Alignment using $K_S \to \pi^+\pi^-$ events

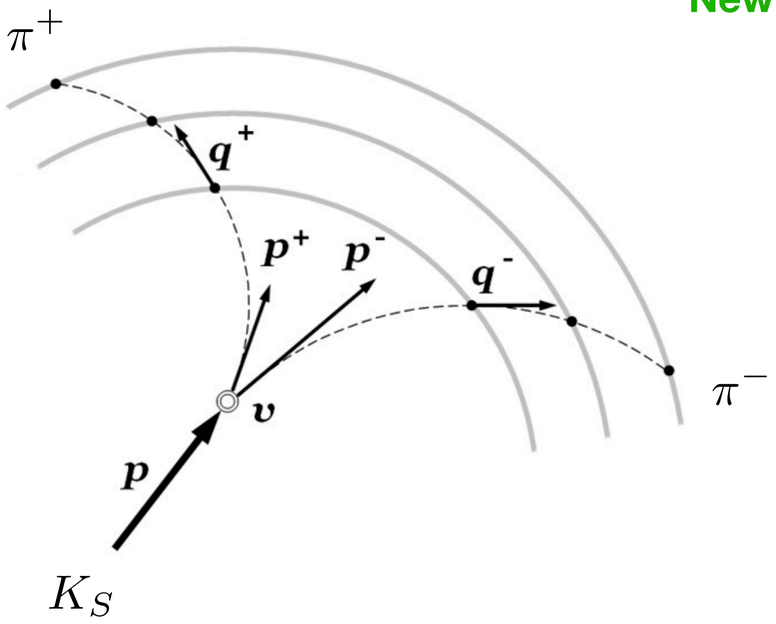
Millepede minimizes $\chi^2(\mathbf{p}, \mathbf{q}) = \sum \left(\frac{\text{residual}(\mathbf{p}, \mathbf{q})}{\text{error}} \right)^2$ to obtain optimized alignment parameters $\mathbf{p}$, using $\frac{\partial \text{residual}(\mathbf{p}, \mathbf{q})}{\partial(\mathbf{p}, \mathbf{q})}$.

alignment parameters **track parameters**

For the original alignment, **track parameters** have 5 components to represent a single track.

