

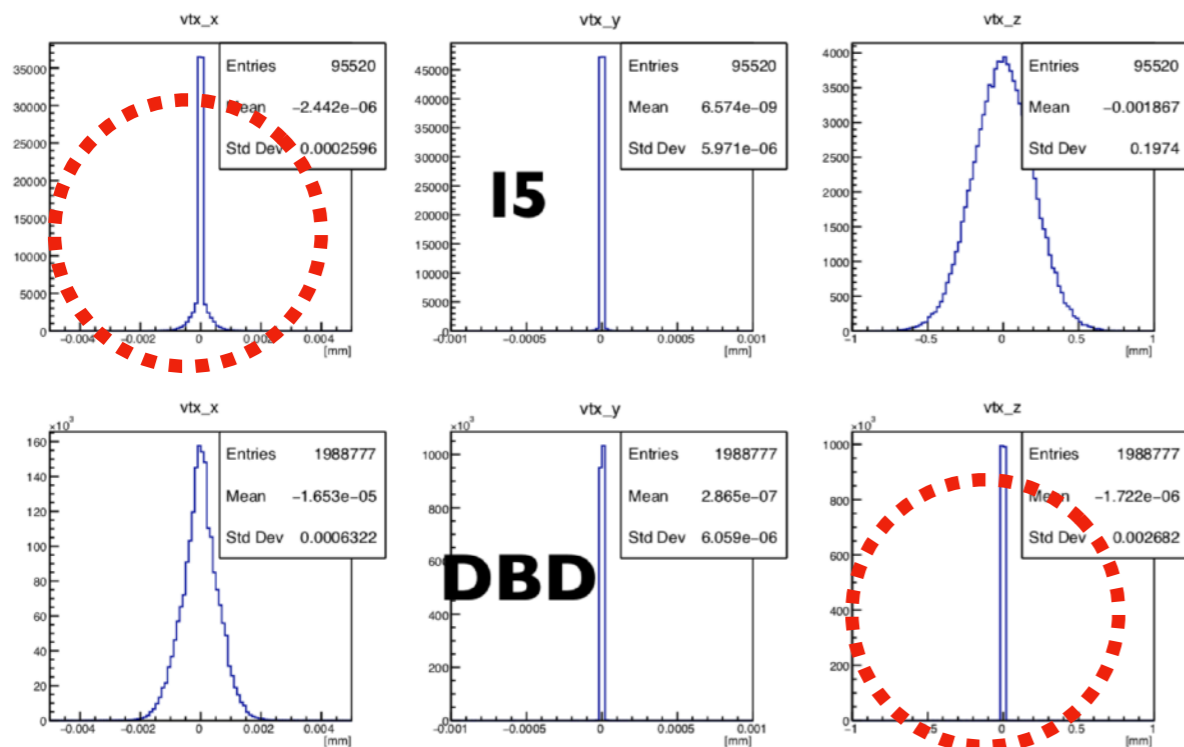
Primary vertex fitting

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Issue?

The last general meeting

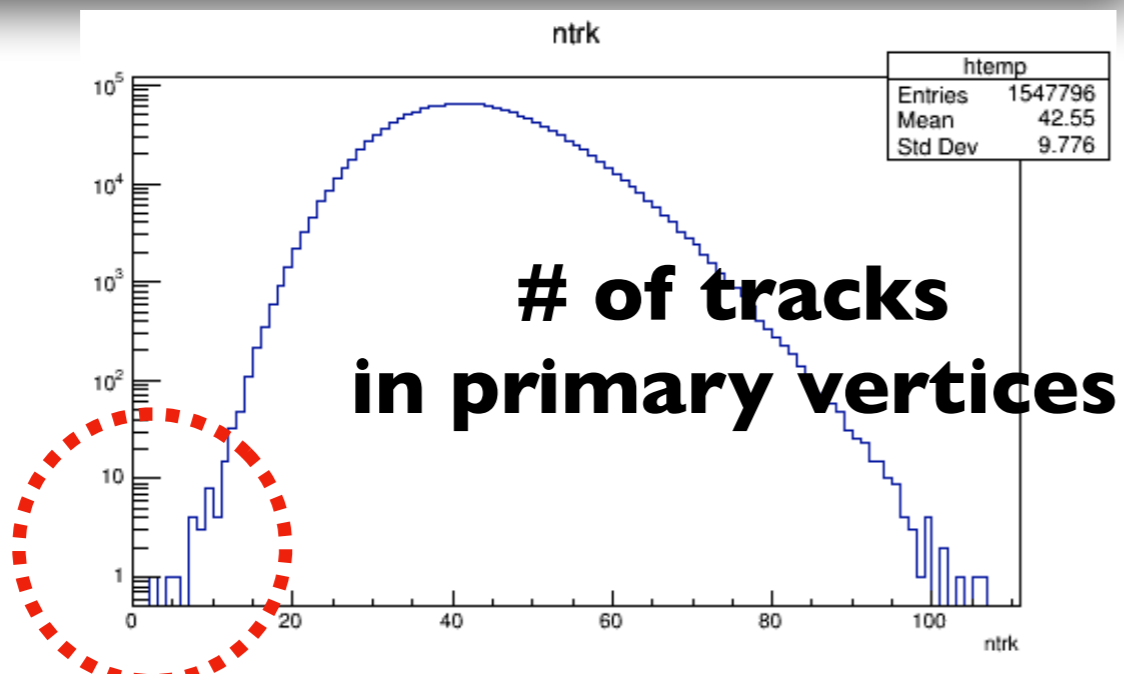
Primary vertex : position (I5 and DBD)



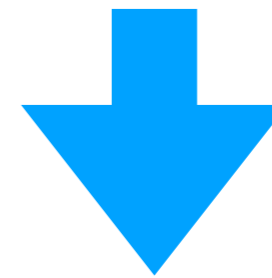
Key to understand:

- smearing in sample
- smearing in LCFIPlus

10



- It was pointed out that
- the peak looks delta function
 - it may indicate fitting failure e.g. take a default value or so.

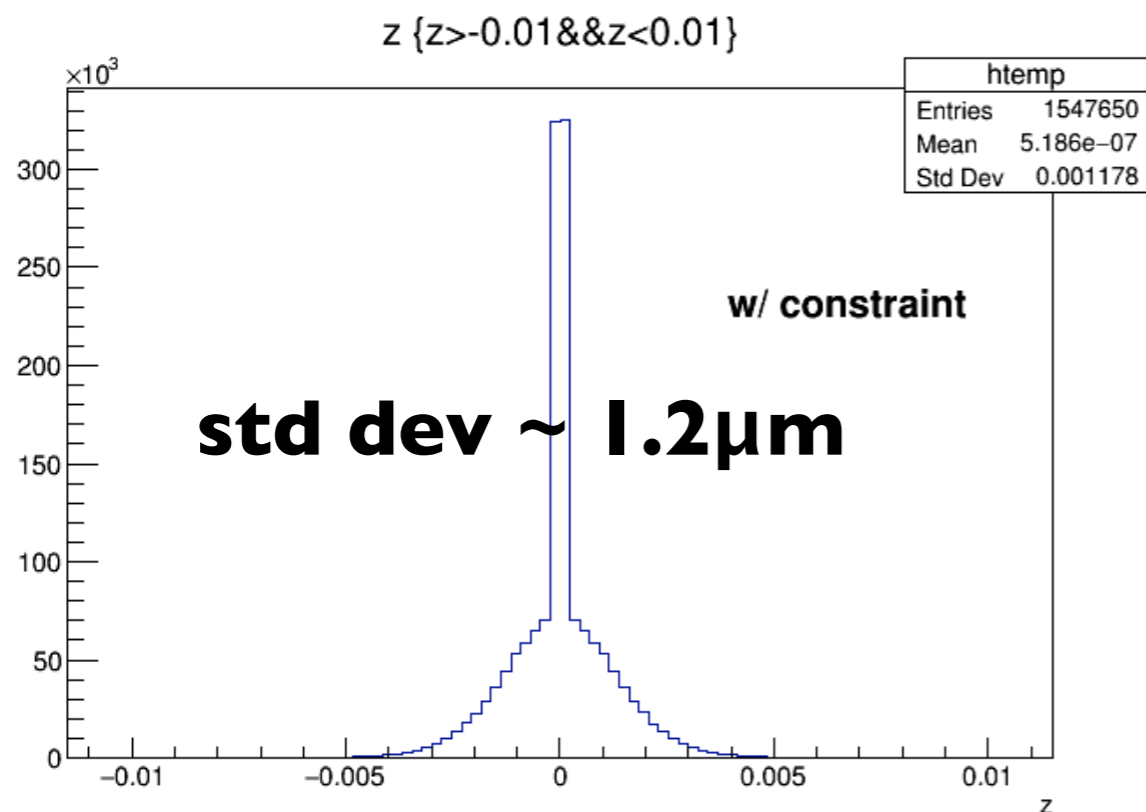


- No error found in the run log
- In fact, there is a treatment so that if the vertex fitting fails, return a vertex that is assigned to (0,0,0) but without any associated tracks.
- Left plot tells us that this is not the case.

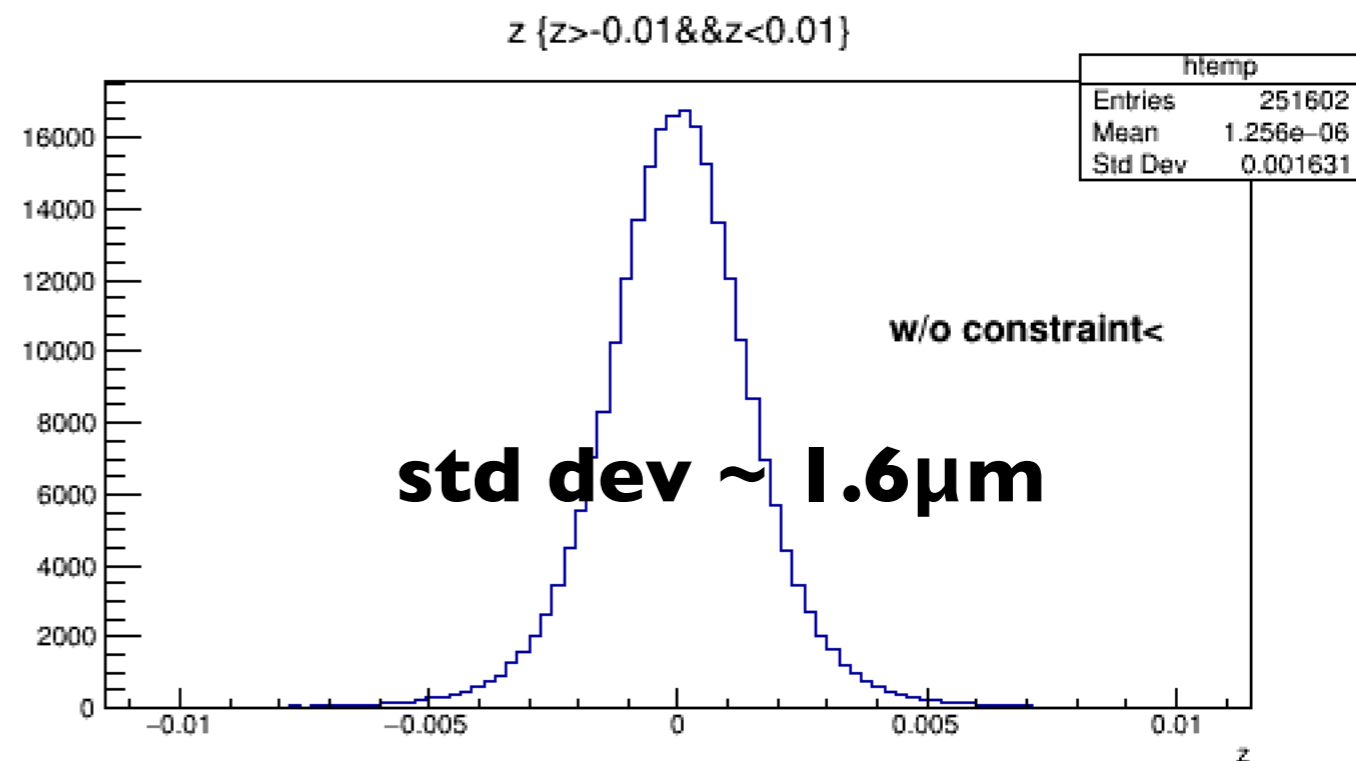
Issue?

A theory was as follows:

- **the delta function is caused by a very good vertex resolution compared to the constraint width.**
- **If this theory is correct, turning off the constraint doesn't change much.**
- **The answer is ...**



with constraint



without constraint

Digging the codes

I have got a suspicious part last night and this is not yet well discussed within the developer's group.

The following code is related to fitting a point with Minuit2.

```
1306     ROOT::Minuit2::VariableMetricMinimizer minlow;
1307     // parameters
1308     ROOT::Minuit2::MnUserParameters param;
1309     param.Add("x",initial.x(),1e-4);
1310     param.Add("y",initial.y(),1e-4);
1311     param.Add("z",initial.z(),1e-4);
1312     ROOT::Minuit2::FCNAdapter<ROOT::Math::IMultiGenFunction> func(f, 1. ); // errordef = 1 in chi2 minimization
1313
1314     int maxfcn = 10000; // max function calls
1315     double tol = 0.01; // tolerance
1316     ROOT::Minuit2::FunctionMinimum m = minlow.Minimize(func, param, ROOT::Minuit2::MnStrategy(1), maxfcn,tol);
1317
```

<https://github.com/ryonamin/LCFIPlus/blob/master/src/geometry.cc#L1309-L1311>

When running minimization, we specify initial point and “error”.

So far I'm not confident what the error means.

My worry is that this initial point might work as an additional fitting point.

I made a quick test with these values being 100 and see what happens.

