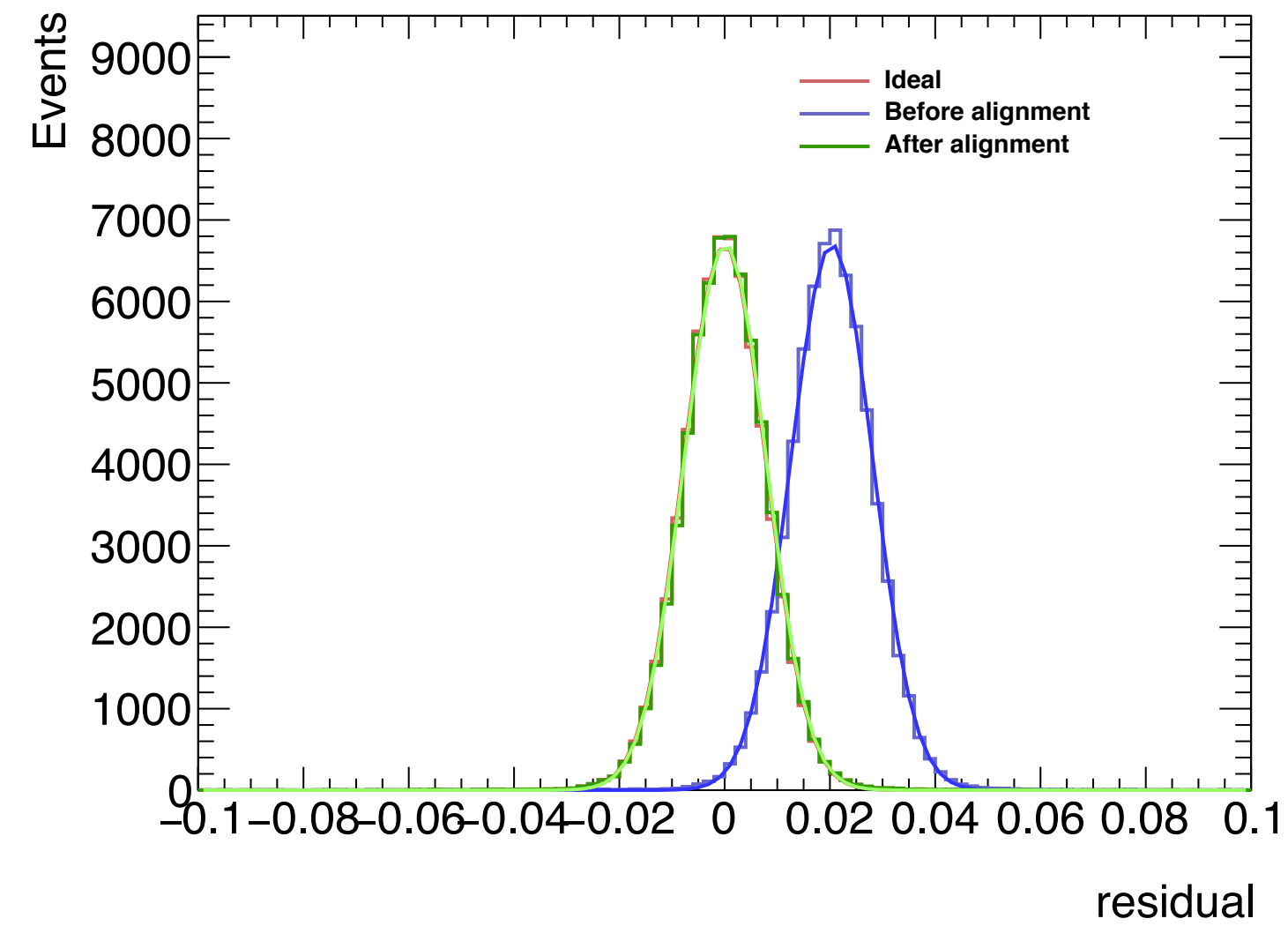
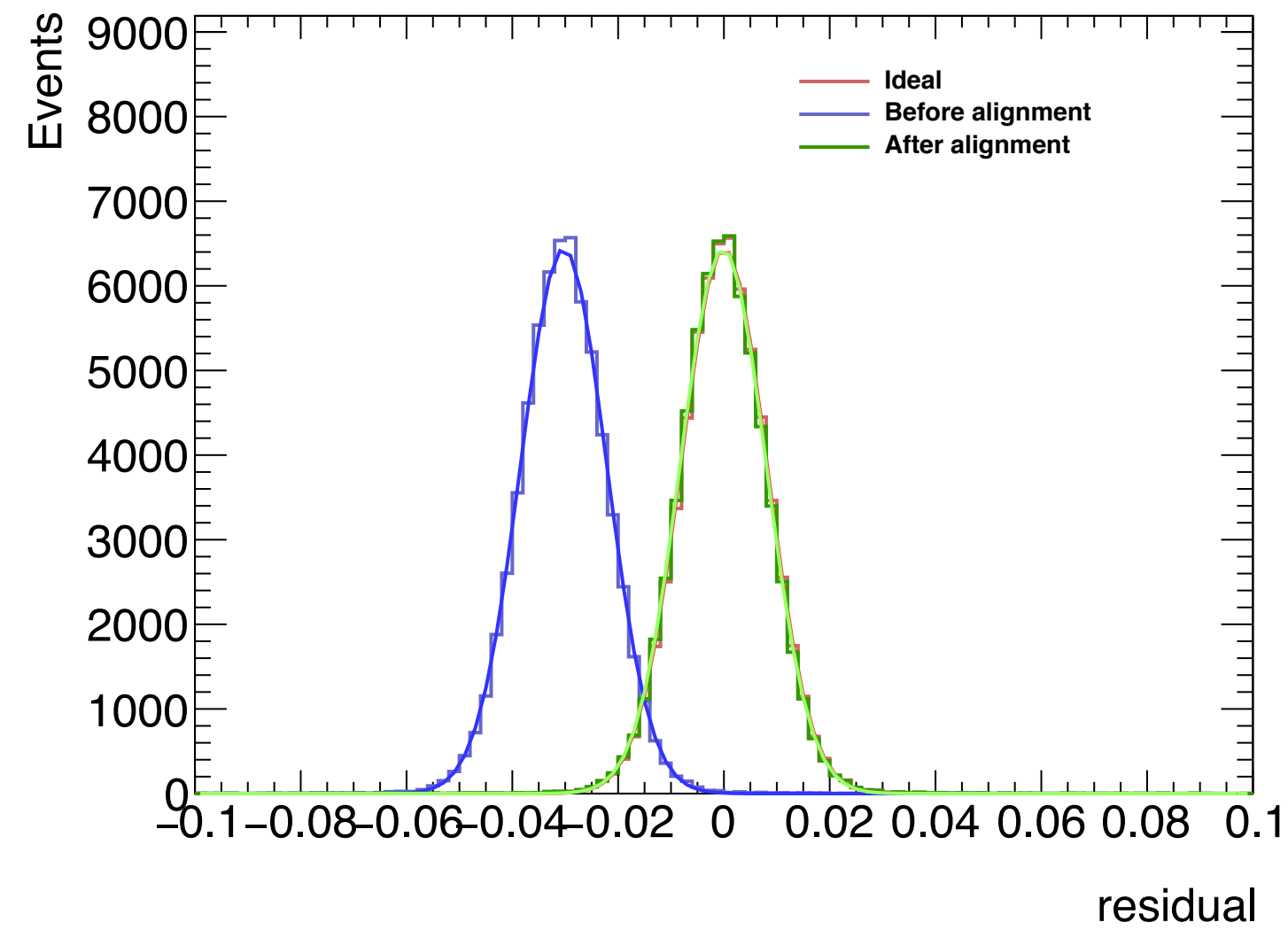
If add Δx , Δy , $\Delta \gamma$ only:

