

VBS Same-sign WW Classification by DNN

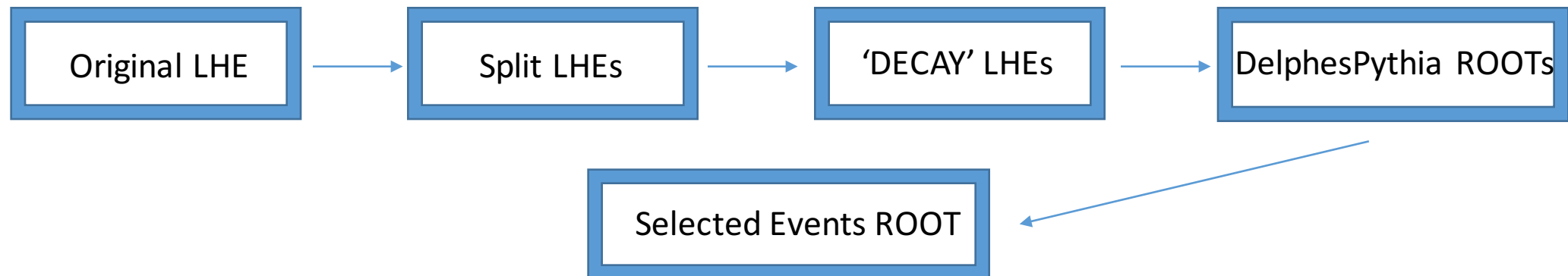
Junho Lee
2018/10/30

VBS Same-sign WW – DNN Strategy

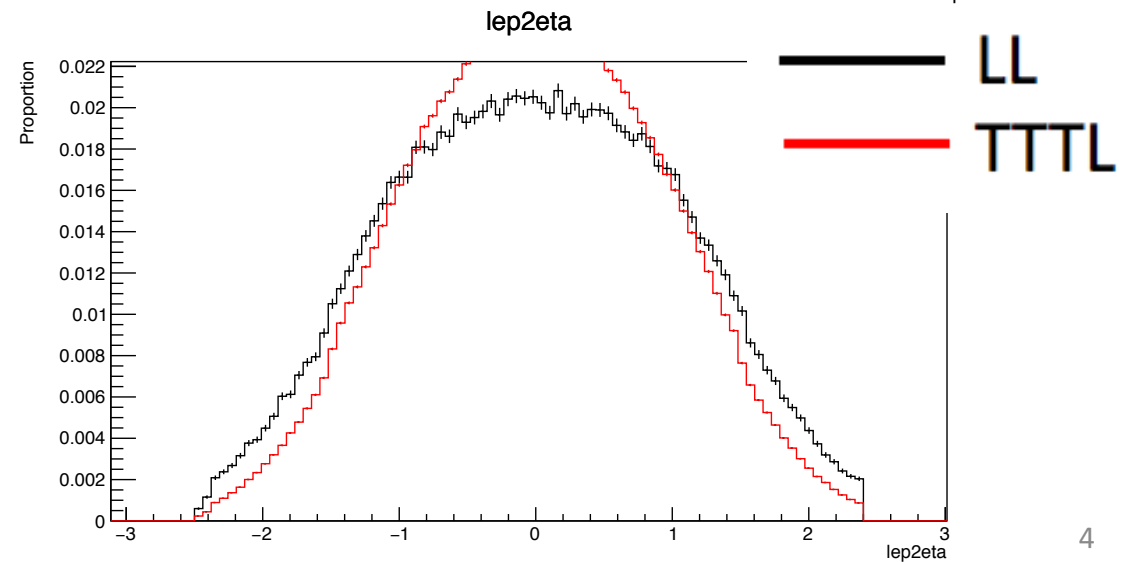
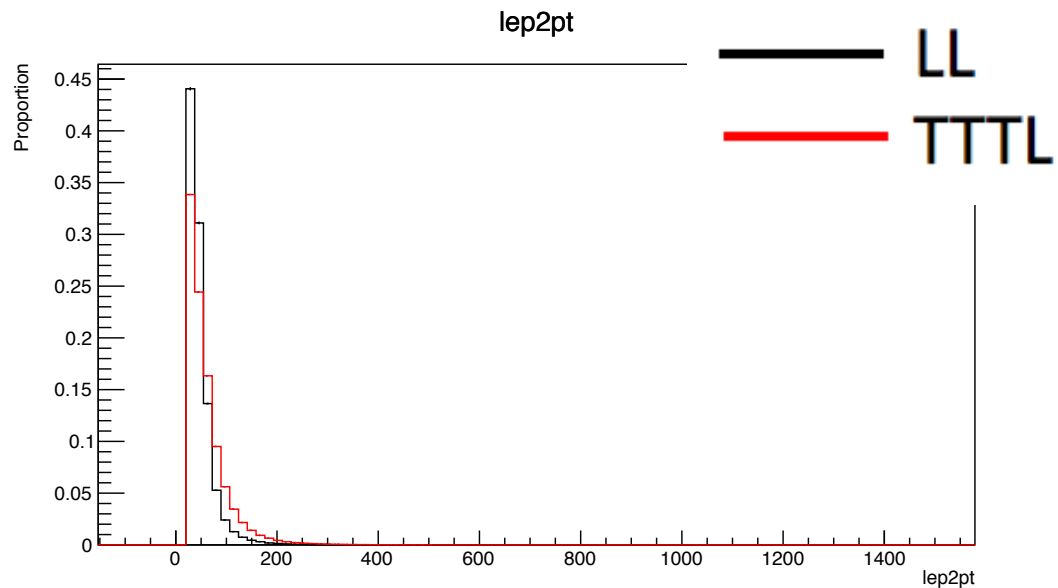
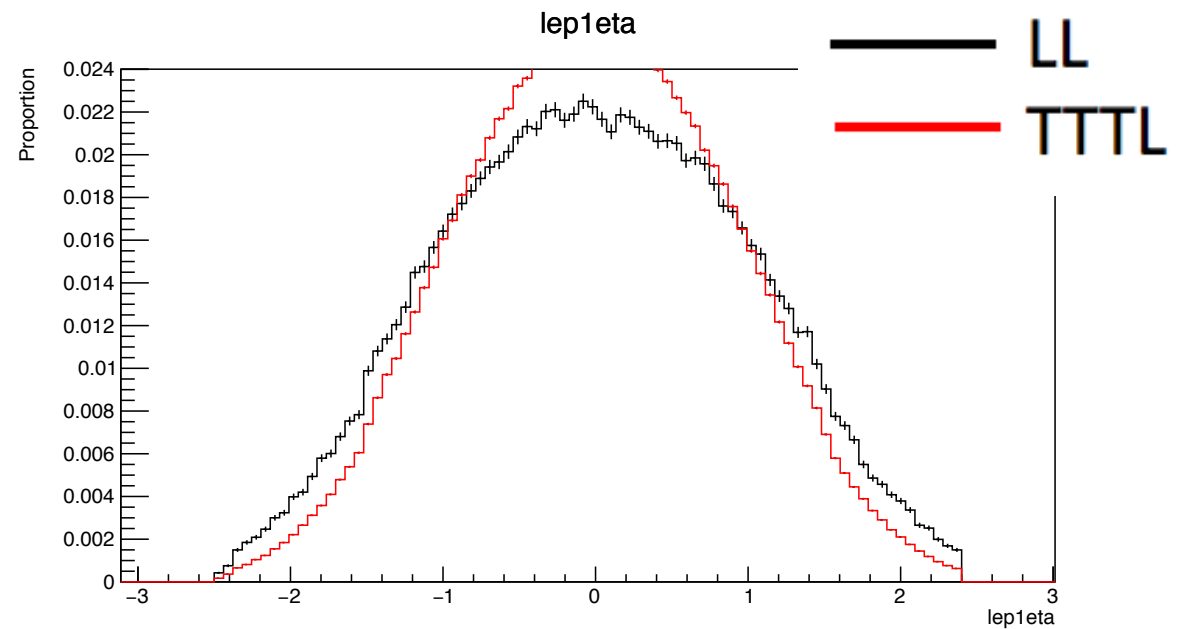
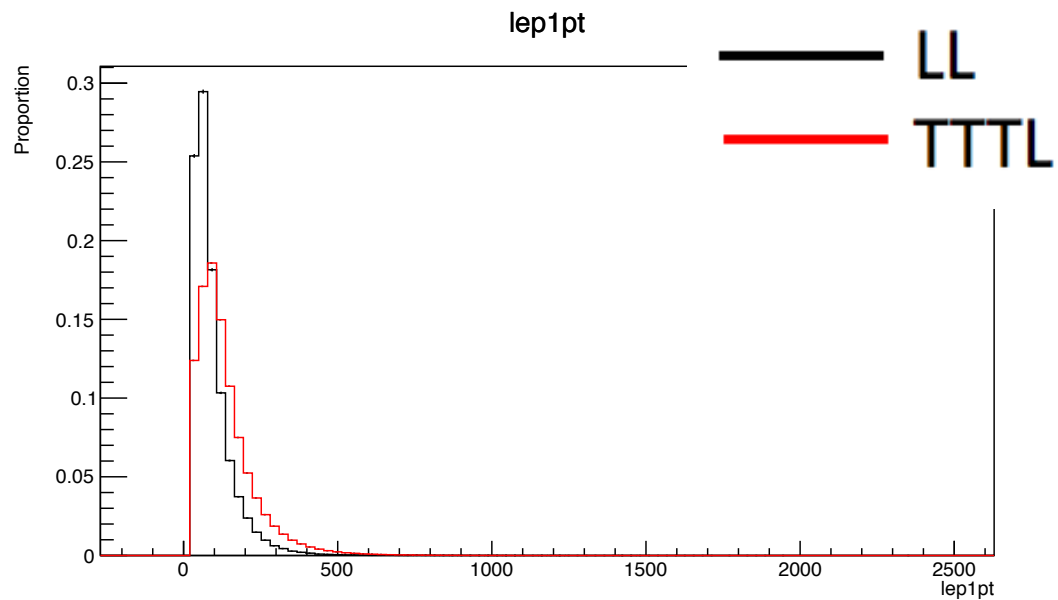
- $P P \rightarrow W W \text{ jet jet}, W \rightarrow \text{lep nu}, W \rightarrow \text{lep nu}$ (Same sign WW)
- Separate Events by Helicity of W boson :
 - $W_{\text{Longitudinal}} + W_{\text{Longitudinal}} \rightarrow \text{LL}$
 - $W_{\text{Transverse}} + W_{\text{Transverse}} \rightarrow \text{TT}$
 - $W_{\text{Longitudinal}} + W_{\text{Transverse}} \rightarrow \text{TL}$
 - $\text{TT} + \text{TL} \rightarrow \text{TTTL}$
- Classify 'LL' and 'TTTL', by DNN (supervised binary classification)
- Template fitting performed to achieve 'LL' fraction.