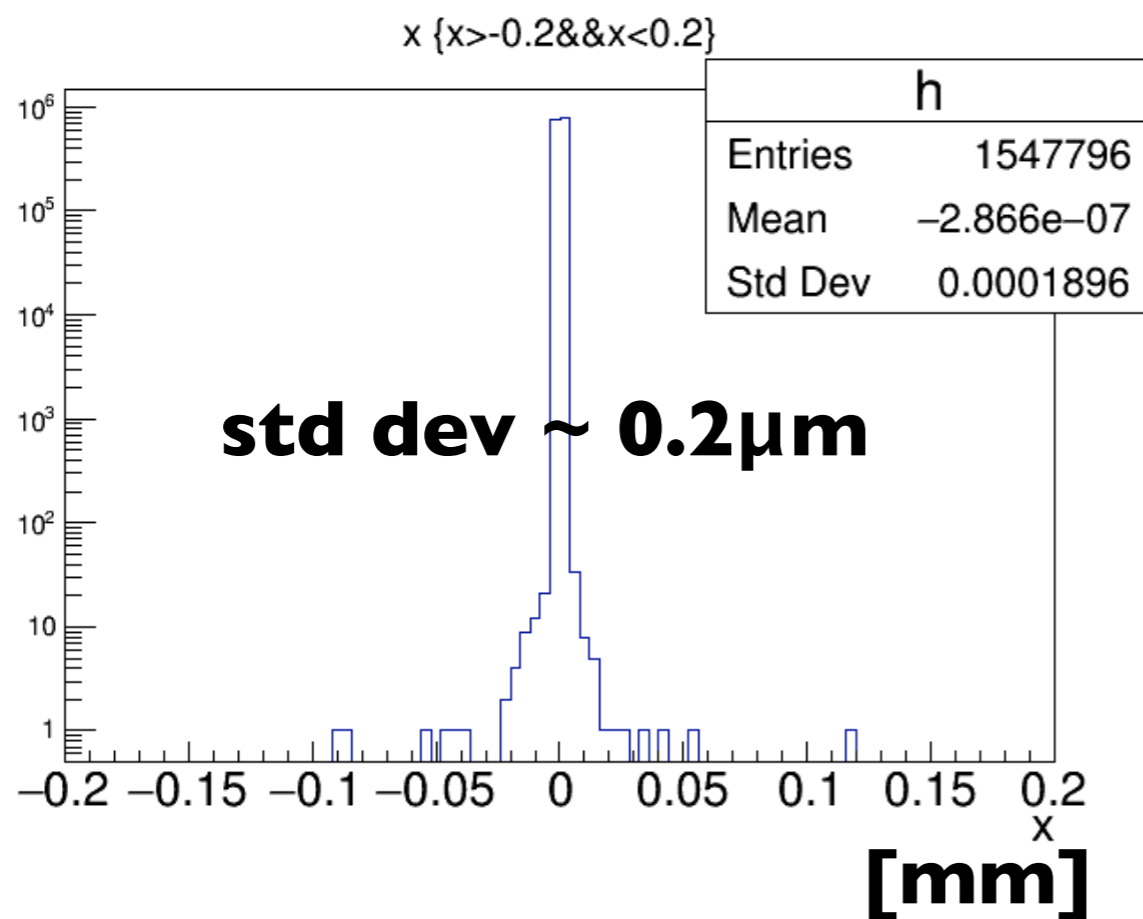
Primary vertex x position

DBD sample with recent vertexing (True value is 0)

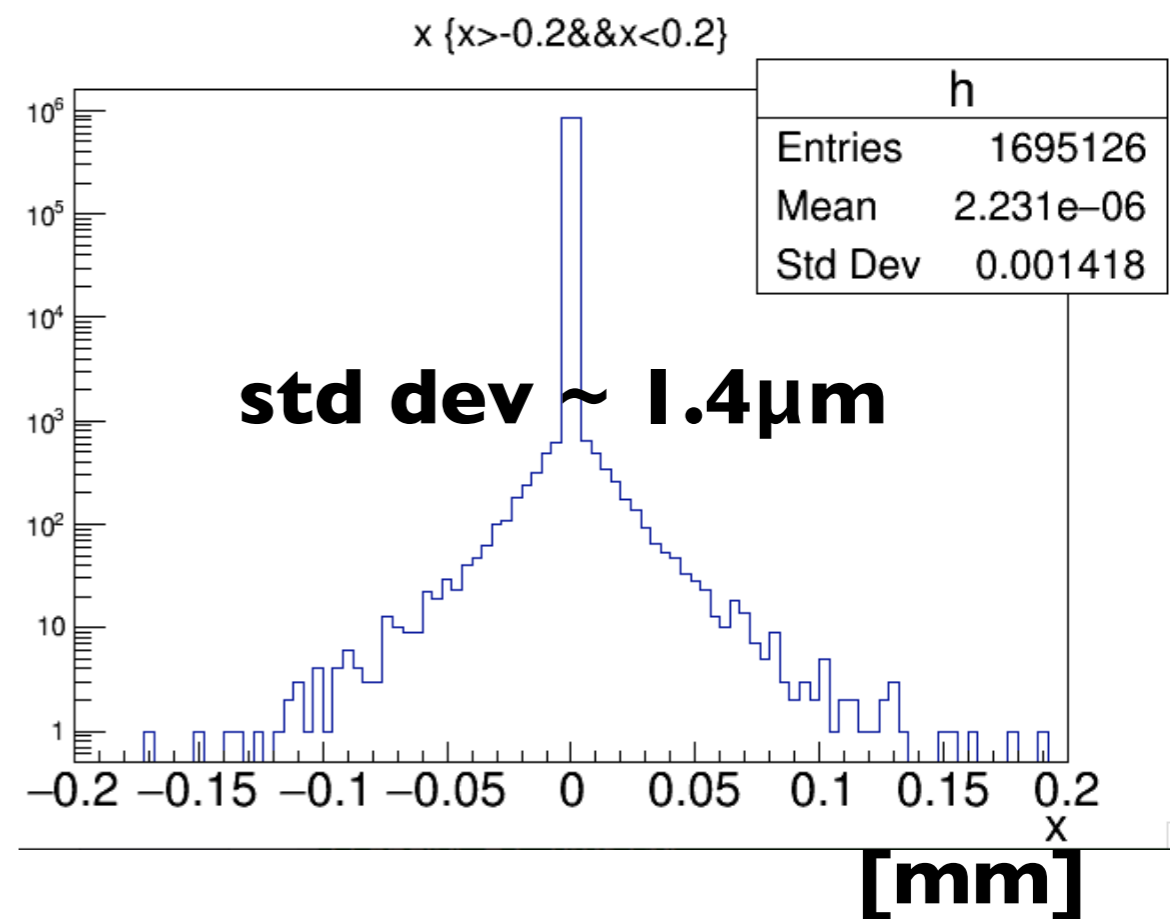
with constraint

at 0 with

$\sigma=639\text{nm}$



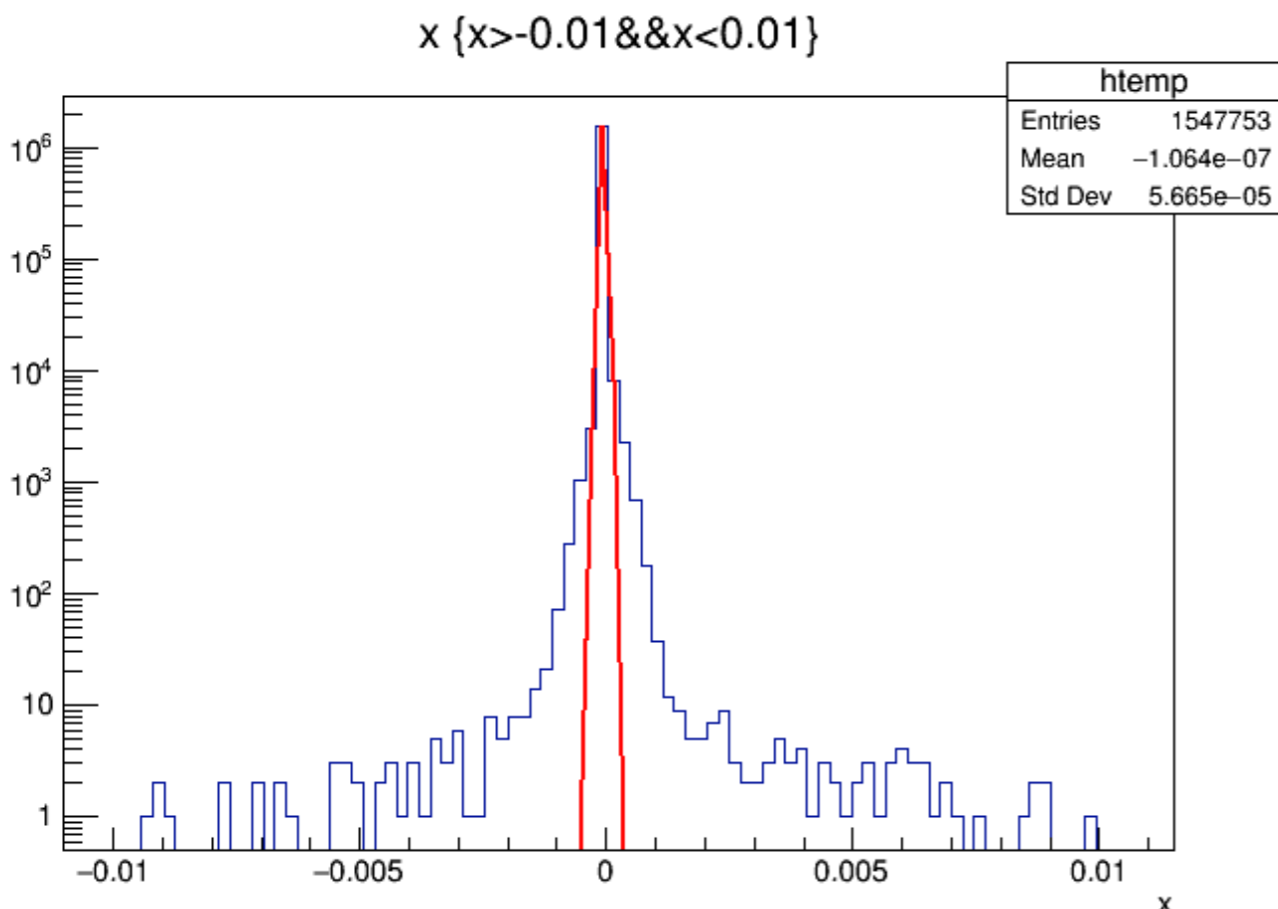
current



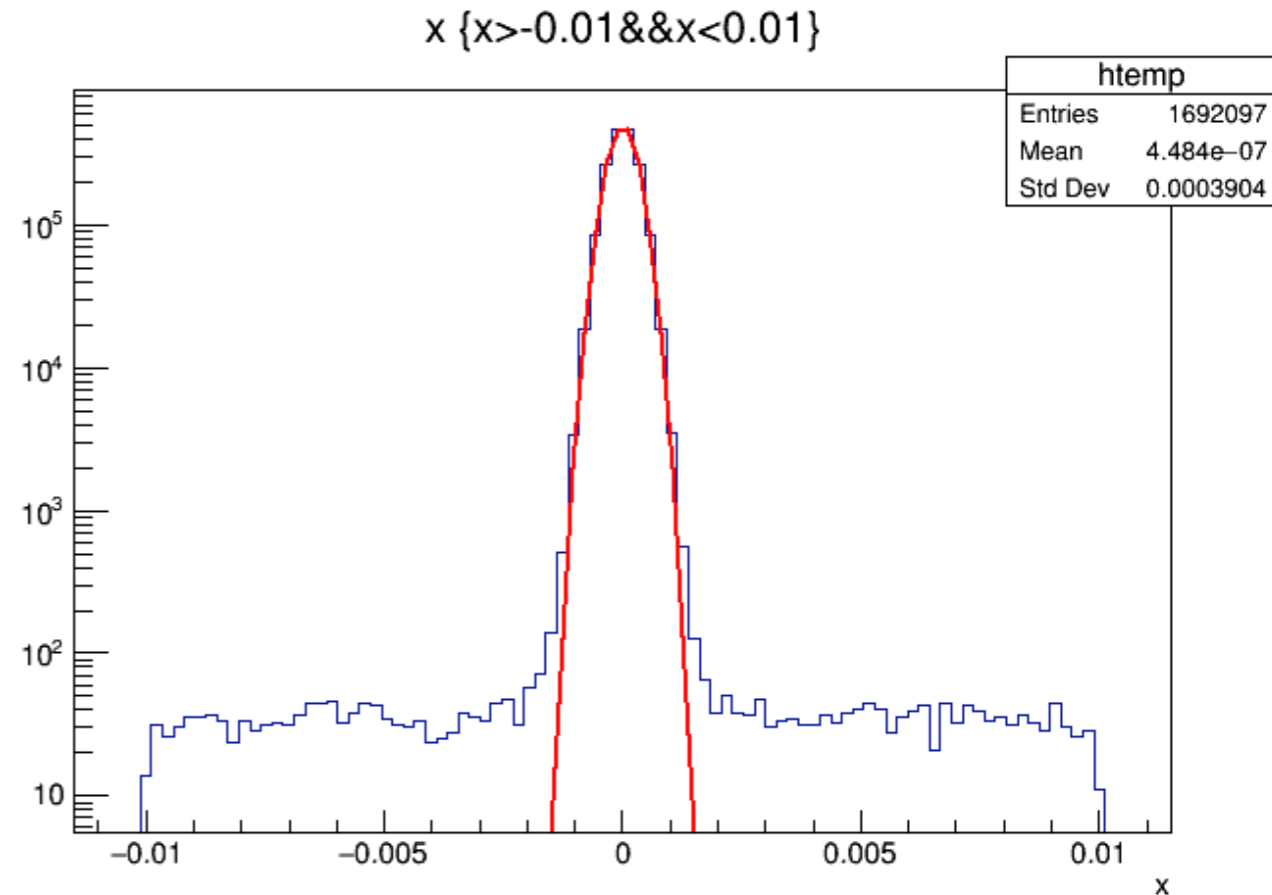
test

ttbar samples used. Contamination from secondary vertices may exist.