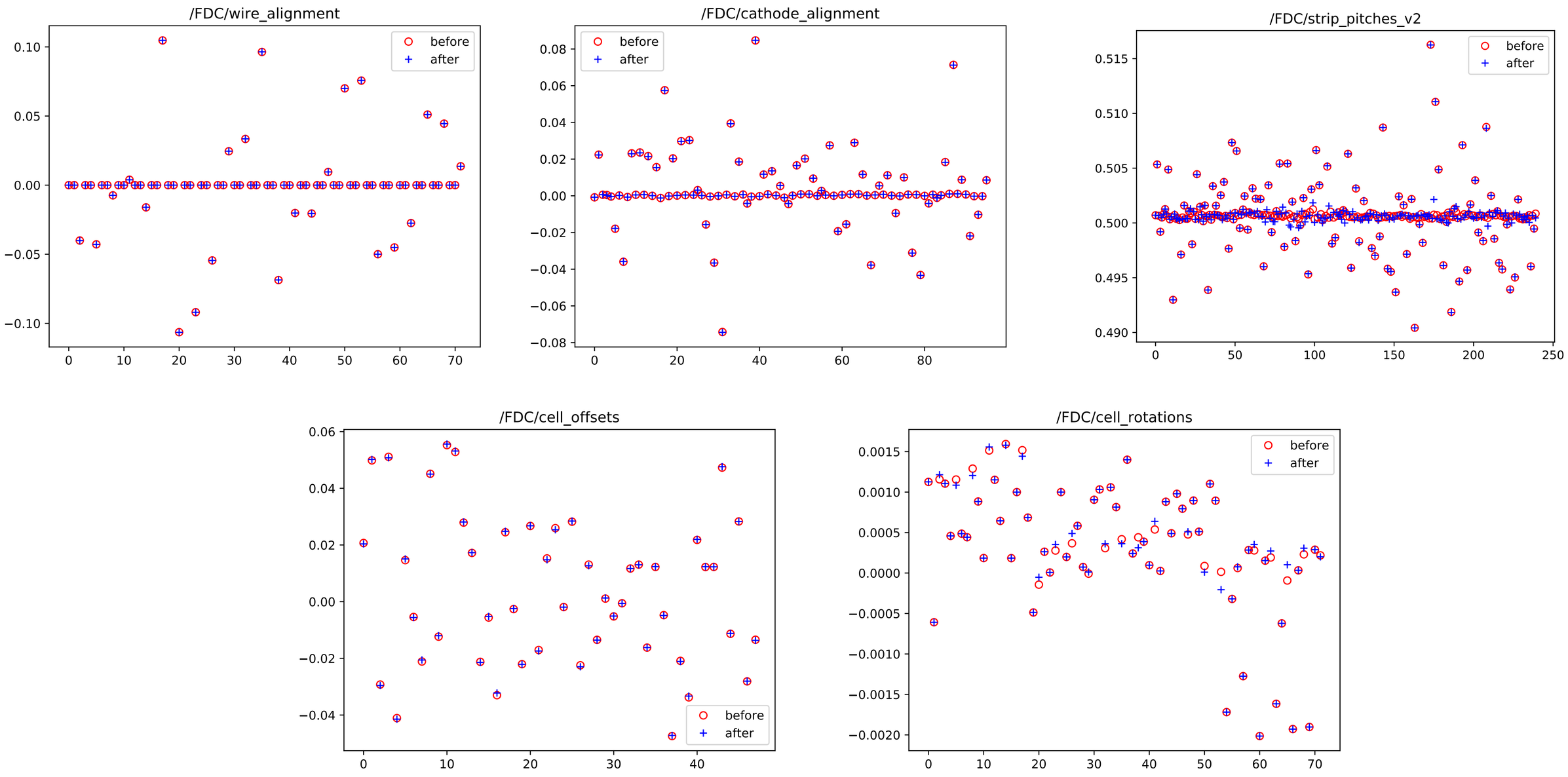
New parametrization uses 8 parameters to represent a $K_S \to \pi^+\pi^-$ event.

3 for K_S momentum $\boldsymbol{p}$
3 for decay vertex $\boldsymbol{v}$
2 for decay angles in K_S rest frame (θ, ϕ)