Unit: mm

Unit: rad

chipID	DeltaX setting	DeltaX fitted	DeltaY setting	DeltaY fitted	Deltay setting	Deltay fitted
1	0.07253	0.07250	-0.02467	-0.02448	0.00046	0.00268
2	0.02036	0.02024	0.02448	0.02448	0.00493	0.00159
3	-0.03740	-0.03747	0.02994	0.02992	-0.00189	-0.00265
4	-0.04566	-0.04552	-0.01967	-0.01993	0.01671	0.00941
5	-0.00856	-0.00853	0.04181	0.04175	-0.00823	-0.00259
6	-0.03031	-0.03015	-0.03201	-0.03207	0.00435	0.00572
7	0.01759	0.01763	-0.03591	-0.03587	0.00090	0.00178
8	-0.02344	-0.02362	-0.01411	-0.01378	-0.01306	-0.01160
9	-0.00738	-0.00738	0.03910	0.03913	-0.00168	-0.00220
10	0.02399	0.02401	-0.02652	-0.02655	0.00099	0.00023
11	-0.00952	-0.00955	0.00229	0.00221	-0.00016	0.00010
12	0.02780	0.02782	0.01526	0.01520	-0.00332	-0.00248

Residual Plots



- Residual plots Ideal/before alignment/ after alignment
- ~10,000 tracks
- All residual plots can be corrected well, although some mis-alignment parameters can't be corrected well

