Beam properties for run 230101

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Some basics

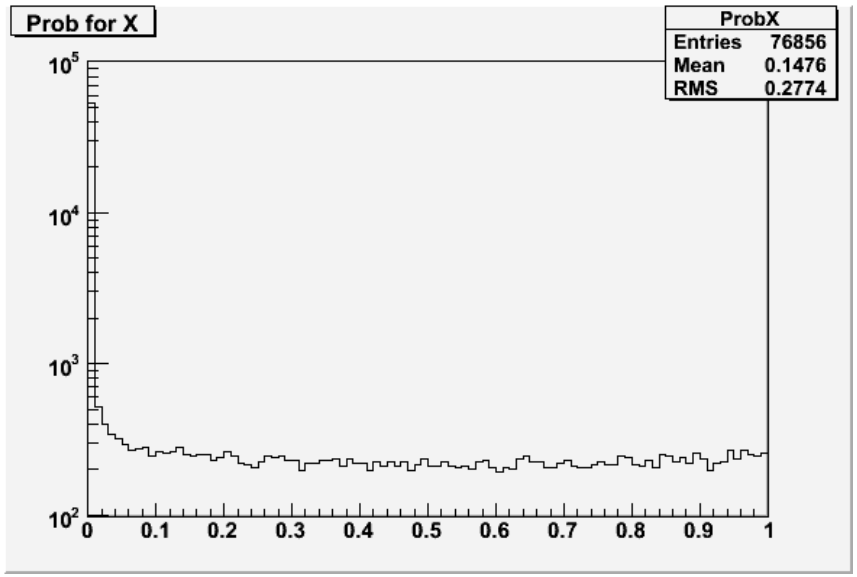
- Layers numbered 0 (closest to ECAL) to 3 (furthest)
  - CERN data will have no hits in layer 3
- Alignment constants defined as:
  - $x = v_d \times t - x_0$ and similar for y
  - Hopefully x_0 will not change even if v_d does
- Values of x_0 determined from run 230101 by defining the coordinate system as the beam in this run
  - But actually measure TDC time peak
  - $x_0 = t_{peak} / v_d$ so values depend on drift velocity
- I estimate for "good" hits the peak values in each layer:
  - X t_{peak} = 1310, 1116, 1183, 1020
  - Y t_{peak} = 1209, 1165, 1113, 1055

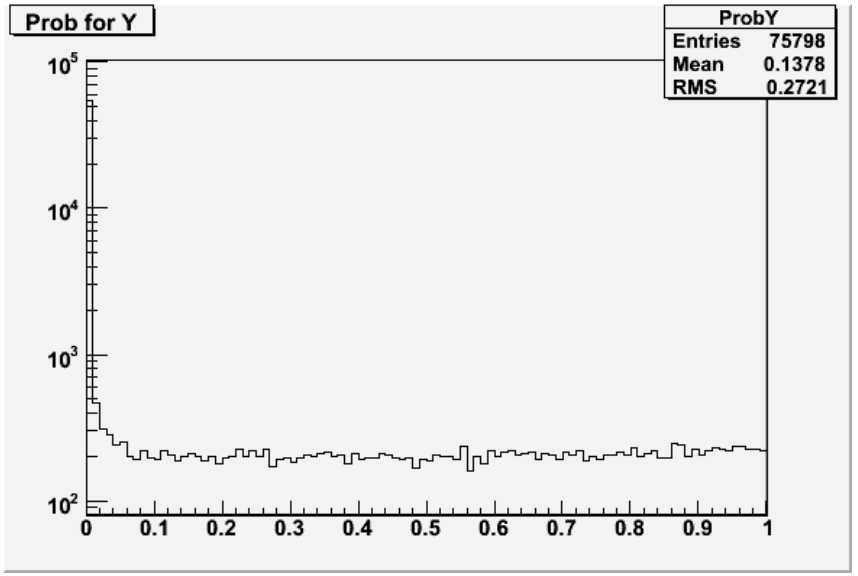
Extrapolation from beam origin

- Project forward from -9185mm in MC
  - Compare with truth hits in the drift chamber
  - No beam spread (as MC), no intrinsic resolution
  - Allows measurement of scattering correlation matrix
- Add on intrinsic resolution per chamber = 0.6mm
  - Uncorrelated addition of $0.36mm^2$ along the diagonal of matrix
  - Gives matrix to use for linear track fit back to beam origin
- Fit data tracks in run 230101 using this matrix
  - Fixed all drift velocities to 0.03mm/ns
- N.B. Exactly the same as method needed for “normal” track fit but using gun rather than fake layer…

