Imperial College London

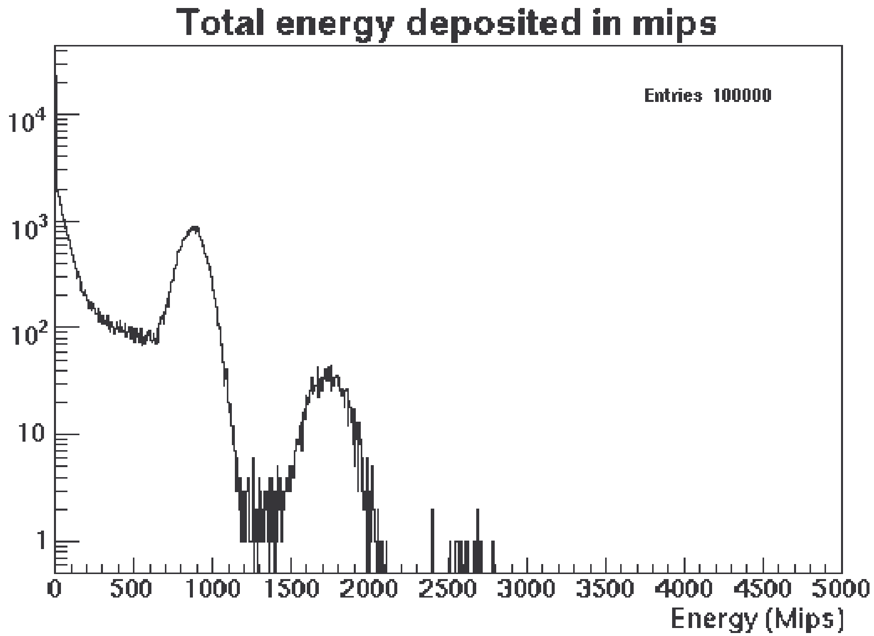
Calculating the Beam Position at the Ecal for DESY Run 230101 (Independent of Tracking)

Hakan Yilmaz

Outline

- Motivation is to use Ecal calculated beam position as a cross-check for the track calculated position
- Method is to compare S-curve of barycentred Ecal hits, per event, with a Gaussian cdf (cumulative distribution function—related to *erf(x)).*
- Can then correct barycentre per event and iterate the procedure with the aim of converging to true mean beam position and RMS

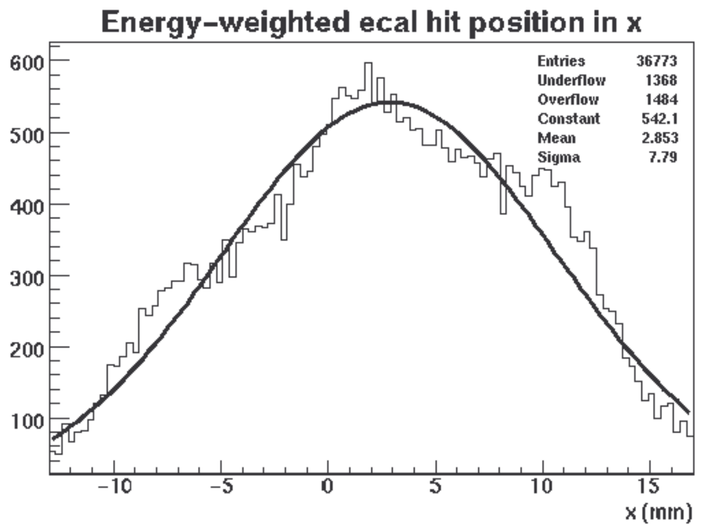
Initial Distributions

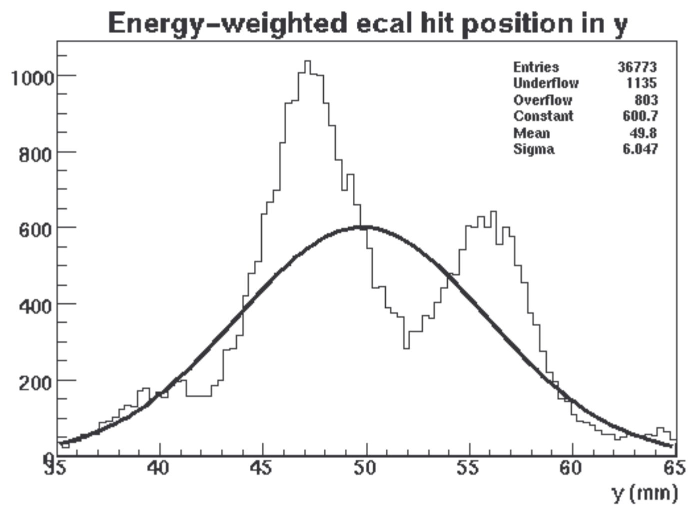


- Threshold cut at 0.5 mips
- Use the range 600-1200 mips
- The distribution is different from George's (presented last week). Seems to be scaled

