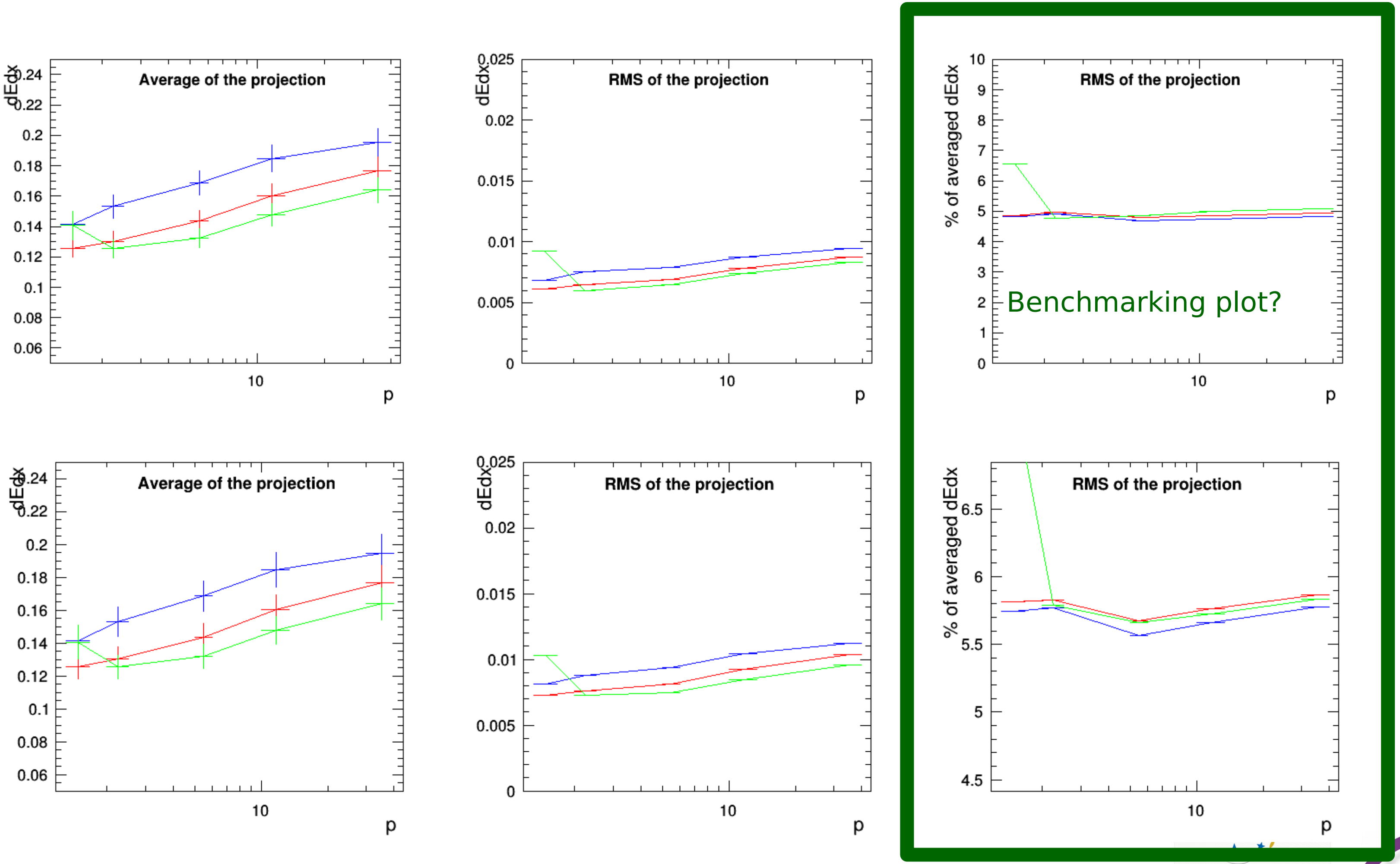
Kaon ID

Kaon ID (truth plots)

- L5 model
- s5 model



Kaon ID, parametrization of the ID algorithm

- KaonTagger parameters for bb 500GeV. Only secondary tracks with p>1.5 GeV
  - Git repository, analysis folder, macro: CalculateParameters.C
  - Optimize parameters to enhance the purity with a minimun efficiency requirement.

- L5 model

```
CASE a (eff>0.5):     purity=0.877307 eff=0.501777;    slope=0.0179762 upper=0.110123 lower=0.100053
CASE b (eff>0.7):     purity=0.853408 eff=0.704211;    slope=0.0179762 upper=0.11206 lower=0.0969549
```

- s5 model

```
CASE a (eff>0.5):     purity=0.815829 eff=0.500574;    slope=0.0179396 upper=0.10853 lower=0.0965993
CASE b (eff>0.7):     purity=0.787966 eff=0.70275;    slope=0.0179396 upper=0.110365 lower=0.0910929
```

- Kaon ID performs much better in a large TPC. Purity improved by ~7%

Asymmetry at 500GeV

Analysis strategy: Jet clustering in LCFIPlus

FastJet Definitions

Durham

```
JetDefinition jet_def(ee_kt_algorithm);
```

$$d_{ij} = 2\min(E_i^2, E_j^2)(1 - \cos\theta_{ij}) \,.$$

Generalized ee_kt

```
JetDefinition jet_def(ee_genkt_algorithm, R, p);
```

$$d_{ij} = \min(E_i^{2p}, E_j^{2p})\frac{(1-\cos\theta_{ij})}{(1-\cos R)} \,,$$

$$d_{iB} = E_i^{2p} \,,$$

LCFIPlus definitions

- **Durham**:
  - is the same but divided by E^2_{vis} (visible energy).
  - $d_{ij} \rightarrow y_{ij}$
- **Durham + Beam Distance** (beam bkg rejection)
  - CosR=-1, p=2
  - Both distances divided by E^2_{vis} too.
  - $d_{iB} = \frac{2E_i^2}{E_{vis}^2}(1-\cos(\theta_{iB}))\alpha^2$
  - α=0 by default

Analysis strategy: Jet clustering in LCFIPlus

LCFIPlus definitions

- **DurhamVertex + Beam Distance** I have only a naive intuition of what is doing:
  - LCFIPlus concept of jet reconstruction using Durham distances but using full vertexes as “seeds”
  - Privileges the reconstruction of jets with only one vertex and add penalties for breaking vertices
  - ??

```
<parameter name="JetClustering.InputVertexCollectionName" type="string" value="BuildUpVertex_Re" /> <!-- vertex collections to be used in JC --

<parameter name="JetClustering.OutputJetCollectionName" type="stringVec" value="VertexJets" /> <!-- output collection name, may be multiple -->
<parameter name="JetClustering.NJetsRequested" type="intVec" value="2" /> <!-- Multiple NJets can be specified -->
<parameter name="JetClustering.YCut" type="doubleVec" value="0." /> <!-- specify 0 if not used -->

<parameter name="JetClustering.JetAlgorithm" type="string" value="DurhamVertex" /> <!-- jet algorithm -->
<parameter name="JetClustering.UseBeamJets" type="int" value="1" /> <!-- beam jet rejection -->

<parameter name="JetClustering.UseMuonID" type="int" value="1" /> <!-- jet-muon ID for jet clustering -->
<parameter name="JetClustering.MuonIDExternal" type="int" value="0" /> <!-- true to use LikelihoodPID, false for good-old simple one -->
<parameter name="JetClustering.MuonIDMinimumD0Significance" type="double" value="5." /> <!-- min D0 significance -->
<parameter name="JetClustering.MuonIDMinimumZ0Significance" type="double" value="5." /> <!-- min Z0 significance -->
<parameter name="JetClustering.MuonIDMaximum3DImpactParameter" type="double" value="5." /> <!-- max 3D significance -->
<parameter name="JetClustering.MuonIDMinimumProbability" type="double" value="0.5" /> <!-- min PID probability, only for external -->

<parameter name="JetClustering.VertexSelectionMinimumDistance" type="double" value="0.3" /> <!-- in mm -->
<parameter name="JetClustering.VertexSelectionMaximumDistance" type="double" value="30." /> <!-- in mm -->
<parameter name="JetClustering.VertexSelectionK0MassWidth" type="double" value="0.02" /> <!-- in GeV -->
<parameter name="JetClustering.YAddedForJetVertexVertex" type="double" value="100"/> <!-- add penalty for combining vertices -->
<parameter name="JetClustering.YAddedForJetLeptonVertex" type="double" value="100"/> <!-- add penalty for combining lepton and vertex -->
<parameter name="JetClustering.YAddedForJetLeptonLepton" type="double" value="100"/> <!-- add penalty for combining leptons -->
```

Analysis strategy: Jet clustering in LCFIPlus

- I reprocess the vertexes and the b-tagging using Ryo's scripts and latest weights

```
<!-- run primary and secondary vertex finders -->
<parameter name="Algorithms" type="stringVec"> PrimaryVertexFinder BuildUpVertex JetClustering JetVertexRefiner FlavorTag ReadMVA</paramete
```

- DurhamVertex + UseBeamJets=1
- Flavour tag:
  - Weight prefix *6q500_v04_p00_ildl5 (or s5)*
  - D0ProbFileName *d0probv2_ildl5_6q500.root (or s5)*
  - z0ProbFileName *z0probv2_ildl5_6q500.root (or s5)*
- For the final analysis I use the same values for the selection:
  - Btag1>0.9, btag2>0.2

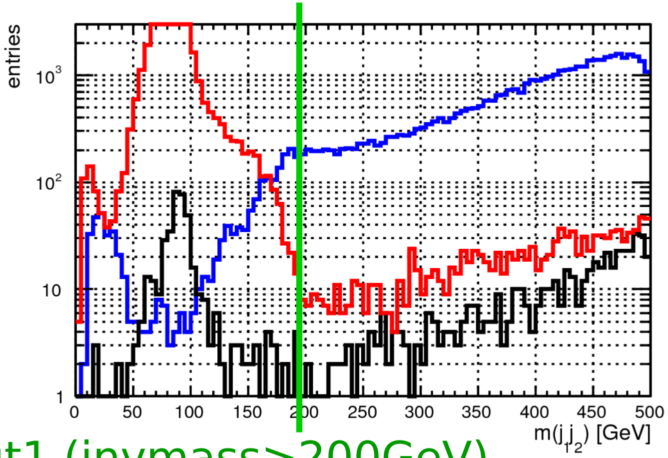
6q500 kinematics is quite different to 2q500...

