

Caratteristiche analisi

- DNN: train e test su eventi di segnale con un'unica massa
- Collezione jet: TCC
- Analisi: merged
- Canale: ggF
- Segnale: Radion (125395 eventi)
- Training fraction: 0.8

Casi studiati

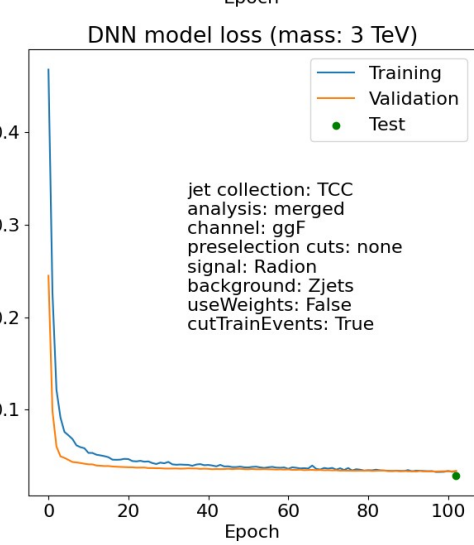
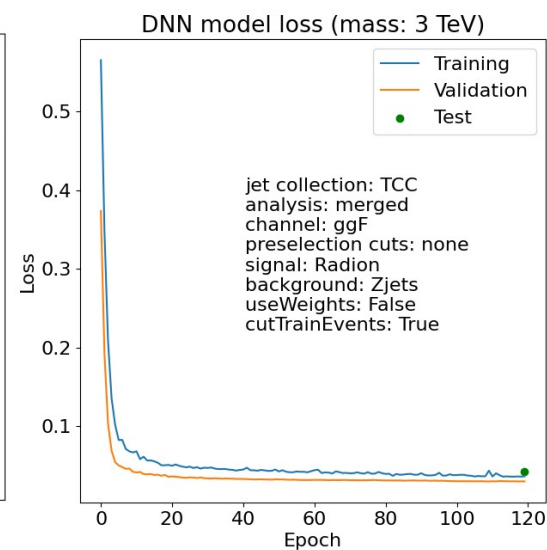
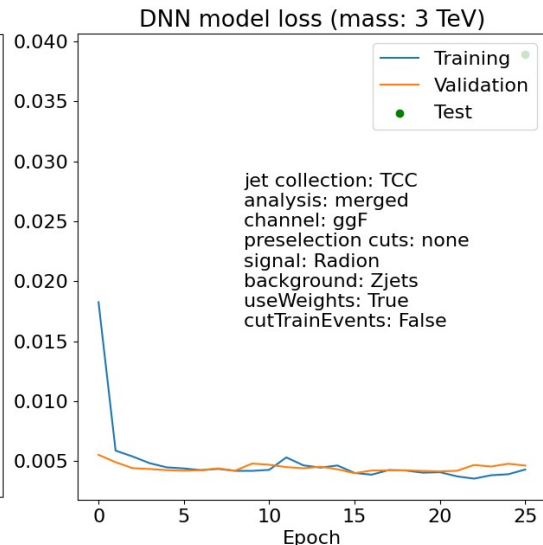
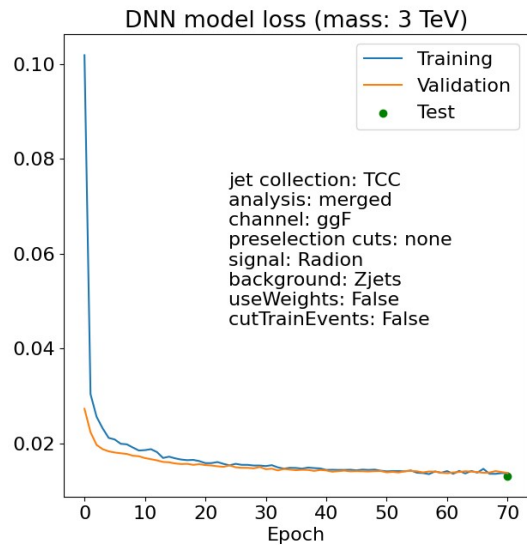
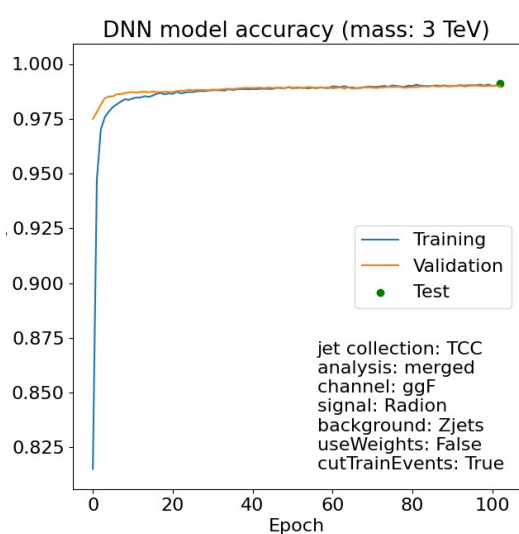
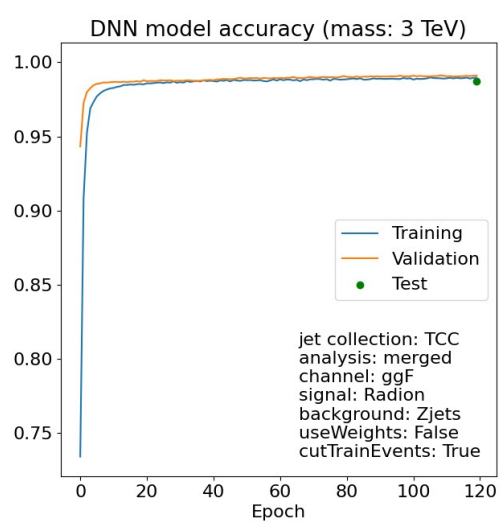
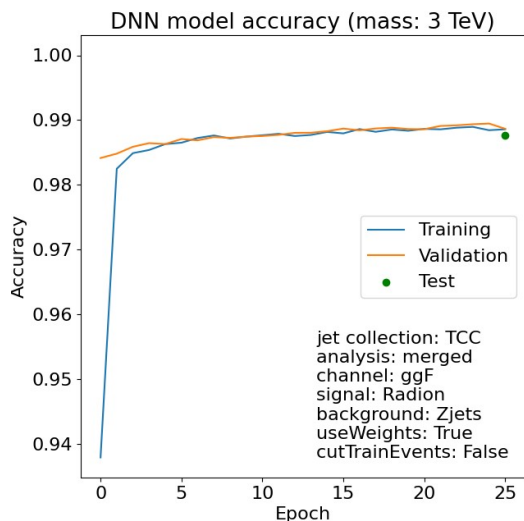
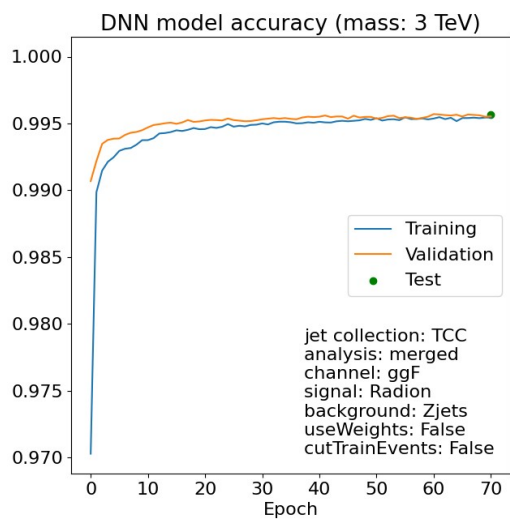
Addestramento della rete confrontato in 4 diversi casi:

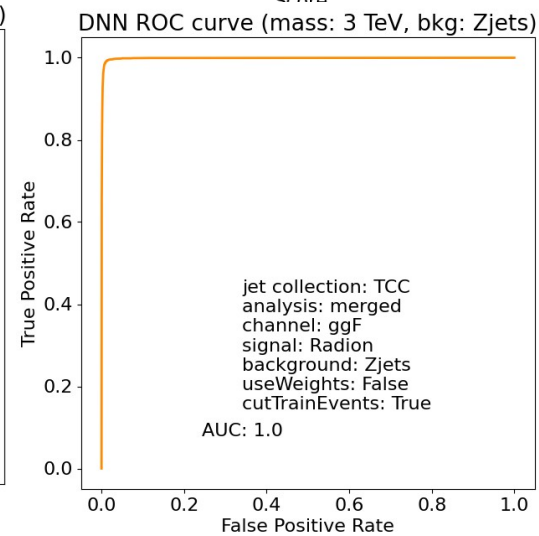
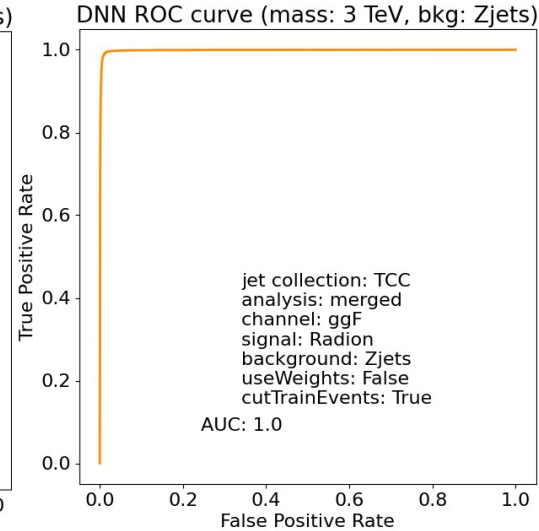
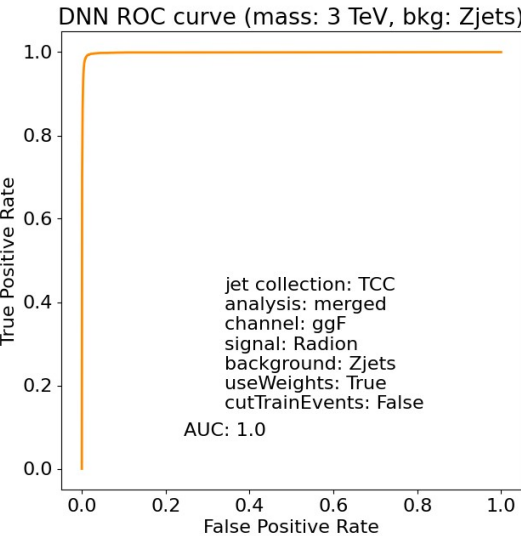
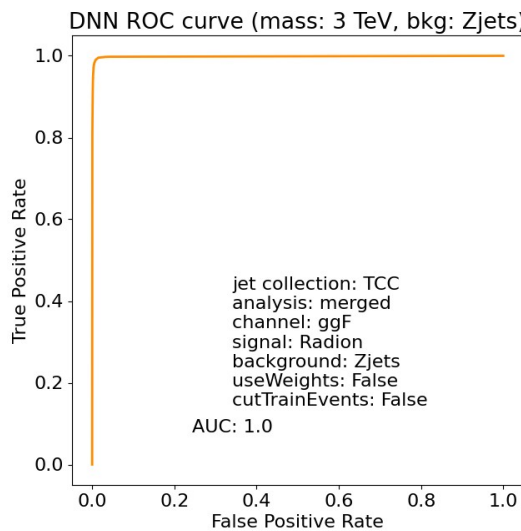
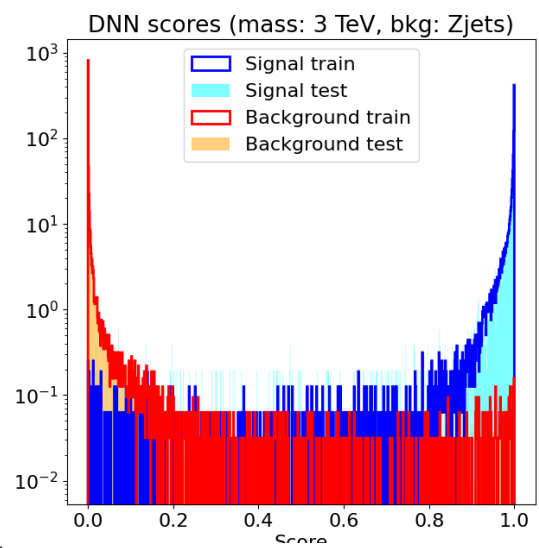
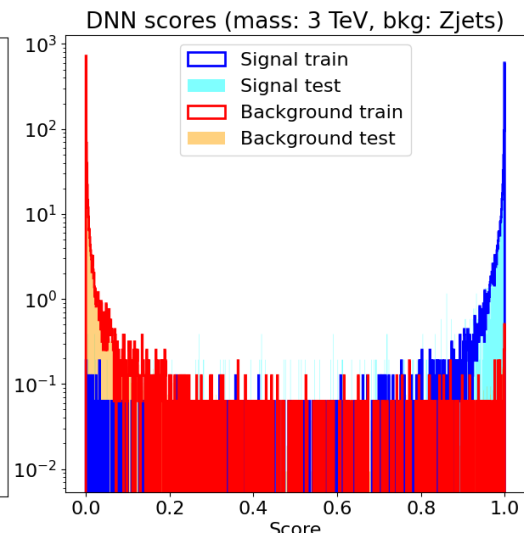
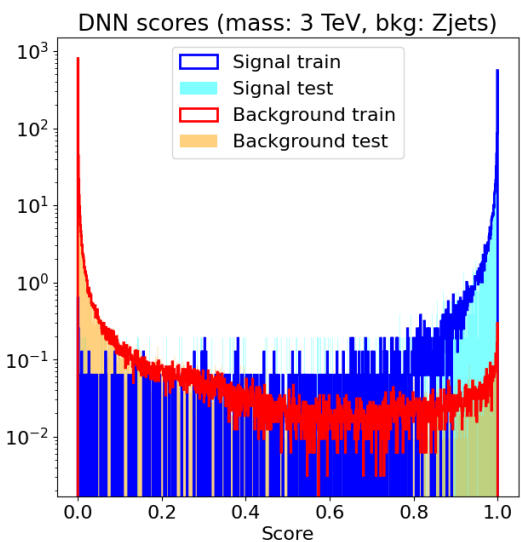
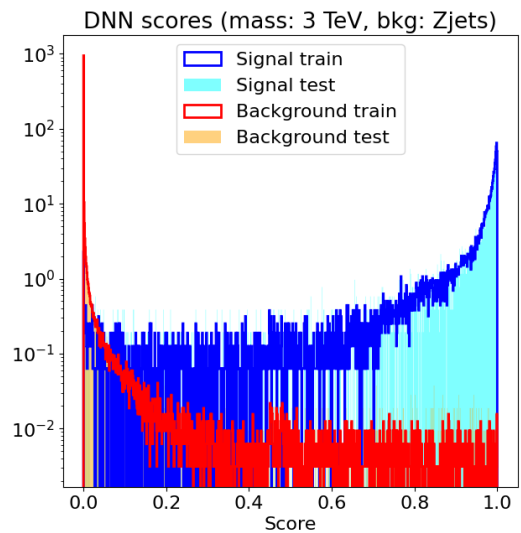
- 1) sull'intero campione di train
- 2) sull'intero campione di train ma con pesi in train e validazione per compensare il diverso numero di eventi di segnale e di background
- 3) su un sottoinsieme del campione di train con uguale numero di eventi di segnale e di background
- 4) su un sottoinsieme del campione di train con $N \cdot \text{sig} = \text{bkg}$ (N fissato a priori)