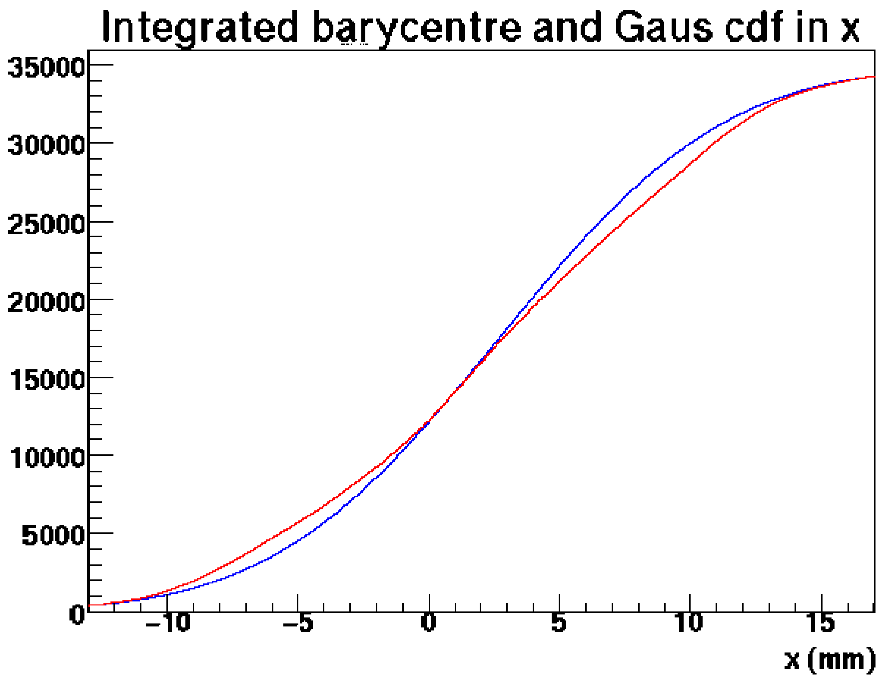
Barycentre distributions

- Cut tails off of barycentre distributions to concentrate on peaks—cut on about 2σ
- Get initial values for mean and sigma of the distributions





Method



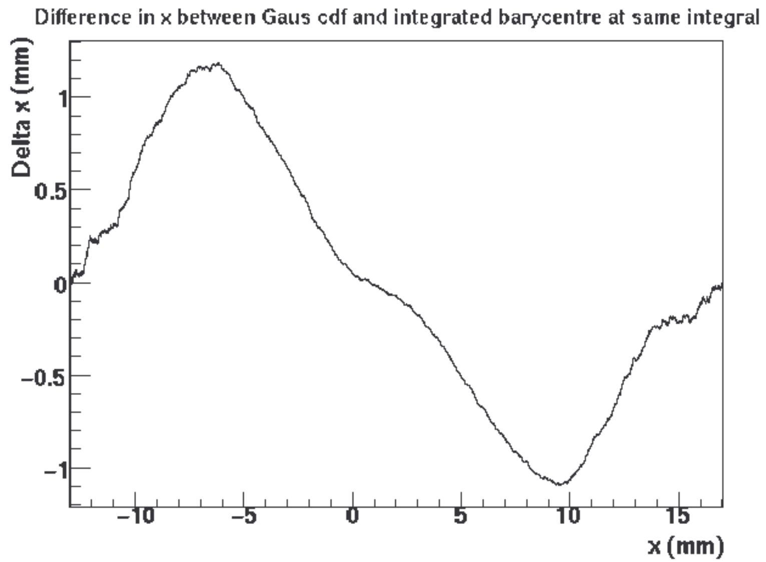
Blue = Gaus cdf

Red = Integrated barycentre

- Assume true beam position is Gaussian at Ecal
- Blue curve is the integrated value of a gaussian from -infinity to x (scaled to number of events in run)
- Red curve is the equivalent for barycentre of Ecal hit distribution
- Expect red curve to wiggle in and out of blue curve due to discrete Ecal hit points (staggering in x is a complication)
- For a given y-axis value, can look at difference between Gaus cdf and integrated barycentre…

