Checking new test sample from vertexing aspects

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General Remarks

❖ **Motivation**

Validate new test samples by looking at variables related to vertexing

❖ **Identical LCFIPlus used for comparison**

To compare samples themselvs

Differences are expected to come from PFO parameters (if same beam spot constraint is used)

❖ **Identical process used for comparison**

$\mu\,\mu$ H process

Samples Used

New test sample
250GeV, w/ IP smearing

DBD sample
250GeV, w/o IP smearing

IDR sample
500GeV, w/ IP smearing

❖ **New test sample (250 GeV)**

rv02-01.sv02-01.mILD_l5_o1_v02_nobg.E250-SetA.I401006.Pe2e2h.eL.pR.n000.d_dstm_14717_X.slcio

❖ **"DBD" sample (250 GeV, w/o IP smearing)**

rv01-16-p10_250.sv01-14-01-p00.mILD_o1_v05.E250-TDR_ws.I106479.Pe2e2h.eL.pR-X-DST.slcio
Reprocess the sample with SetA beam spot constraint
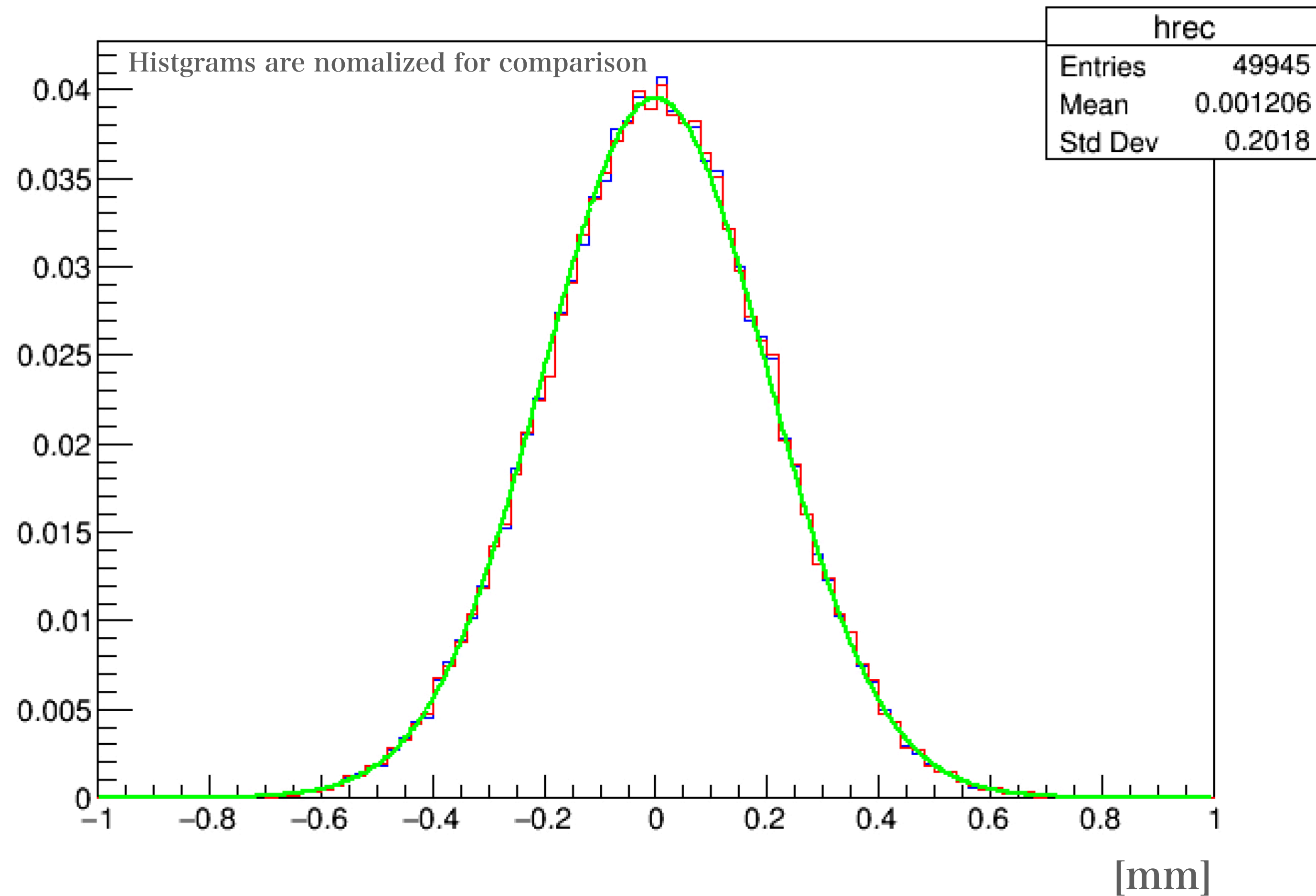
❖ **"IDR" sample (500 GeV, w/ IP smearing)**

rv02-00-01.sv02-00-01.mILD_l5_o1_v02.E500-TDR_ws.I106519.Pe2e2h.eL.pR.n001.d_dstm_10263_0.slcio
Reprocess the sample with SetA beam spot constraint

Primary Vertex
Comparison between Reco and MC

Primary Vertex : z-position

Histgrams are nomalized for comparison

hrec	
Entries	49945
Mean	0.001206
Std Dev	0.2018

New test sample,
Blue : Reconstructed
Red : MC
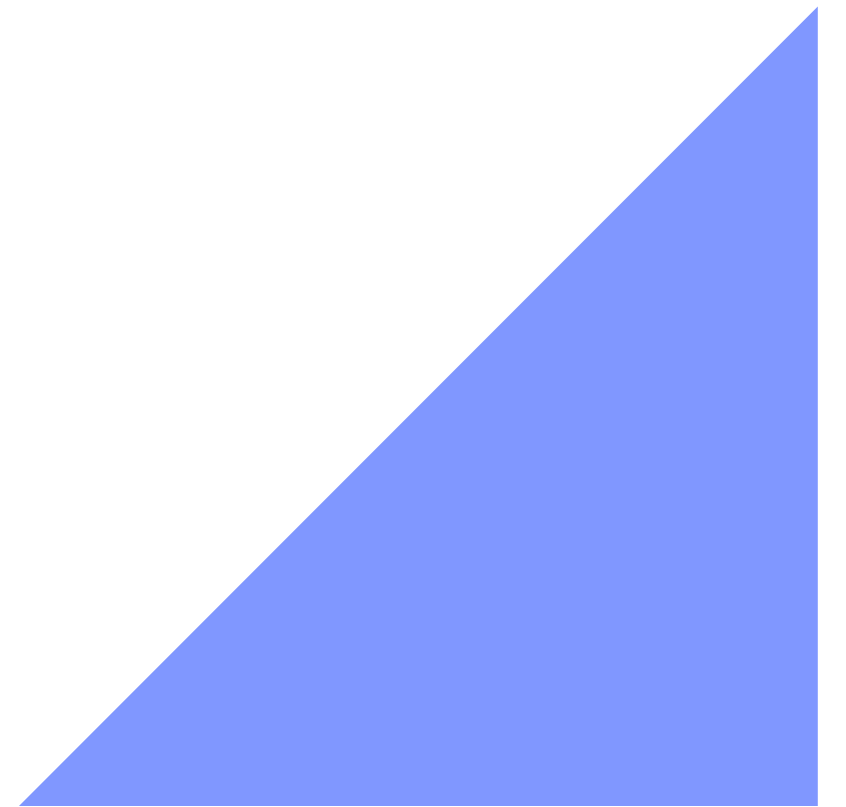Green : Gaussian with sigma of beam spot constraint (202.e-3)

How we constrain vertex position?
A virtual point having central value of 0 and sigma of 202.e-3 is used in vertex fitting.
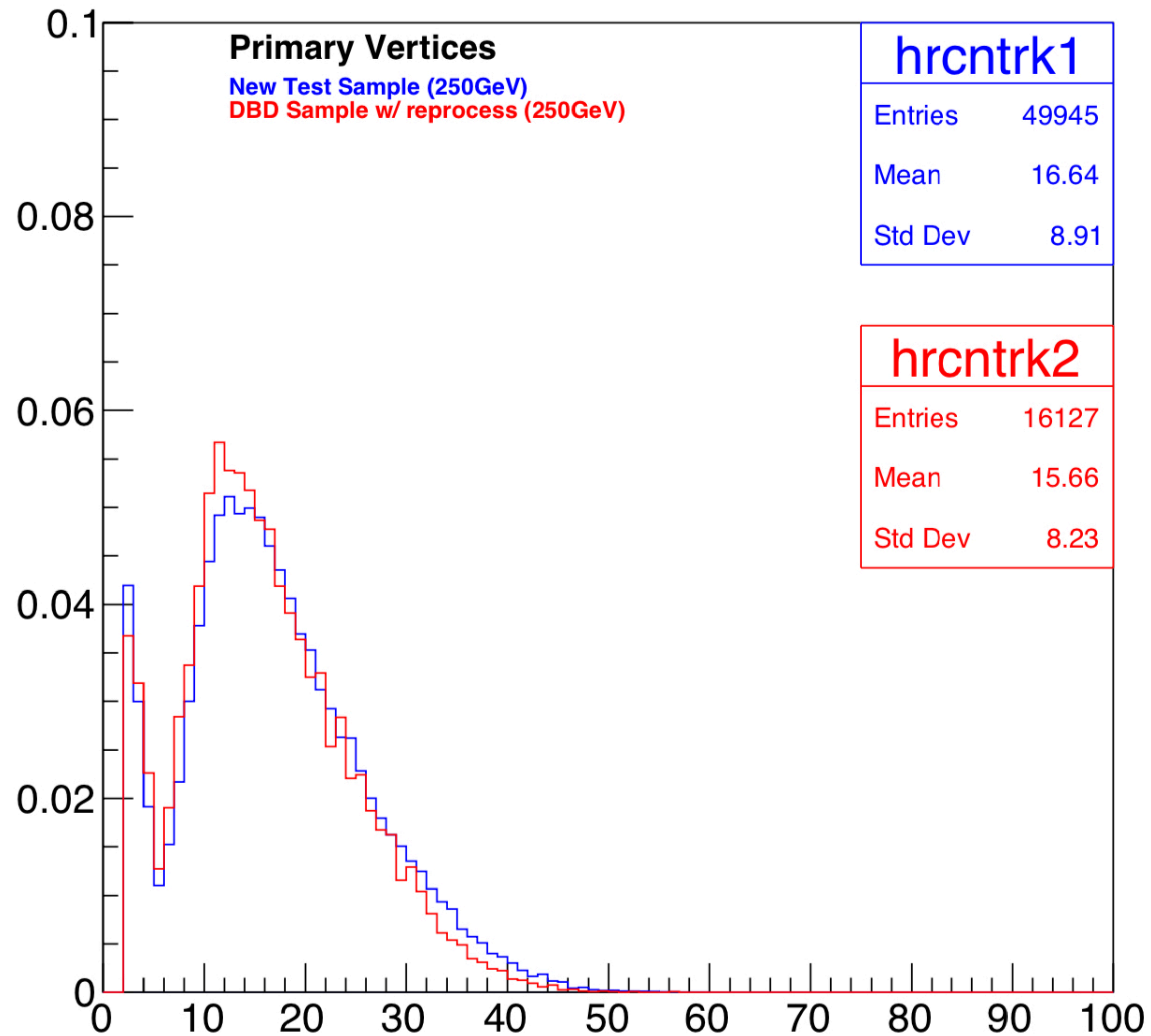
See backup for x and y.

Reco and MC are consistent with beam spot constraint

Primary Vertex

Comparison between New test sample and "DBD" sample (250 GeV, w/o IP smearing)
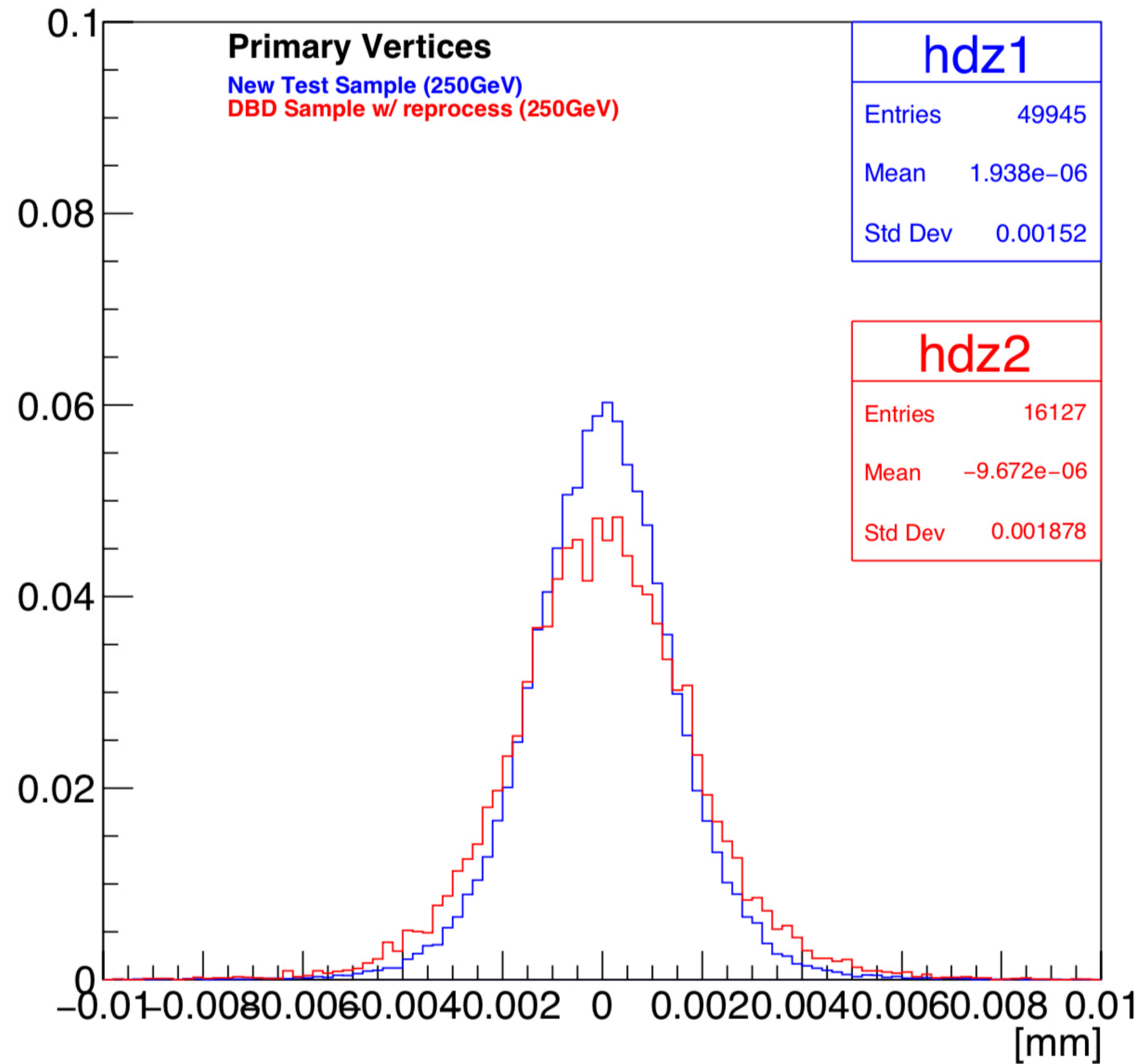
Primary Vertex : # of tracks

Primary Vertices
New Test Sample (250GeV)
DBD Sample w/ reprocess (250GeV)

hrcntrk1	
Entries	49945
Mean	16.64
Std Dev	8.91

hrcntrk2	
Entries	16127
Mean	15.66
Std Dev	8.23

Blue : New test sample
Red : DBD sample w/ reprocess (250 GeV, w/ o IP smearing)

No clear difference

Primary Vertex : z-position residual

= (Rec - MC)

Blue : New test sample
Red : DBD sample w/ reprocess (250 GeV, w/ o IP smearing)
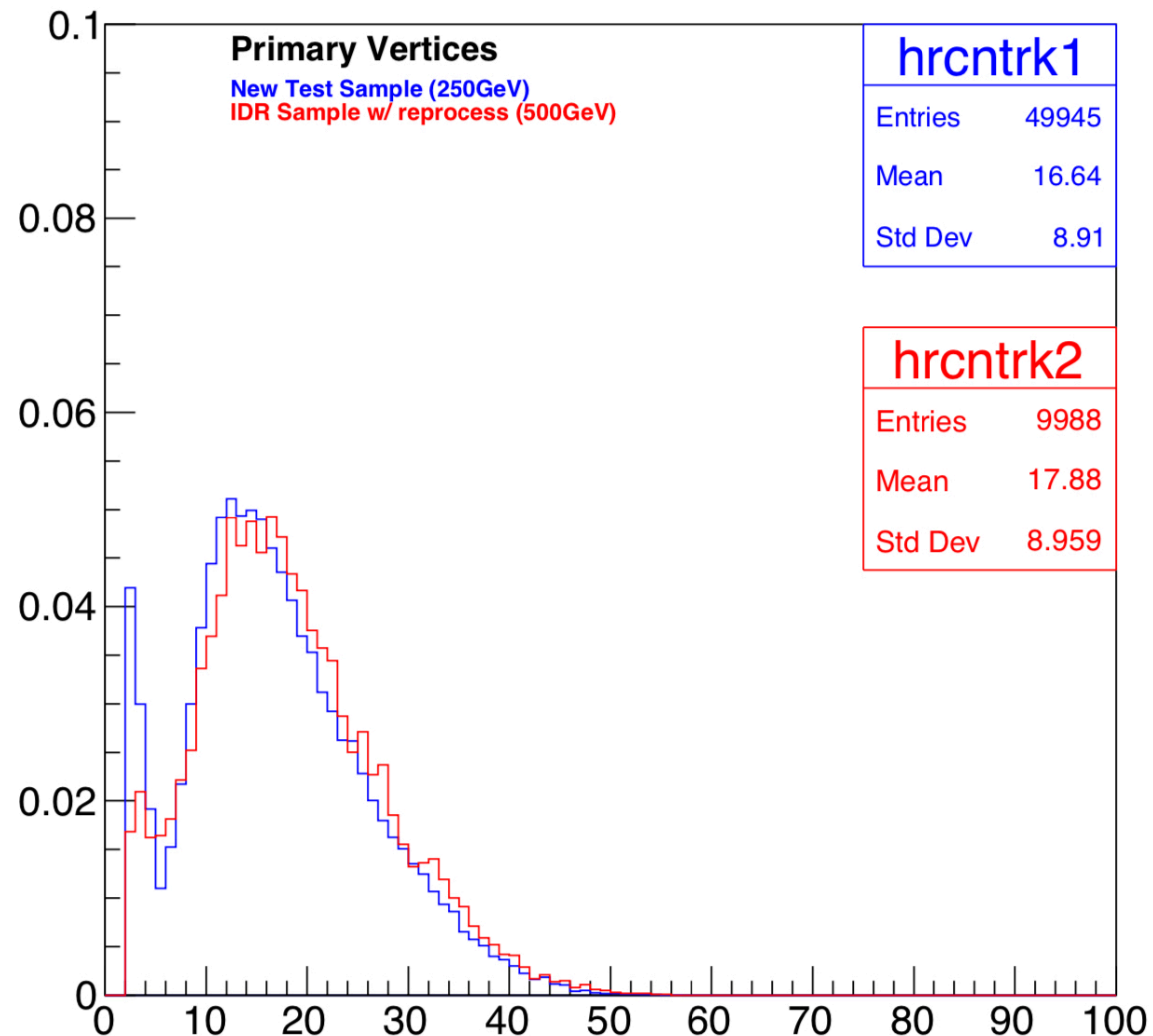
See backup for x and y.