PRESTIGE POSTDOCTORAL RESEARCH FELLOWSHIPS IN FRANCE

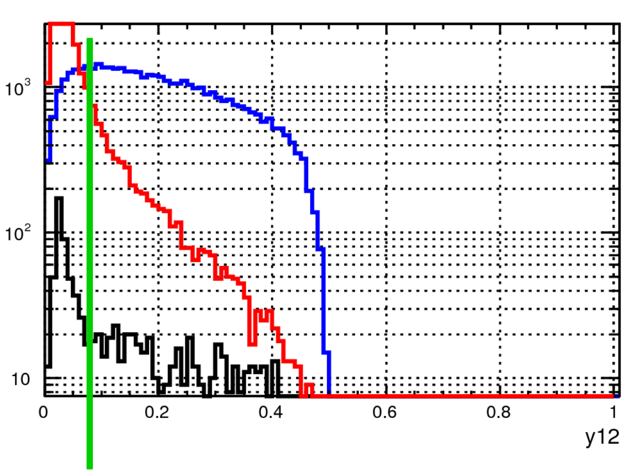
LABORATOIRE DE L'ACCÉLÉRATEUR LINÉAIRE

Large vs Small models, not track recovery is done

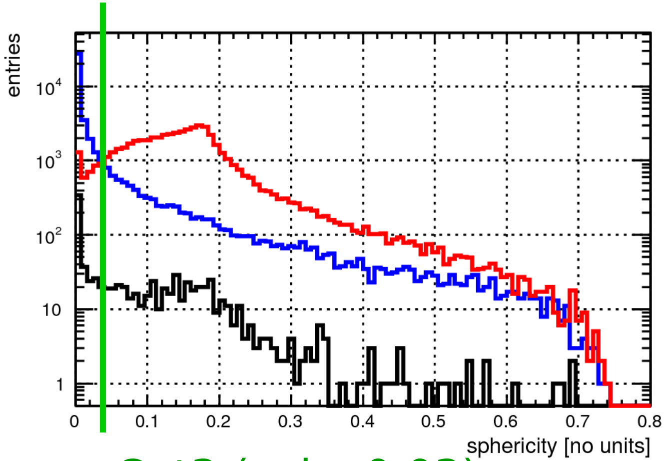
Cut selection (large model, only qq and Z-radiative bkg)



Cut1 (invmass>200GeV)



Cut2 (y12>0.1)



Cut3 (sph>0.03)

$b\bar{b}$

$q\bar{q}$, 2.1%

Z-recoil, 128.5%

CutFlow, ls vs s5

- Cut flow (before selection by charge calculation)

Left polarization, Large Model

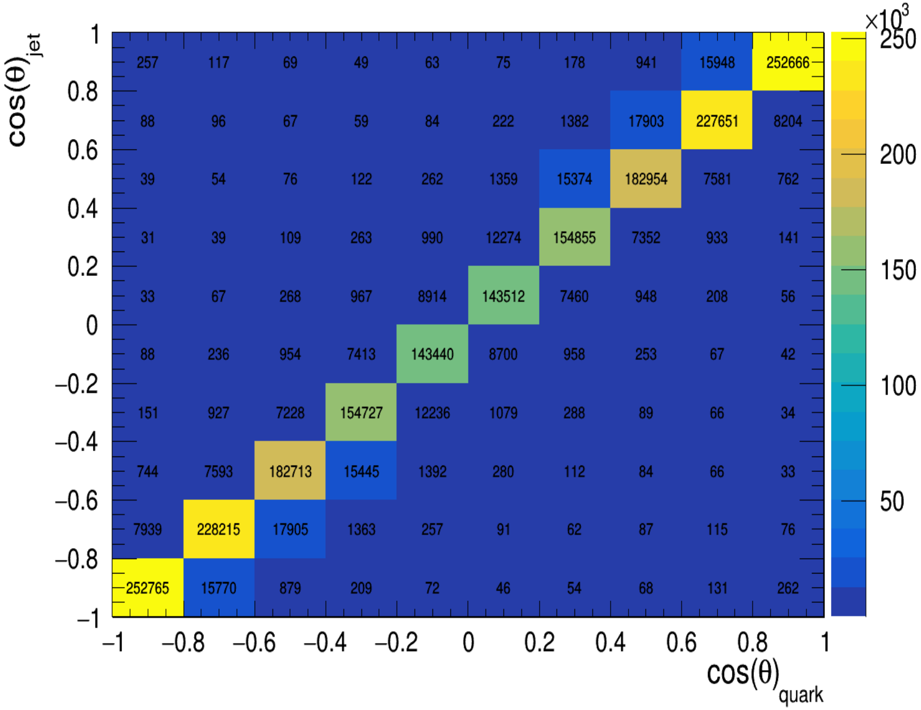
	bb	qq	Radiative Z	**bb (eff)**	**qq (contam.)**	**Radiative Z (contam.)**
all	71150	1.20E+06	233289	100.0%	1688.3%	327.9%
btag	43694	7.19E+02	56214	61.4%	1.6%	128.7%
+inv mass	41895	383	1198	58.9%	0.9%	2.9%
+Y12	32099	299	644	45.1%	0.9%	2.0%
+sphe	24979	231	456	35.1%	0.9%	1.8%

Left polarization, Small Model

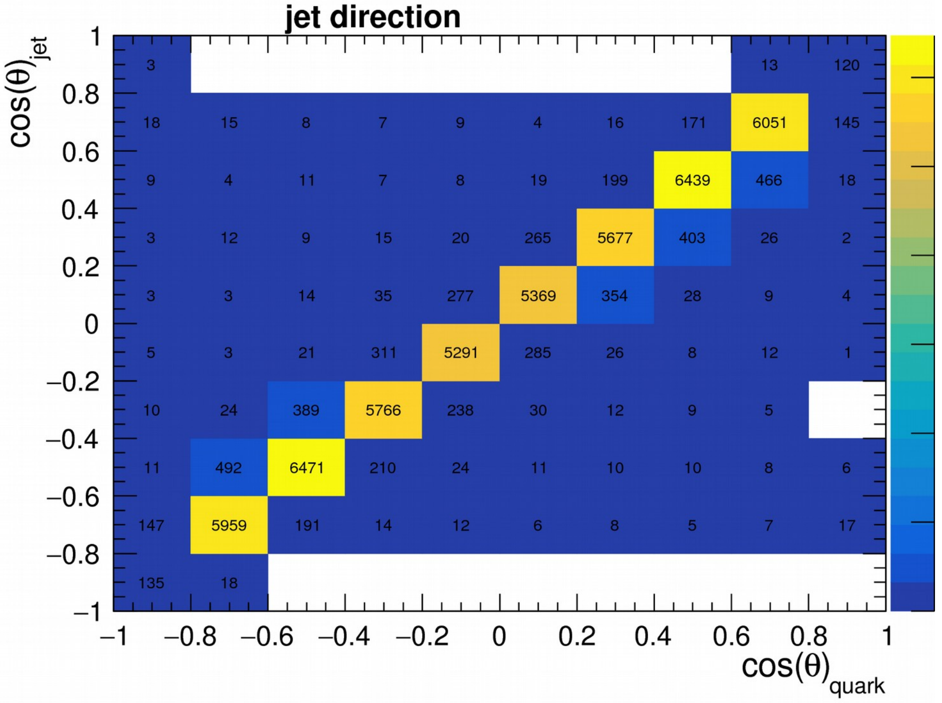
	bb	qq	Radiative Z	**bb (eff)**	**qq (contam.)**	**Radiative Z (contam.)**
all	71155	1.20E+06	233314	100.0%	1688.4%	327.9%
btag	43512	7.46E+02	56214	61.2%	1.7%	129.2%
+inv mass	41712	366	1172	58.6%	0.9%	2.8%
+Y12	31938	270	607	44.9%	0.8%	1.9%
+sphe	24844	207	459	34.9%	0.8%	1.8%

Something funny...

- DBD (250 GeV)



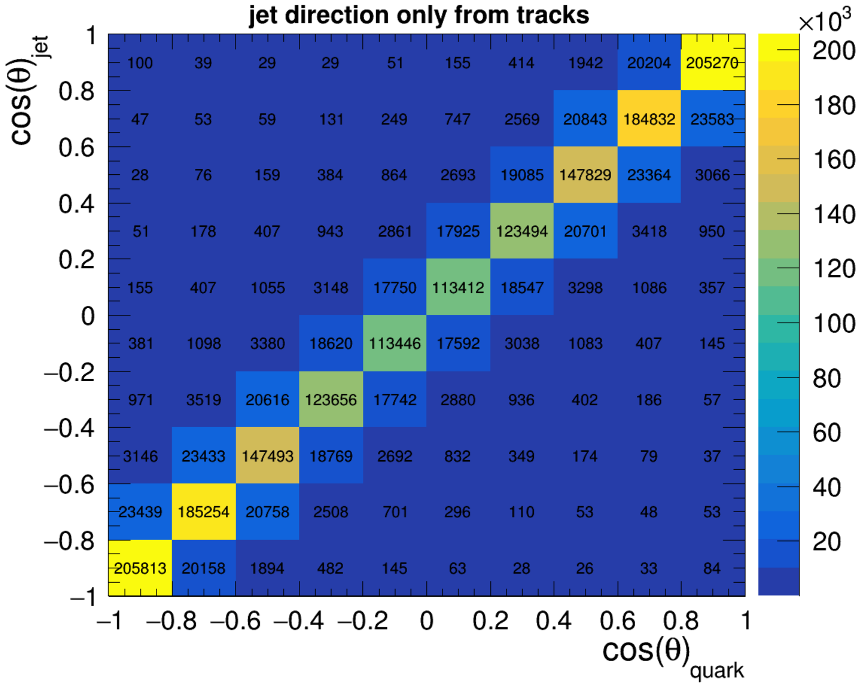
- l5



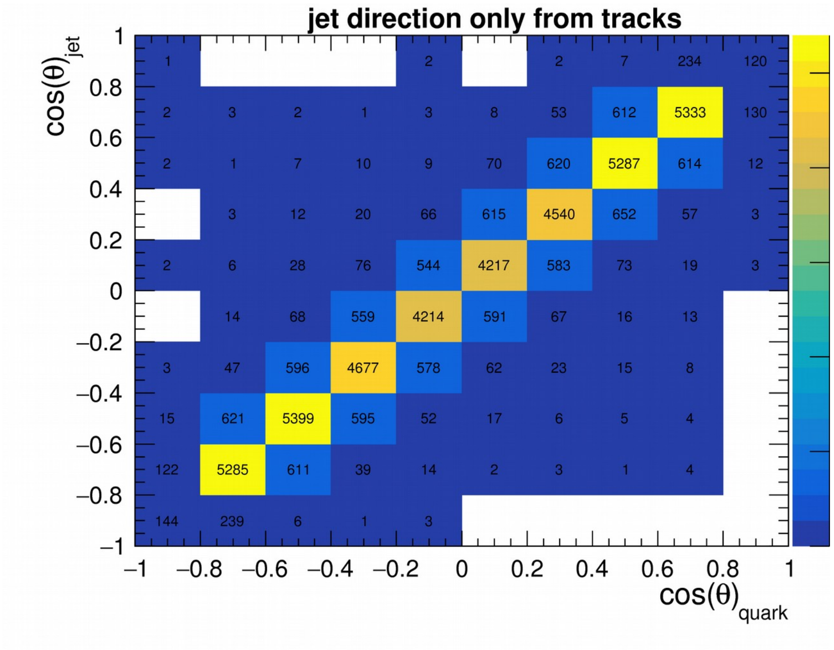
- The migration matrix shape for jet(with all PFOs) vs parton is opposite. The asymmetry is smaller but it goes in the wrong direction... Difficult to say if it is an improvement or not.

Something funny… (2)

- DBD (250 GeV, only tracks)



- L5 (only tracks)



- For tracks looks better, at least for 0.4<cos(theta)<0.4

CutFlow, ls vs s5

- Final selection efficiency, per categories

Large Model

BcBc:	7.0 %
KcKc:	9.8 %
BcKc(jet1):	3.1 %
BcKc(jet2):	0.6 %
BcKc:	0.6 %
KcBc:	0.8 %
total	**21.8 %**

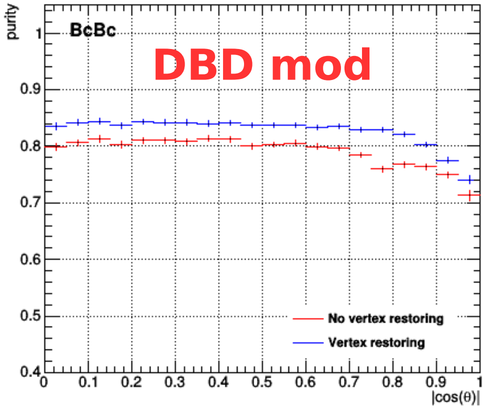
Small Model

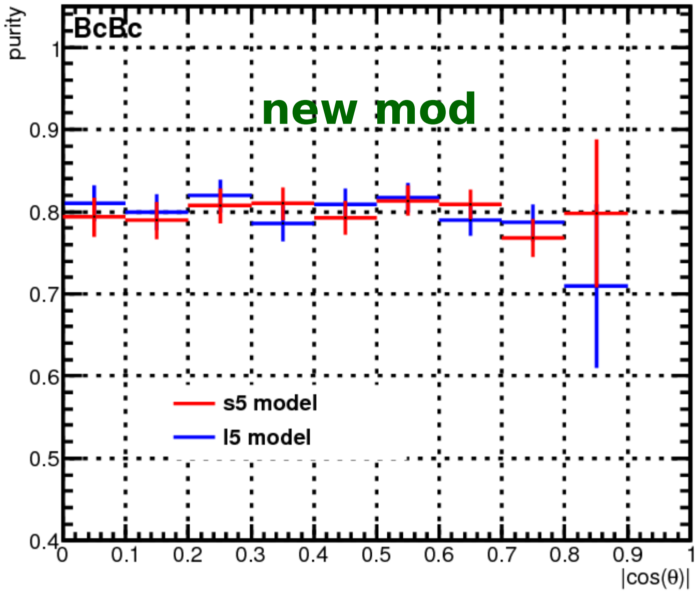
BcBc:	7.0 %
KcKc:	9.4 %
BcKc(jet1):	3.1 %
BcKc(jet2):	0.6 %
BcKc:	0.6 %
KcBc:	0.8 %
total	**21.5 %**