Check quality of track fit

- Probability from χ^2/DOF

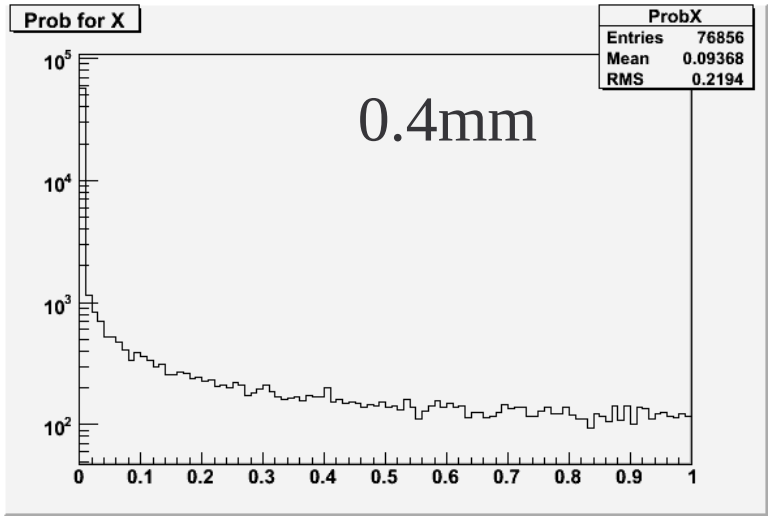


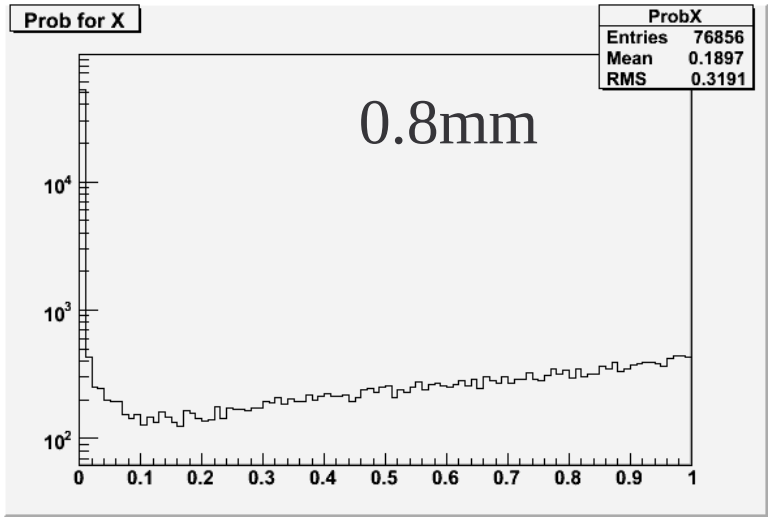


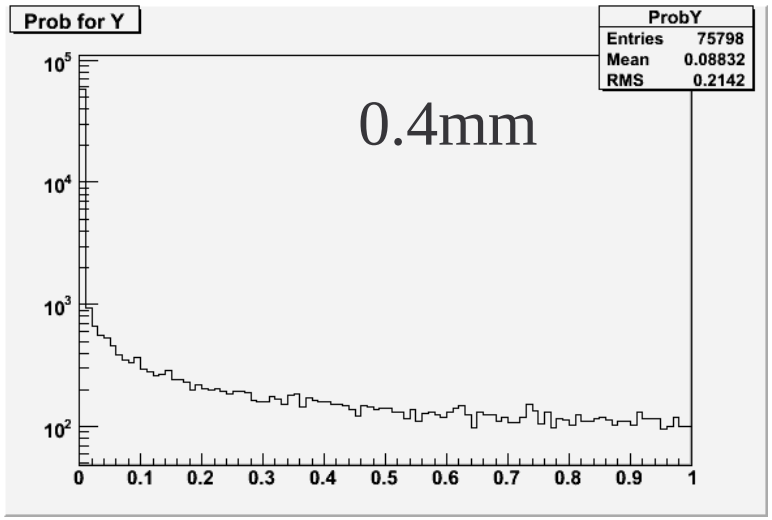
- Large peak near zero; wrong combinations (?)
- “Good” tracks have flat distribution J
- Note, only about half the events have “good” track; using file from George with only one TDC hit/chamber/event (selected how?)