Looks slightly improved

Primary Vertex
Comparison between new test sample and "IDR" sample (500GeV, w/ IP smearing)

Primary Vertex : # of tracks

Primary Vertices
New Test Sample (250GeV)
IDR Sample w/ reprocess (500GeV)

hrcntrk1	
Entries	49945
Mean	16.64
Std Dev	8.91

hrcntrk2	
Entries	9988
Mean	17.88
Std Dev	8.959

Blue : New test sample
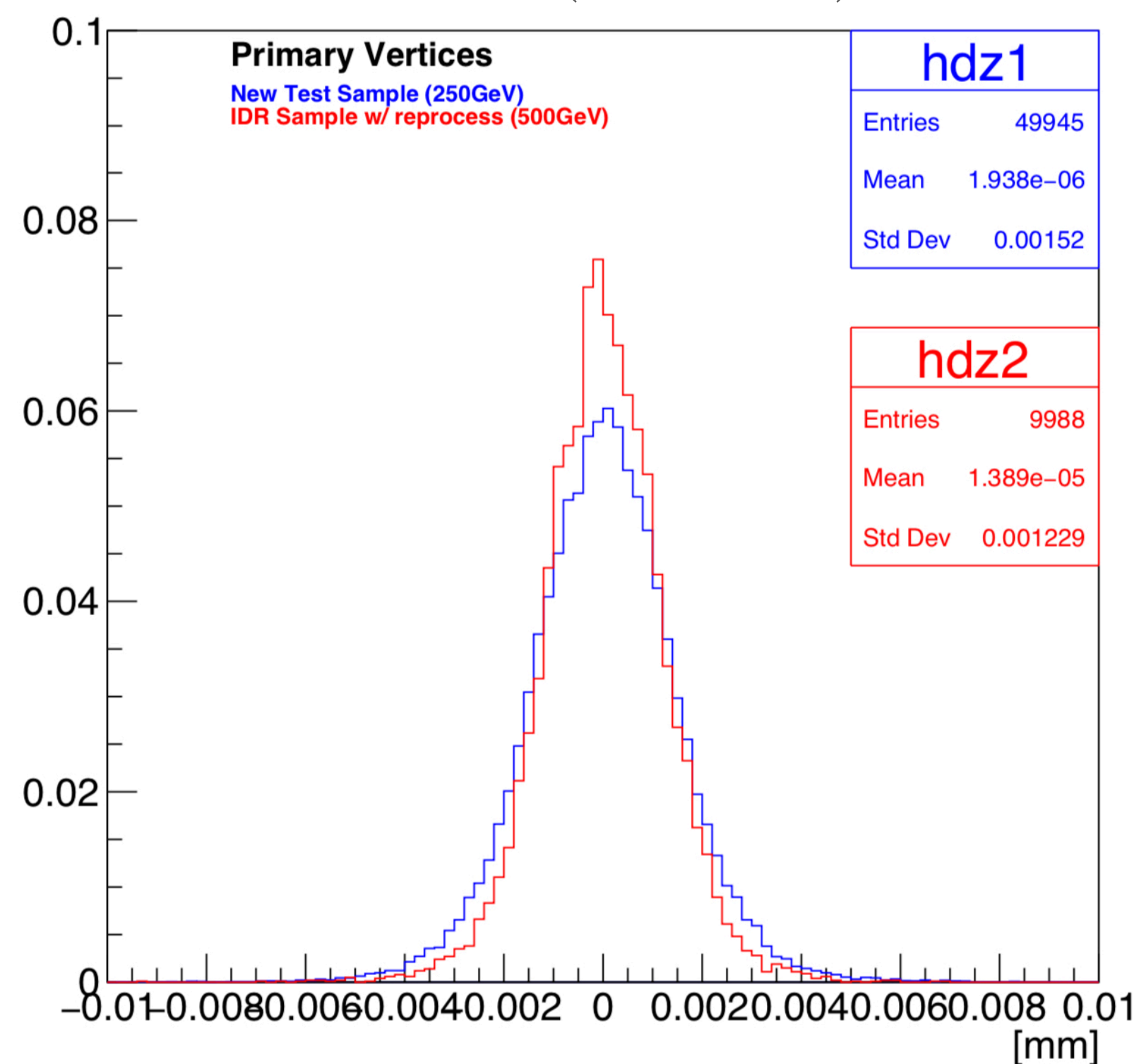**Red** : IDR sample w/ reprocess (500 GeV, w/ IP smearing)

S

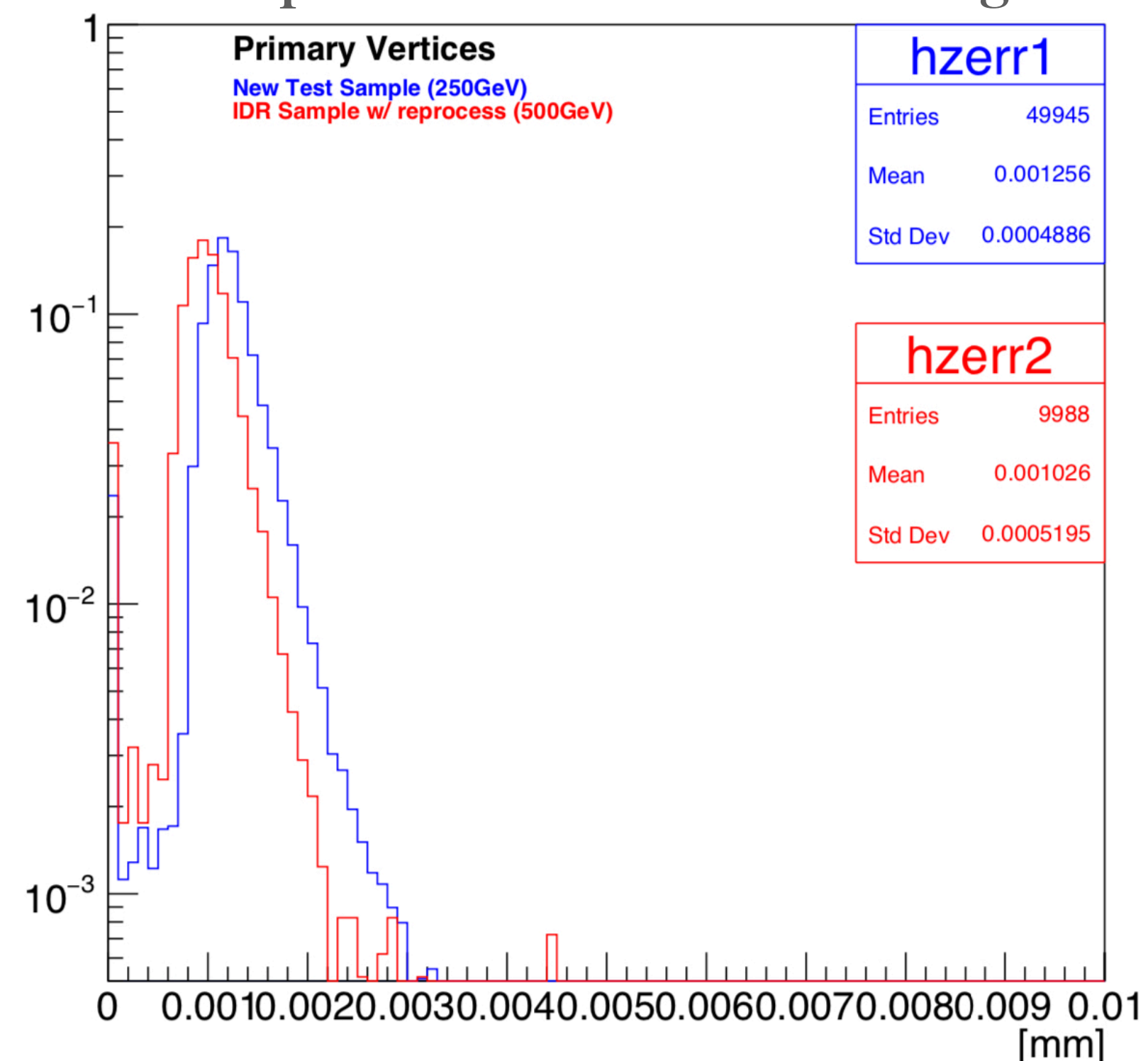# Primary Vertex : z-position residual

Blue : New test sample

Red : IDR sample w/ reprocess (500 GeV, w/ IP smearing)

residual (Rec - MC)
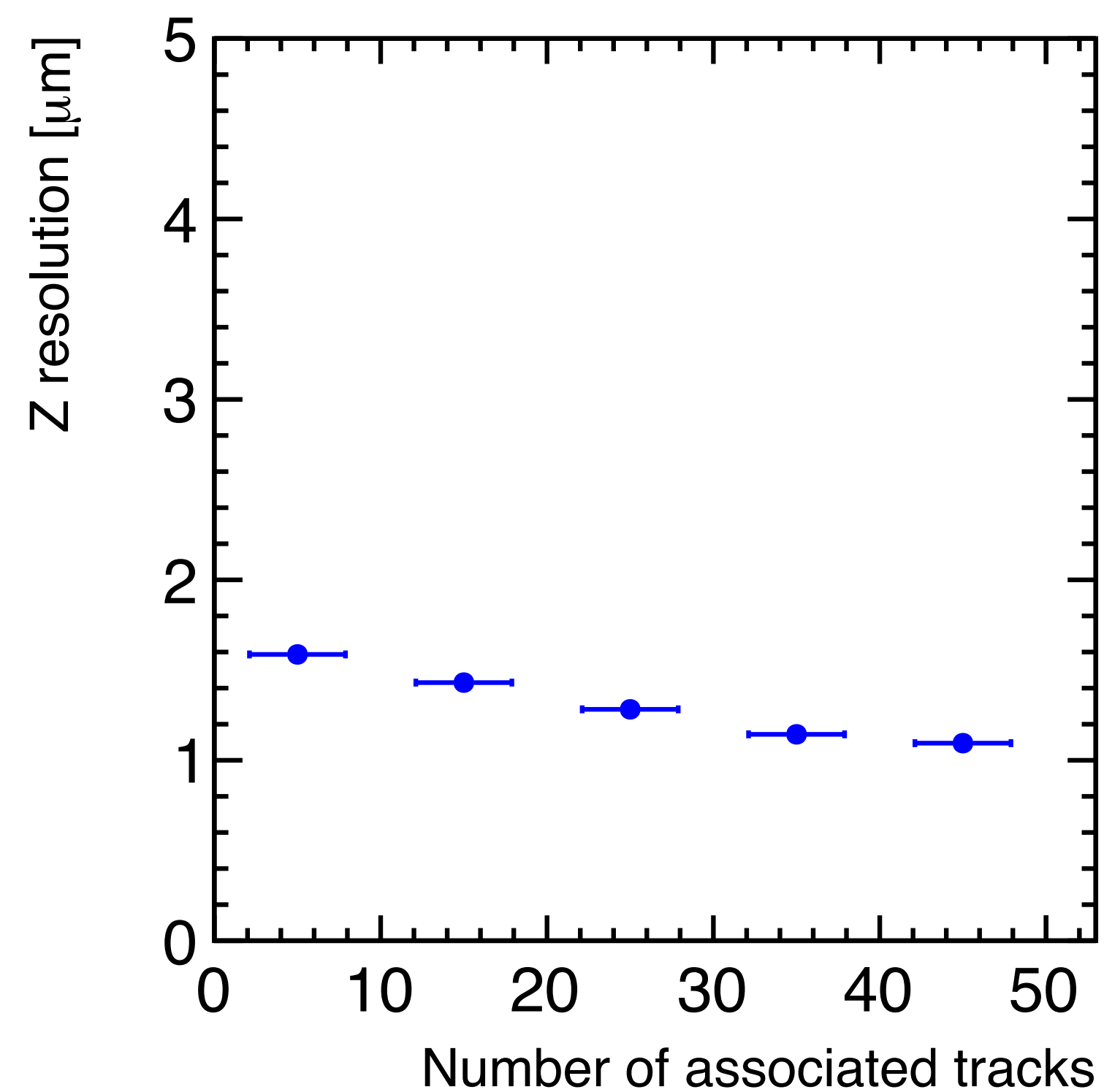
z position error from fitting

New test sample is slightly worse in z-position resolution, probably reflecting track parameter errors.
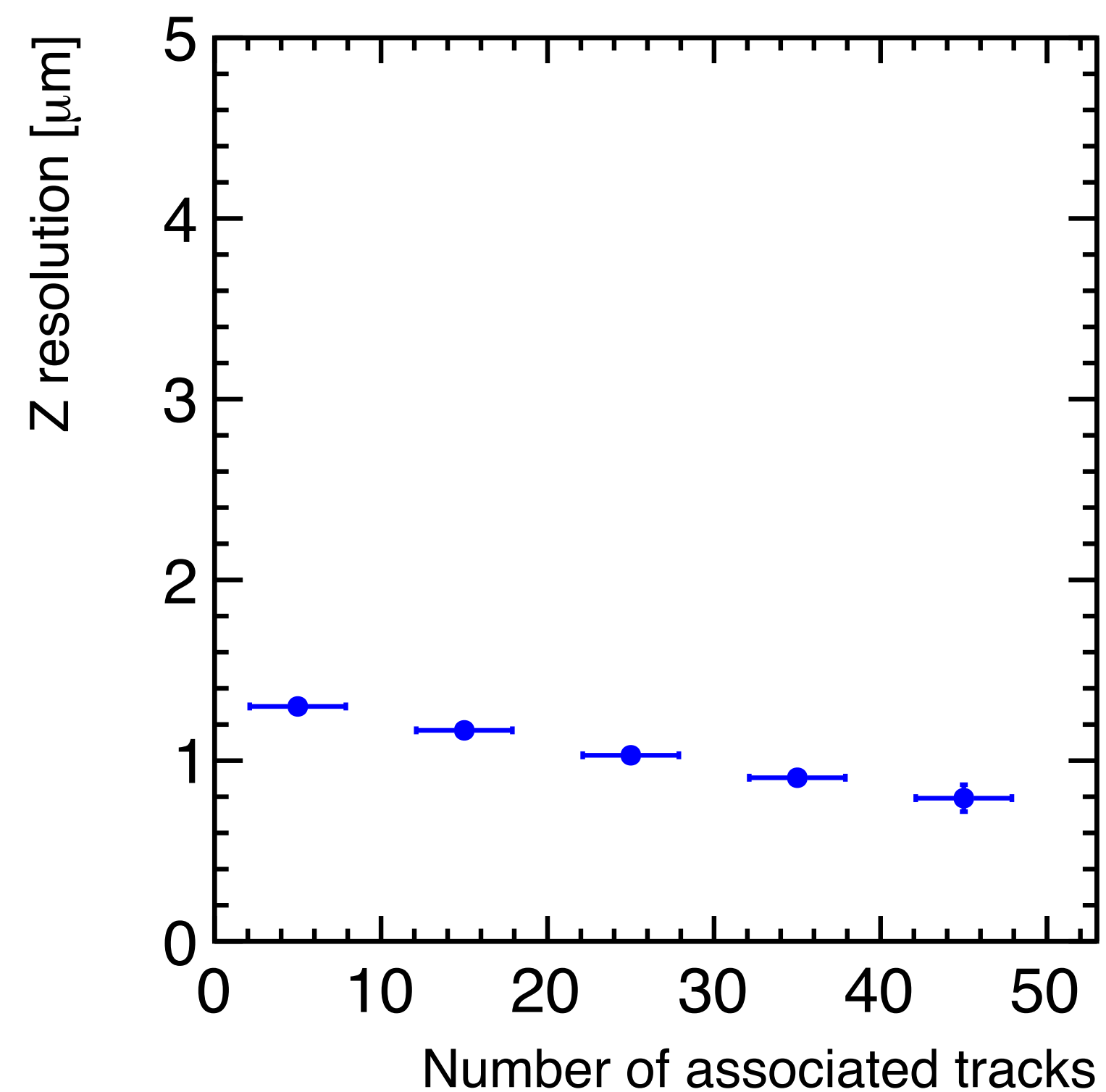
No clear sign of problems

Primary Vertex : z-position resolution vs # of tracks in vtx
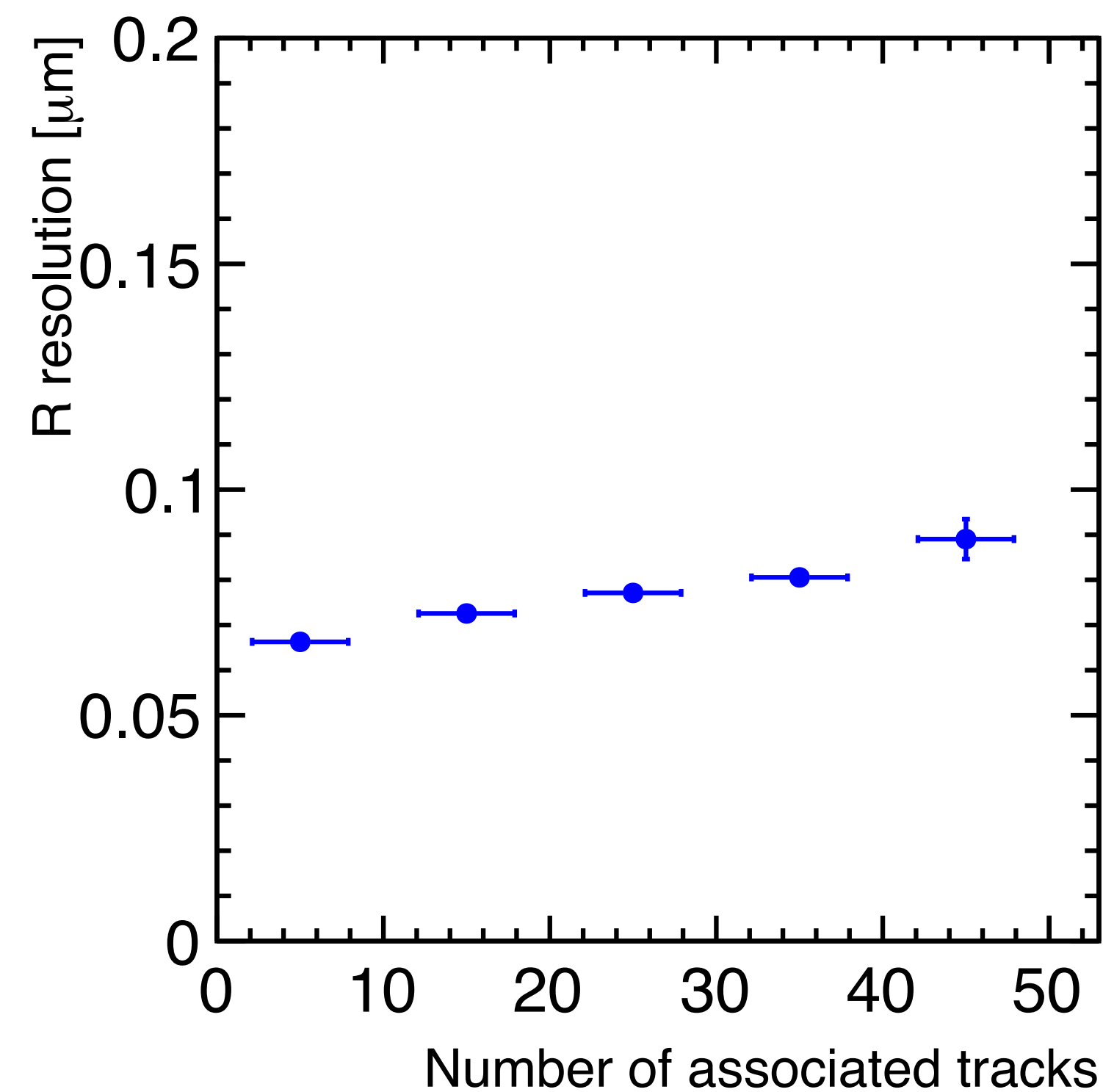
New test sample

