

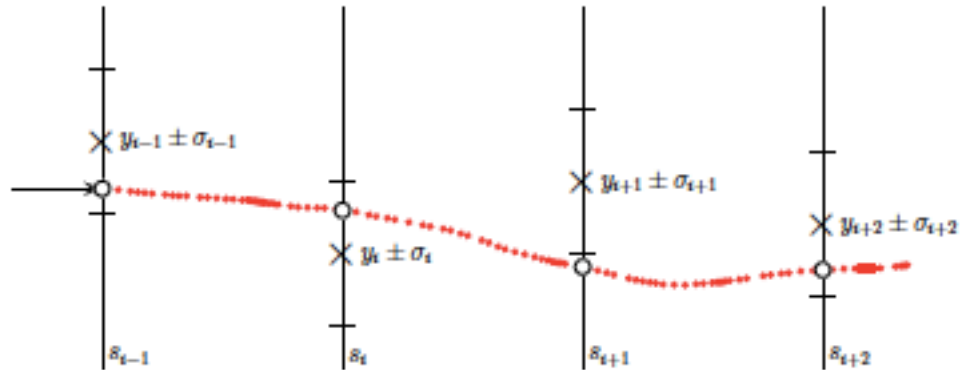
# Update on GBL

Per Hansson Adrian

# Tracking update

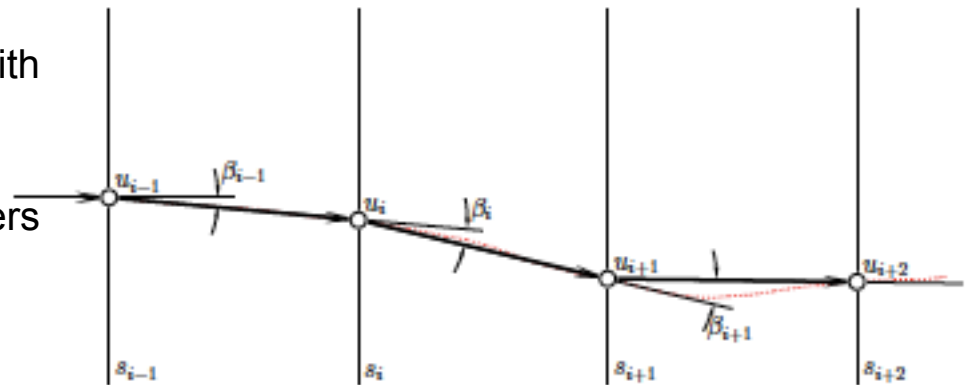
## GBL (Broken Lines)

- Track fit with multiple scattering
- Used in e.g. CMS detector alignment
- Equivalent performance to Kalman Filter (?)



## GBL is a track refit

- Initial fit to estimate residuals and momentum (using our circle/zfit here)
- Use residuals from initial fit, together with estimated momentum, in a second fit that includes multiple scattering
- Covariance matrix of all track parameters are available (at each point)



Iteration needed for energy loss

Millepede(2) “supported” (alignment files already obtained)

$$S(\mathbf{u}) = \sum_{i=1}^n \frac{(y_i - u_i)^2}{\sigma_i^2} + \sum_{i=2}^{n-1} \frac{\beta_i^2}{\sigma_{\beta,i}^2}$$

## Samples

- Full simulation, “proposal 2014” v4 detector
- $m(A')=40\text{MeV}$
- $A'$  from (0,0,0) with no beam spot (played a lot with truth impact parameter(s))