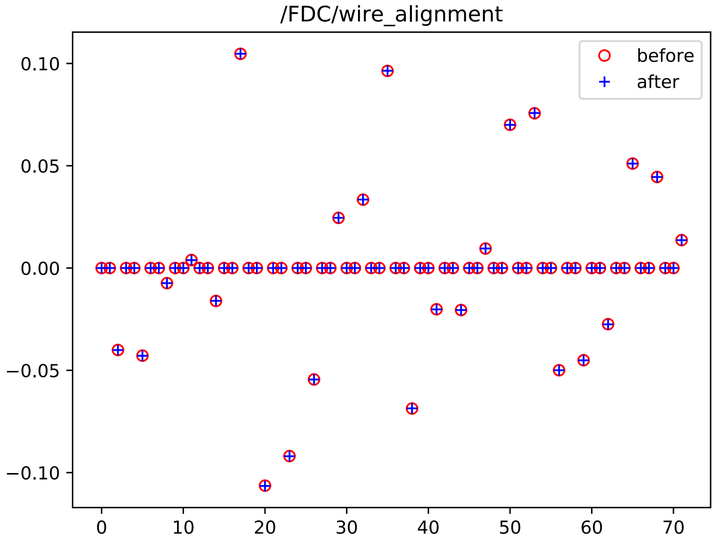


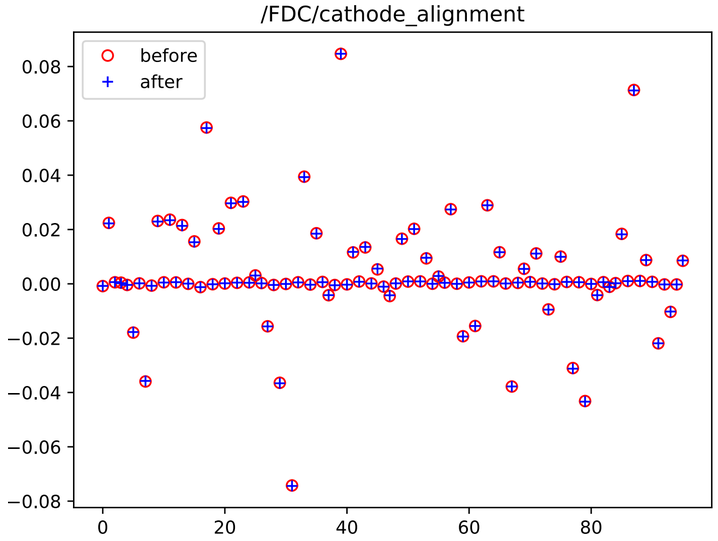
By using this parametrization, we can automatically leverage the information of K_S mass and common vertex.

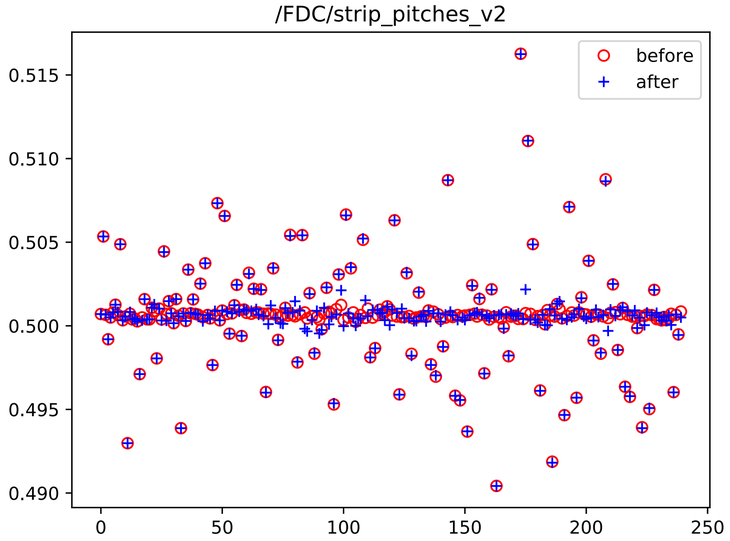
FDC alignment (t_0 fixed)