IDR sample w/ reprocess
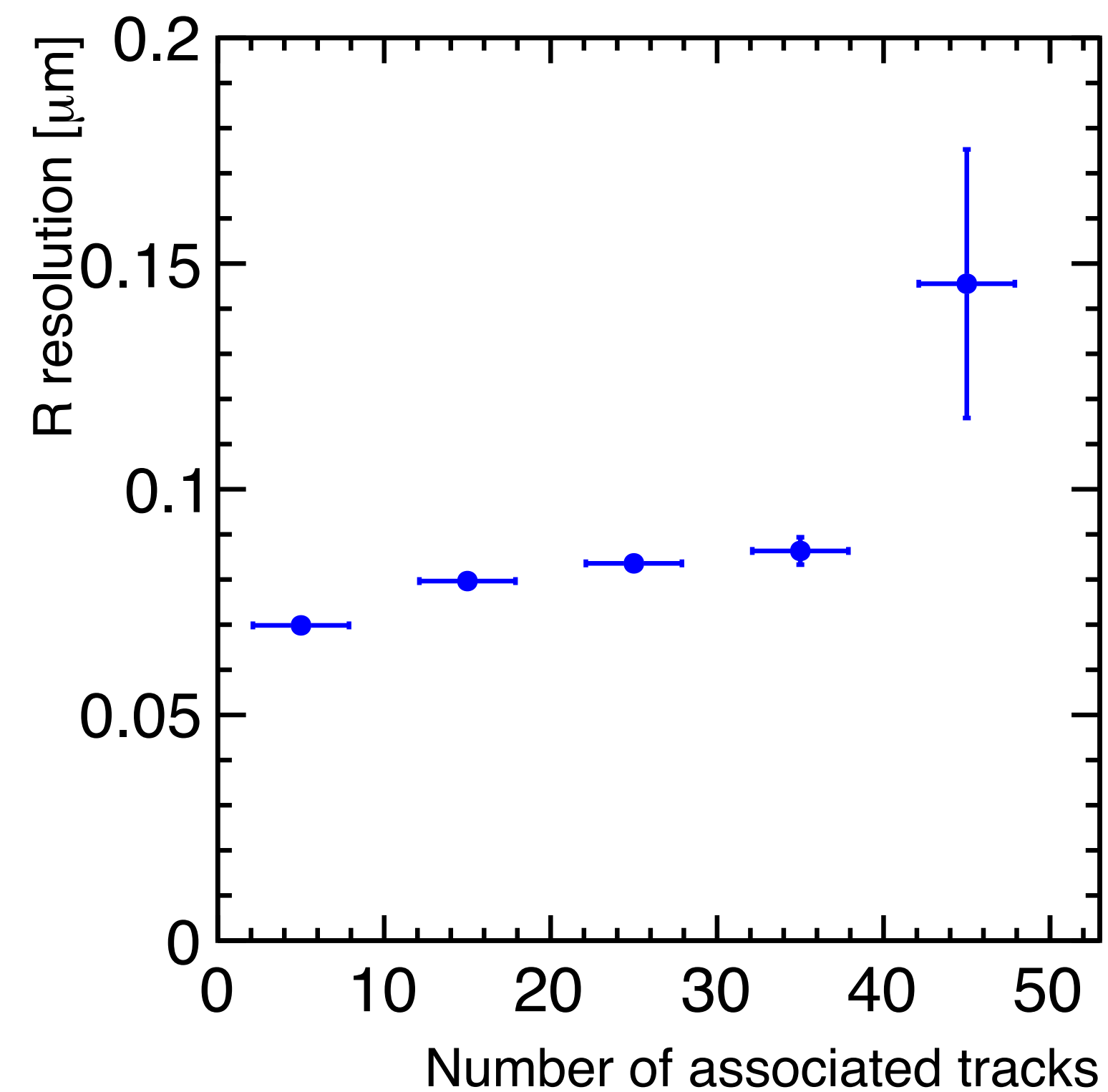

No clear sign of problems

Primary Vertex : r-position resolution vs # of tracks in vtx
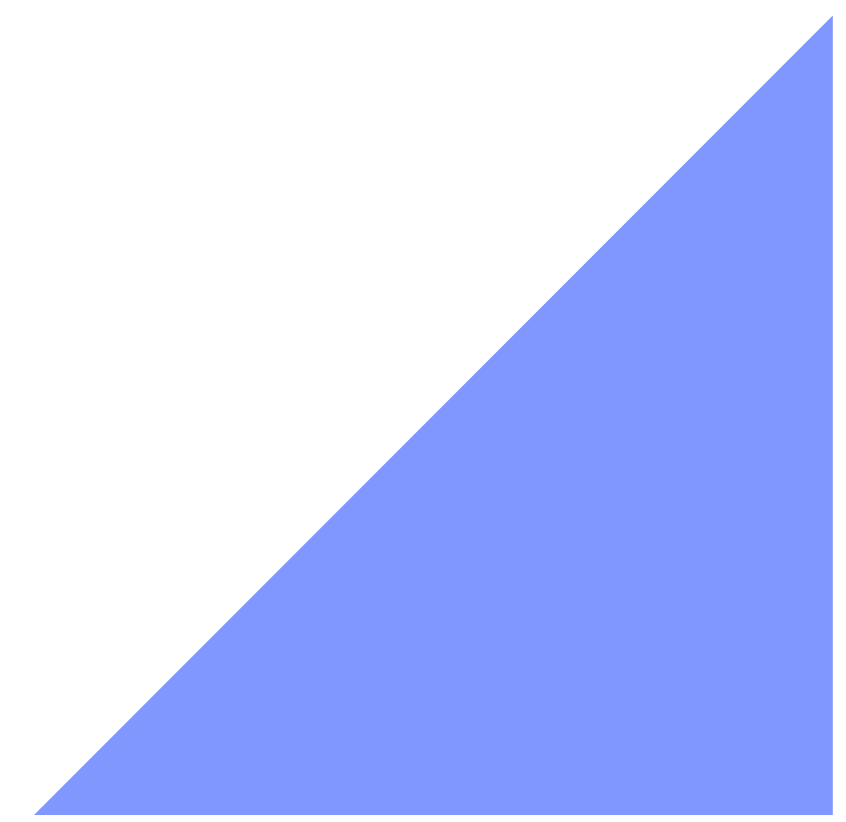
$$r := \sqrt{x^2 + y^2}$$

New test sample

IDR sample w/ reprocess

No clear sign of problems

Secondary Vertex

Comparison between New test sample and "DBD" sample (250 GeV, w/o IP smearing)

Secondary Vertex : x-position

Secondary Vertices
New Test Sample (250GeV)
DBD Sample w/ reprocess (250GeV)

hrcx1	
Entries	72301
Mean	0.01902
Std Dev	3.086

hrcx2	
Entries	22741
Mean	0.03084
Std Dev	3.101

[mm]

Blue : New test sample
Red : DBD sample w/ reprocess (250 GeV, w/ o IP smearing)

See backup for y and z.

No clear difference

Secondary Vertex : Invariant mass of charged tracks
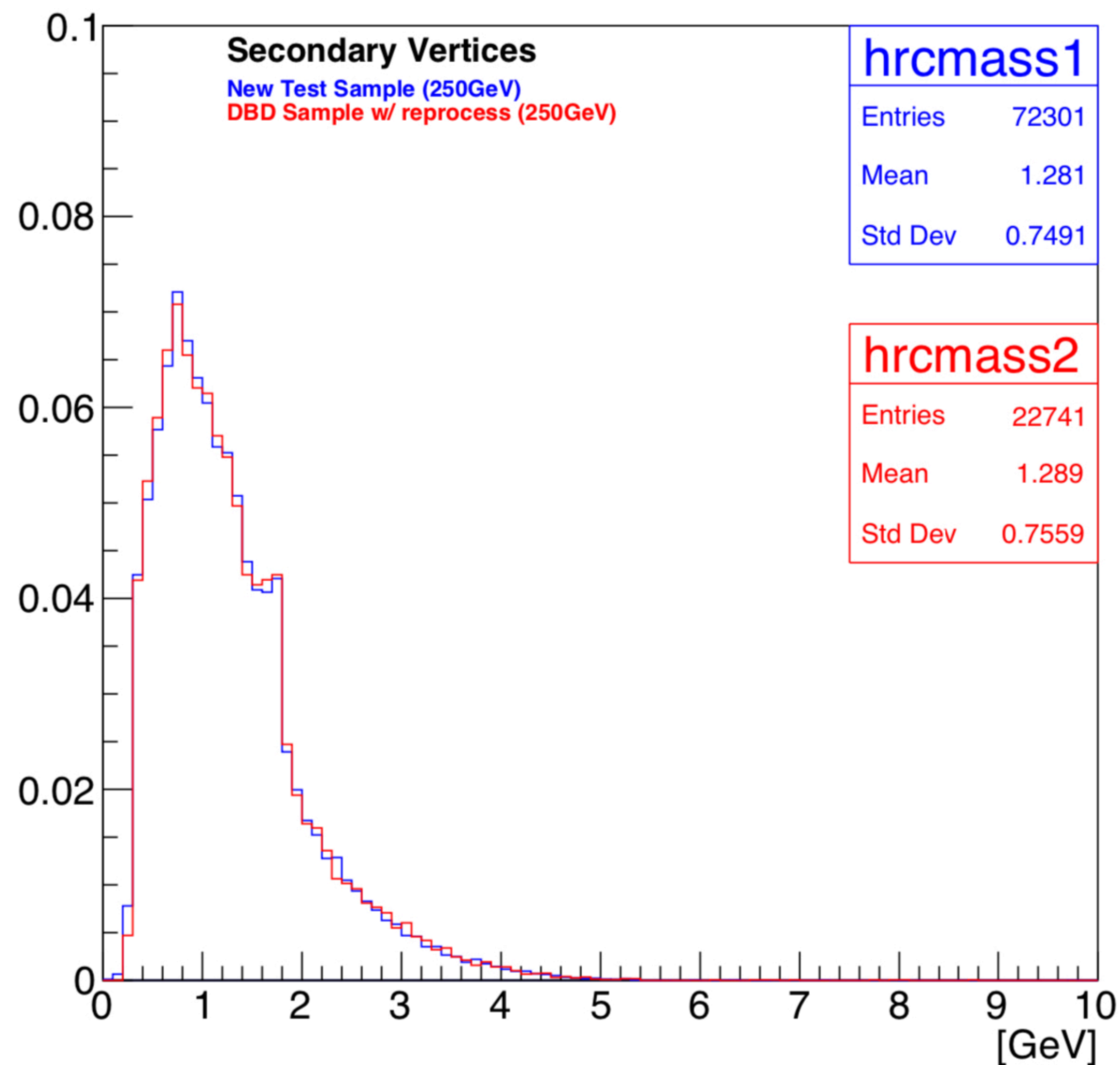

Secondary Vertices
New Test Sample (250GeV)
DBD Sample w/ reprocess (250GeV)

hrcmass1	
Entries	72301
Mean	1.281
Std Dev	0.7491

hrcmass2	
Entries	22741
Mean	1.289
Std Dev	0.7559

[GeV]
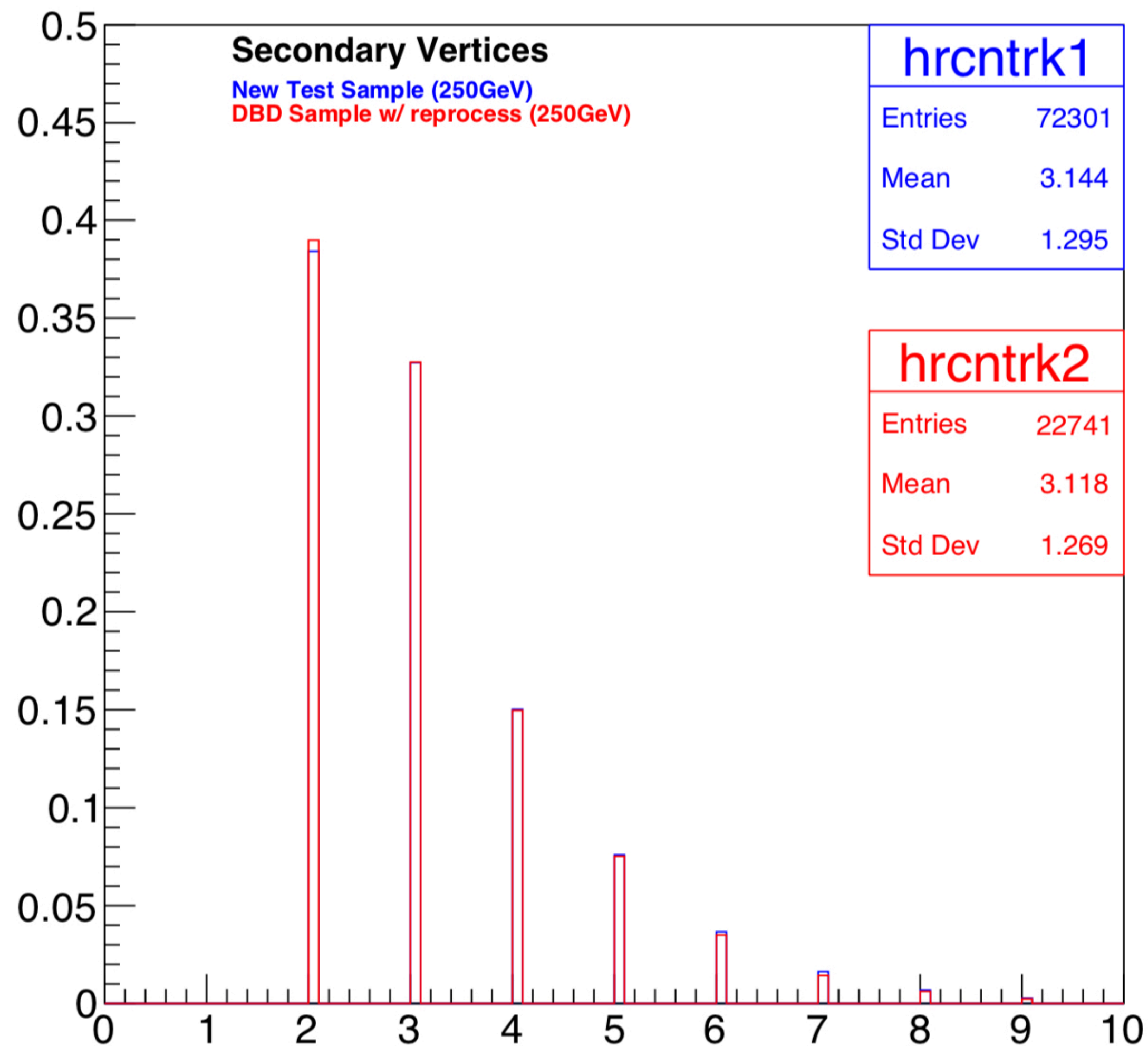
Blue : New test sample
Red : DBD sample w/ reprocess (250 GeV, w/o IP smearing)

No clear difference

Secondary Vertex : # of tracks

Secondary Vertices
New Test Sample (250GeV)
DBD Sample w/ reprocess (250GeV)

hrcntrk1

Entries	72301
Mean	3.144
Std Dev	1.295

hrcntrk2

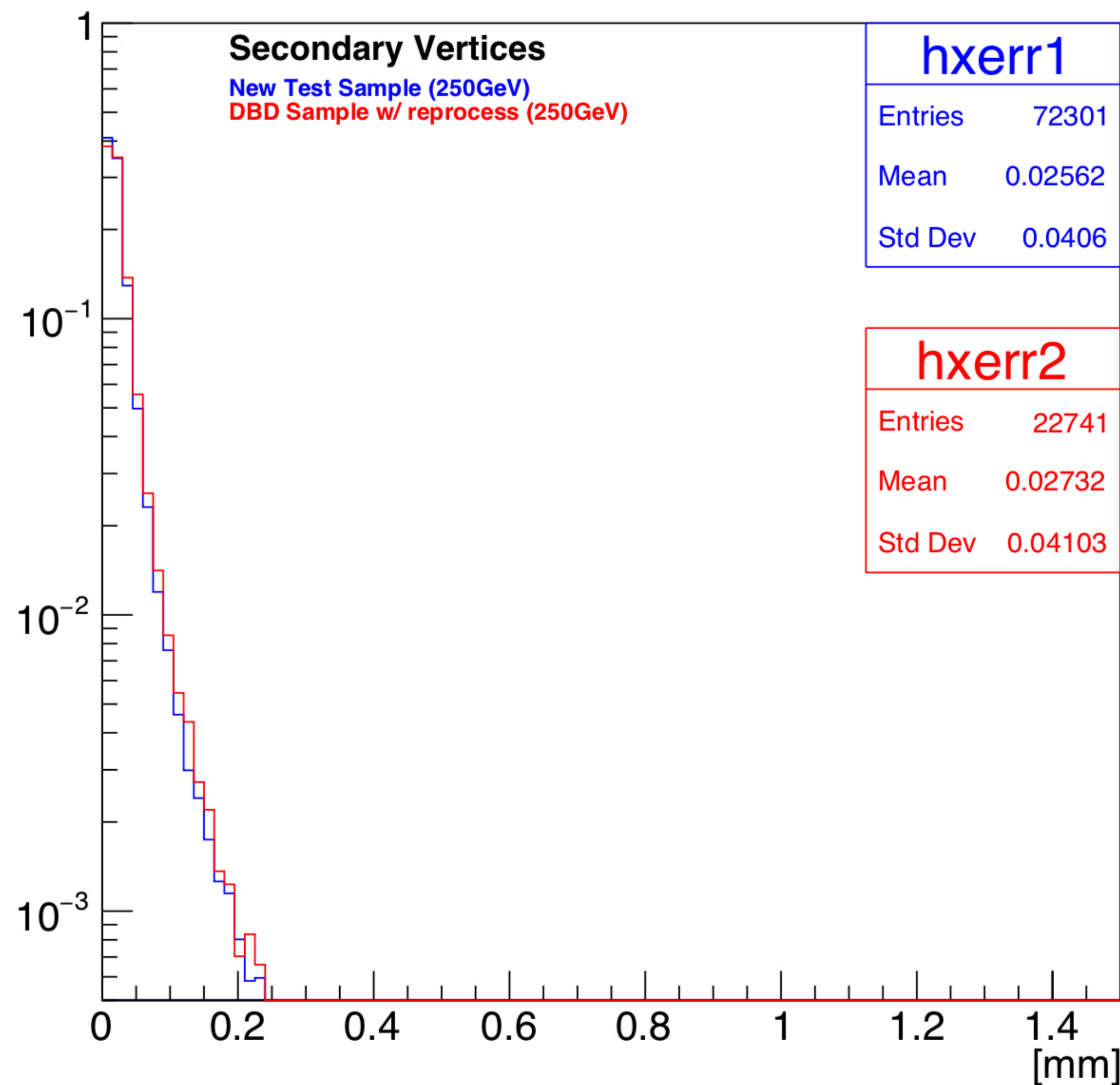| Entries	22741
Mean	3.118
Std Dev	1.269

Blue : New test sample
Red : DBD sample w/ reprocess (250 GeV, w/o IP smearing)