Event production work-flow

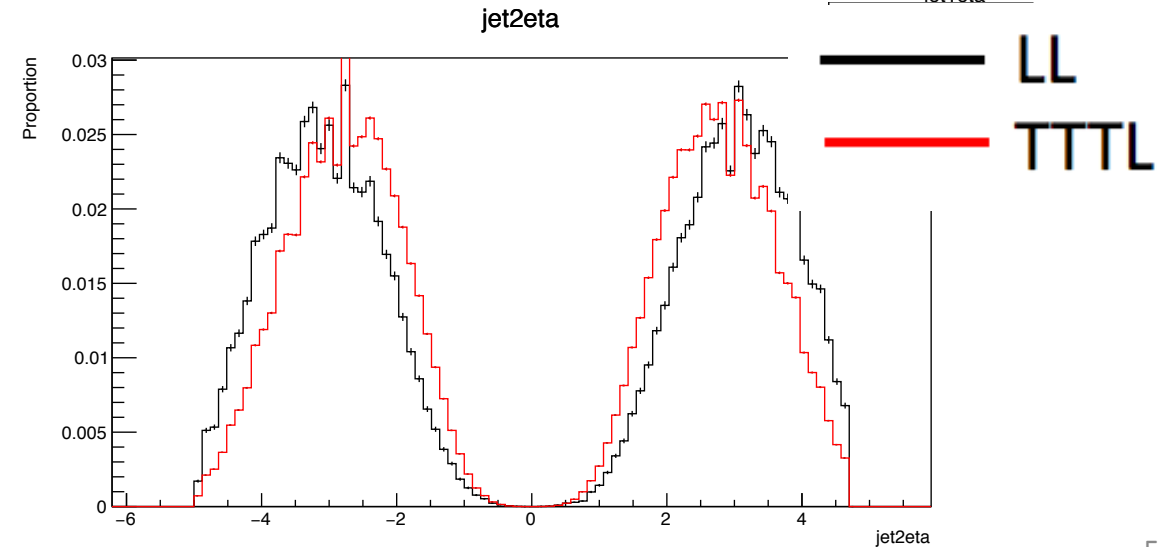
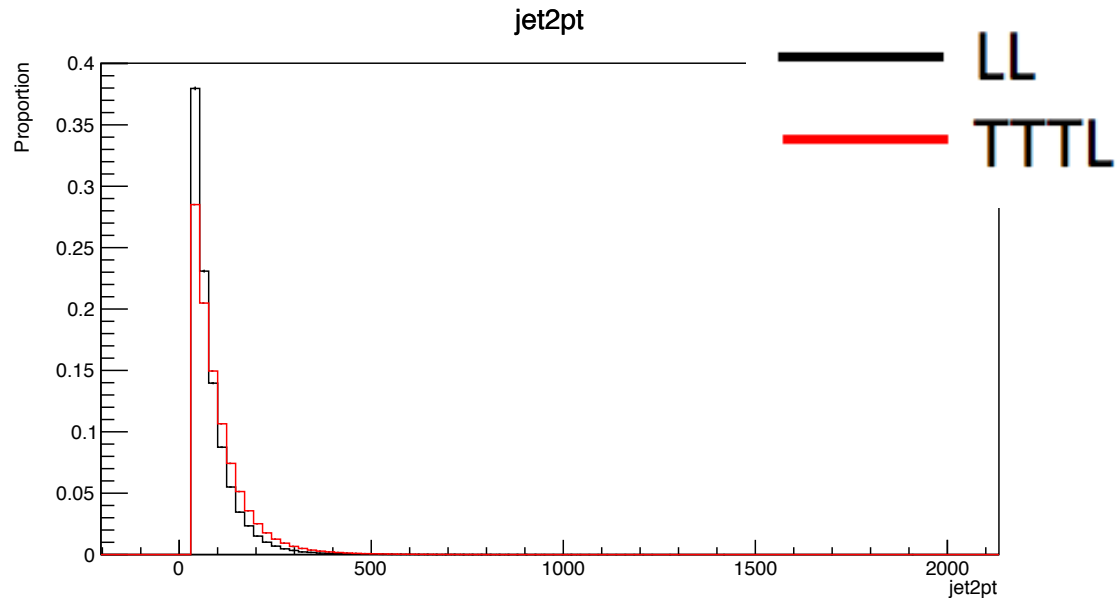
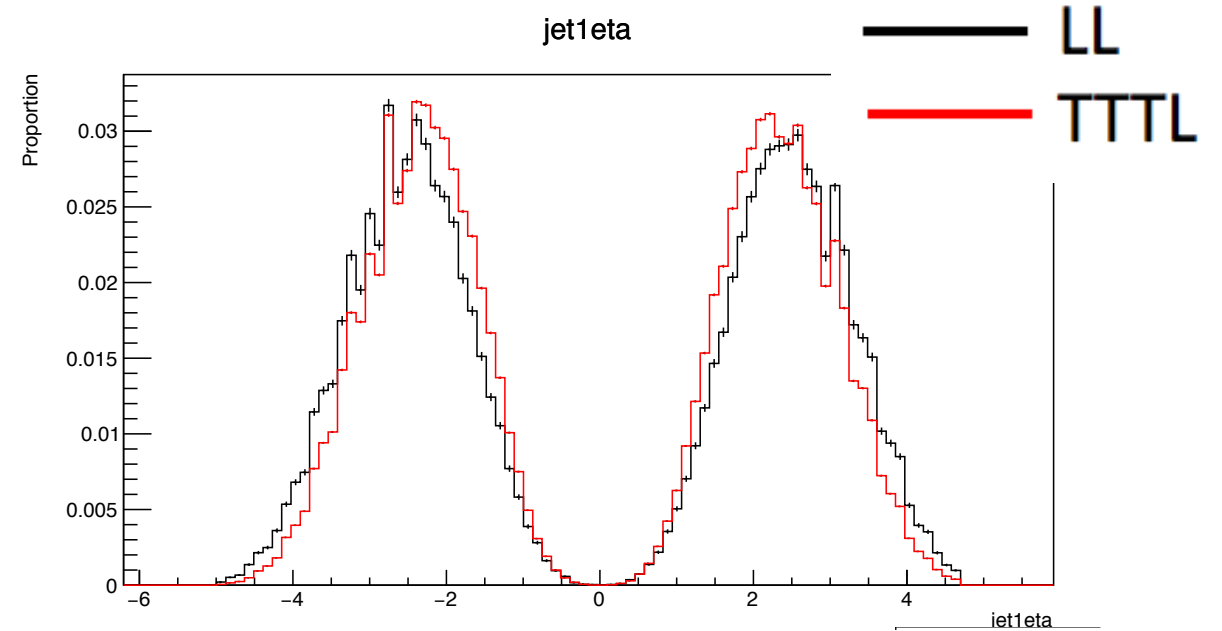
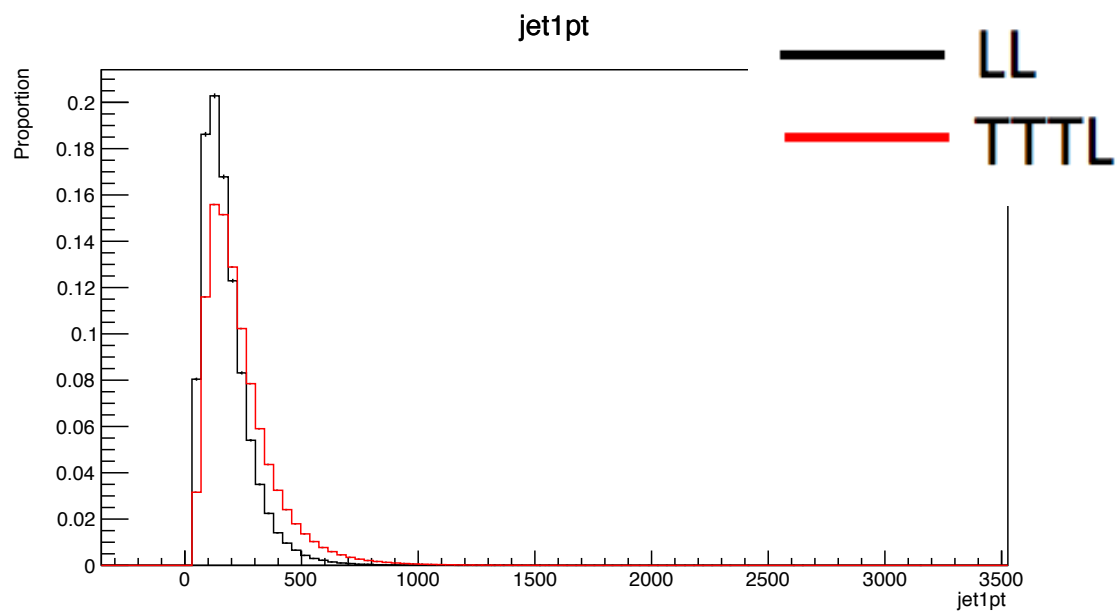
- 1. LHE
 - Generating on 'PKU-cluster'. (with 128 CPU cores)
 - "p p > w+ w+ j j [QCD=0]" and "p p > w- w- j j [QCD=0]"
- 2. Transfer
 - Transfer LHE from 'PKU-cluster' to 'Ixplus EOS space'
- 3. Split LHE & DECAY & Pythia & Delphes & Event Selection
 - By batch job