Method

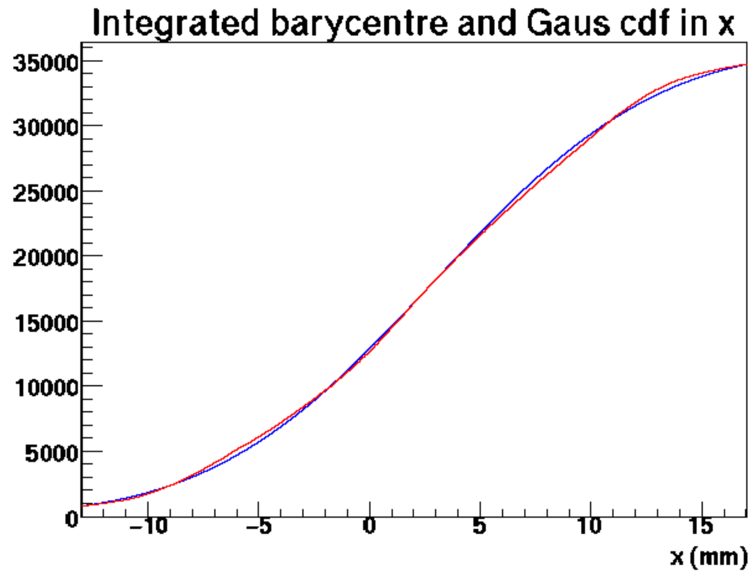
- Expect the wiggle to give something which looks like a sine curve
- Can then parametrise this curve and re-process run with barycentre correction in order to smooth out peaks into expected Gaussian
- Can then fit a Gaussian to barycentre distribution as before and use new parameter values
- Iterate until convergence