Ogni caso è stato studiato per massa del segnale = 3 TeV e due diversi background (Zjets o Diboson)

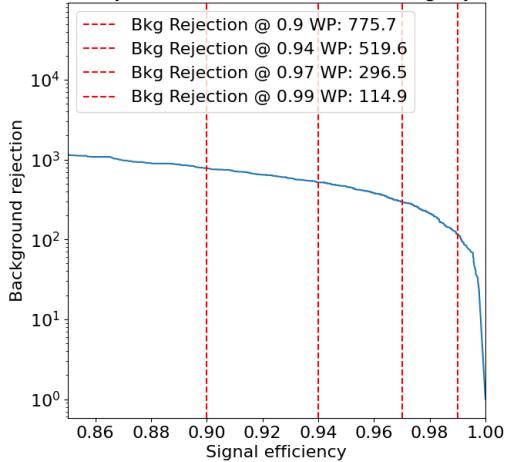
Mass = 3 TeV, bkg = Zjets

| | Whole sample | Whole sample + weights | Bkg = sig | Bkg = 2sig |
|-------------------------|--------------|------------------------|-----------|------------|
| Signal train + val | 15887 | | | |
| Bkg train + val | 321055 | | | 31774 |
| Signal test | 5181 | | | |
| Bkg test | 107046 | | | |
| Train loss | 0.0135 | 0.0037 | 0.0389 | 0.0327 |
| Train accuracy | 0.9955 | 0.9892 | 0.9893 | 0.9905 |
| Validation loss | 0.0138 | 0.0046 | 0.0299 | 0.0332 |
| Validation accuracy | 0.9955 | 0.9887 | 0.9910 | 0.9900 |
| Test loss | 0.0132 | 0.0398 | 0.0424 | 0.0293 |
| Test accuracy | 0.9957 | 0.9877 | 0.9875 | 0.9911 |
| AUC | 0.997 | 0.998 | 0.998 | 0.998 |
| Bkg rejection @ 0.90 WP | 775.7 | 393.6 | 400.9 | 431.6 |
| Bkg rejection @ 0.99 WP | 114.9 | 90.0 | 87.4 | 92.7 |

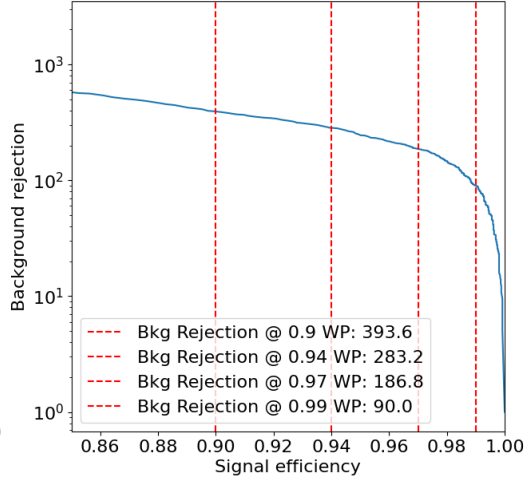




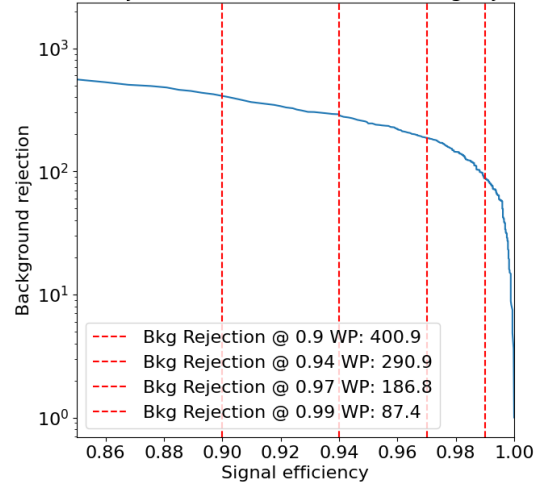
DNN rejection curve (mass: 3 TeV, bkg: Zjets)



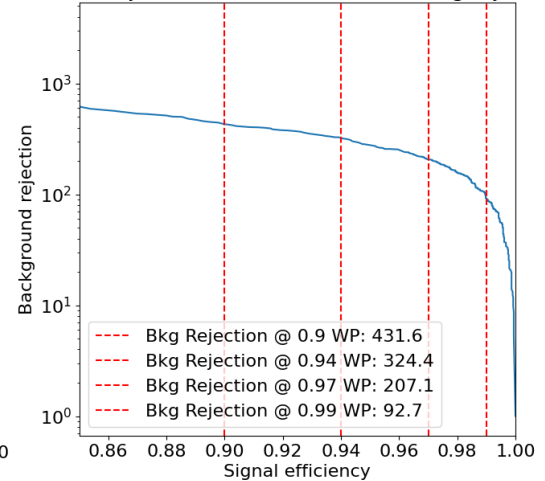
DNN rejection curve (mass: 3 TeV, bkg: Zjets)



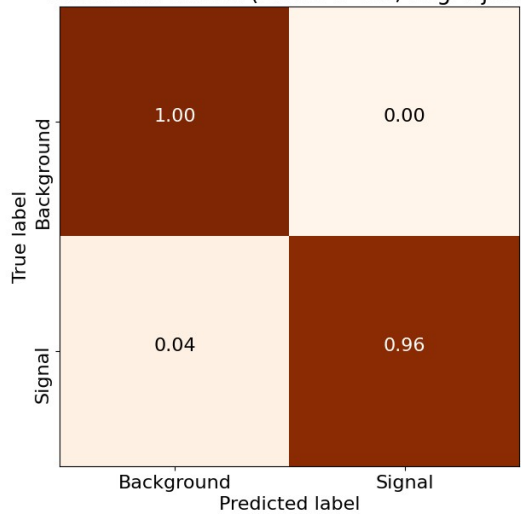
DNN rejection curve (mass: 3 TeV, bkg: Zjets)



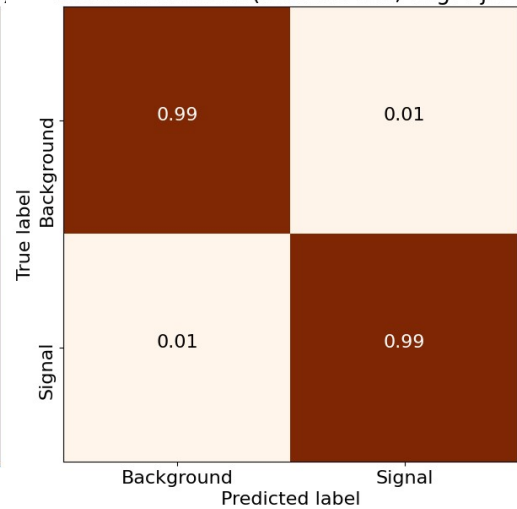
DNN rejection curve (mass: 3 TeV, bkg: Zjets)



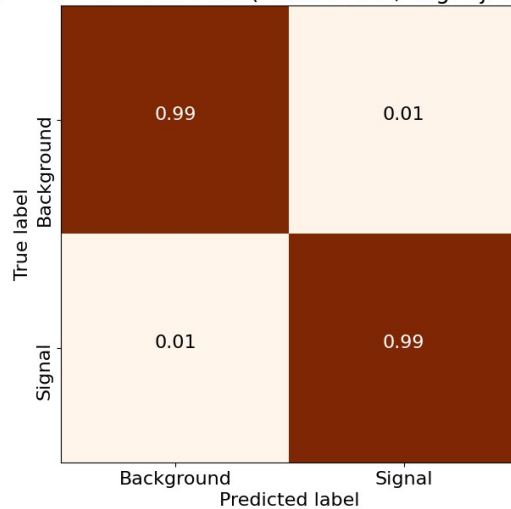
Confusion matrix (mass: 3 TeV, bkg: Zjets)



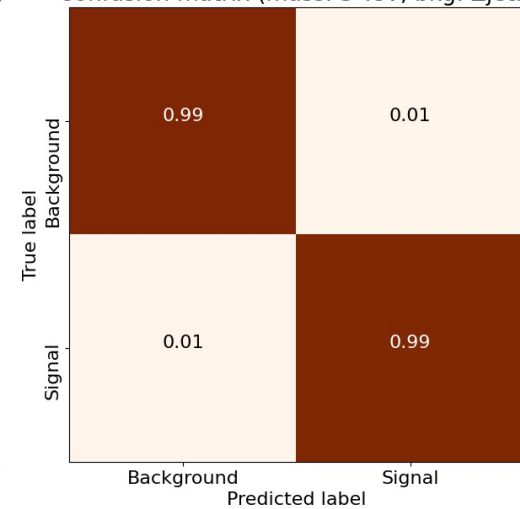
Confusion matrix (mass: 3 TeV, bkg: Zjets)



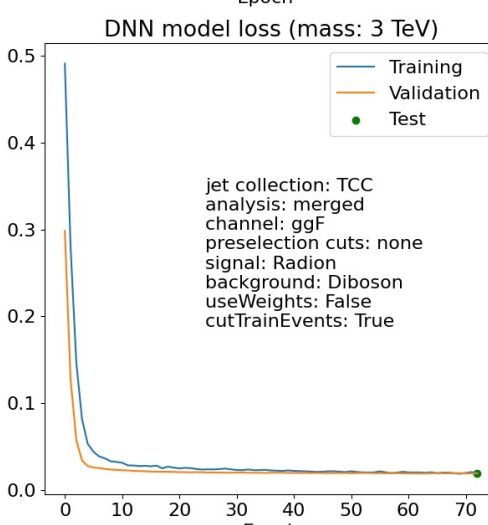
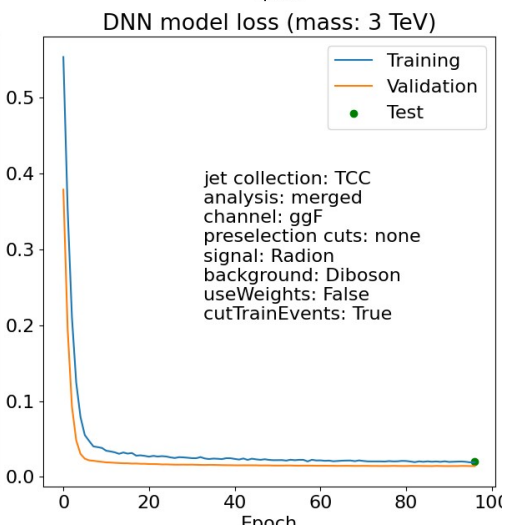
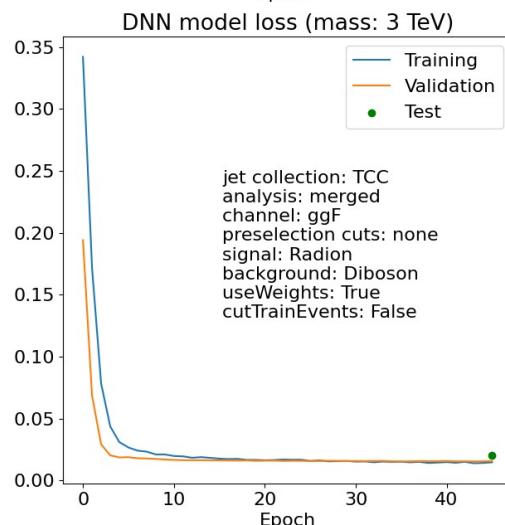
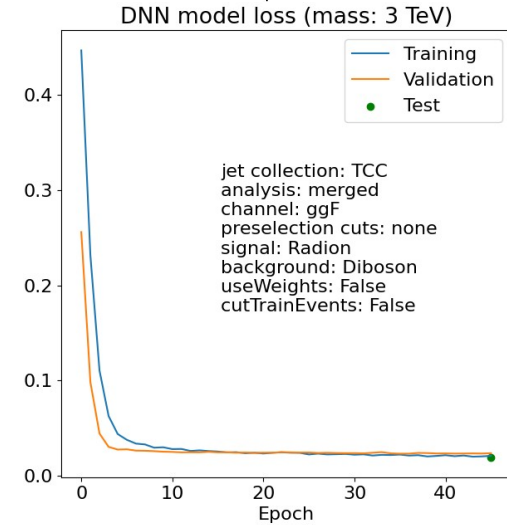
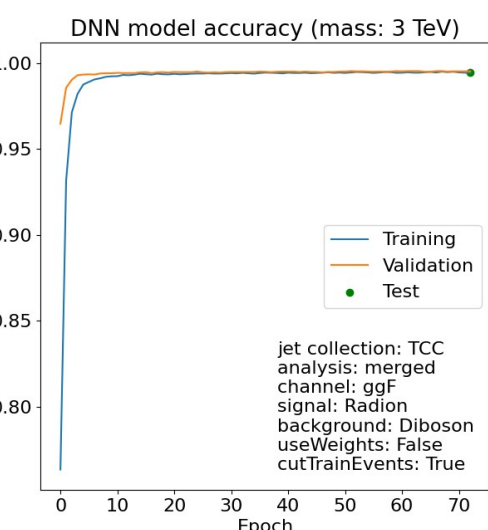
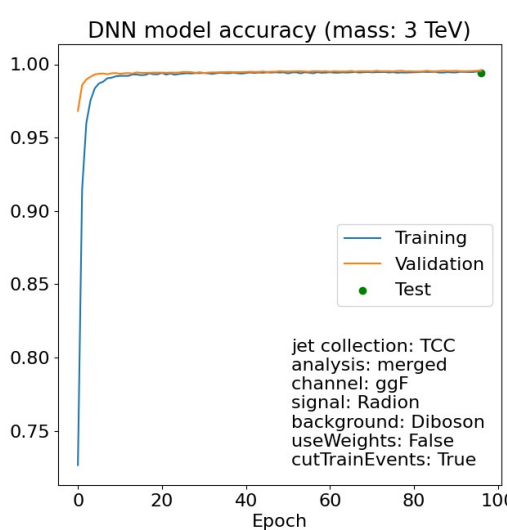
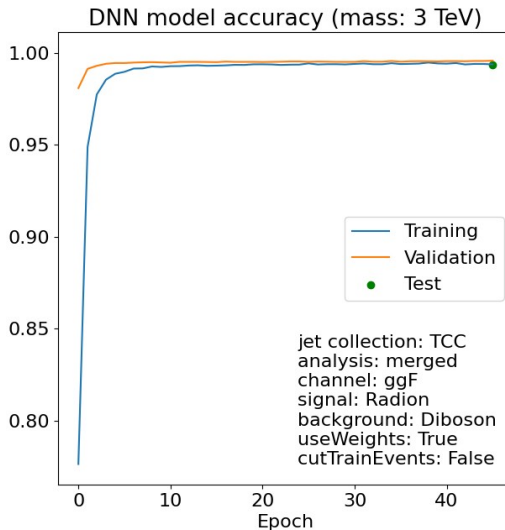
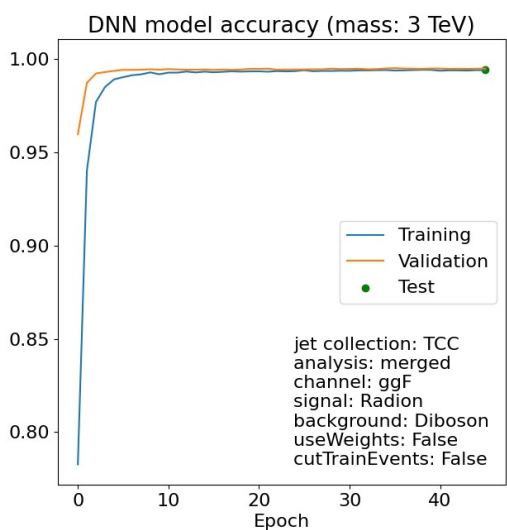
Confusion matrix (mass: 3 TeV, bkg: Zjets)