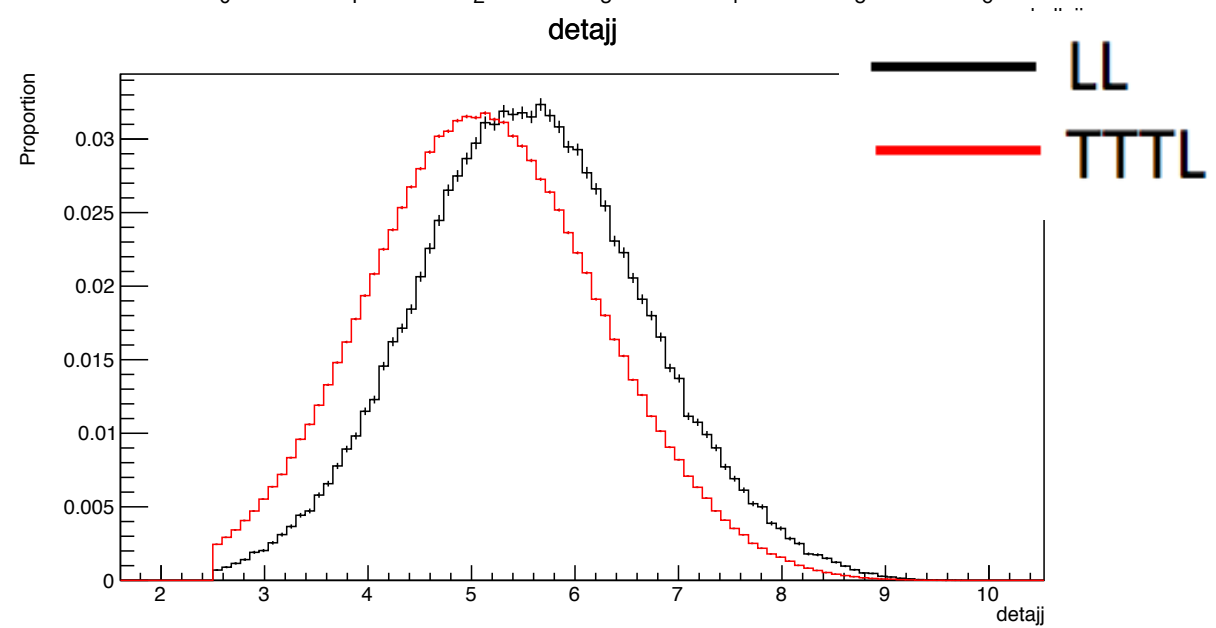
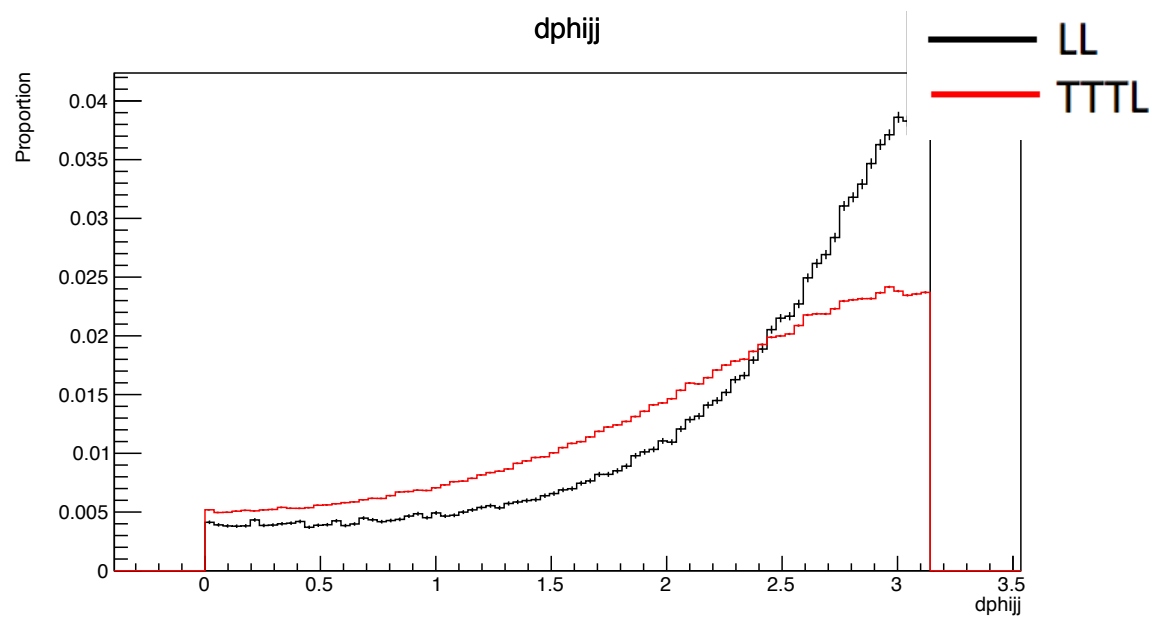
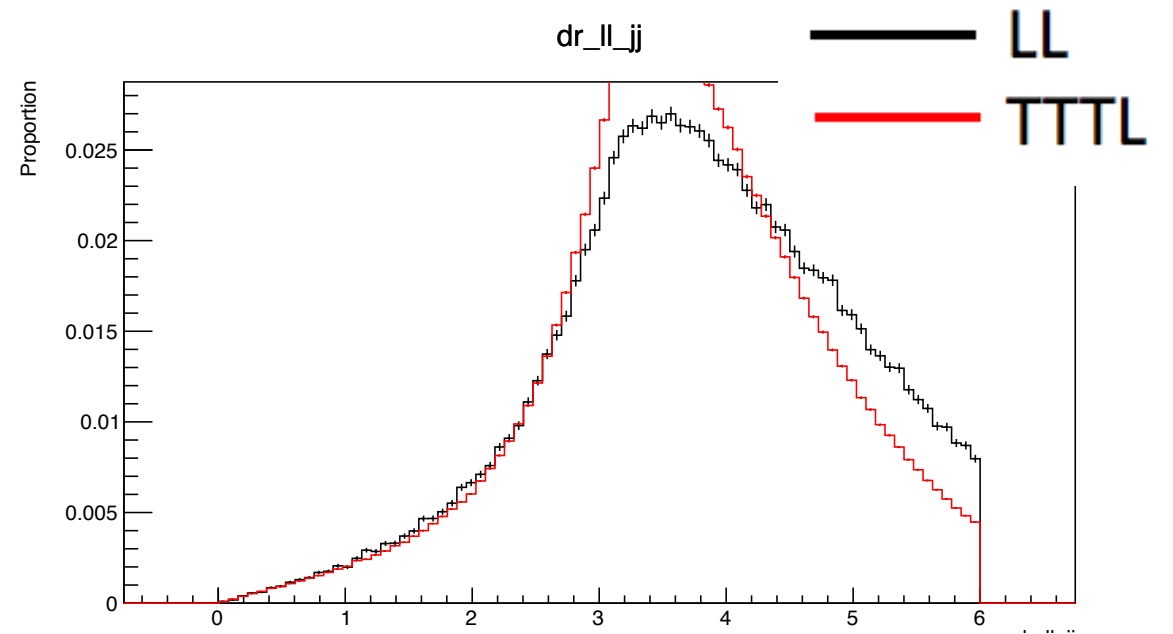
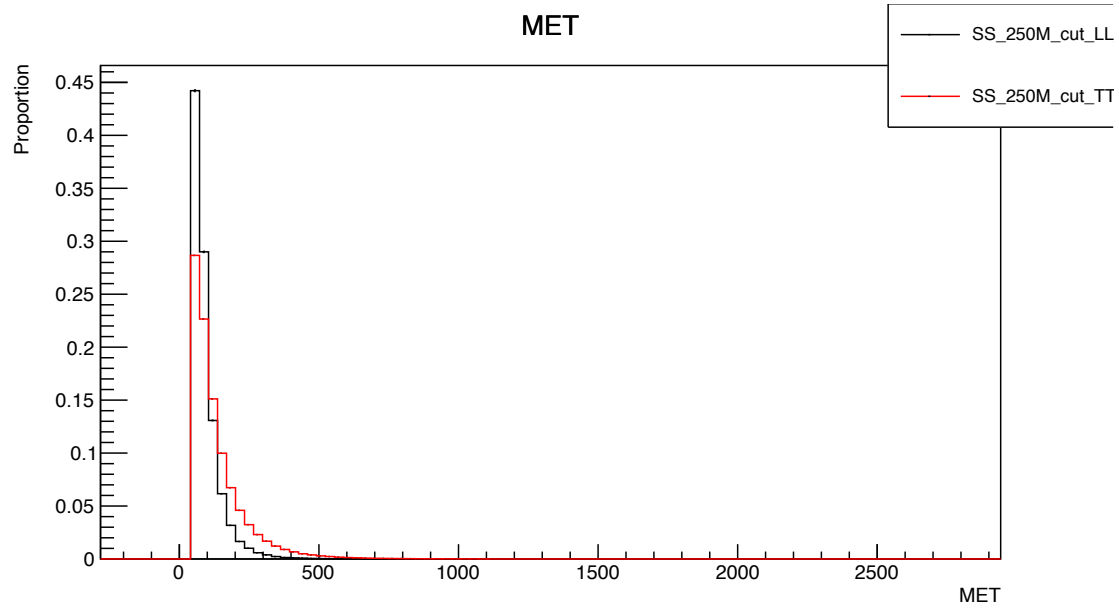