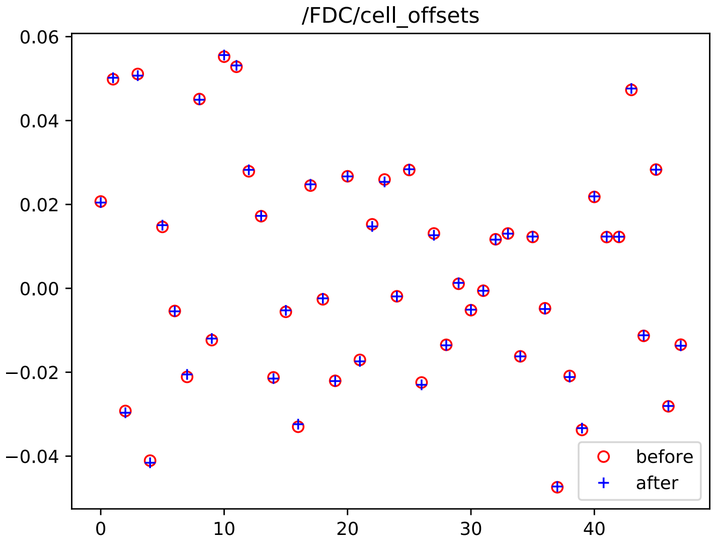


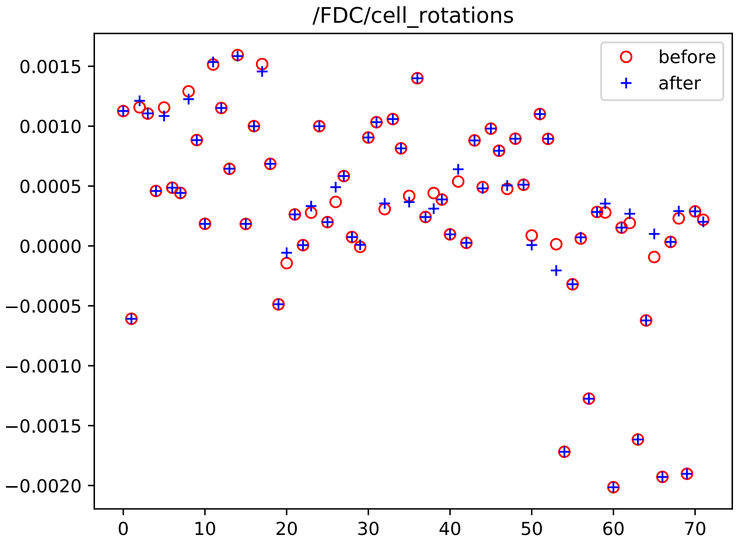
FDC alignment (t_0 variable)