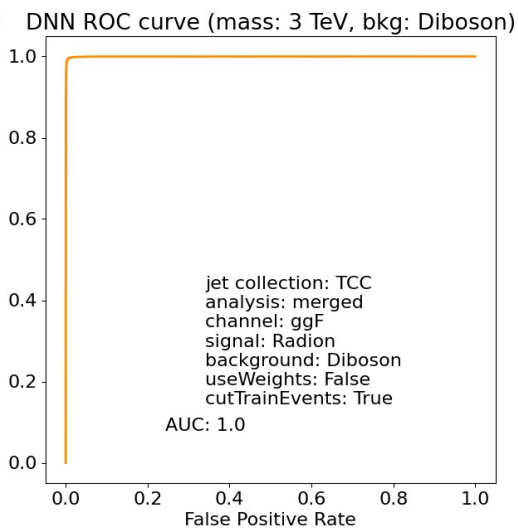
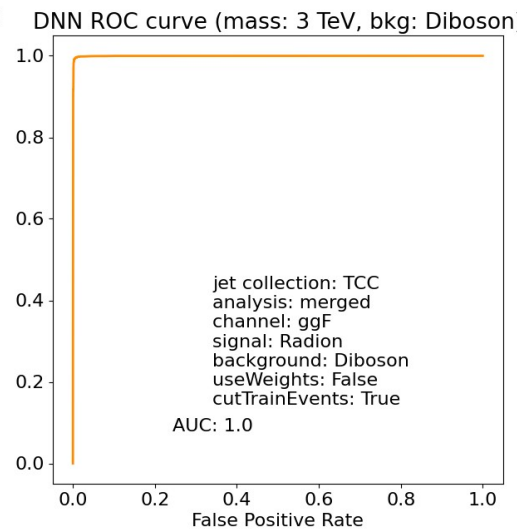
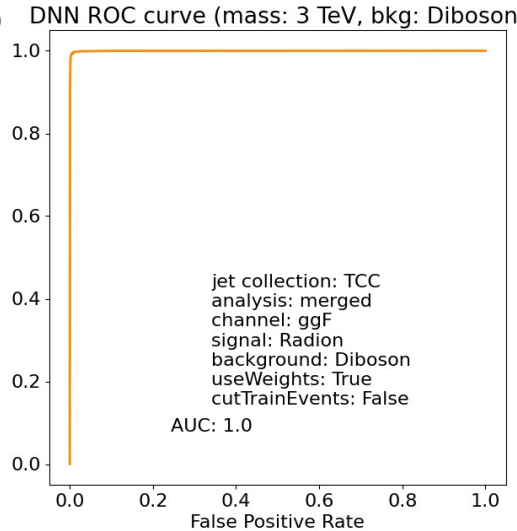
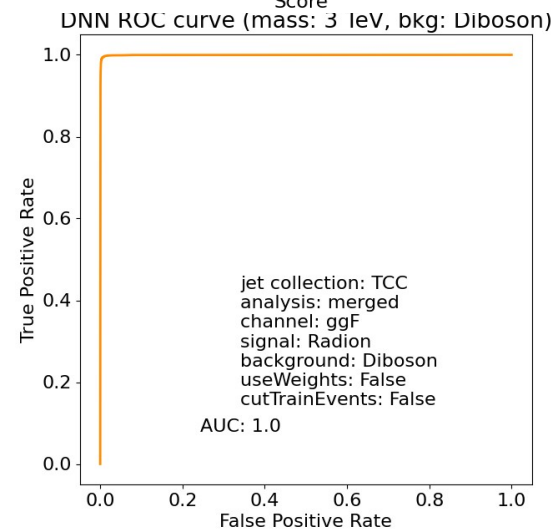
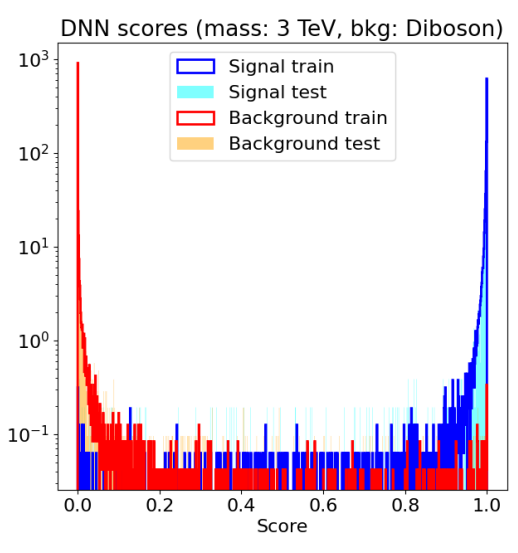
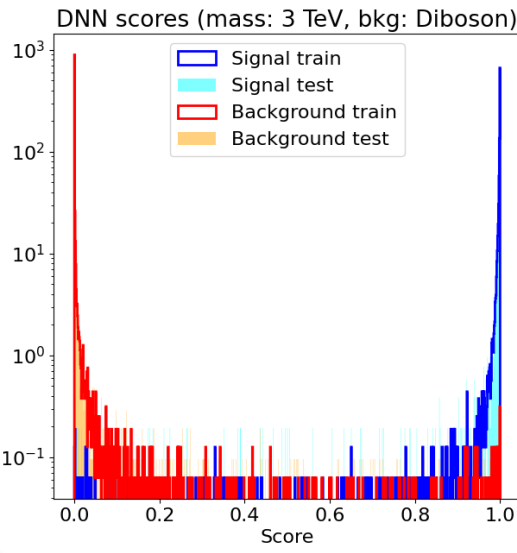
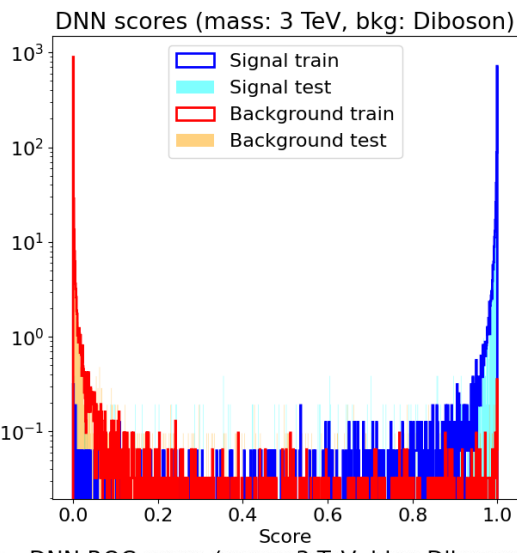
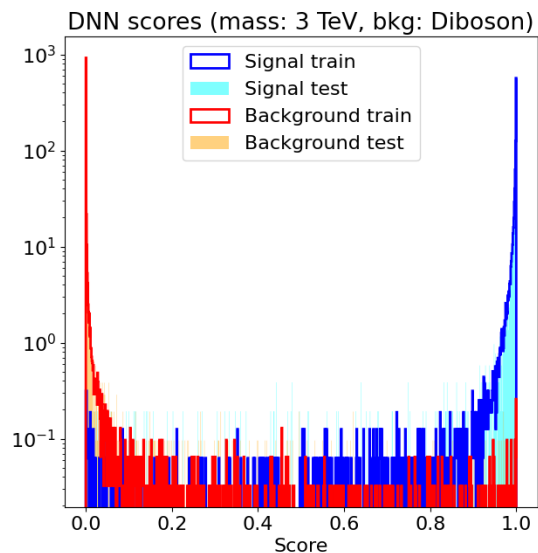


Confusion matrix (mass: 3 TeV, bkg: Zjets)

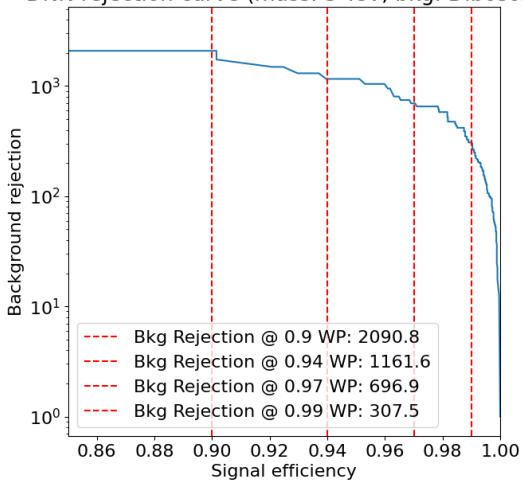


| Mass=3 TeV, bkg=Diboson | Whole sample | Whole sample + weights | Bkg = sig | Bkg = 2sig |
|--------------------------------|--------------|------------------------|-----------|------------|
| Signal train + val | 15888 | | | |
| Bkg train + val | 30918 | | 15888 | 23832 |
| Signal test | 5180 | | | |
| Bkg test | 10454 | | | |
| Train loss | 0.0214 | 0.0149 | 0.0200 | 0.0200 |
| Train accuracy | 0.9941 | 0.9939 | 0.9947 | 0.9948 |
| Validation loss | 0.0229 | 0.0153 | 0.0212 | 0.0191 |
| Validation accuracy | 0.9953 | 0.9951 | 0.9940 | 0.9952 |
| Test loss | 0.0193 | 0.0204 | 0.0209 | 0.0190 |
| Test accuracy | 0.9942 | 0.9936 | 0.9940 | 0.9946 |
| AUC | 0.999 | 0.999 | 0.999 | 0.999 |
| Bkg rejection @ 0.90 WP | 2090.8 | 2090.8 | 1742.3 | 1493.4 |
| Bkg rejection @ 0.99 WP | 307.5 | 307.5 | 307.5 | 326.7 |

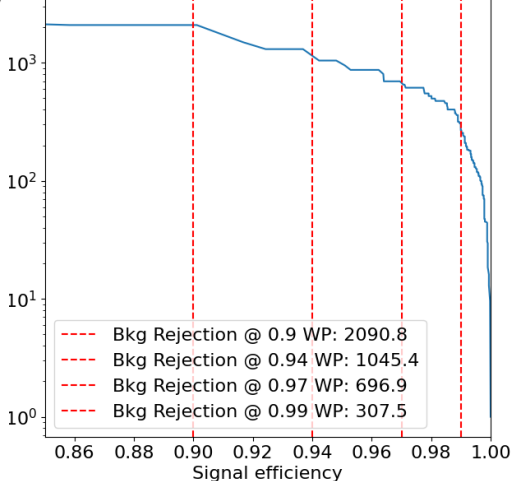




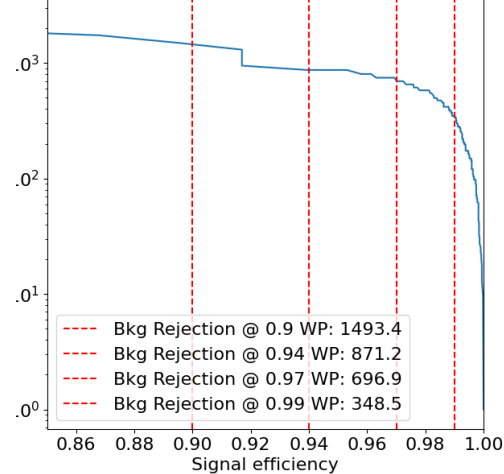
DNN rejection curve (mass: 3 TeV, bkg: Diboson)



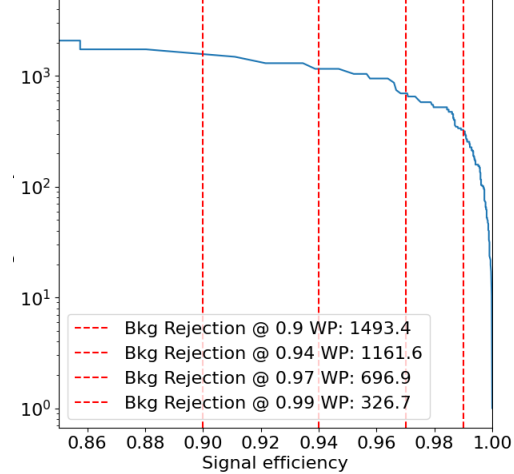
DNN rejection curve (mass: 3 TeV, bkg: Diboson)



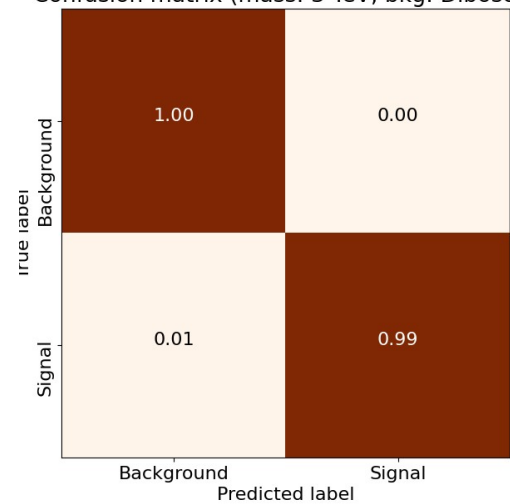
DNN rejection curve (mass: 3 TeV, bkg: Diboson)



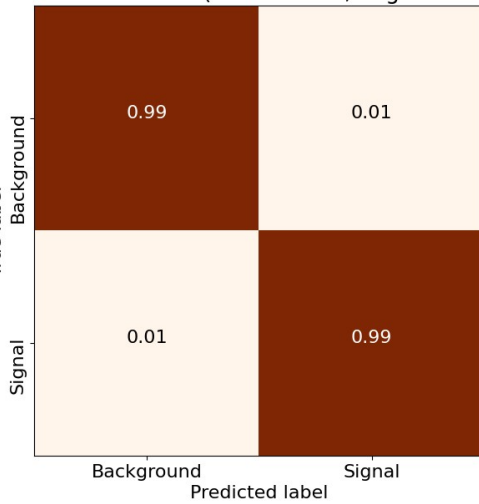
DNN rejection curve (mass: 3 TeV, bkg: Diboson)