VBS Same-sign WW – Distribution

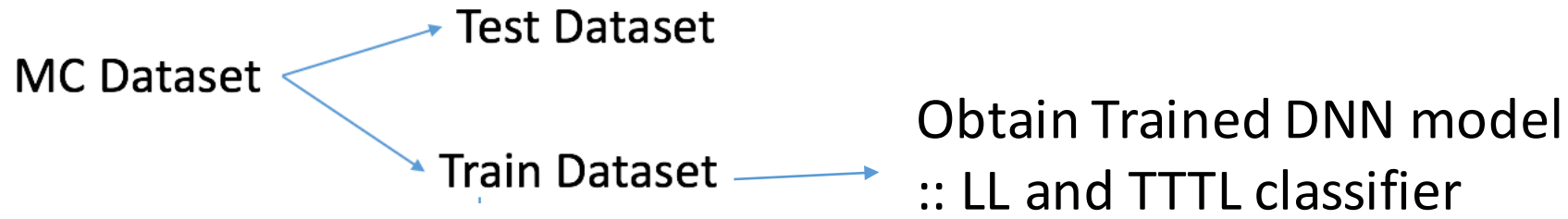


VBS Same-sign WW – Distribution

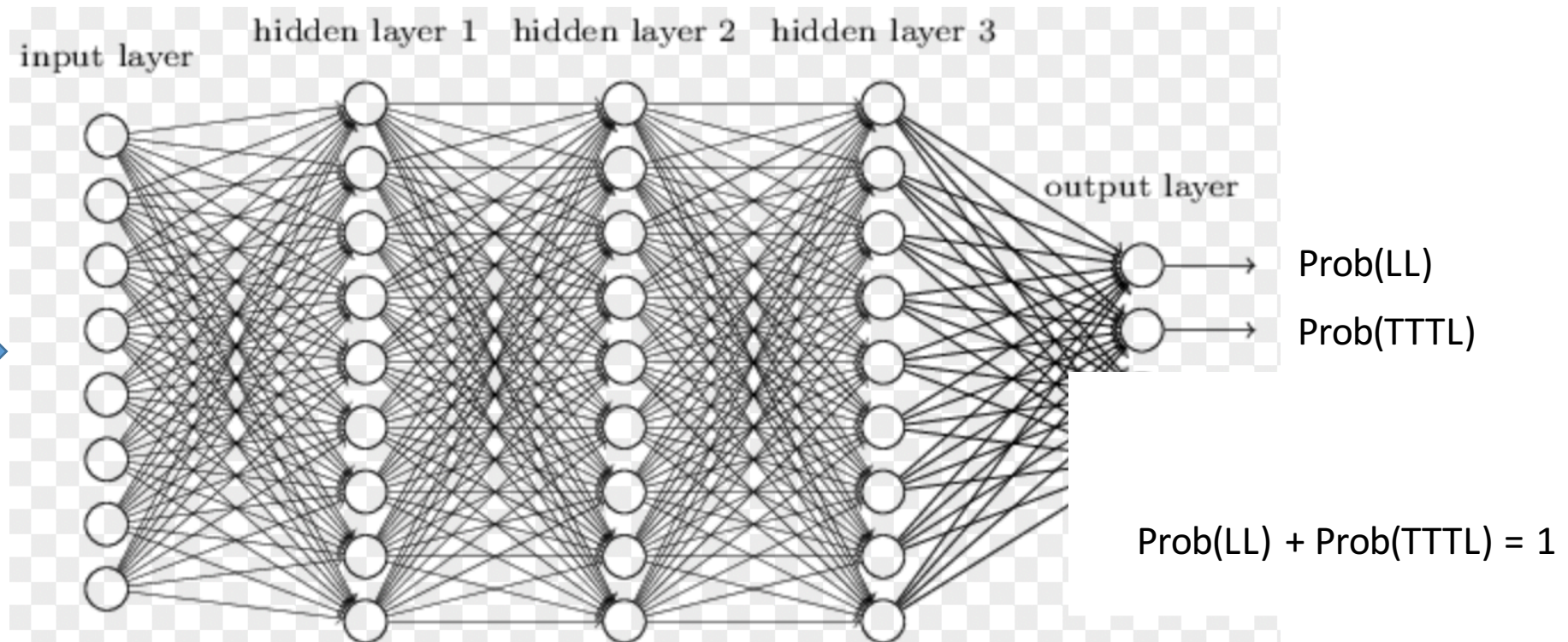




VBS Same-sign WW – DNN work flow

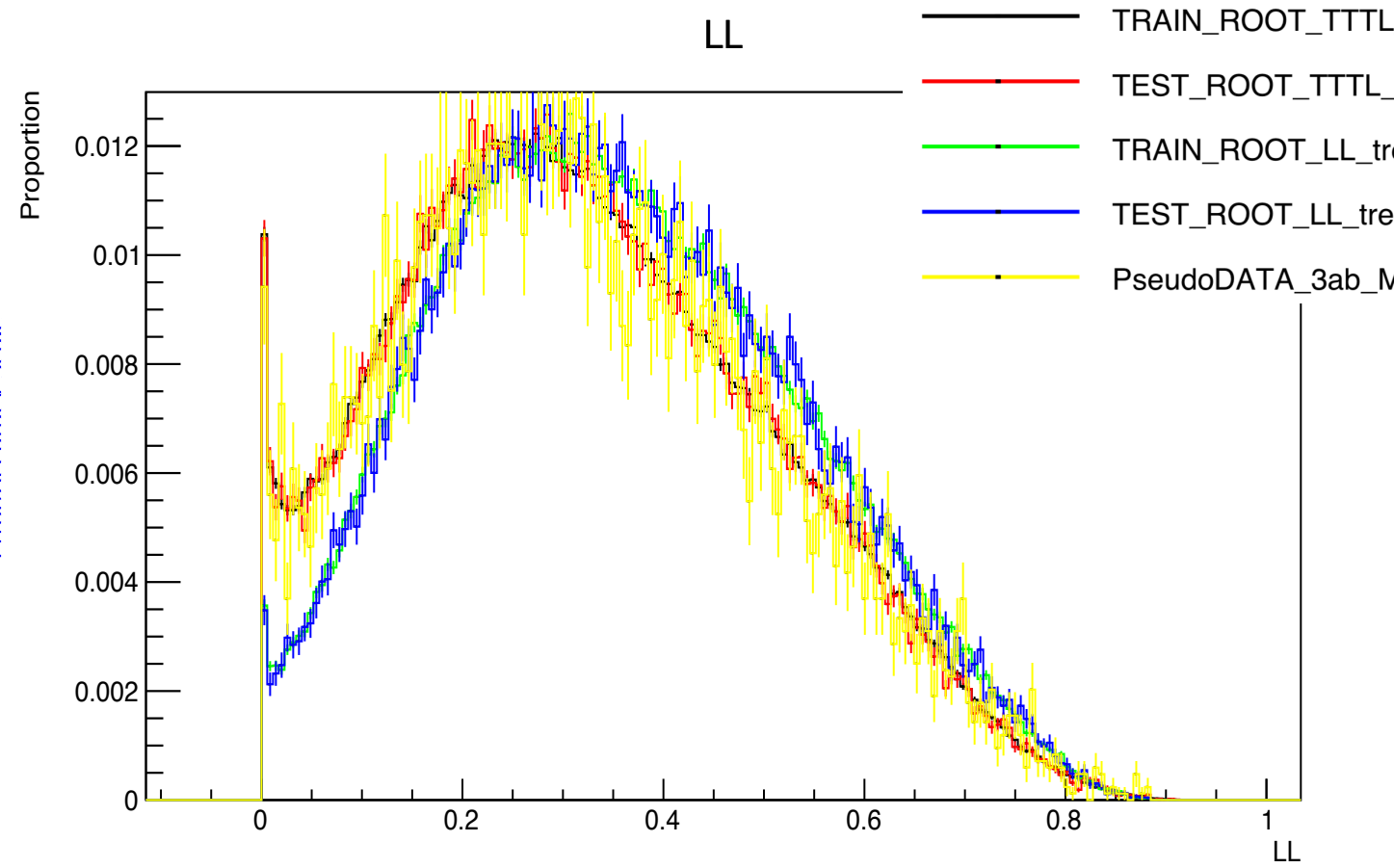
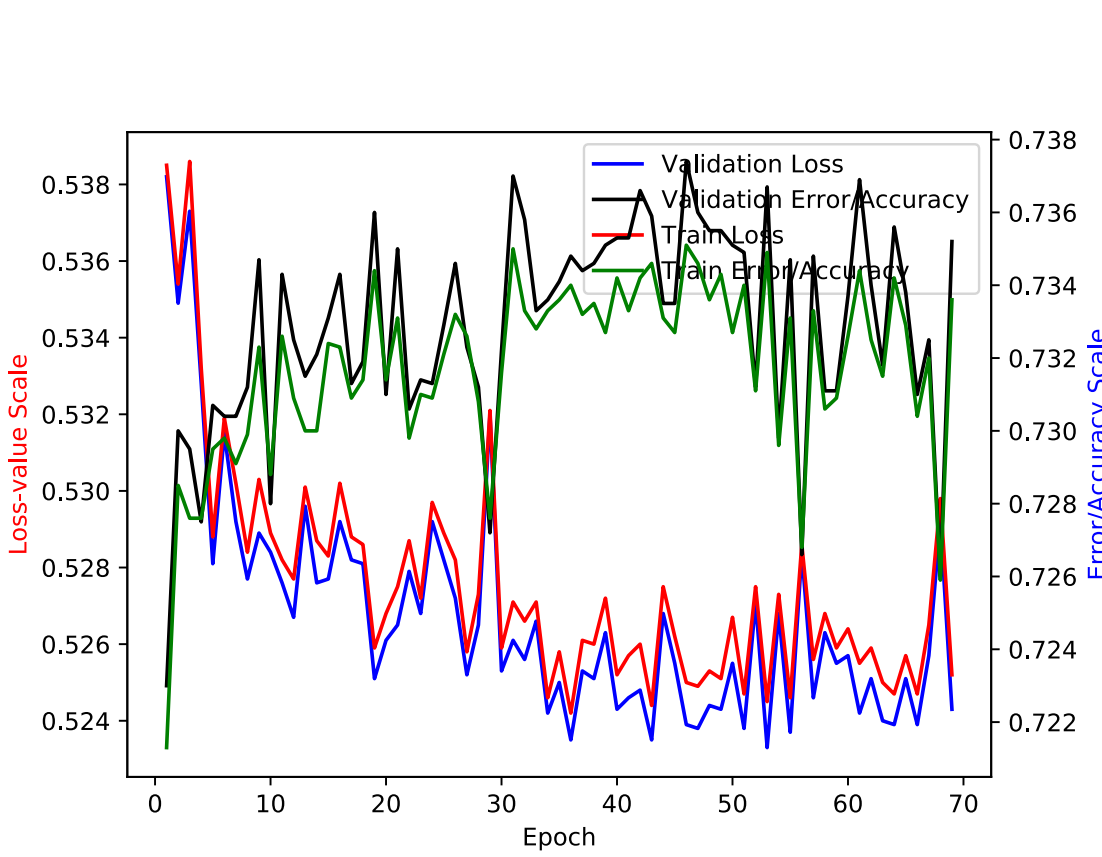


lep1pt,
lep1eta,
lep2pt,
lep2eta,
jet1pt,
jet1eta,
jet2pt,
jet2eta,
MET,
dr_ll_jj,
dphijj,
detajj,
Mll



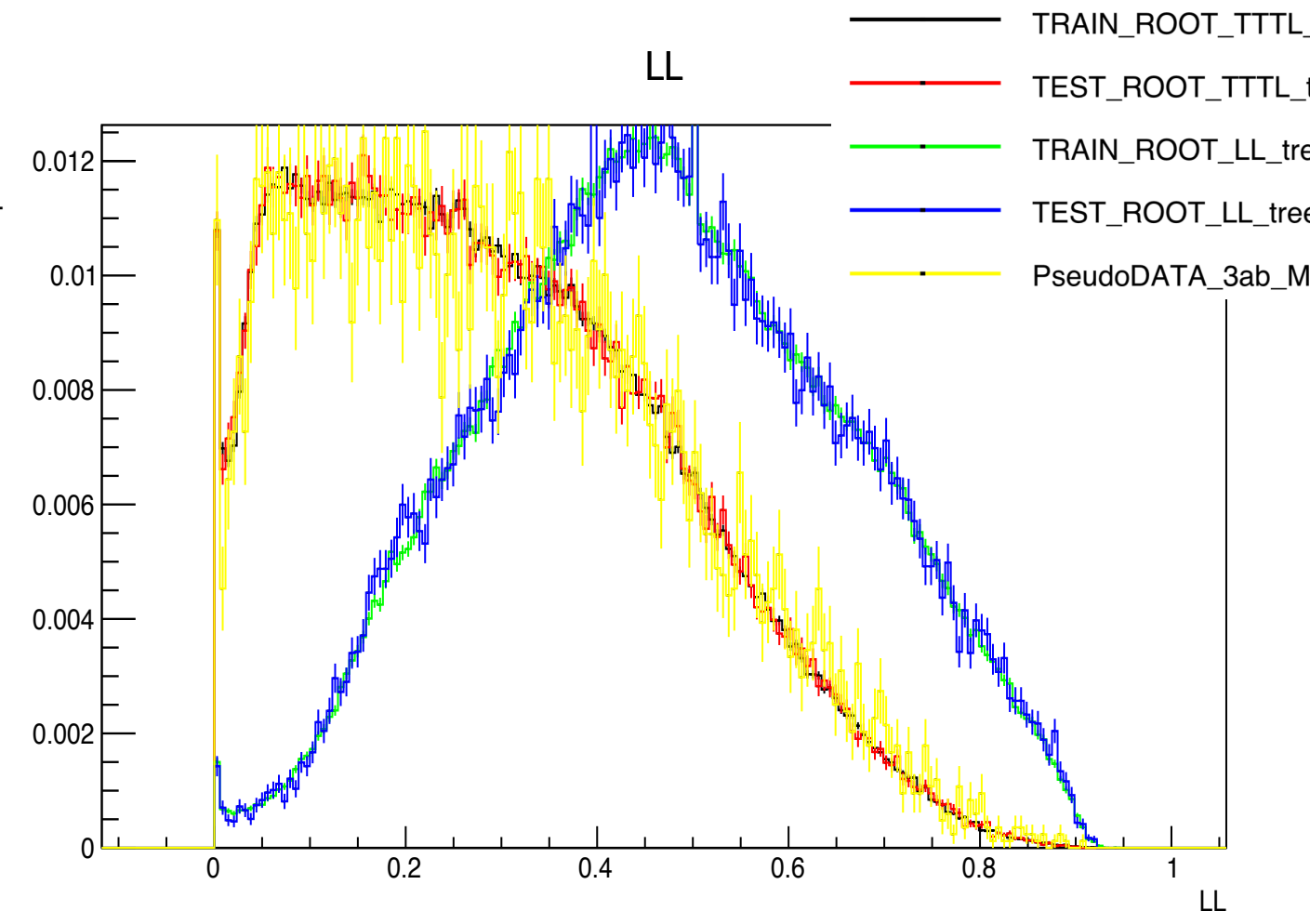
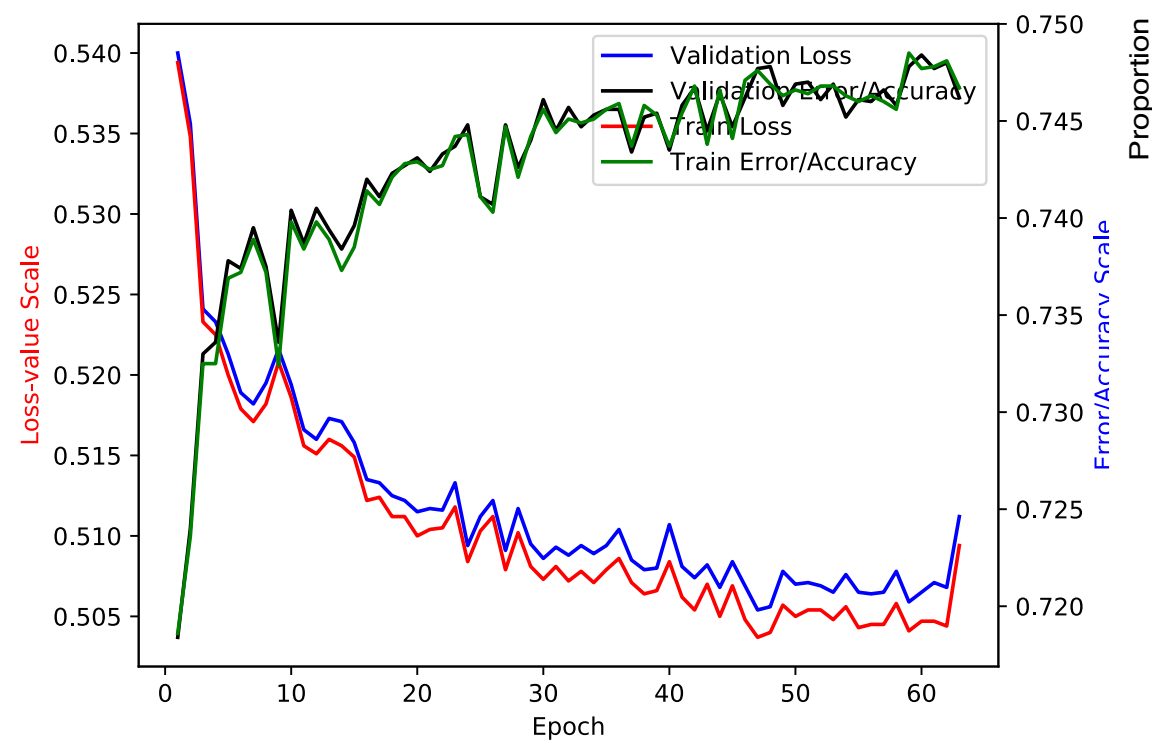
Layer 1, Node 150
Training Num : 0.9M,
Test Num: 0.1M.

