

Analysis of 4top process with VLL model(2018)

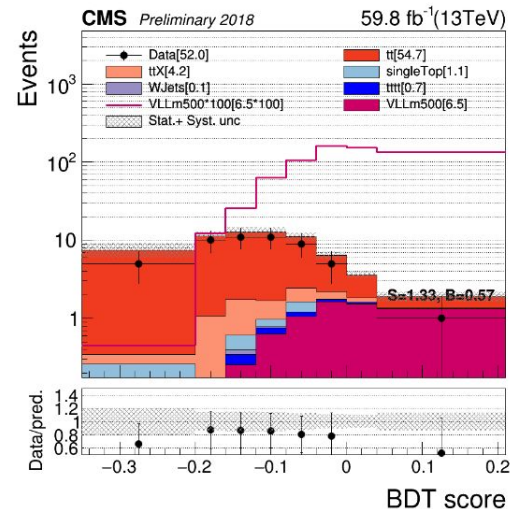
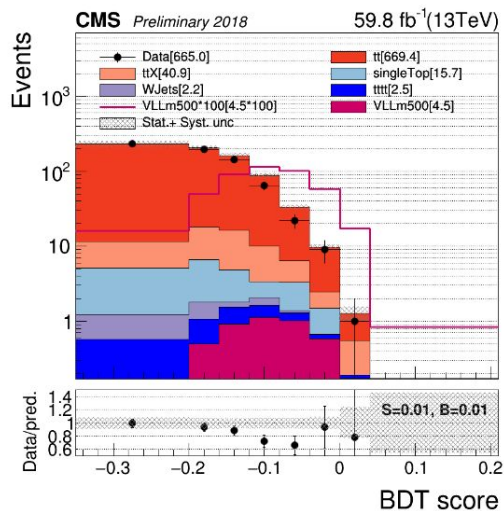
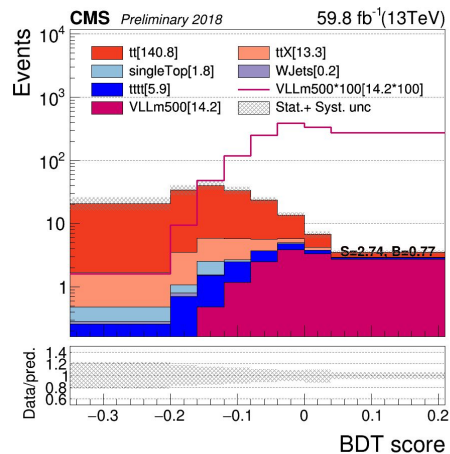
The optimization of binning at different mass points

The datacards used are shown in below figure.

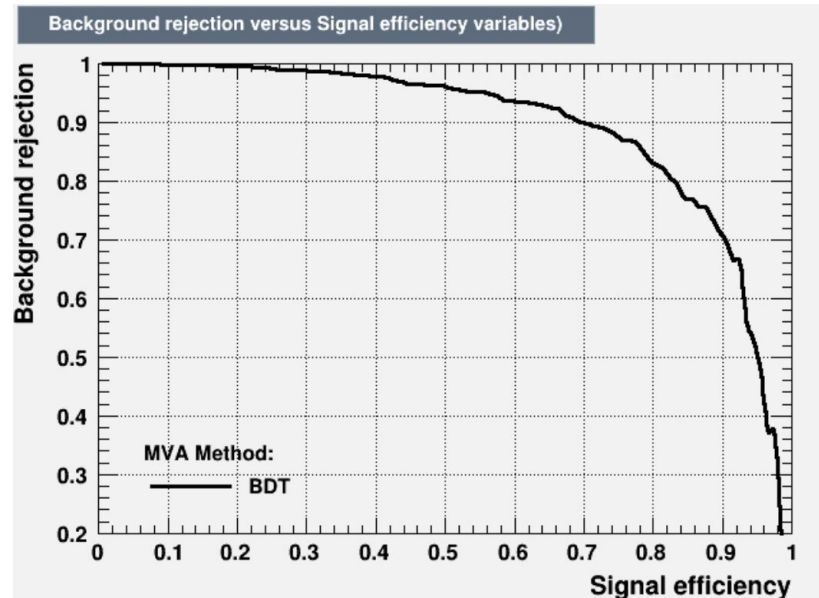
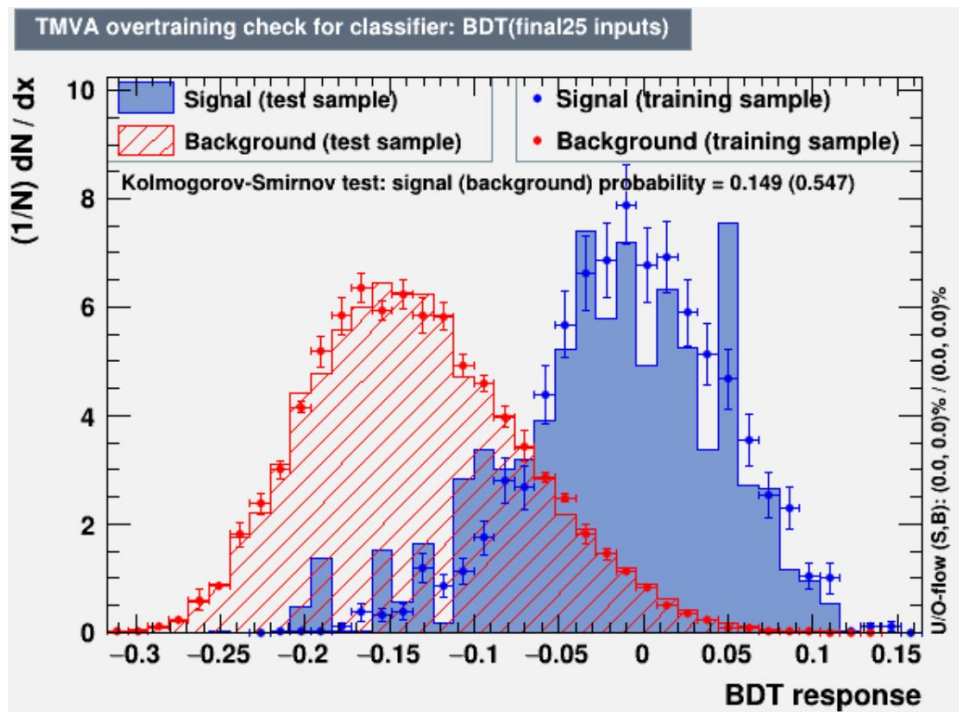
```
imax * number of bins
jmax * number of processes minus 1
kmax * number of nuisance parameters

-----
shapes * SR1tau1l_2018 /publicfs/cms/user/turuobing/tauOfTTTT_NanoAODOfficial/forMVA/2018/v0baselineHardroSR_v81addSysSum/mc/variableHists_v0Basic
-----
bin SR1tau1l_2018
observation -1
-----
bin SR1tau1l_2018 SR1tau1l_2018 SR1tau1l_2018 SR1tau1l_2018 SR1tau1l_2018 SR1tau1l_2018
process tttt singleTop tt ttX WJets VLLm600
process 5 1 2 3 4 0
rate -1 -1 -1 -1 -1 -1
-----
lumi_13TeV_2018 lnN 1.025 1.025 1.025 1.025 1.025 1.025
CMS_pileup_2018 shape 1 1 1 1 1 1
CMS_prefiring_2018 shape 1 1 1 1 1 1
CMS_eff_t_vsJet_2018 shape 1 1 1 1 1 1
CMS_eff_t_vsMu_2018 shape 1 1 1 1 1 1
CMS_eff_t_vsEle_2018 shape 1 1 1 1 1 1
CMS_tttt_eff_e_2018 shape 1 1 1 1 1 1
CMS_tttt_eff_m_2018 shape 1 1 1 1 1 1
CMS_tttt_eff_hlt_stats_2018 shape 1 1 1 1 1 1
CMS_eff_bWPM_2018 shape 1 1 1 1 1 1
pdf_2018 shape 1 1 1 1 1 1
pdfAlphaS_normalised_2018 shape 1 1 1 1 1 1
QCDscale_Re_normalised_2018 shape 1 1 1 1 1 1
QCDscale_Fa_normalised_2018 shape 1 1 1 1 1 1
-----
SR1tau1l_2018 autoMCStats 10 0 1
```

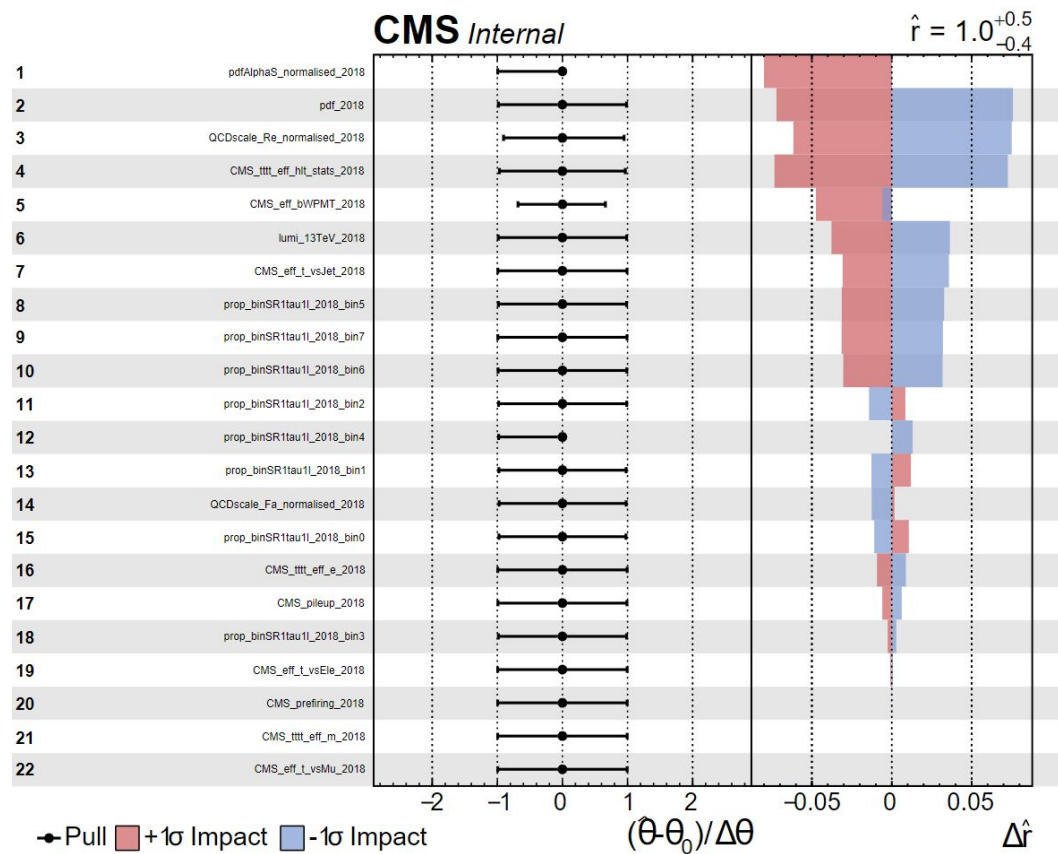
VLLm500 **best bin**(last bin: 0.04-0.2)



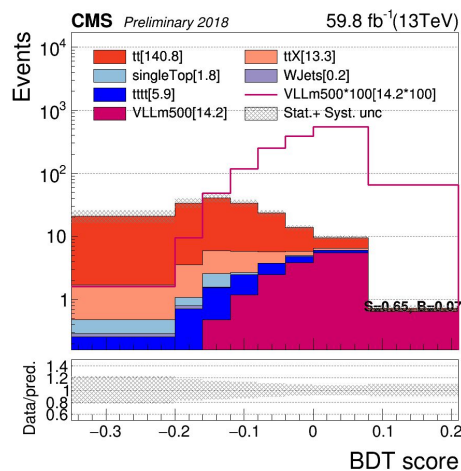
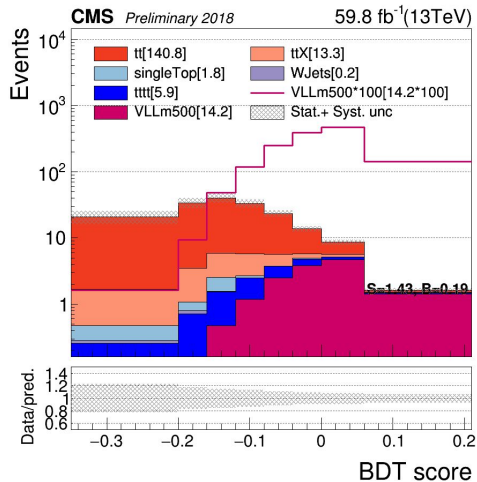
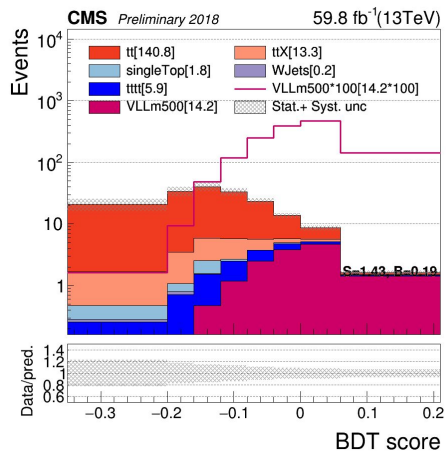
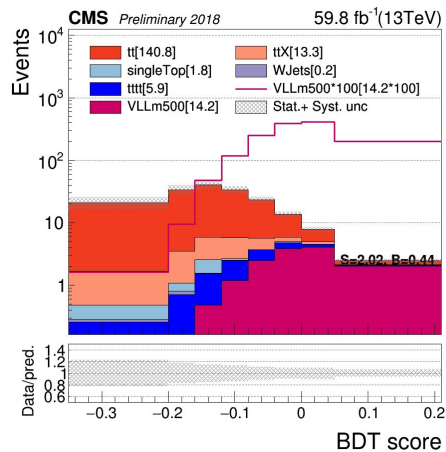
TMVA check