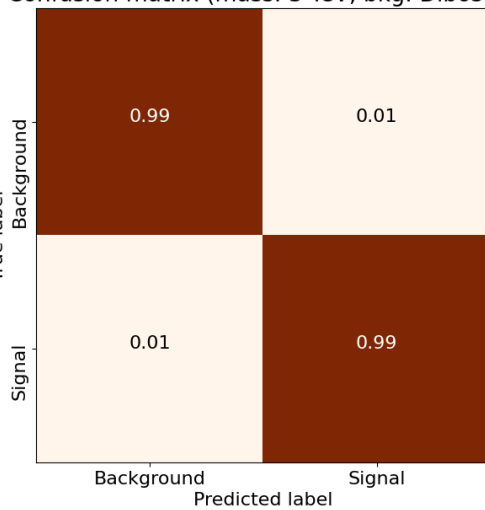
Confusion matrix (mass: 3 TeV, bkg: Diboson)



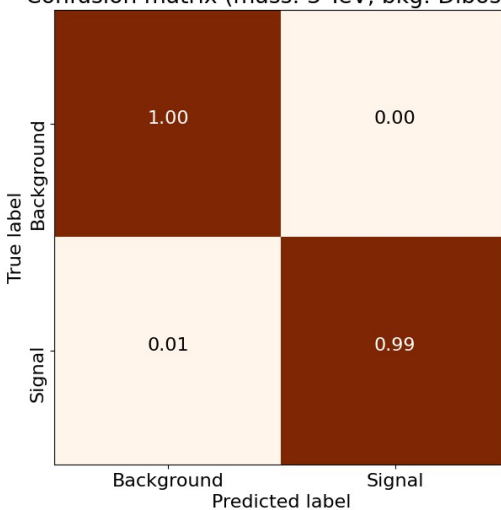
Confusion matrix (mass: 3 TeV, bkg: Diboson)



Confusion matrix (mass: 3 TeV, bkg: Diboson)



Confusion matrix (mass: 3 TeV, bkg: Diboson)



Mixing backgrounds

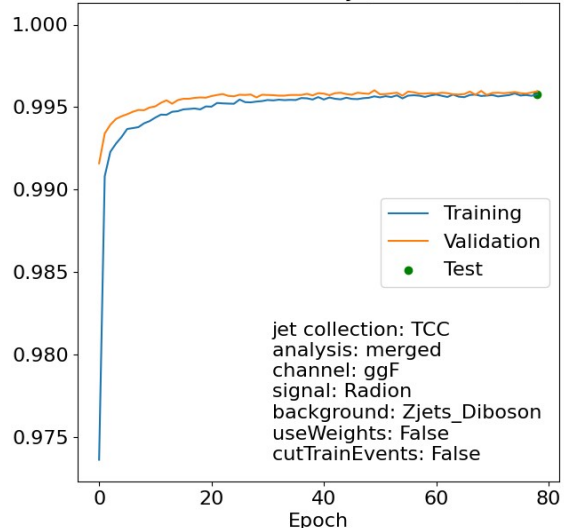
- Training with Radion, Zjets and Diboson (mass = 3 TeV)
- Test with Zjets only, Diboson only, Zjets + Diboson (mass = 3 TeV)
- Validation sample = last 20% of the train sample
- 5 different cases:
 - case 0: all background events (no cut nor weights)
 - case 1: all background events (no cut) but Zjets and Diboson weighted to the signal statistics
 - case 2: all background events (no cut) but Zjets and Diboson weighted to half of the signal statistics
 - case 3: $N(\text{Zjets}) = N(\text{Diboson}) = N(\text{Signal})$
 - case 4: $N(\text{Zjets}) = N(\text{Diboson}) = N(\text{Signal}) / 2$

Mass = 3 TeV, bkg = Zjets + Diboson

| | Case 0 | Case 1 | Case 2 | Case 3 | Case 4 |
|---------------------|--------------------|--------|--------|--------|--------|
| Signal train + val | 15873 | | | | |
| Bkg train + val | 351939 (91% Zjets) | | | 31746 | 15873 |
| Signal test | 5195 | | | | |
| Bkg test | 117534 (91% Zjets) | | | | |
| Train loss | 0.0133 | 0.0046 | 0.0031 | 0.0279 | 0.0289 |
| Train accuracy | 0.9956 | 0.9898 | 0.9892 | 0.9914 | 0.9915 |
| Validation loss | 0.0122 | 0.0047 | 0.0034 | 0.0331 | 0.0238 |
| Validation accuracy | 0.9960 | 0.9903 | 0.9904 | 0.9898 | 0.9932 |
| Test loss | 0.0122 | 0.0345 | 0.0448 | 0.0330 | 0.0506 |
| Test accuracy | 0.9957 | 0.9876 | 0.9839 | 0.9899 | 0.9857 |

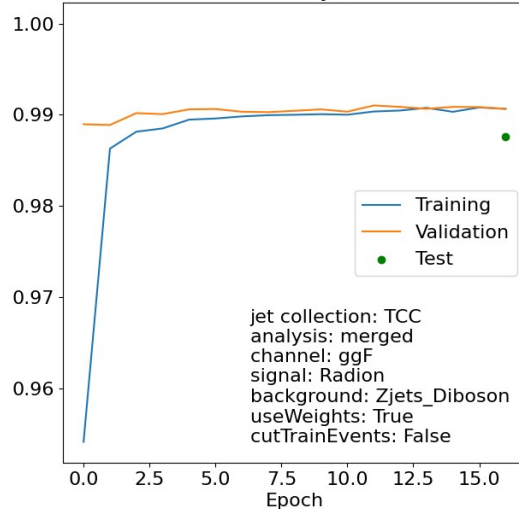
Case 0

DNN model accuracy (mass: 3 TeV)



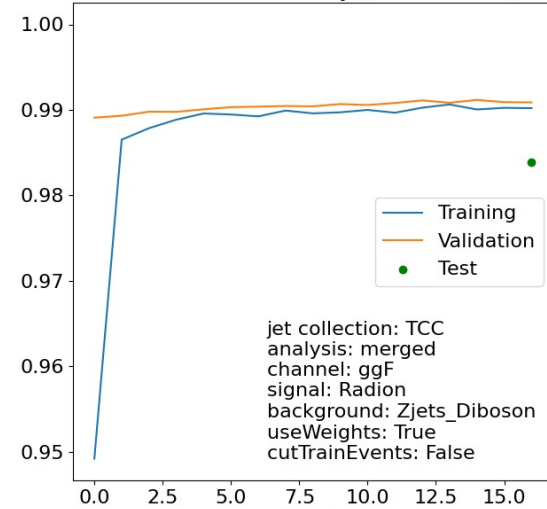
Case 1

DNN model accuracy (mass: 3 TeV)

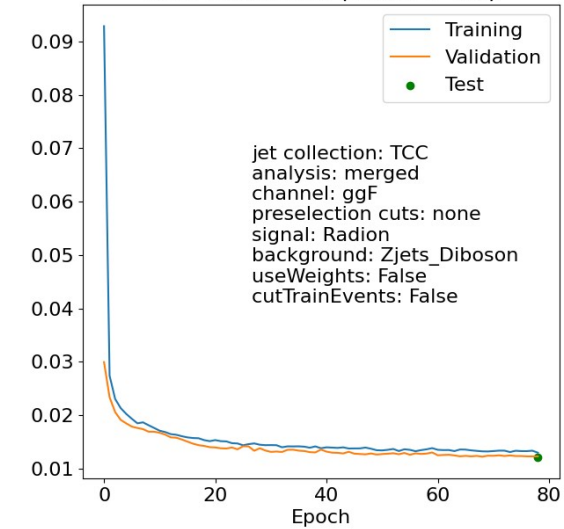


Case 2

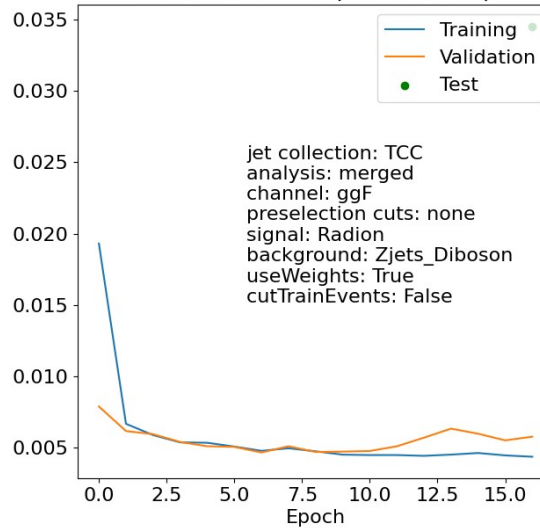
DNN model accuracy (mass: 3 TeV)



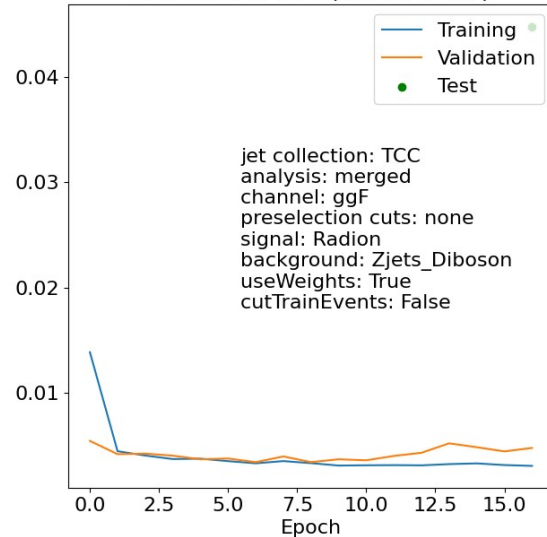
DNN model loss (mass: 3 TeV)



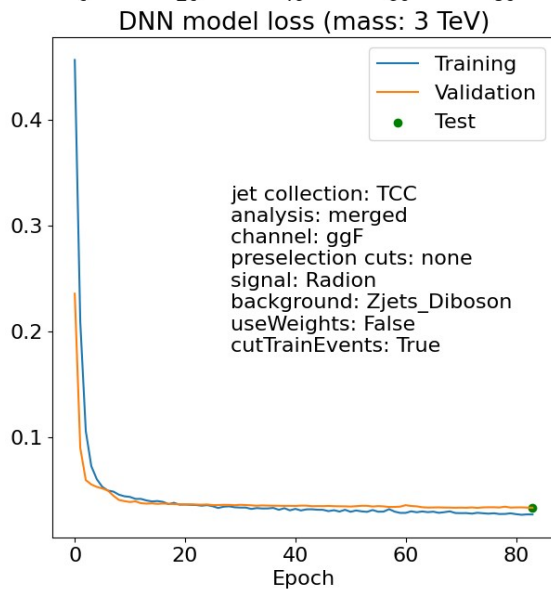
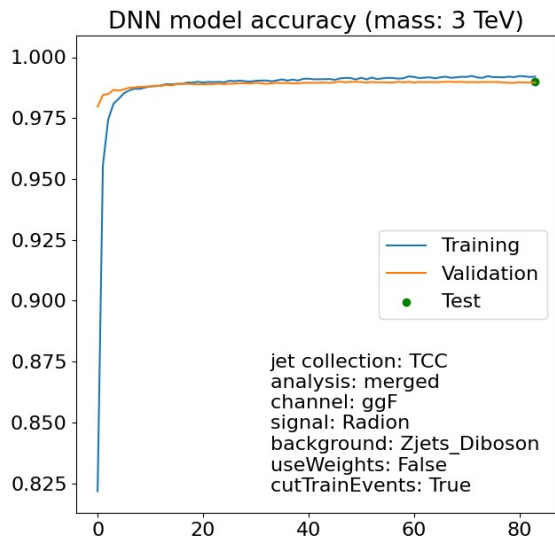
DNN model loss (mass: 3 TeV)



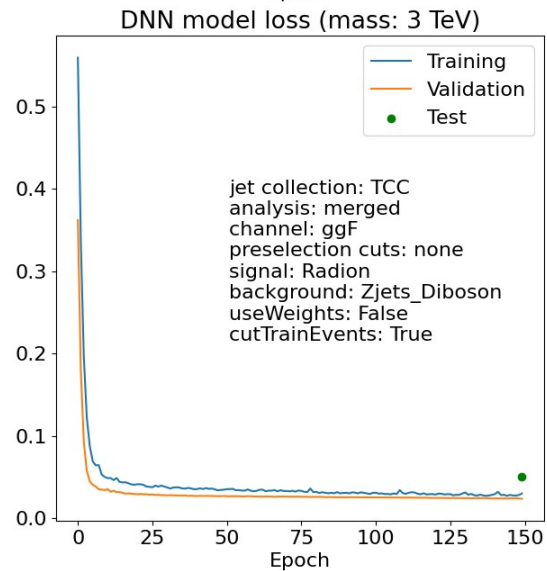
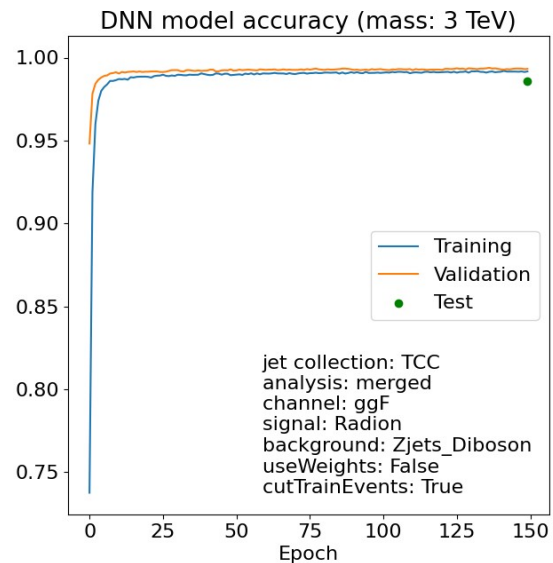
DNN model loss (mass: 3 TeV)



Case 3

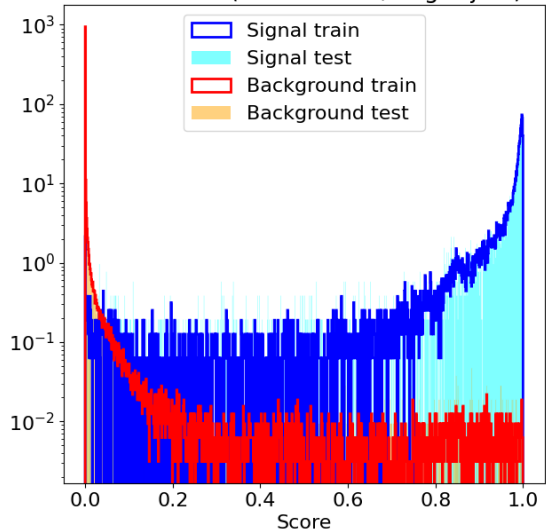


Case 4



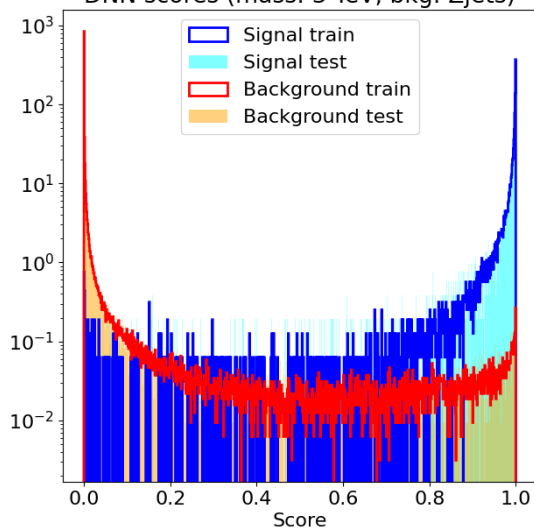
Case 0

DNN scores (mass: 3 TeV, bkg: Zjets)