No clear difference

Secondary Vertex : x-position error form vtx fitting

Secondary Vertices
New Test Sample (250GeV)
DBD Sample w/ reprocess (250GeV)

hxerr1	
Entries	72301
Mean	0.02562
Std Dev	0.0406

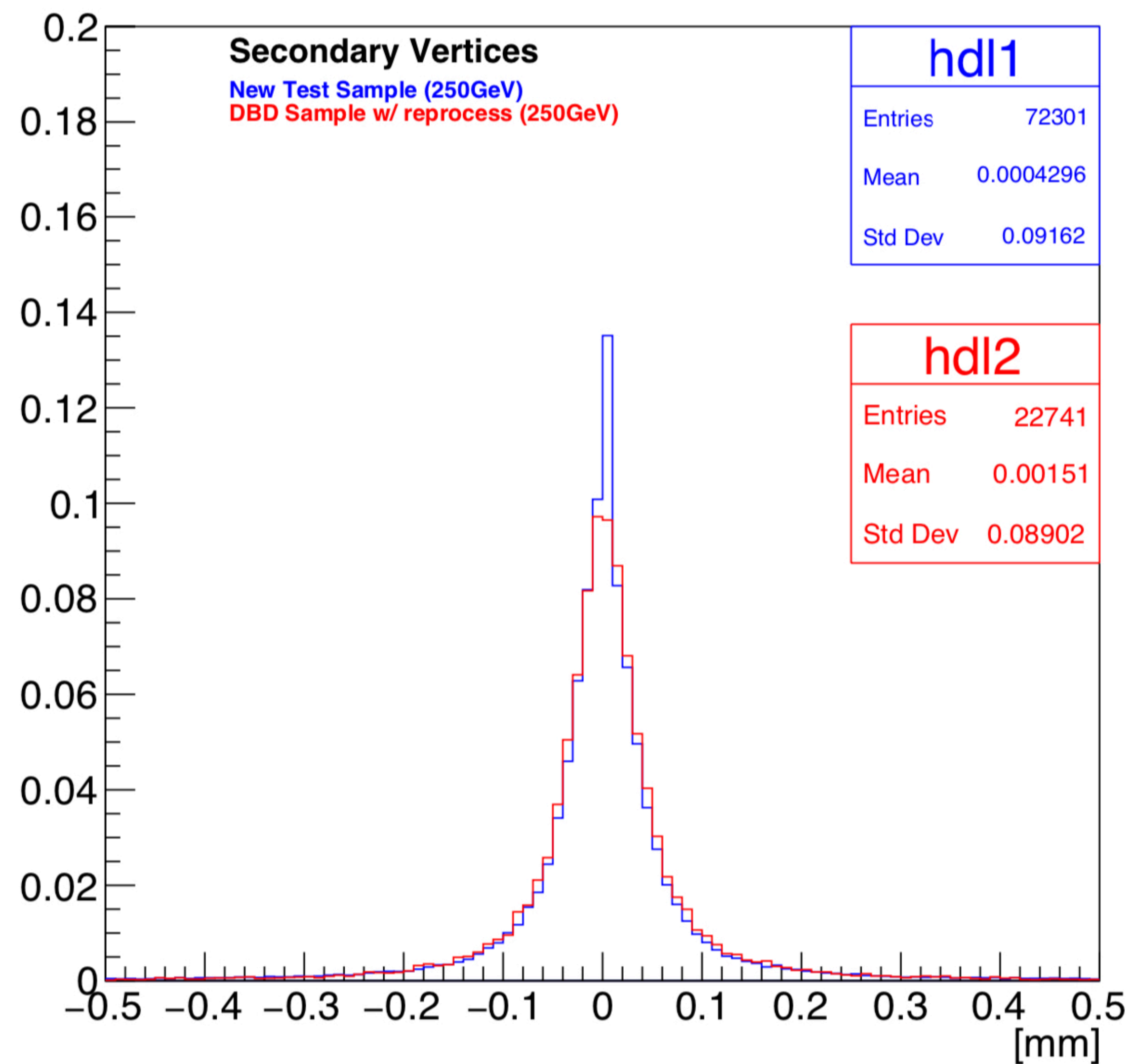| hxerr2	
Entries	22741
Mean	0.02732
Std Dev	0.04103

[mm]

Blue : New test sample
Red : DBD sample w/ reprocess (250 GeV, w/o IP smearing)
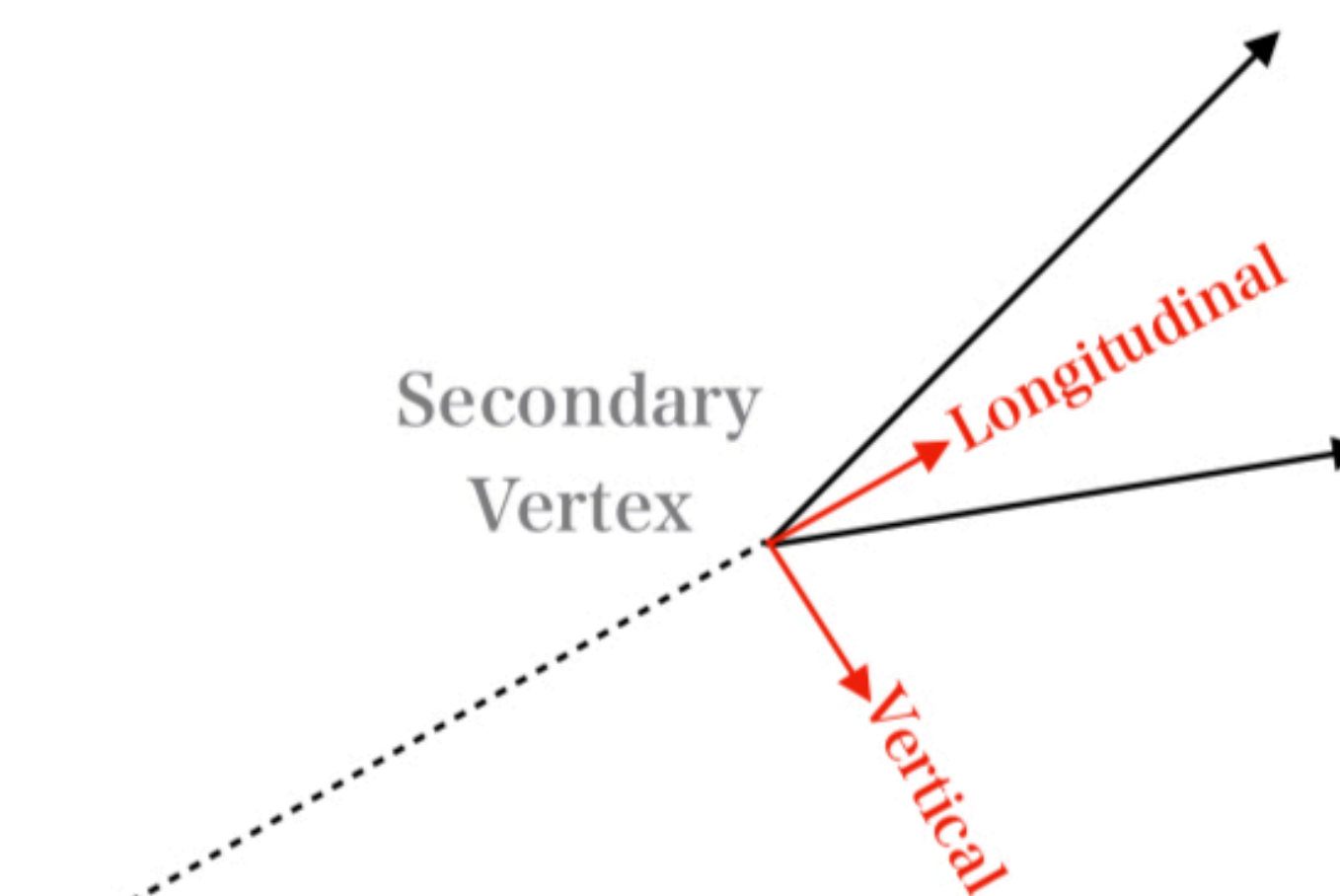
See backup for y and z.

No clear difference

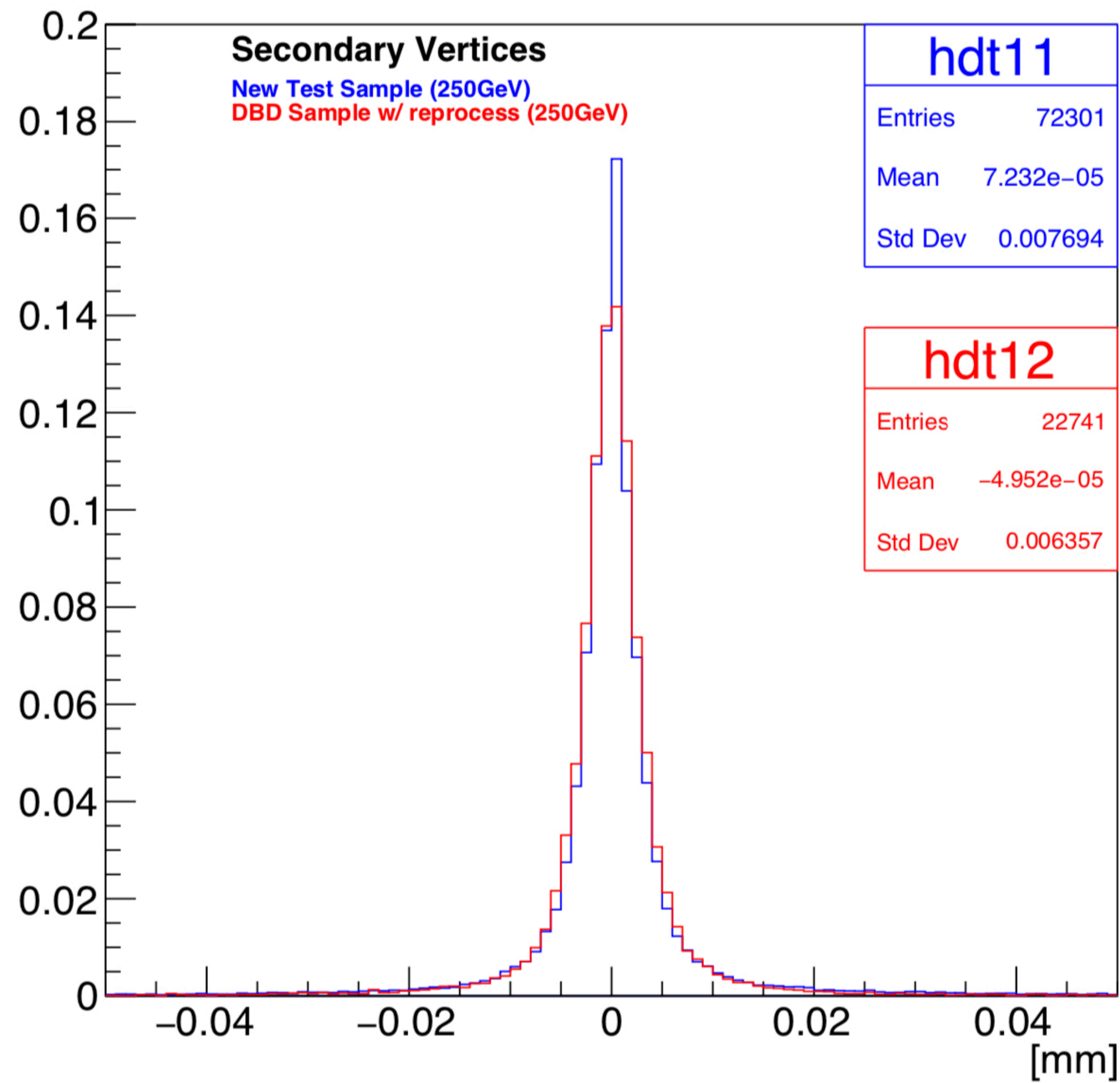# Secondary Vertex : Longitudinal resolution

Blue : New test sample
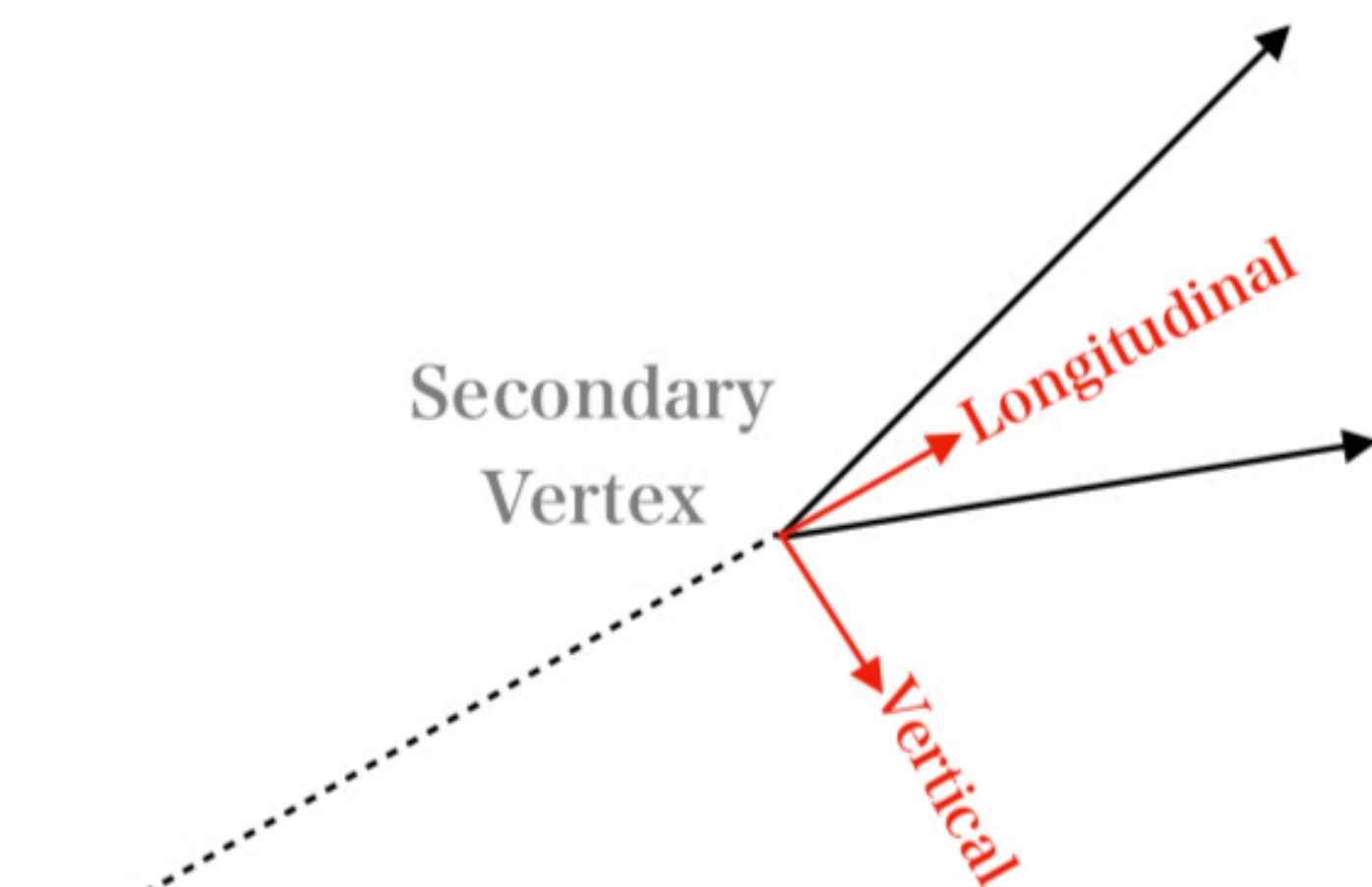Red : DBD sample w/ reprocess (250 GeV, w/ o IP smearing)

Looks slightly improved

Secondary Vertex : Transverse resolution

Secondary Vertices
New Test Sample (250GeV)
DBD Sample w/ reprocess (250GeV)

hdt11	
Entries	72301
Mean	7.232e−05
Std Dev	0.007694

hdt12	
Entries	22741
Mean	−4.952e−05
Std Dev	0.006357

Blue : New test sample
Red : DBD sample w/ reprocess (250 GeV, w/ o IP smearing)