Zoom-up to centre



Fit $\sigma \sim 66\text{nm}$
current

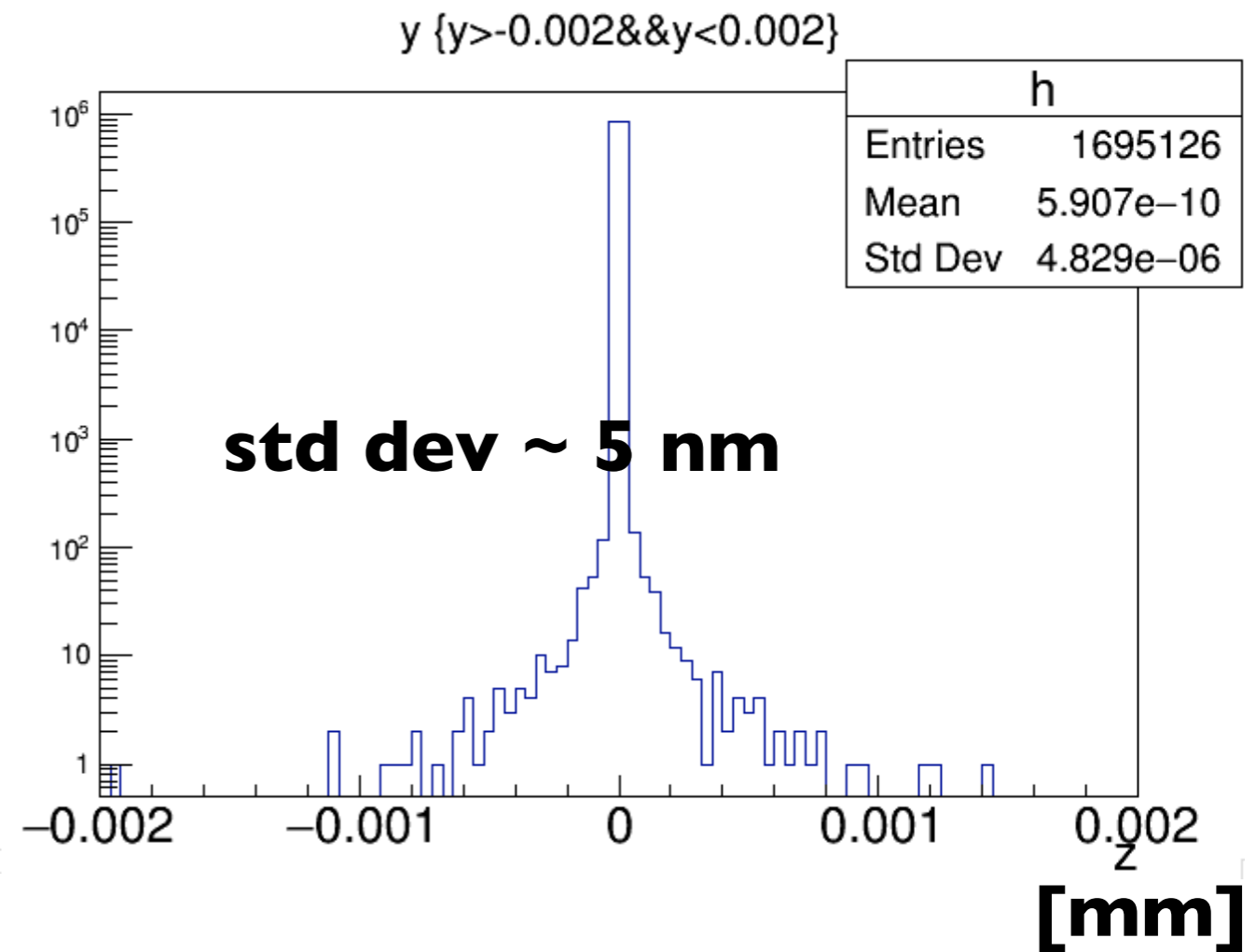
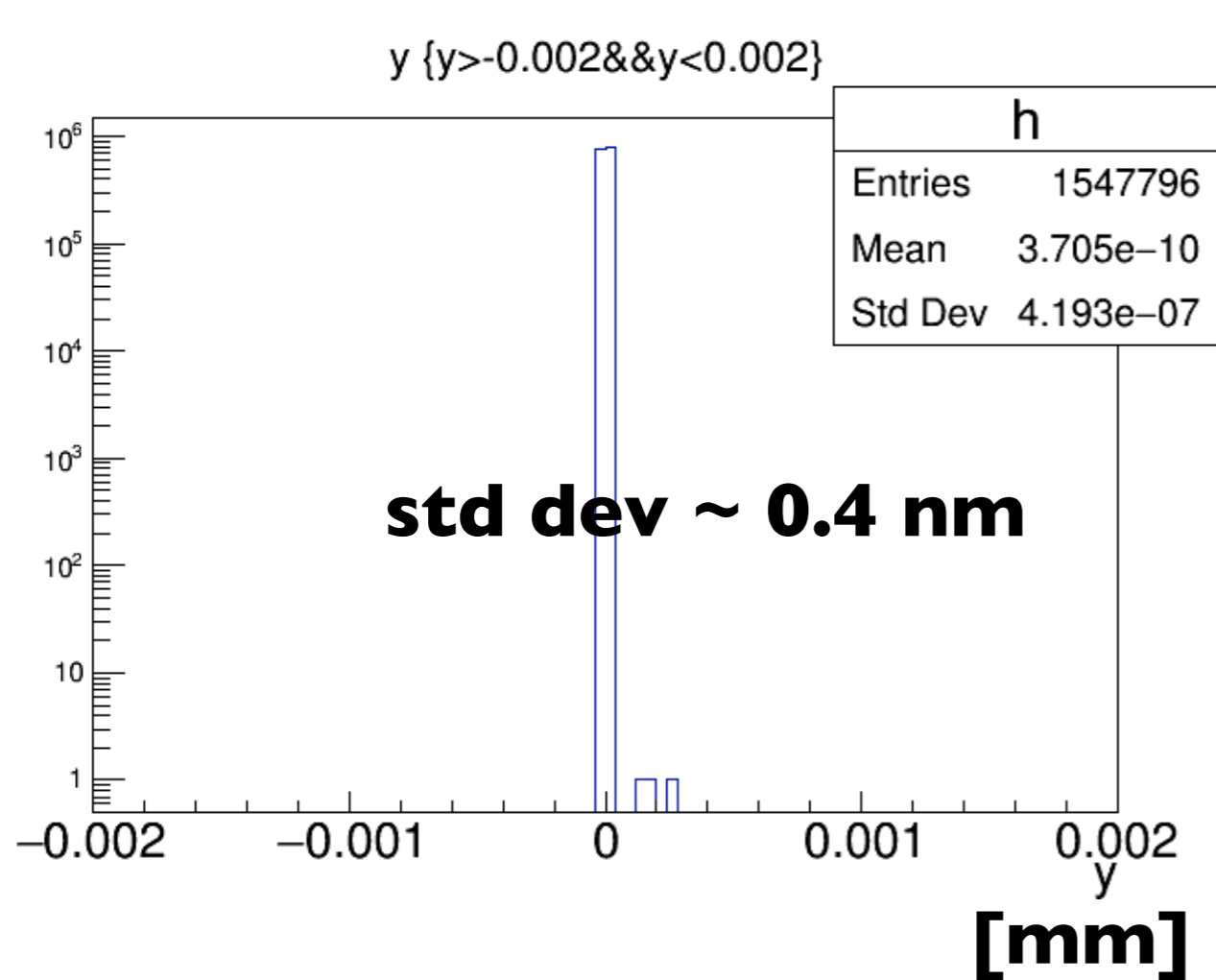


Fit $\sigma \sim 300\text{nm}$
test

Primary vertex y position

DBD sample with recent vertexing (True value is 0)

with constraint
at 0 with
 $\sigma=5.7\text{nm}$



current

test

ttbar samples used. Contamination from secondary vertices may exist.

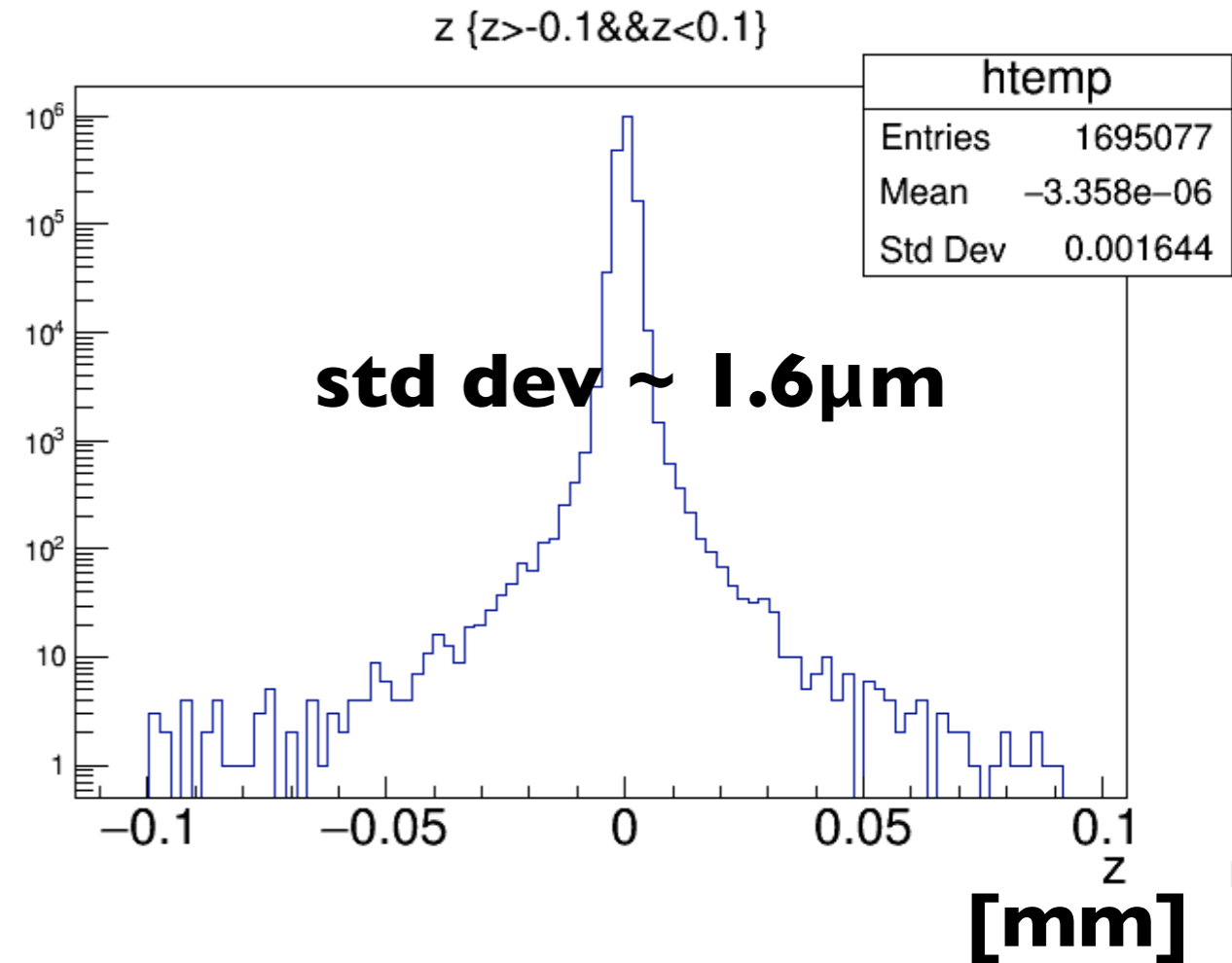
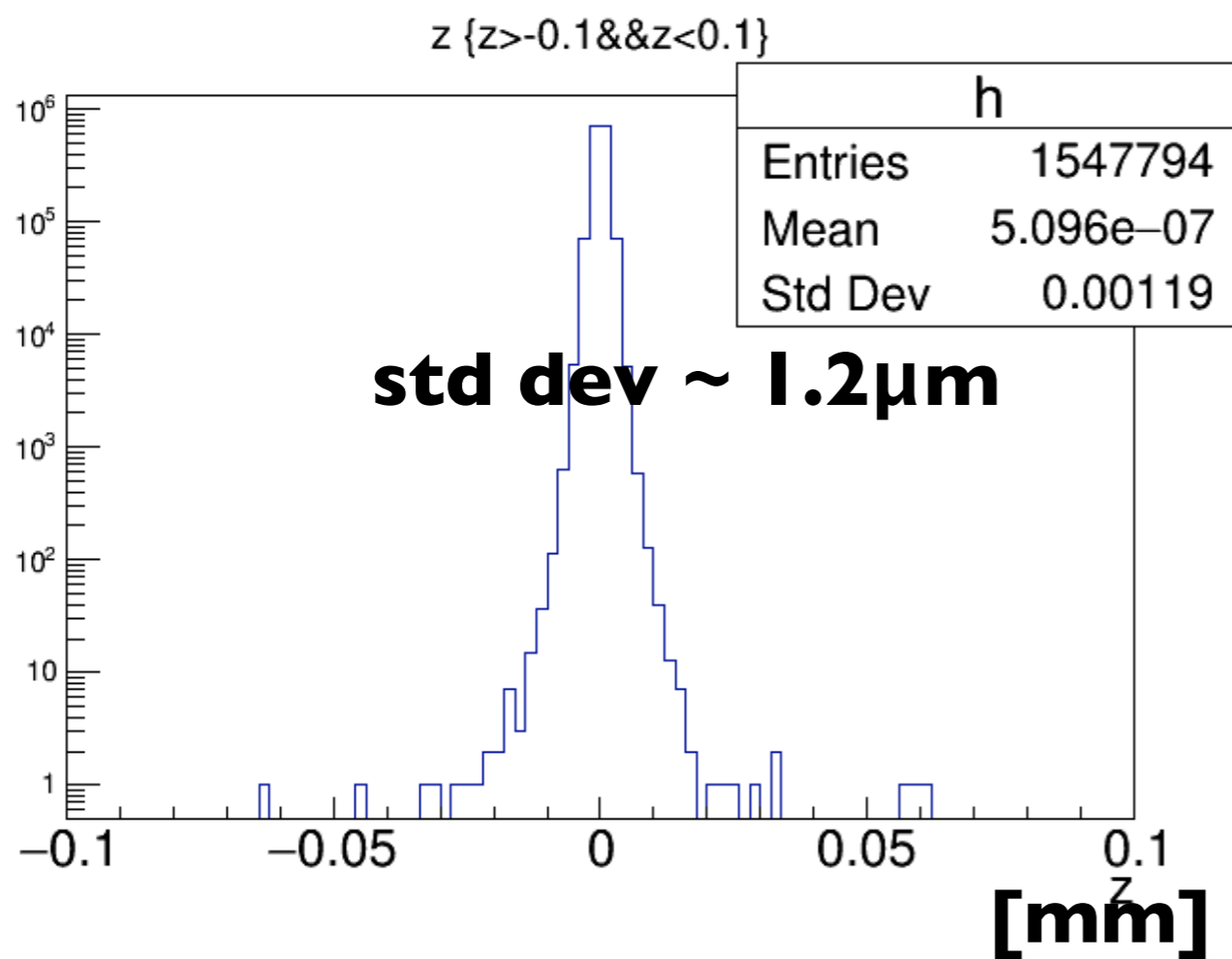
Primary vertex z position