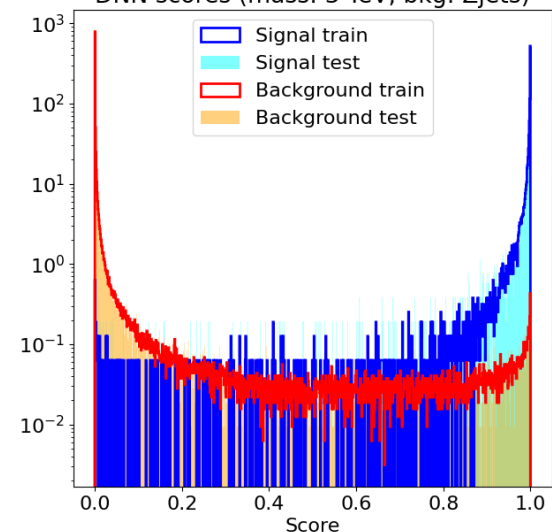
Case 1

DNN scores (mass: 3 TeV, bkg: Zjets)

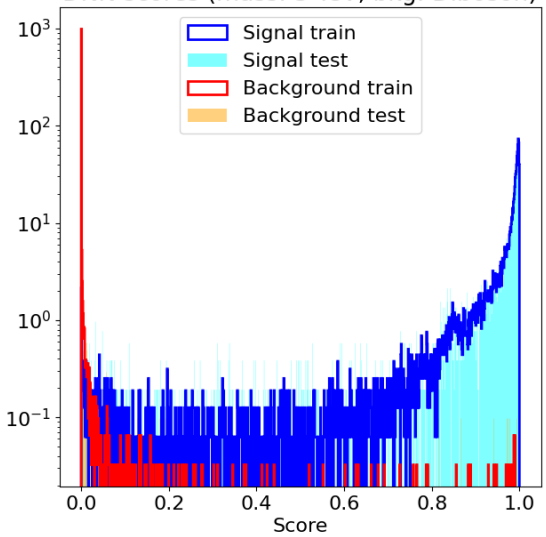


Case 2

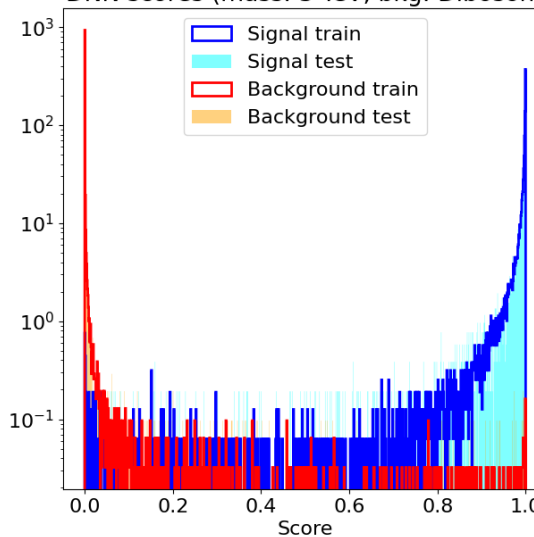
DNN scores (mass: 3 TeV, bkg: Zjets)



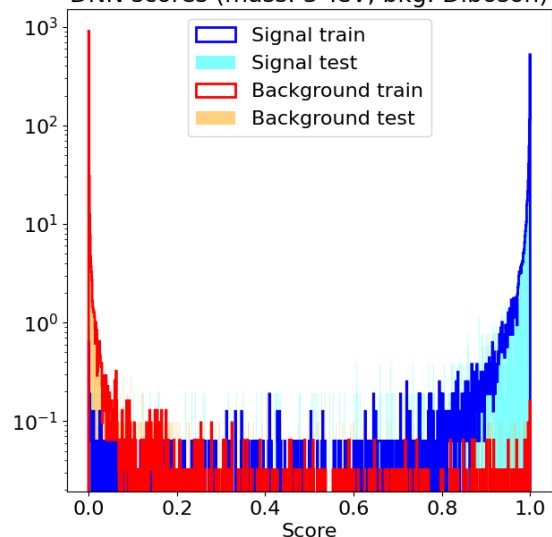
DNN scores (mass: 3 TeV, bkg: Diboson)



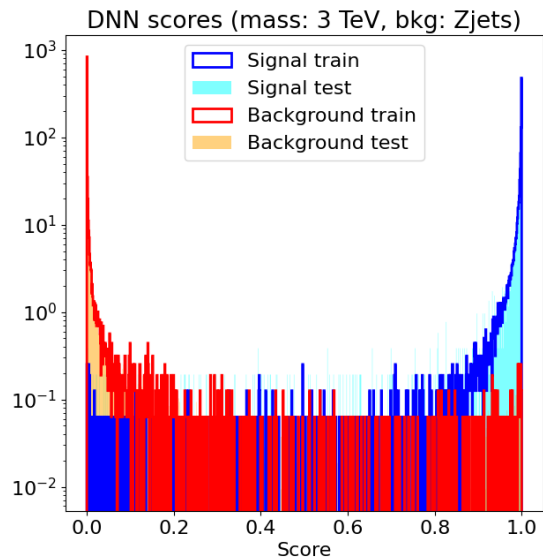
DNN scores (mass: 3 TeV, bkg: Diboson)



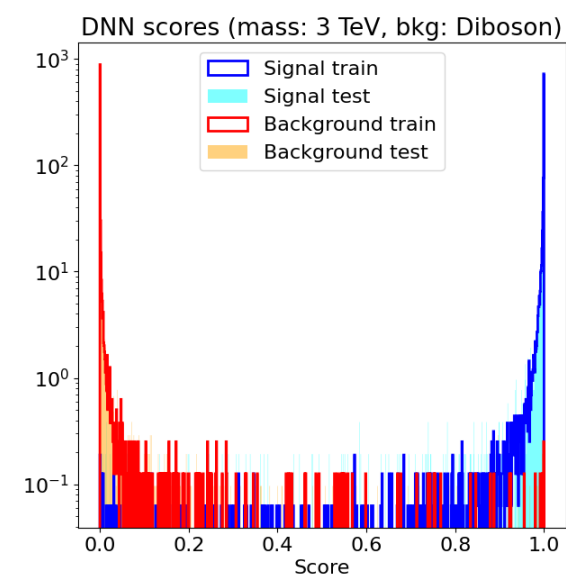
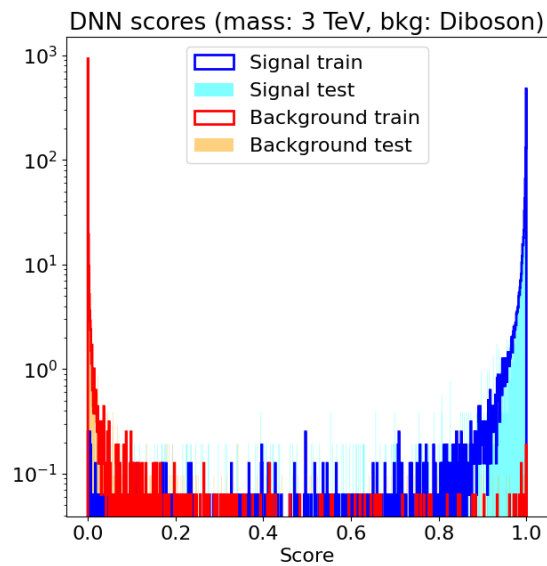
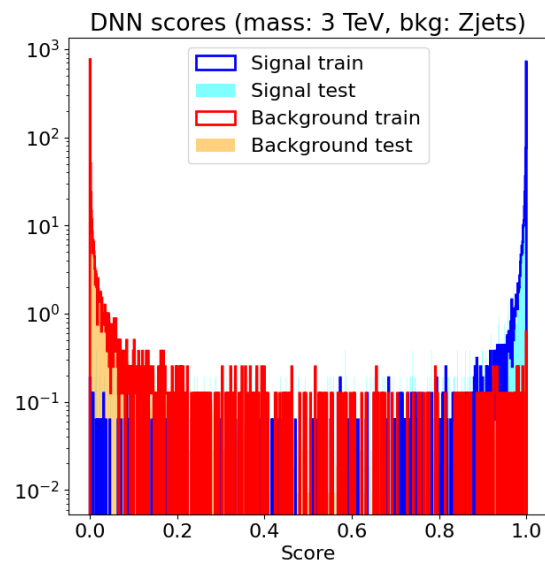
DNN scores (mass: 3 TeV, bkg: Diboson)



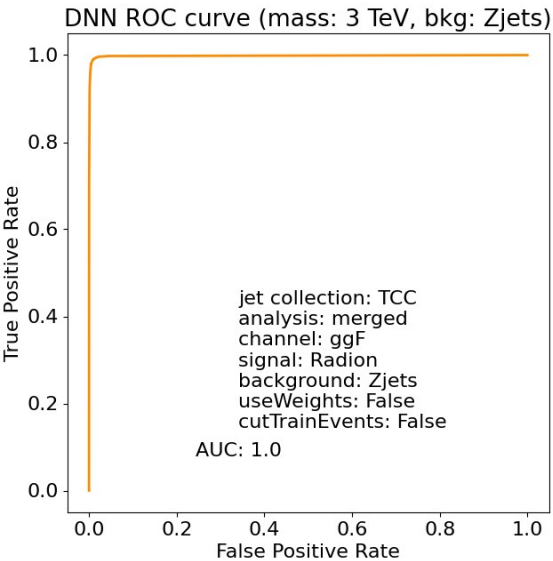
Case 3



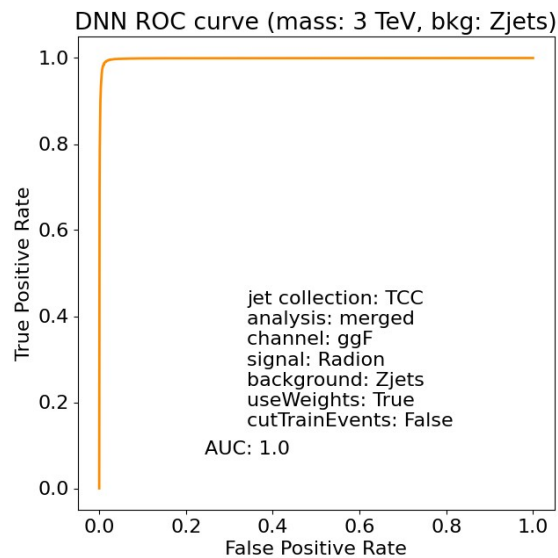
Case 4



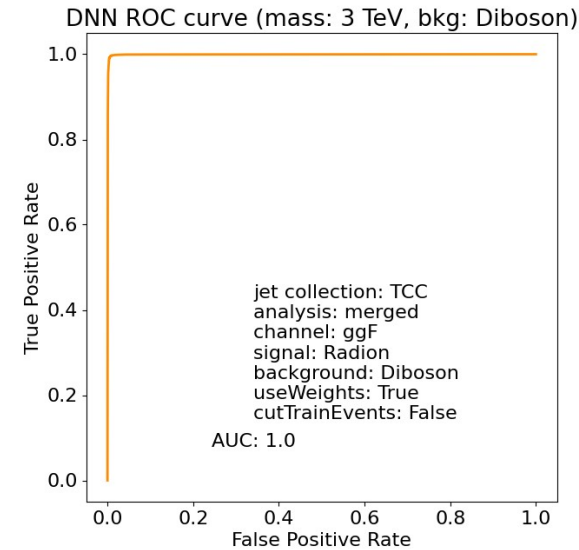
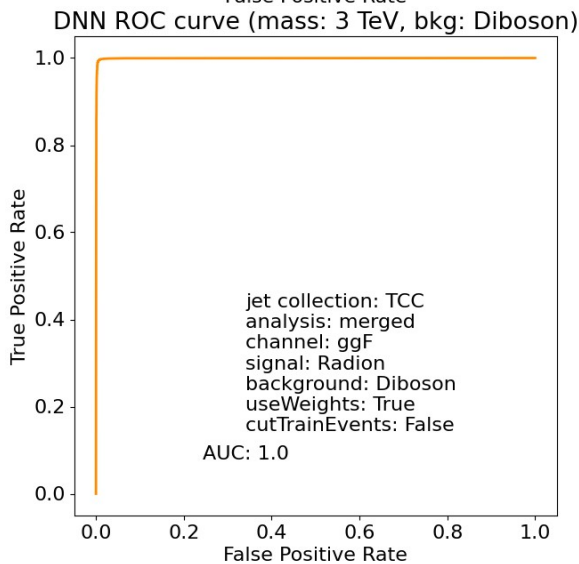
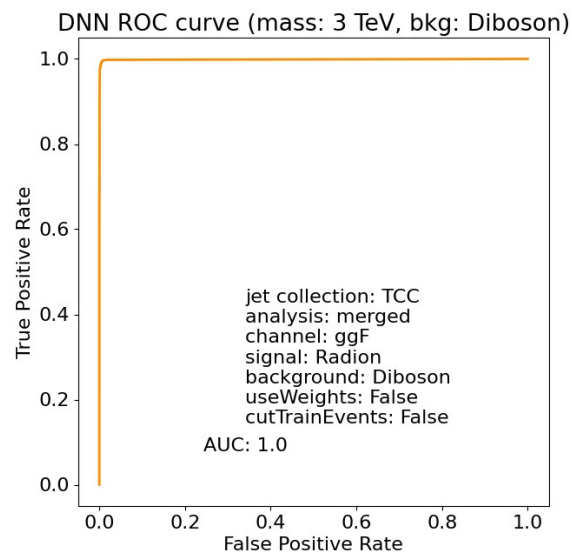
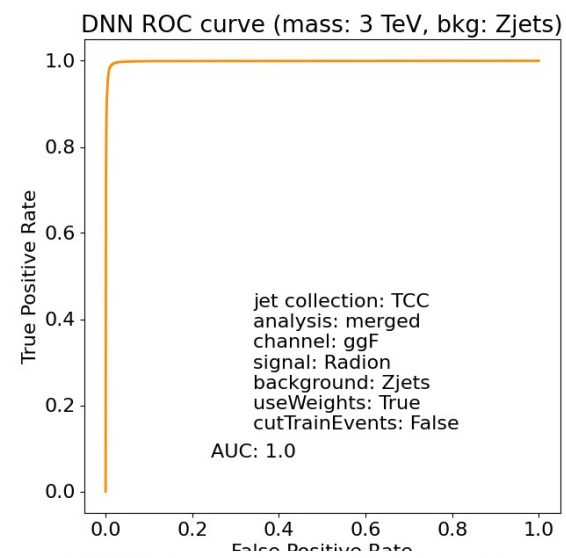
Case 0