- **I made a mistake on the implementation of the Kaon ID in the analysis. Do take all Kc related results with special care!**

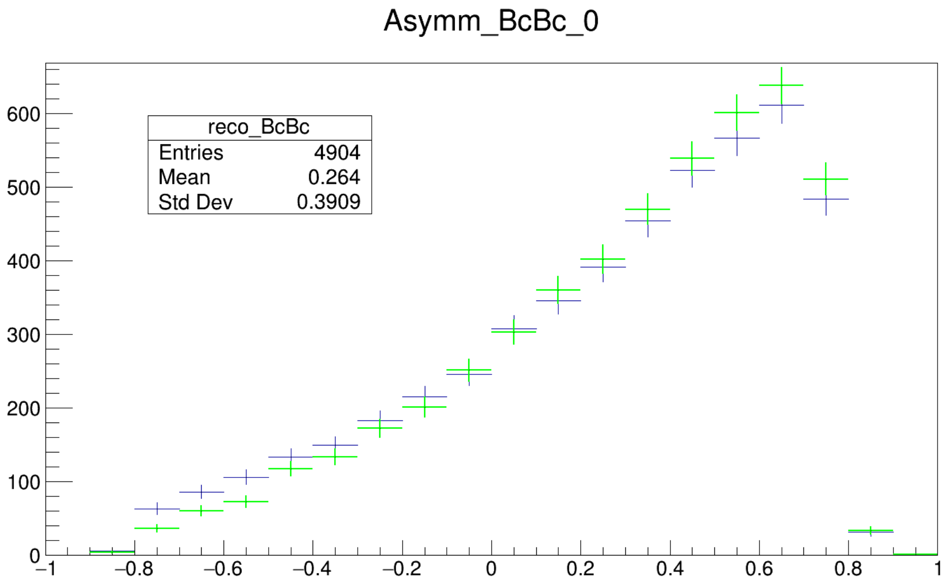
Calculated purity (l5 vs s5)

- k5 and DBD model are similar before the tracking restoring.
- Similar values for both models.
- Very short statistics, 46fb-1,
  - the calculation of p crashes for some categories and also for some bins… (I guess that this is improvable but I don't expect miracles)





BcBc vs KcKc cases (l5 model)

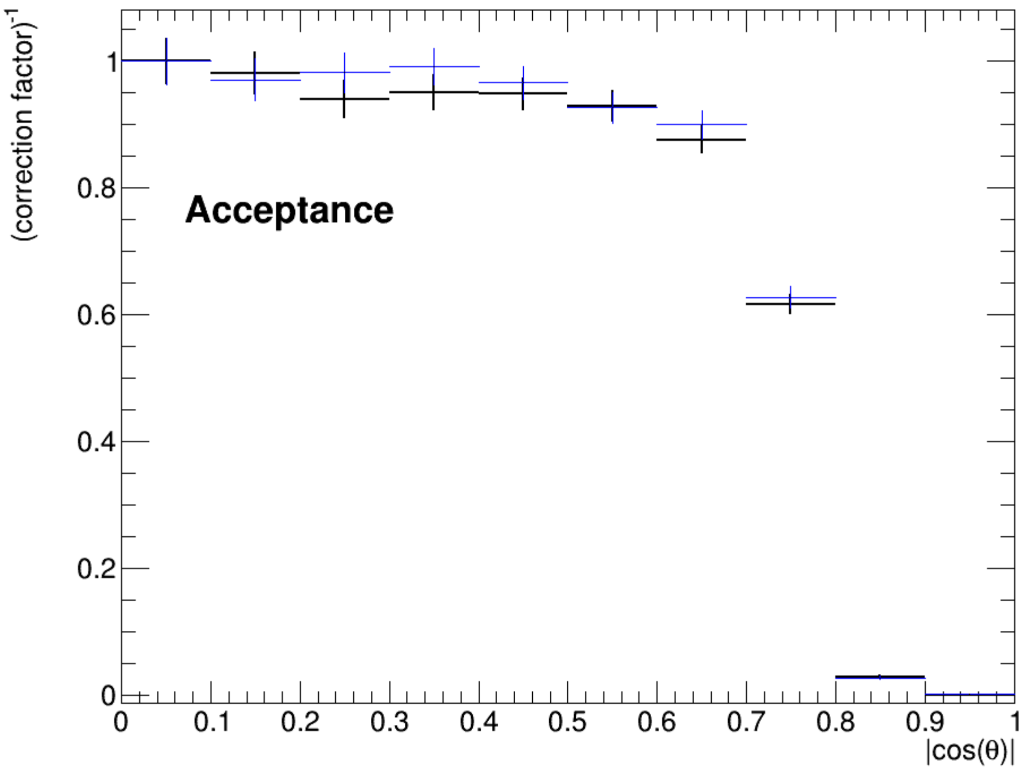


Detector acceptance

- Correction factor = distribution parton level / distribution parton level (reco cuts)

- **Black: large model**
- **Blue: small model**

- The small model seems to have more homogeneous acceptance. In any case, it collapses at cos(theta)>0.7 (and it is of 10% already before)



- **This plots includes all categories (also the Kc-related)**

Are we now better at measuring the jet-angle?

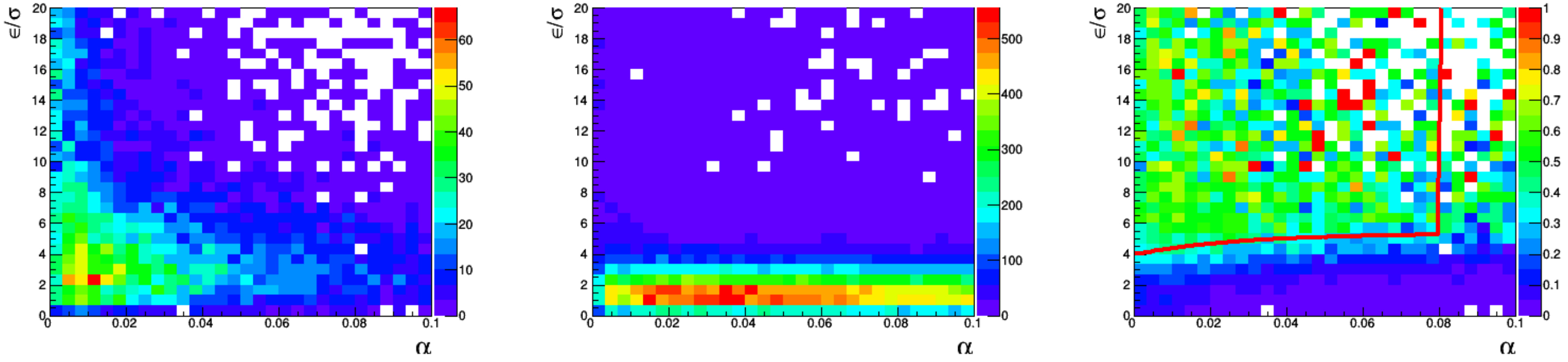
- The statistics is too short and the kinematics too different to the 250GeV case to extract any conclusion
- There are too many different things that make the comparison difficult
  - I don't have yet the equivalent plot for 500 GeV, DBD. I will make it and if it is different, it can serve to make more pressure to get new 250 GeV samples.

Recovery l5 vs s5 models

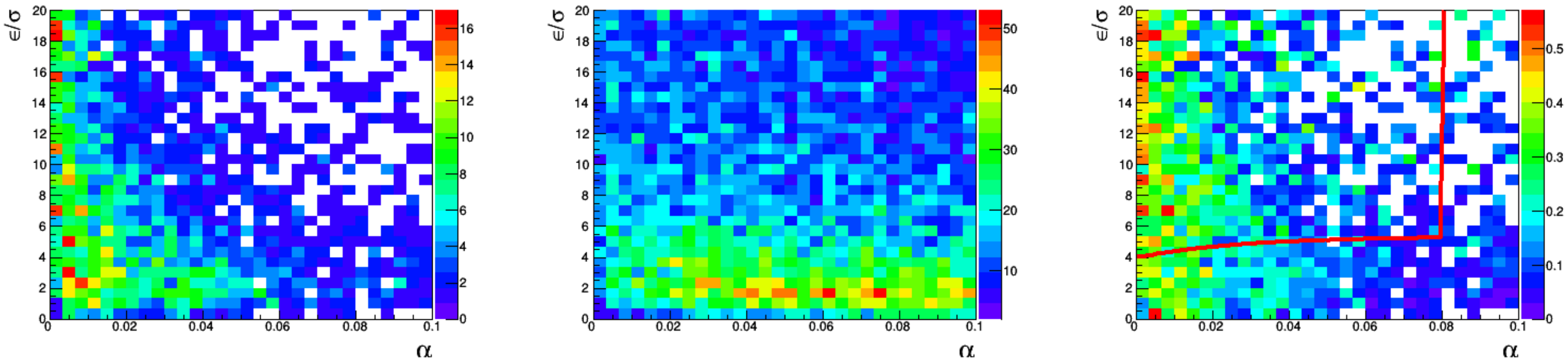
Track/Vertex DBD vs IDR ($b\bar{b}$, 500GeV, left pol.)