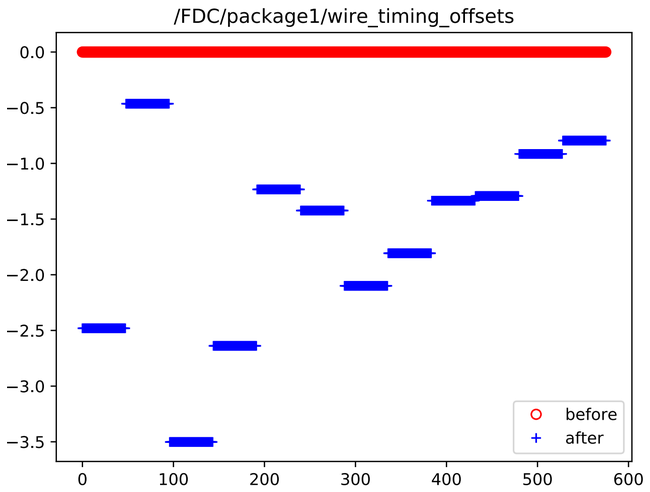


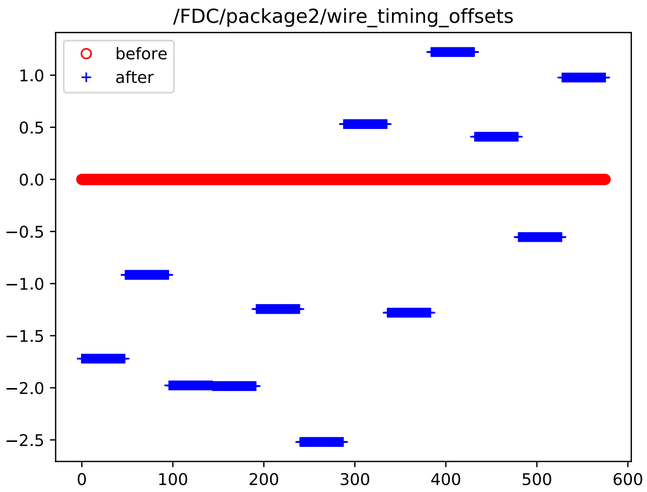


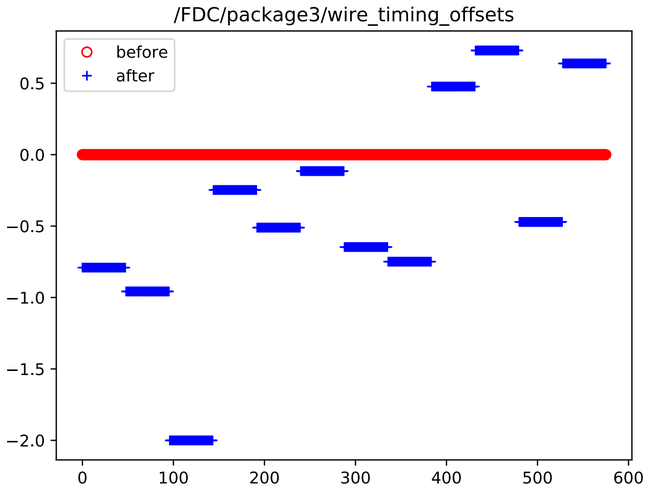


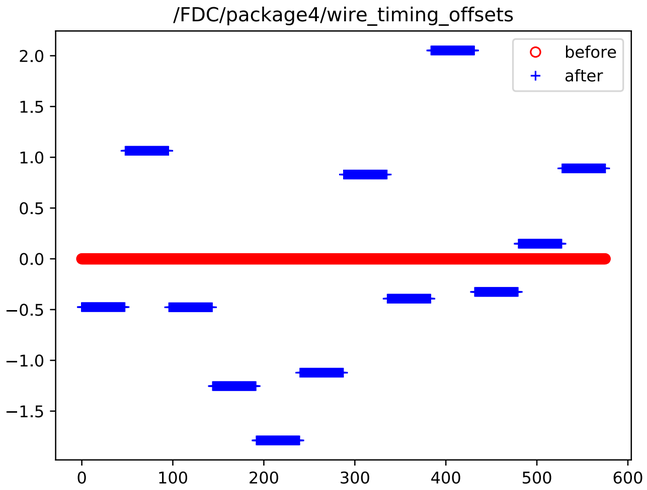


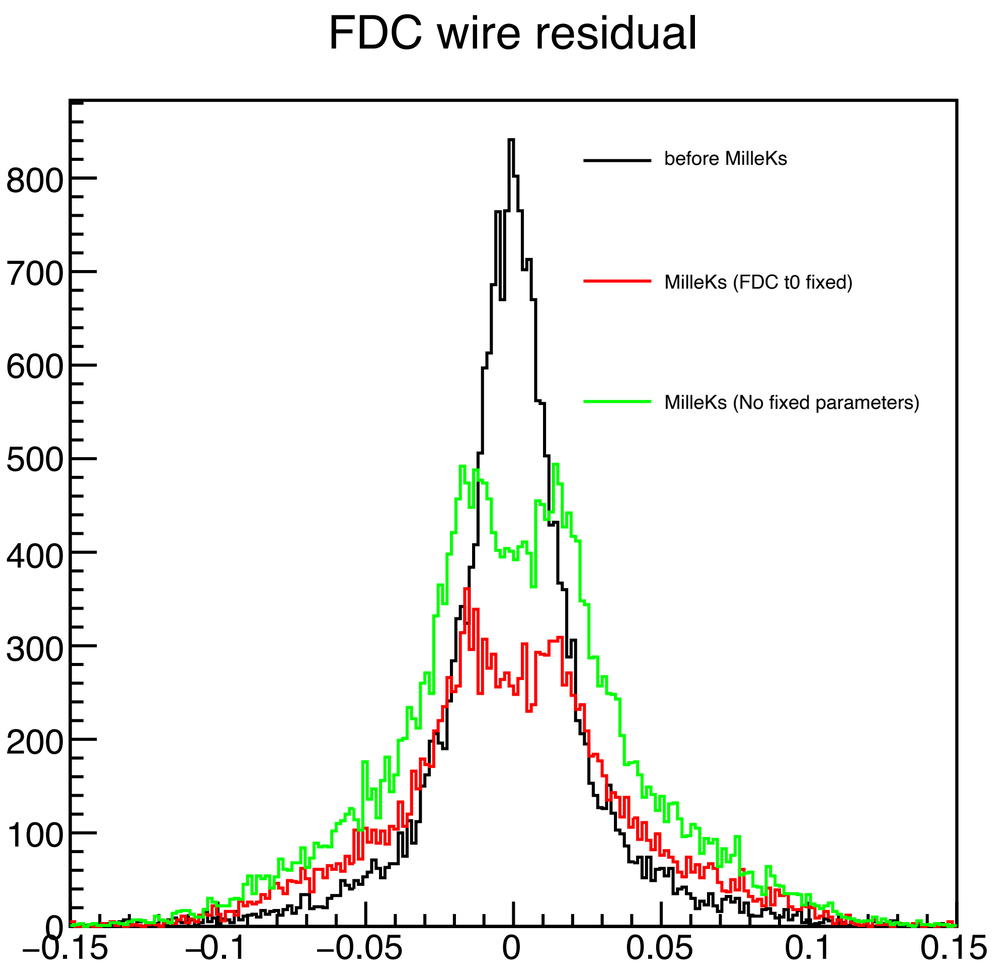
FDC alignment (t_0 variable) [continued]