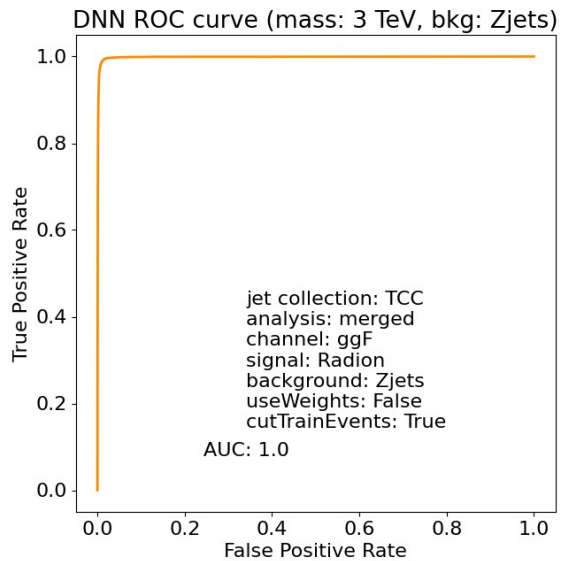
Case 1



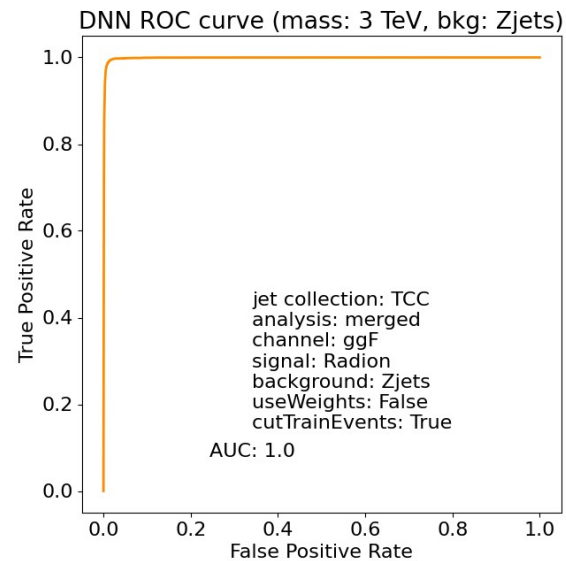
Case 2



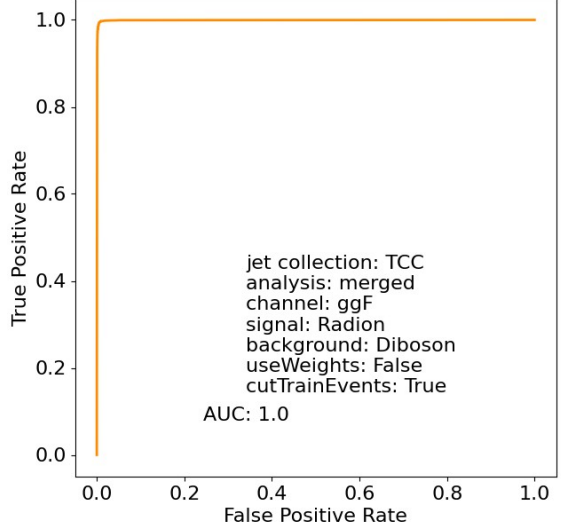
Case 3



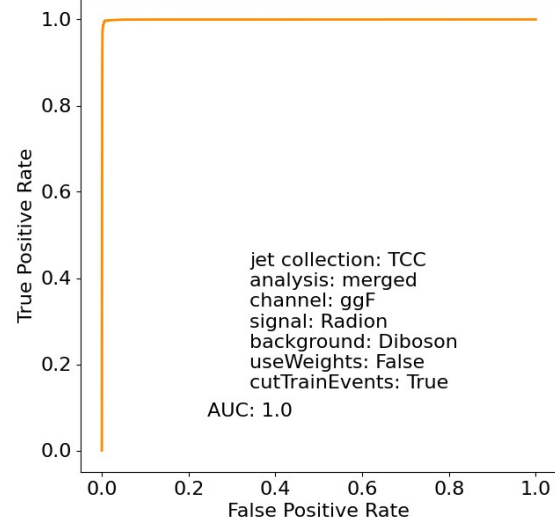
Case 4



DNN ROC curve (mass: 3 TeV, bkg: Diboson)

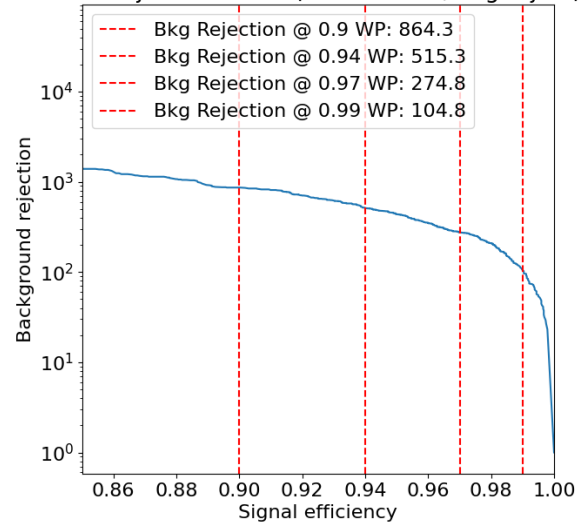


DNN ROC curve (mass: 3 TeV, bkg: Diboson)



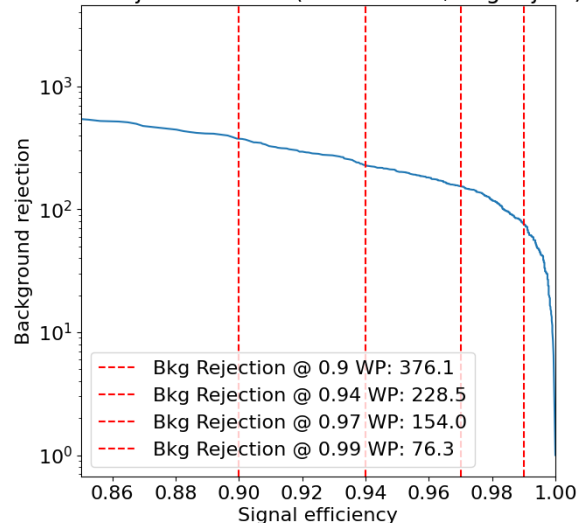
Case 0

DNN rejection curve (mass: 3 TeV, bkg: Zjets)



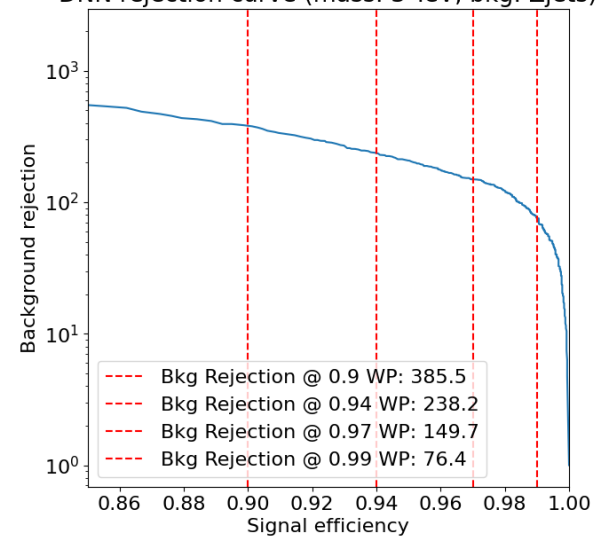
Case 1

DNN rejection curve (mass: 3 TeV, bkg: Zjets)

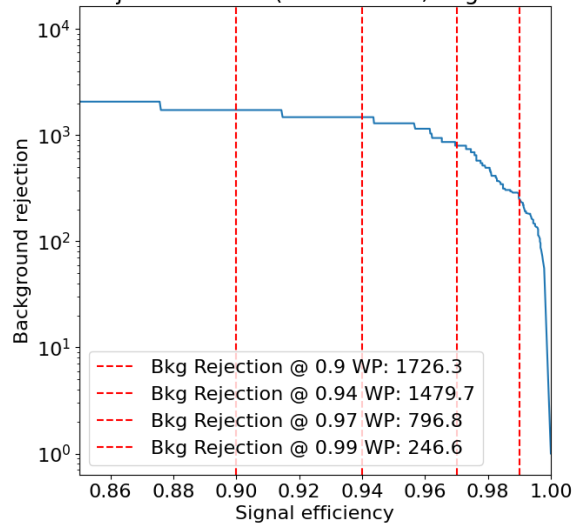


Case 2

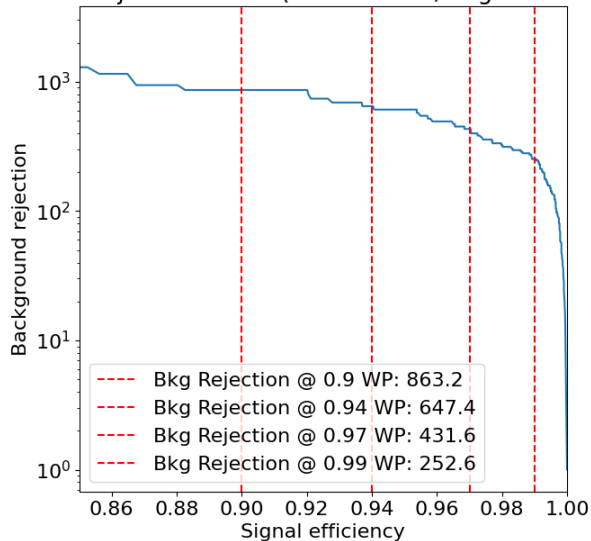
DNN rejection curve (mass: 3 TeV, bkg: Zjets)



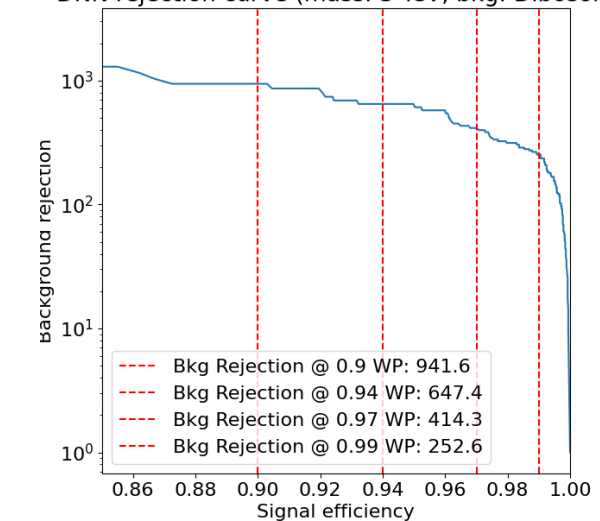
DNN rejection curve (mass: 3 TeV, bkg: Diboson)



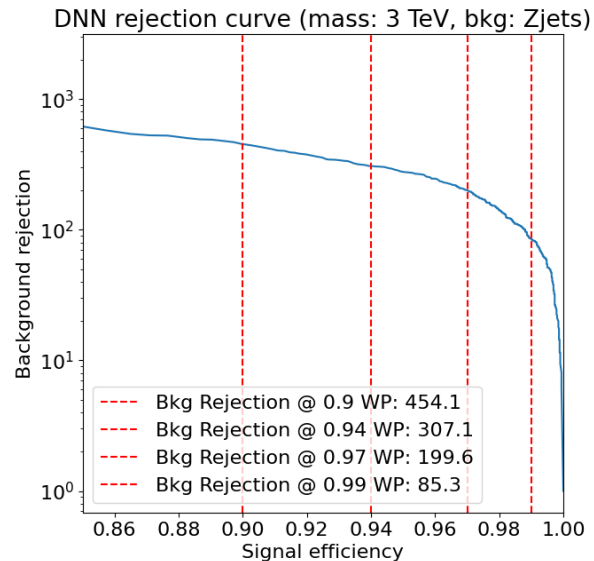
DNN rejection curve (mass: 3 TeV, bkg: Diboson)



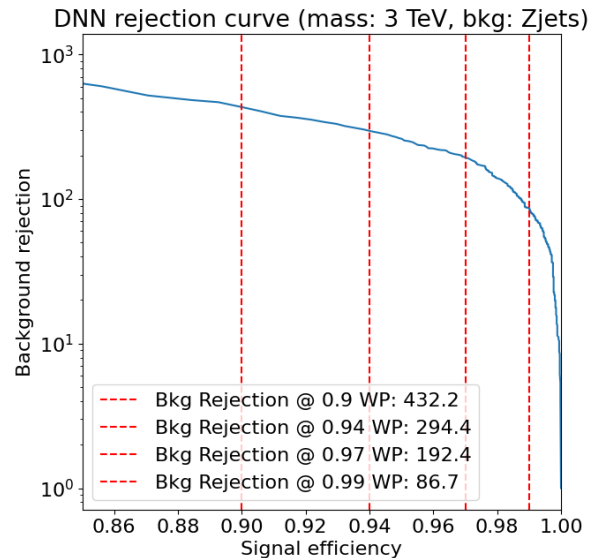
DNN rejection curve (mass: 3 TeV, bkg: Diboson)



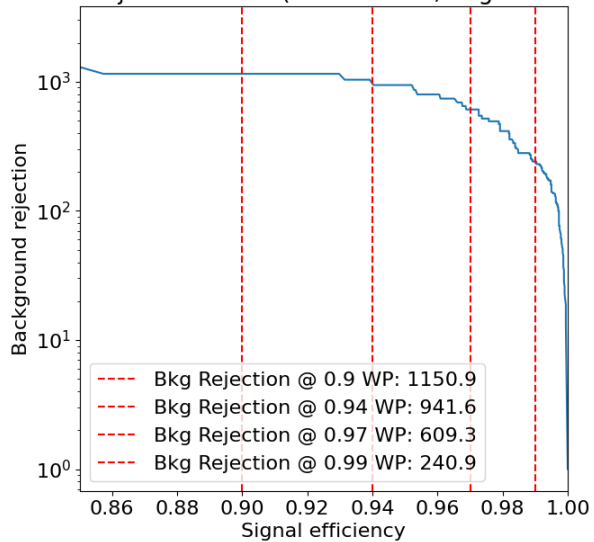
Case 3



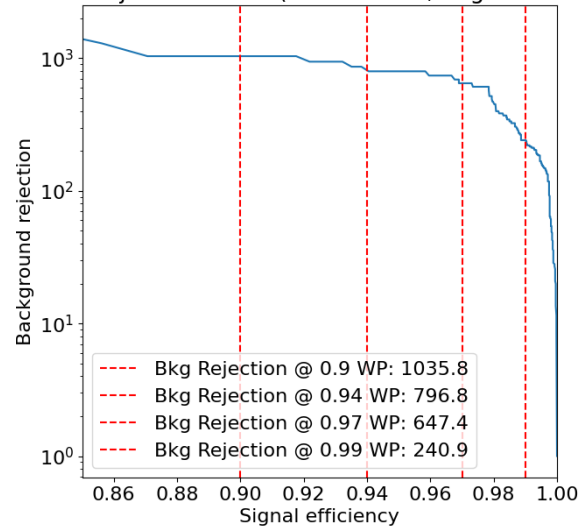
Case 4



DNN rejection curve (mass: 3 TeV, bkg: Diboson)