Combine impact result



VLLm500



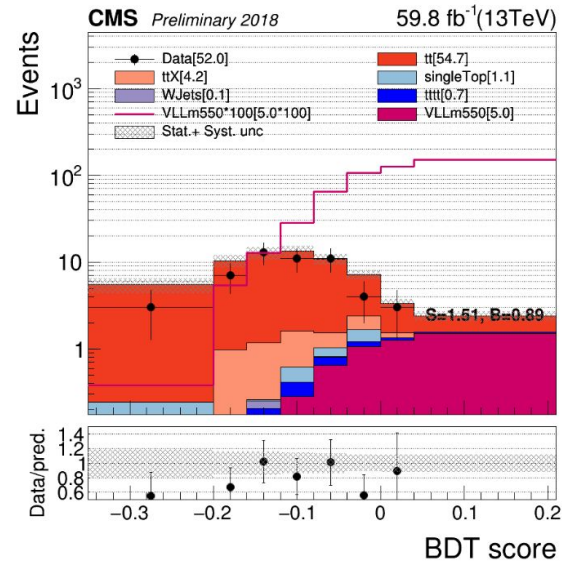
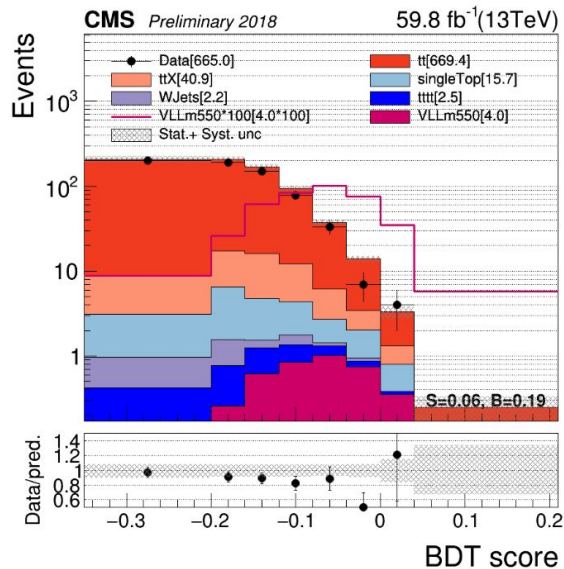
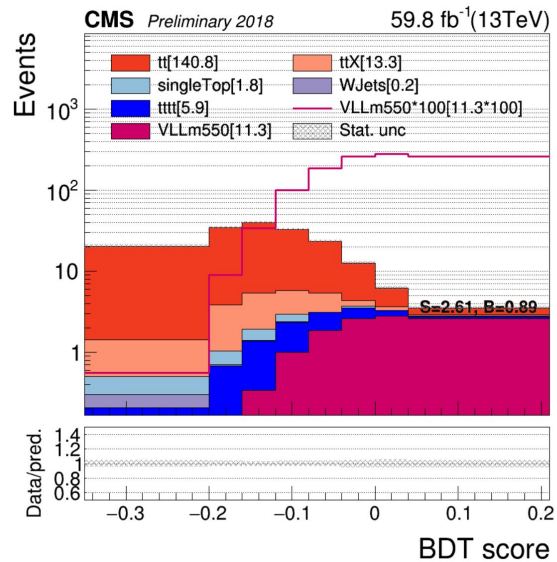
limit: 0.76
significance: 2.81
last bin: 0.05-0.2

last bin: 0.06-0.2

last bin: 0.07-0.2

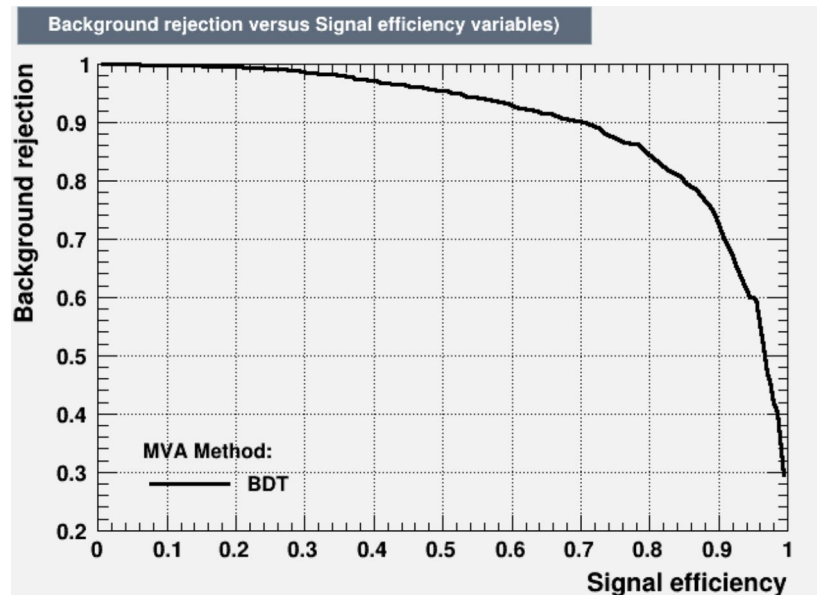
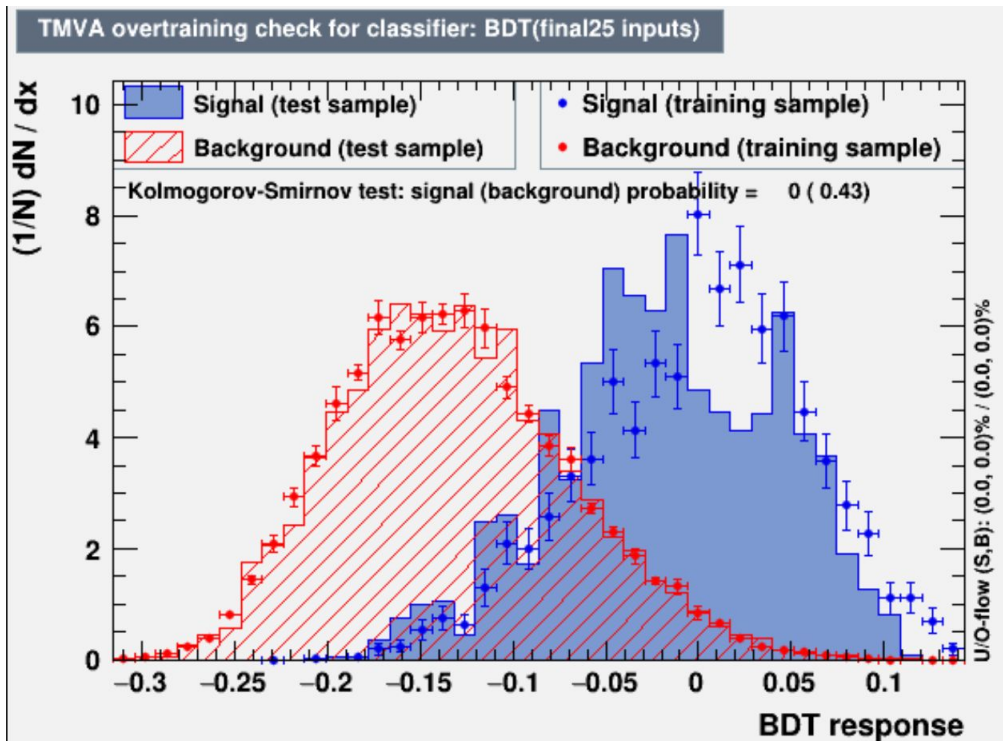
last bin: 0.08-0.2

VLLm550 **best bin**(last bin: 0.04-0.2)

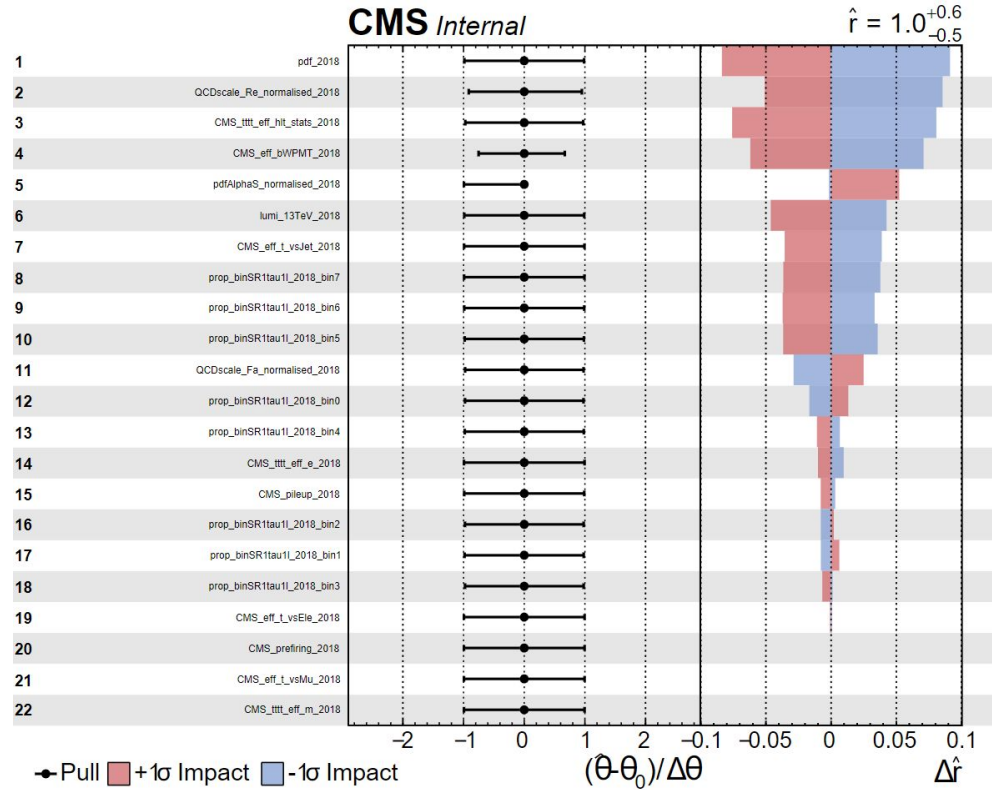


limit: 0.89 significance: 2.49

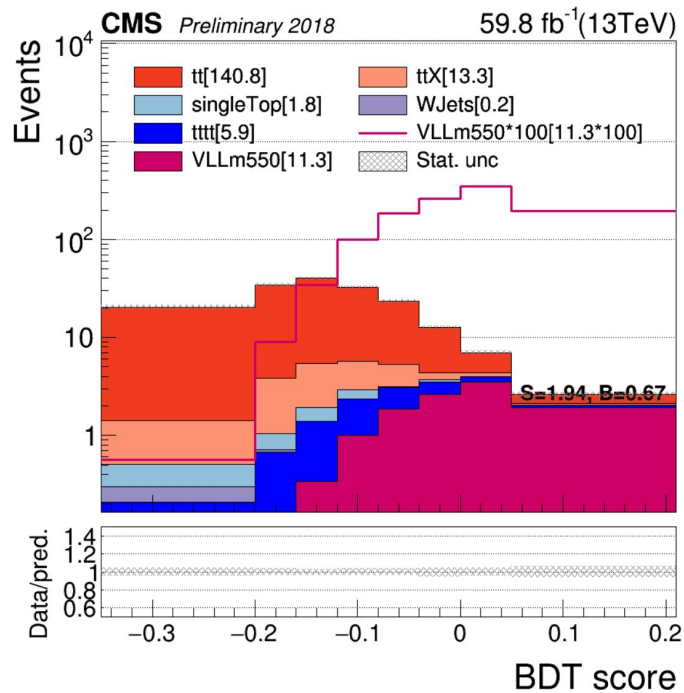
TMVA check



Combine impact result



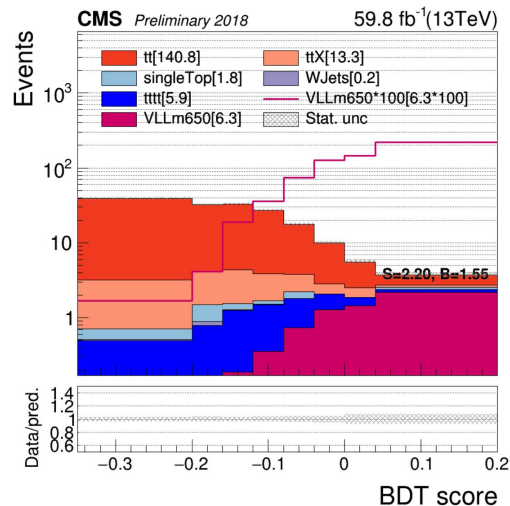
VLLm550 last bin: 0.05-0.2



limit: 0.92

significance: 2.40

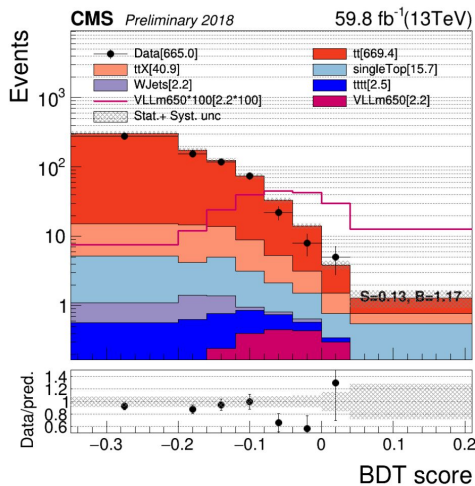
VLLm650 **best bin**(last bin: 0.04-0.2)