VBS Same-sign WW – DNN performance



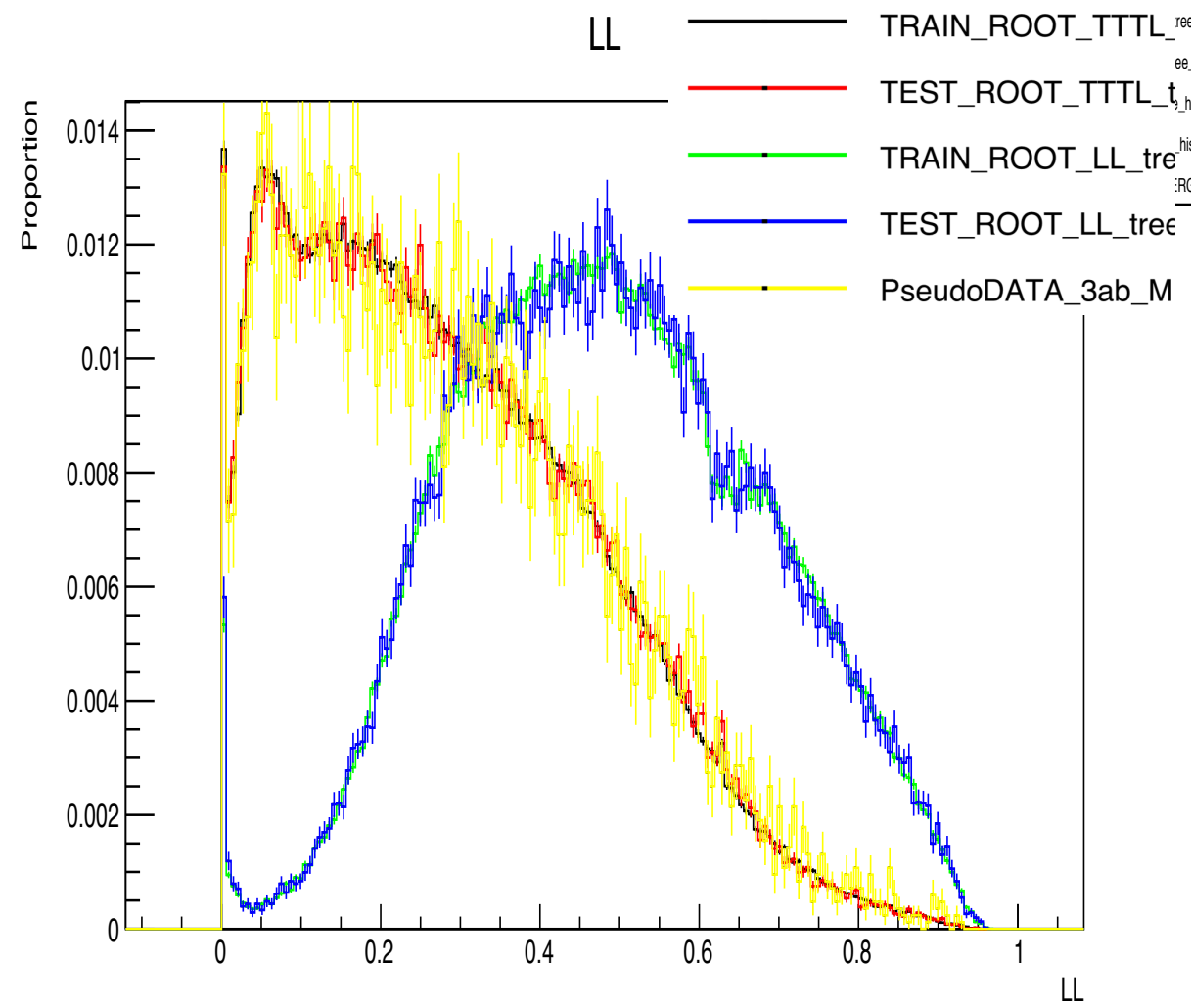
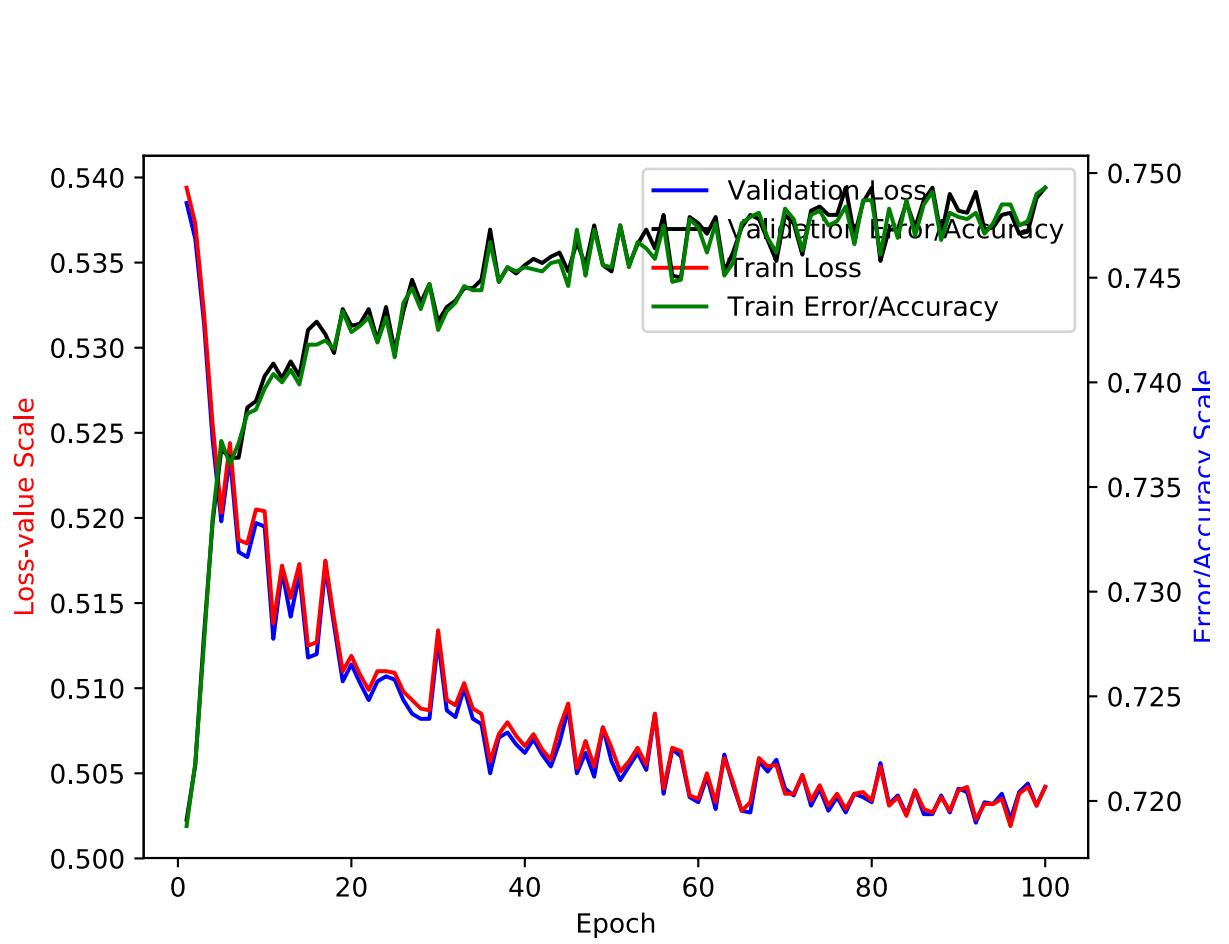
Layer 5, Node 150
Training Num : 0.9M,
Test Num: 0.1M.