DBD sample with recent vertexing (True value is 0)

with constraint

at 0 with

$\sigma=91.3\mu\text{m}$

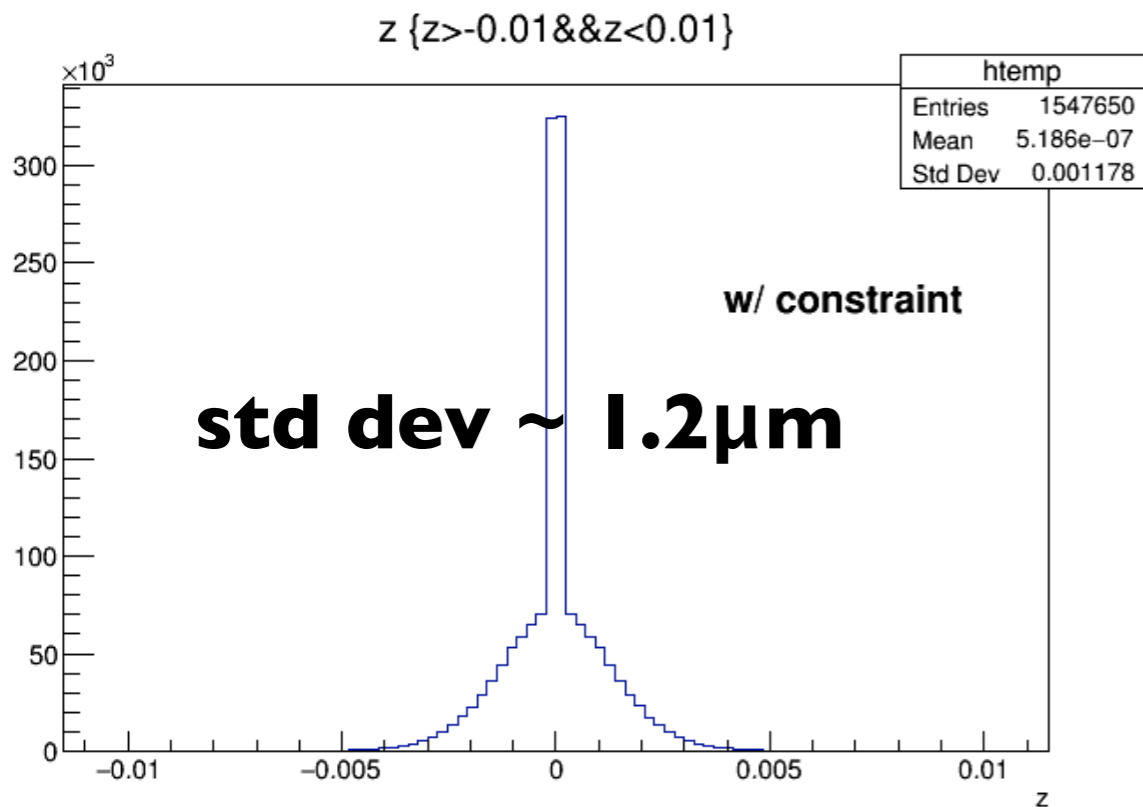


current

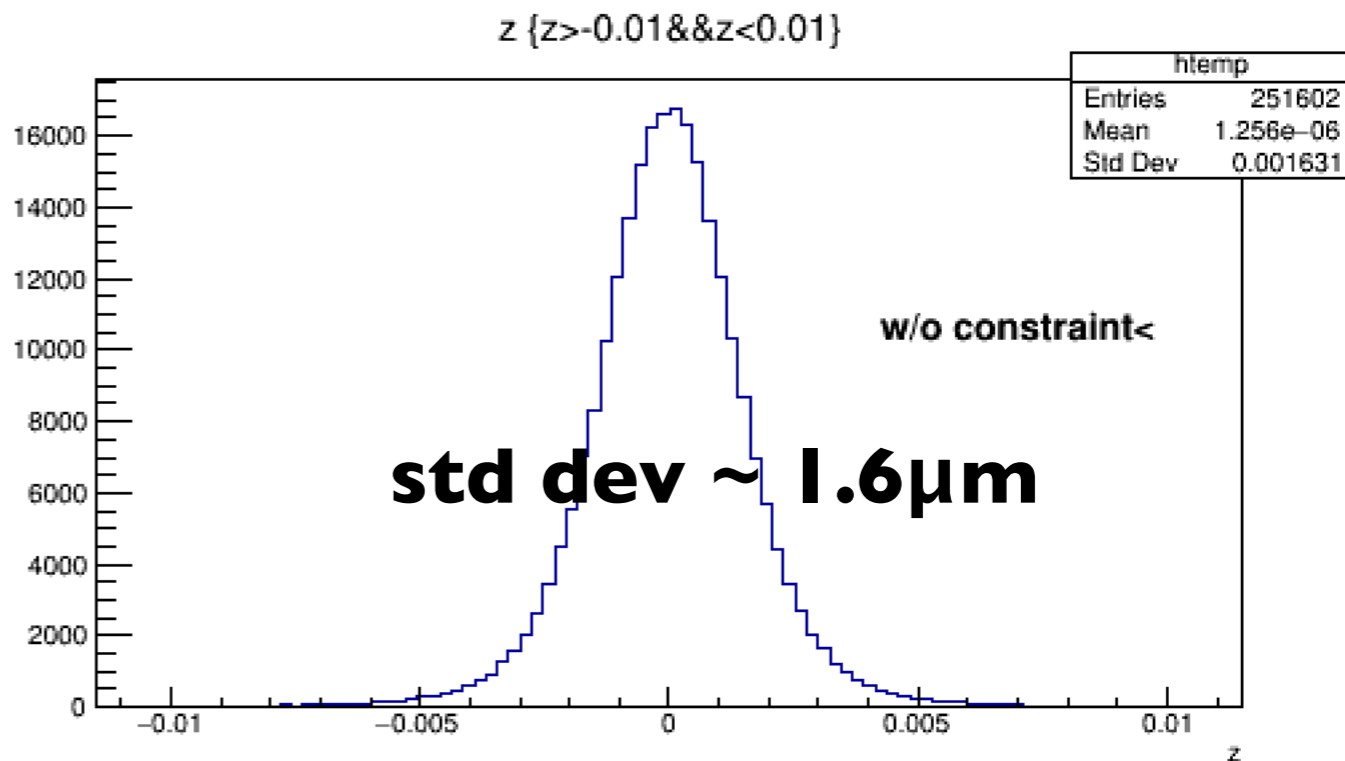
test

ttbar samples used. Contamination from secondary vertices may exist.

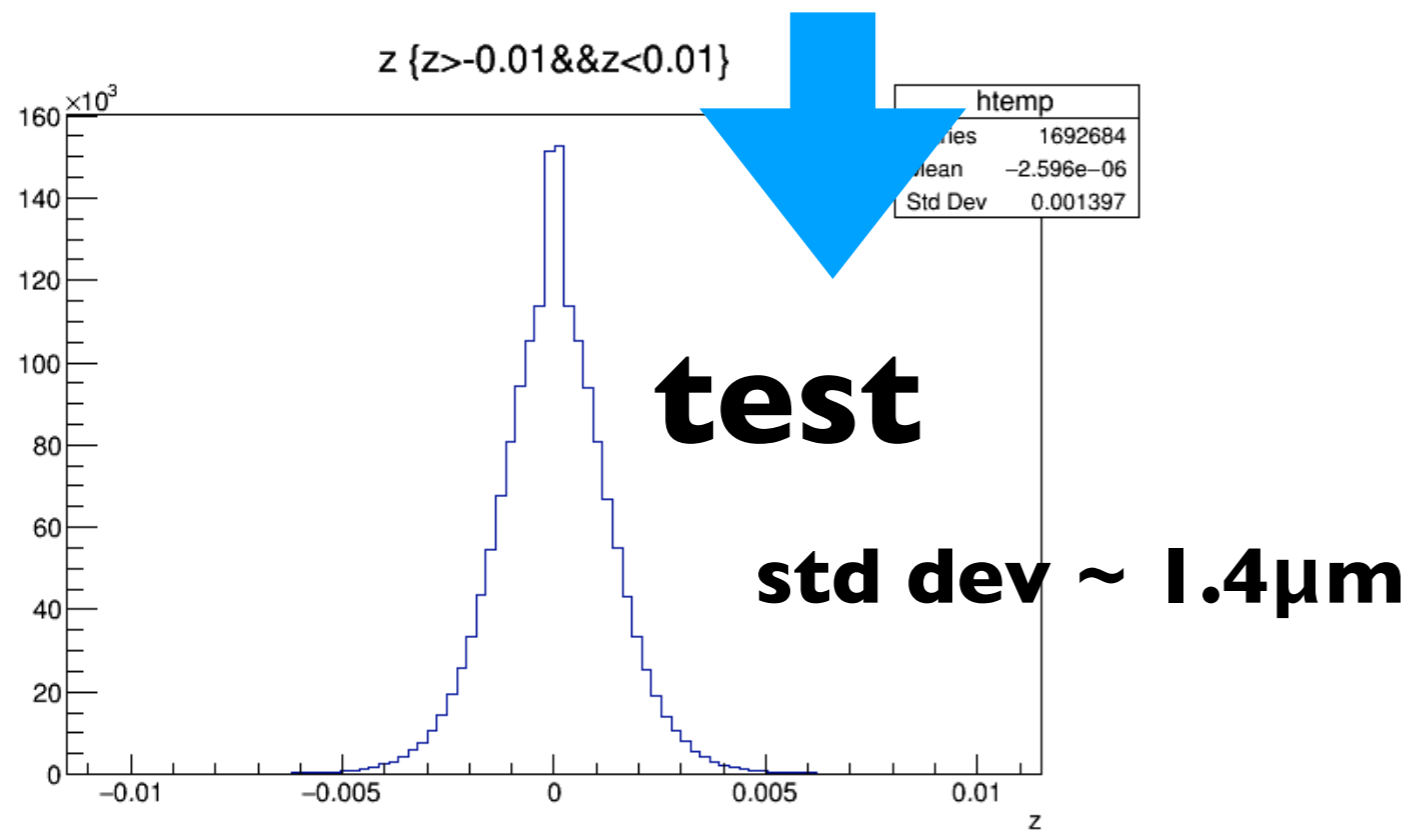
Revisit page 3



with constraint



without constraint



Slides added after meeting

**During the meeting,
Keisuke suggested me to**

- make similar plots with errors of $10*\sigma_{\text{beamconstraint}}$ and confirm this would not differ from the result of error of 100mm**
- try sample of $\mu\mu$ to see if the tails seen in the right plots.**

Akiya suggested me to

- check also chi2.**
- report the software conveners as soon as possible if these are consistent with what we expect.**

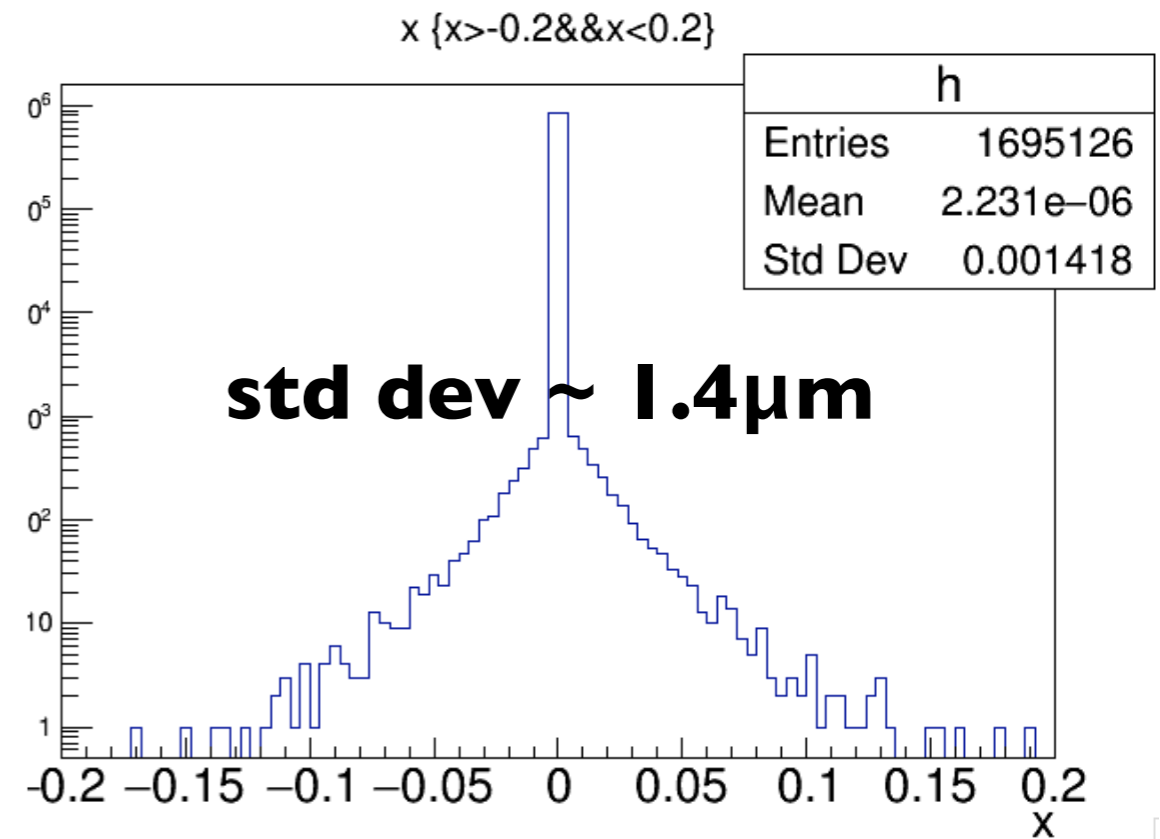
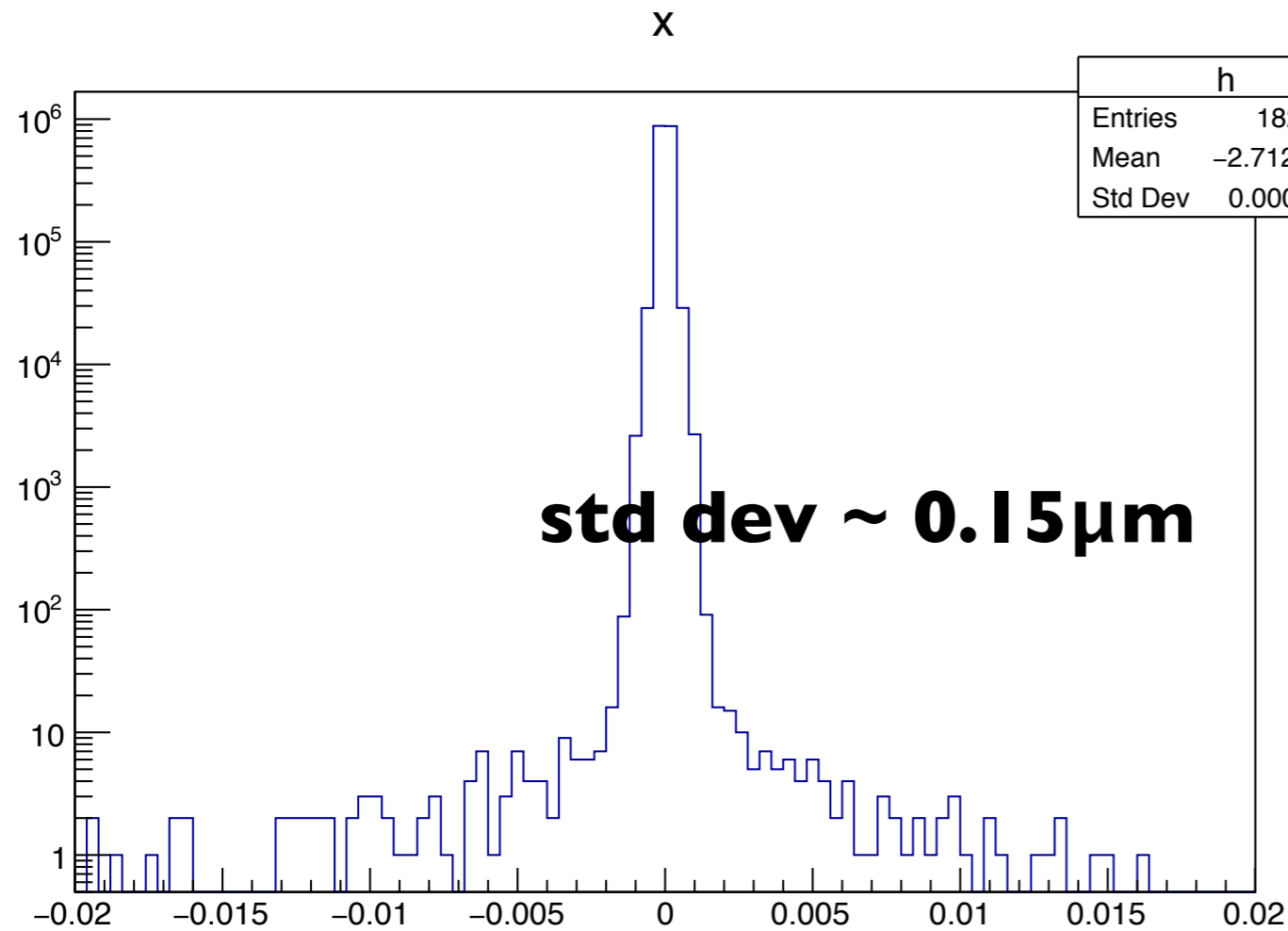
Daniel suggested me to