Tune of the recovery method

- DBD

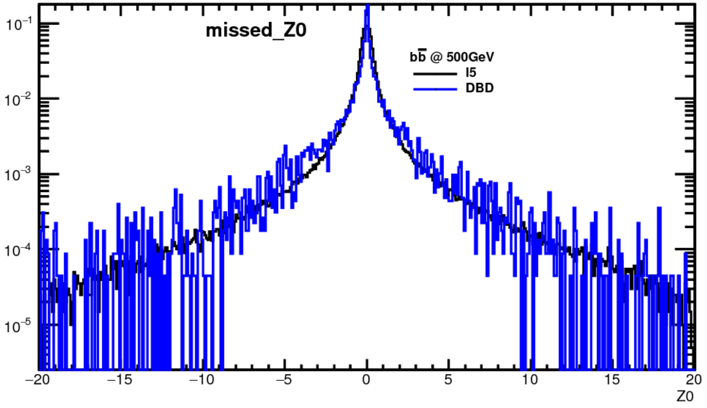


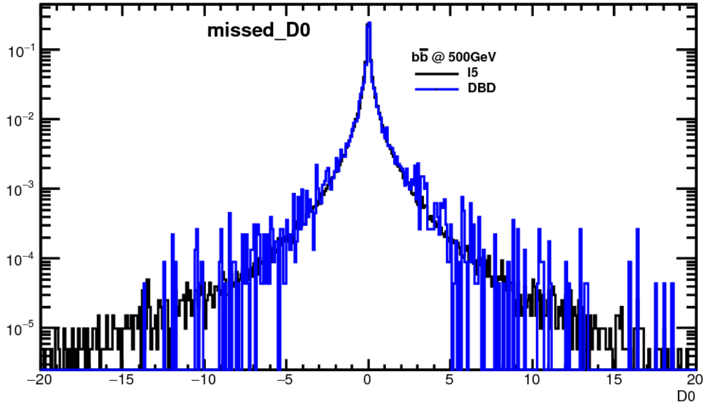
- IDR, large model

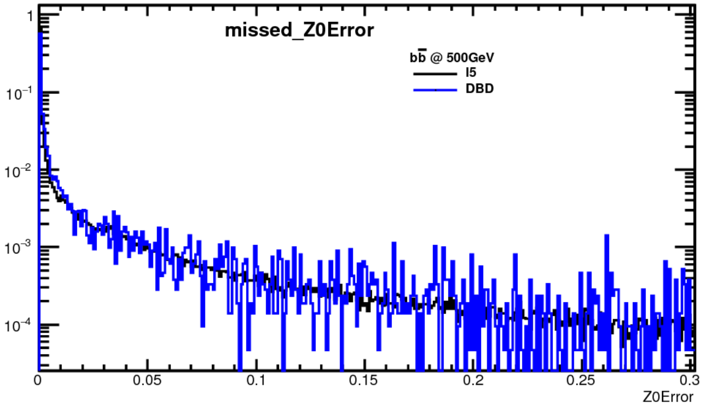


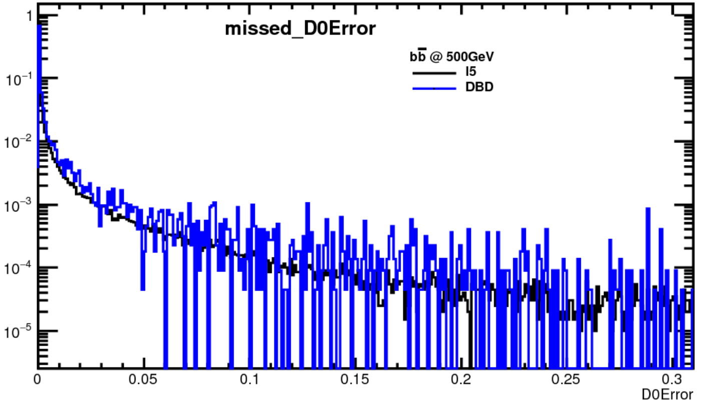
$$\epsilon/\sigma = d_0/\sigma_{d_0} + z_0/\sigma_{z_0}$$

DBD vs IDR

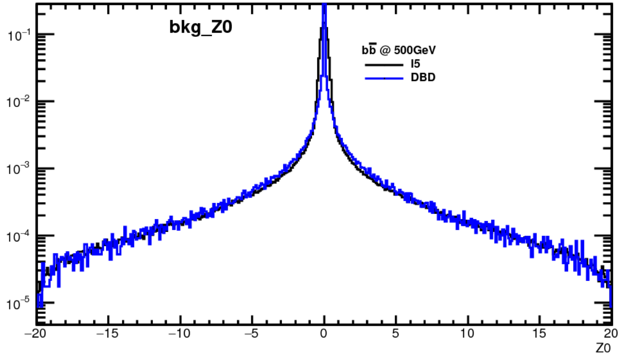

missed_Z0
bb̄ @ 500GeV
l5
DBD
Z0

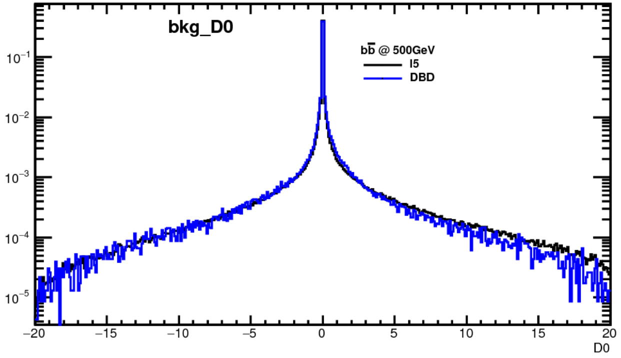

missed_D0
bb̄ @ 500GeV
l5
DBD
D0

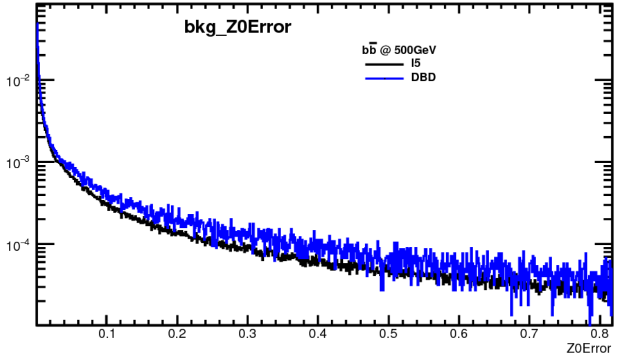

missed_Z0Error
bb̄ @ 500GeV
l5
DBD
Z0Error

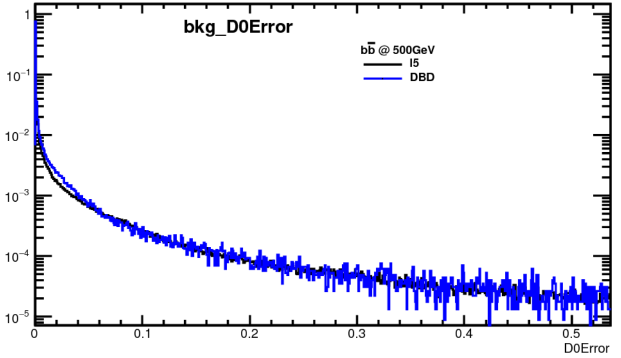

missed_D0Error
bb̄ @ 500GeV
l5
DBD
D0Error

DBD vs IDR

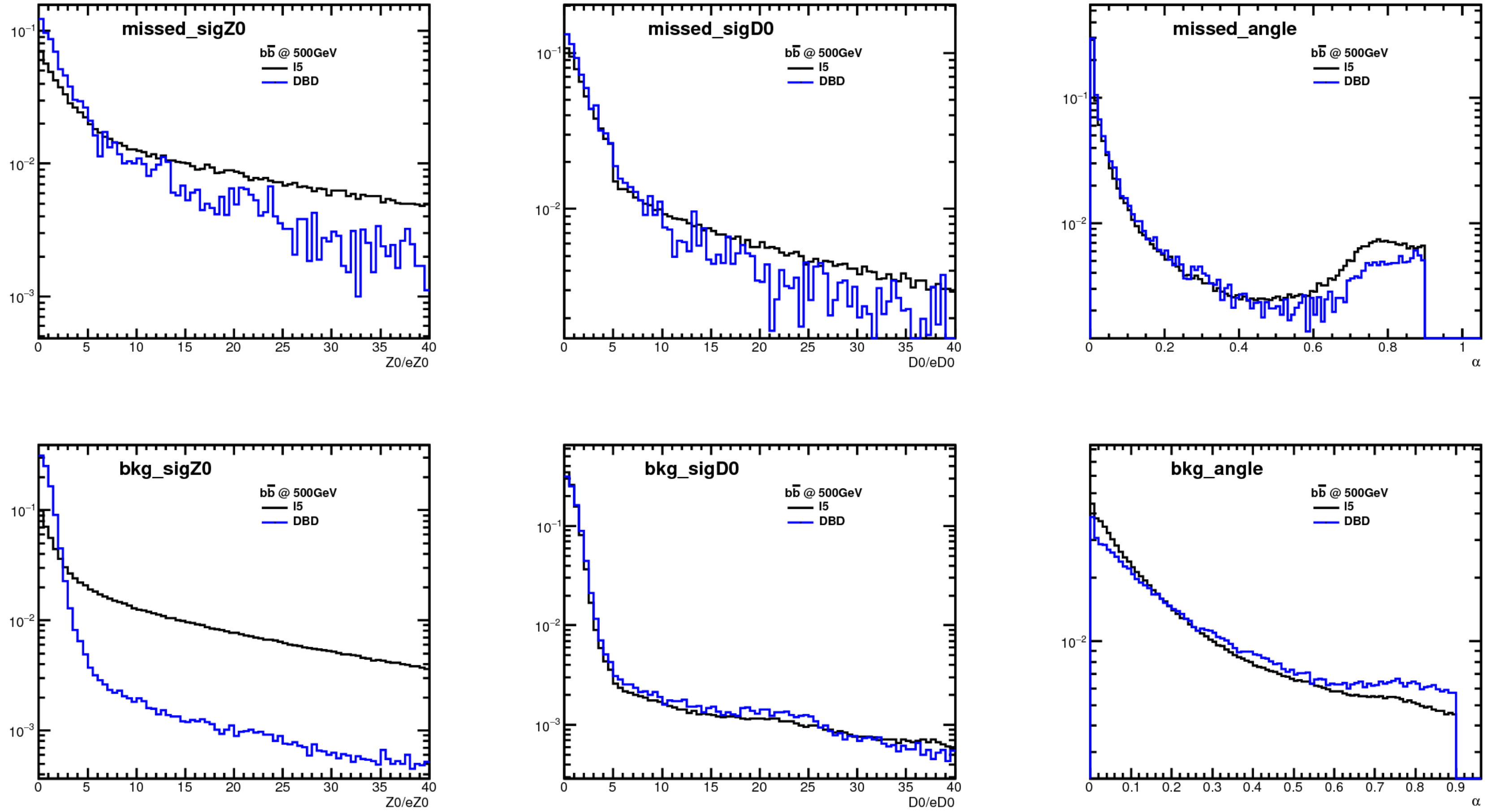

bkg_Z0
$b\bar{b}$ @ 500GeV
I5
DBD
Z0


bkg_D0
$b\bar{b}$ @ 500GeV
I5
DBD
D0


bkg_Z0Error
$b\bar{b}$ @ 500GeV
I5
DBD
Z0Error


bkg_D0Error
$b\bar{b}$ @ 500GeV
I5
DBD
D0Error

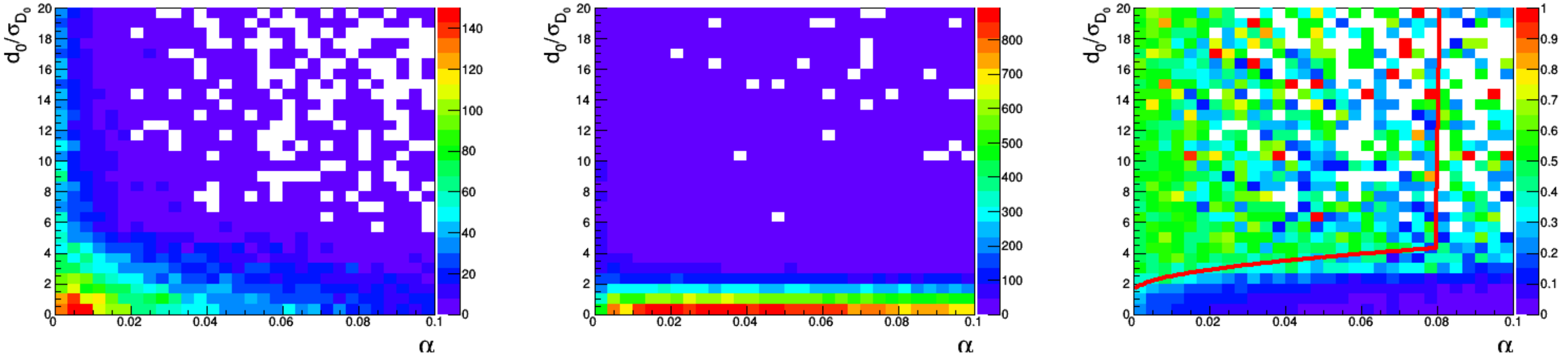
DBD vs IDR


missed_sigZ0
missed_sigD0
missed_angle
bkg_sigZ0
bkg_sigD0
bkg_angle
$b\bar{b}$ @ 500GeV
l5
DBD
Z0/eZ0
D0/eD0
α

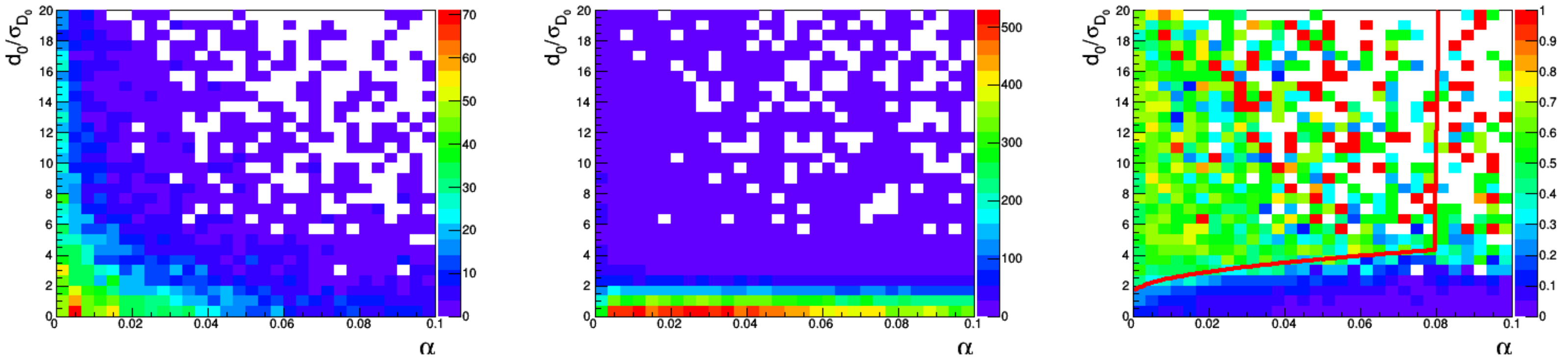
Track/Vertex DBD vs IDR ($b\bar{b}$, 500GeV, left pol.)