VBS Same-sign WW – DNN performance



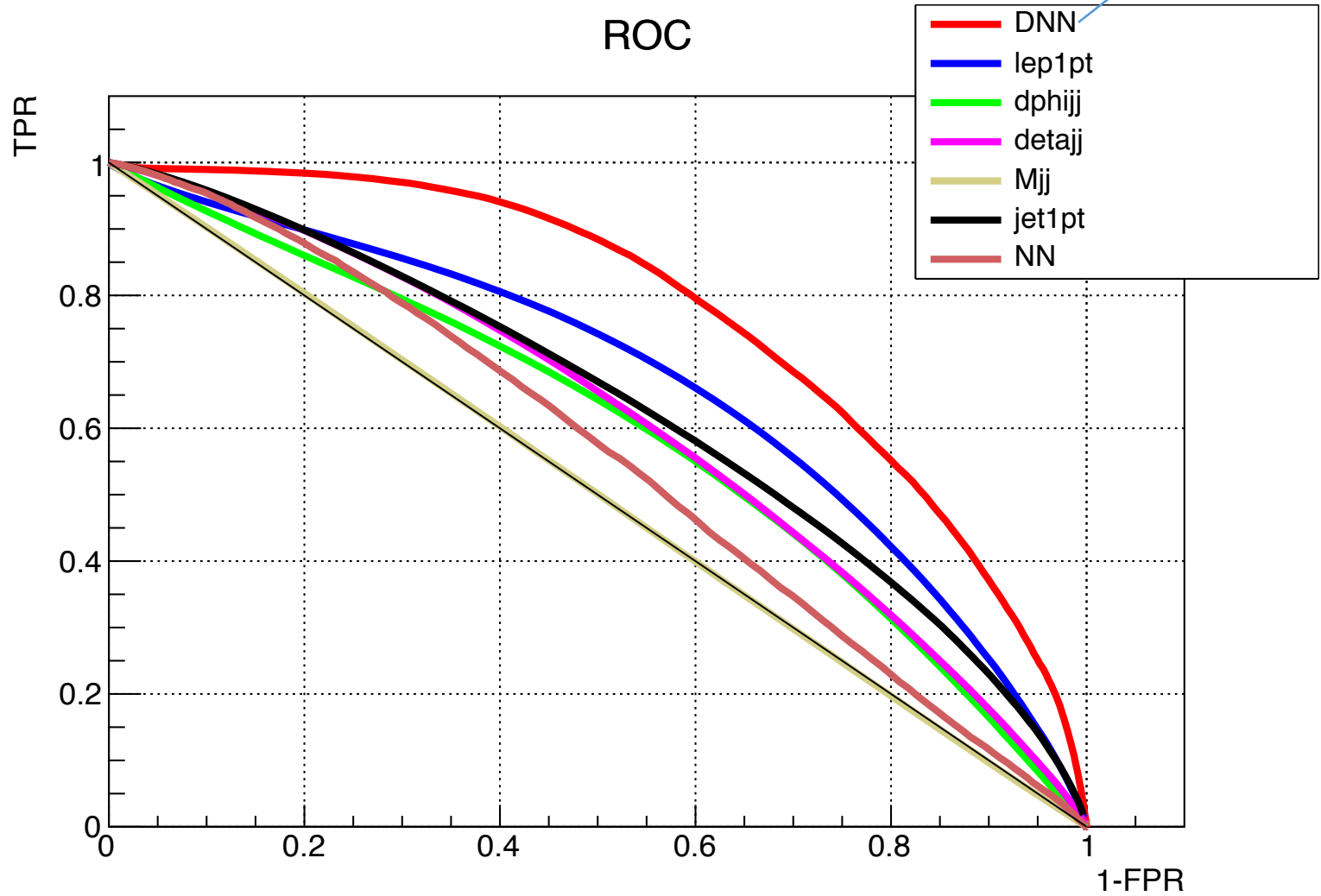
Layer 7, Node 150
Training Num : 0.9M,
Test Num: 0.1M.

VBS Same-sign WW – DNN performance



ROC curve

Layer 7, Node 150
Training Num : 0.9M,
Test Num: 0.1M.

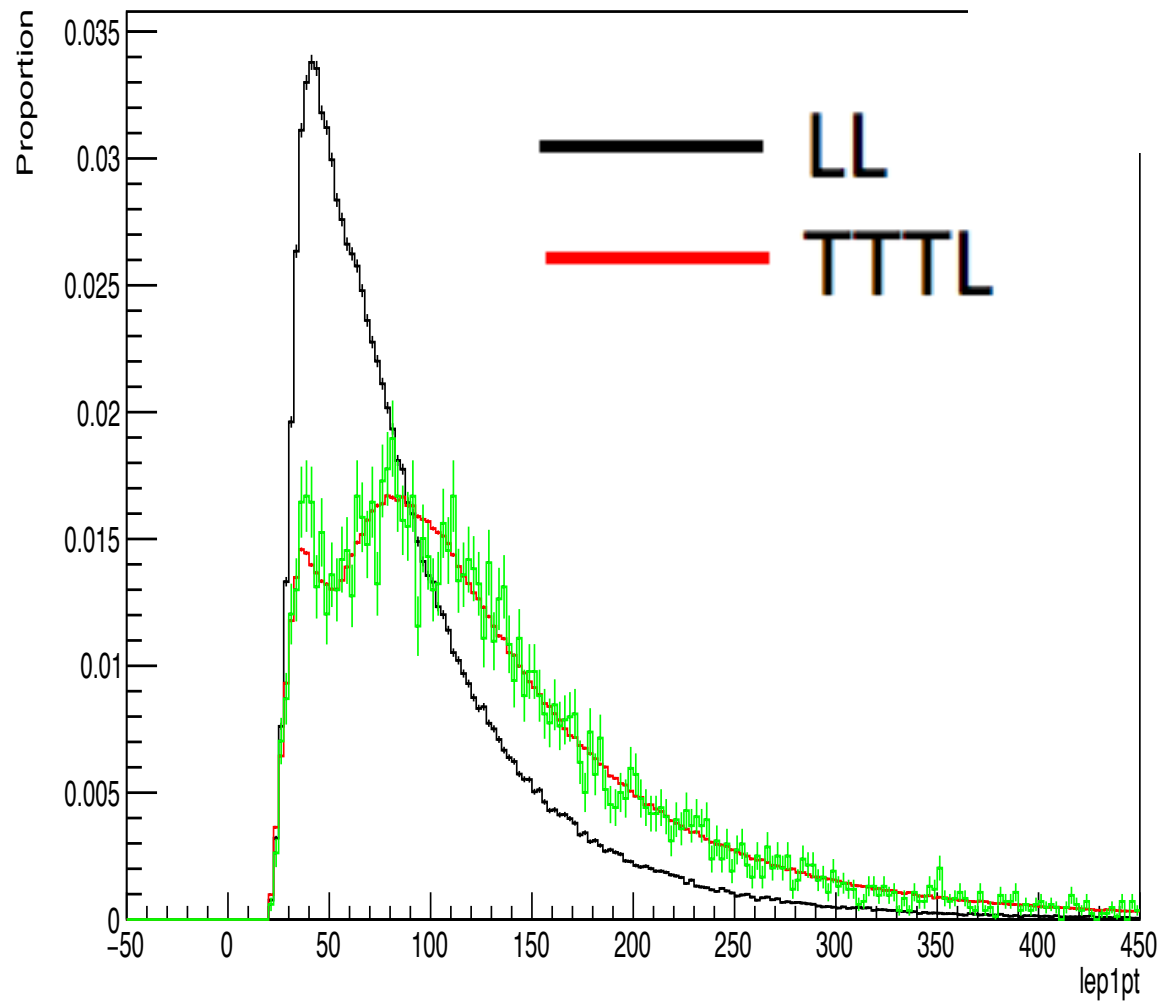


Template Fitting to PseudoData with 'lep1pt' & 'dphijj' distribution

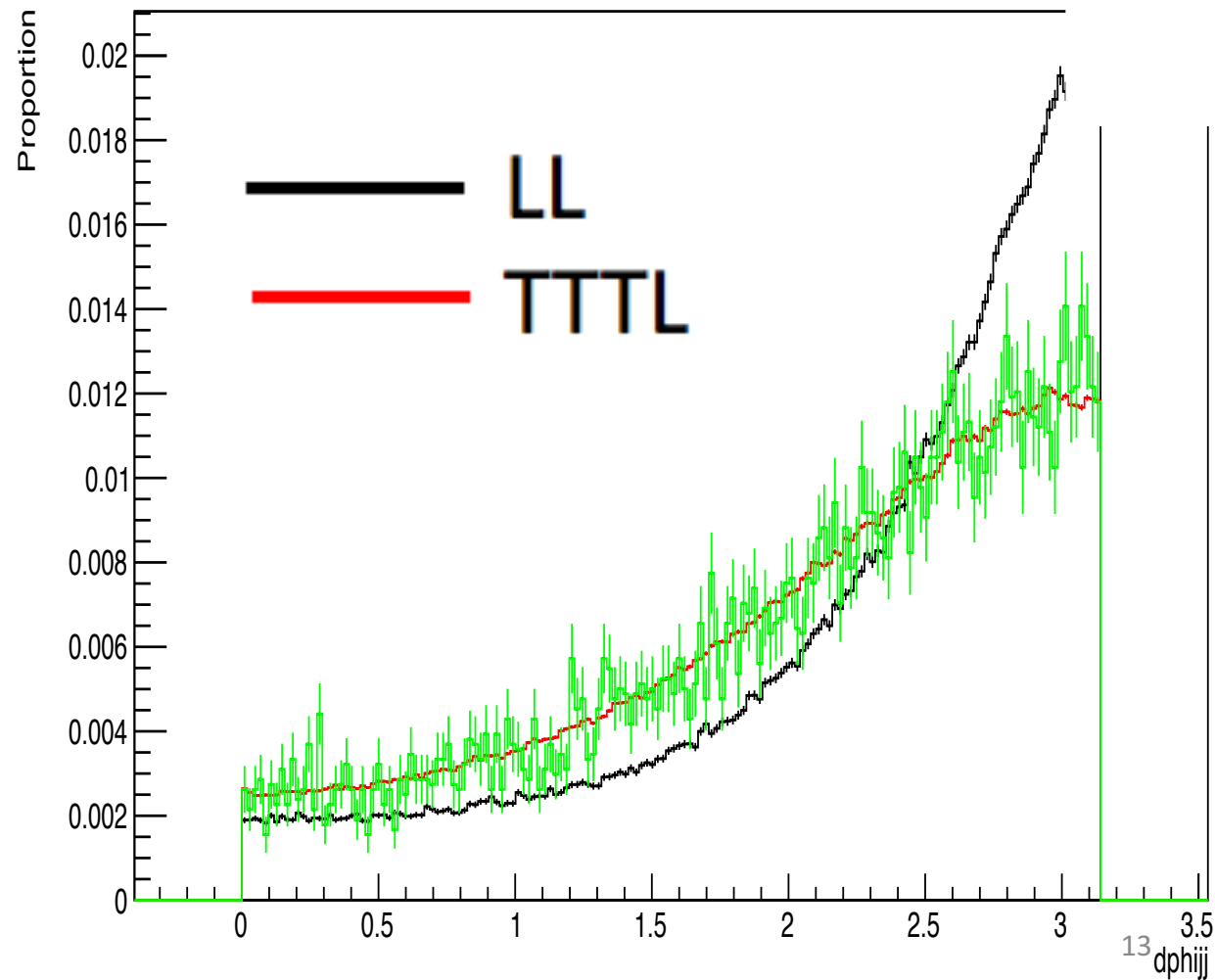
- PseudoData (for performing template fit)
 - XSec of VBS Same-sign WW : ~ 0.1786 pb
 - $3ab^{-1} \rightarrow \sim 536,000$ Events (LL,TL and TT mixed, before Event selection)
- Using MC Template shape of LL and TTTL, perform template fit
 - Poisson fluctuation applied on each bin of pseudoData's histogram, perform fitting multiple times
 - The distribution of LL Fraction is studied.
 - Randomly fluctuate each bin independently.
- MC truth LL Fraction : $\sim 5.0\%$ (Selected LL events \div Selected LL & TTTL events)