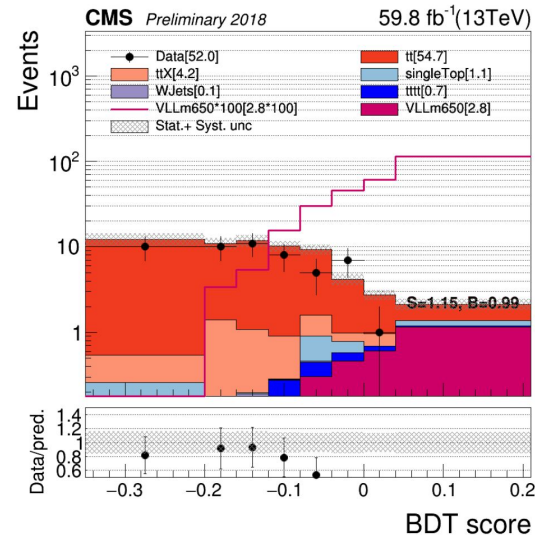
SR

limit: 1.50

significance: 1.23



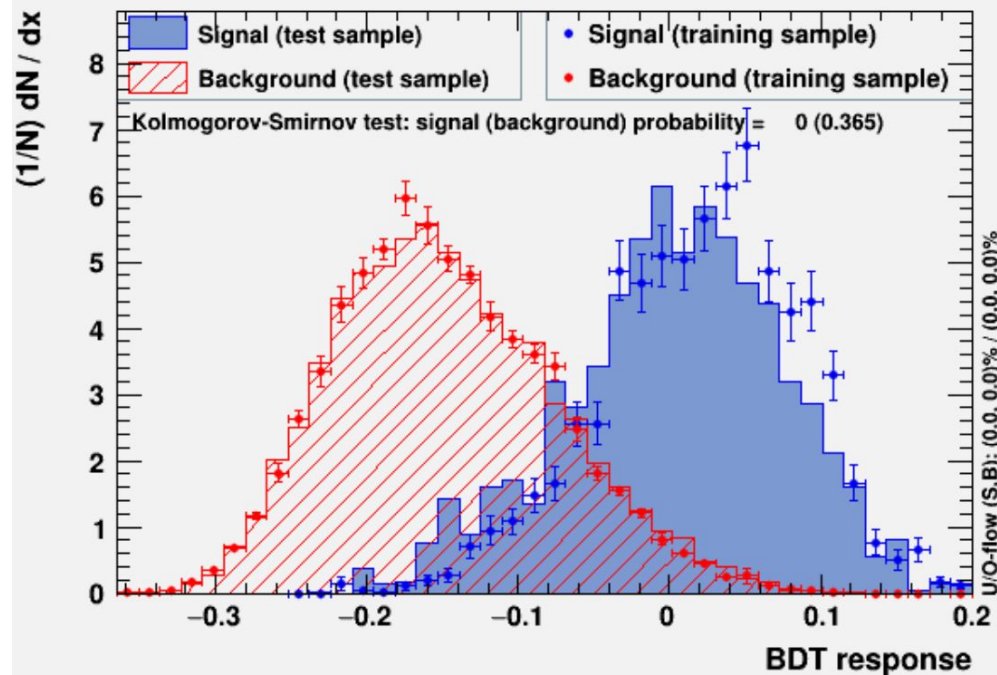
CR1



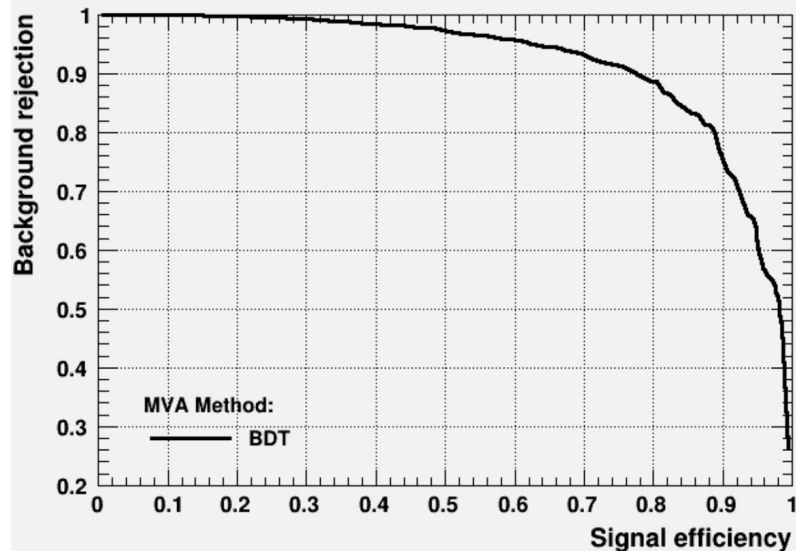
CR2

TMVA check

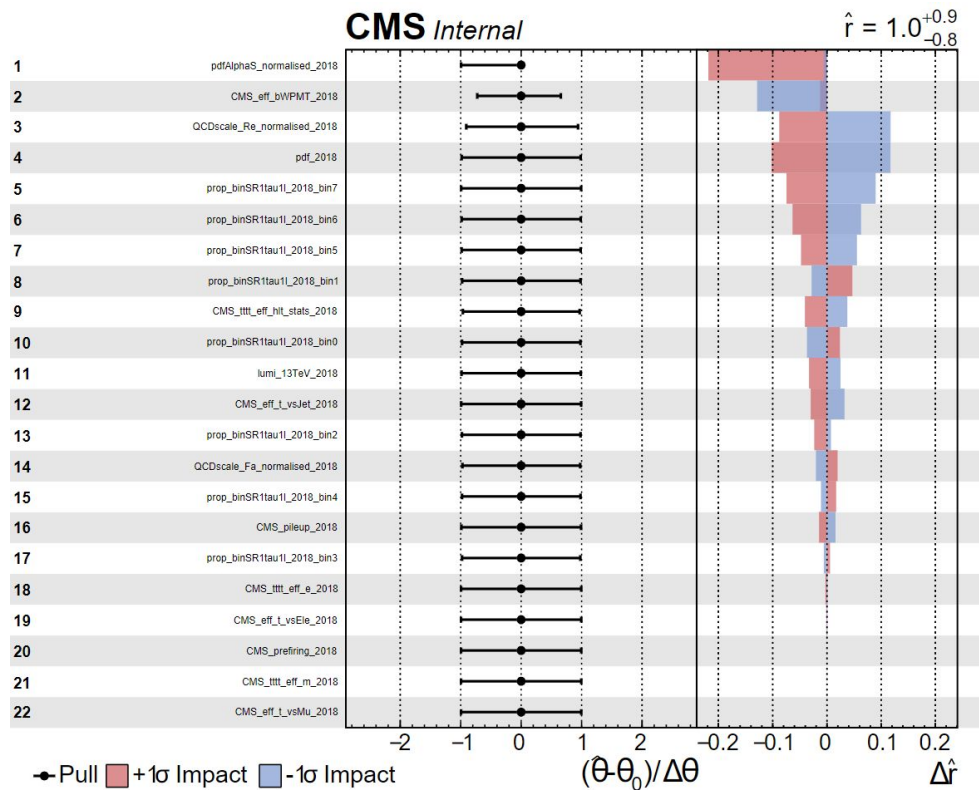
TMVA overtraining check for classifier: BDT(final25 inputs)



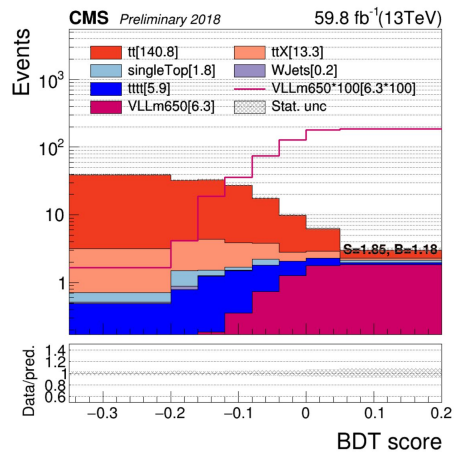
Background rejection versus Signal efficiency variables)



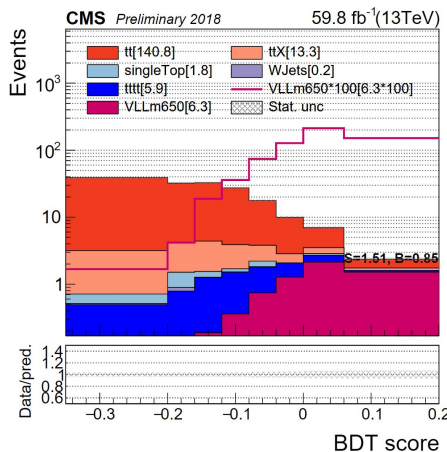
Combine impact result



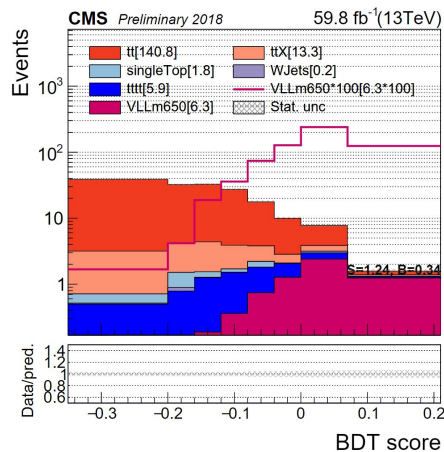
VLLm650



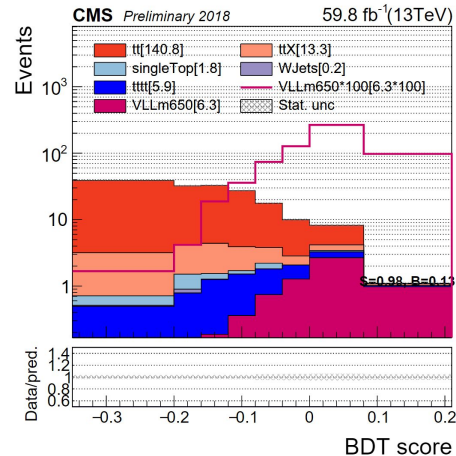
limit: 1.52
significance: 1.23
last bin: 0.05-0.2



limit: 1.51
significance: 1.57
last bin: 0.06-0.2

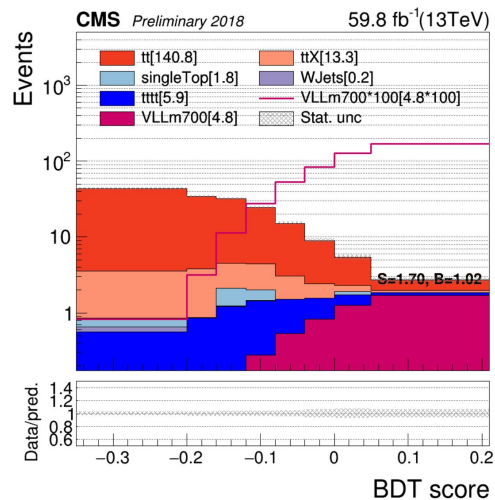


limit: 1.43
significance: 1.76
last bin: 0.07-0.2



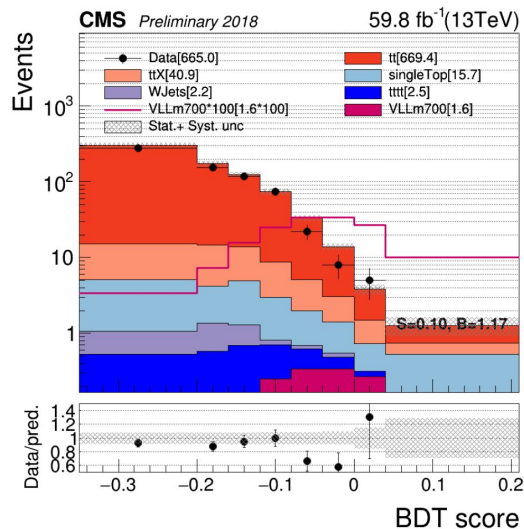
limit: 1.41
significance: 1.92
last bin: 0.08-0.2

VLLm700 **best bin**(last bin: 0.05-0.2)

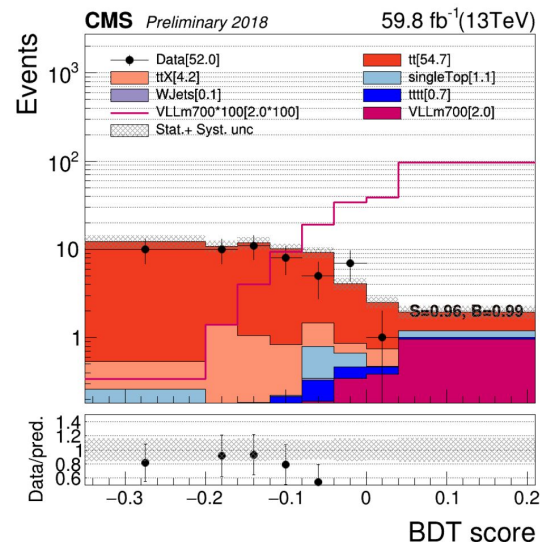


SR

limit: 1.74 significance: 1.48



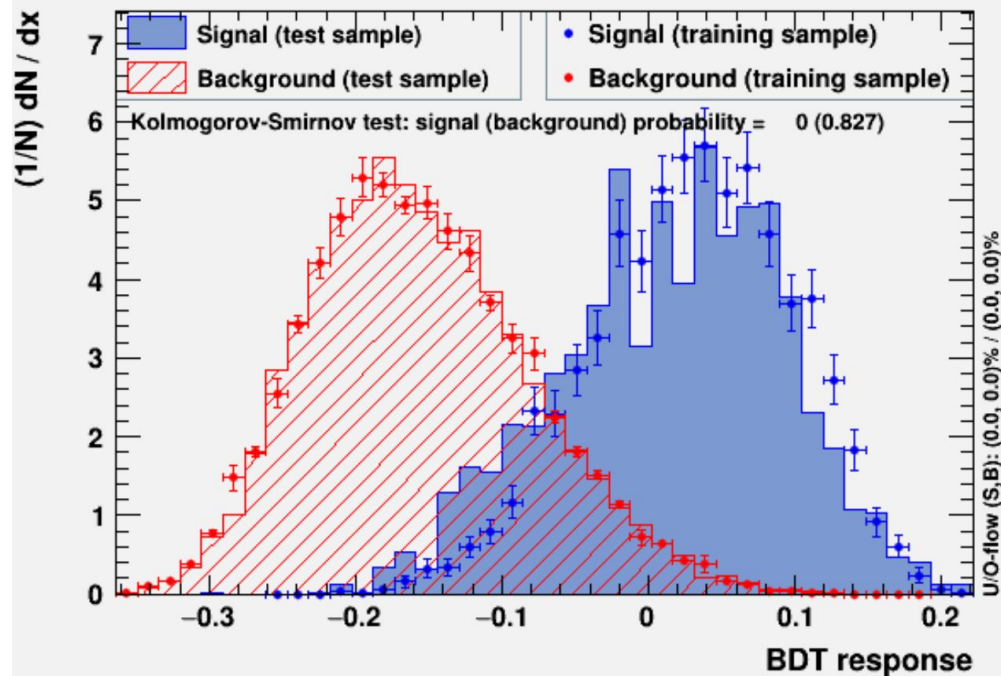
CR1



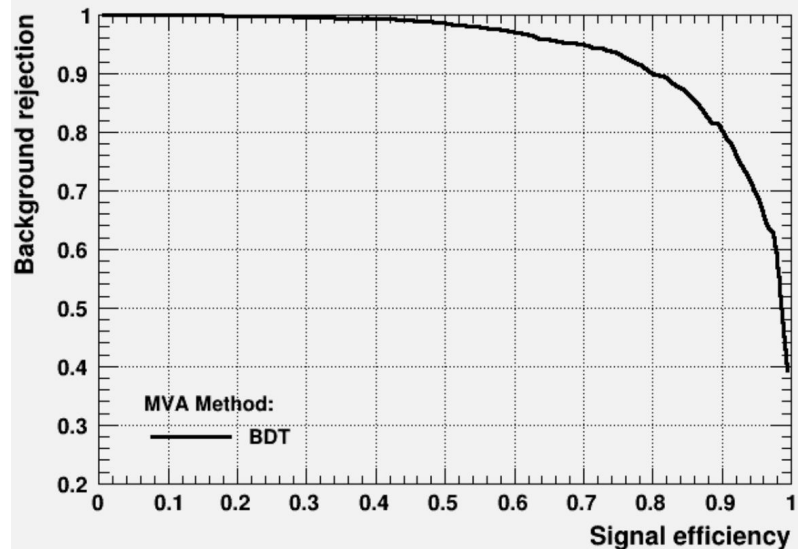
CR2

TMVA check

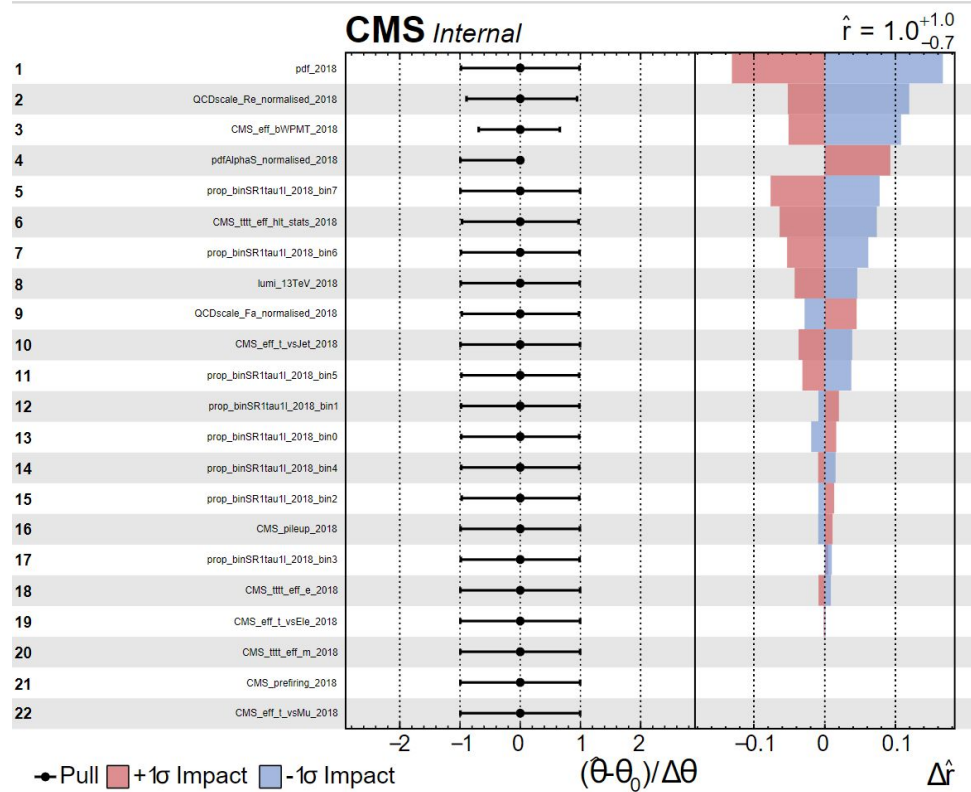
TMVA overtraining check for classifier: BDT(final25 inputs)