## Practicalities

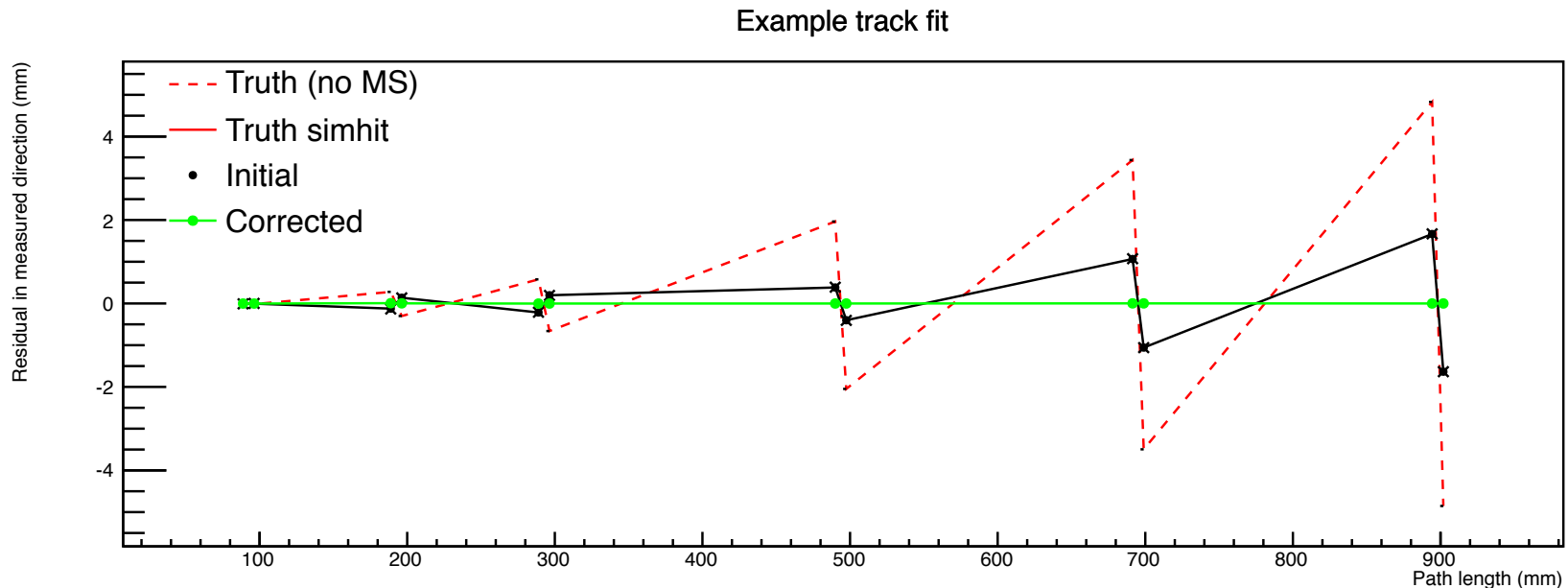
- Working with python implementation; good for development
- Work on Java version can wait (in my opinion)