Tune of the recovery method, **only using d0**

- DBD



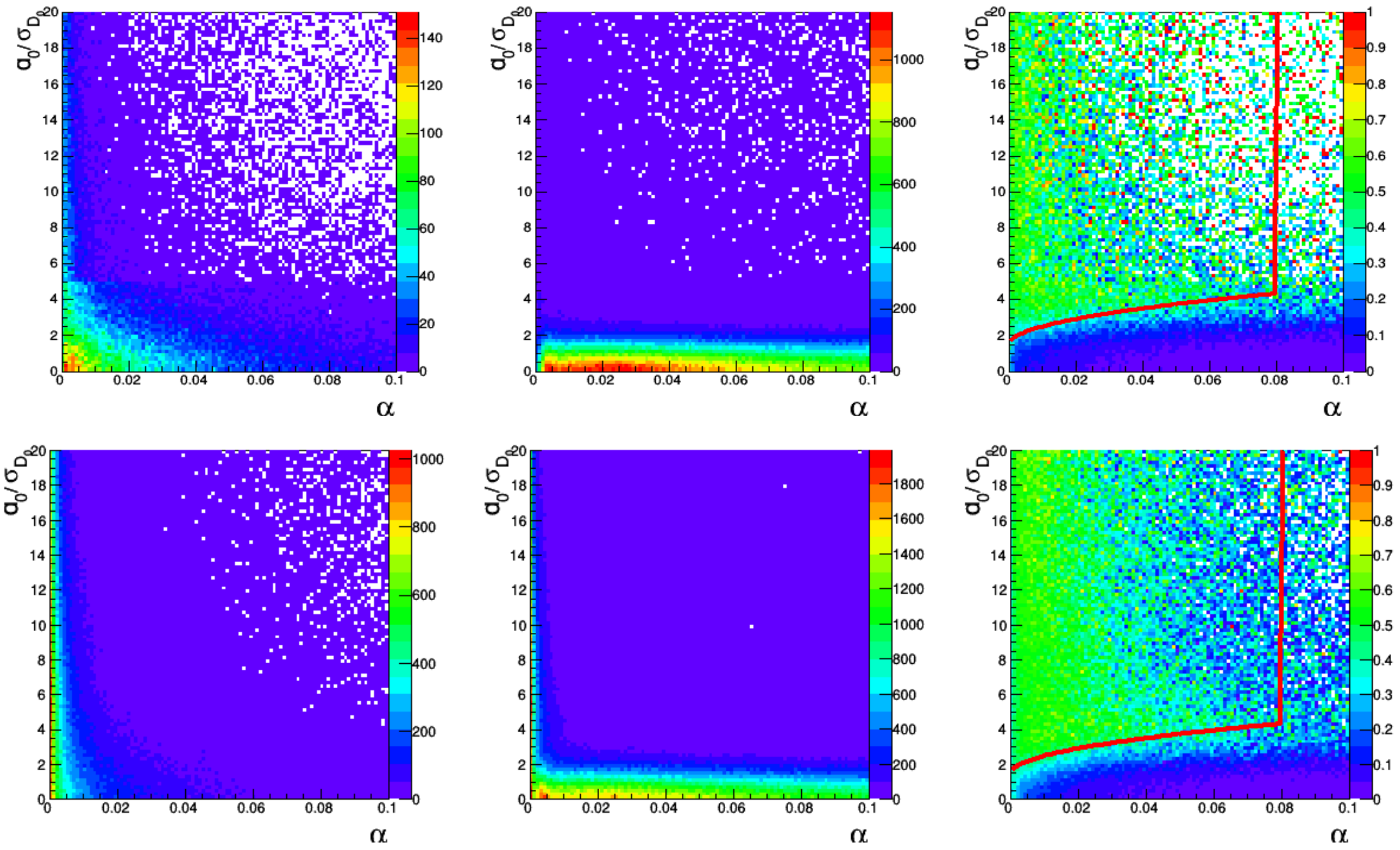
- IDR, large model



$$\epsilon/\sigma = d_0/\sigma_{d_0} + z_0/\sigma_{z_0}$$

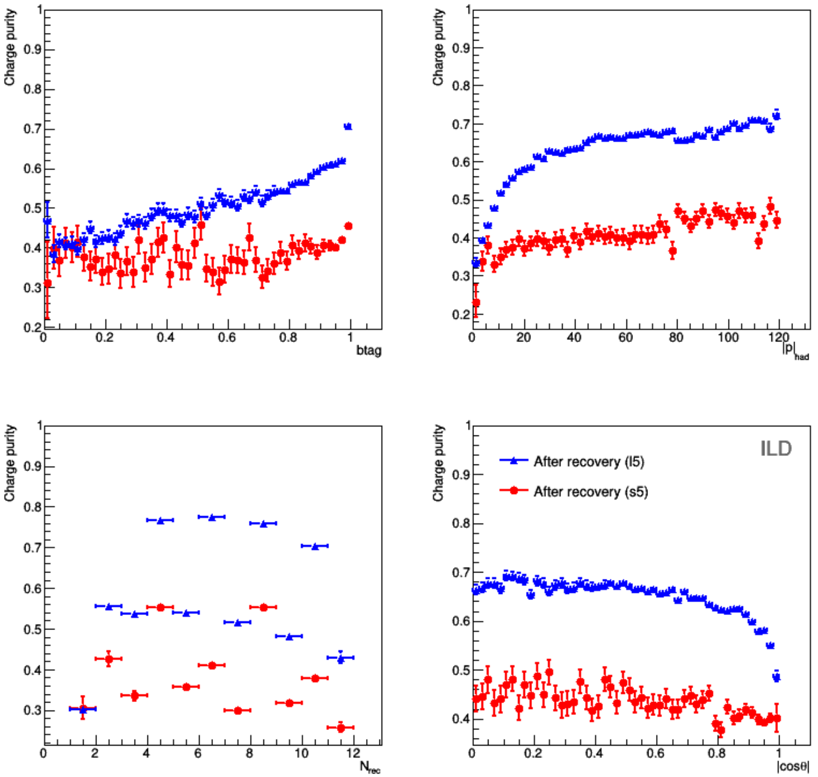
New Tracking / Reconstruction Improvements ($b\bar{b}$, 500GeV, left pol.)

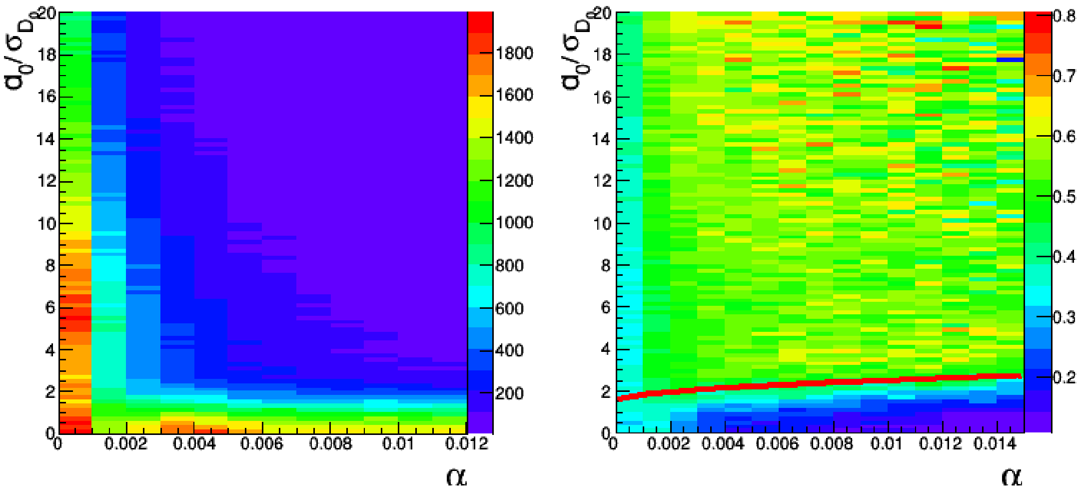
- L5 model
- s5 model



New Tracking / Reconstruction Improvements ($b\bar{b}$, 500GeV, left pol.)

- **s5** vs **l5**,

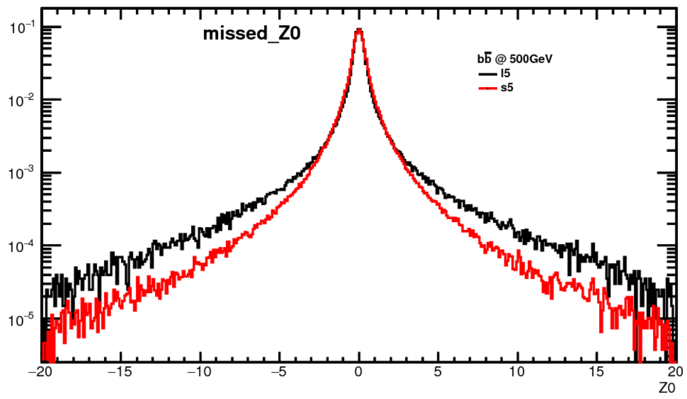


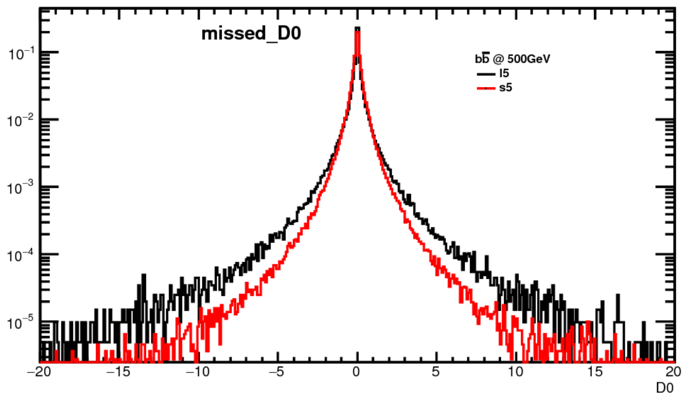


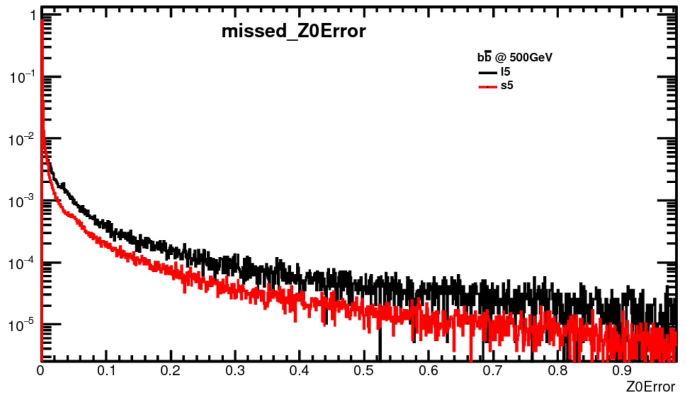
Zoom on the 2-d plot of slide 7
(fakes and purity)

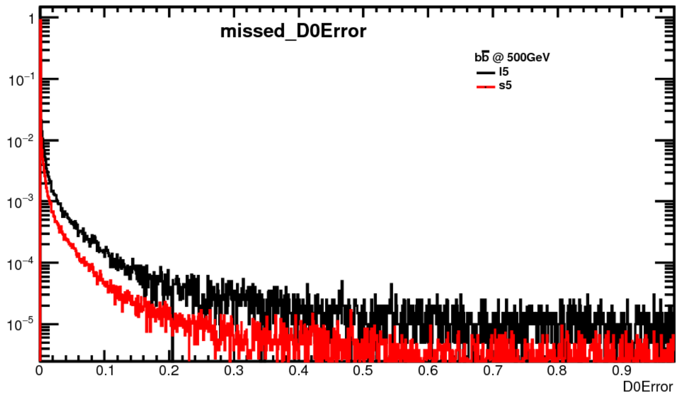
Irles, A.