Distribution of “lep1pt” and “dphijj”

lep1pt

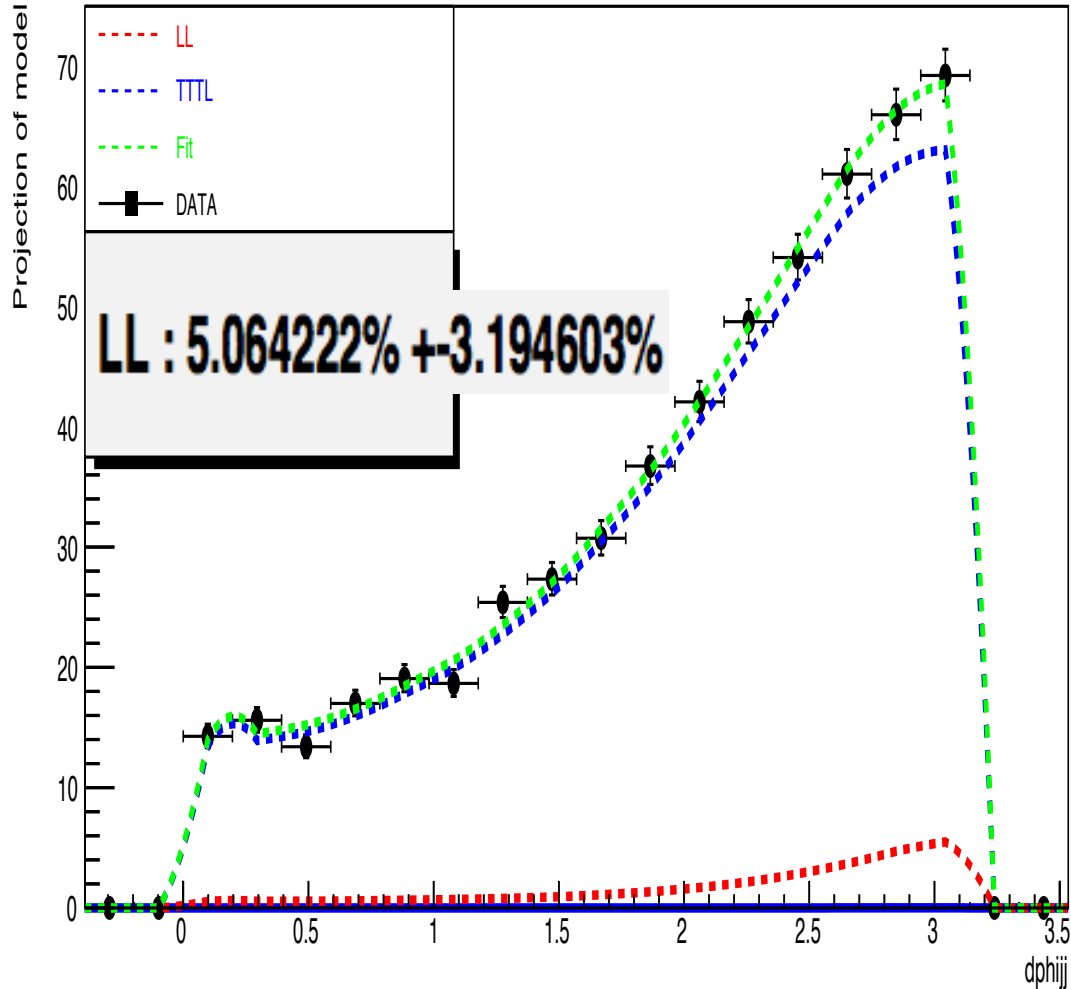


dphijj

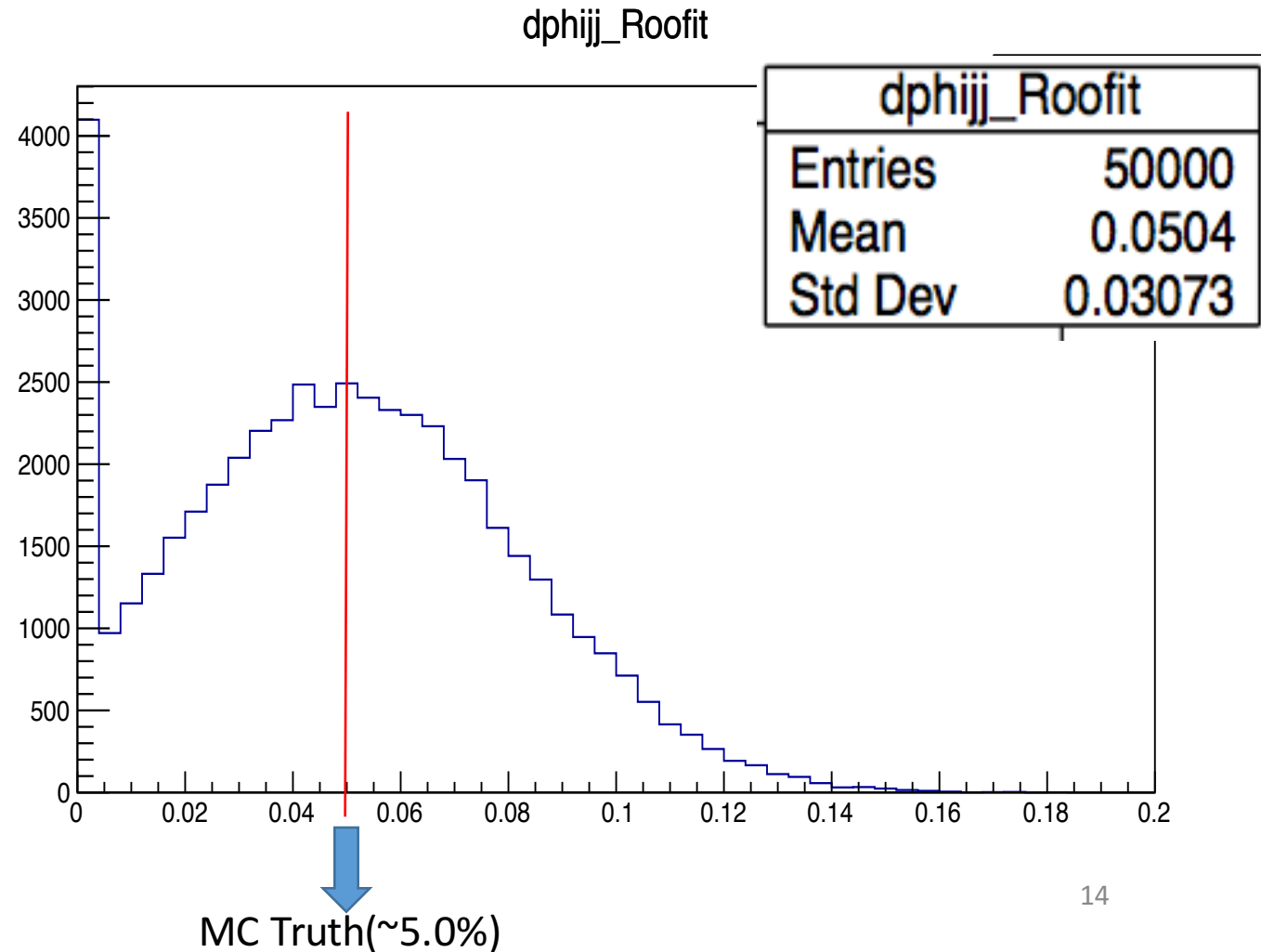


Template fit on 'dphijj'