Support from Claus Kleinwort (DESY) invaluable

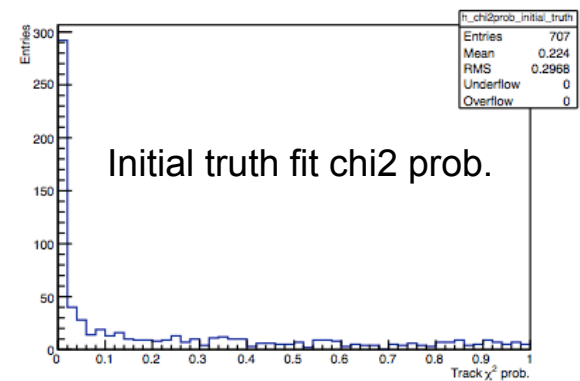
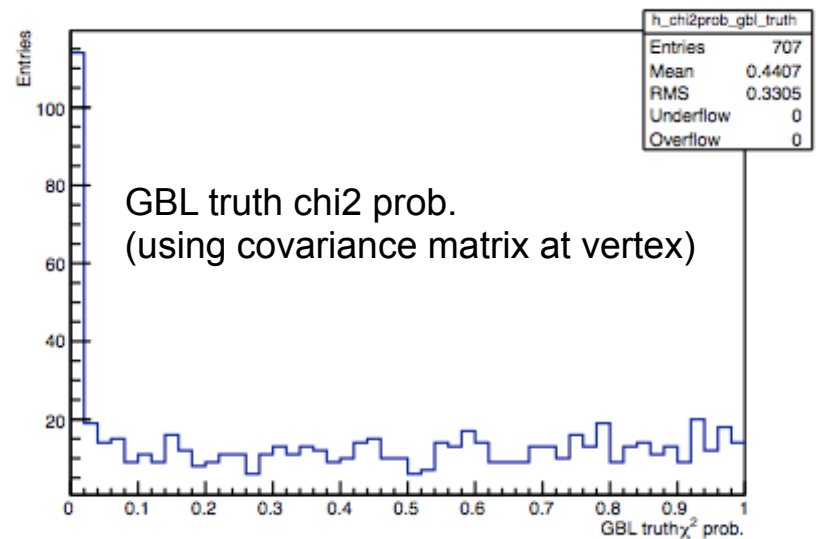
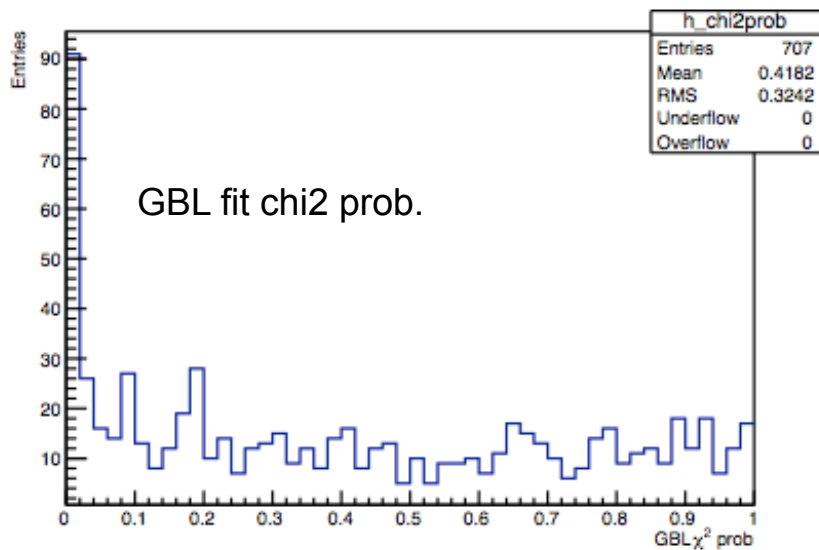
# GBL Example Fit

## Fitting kinked track

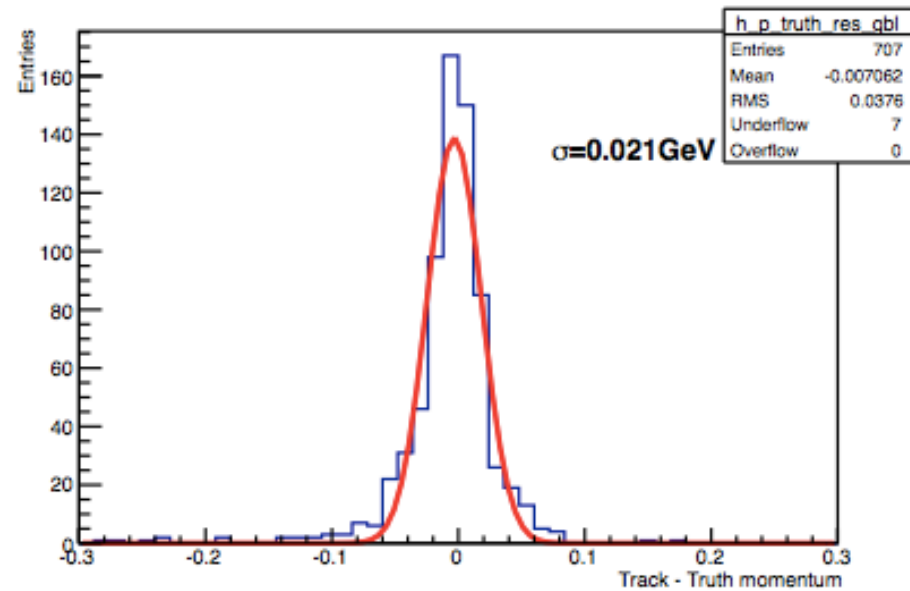
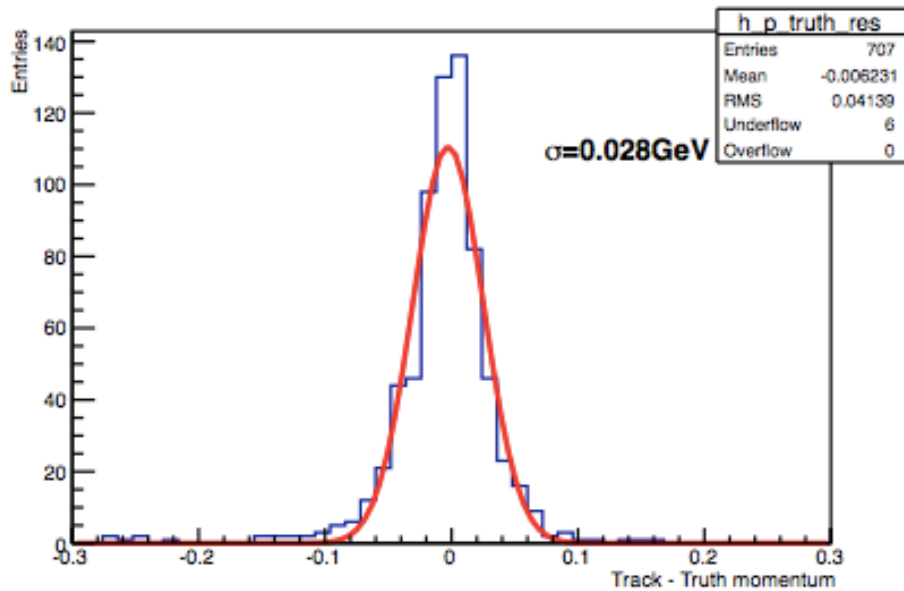
- With correct material description and no real noise contribution all “GBL residuals” within (hit) measurement uncertainty ( $\sim 6\mu\text{m}$ )