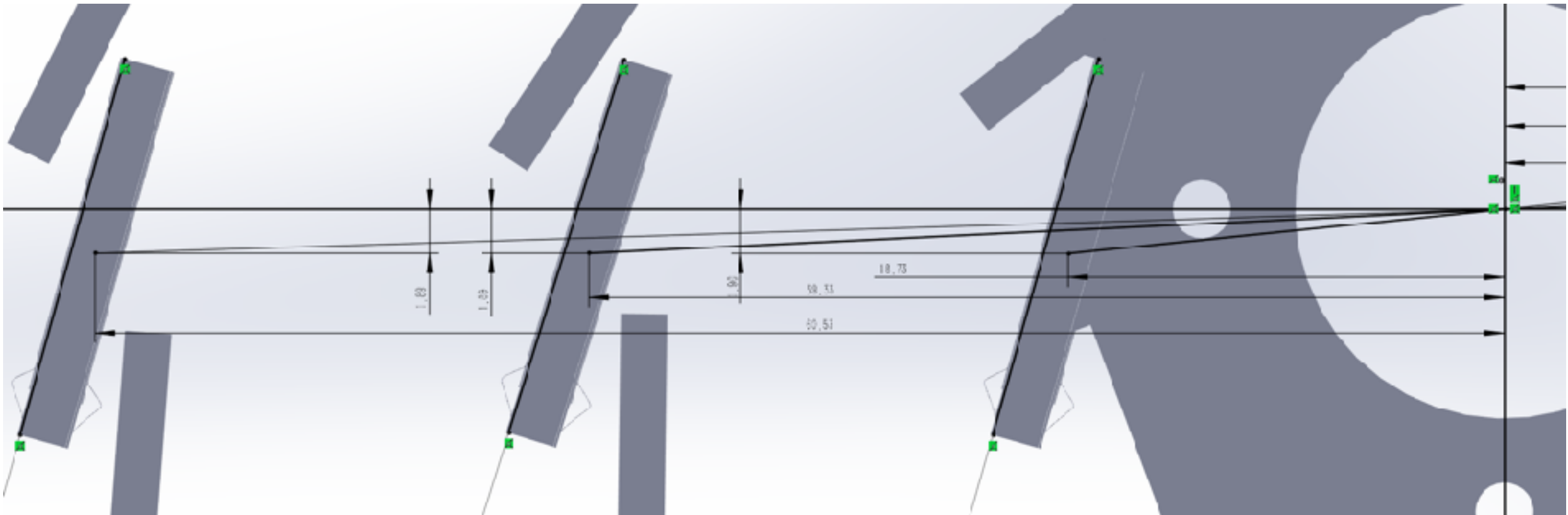
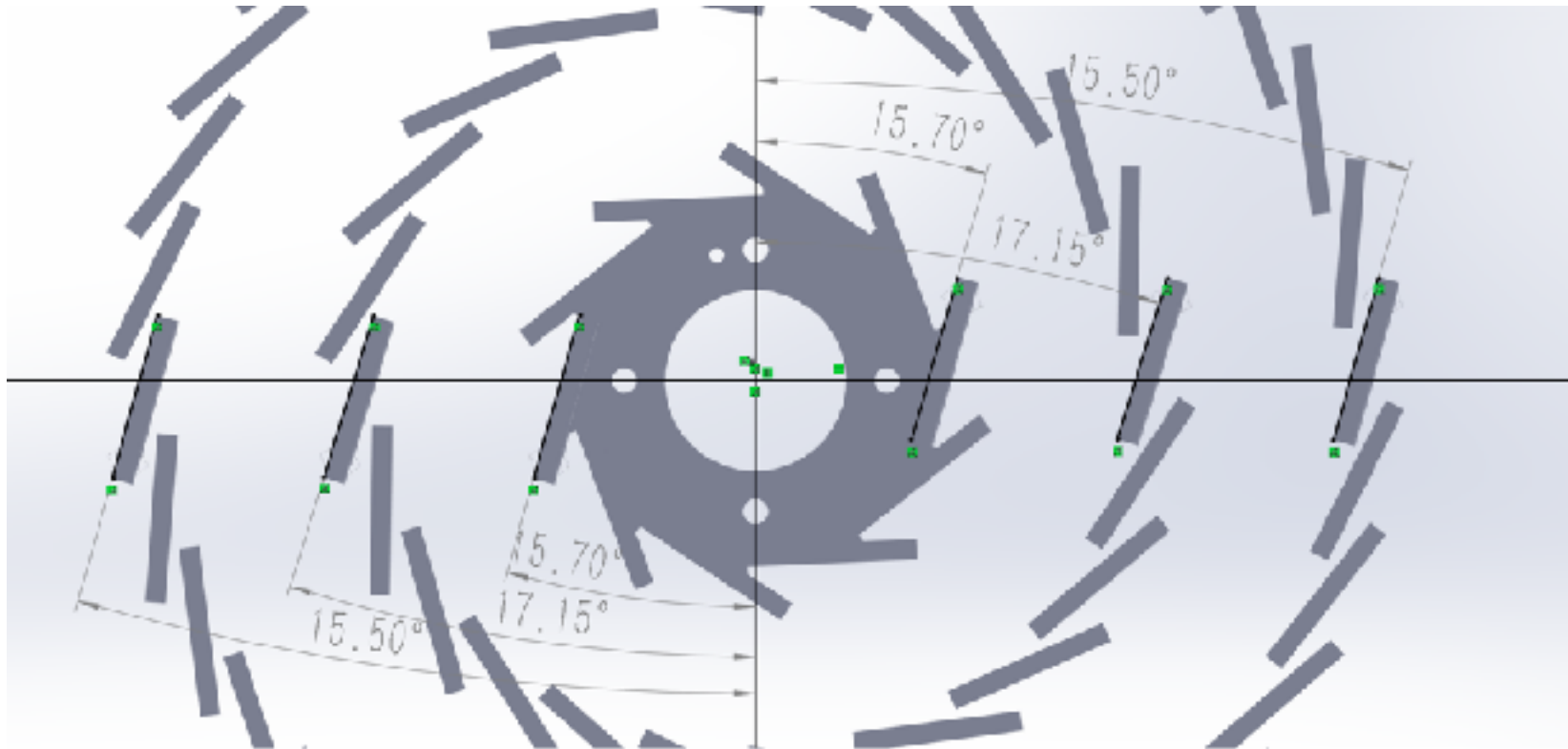
Next Plan