Small vs large

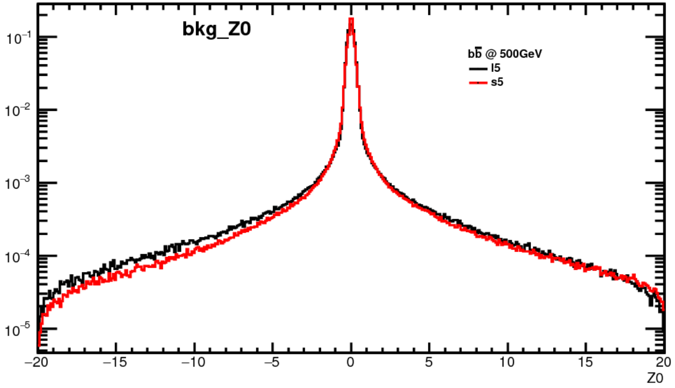


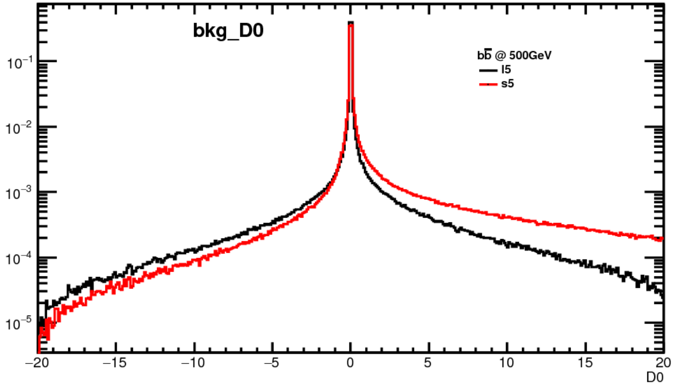


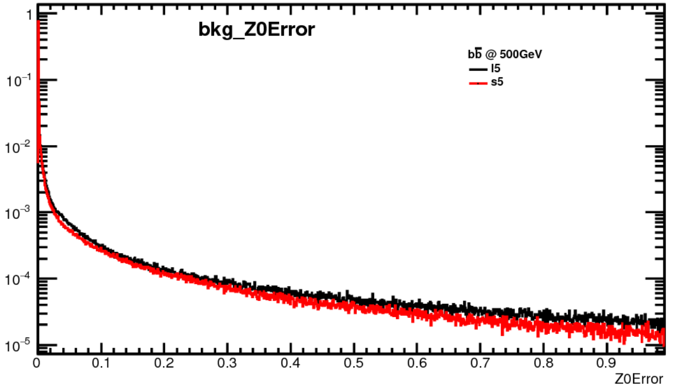


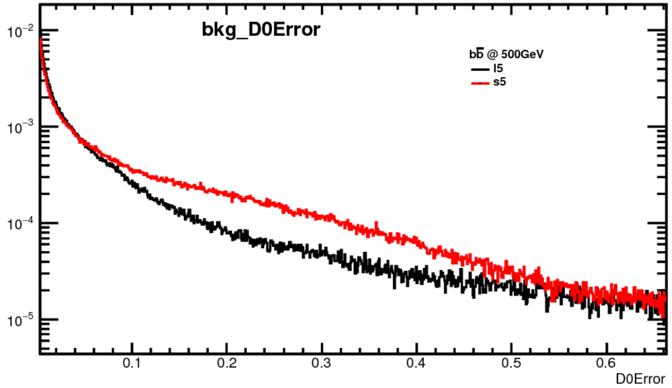


Small vs large

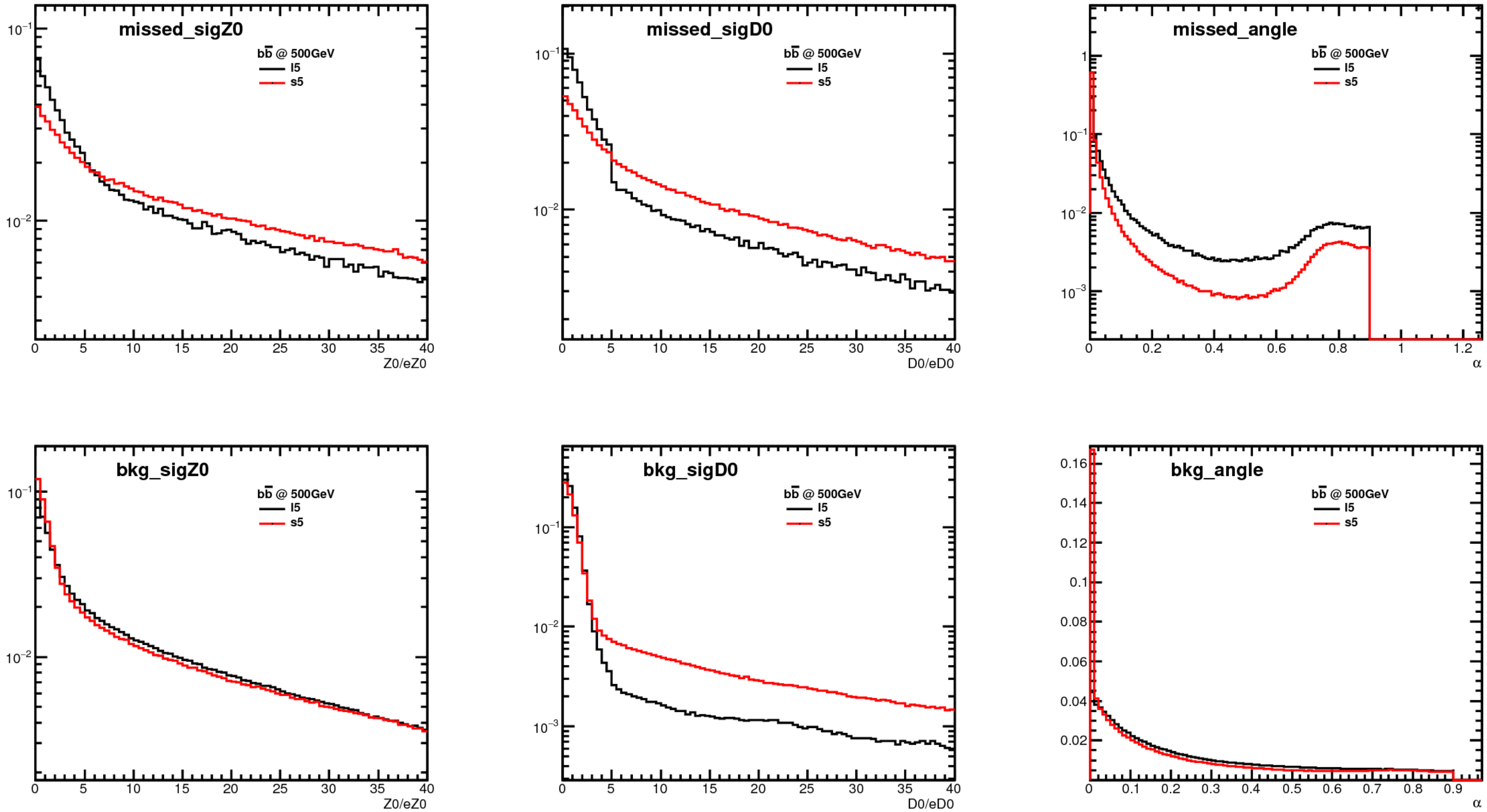








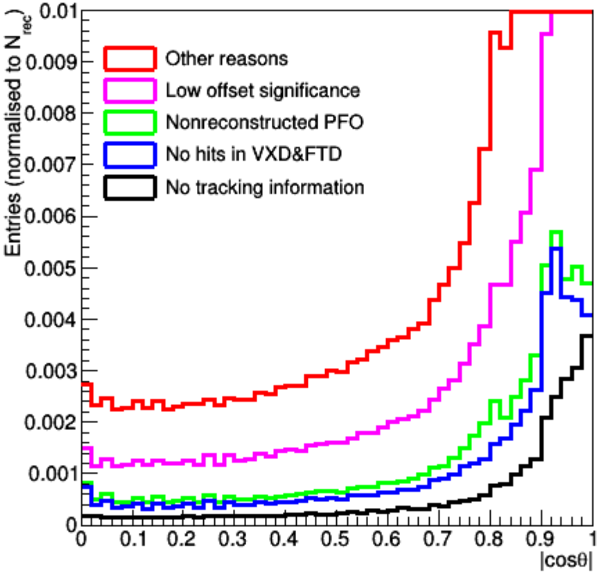
Small vs large



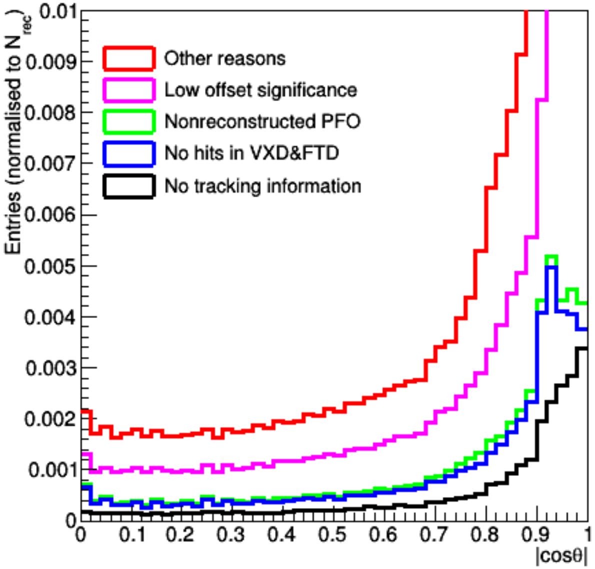
Before vs After Recovery for large model

New Tracking / Reconstruction Improvements ($b\bar{b}$, 500GeV, left pol.)