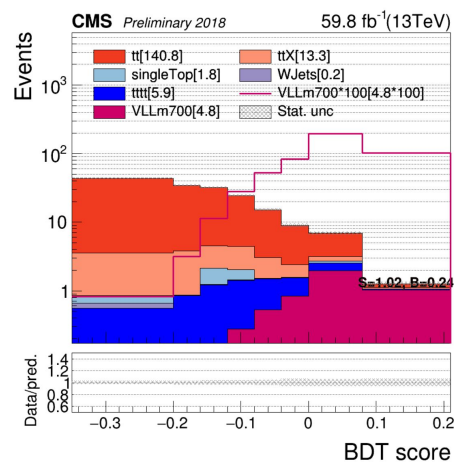
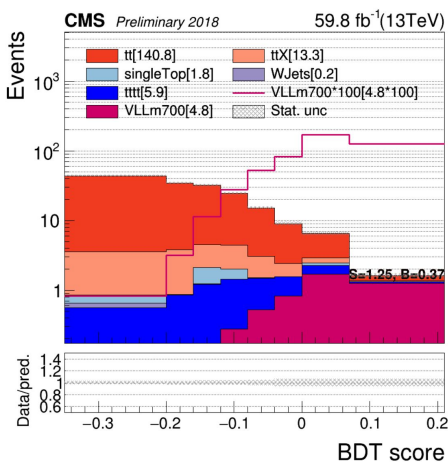
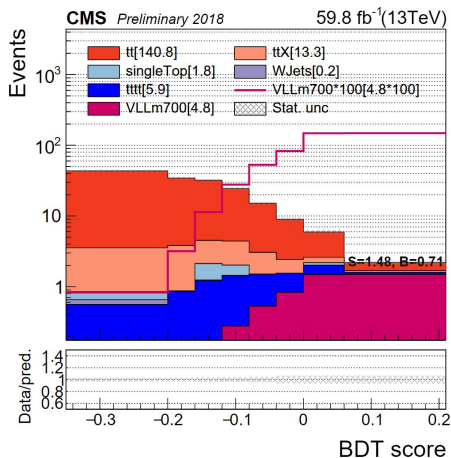
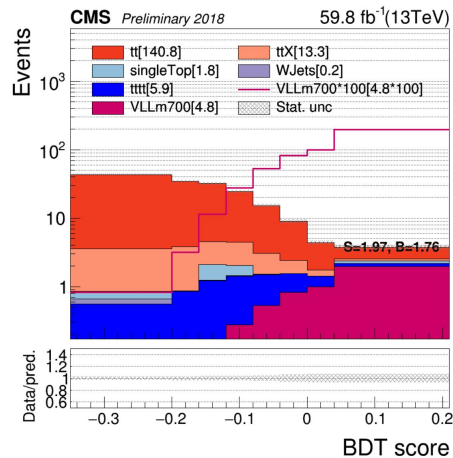
Background rejection versus Signal efficiency variables)



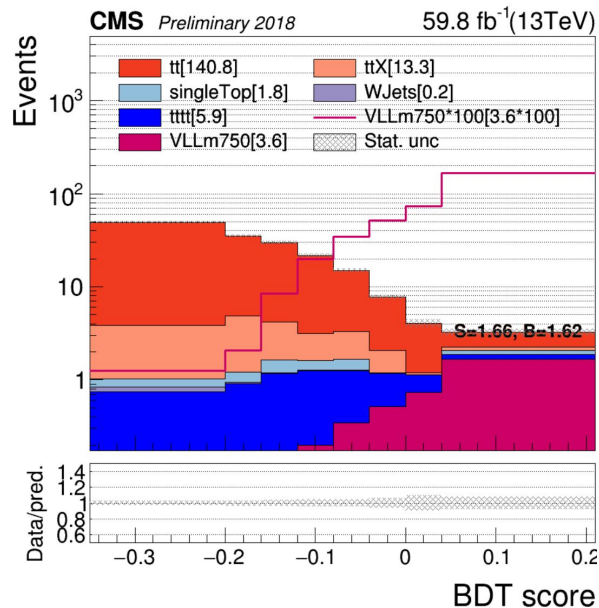
Combine impact result



VLLm700



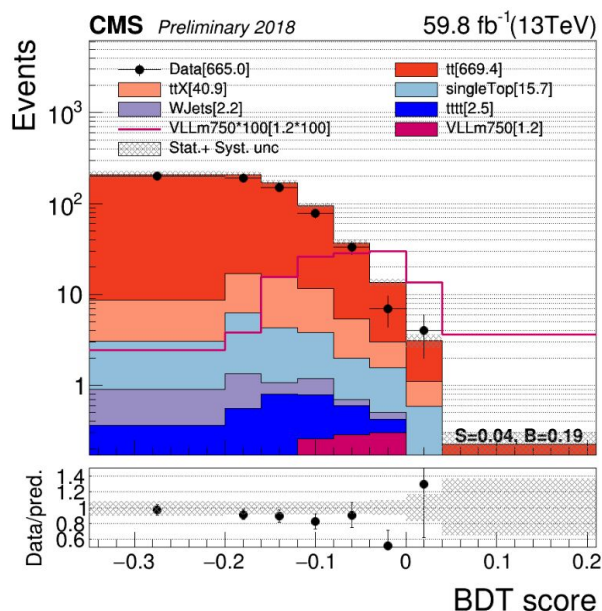
VLLm750 **best bin**(last bin: 0.04-0.2)



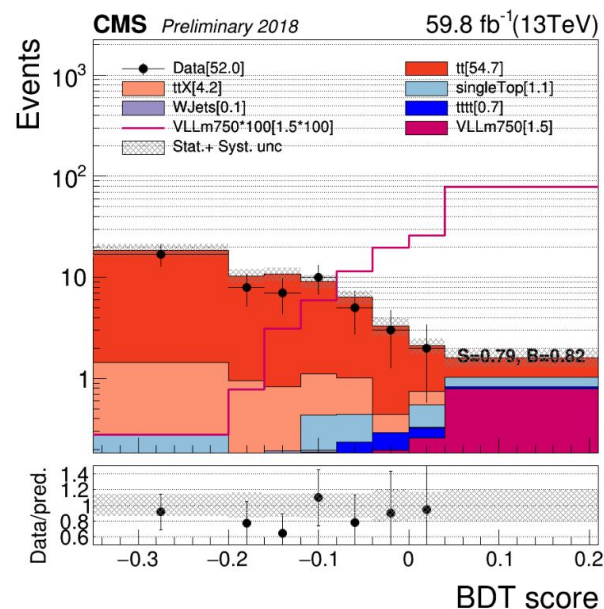
SR

limit: 2.21

significance: 1.00



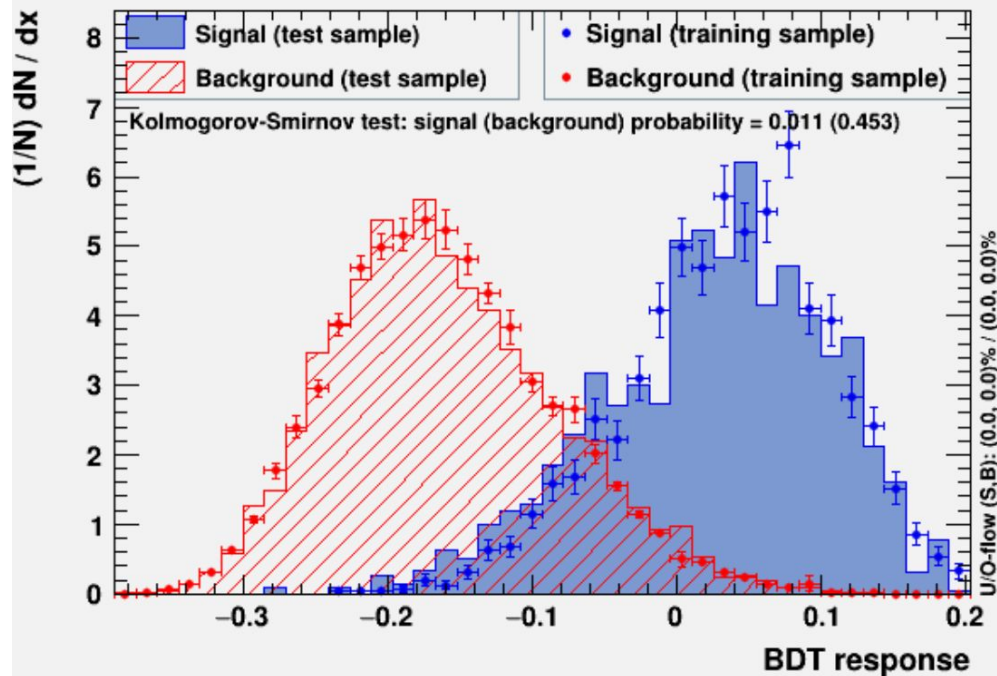
CR1



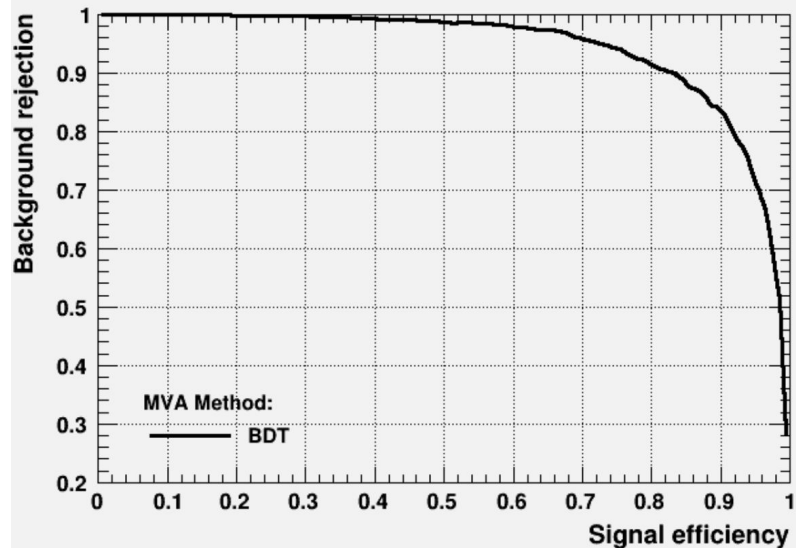
CR2

TMVA check

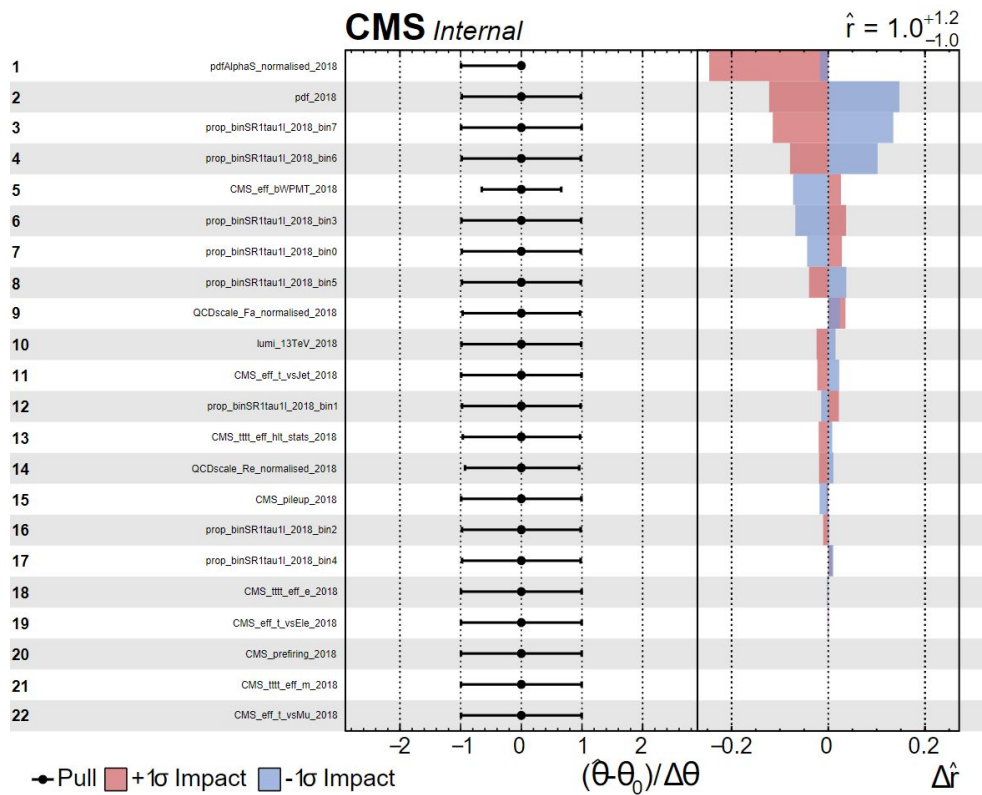
TMVA overtraining check for classifier: BDT(final25 inputs)