Secondary
Vertex

Longitudinal

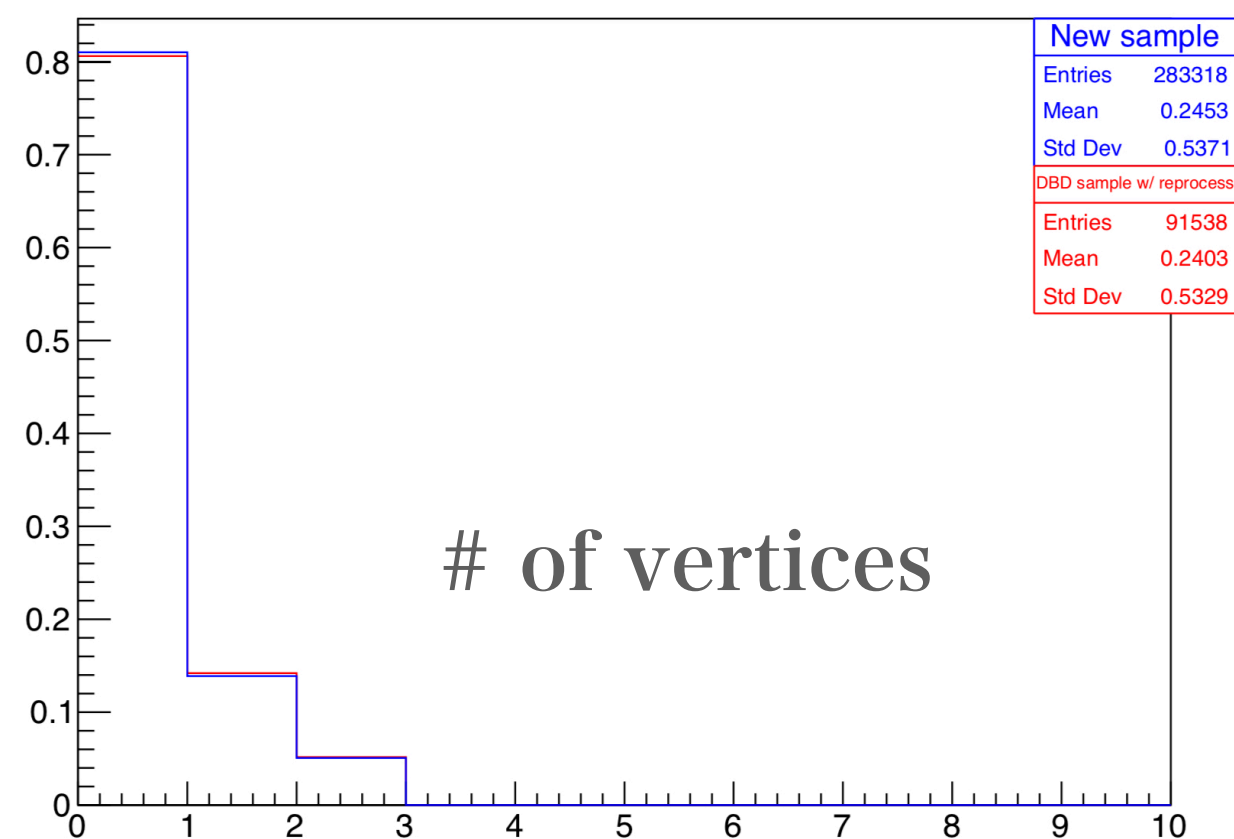Vertical

Looks slightly improved

Input variables for flavour tagging

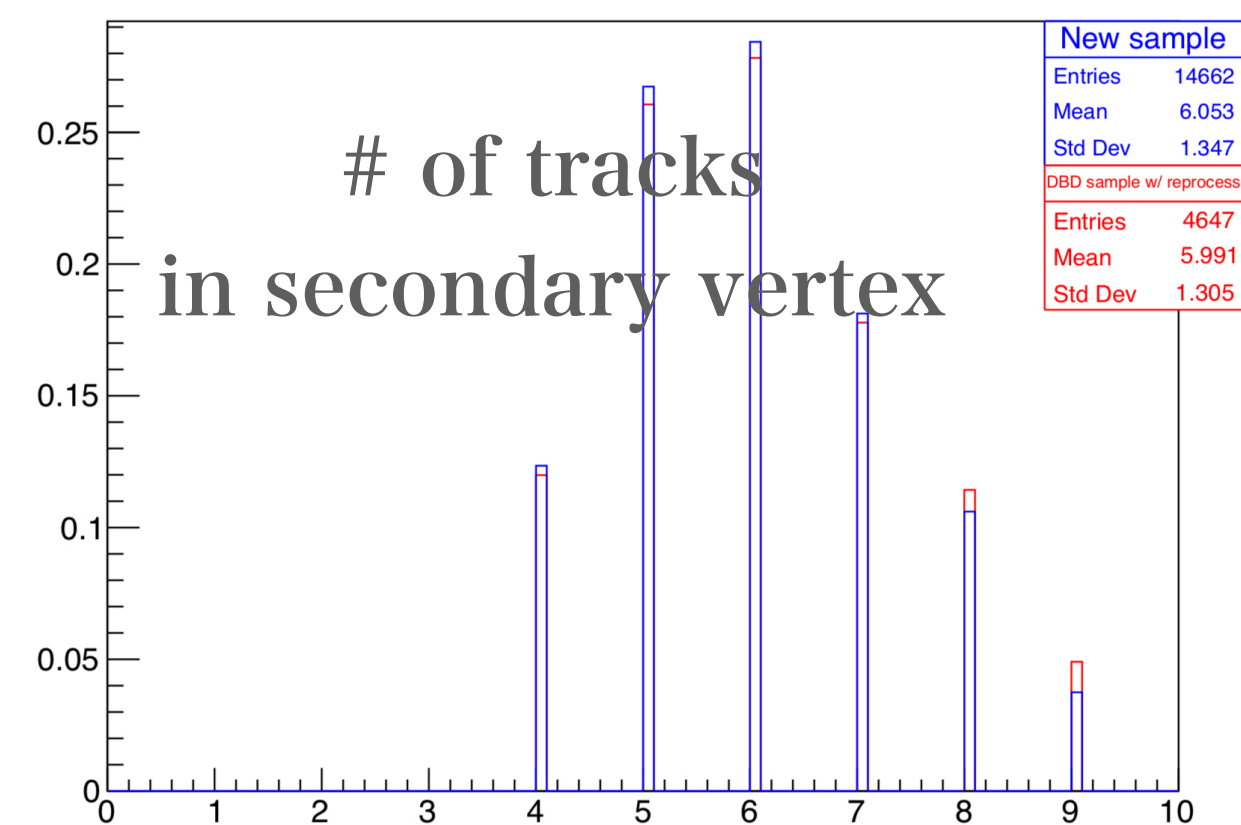## Comparison between New test sample and "DBD" sample (250 GeV, w/o IP smearing)

Examples of input variables for flavor tagging

nvtx, trk1d0sig!=0

# of vertices

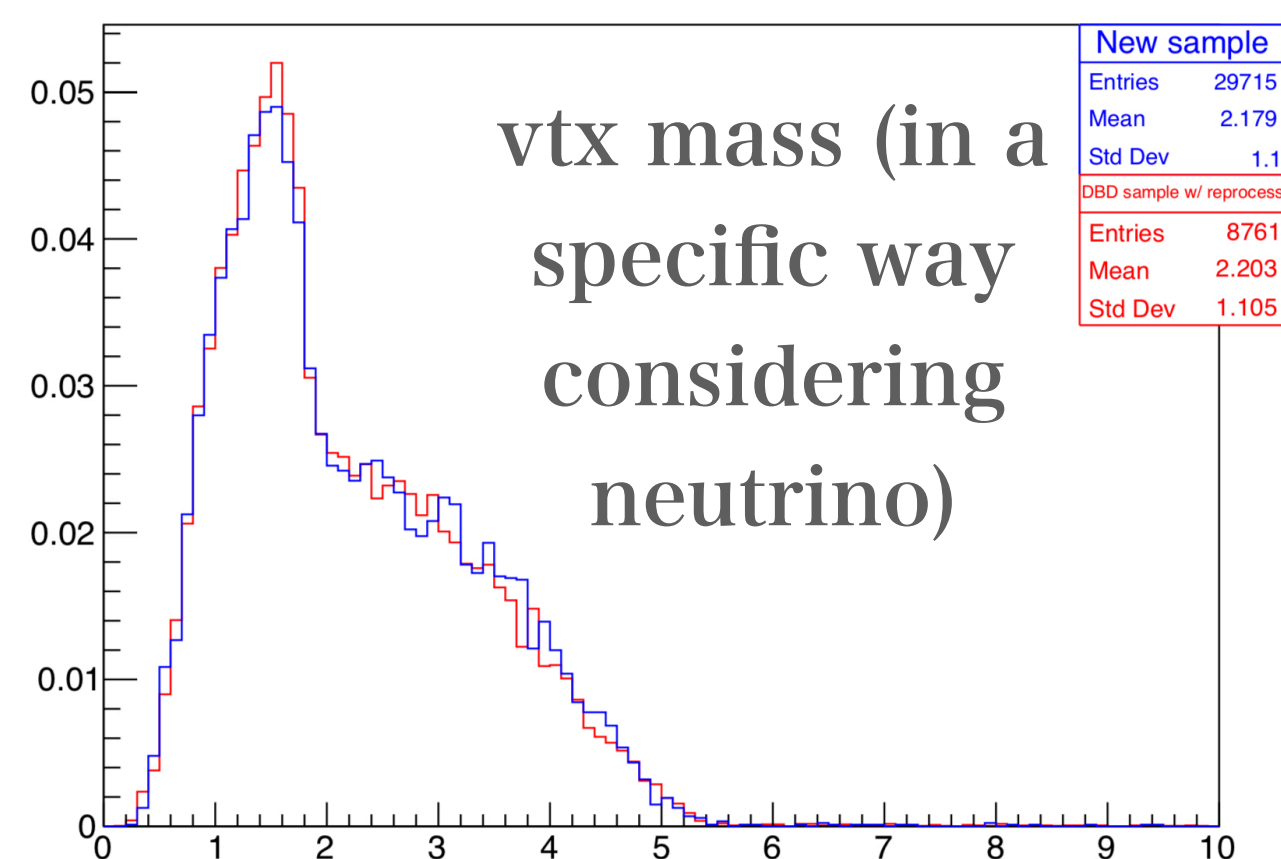vtxmult, nvtx>=2

# of tracks
in secondary vertex

Blue : New test sample
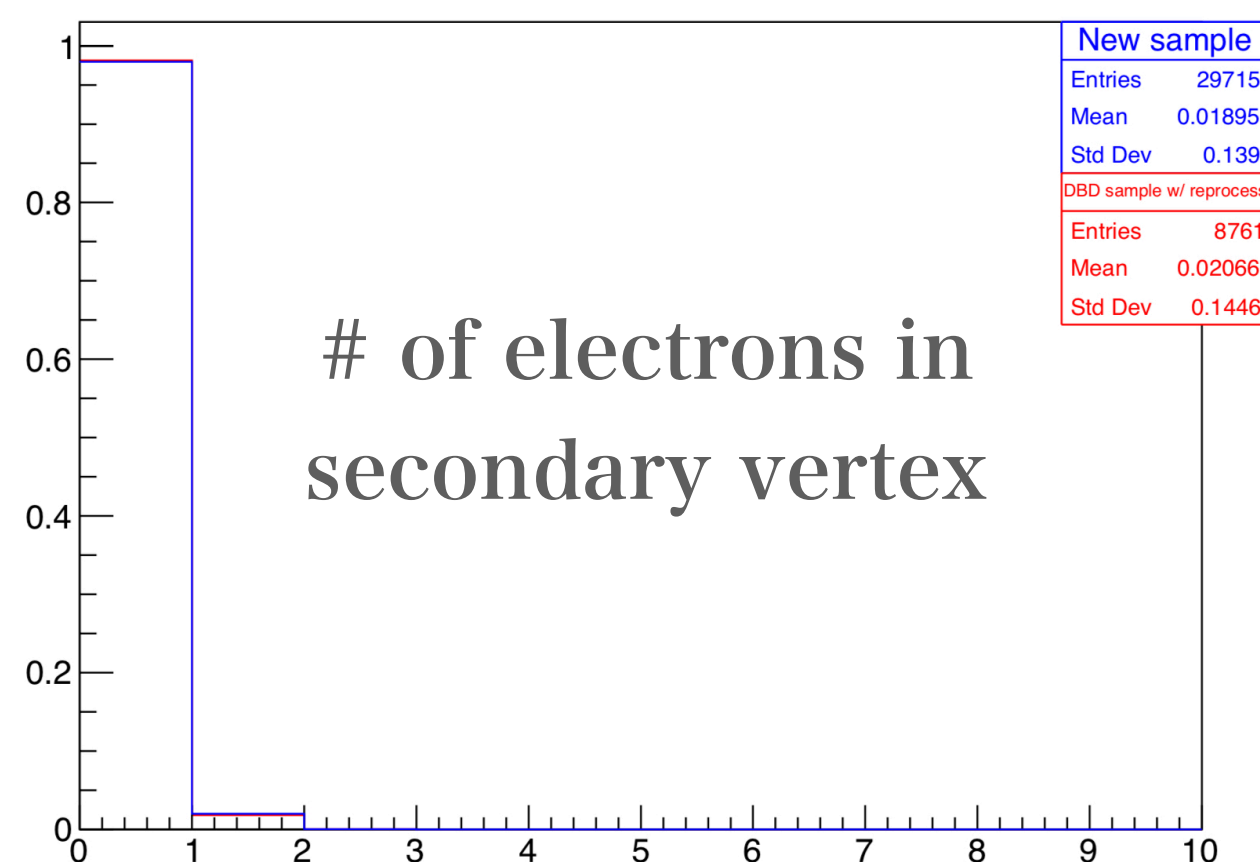**Red** : DBD sample w/ reprocess (250 GeV, w/o IP smearing)

The other plots are also checked but no clear difference found.

vtxmasspc , nvtx==1&&nvtxall==1&&trk1d0sig!=0

vtx mass (in a specific way considering neutrino)

nelectron , nvtx==1&&nvtxall==1&&trk1d0sig!=0

# of electrons in secondary vertex

nmuon, nvtx==1&&nvtxall==1&&trk1d0sig!=0

# of muons in secondary vertex
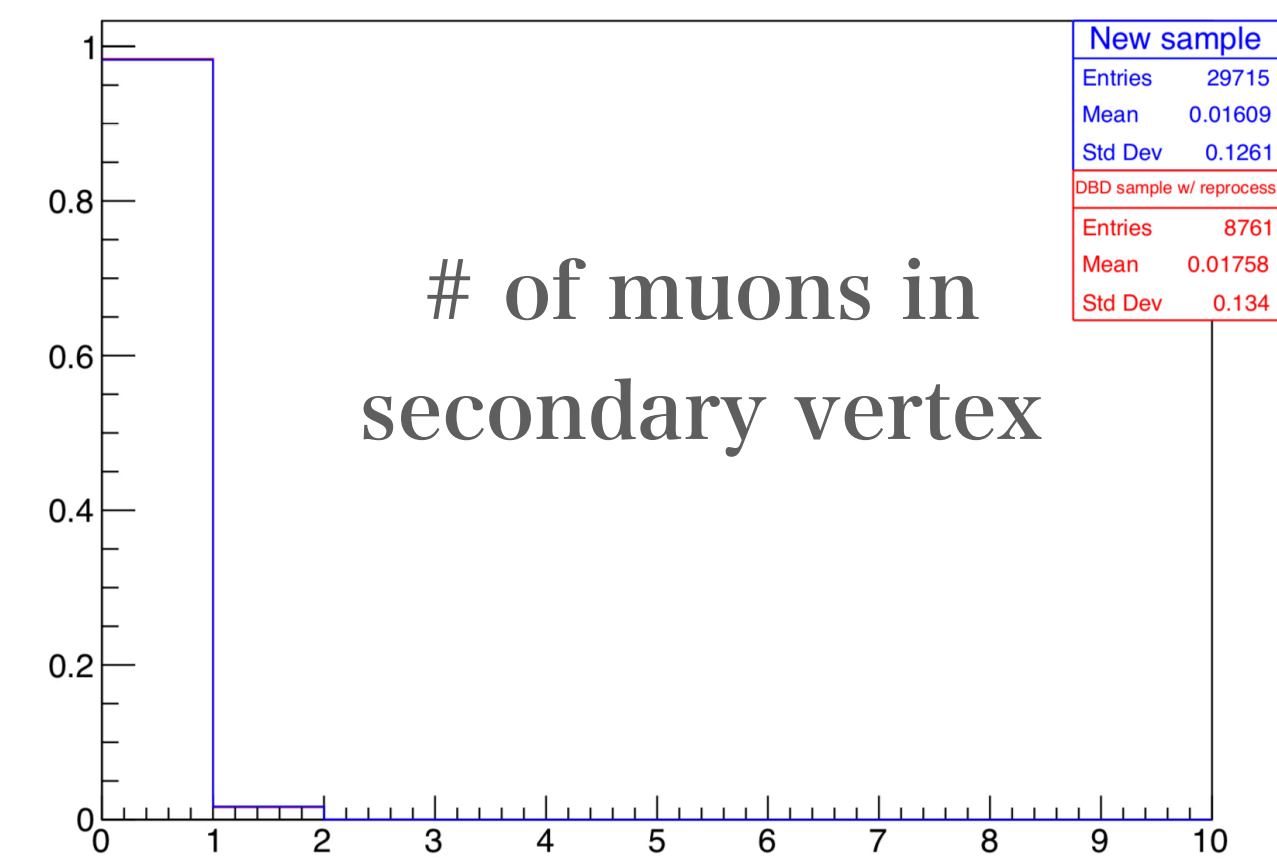
No clear difference

Summary

New test sample (e2e2h) is checked comparing with previous MC samples (DBD, IDR)

No clear sign of problems found (slight improvement can be seen in some cases)

Dedicated test samples for flavour tagging (b,c,q) allows us to check further (flavour tag performance etc)

Backup

Primary Vertex : x-position

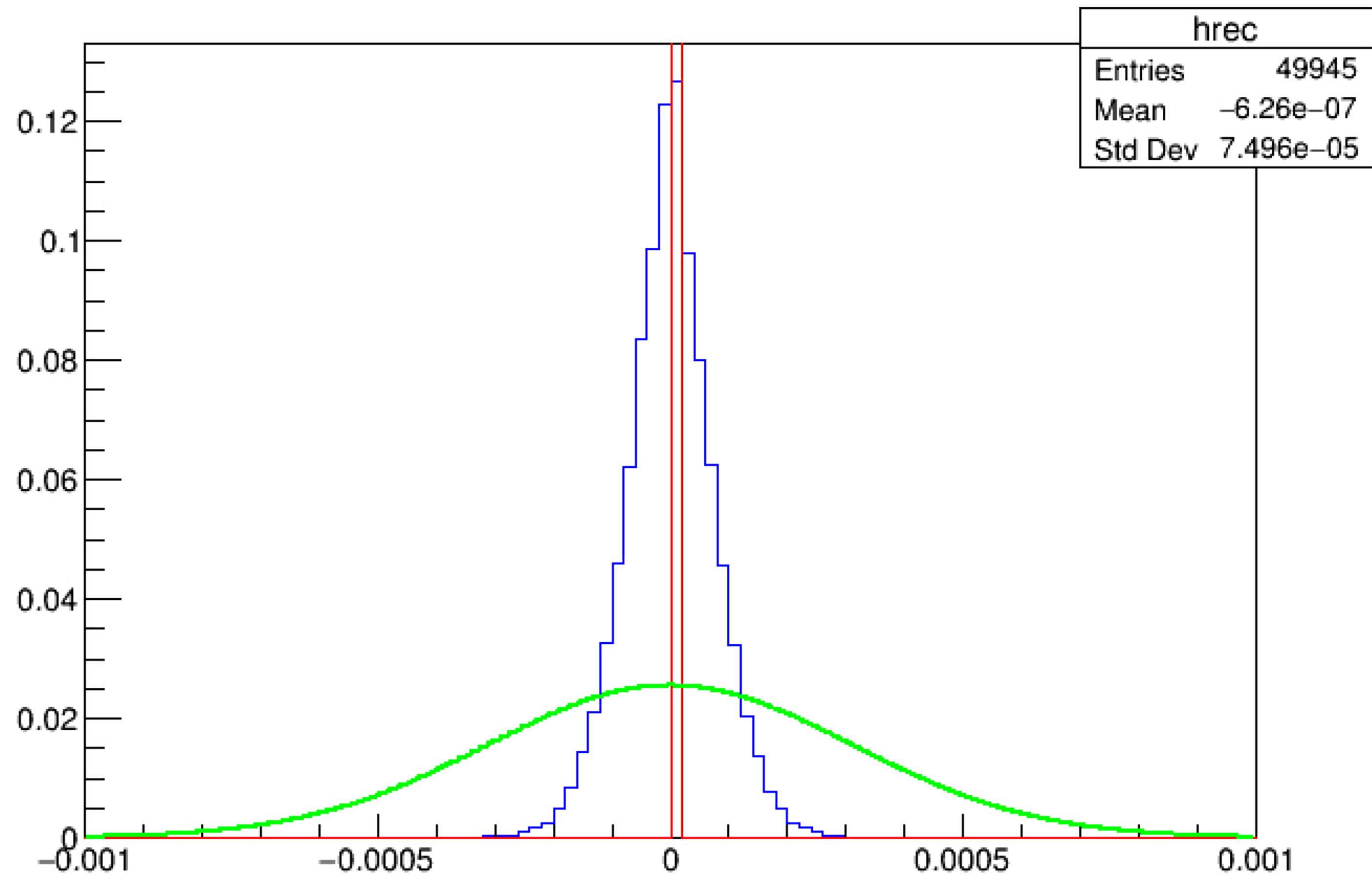| hrec	
Entries	49945
Mean	−6.26e−07
Std Dev	7.496e−05

New test sample,
Blue : Reconstructed
Red : MC = 0
Green : Gaussian with sigma of beam spot constraint (313.e-6)

How we constrain vertex position? A virtual point having central value of 0 and sigma of 313.e-6 is used in vertex fitting.