# GBL Fit Chi2

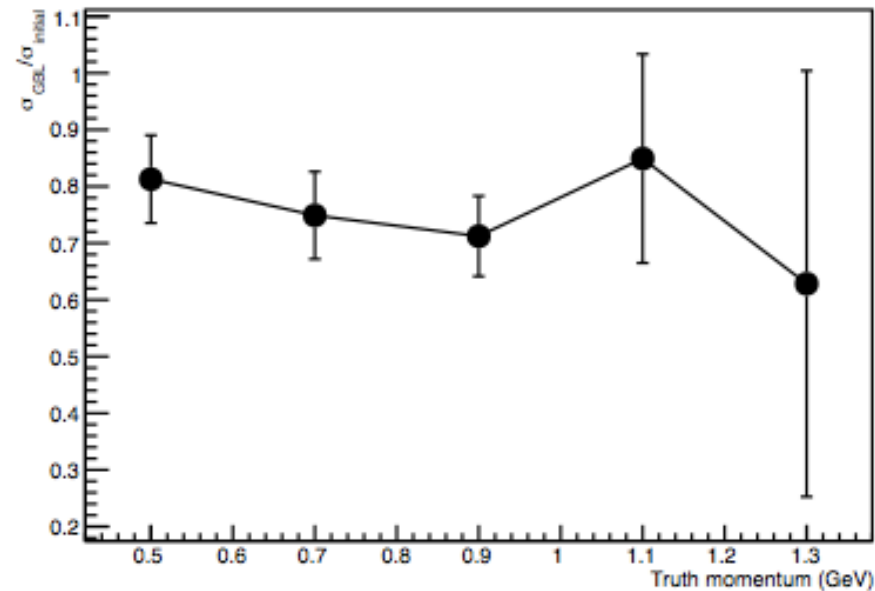
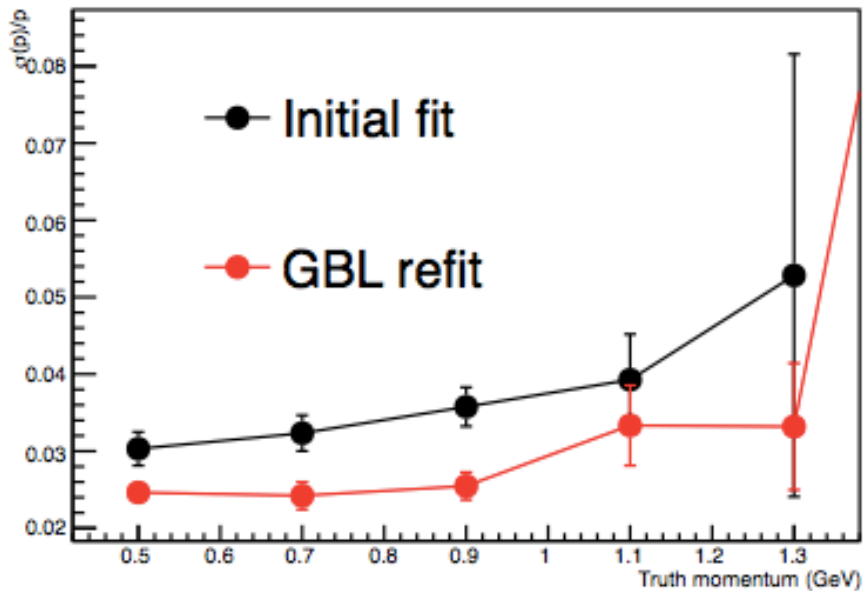