- check if this affects secondary vertex finding.**

Primary vertex x position

DBD sample with recent vertexing (True value is 0)

with constraint
at 0 with
 $\sigma=639\text{nm}$

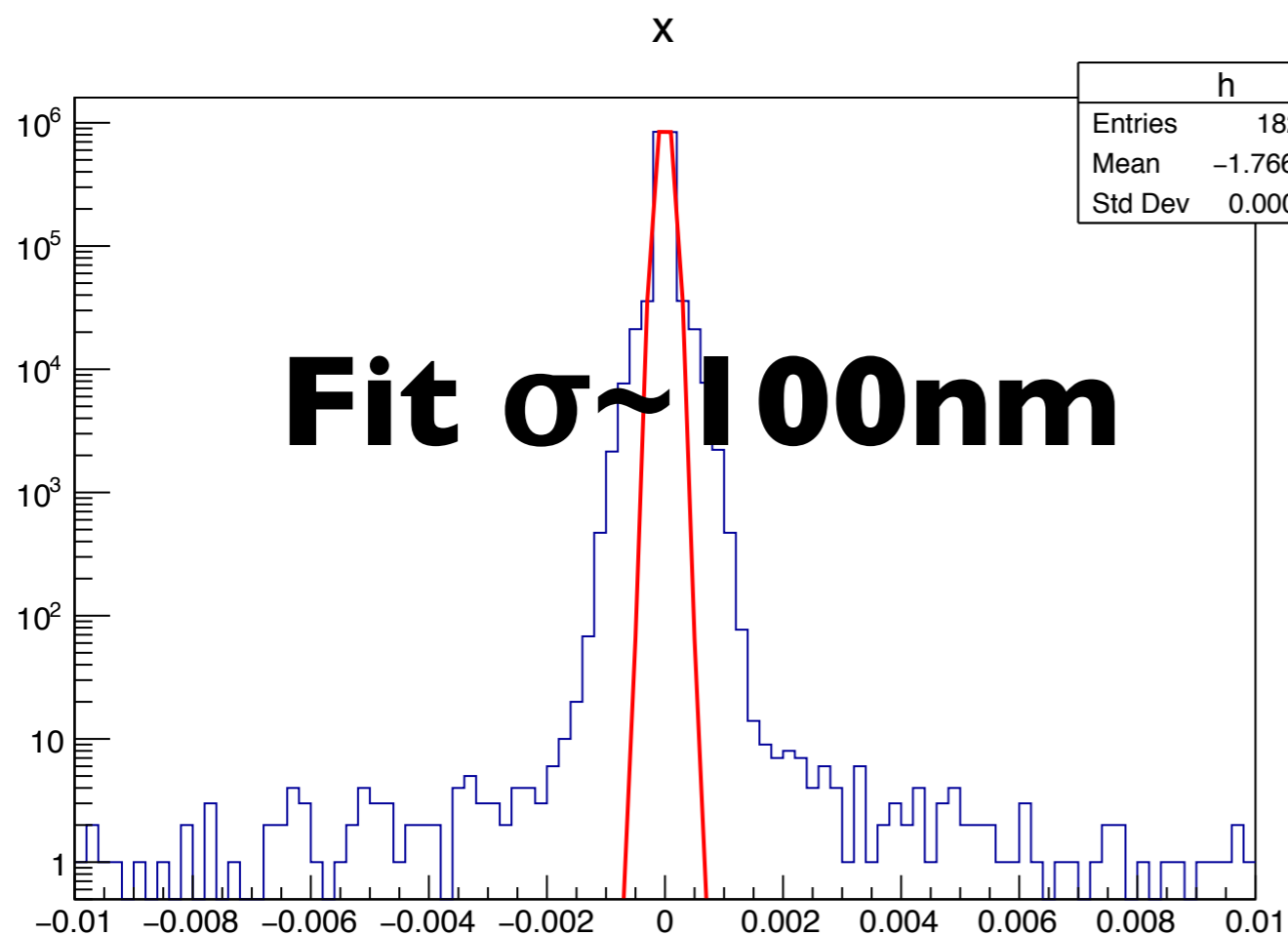


Error 10*σ

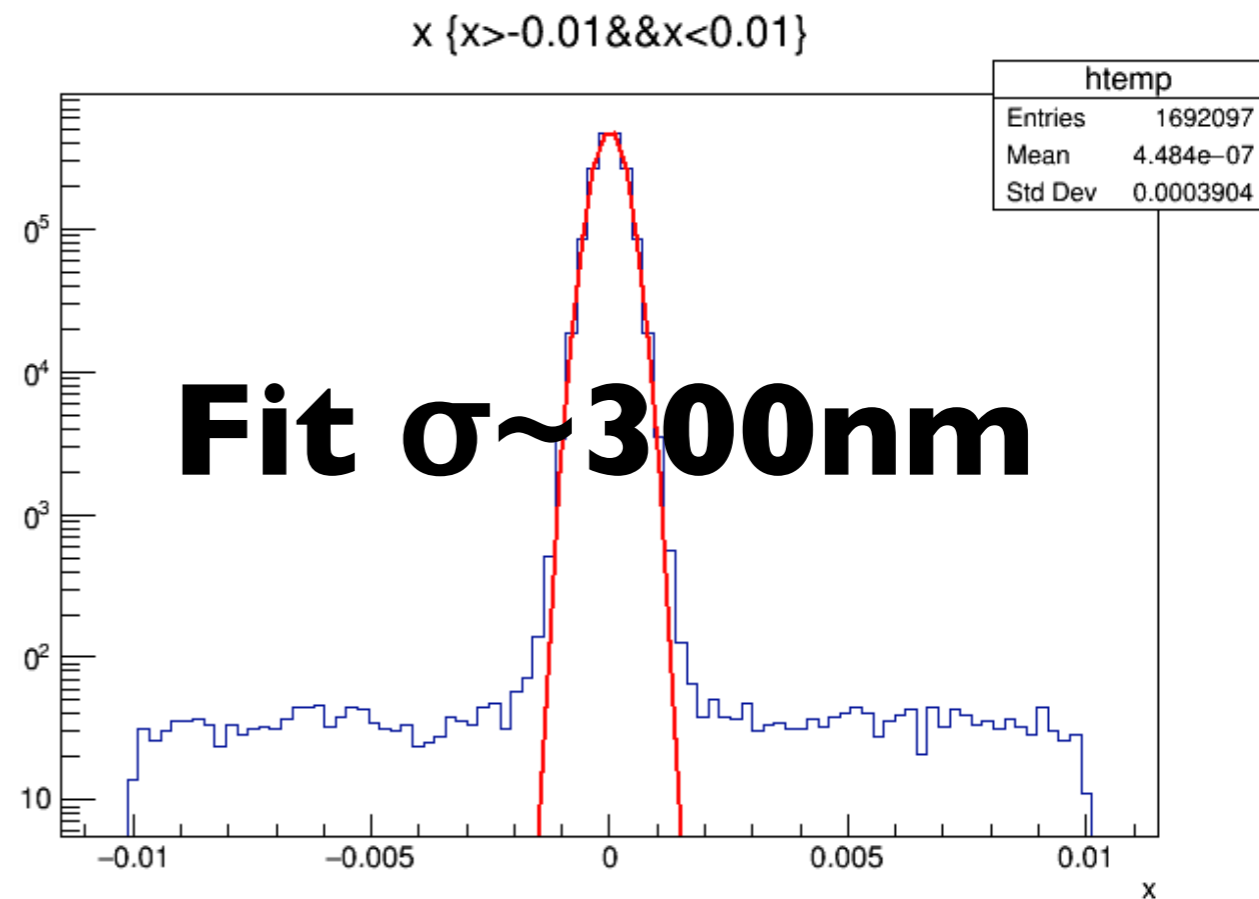
Error 100
(same as “test”)

ttbar samples used. Contamination from secondary vertices may exist.

Zoom-up to centre



Error $10 * \sigma$



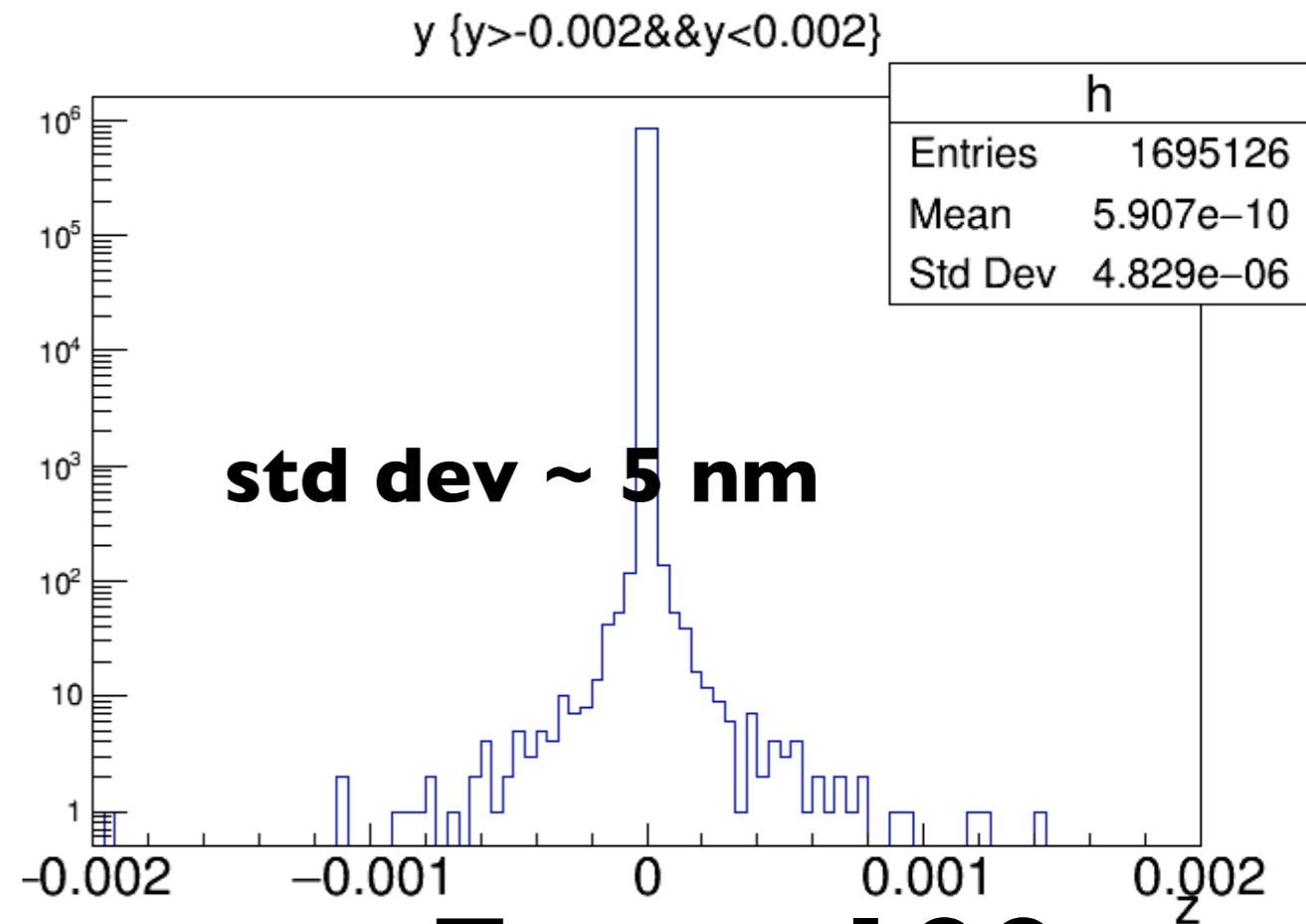
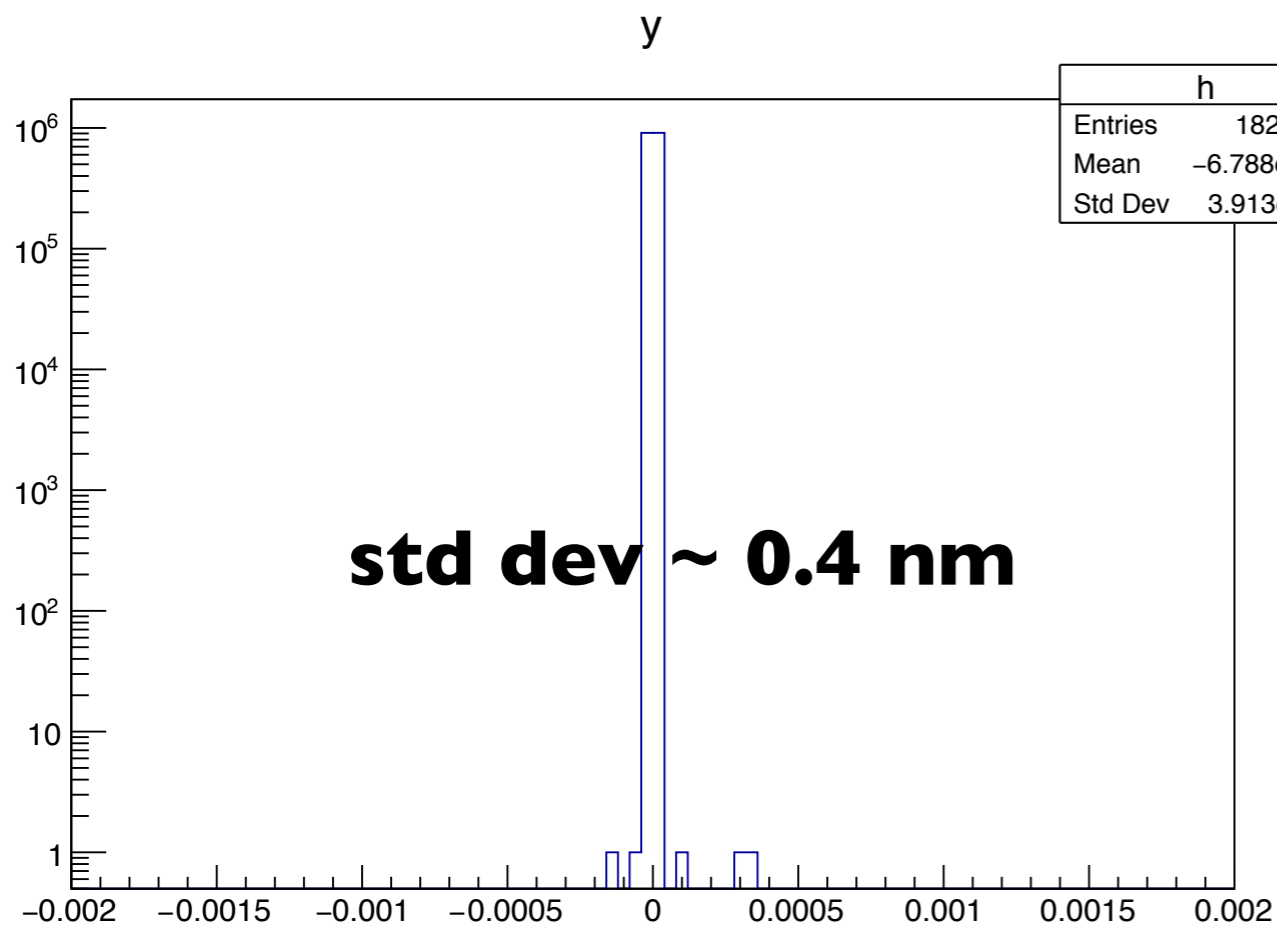
**Error 100
(same as “test”)**