Primary Vertex : y-position

Histgrams are nomalized for comparison

hrec	
Entries	49945
Mean	5.403e−11
Std Dev	3.169e−08

New test sample,
Blue : Reconstructed
Red : MC = 0
Green : Gaussian with sigma of beam spot constraint (3.14e-6)

Reconstructed position is almost 0 due to the strongest constraint.

Primary Vertex : x-position

New test sample,
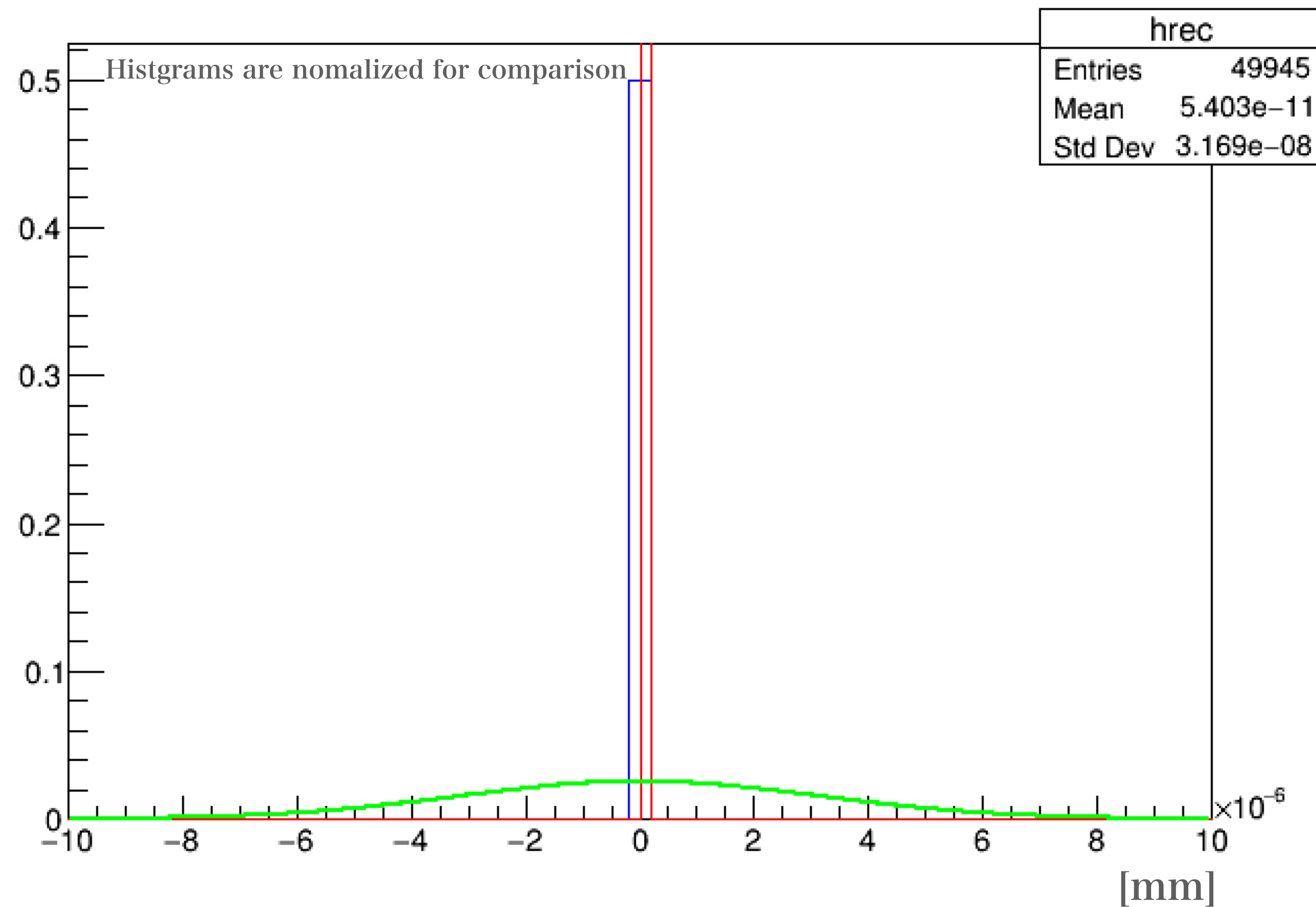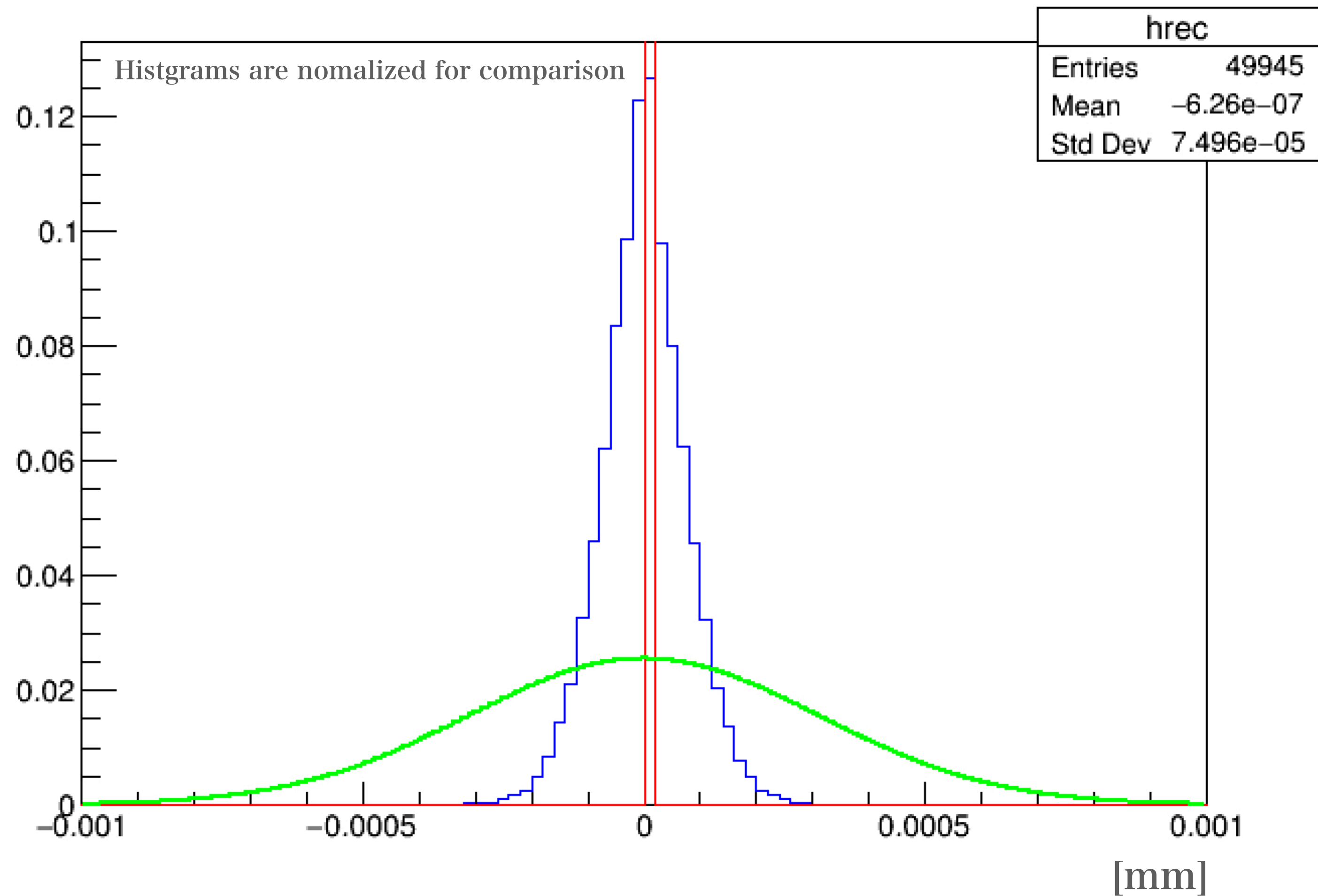Blue : Reconstructed
Red : MC = 0
Green : Gaussian with sigma of beam spot constraint (313.e-6)

Reconstructed position is intermediate in width between z and y.

Primary Vertex : y-position residual

= (Rec - MC)

Primary Vertices
New Test Sample (250GeV)
DBD Sample w/ reprocess (250GeV)

hdy1

Entries	49945
Mean	2.23e−11
Std Dev	9.716e−09

hdy2

Entries	16127
Mean	3.347e−10
Std Dev	2.405e−08

Blue : New test sample
Red : DBD sample w/ reprocess (250 GeV, w/o IP smearing)

[mm]
×10⁻⁶

Primary Vertex : x-position residual

= (Rec - MC)

Primary Vertices
New Test Sample (250GeV)
DBD Sample w/ reprocess (250GeV)

hdx1	
Entries	49945
Mean	−6.26e−07
Std Dev	7.496e−05

hdx2	
Entries	16127
Mean	−2.959e−07
Std Dev	0.0002527

Blue : New test sample
Red : DBD sample w/ reprocess (250 GeV, w/ o IP smearing)

Secondary Vertex : y-position

Secondary Vertices
New Test Sample (250GeV)
DBD Sample w/ reprocess (250GeV)

hrcy1	
Entries	72301
Mean	−0.01349
Std Dev	3.088

hrcy2	
Entries	22741
Mean	−0.03095
Std Dev	3.104

Blue : New test sample
Red : DBD sample w/ reprocess (250 GeV, w/o IP smearing)

Secondary Vertex : z-position

Secondary Vertices
New Test Sample (250GeV)
DBD Sample w/ reprocess (250GeV)

hrcz1	
Entries	72301
Mean	0.003178
Std Dev	2.943

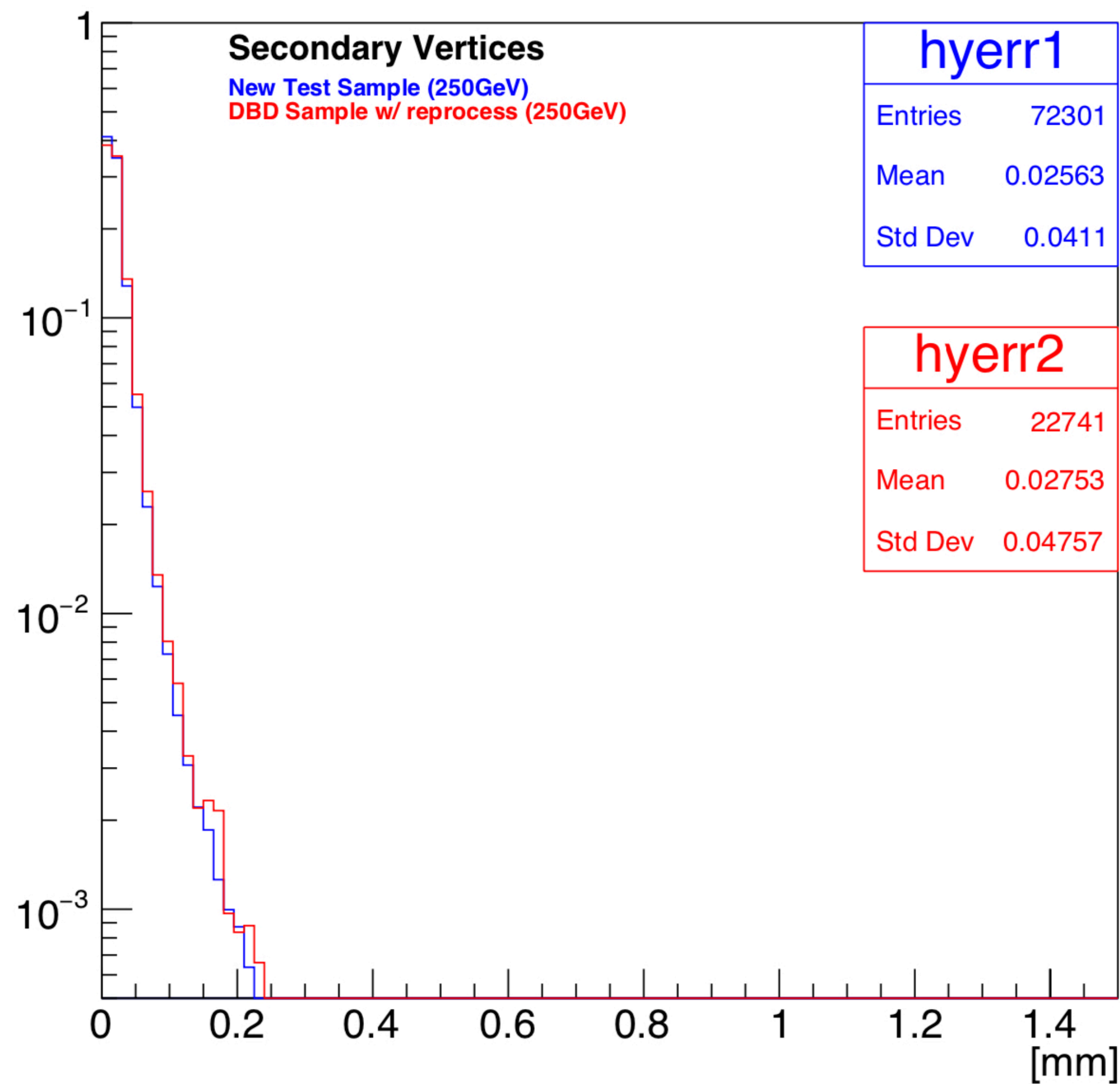| hrcz2	
Entries	22741
Mean	−0.001776
Std Dev	2.948

Blue : New test sample
Red : DBD sample w/ reprocess (250 GeV, w/o IP smearing)

Secondary Vertex : y-position error from vtx fitting

Secondary Vertices
New Test Sample (250GeV)
DBD Sample w/ reprocess (250GeV)

hyerr1	
Entries	72301
Mean	0.02563
Std Dev	0.0411

hyerr2	
Entries	22741
Mean	0.02753
Std Dev	0.04757

[mm]

Blue : New test sample
Red : DBD sample w/ reprocess (250 GeV, w/o IP smearing)

Secondary Vertex : z-position error from vtx fitting

Secondary Vertices
New Test Sample (250GeV)
DBD Sample w/ reprocess (250GeV)