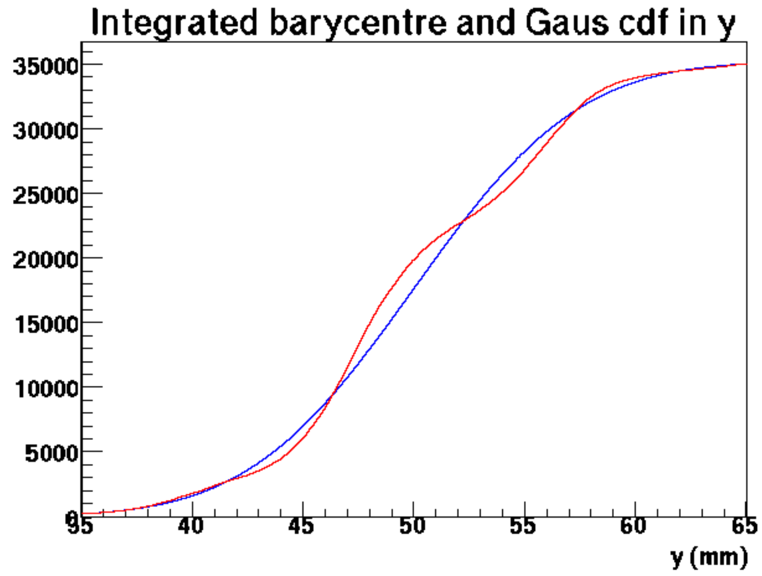


$$position \pm = A \sin(2\pi / period\ (position - offset))$$

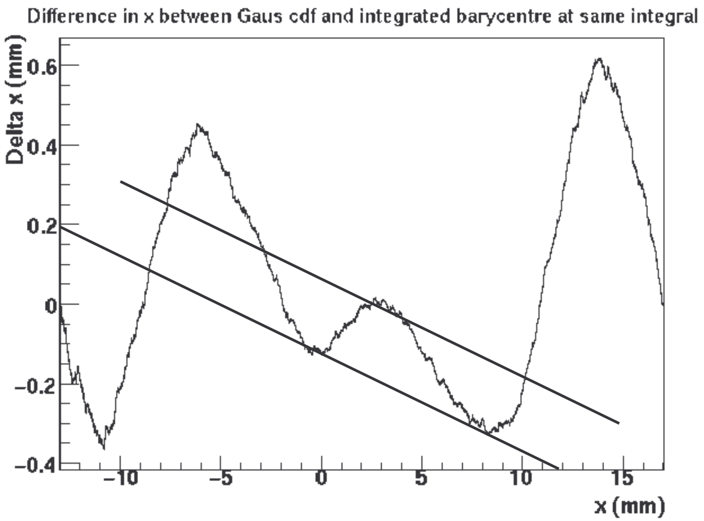
Results

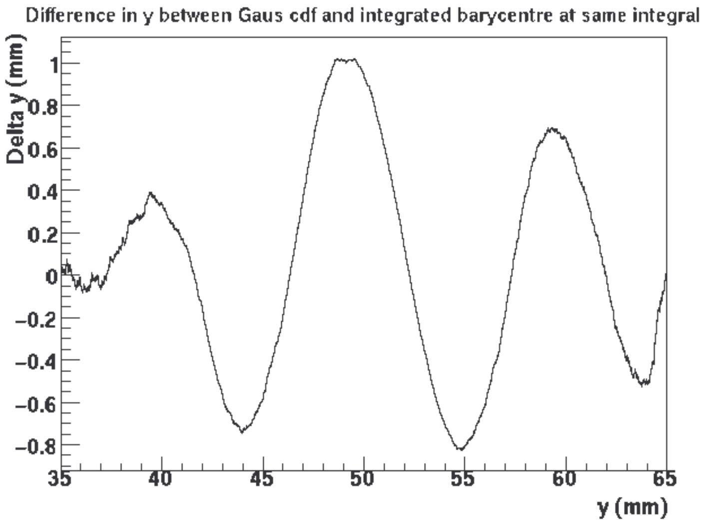
- After a few iterations both x and y can be seen to fit the blue curve well
- This means the mean and sigma of the Gaussian are close to correct





Results

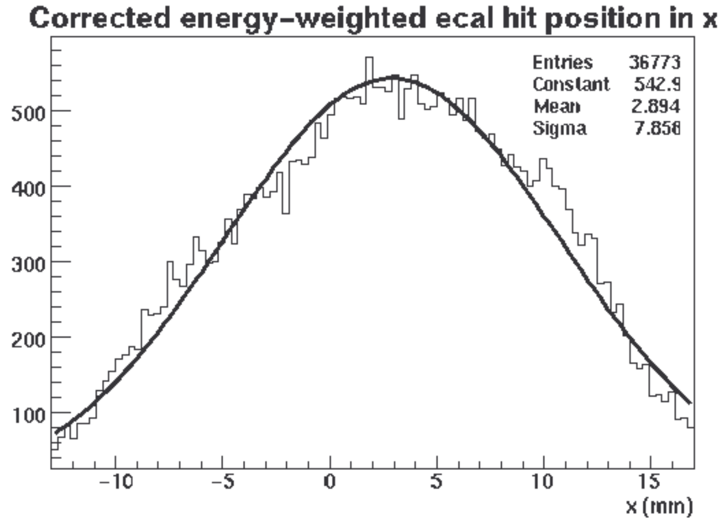


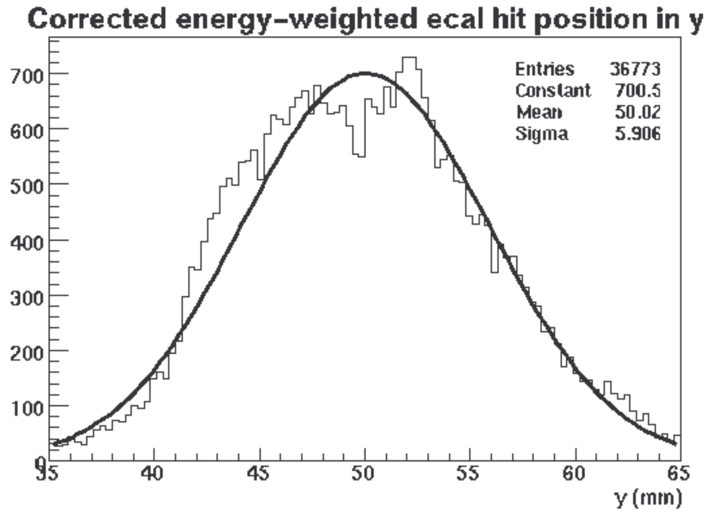


- These distributions are very sensitive to changes in the Gaussian parameters
- Staggering in x makes measurement of the amplitude tricky—parallel lines show ~0.11mm
- y is easier—0.9 mm is a good estimate
- Can also measure offset and period