ttbar samples used. Contamination from secondary vertices may exist.

Primary vertex y position

DBD sample with recent vertexing (True value is 0)

with constraint
at 0 with
 $\sigma=5.7\text{nm}$



Error 10* σ (= current) **Error 100**
(same as "test")

ttbar samples used. Contamination from secondary vertices may exist.

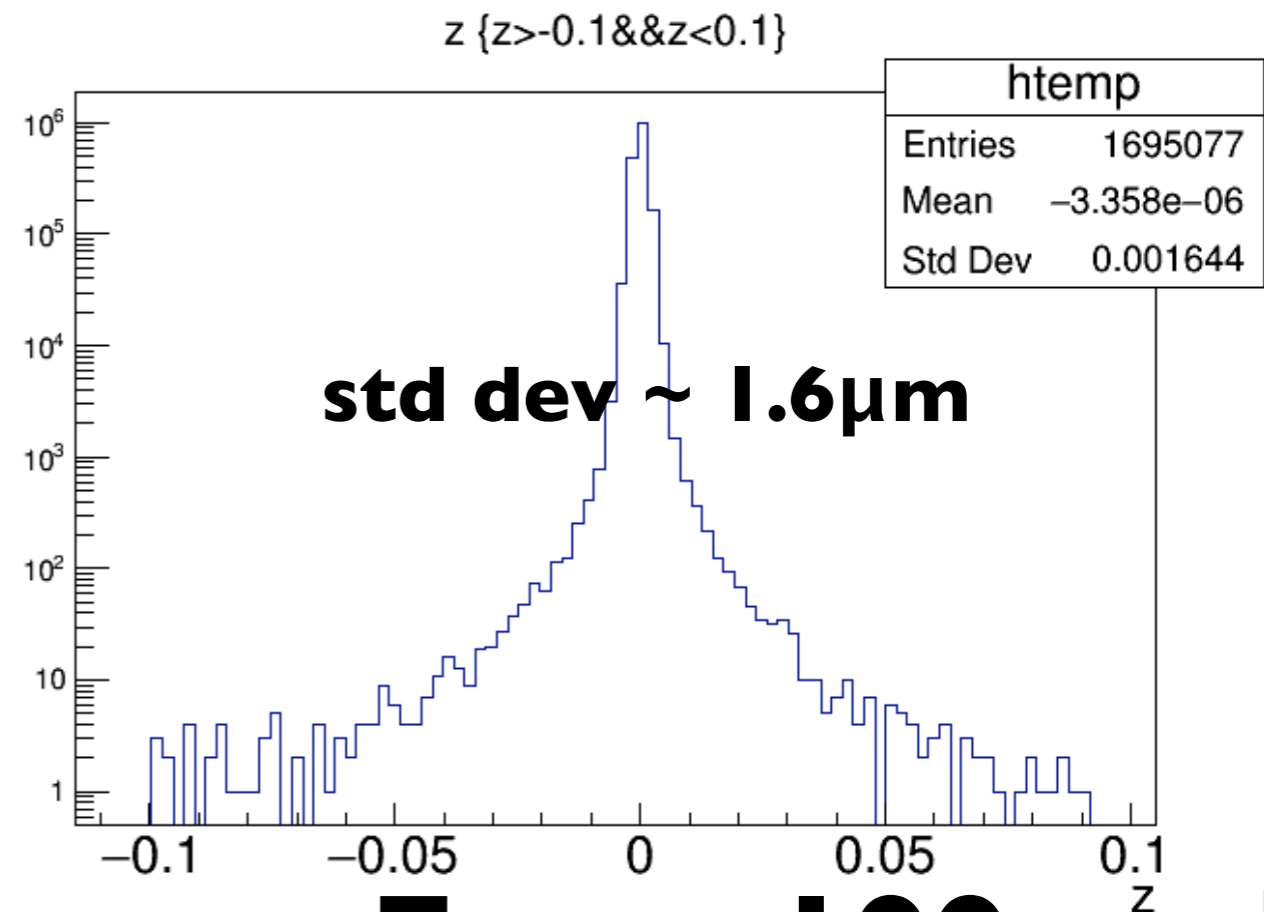
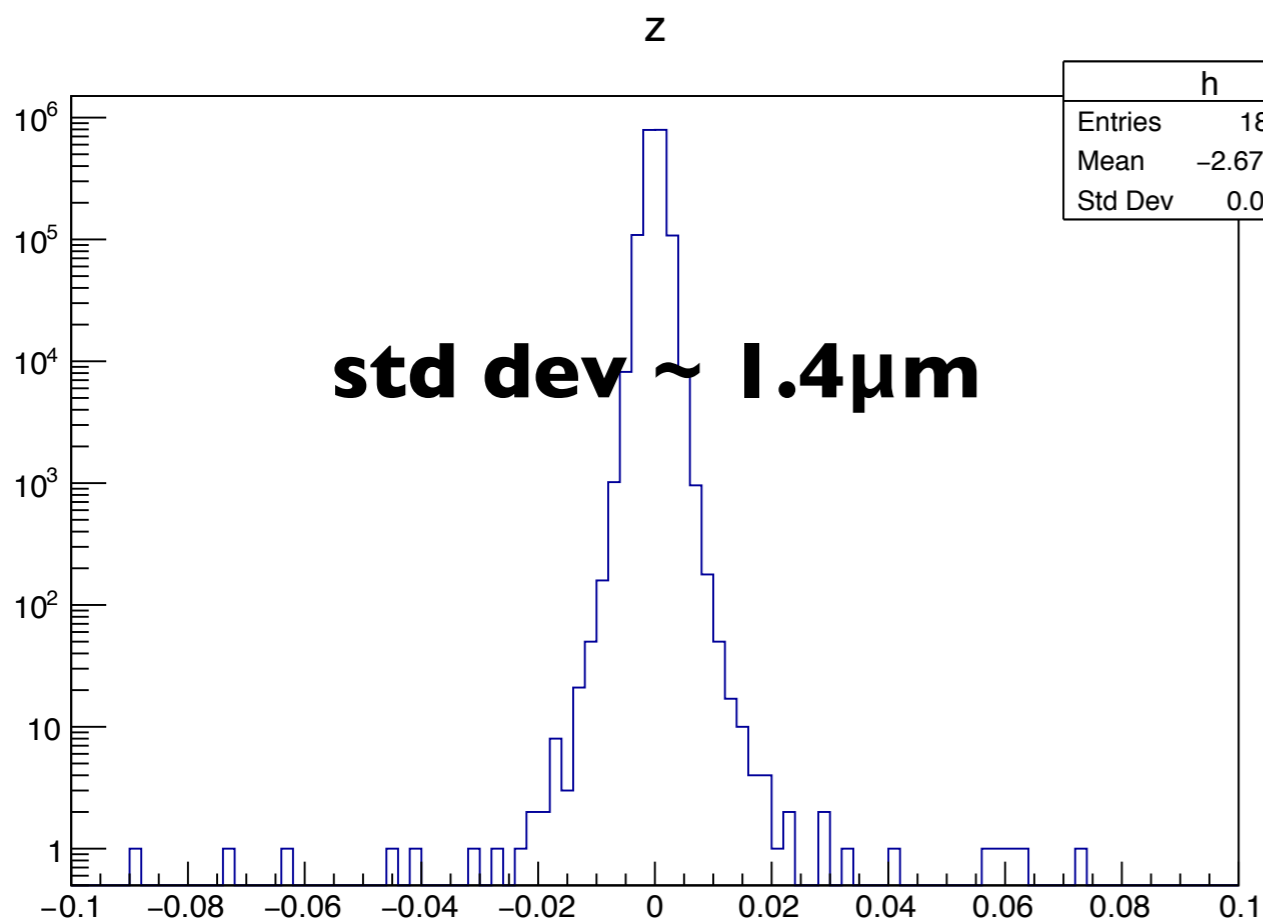
Primary vertex z position

DBD sample with recent vertexing (True value is 0)