hzerr1	
Entries	72301
Mean	0.02766
Std Dev	0.04957

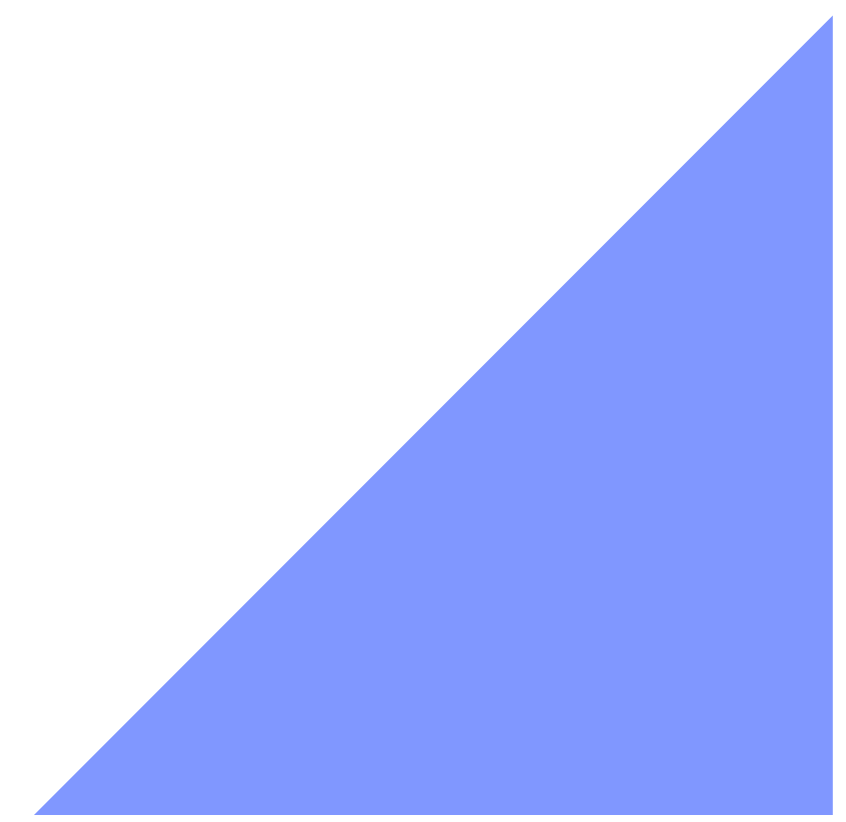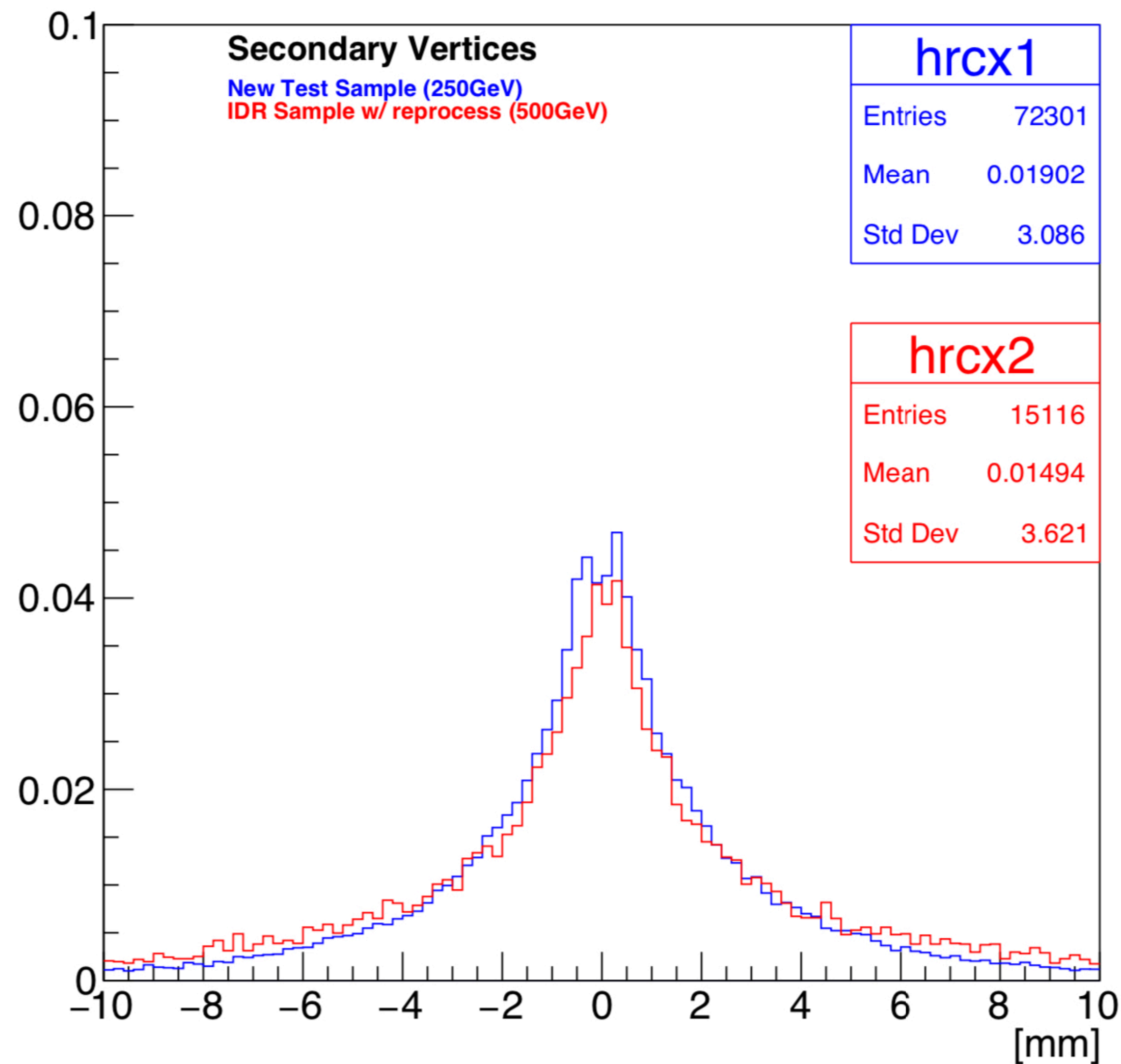| hzerr2	
Entries	22741
Mean	0.02914
Std Dev	0.05101

Blue : New test sample
Red : DBD sample w/ reprocess (250 GeV, w/o IP smearing)

Secondary Vertex

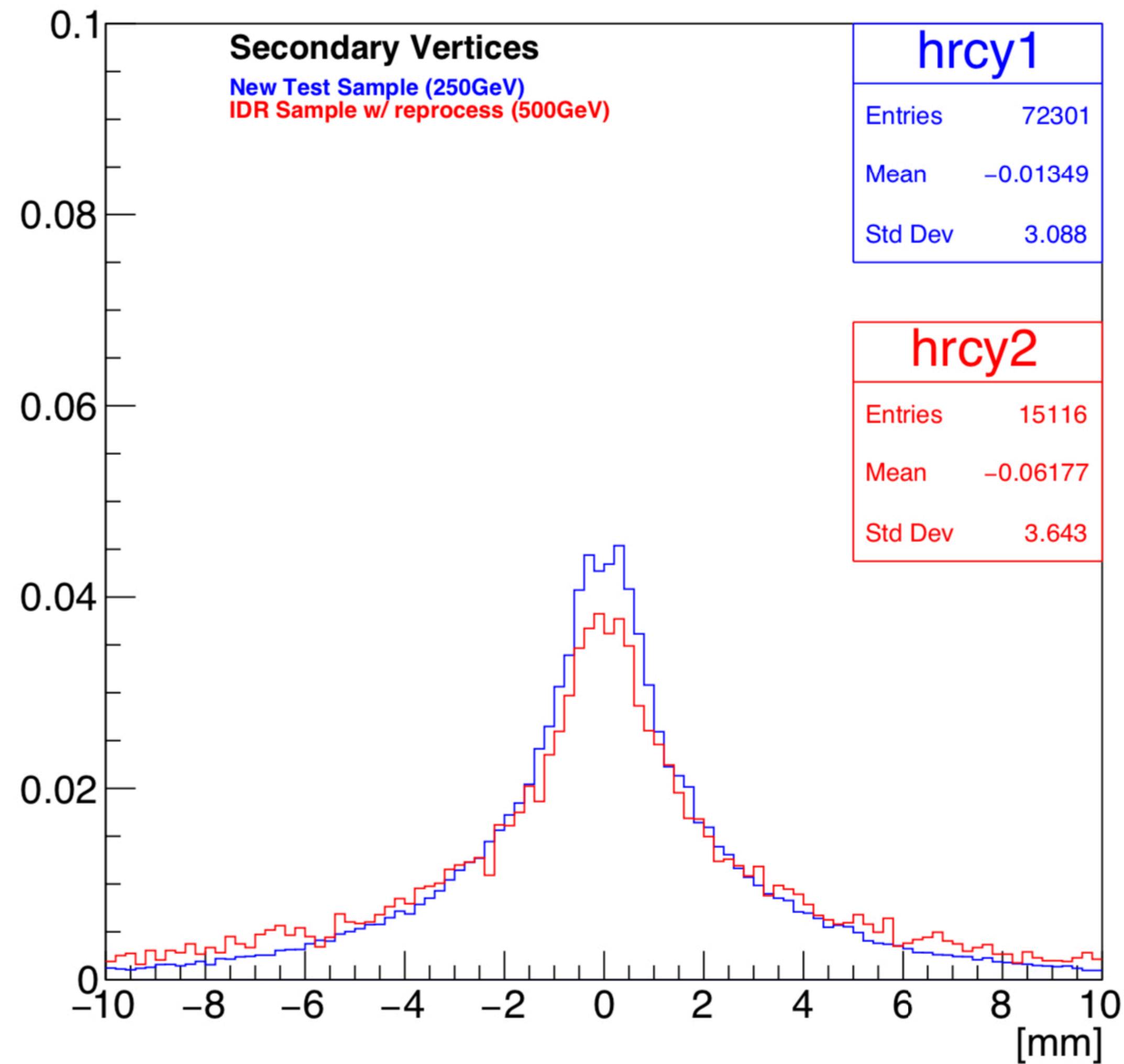## Comparison between New test sample and "IDR" sample (500 GeV, w/ IP smearing)

Secondary Vertex : x-position

Blue : New test sample
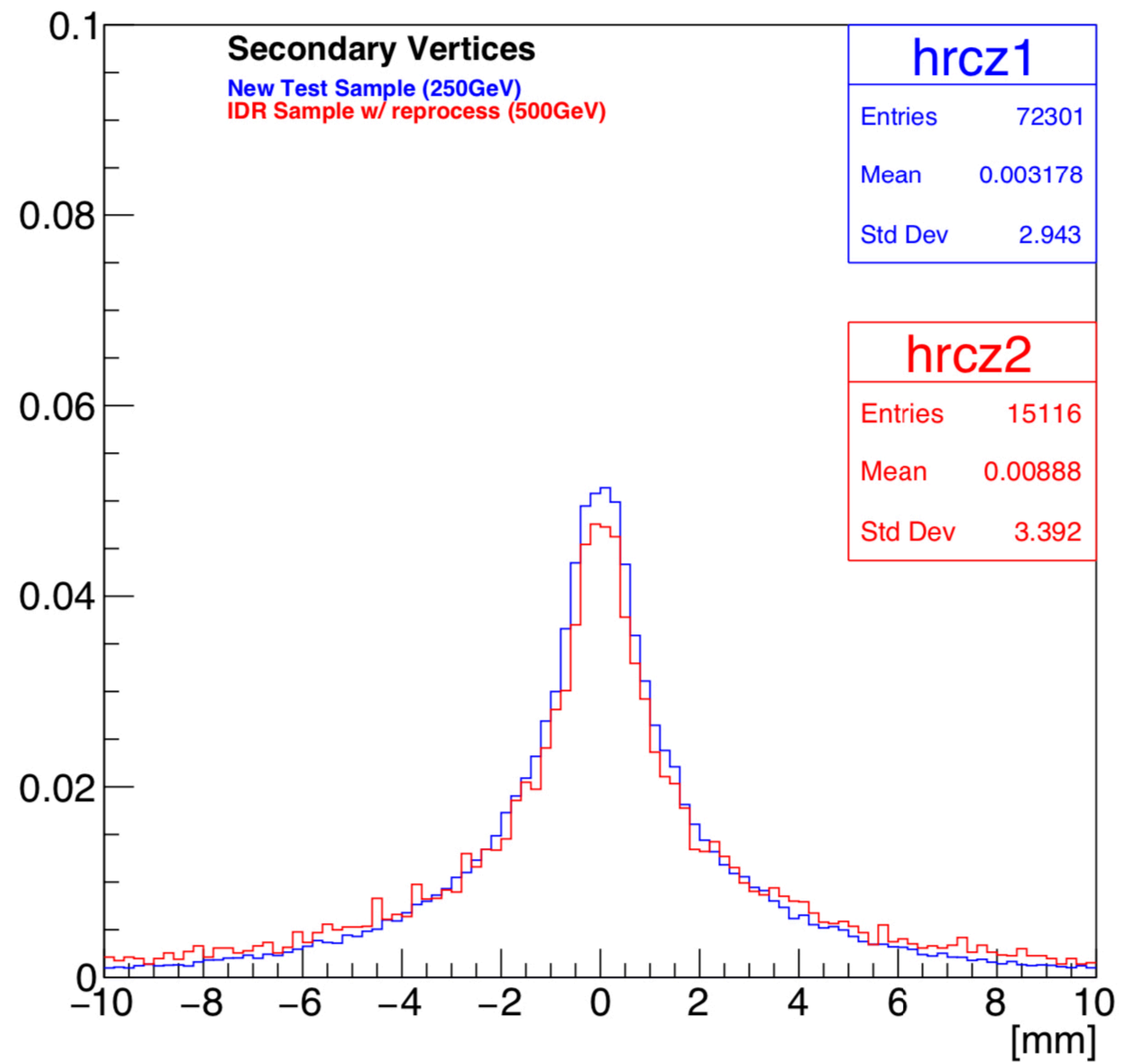Red : IDR sample w/ reprocess (500 GeV, w/ IP smearing)

Secondary Vertex : y-position

Blue : New test sample
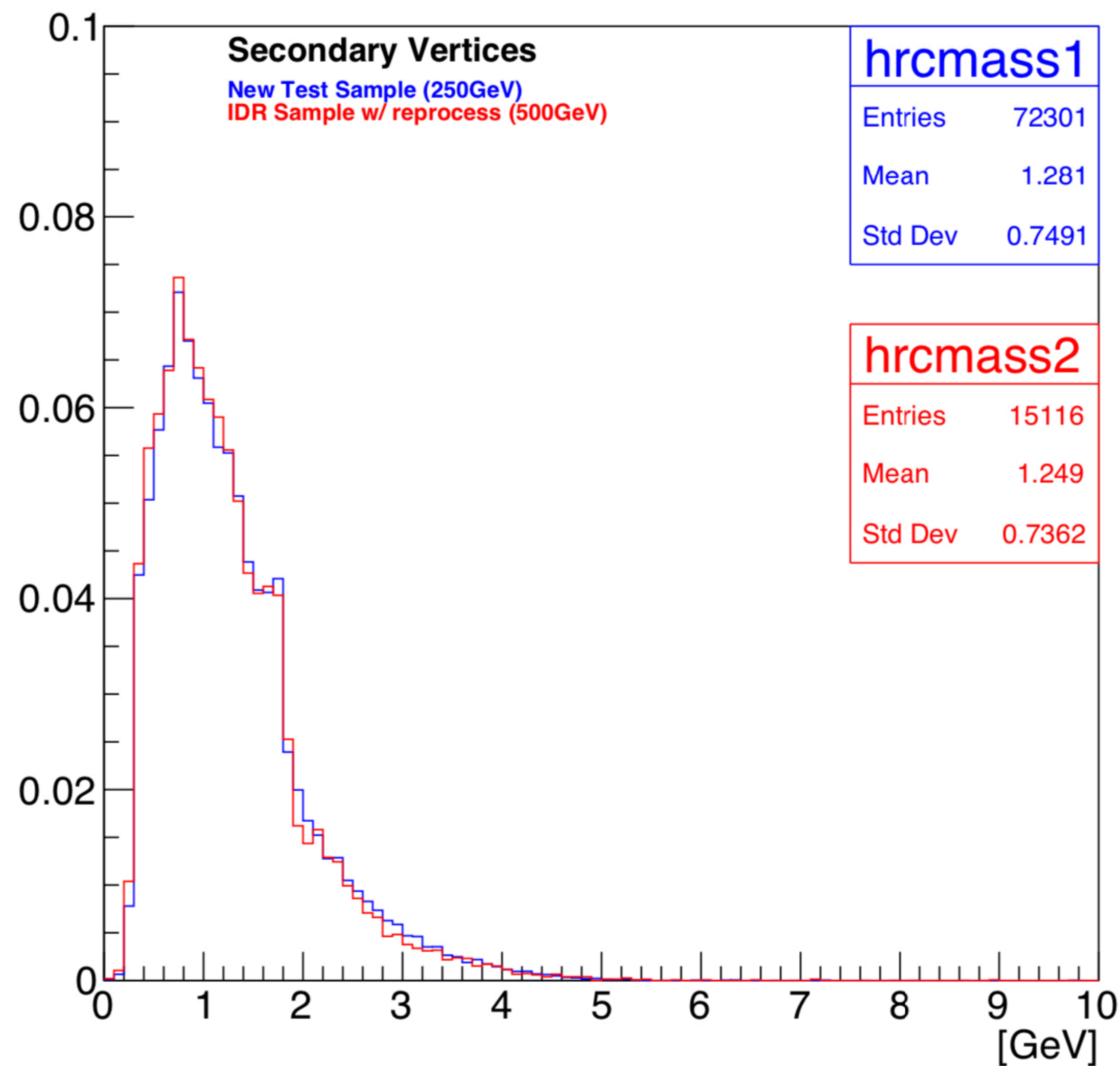**Red** : IDR sample w/ reprocess (500 GeV, w/ IP smearing)

Secondary Vertex : z-position

Blue : New test sample
Red : IDR sample w/ reprocess (500 GeV, w/ IP smearing)

Secondary Vertex : Invariant mass of charged tracks

Secondary Vertices
New Test Sample (250GeV)
IDR Sample w/ reprocess (500GeV)

hrcmass1

Entries	72301
Mean	1.281
Std Dev	0.7491

hrcmass2

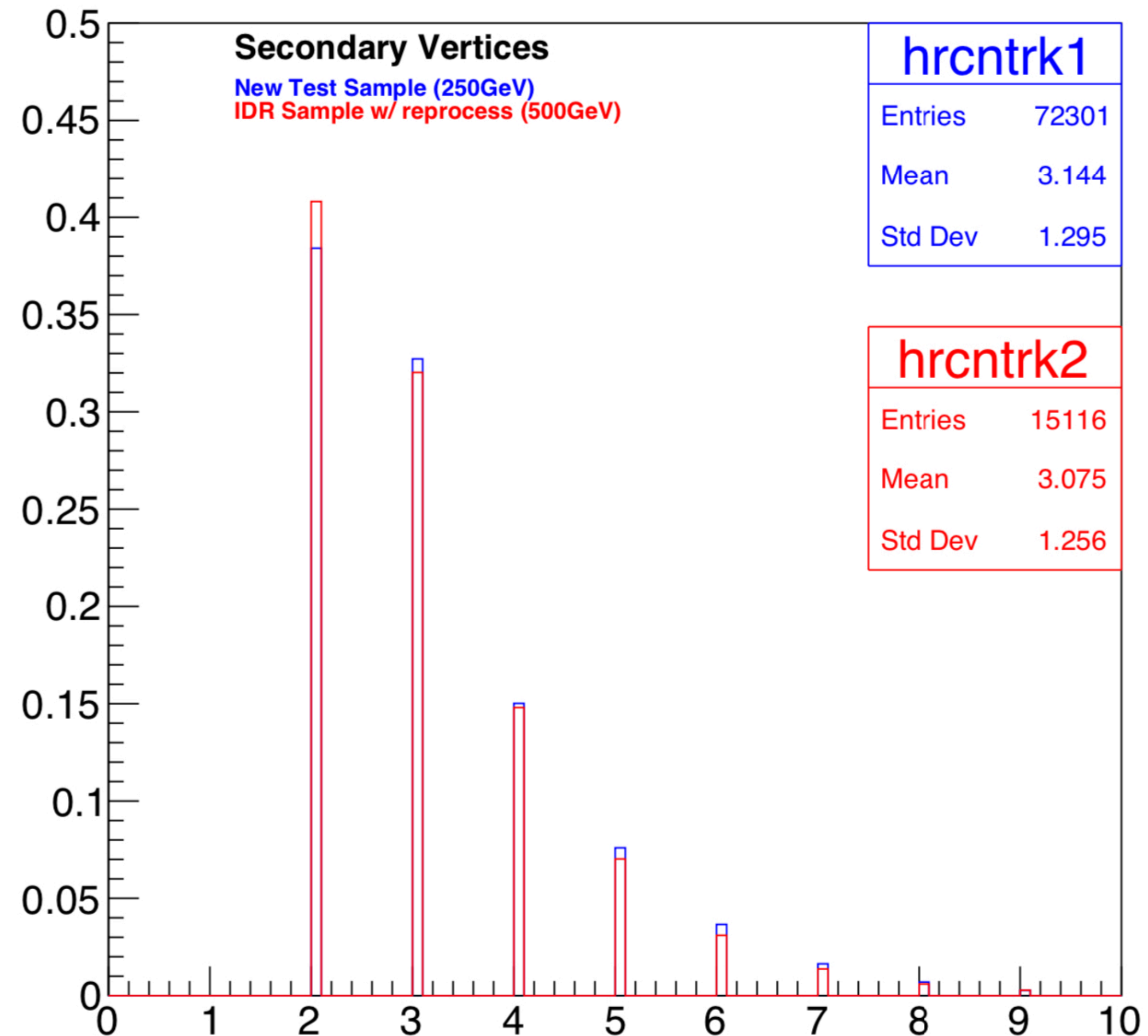| Entries	15116
Mean	1.249
Std Dev	0.7362