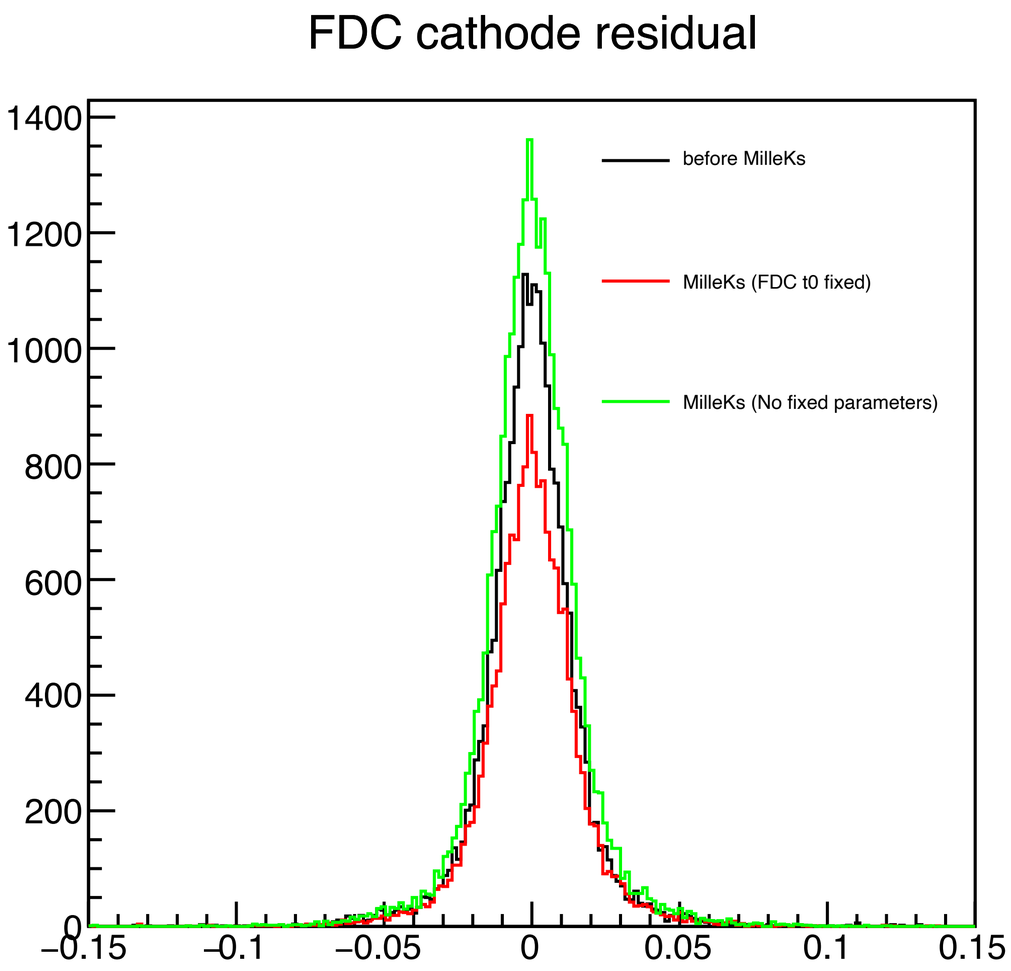









FDC wire residual
before MilleKs
MilleKs (FDC t0 fixed)
MilleKs (No fixed parameters)
800
700
600
500
400
300
200
100
0
−0.15
−0.1
−0.05
0
0.05
0.1
0.15


FDC cathode residual
before MilleKs
MilleKs (FDC t0 fixed)
MilleKs (No fixed parameters)
1400
1200
1000
800
600
400
200
0
−0.15
−0.1
−0.05
0
0.05
0.1
0.15