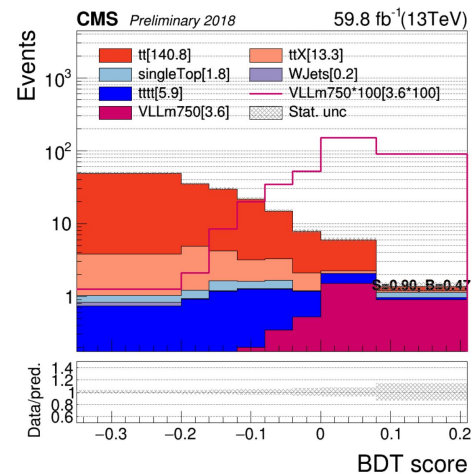
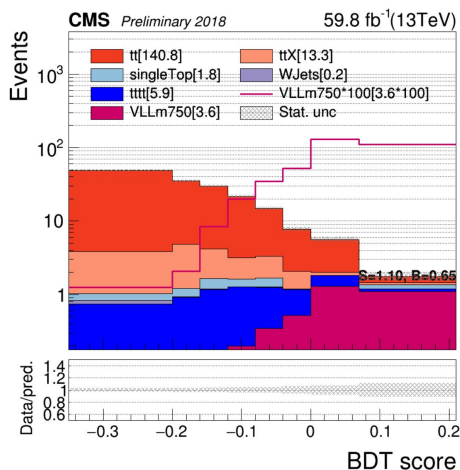
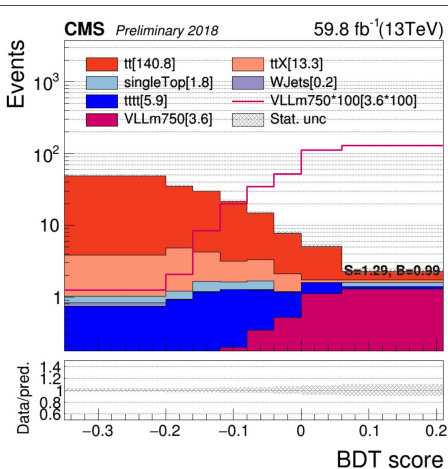
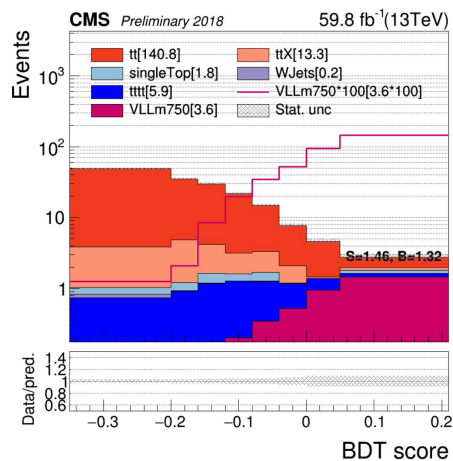
Background rejection versus Signal efficiency variables)



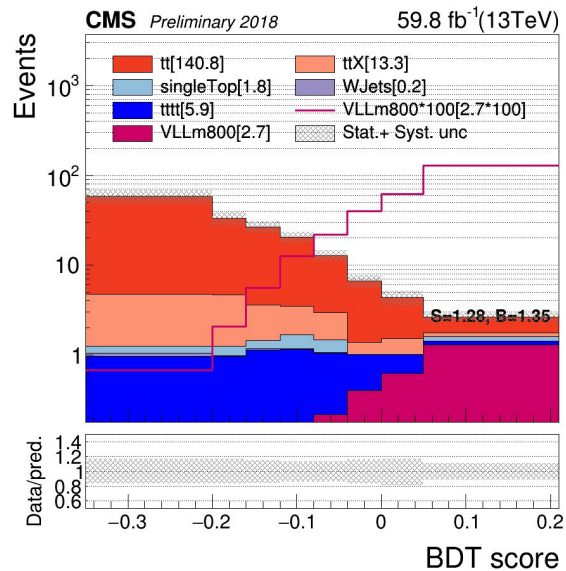
Combine impact result



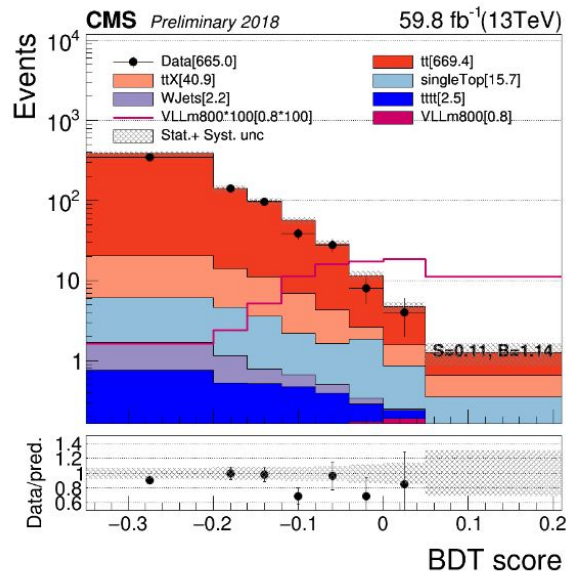
VLLm750



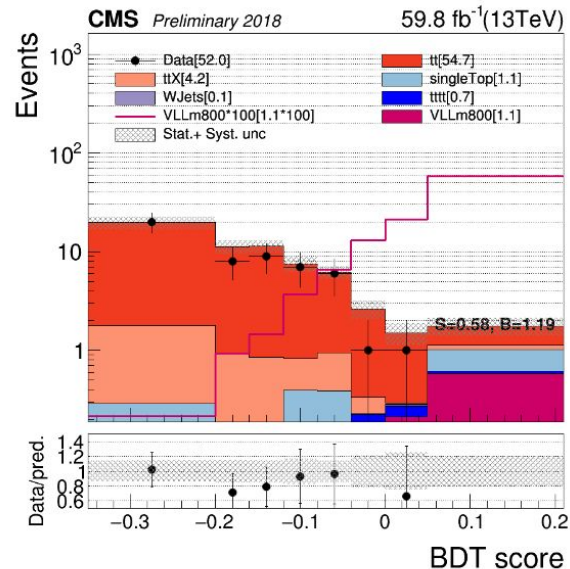
VLLm800 **best bin**(last bin: 0.05-0.2)



SR



CR1

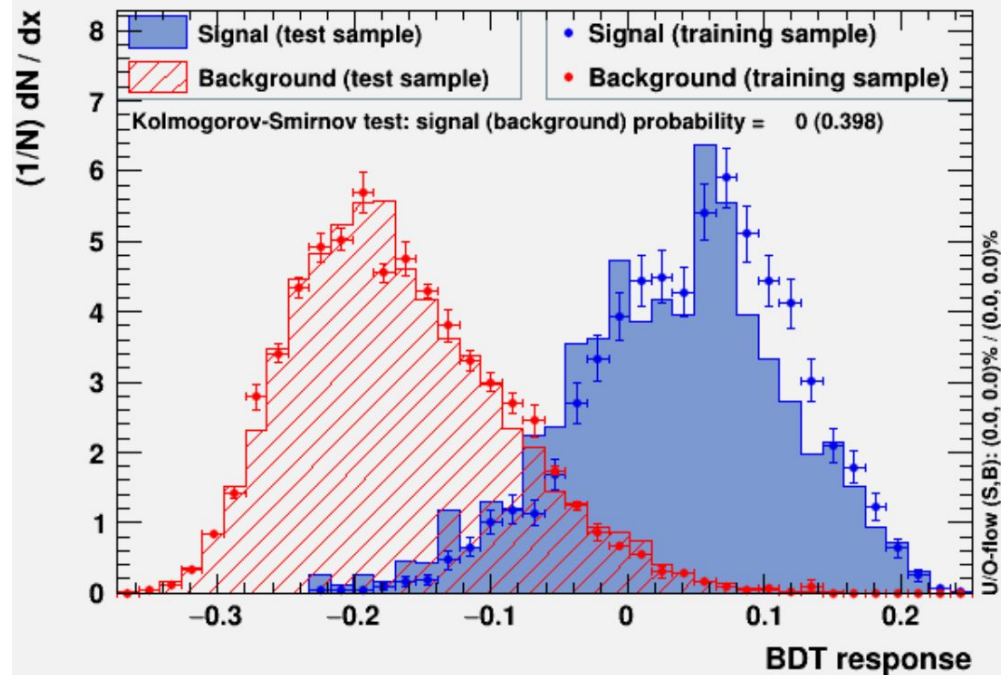


CR2

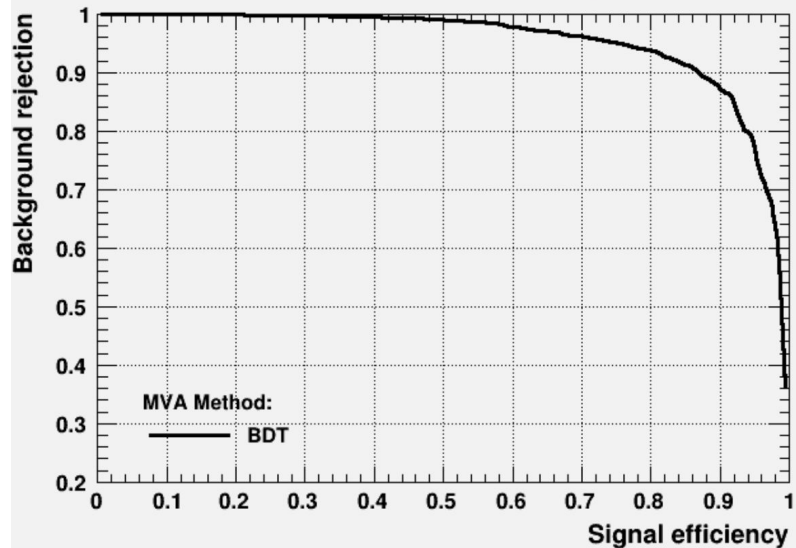
limit: 2.75 significance: 0.78

TMVA check

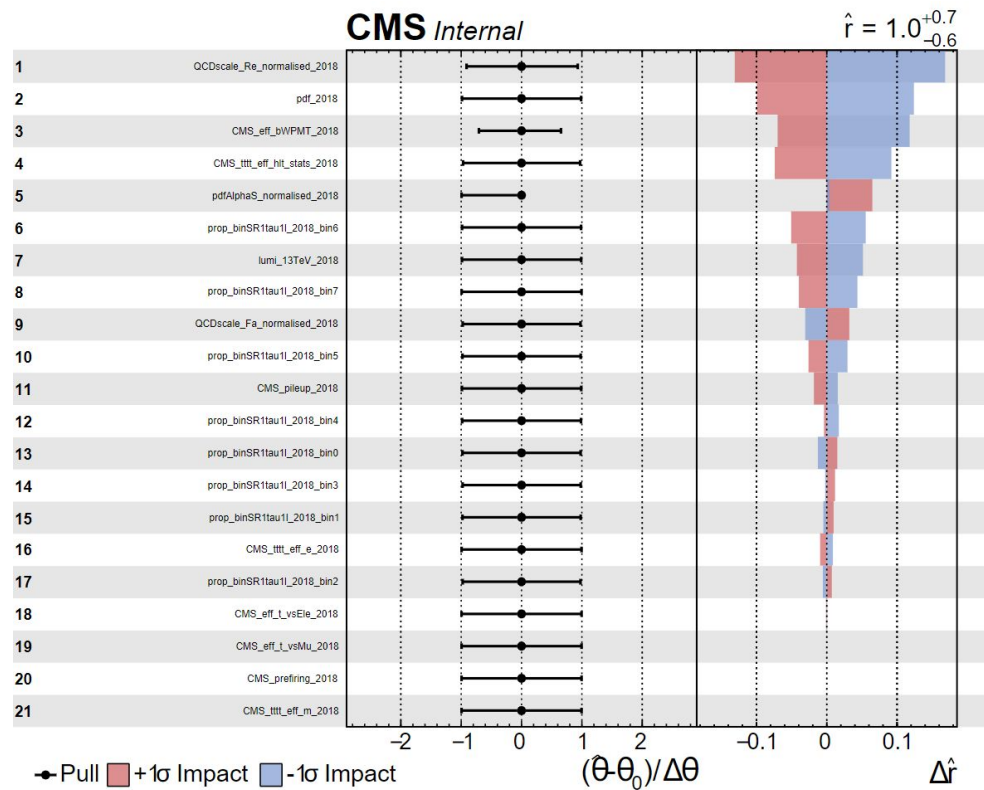
TMVA overtraining check for classifier: BDT(final25 inputs)



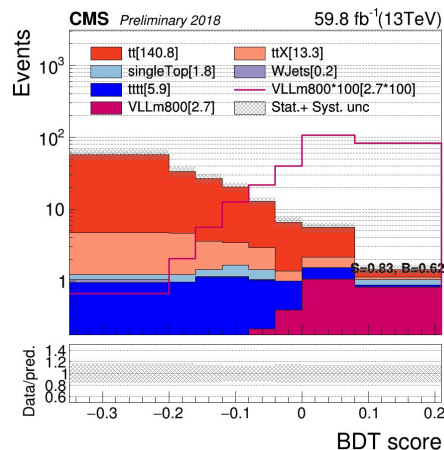
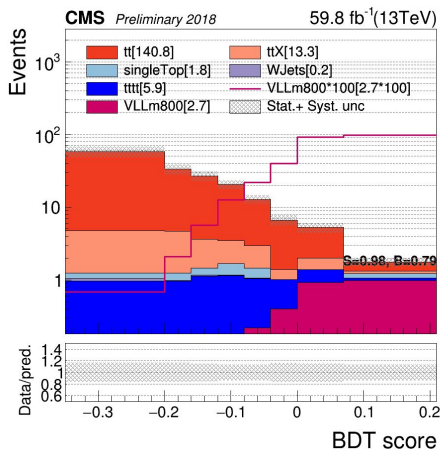
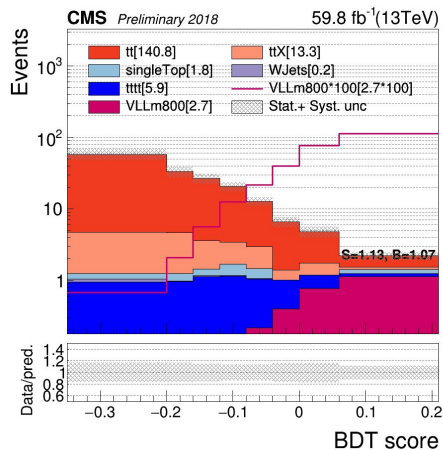
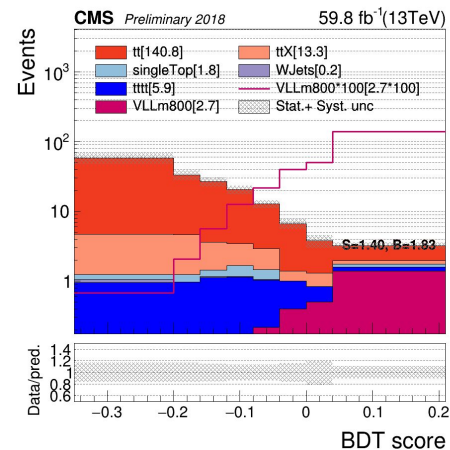
Background rejection versus Signal efficiency variables