- using actual geometry simulation data

Backup

11 hits position fit, residual calculated from another hit

	material budget (X/X0 %)	chip0 sigma (um)	chip2 sigma (um)	chip4 sigma (um)	chip6 sigma (um)	chip8 sigma (um)	chip10 sigma (um)
50um	0.697	6.79/6.55	3.69/3.75	4.56/4.55	4.76/4.67	3.79/3.72	6.74/6.85
100um	0.804	7.12/6.95	3.82/3.84	4.91/4.85	4.99/4.99	3.86/3.79	6.91/7.32
150um	0.911	7.54/7.00	3.85/3.96	5.11/5.06	5.16/5.17	3.90/3.92	7.25/7.54



Alignment

- straight line model: $x = X(z) + x_{res} = az + b + x_{res}; y = Y(z) + y_{res} = cz + d + y_{res}$
- considering misalignment:

local parameters (track parameters): a, b, c, d

global parameters (alignment parameters): $\Delta x, \Delta y, \Delta \gamma, \Delta z, \Delta \alpha, \Delta \beta$

$$X(\vec{p}^{local}, \vec{a}^{global}) = az + b - \Delta x + y\Delta y + a(\Delta z + x\Delta \beta + y\Delta \alpha)$$

$$Y(\vec{p}^{local}, \vec{a}^{global}) = cz + d - \Delta y - x\Delta \gamma + c(\Delta z + x\Delta \beta + y\Delta \alpha)$$

- minimize: $\chi^2 = \sum_{\text{data sets}} \left(\sum_{\text{events}} \left(\sum_{\text{tracks}} \left(\sum_{\text{hits}} w_i r_i^2 \right) \right) \right)$
global parameters that' we want to get

- solution:
$$\left(\begin{array}{c|ccc} C & \cdots & H_k & \cdots \\ \hline \vdots & \ddots & 0 & 0 \\ H_k^T & 0 & \Gamma_k & 0 \\ \vdots & 0 & 0 & \ddots \end{array} \right) \times \left(\begin{array}{c} \vec{a} \\ \vdots \\ \vec{p}_k \\ \vdots \end{array} \right) = \left(\begin{array}{c} \vec{b} \\ \vdots \\ \vec{\beta}_k \\ \vdots \end{array} \right)$$

global and local

Loop over all tracks

$$C_k = \sum_i w_{ki} \vec{d}_{ki}^{global} (\vec{d}_{ki}^{global})^T,$$

$$\vec{b}_k = \sum_i w_{ki} r_{ki} \vec{d}_{ki}^{global},$$

related to global

derivative vectors w.r.t the global parameters

$$\vec{a} = C'^{-1} \vec{b}'$$

$$C' = \sum_k C_k - \sum_k H_k \Gamma_k^{-1} H_k^T,$$

$$\vec{b}' = \sum_k \vec{b}_k - \sum_k H_k \Gamma_k^{-1} \vec{\beta}_k.$$

Summary

- track alignment using millepede matrix method
- considering Δx , Δy , $\Delta \gamma$ only, most misalignments can be corrected, Δy can be corrected better than Δx , Δz
- Also considering 6 alignment paras, many parameters can't be corrected, except Δy , debugging...
- Plans:
 - ◉ using actual geometry simulation data