- IDR, l5, new vtx reprocessing



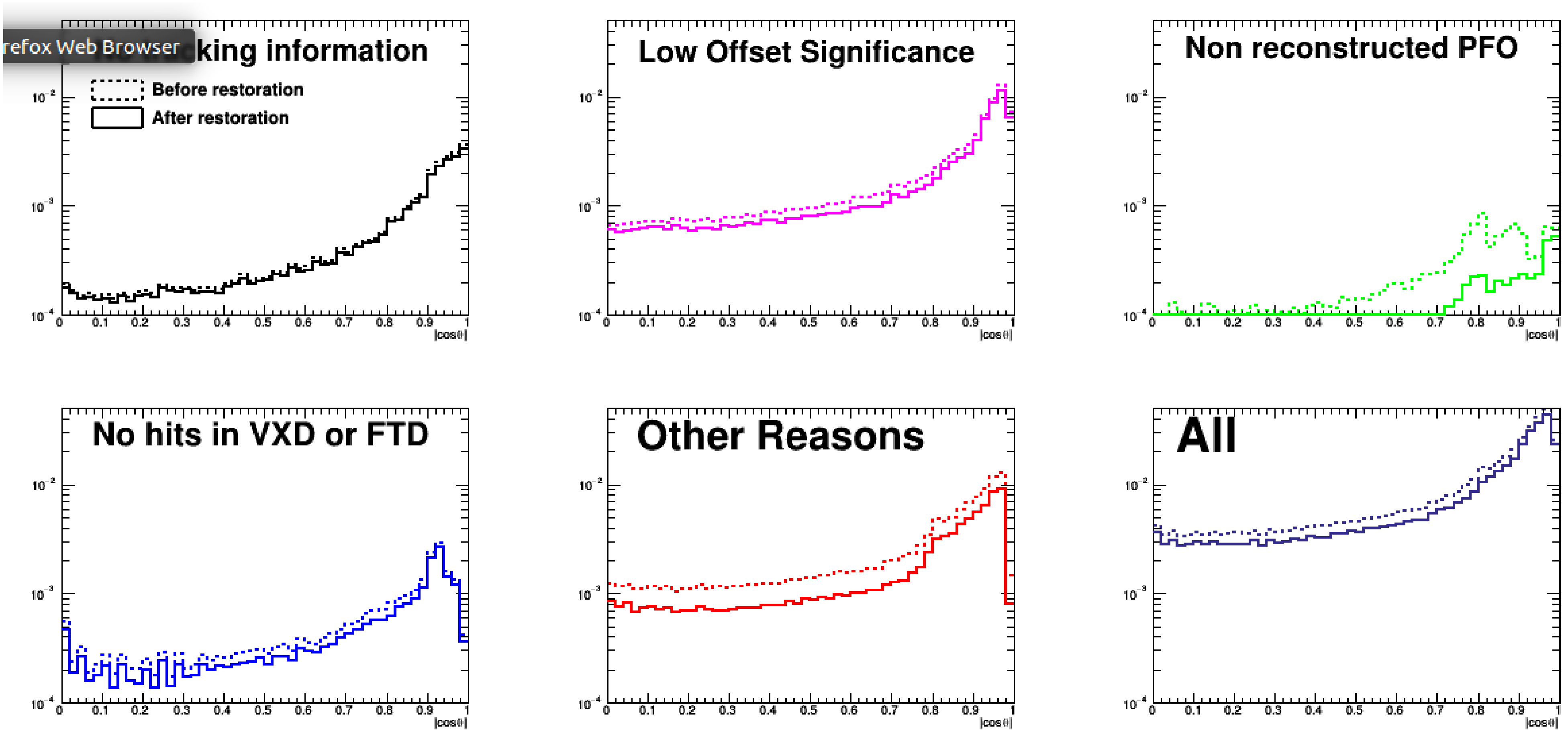
Before Recovery



After Recovery

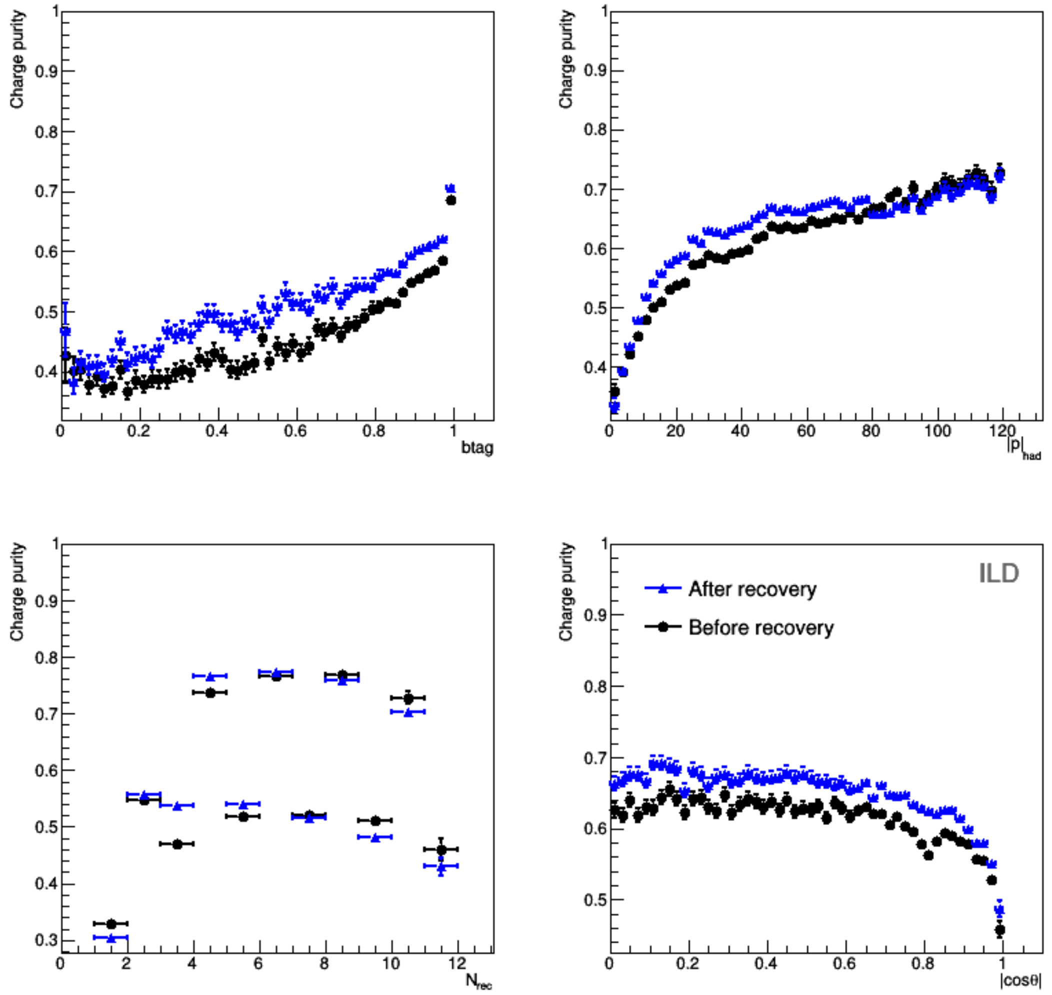
New Tracking / Reconstruction Improvements ($b\bar{b}$, 500GeV, left pol.)

- Before vs After



New Tracking / Reconstruction Improvements ($b\bar{b}$, 500GeV, left pol.)

- **Before** vs **After**,
- l5 model



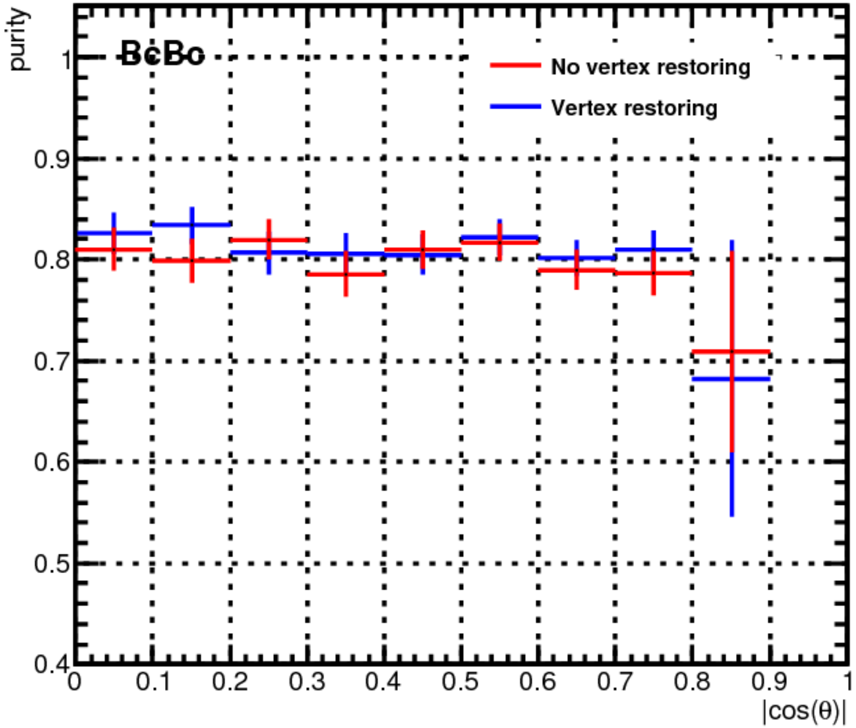
CutFlow, ls : w/o and with restoring

- Moderated increase

Large Model		Large Model (+restoring)	
BcBc:	7.0 %	BcBc:	7.1 %
KcKc:	9.8 %	KcKc:	10.2 %
BcKc(jet1):	3.1 %	BcKc(jet1):	3.0 %
BcKc(jet2):	0.6 %	BcKc(jet2):	0.6 %
BcKc:	0.6 %	BcKc:	0.6 %
KcBc:	0.8 %	KcBc:	0.7 %
total	**21.8 %**	**total**	**22.3 %**

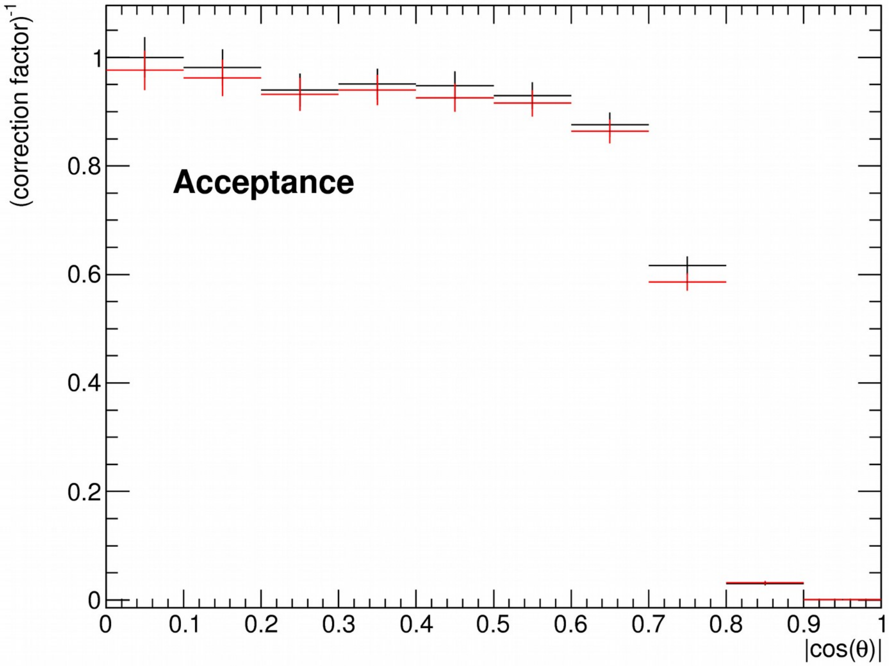
Purity calculation (l5 model)

- Moderated improvement for BcBc.
- Stat unc. Are too large.