Combine impact result



VLLm800



limit: 2.81

significance: 0.94

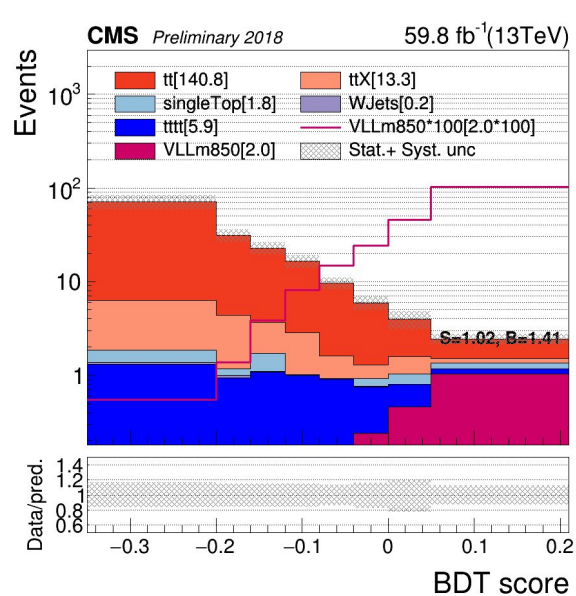
last bin: 0.04-0.2

last bin: 0.06-0.2

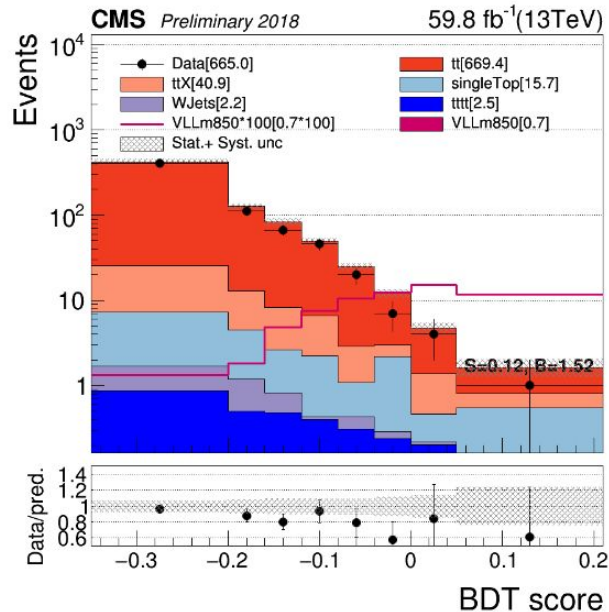
last bin: 0.07-0.2

last bin: 0.08-0.2

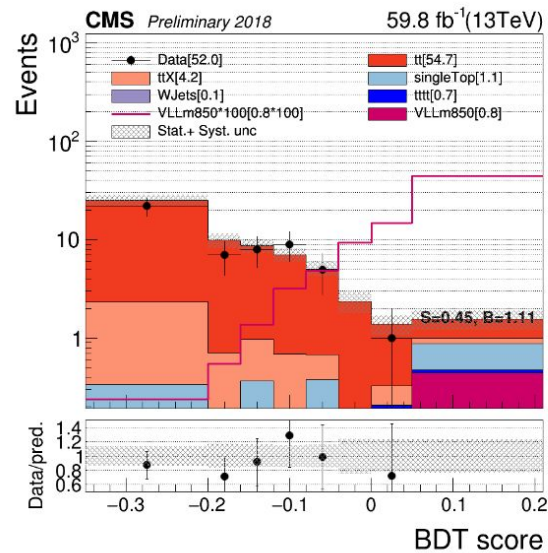
VLLm850 **best bin**(last bin: 0.05-0.2)



SR



CR1



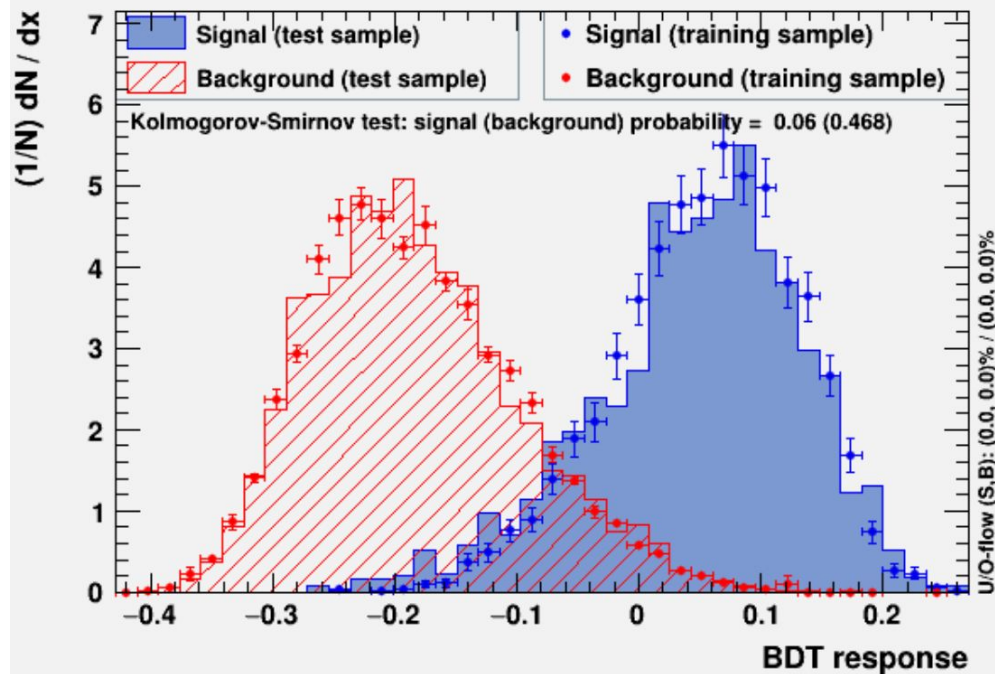
CR2

limit: 3.62

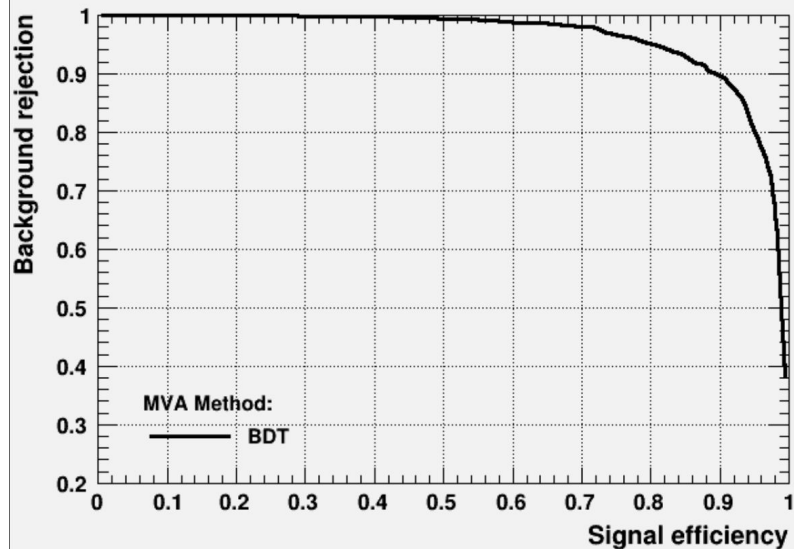
significance: 0.69

TMVA check

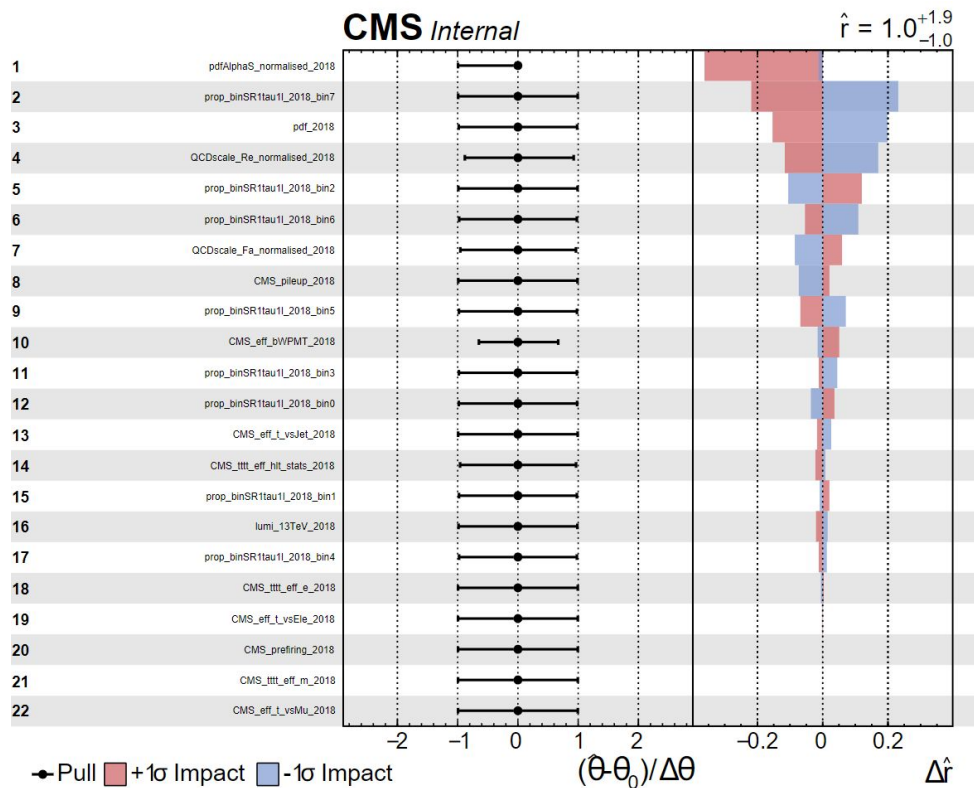
TMVA overtraining check for classifier: BDT(final25 inputs)



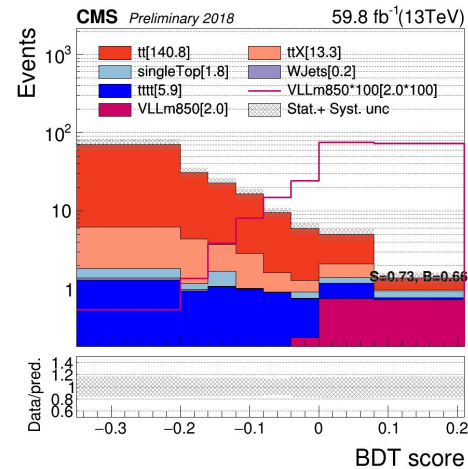
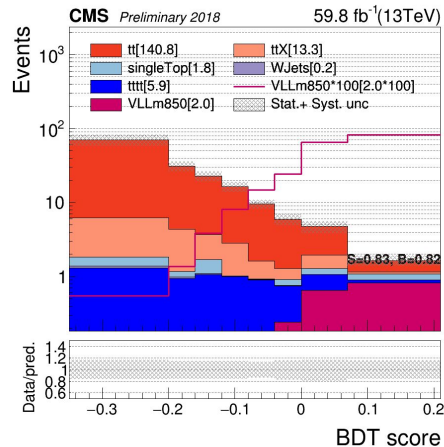
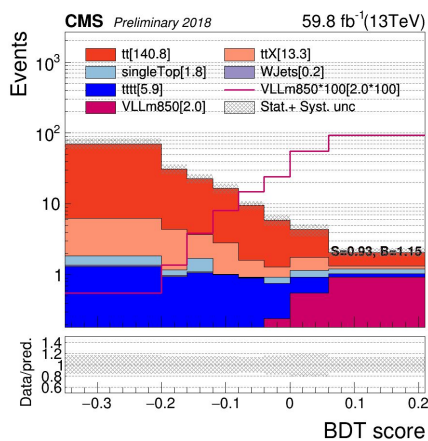
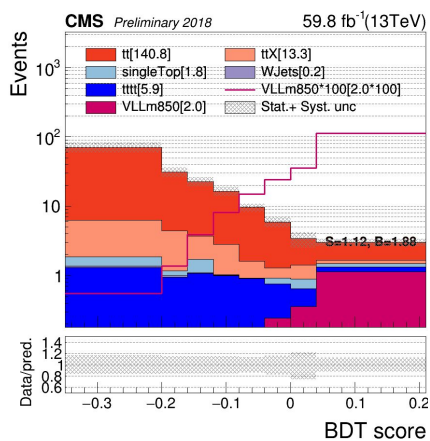
Background rejection versus Signal efficiency variables)



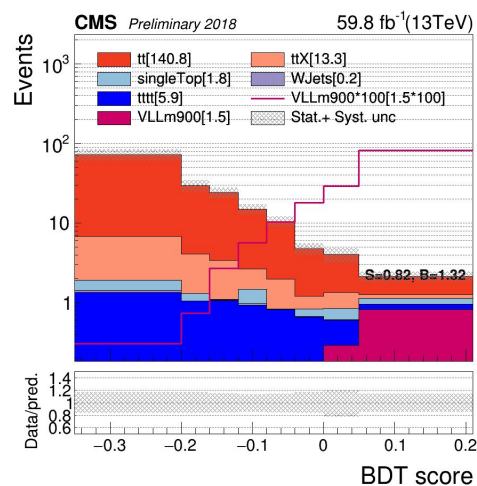
Combine impact result



VLLm850



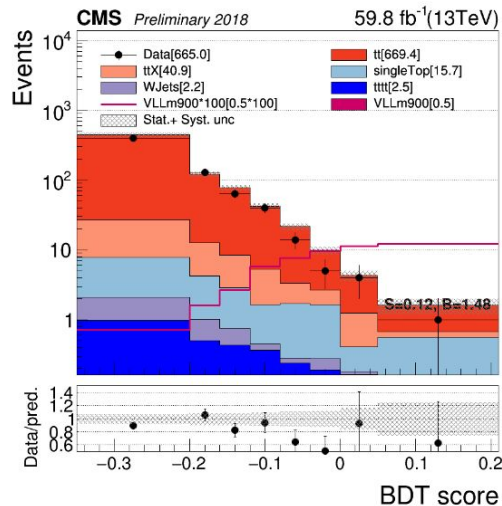
VLLm900 **best bin**(last bin: 0.05-0.2)