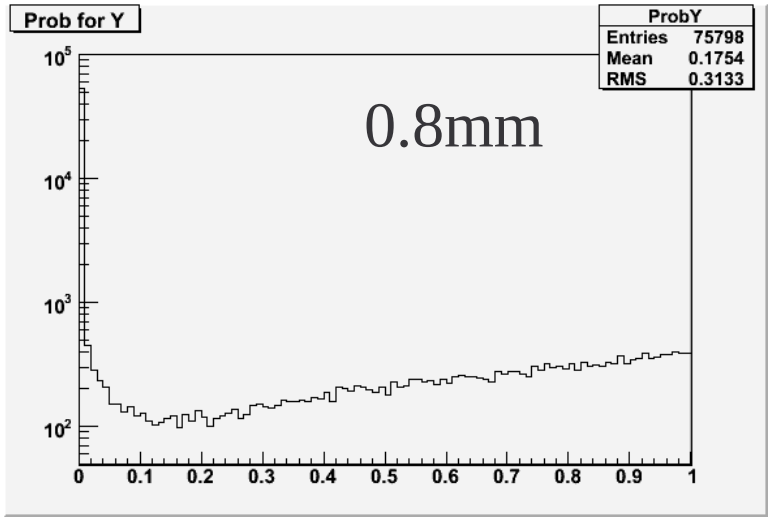
Sensitivity to intrinsic resolution

- Tried 0.4mm, 0.8mm intrinsic resolutions; 0.6mm best of these

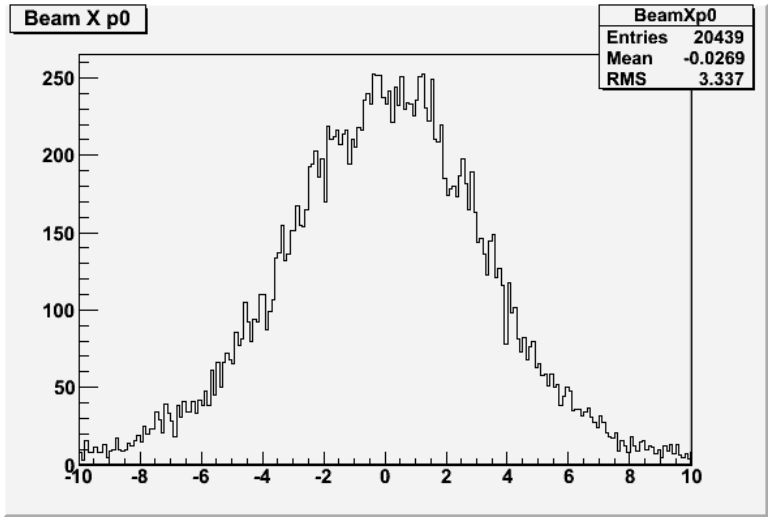


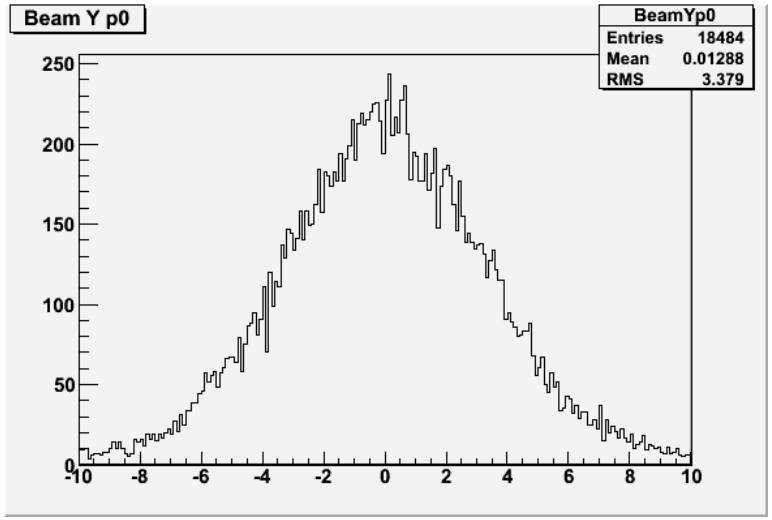




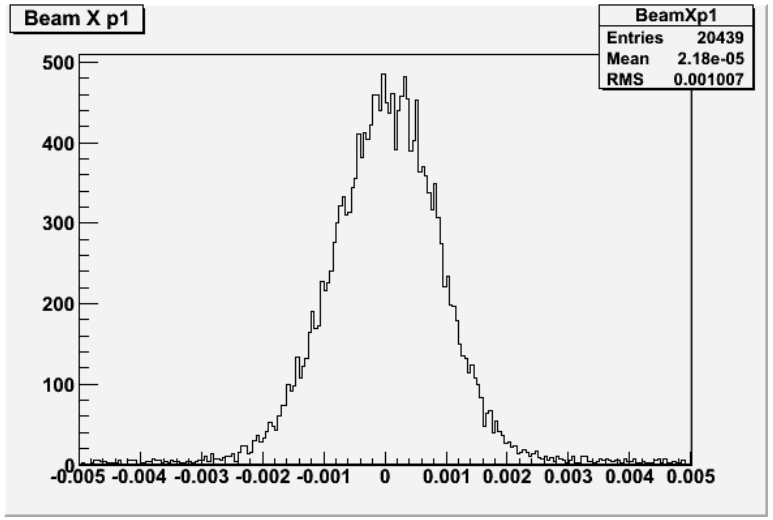


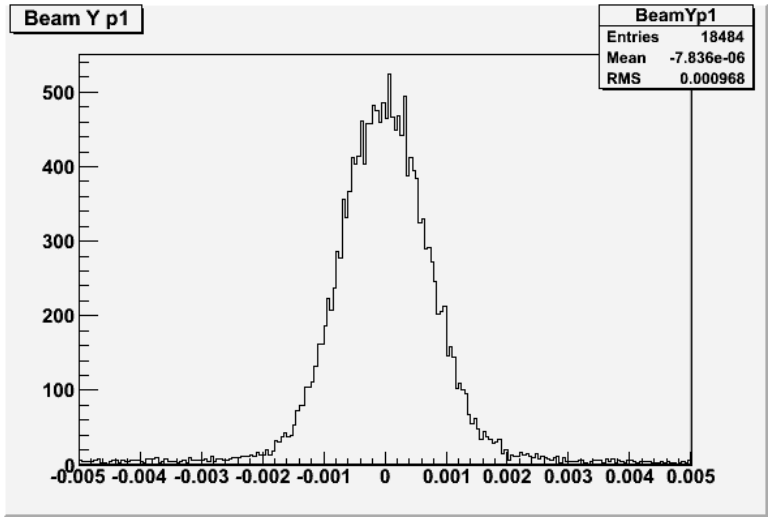
Apparent beam spread





Intercept at z=0





tan(angle)

Apparent spread includes track errors

- Can only be estimated from track fit
  - Flat probability gives some confidence they are reasonable
- Apparent error matrices in x and y

10.29	-0.00143
-0.00143	6.73e-07

10.40	-0.00127
-0.00127	4.71e-07

- Track error matrices

9.70	-0.00157
-0.00157	2.93e-07

9.70	-0.00157
-0.00157	2.93e-07

- Difference = beam shape

0.59	0.00014
0.00014	3.78e-07

0.70	0.00029
0.00029	1.77e-07

$\sigma_x = 0.8\text{mm}\ \sigma_{tx} = 0.6\text{mrad}$ $\sigma_y = 0.8\text{mm},\ \sigma_{ty} = 0.4\text{mrad}$

Not a huge position-angle correlation; could be ignored

Redo with different drift velocities

- Drift velocity = 0.030mm/ns

0.59	0.00014
0.00014	3.78e-07

0.70	0.00029
0.00029	1.77e-07

- Drift velocity = 0.027mm/ns

-1.18	0.00038
0.00038	2.57e-07

-1.11	0.00051
0.00051	0.94e-07

- Drift velocity = 0.033mm/ns

2.53	-0.00011
-0.00011	5.10e-07

2.57	0.00008
0.00008	2.68e-07

- 0.027mm/ns gives unphysical result
  - Track error is bigger than measured spread of beam position
- Beam size changes strongly, angle spread is less sensitive