Detector acceptance

- Correction factor = distribution parton level (reco cuts)/ distribution parton level
- **Red: before restoring**
- **Black: after**



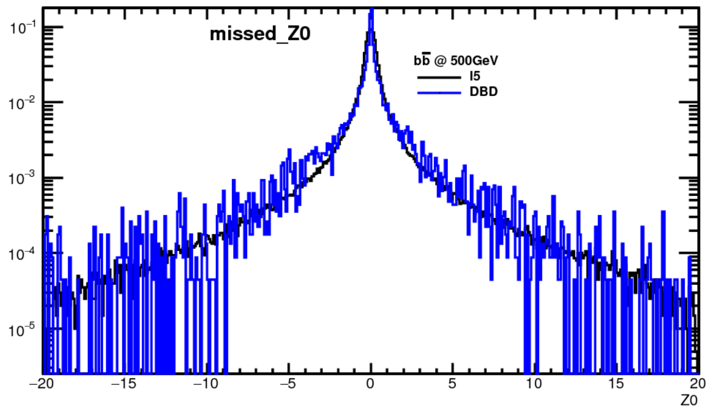
CutFlow, ls : w/o and with restoring

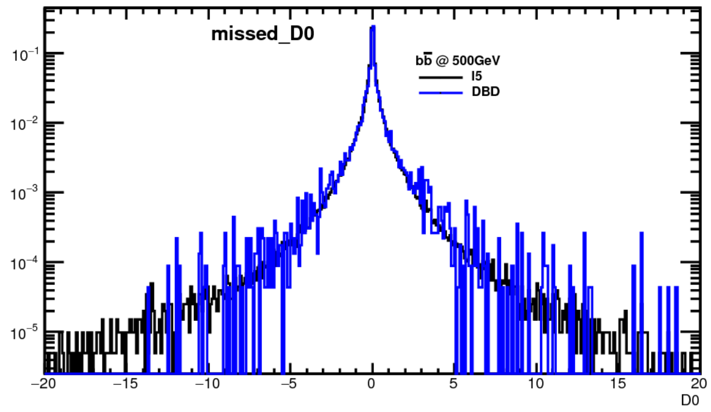
- Moderated increase

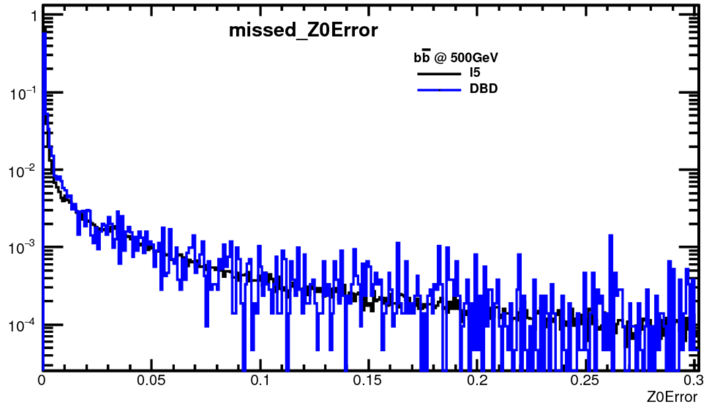
Large Model		Large Model (+restoring)	
BcBc:	7.0 %	BcBc:	7.1 %
KcKc:	9.8 %	KcKc:	10.2 %
BcKc(jet1):	3.1 %	BcKc(jet1):	3.0 %
BcKc(jet2):	0.6 %	BcKc(jet2):	0.6 %
BcKc:	0.6 %	BcKc:	0.6 %
KcBc:	0.8 %	KcBc:	0.7 %
total	**21.8 %**	**total**	**22.3 %**

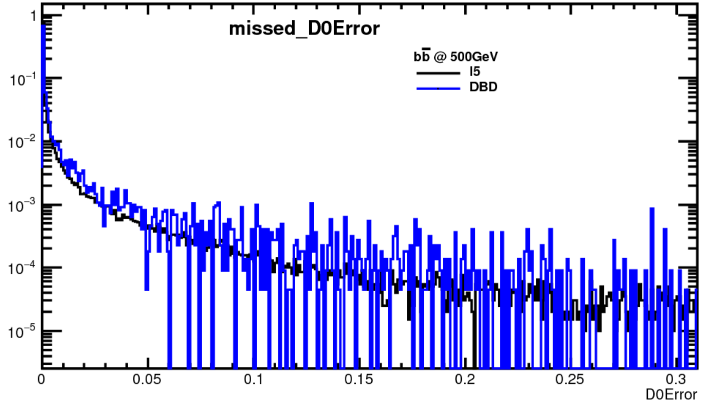
Back-up

DBD vs IDR

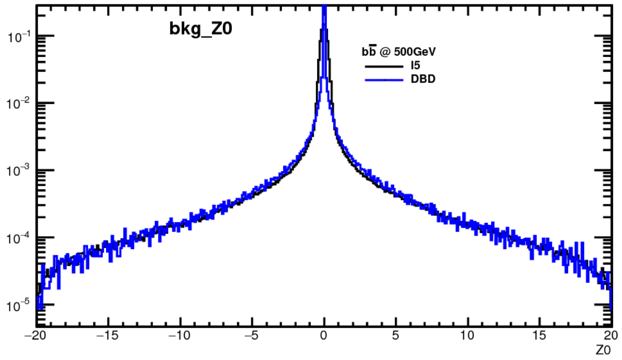

missed_Z0
$b\bar{b}$ @ 500GeV
l5
DBD
Z0

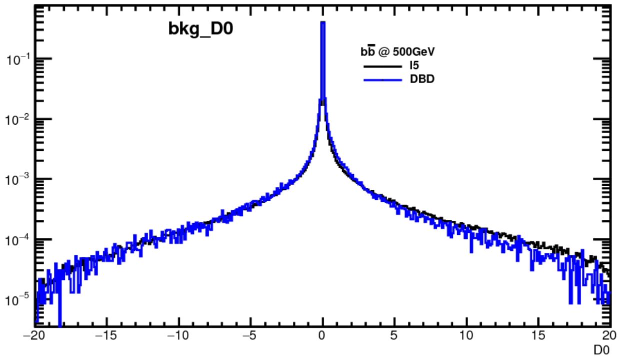

missed_D0
$b\bar{b}$ @ 500GeV
l5
DBD
D0

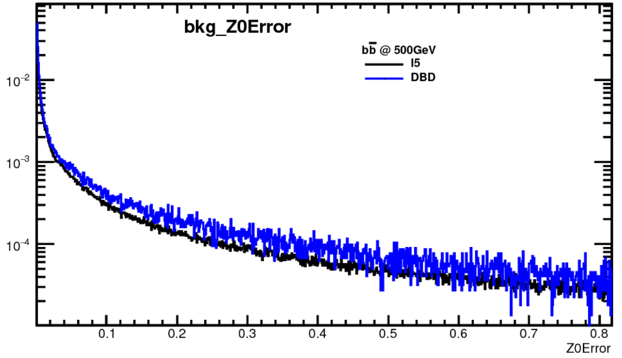

missed_Z0Error
$b\bar{b}$ @ 500GeV
l5
DBD
Z0Error

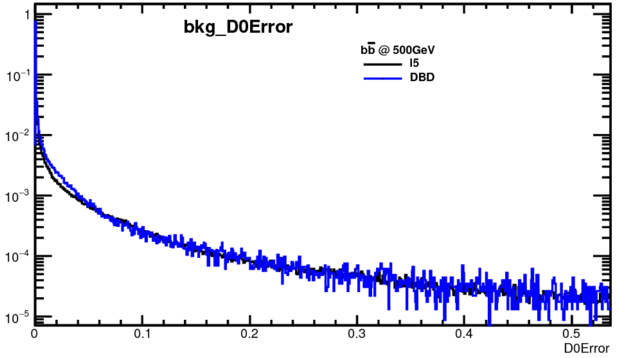

missed_D0Error
$b\bar{b}$ @ 500GeV
l5
DBD
D0Error

DBD vs IDR

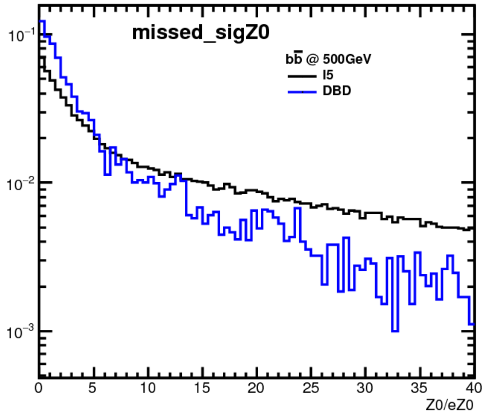

bkg_Z0
$b\bar{b}$ @ 500GeV
I5
DBD
Z0

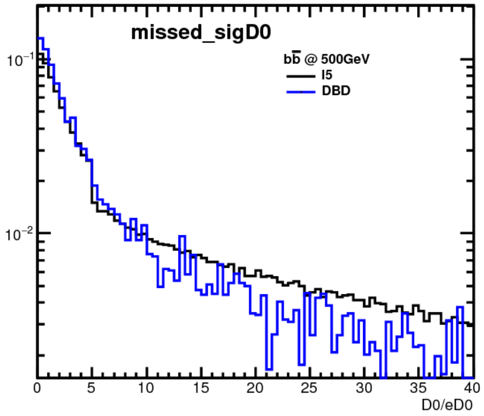

bkg_D0
$b\bar{b}$ @ 500GeV
I5
DBD
D0

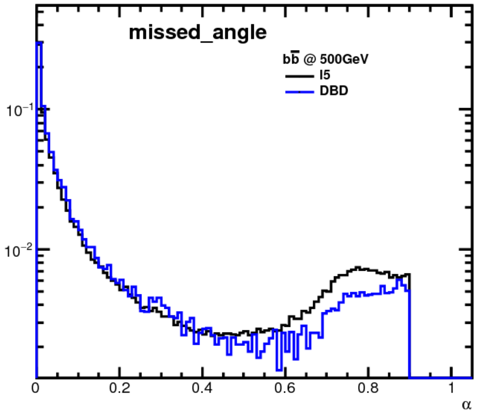

bkg_Z0Error
$b\bar{b}$ @ 500GeV
I5
DBD
Z0Error

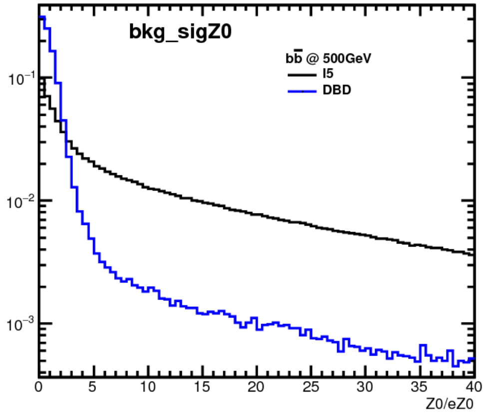

bkg_D0Error
$b\bar{b}$ @ 500GeV
I5
DBD
D0Error

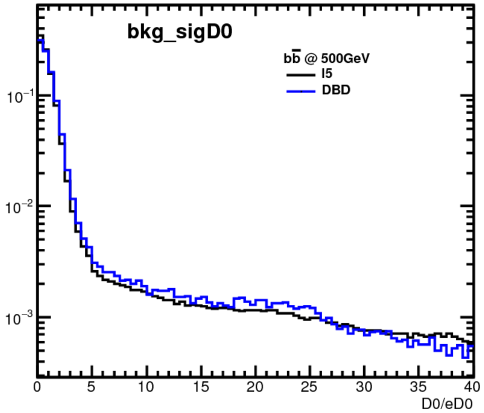
DBD vs IDR

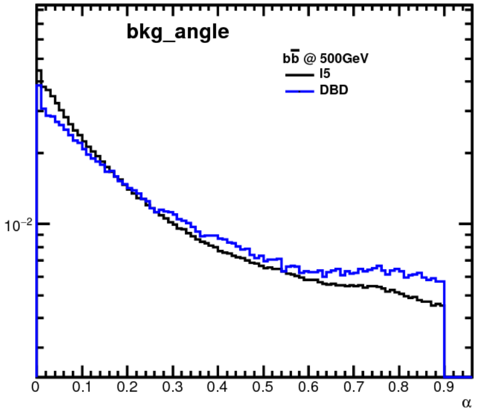

missed_sigZ0
$b\bar{b}$ @ 500GeV
l5
DBD
Z0/eZ0


missed_sigD0
$b\bar{b}$ @ 500GeV
l5
DBD
D0/eD0


missed_angle
$b\bar{b}$ @ 500GeV
l5
DBD
α


bkg_sigZ0
$b\bar{b}$ @ 500GeV
l5
DBD
Z0/eZ0


bkg_sigD0
$b\bar{b}$ @ 500GeV
l5
DBD
D0/eD0


bkg_angle
$b\bar{b}$ @ 500GeV
l5
DBD
α