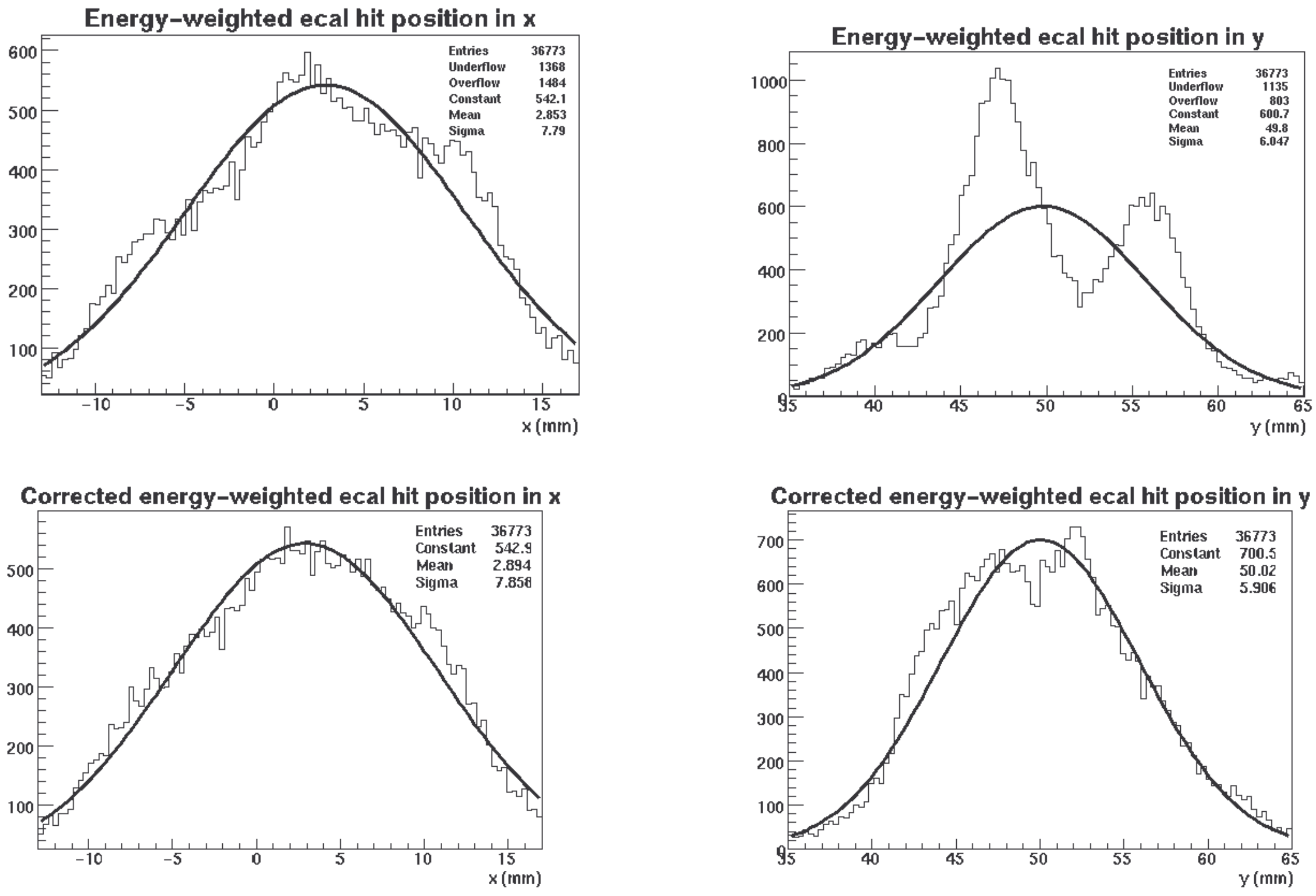
Results

- Reprocessing gives converged results
- Correction can be seen to be very effective in y, especially
- Final values in x:
  - Mean = 2.9mm
  - Sigma = 7.9mm
- In y:
  - Mean = 50.0mm
  - Sigma = 5.9mm
- Agreement with tracking to within 50 microns!





Comparison slide



Above = before correction; Below=after correction