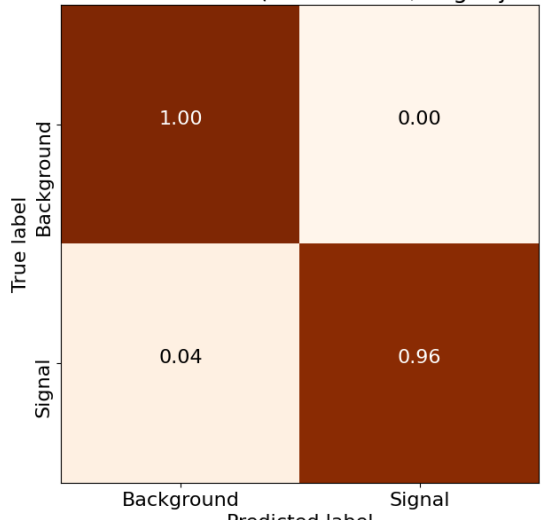


DNN rejection curve (mass: 3 TeV, bkg: Diboson)



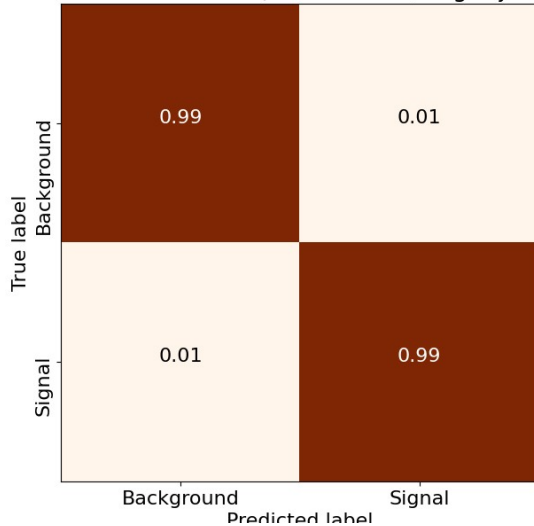
Case 0

Confusion matrix (mass: 3 TeV, bkg: Zjets)



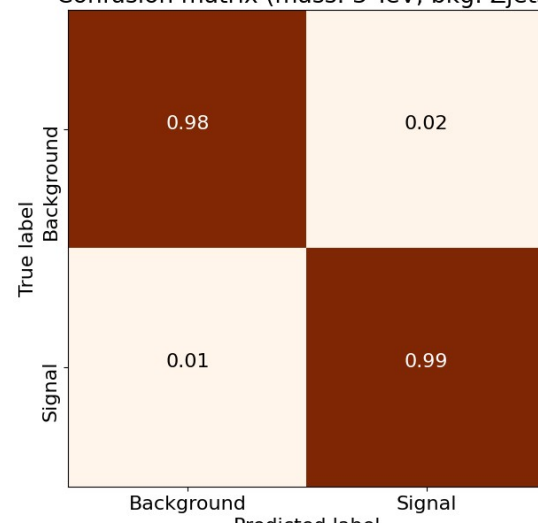
Case 1

Confusion matrix (mass: 3 TeV, bkg: Zjets)

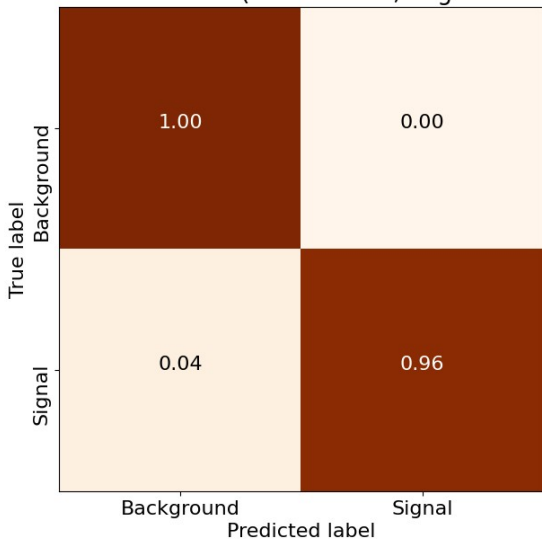


Case 2

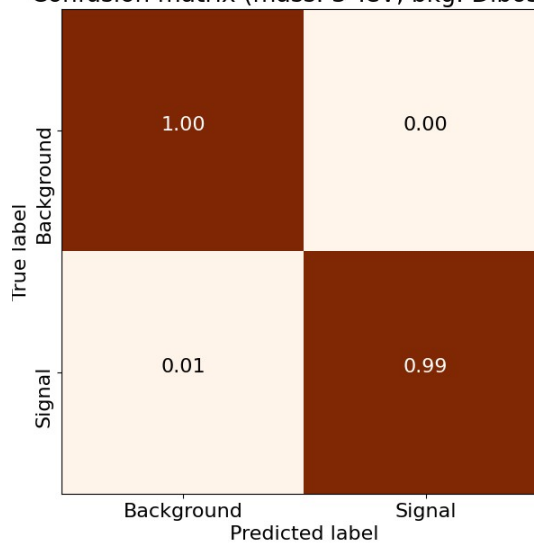
Confusion matrix (mass: 3 TeV, bkg: Zjets)



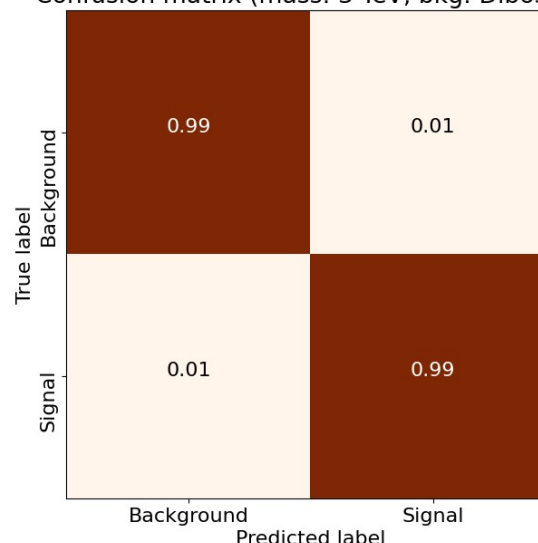
Confusion matrix (mass: 3 TeV, bkg: Diboson)



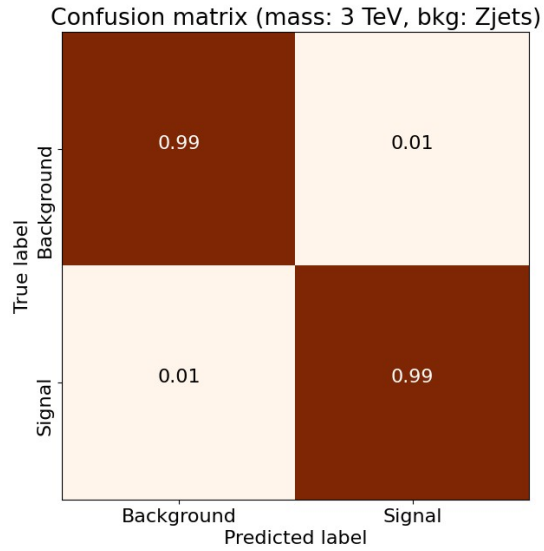
Confusion matrix (mass: 3 TeV, bkg: Diboson)



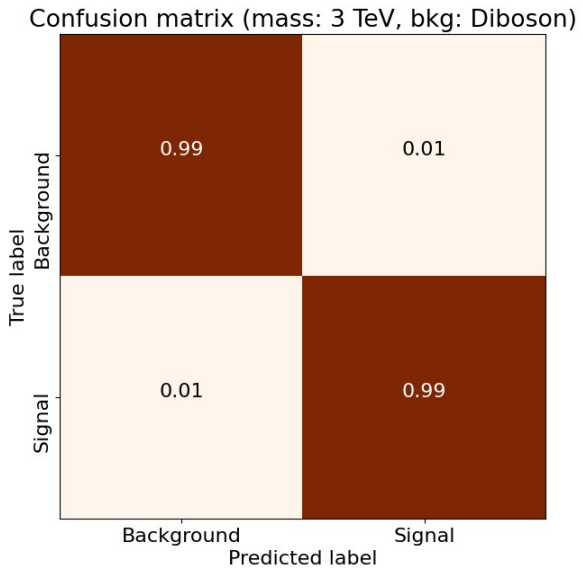
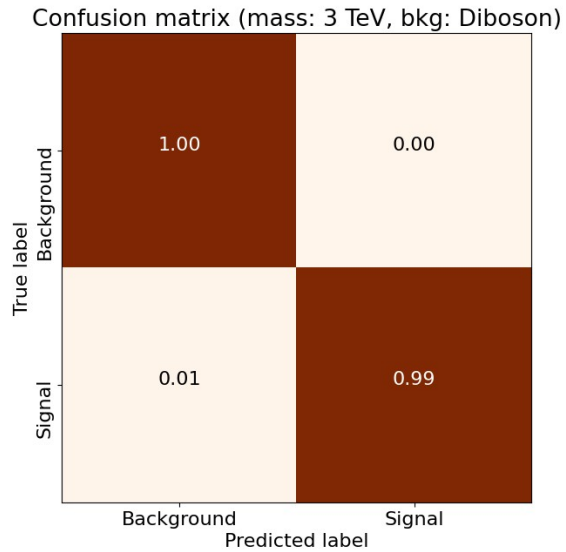
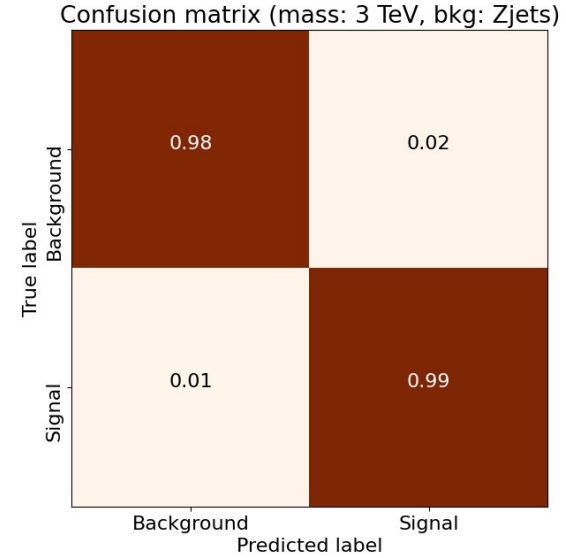
Confusion matrix (mass: 3 TeV, bkg: Diboson)



Case 3

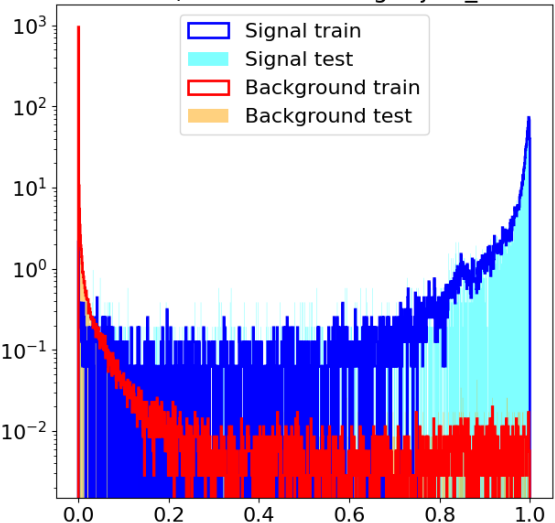


Case 4



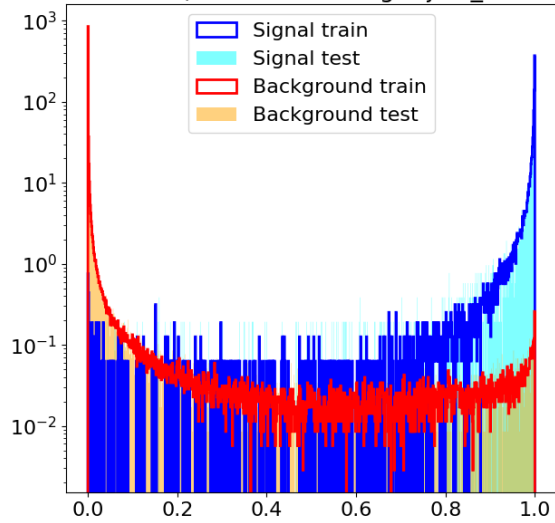
Case 0 (all bkg types)

DNN scores (mass: 3 TeV, bkg: Zjets_Diboson)



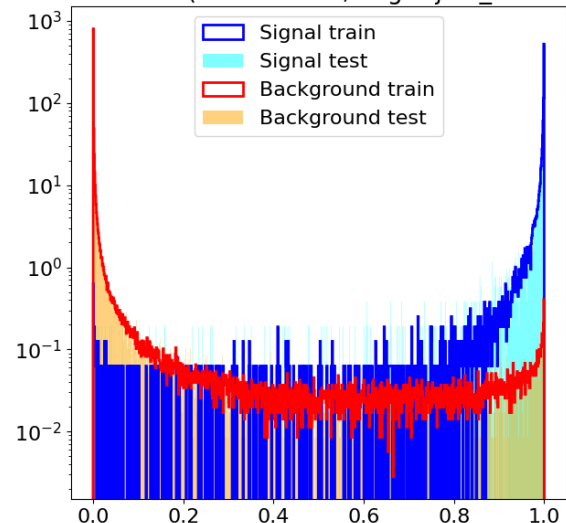
Case 1 (all bkg types)

DNN scores (mass: 3 TeV, bkg: Zjets_Diboson)

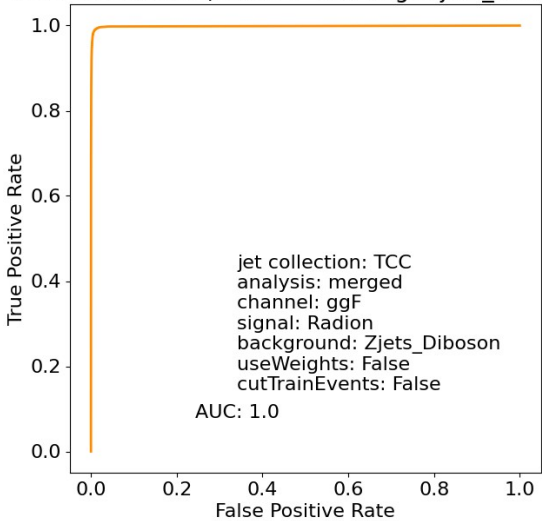


Case 2 (all bkg types)