# Momentum Resolution



25% resolution improvement on this sample

# Momentum Resolution

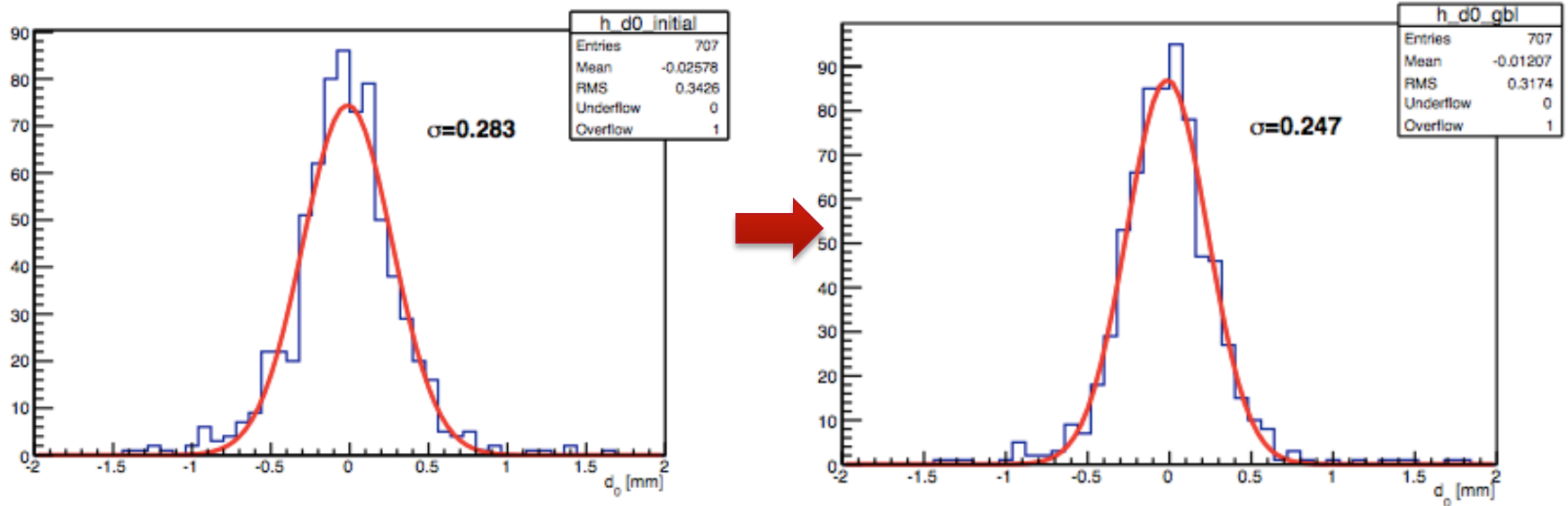


20-30% resolution improvement

(Expect  $(p)/p \sim \text{const.}$  when MS dominates (otherwise  $\sim p$ ))

# Impact Parameter Resolution

Bend plane impact parameter: ~13% improvement in this sample





# Impact Parameter Resolution

Non-bend plane impact parameter: ~15% improvement in this sample