with constraint

at 0 with

$\sigma=91.3\mu\text{m}$

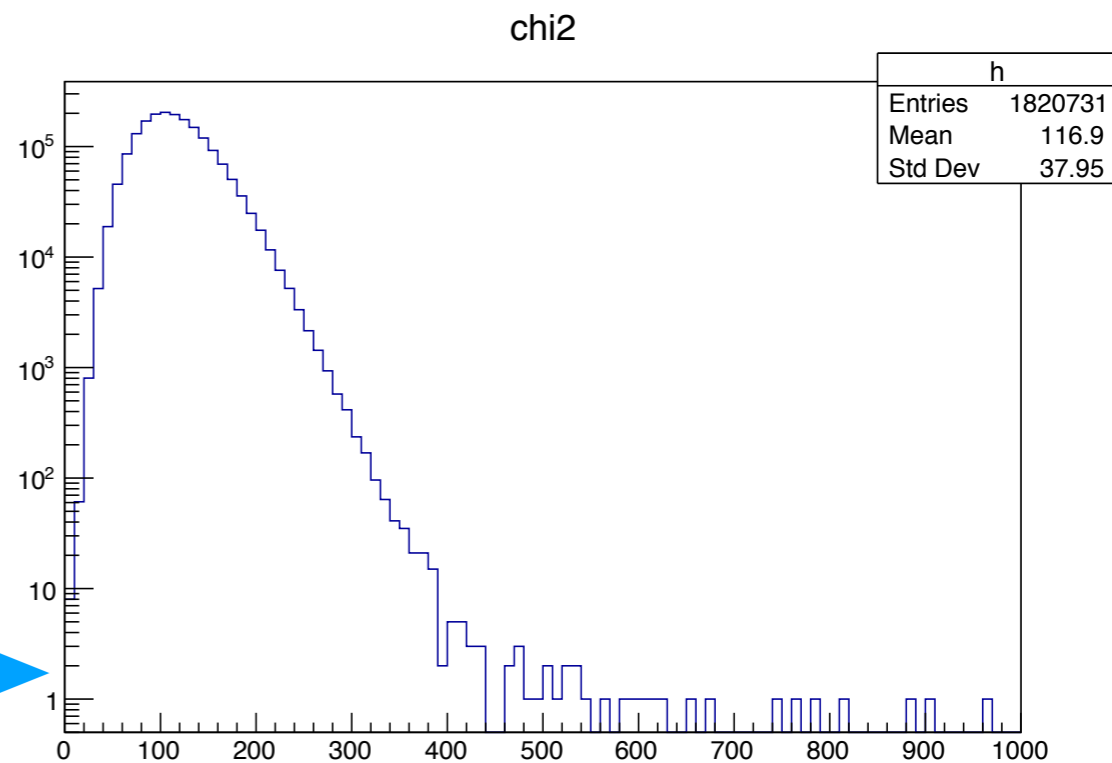
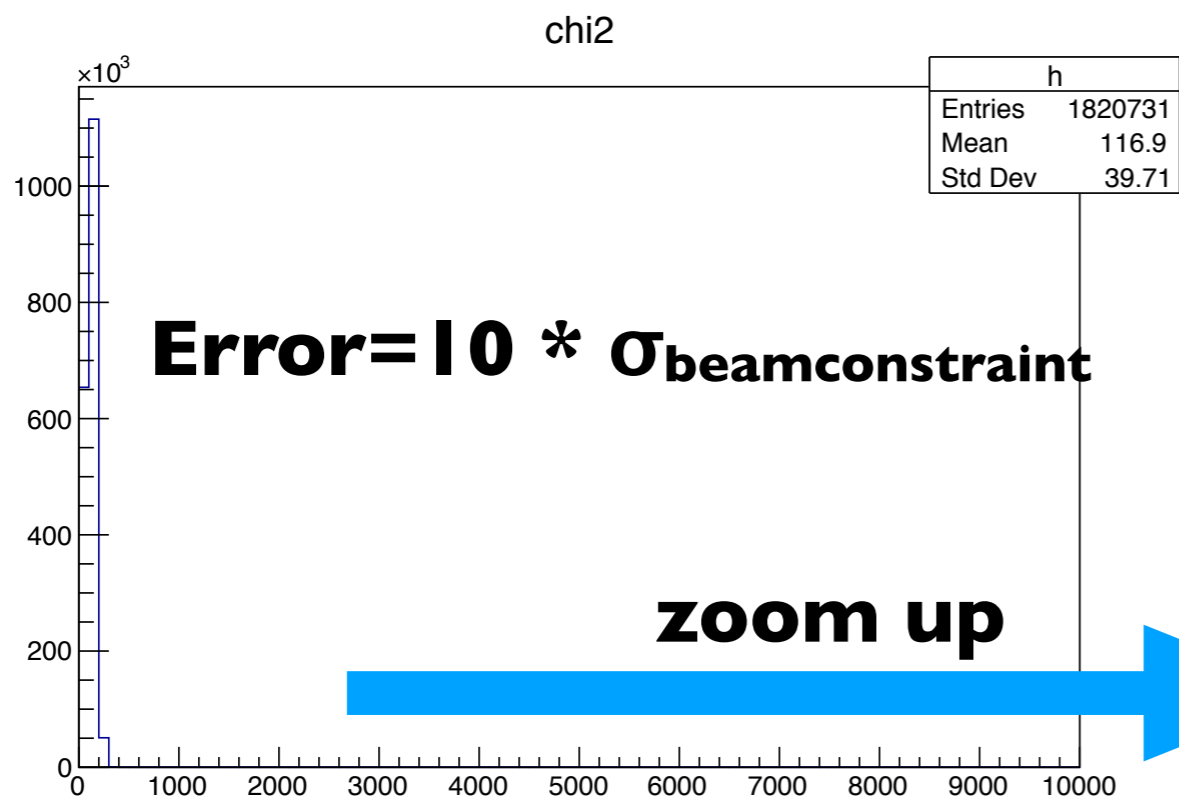
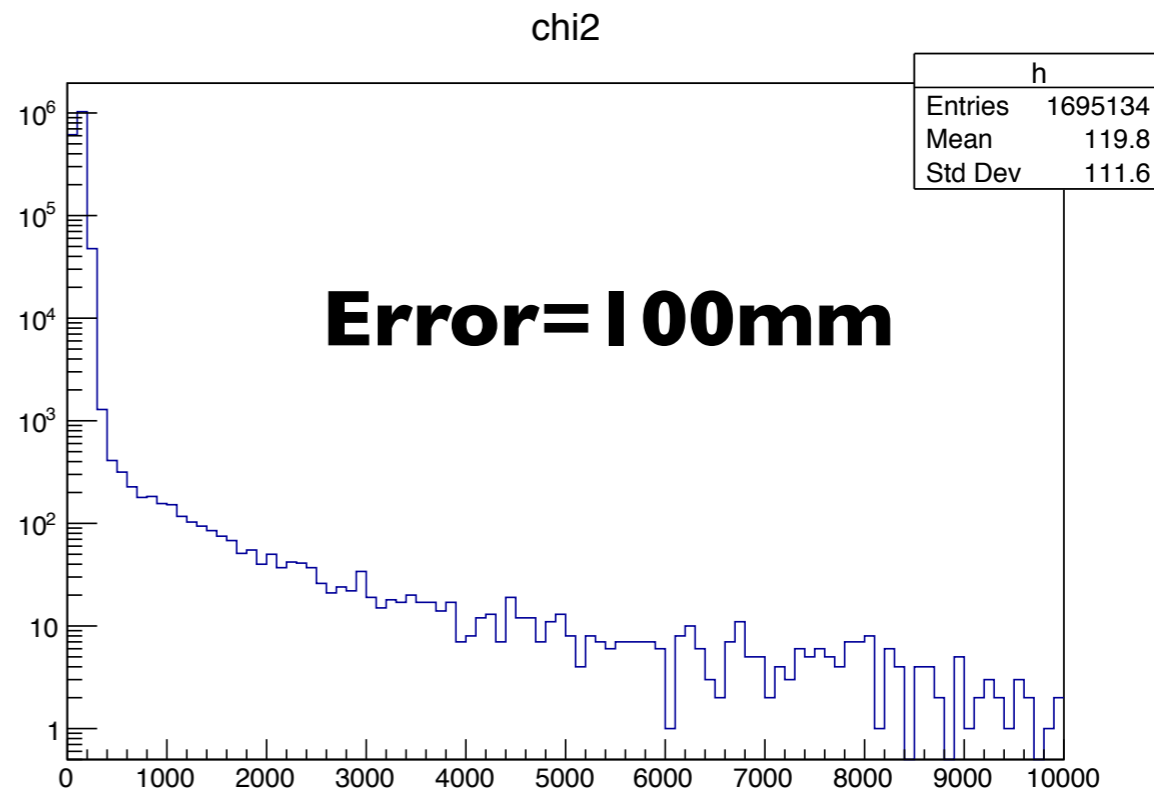
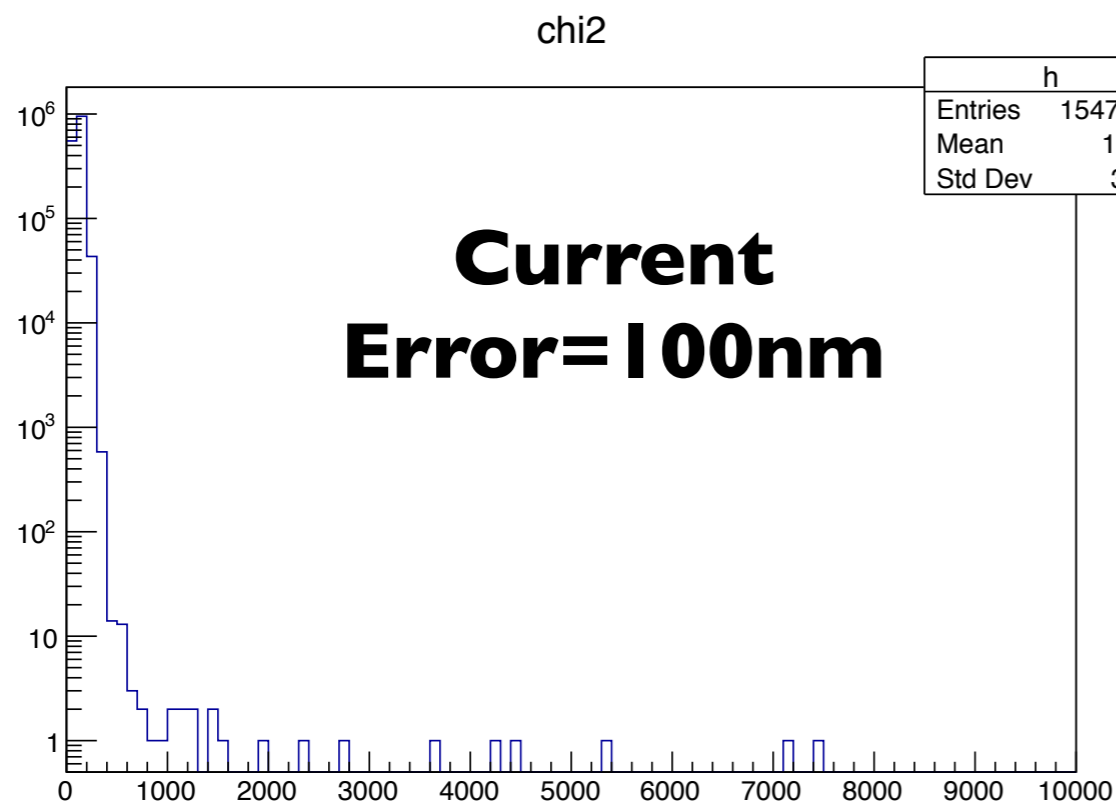


Error 100

(same as “test”)

ttbar samples used. Contamination from secondary vertices may exist.

Chi2

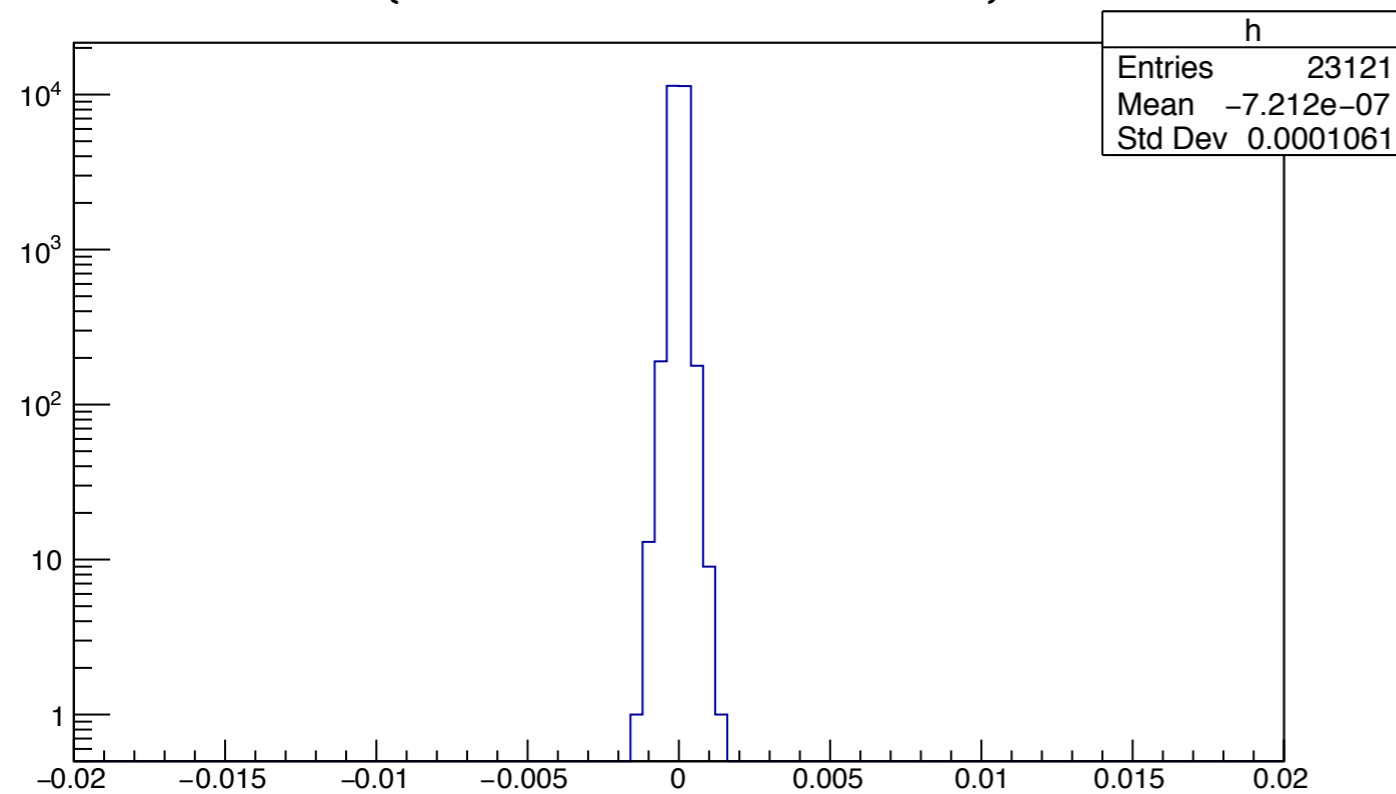


Primary vertex x position

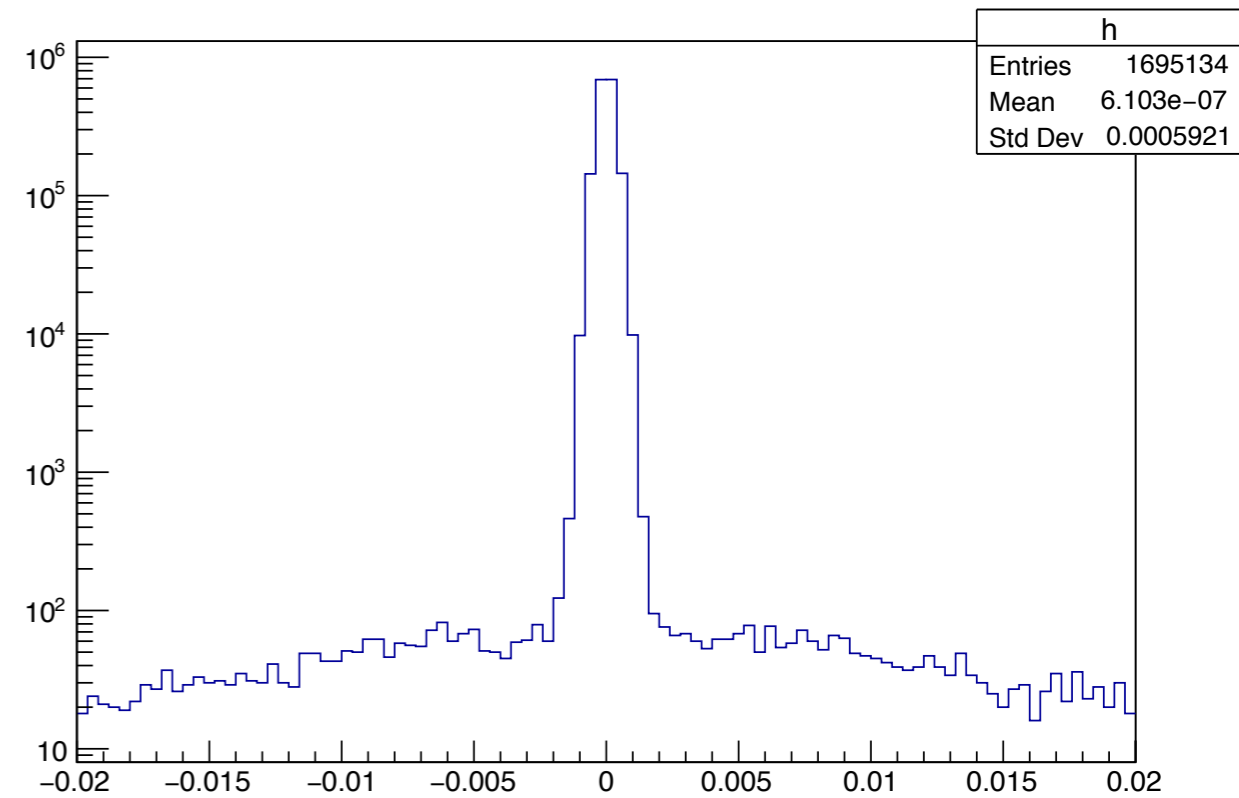
DBD sample with recent vertexing (True value is 0)

with constraint
at 0 with
 $\sigma=639\text{nm}$

x {ntrk==2&&mass<100&&mass>80}



x



2f_z_l sample used.

of vertex track = 2,

80 < vertex mass < 100 required.