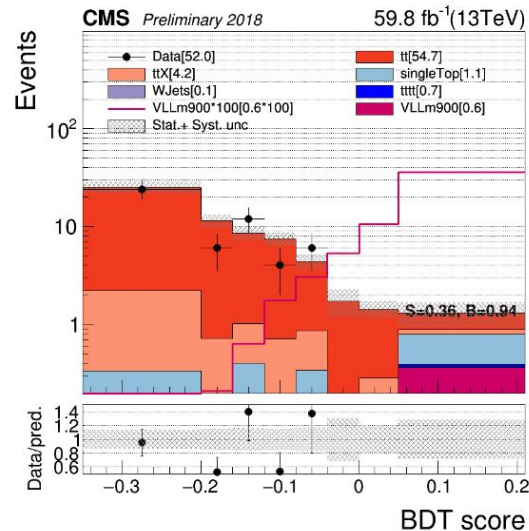
SR

limit: 4.54

significance: 0.63



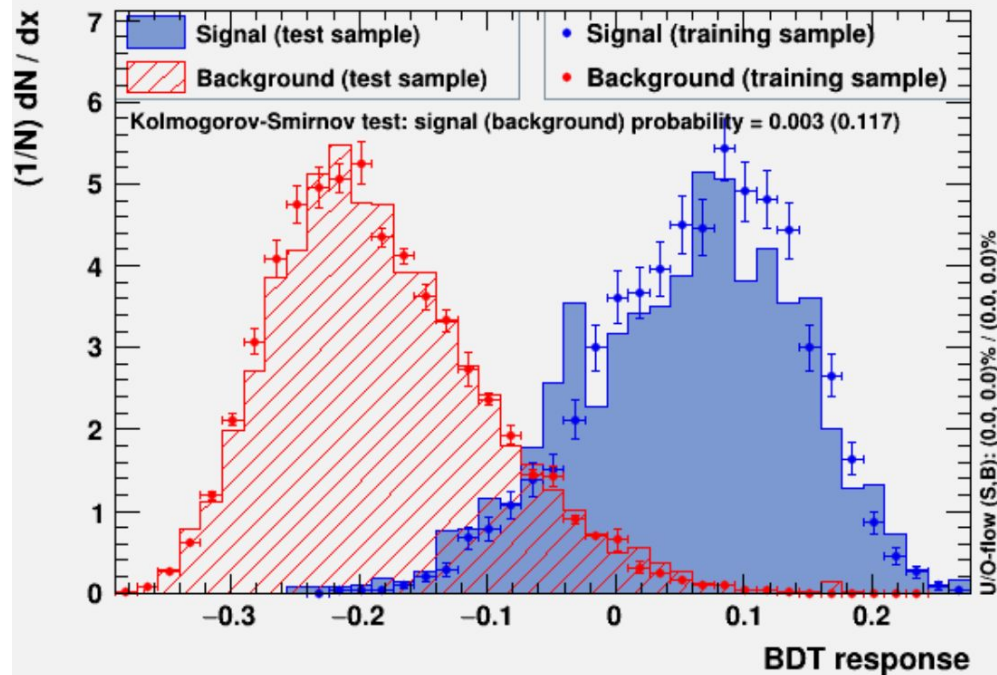
CR1



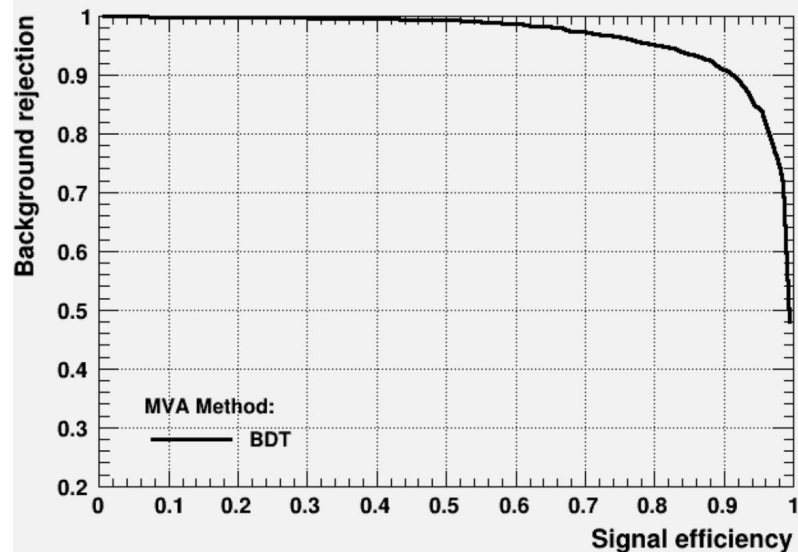
CR2

TMVA check

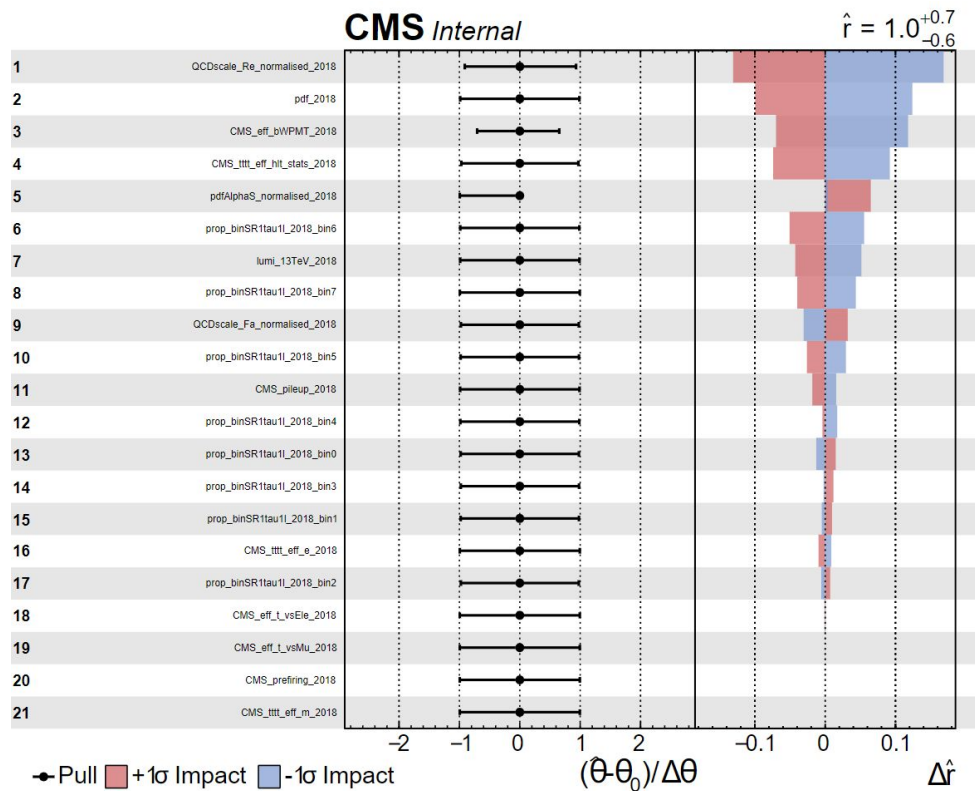
TMVA overtraining check for classifier: BDT(final25 inputs)



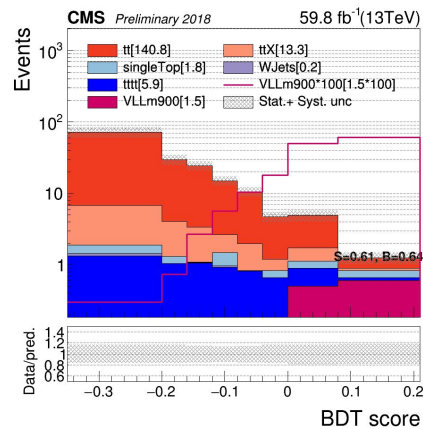
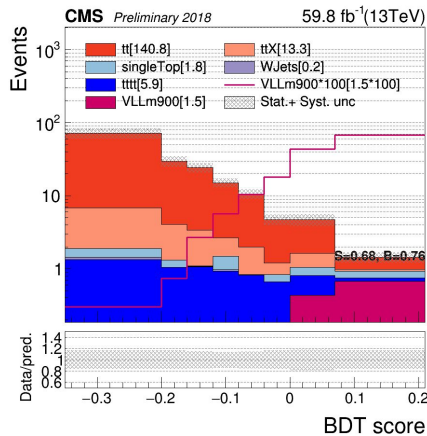
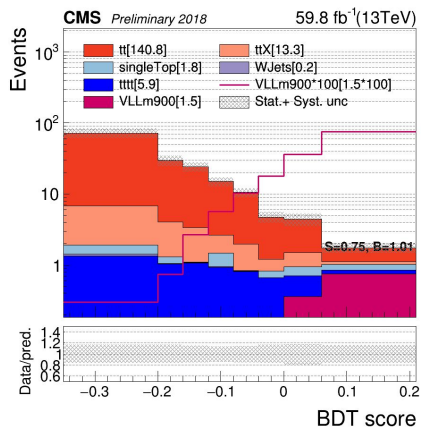
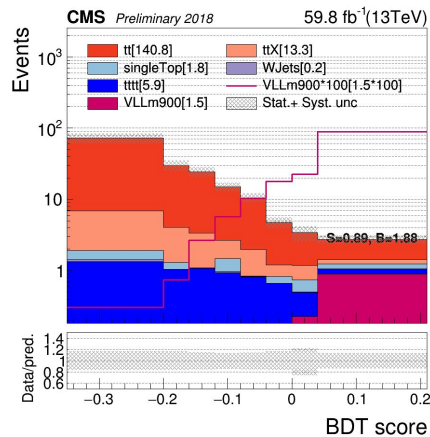
Background rejection versus Signal efficiency variables)



Combine impact result



VLLm900



limit: 4.73

significance: 0.59

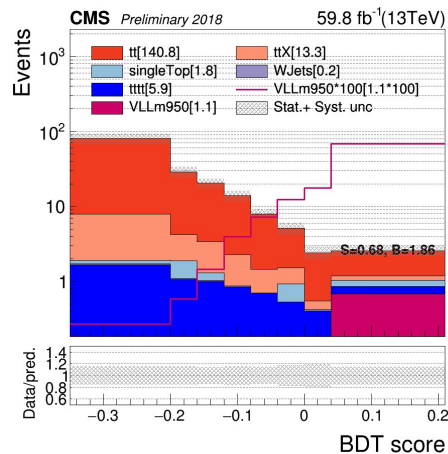
last bin: 0.04-0.2

last bin: 0.06-0.2

last bin: 0.07-0.2

last bin: 0.08-0.2

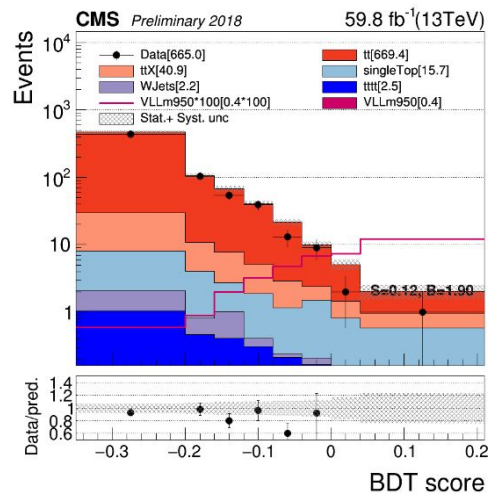
VLLm950 **best bin**(last bin: 0.04-0.2)



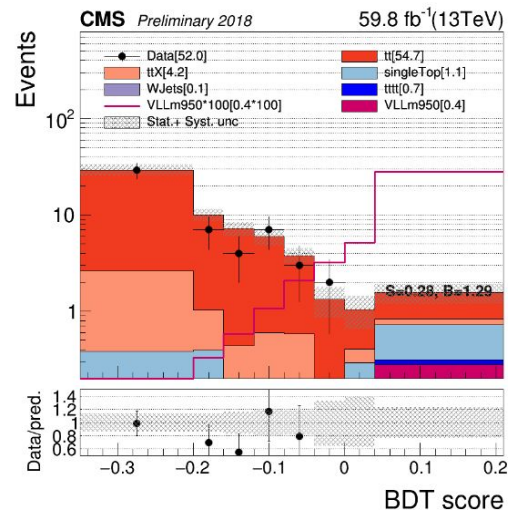
SR

limit: 5.84

significance: 0.47



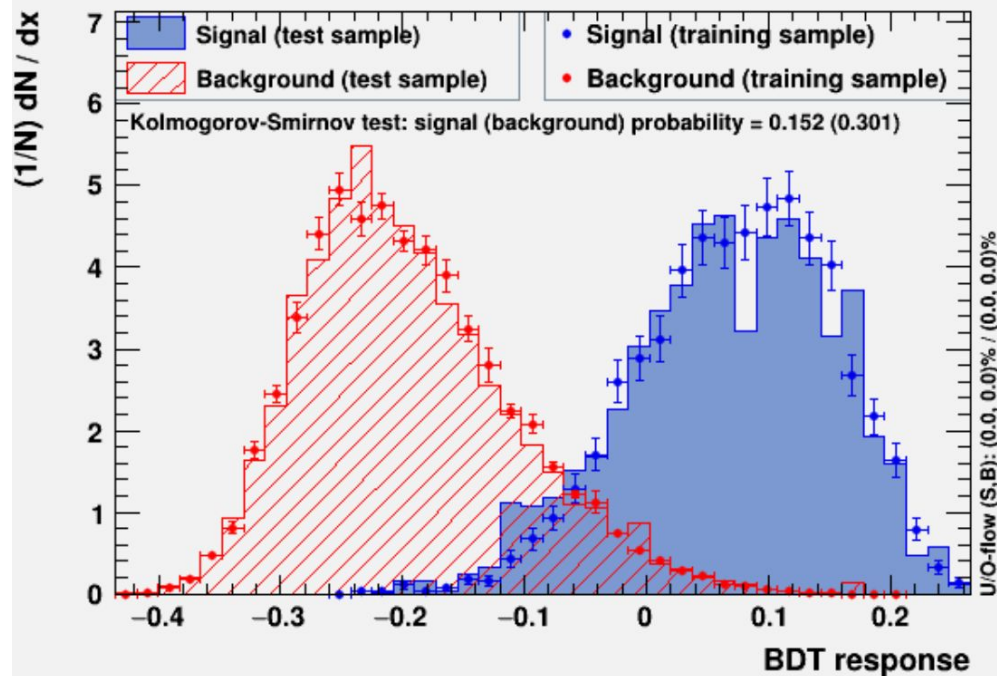
CR1



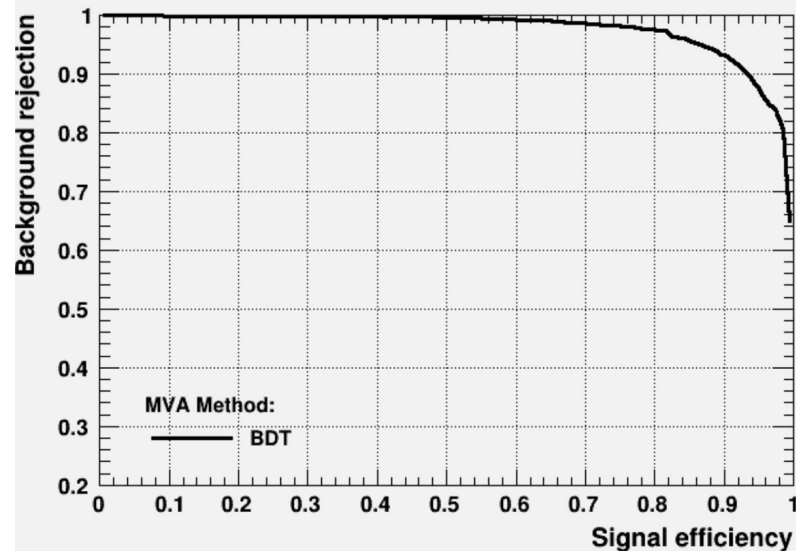
CR2

TMVA check

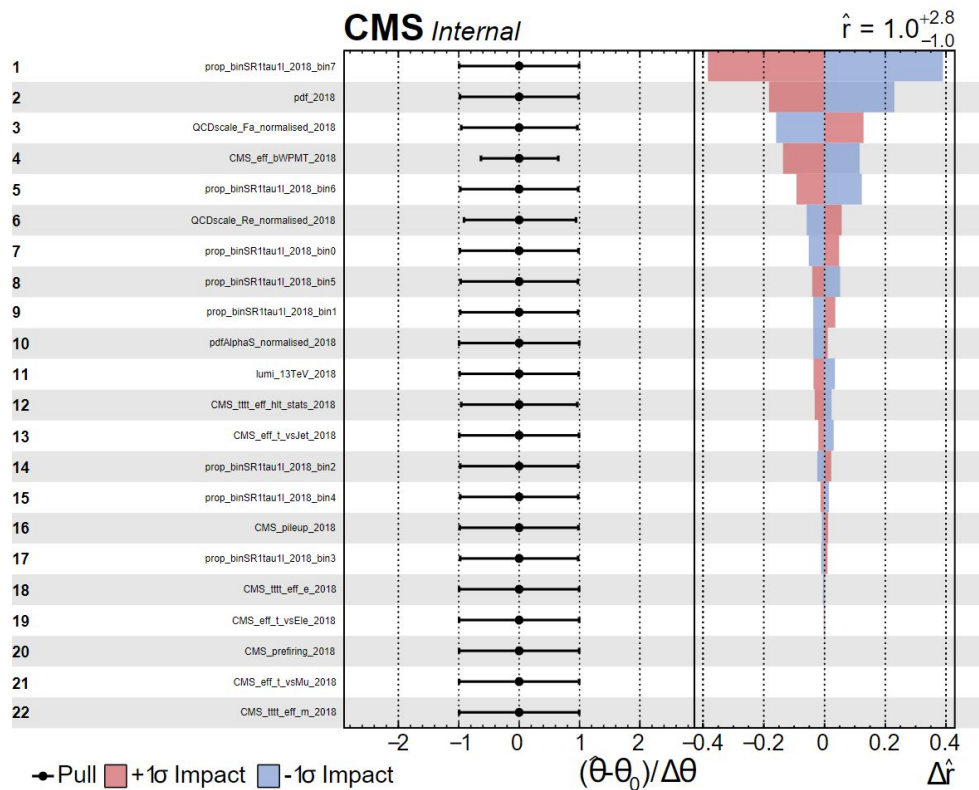
TMVA overtraining check for classifier: BDT(final25 inputs)