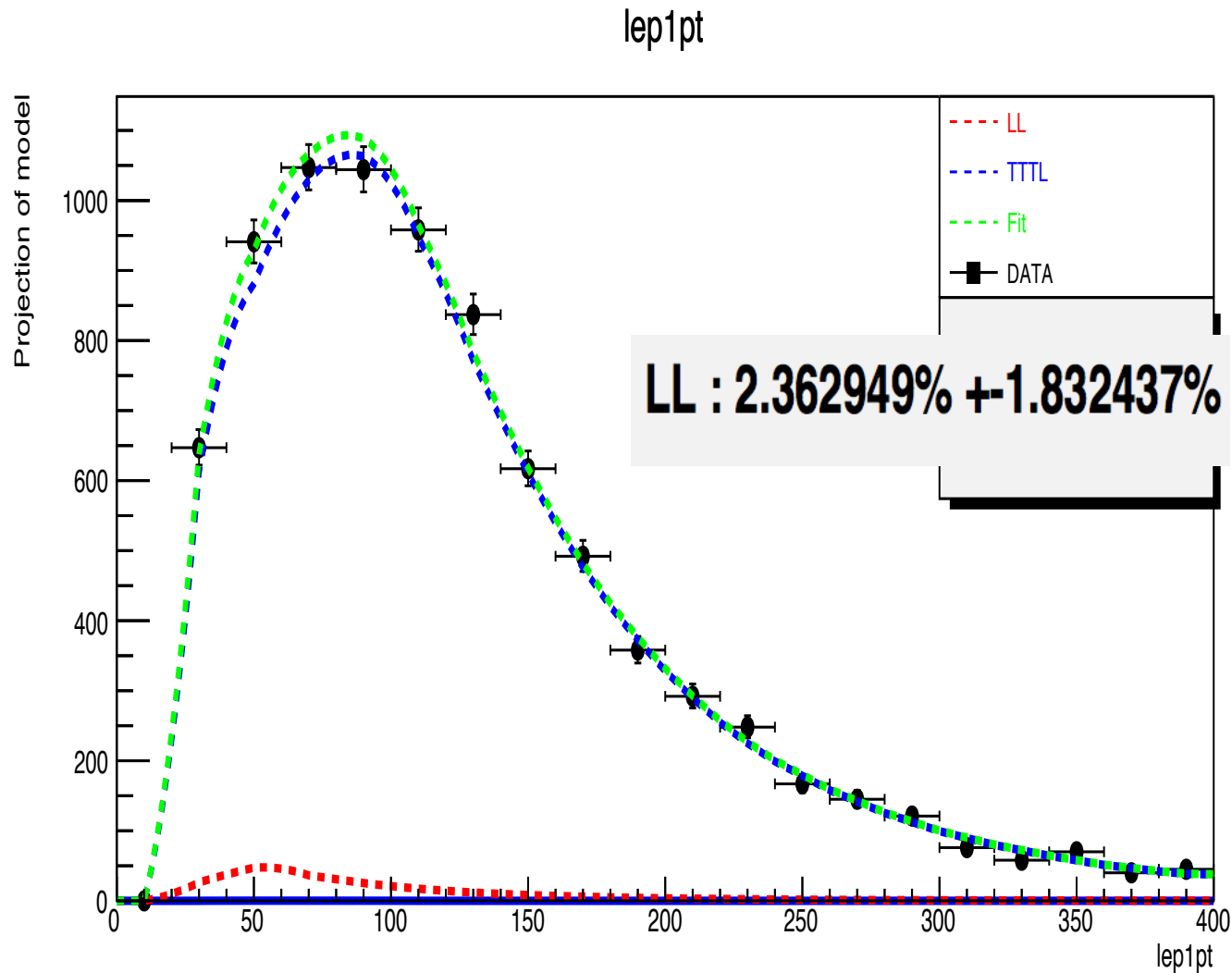
dphijj



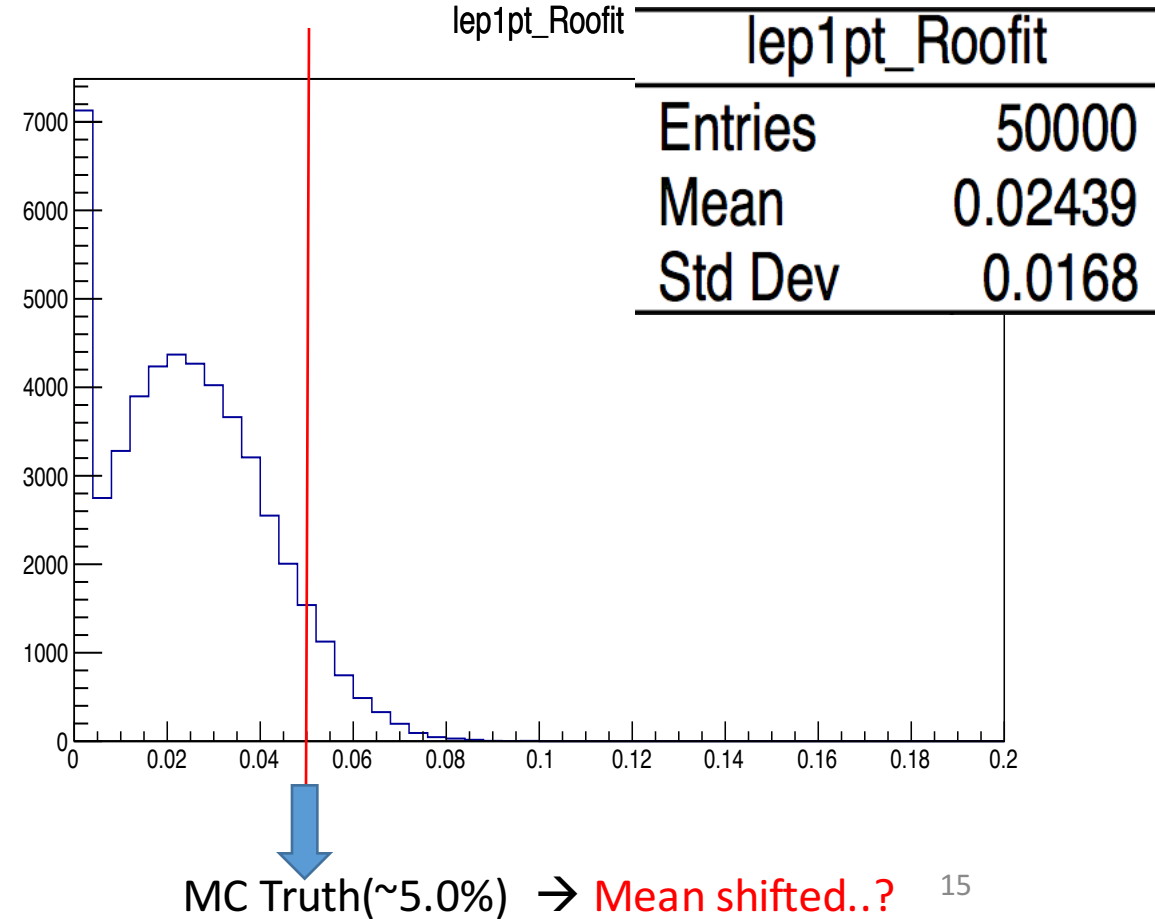
Distribution of "mean fraction" value for 50K times fitting



Template fit on 'Lep1pt'

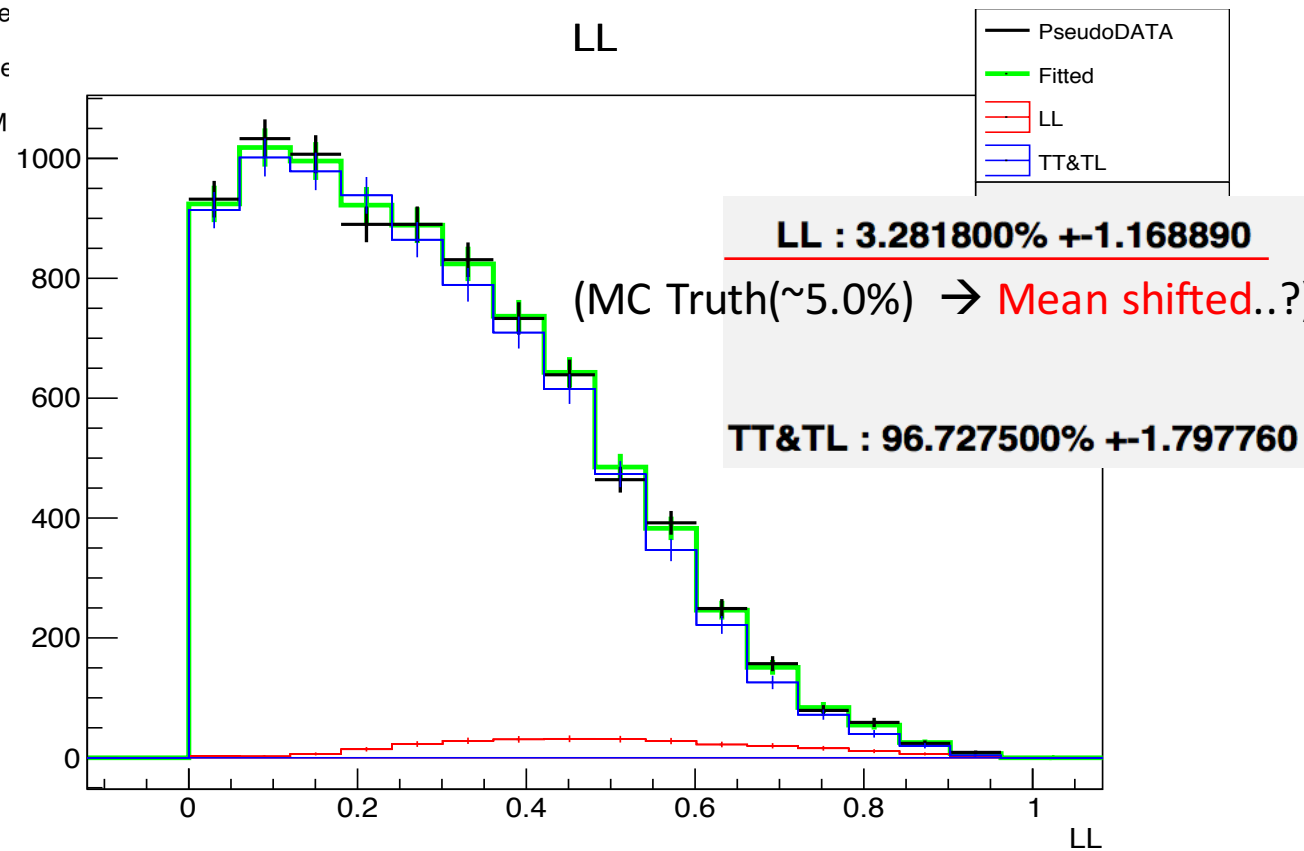
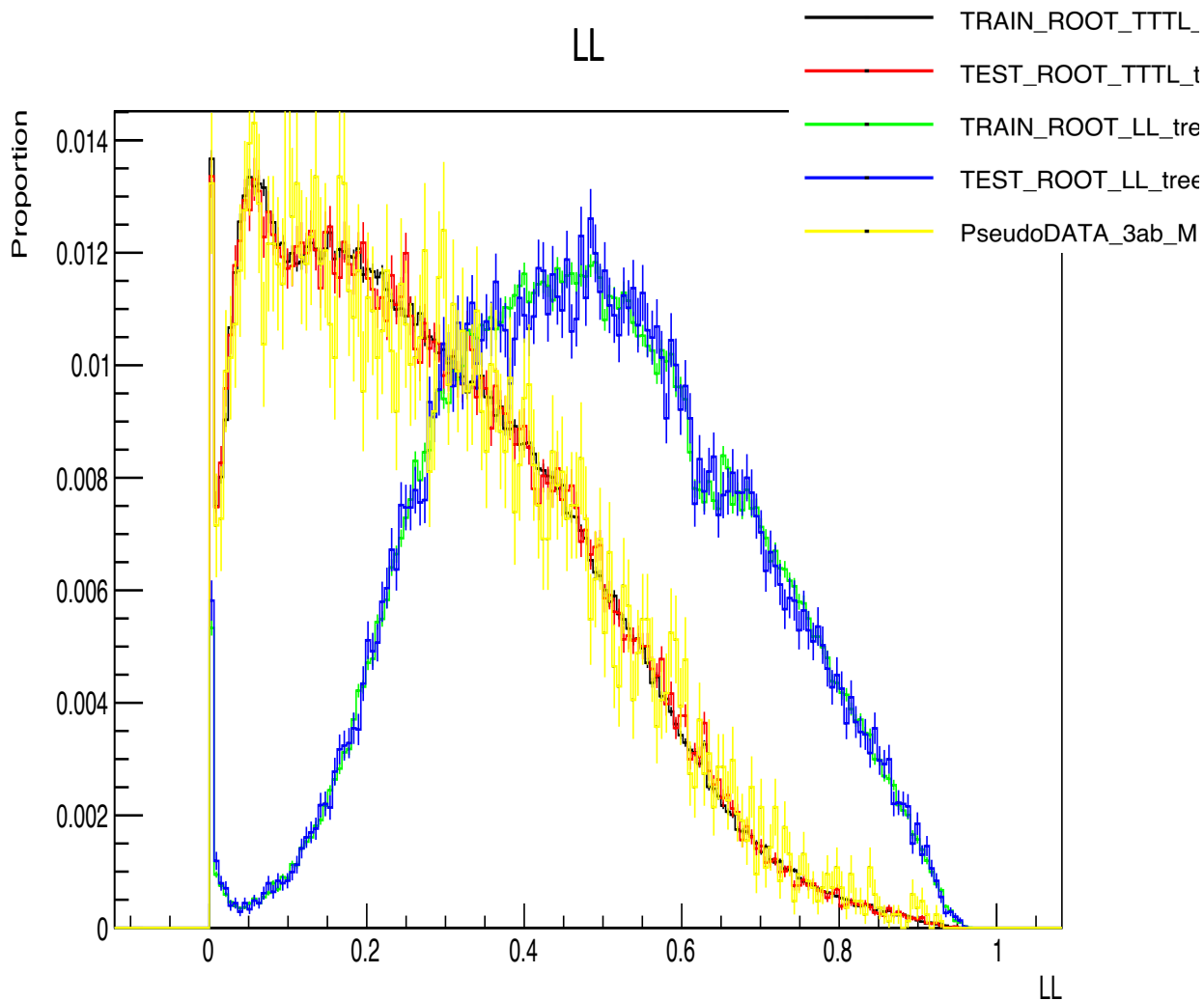


Distribution of "mean fraction" value for 50K times fitting



Template fitting by DNN

Layer 7, Node 150
Training Num : 0.9M,
Test Num: 0.1M.



To Do

- Use Asimov Dataset instead of PseudoData, and try template fit
 - To see if there still is shifted mean
- Add 'BDT' into ROC curve

Thank you