Error 10* σ

Error 100

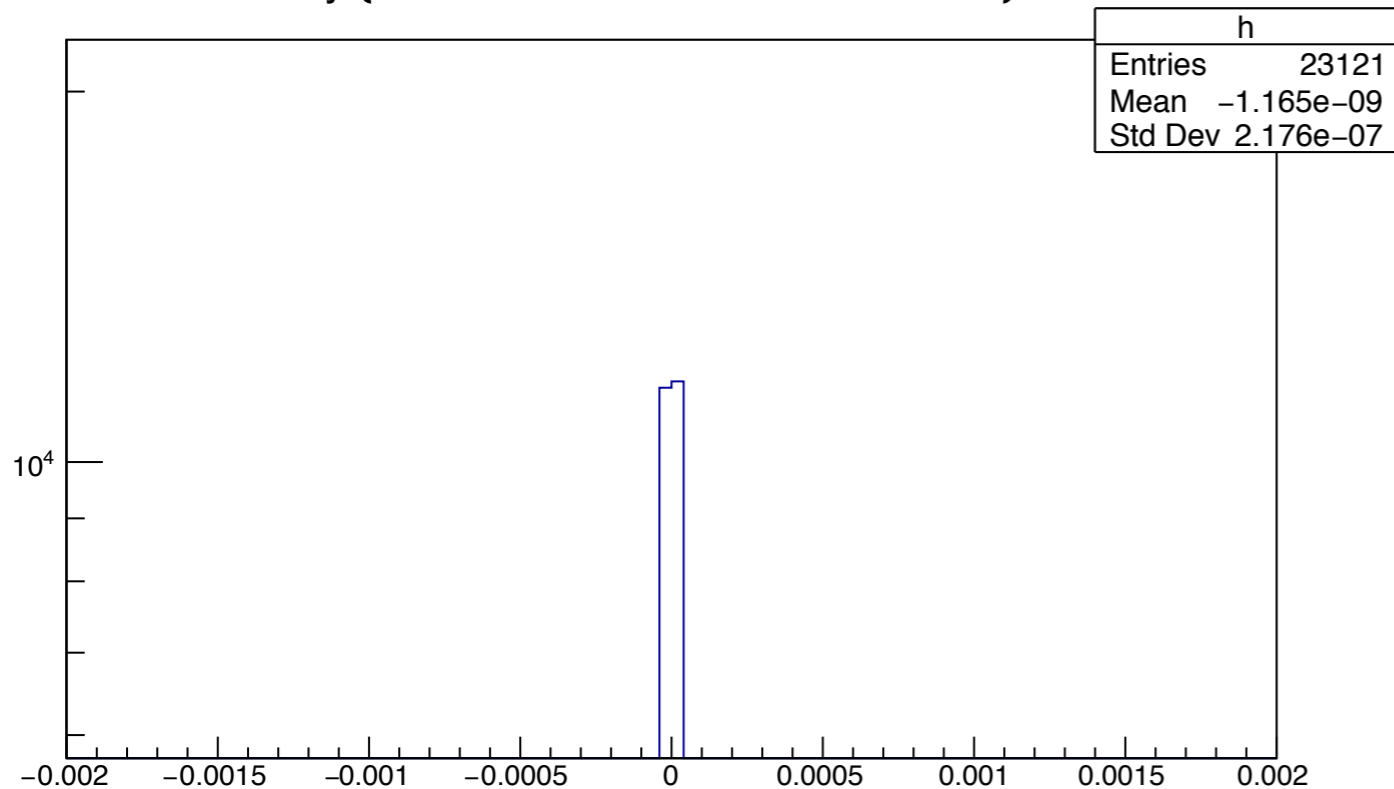
(same as “test”)

Primary vertex y position

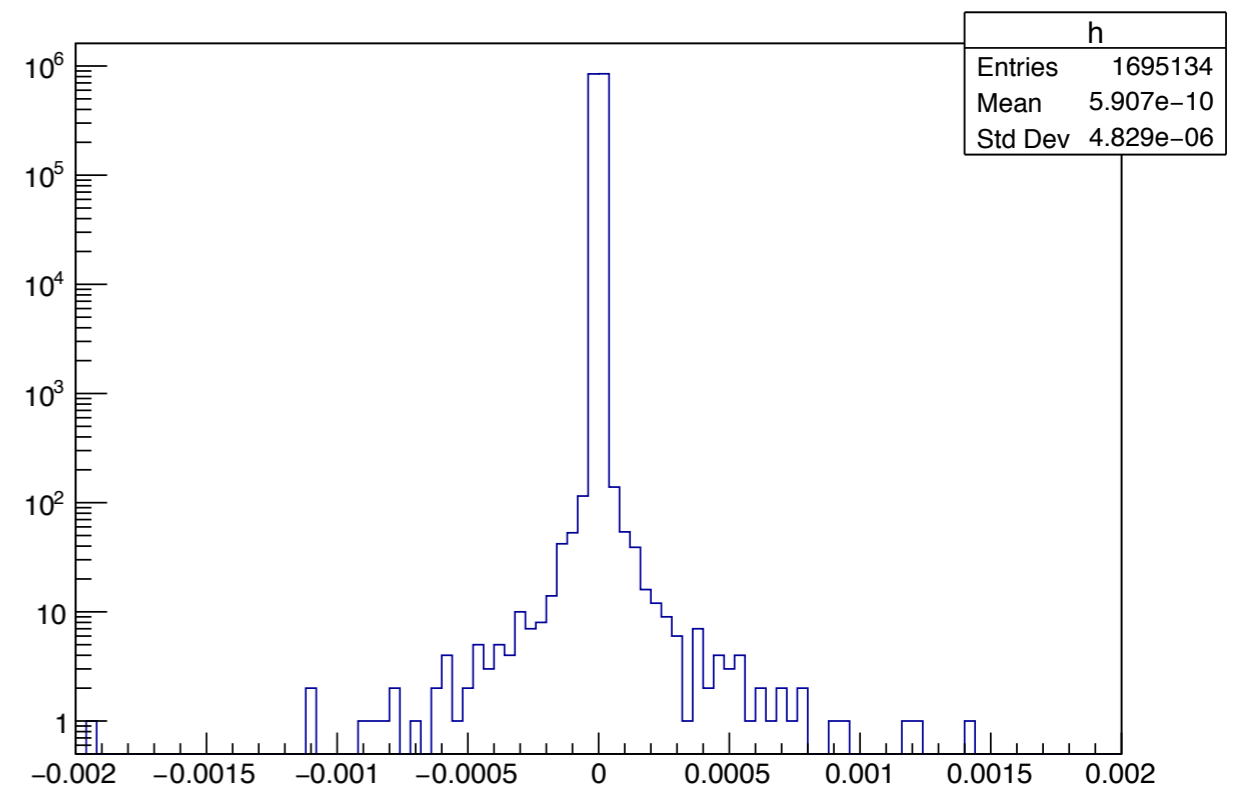
DBD sample with recent vertexing (True value is 0)

with constraint
at 0 with
 $\sigma=5.7\text{nm}$

y {ntrk==2&&mass<100&&mass>80}



y



2f_z_l sample used.

of vertex track = 2,

80 < vertex mass < 100 required.

Error 10* σ

Error 100

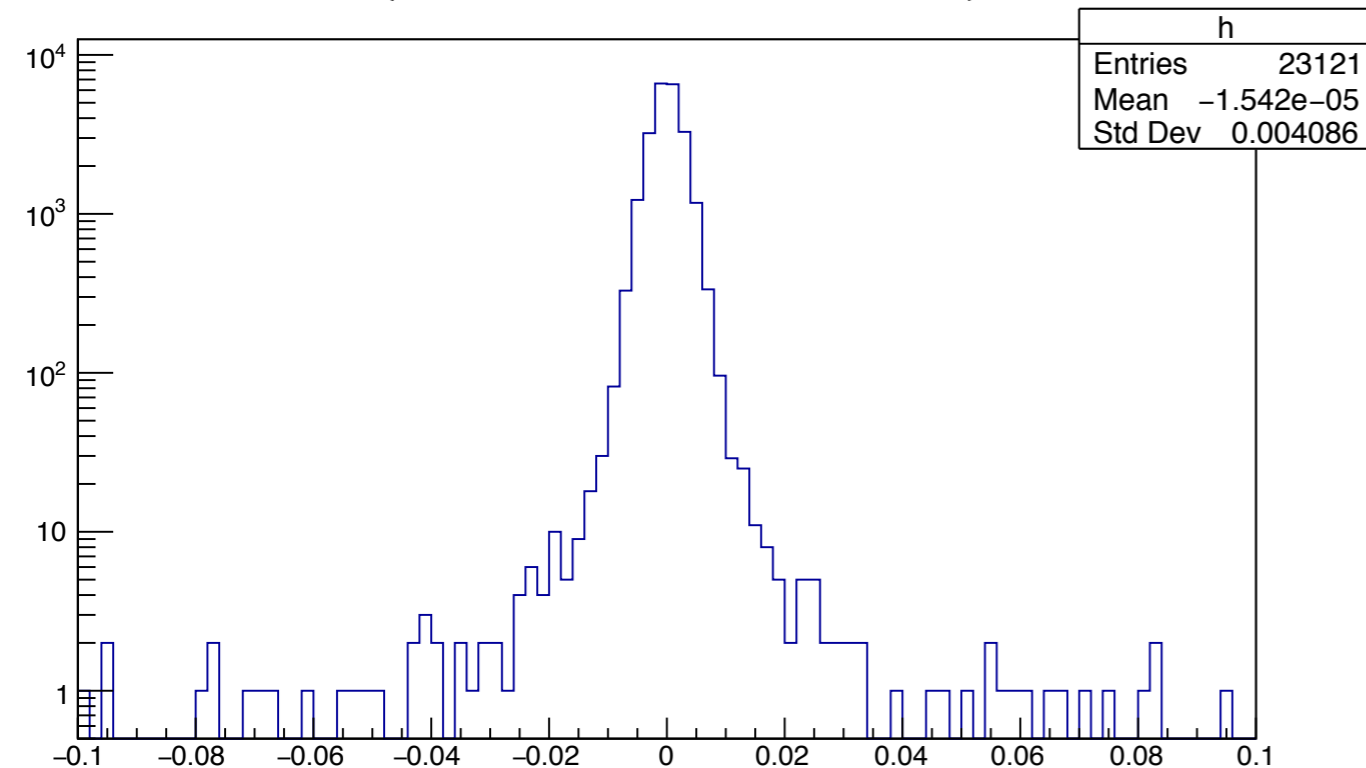
(same as “test”)

Primary vertex z position

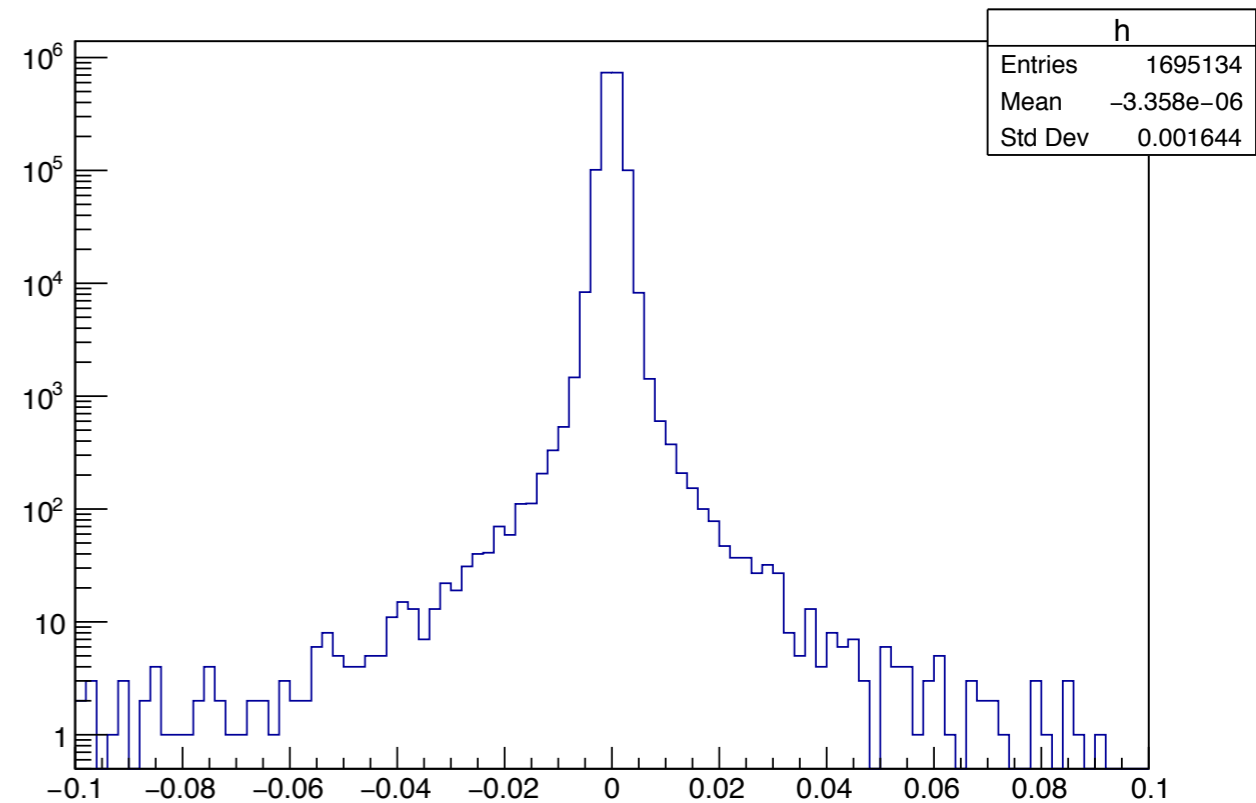
DBD sample with recent vertexing (True value is 0)

with constraint
at 0 with
 $\sigma=91.3\mu\text{m}$

z {ntrk==2&&mass<100&&mass>80}



z



2f_z_l sample used.

of vertex track = 2,

80 < vertex mass < 100 required.

Error 10* σ

Error 100

(same as “test”)

**I have checked the codes if this error affects the secondary vertex finding,
and I have realized that the secondary vertex finding also USE the same error at some point. This is not what I expected.**

If we need to change the error e.g. $10 * \sigma_{\text{beamconstraint}}$ we need to modify the code more than I expected. I think the modification should be carefully done by real experts.

The following modification was made assuming the error does not affect secondary vertex finding.

3files : [geometry.cc](#), [geometry.h](#), [VertexFitterSimple.h](#)

<https://github.com/lcfiplus/LCFIPlus/compare/master...ryonamin:dev20180420>