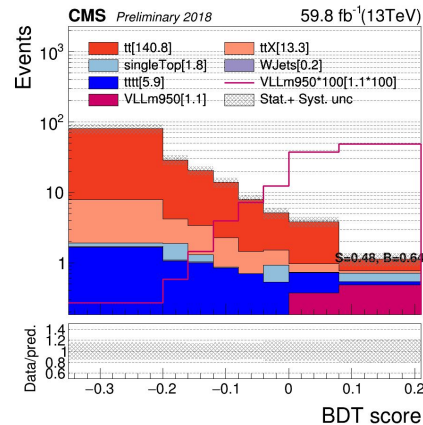
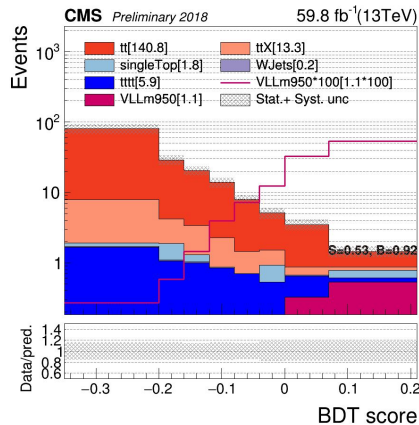
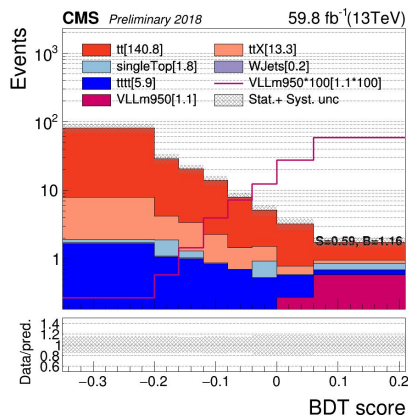
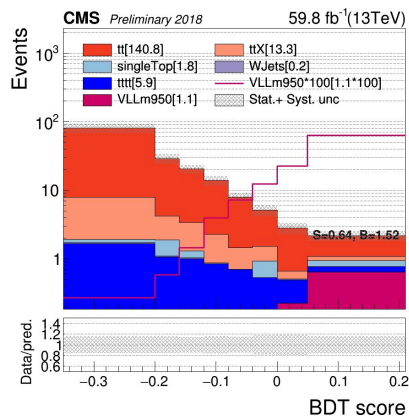
Background rejection versus Signal efficiency variables



Combine impact result



VLLm950



limit: 4.92

significance: 0.43

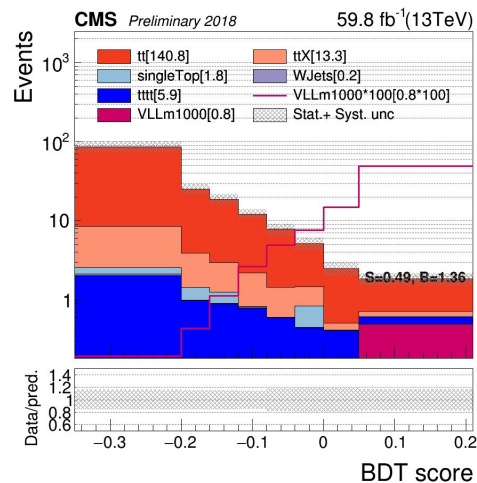
last bin: 0.05-0.2

last bin: 0.06-0.2

last bin: 0.07-0.2

last bin: 0.08-0.2

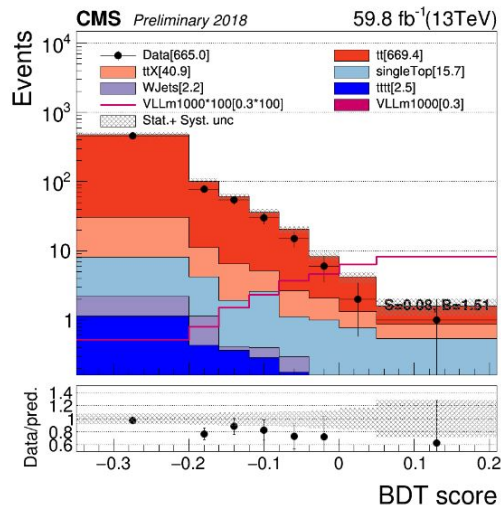
VLLm1000 best bin(last bin: 0.05-0.2)



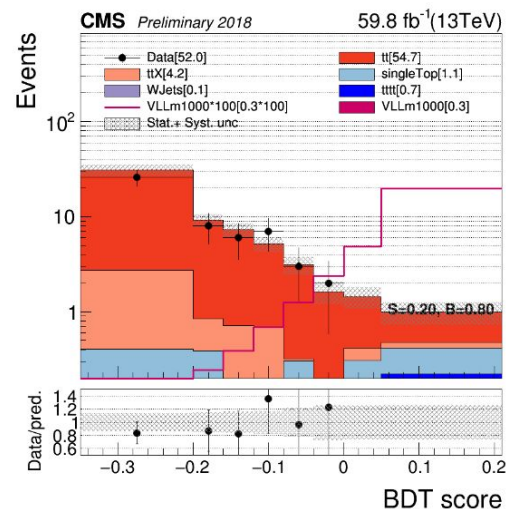
SR

limit: 7.62

significance: 0.40



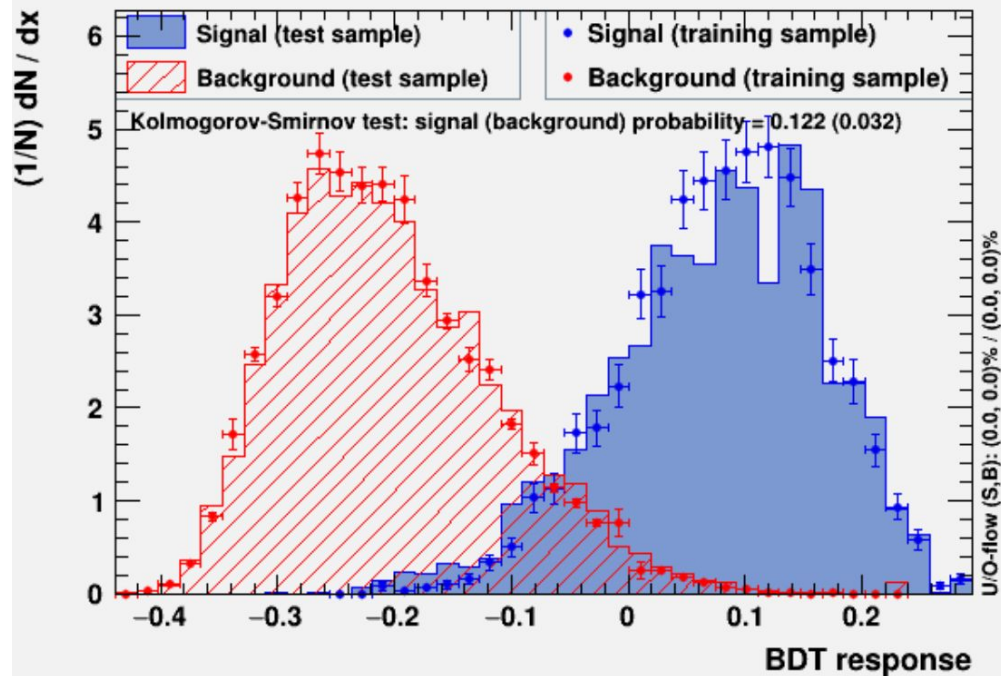
CR1



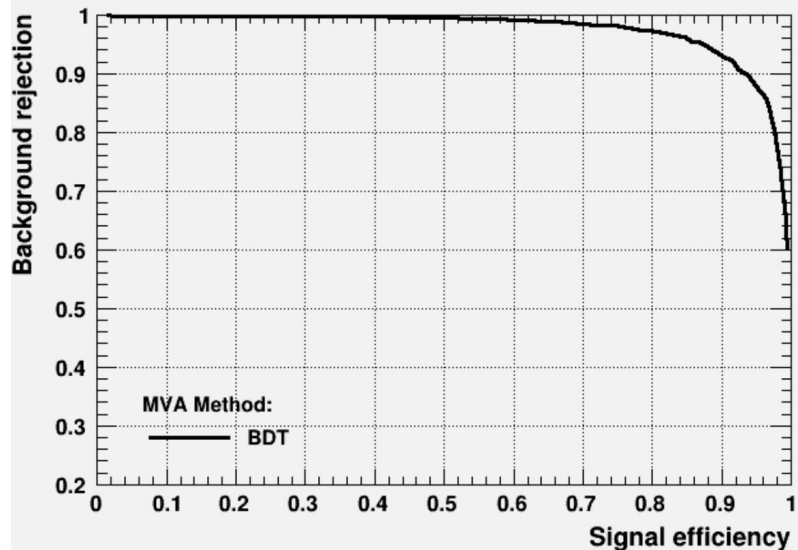
CR2

TMVA check

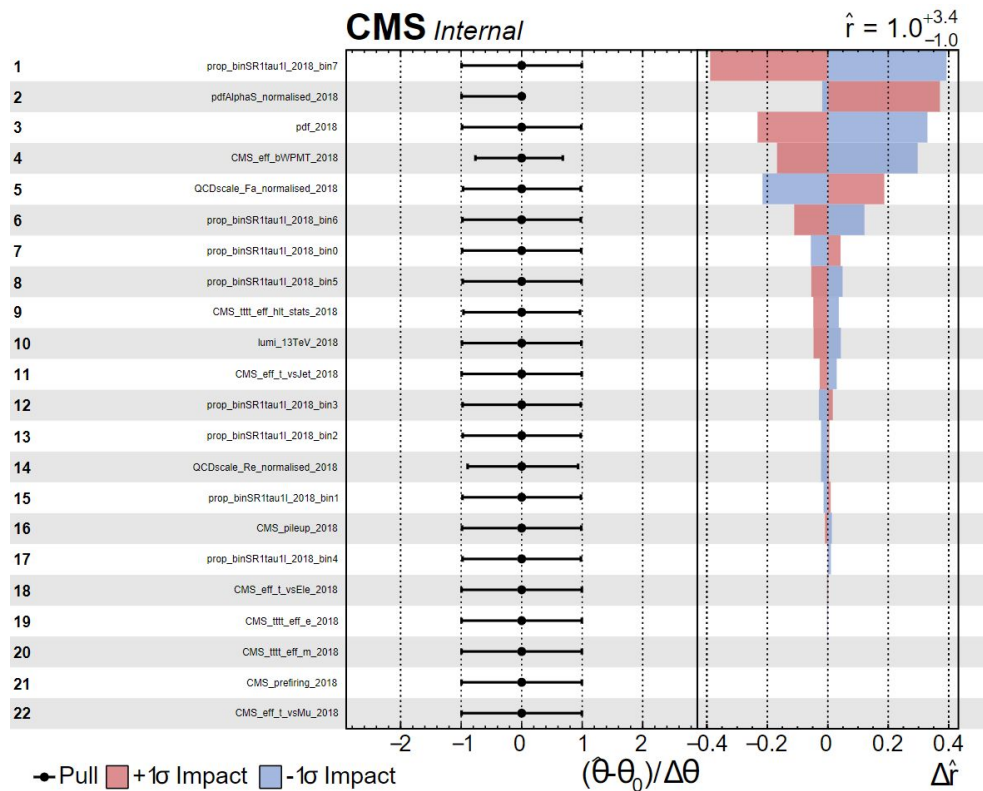
TMVA overtraining check for classifier: BDT(final25 inputs)



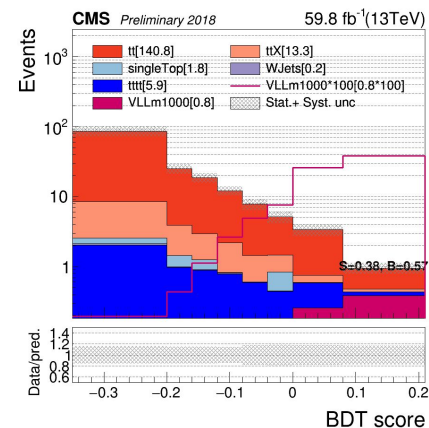
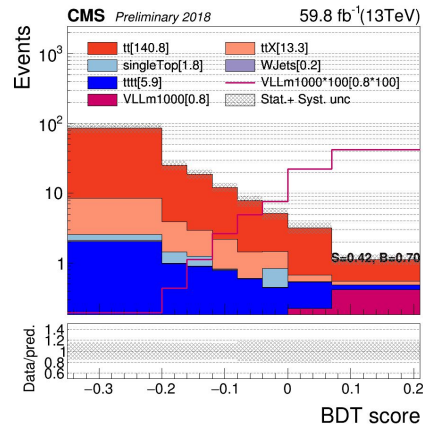
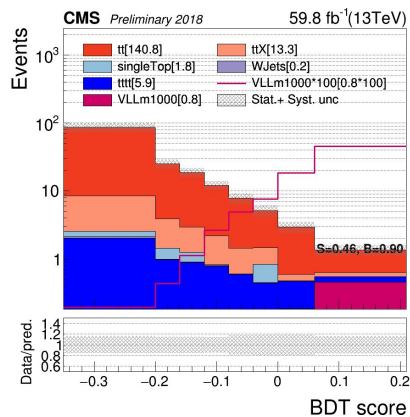
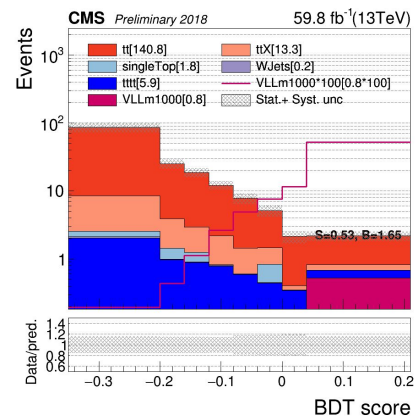
Background rejection versus Signal efficiency variables)



Combine impact result



VLLm1000



limit: 7.75

significance: 0.39

last bin: 0.04-0.2

last bin: 0.06-0.2

last bin: 0.07-0.2

last bin: 0.08-0.2

CMS Preliminary 2018

59.8 fb⁻¹(13TeV)