[GeV]

Blue : New test sample
Red : IDR sample w/ reprocess (500 GeV, w/ IP smearing)

No clear difference
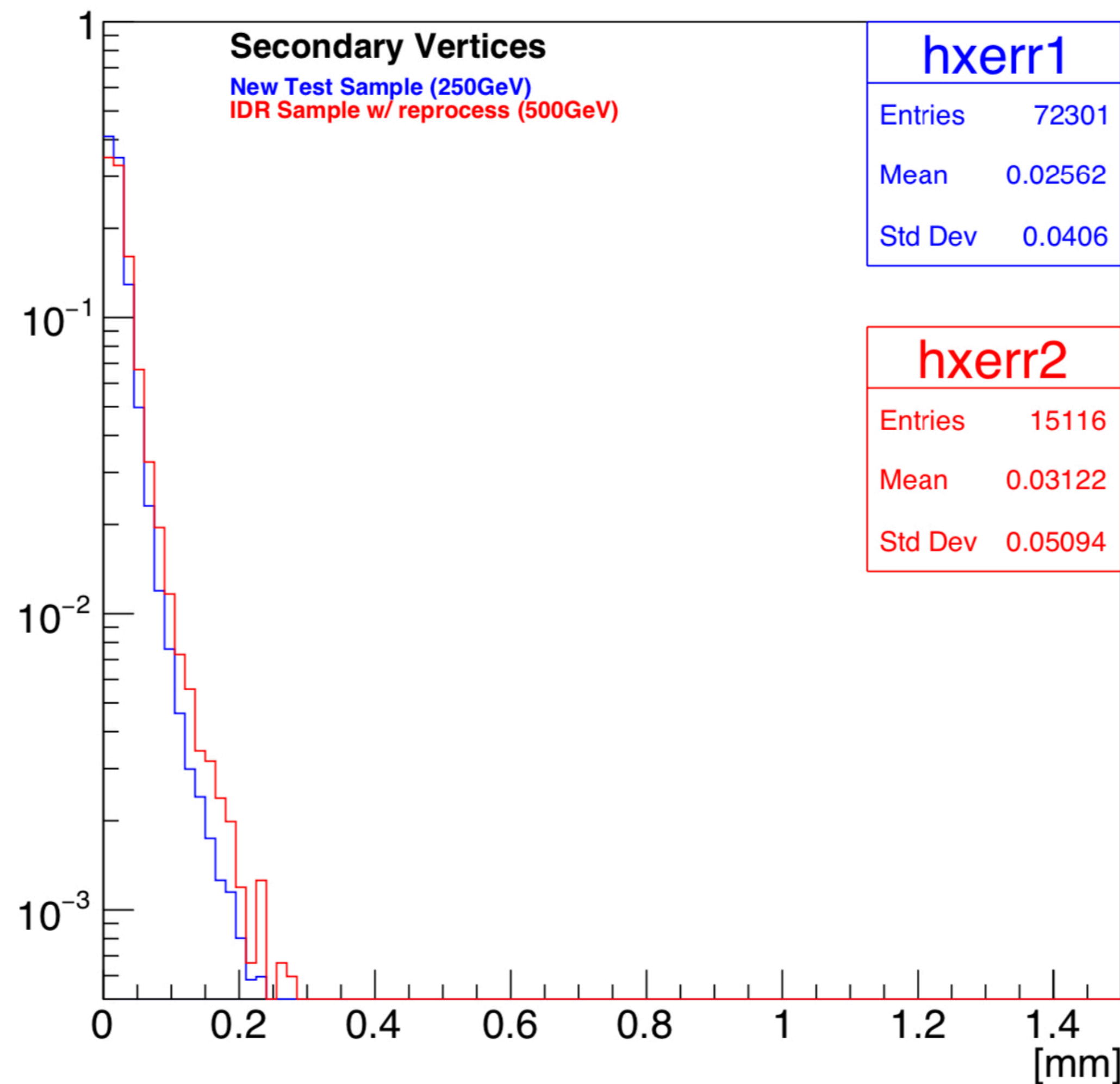
Secondary Vertex : # of tracks

Blue : New test sample
Red : IDR sample w/ reprocess (500 GeV, w/ IP smearing)

No clear sign of problems

Secondary Vertex : x-position error from vtx fitting

Secondary Vertices
New Test Sample (250GeV)
IDR Sample w/ reprocess (500GeV)

hxerr1	
Entries	72301
Mean	0.02562
Std Dev	0.0406

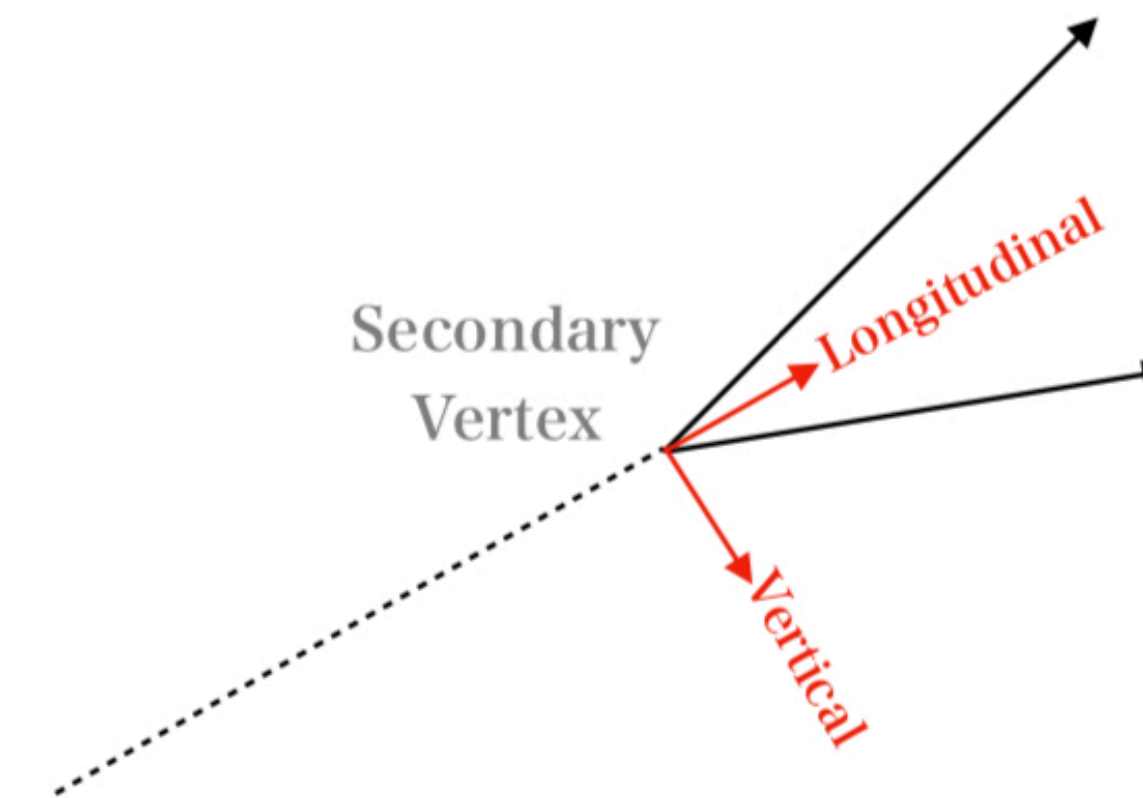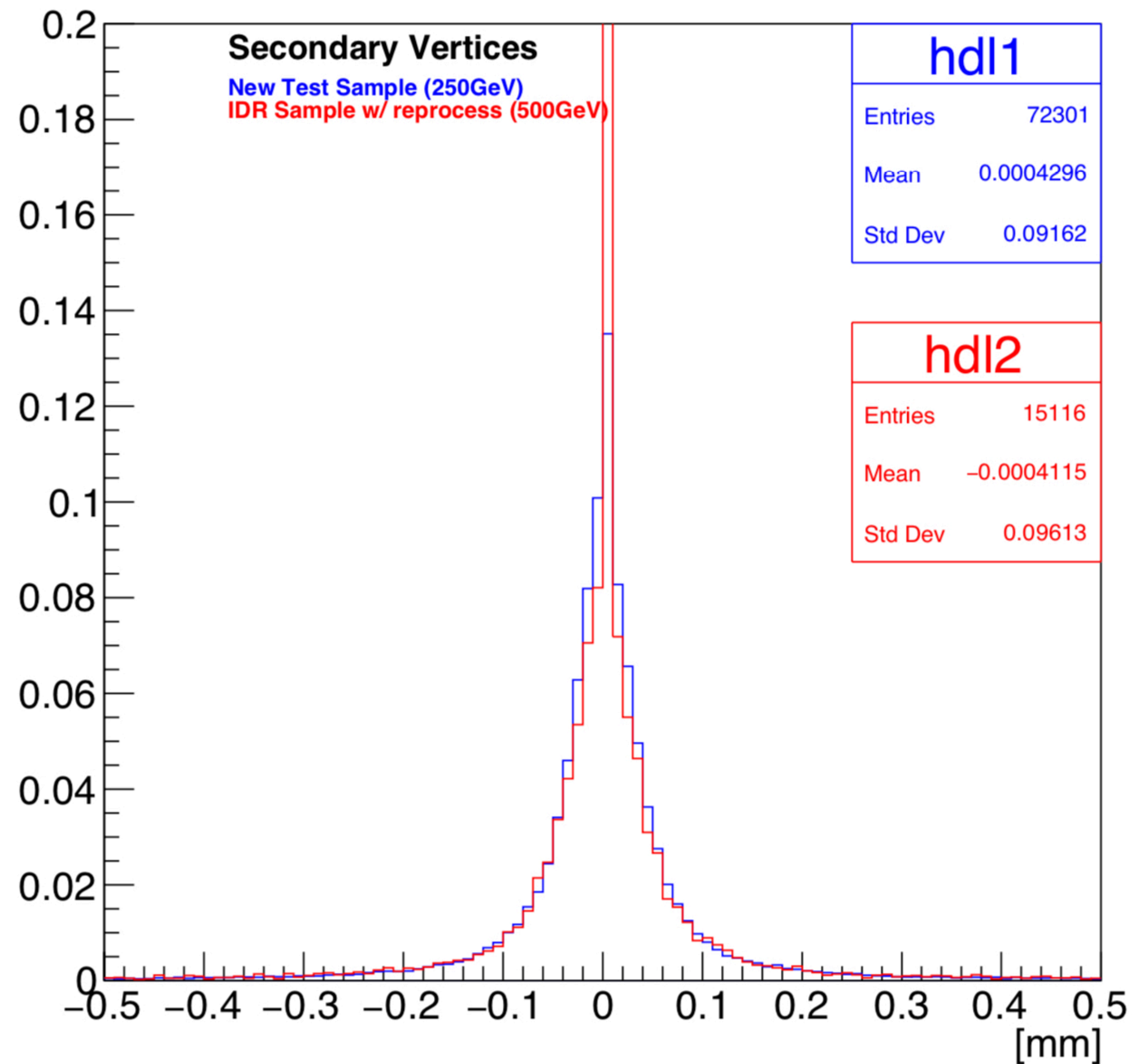| hxerr2	
Entries	15116
Mean	0.03122
Std Dev	0.05094

[mm]

Blue : New test sample
Red : IDR sample w/ reprocess (500 GeV, w/ IP smearing)

See backup for y and z.

No clear sign of problems
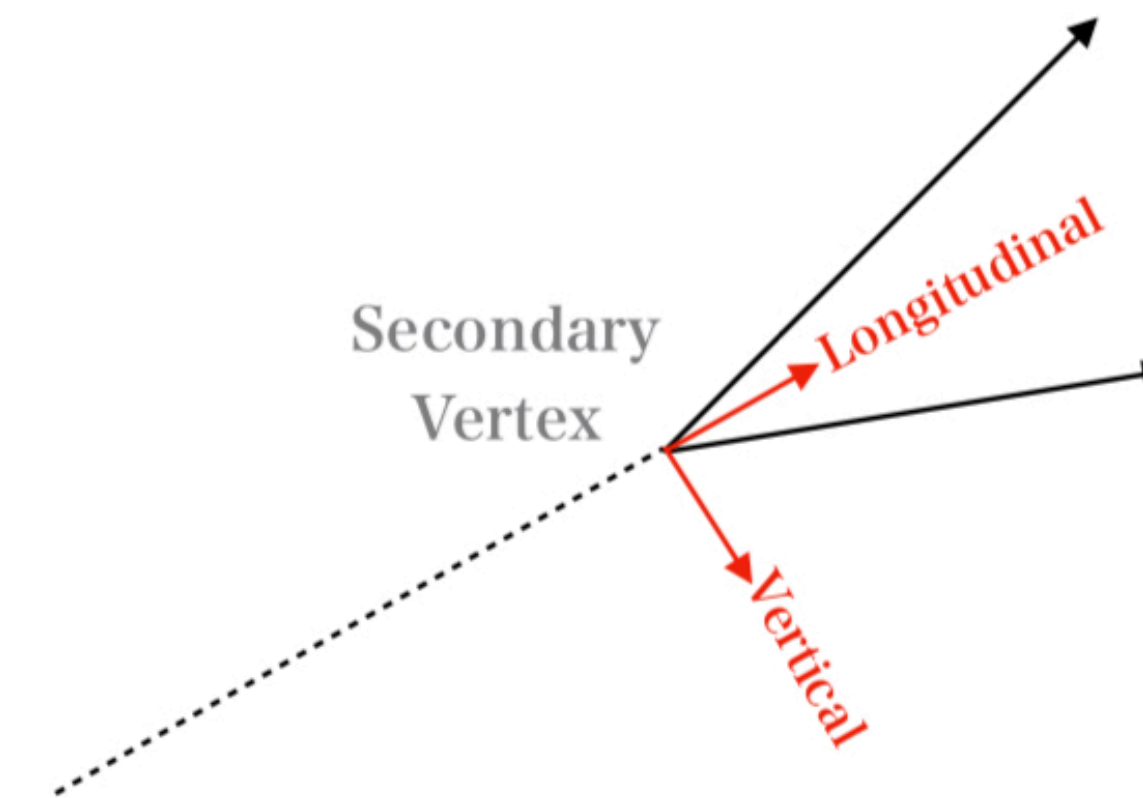
Secondary Vertex : longitudinal resolution

Secondary Vertices
New Test Sample (250GeV)
IDR Sample w/ reprocess (500GeV)

hdl1	
Entries	72301
Mean	0.0004296
Std Dev	0.09162

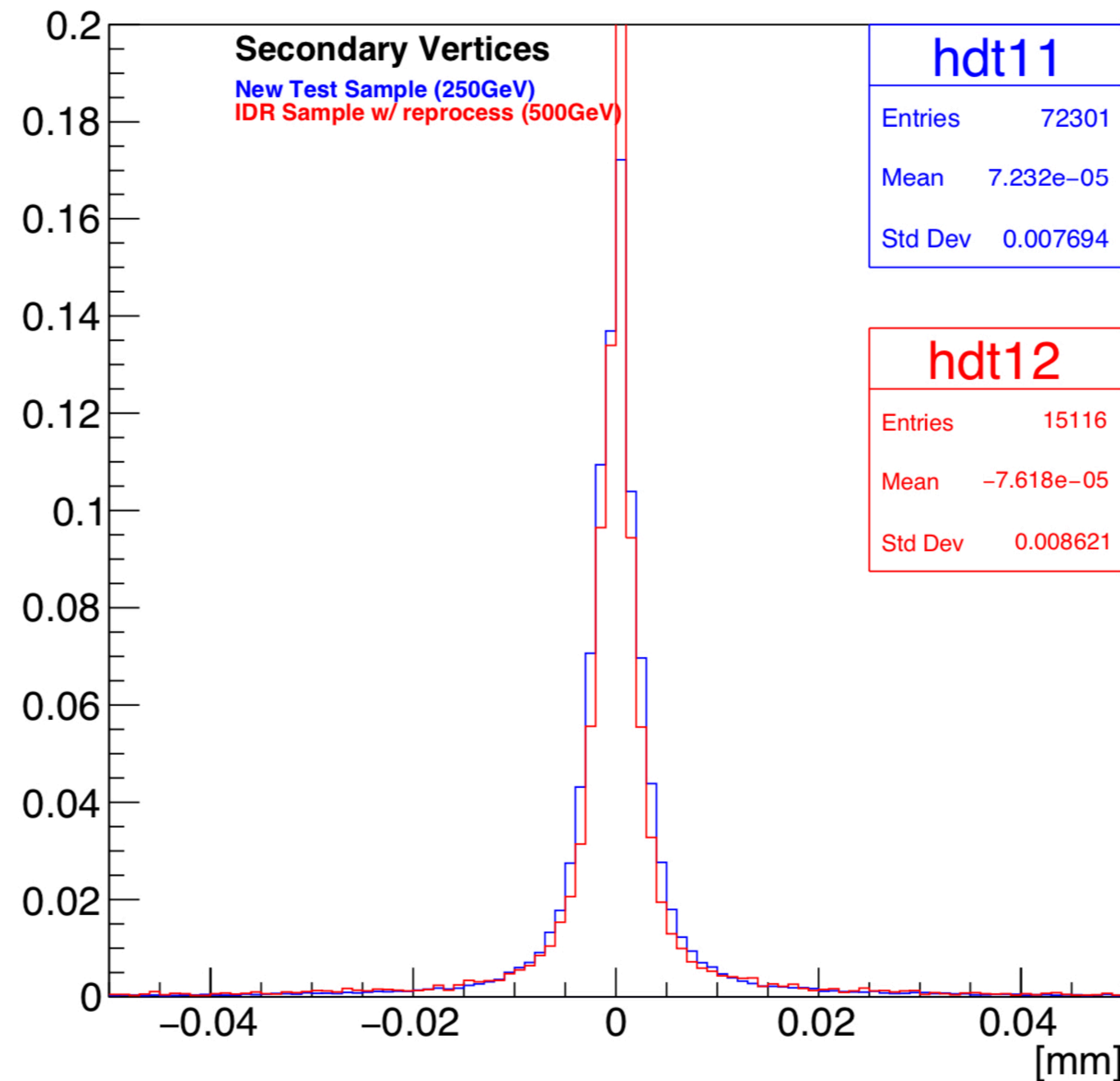| hdl2	
Entries	15116
Mean	−0.0004115
Std Dev	0.09613

[mm]

Blue : New test sample
Red : IDR sample w/ reprocess (500 GeV, w/ IP smearing)

No clear sign of problems

Secondary Vertex : Transverse resolution

Secondary Vertices
New Test Sample (250GeV)
IDR Sample w/ reprocess (500GeV)

hdt11	
Entries	72301
Mean	7.232e−05
Std Dev	0.007694

hdt12	
Entries	15116
Mean	−7.618e−05
Std Dev	0.008621

[mm]

Secondary
Vertex

Longitudinal

Vertical

Blue : New test sample
Red : IDR sample w/ reprocess (500 GeV, w/ IP smearing)

No clear sign of problems