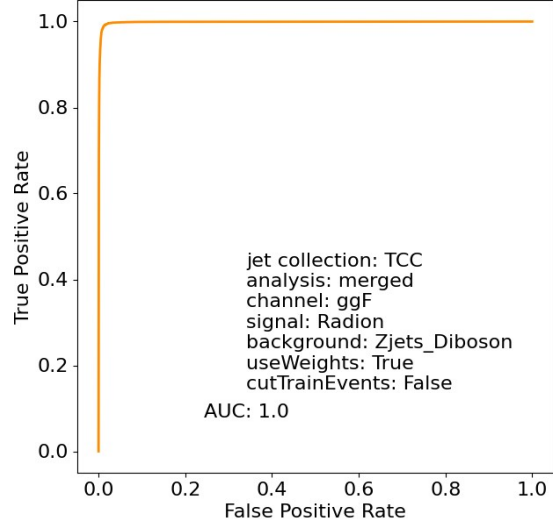
DNN scores (mass: 3 TeV, bkg: Zjets_Diboson)



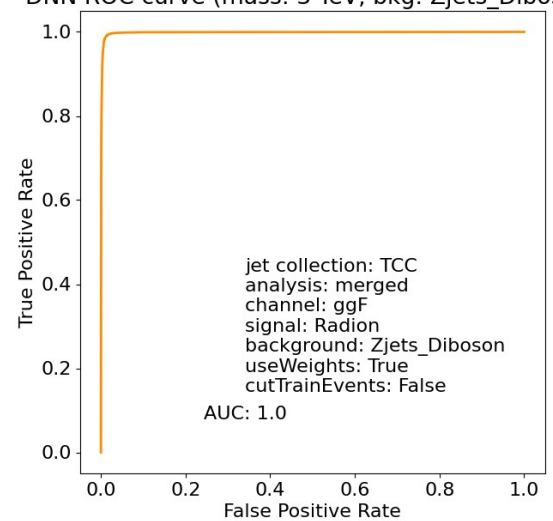
DNN ROC curve (mass: 3 TeV, bkg: Zjets_Diboson)



DNN ROC curve (mass: 3 TeV, bkg: Zjets_Diboson)

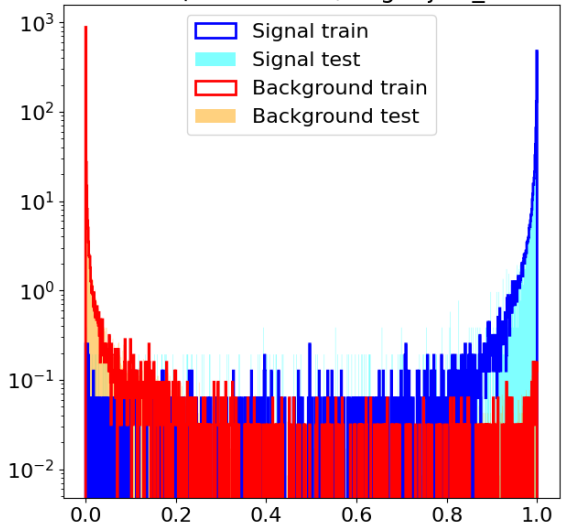


DNN ROC curve (mass: 3 TeV, bkg: Zjets_Diboson)

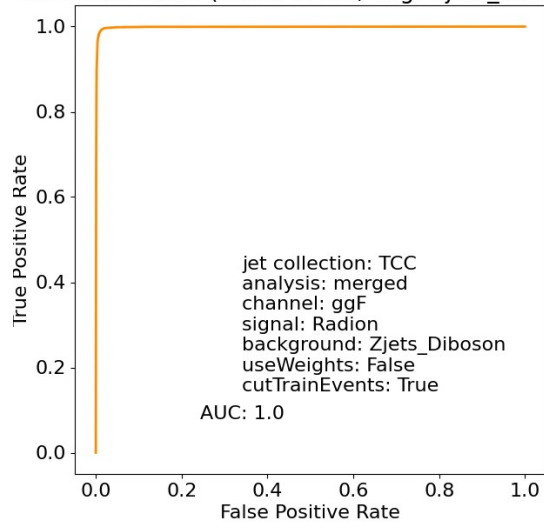


Case 3 (all bkg types)

DNN scores (mass: 3 TeV, bkg: Zjets_Diboson)

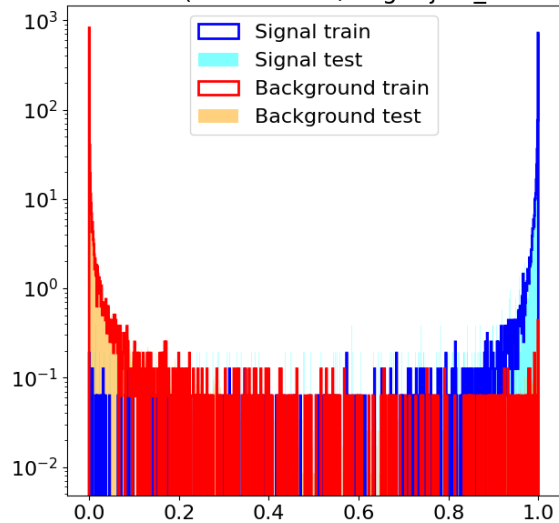


DNN ROC curve (mass: 3 TeV, bkg: Zjets_Diboson)

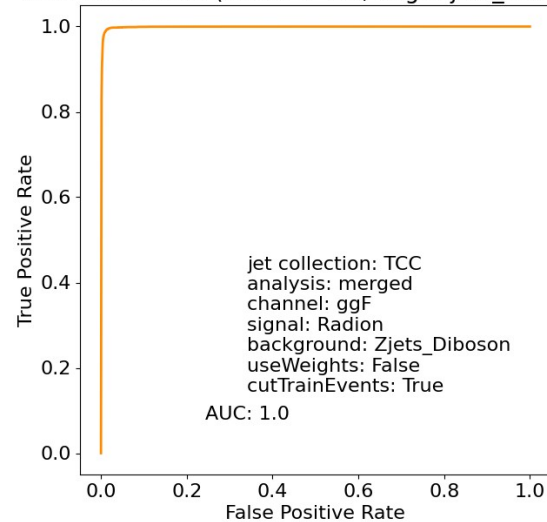


Case 4 (all bkg types)

DNN scores (mass: 3 TeV, bkg: Zjets_Diboson)

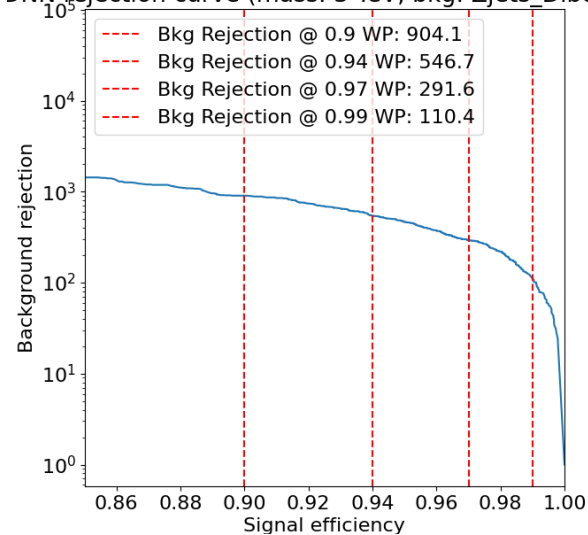


DNN ROC curve (mass: 3 TeV, bkg: Zjets_Diboson)

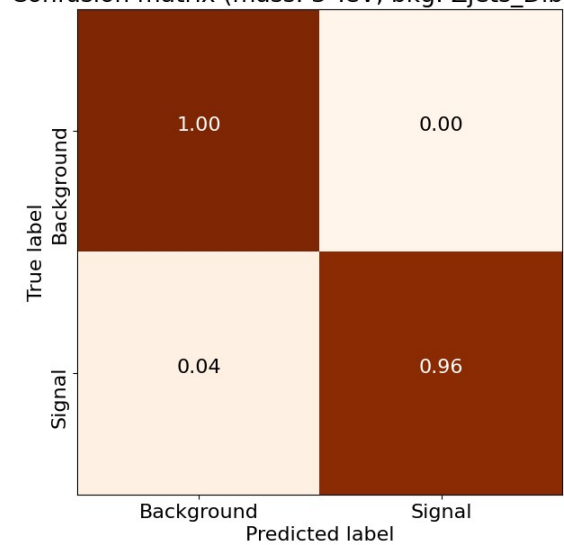


Case 0 (all bkg types)

DNN rejection curve (mass: 3 TeV, bkg: Zjets_Diboson)

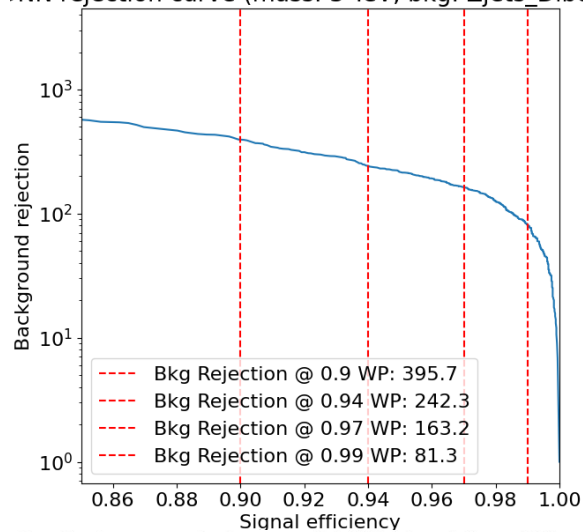


Confusion matrix (mass: 3 TeV, bkg: Zjets_Diboson)

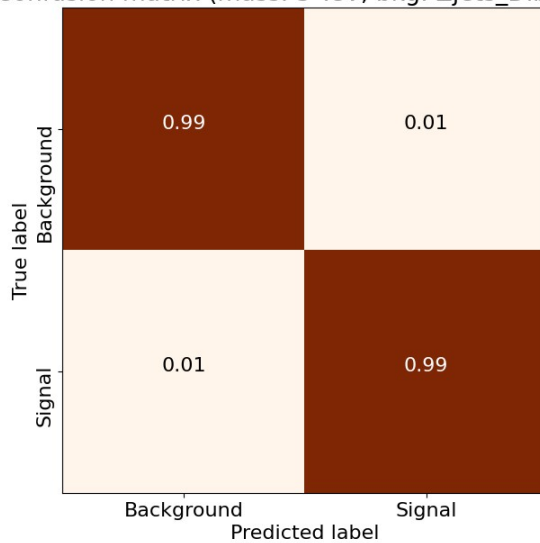


Case 1 (all bkg types)

DNN rejection curve (mass: 3 TeV, bkg: Zjets_Diboson)

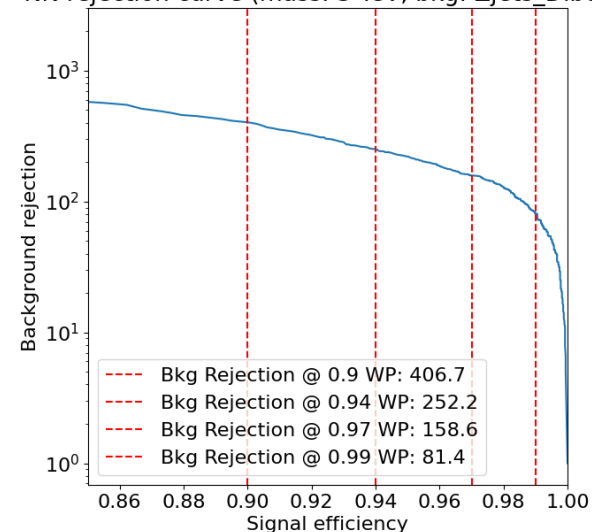


Confusion matrix (mass: 3 TeV, bkg: Zjets_Diboson)

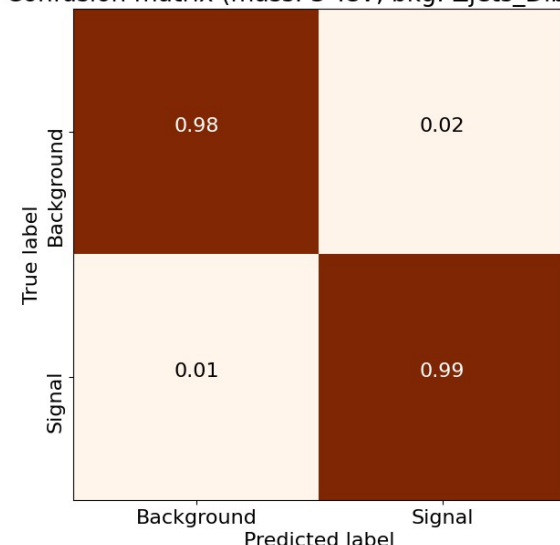


Case 2 (all bkg types)

DNN rejection curve (mass: 3 TeV, bkg: Zjets_Diboson)

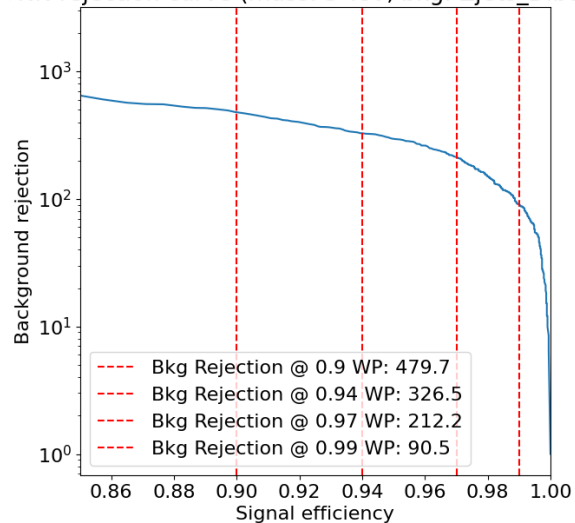


Confusion matrix (mass: 3 TeV, bkg: Zjets_Diboson)

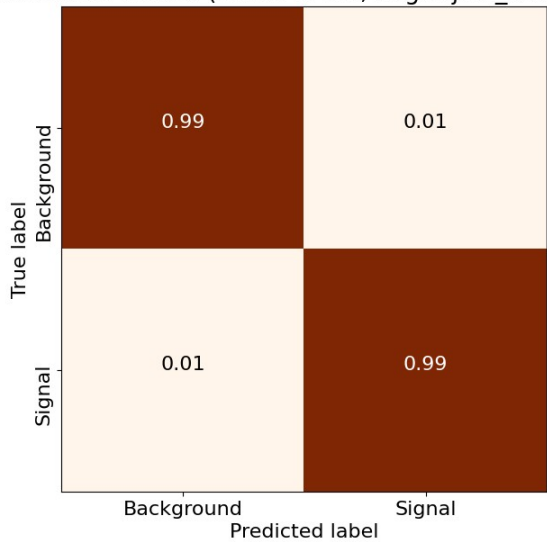


Case 3 (all bkg types)

NN rejection curve (mass: 3 TeV, bkg: Zjets_Diboso)

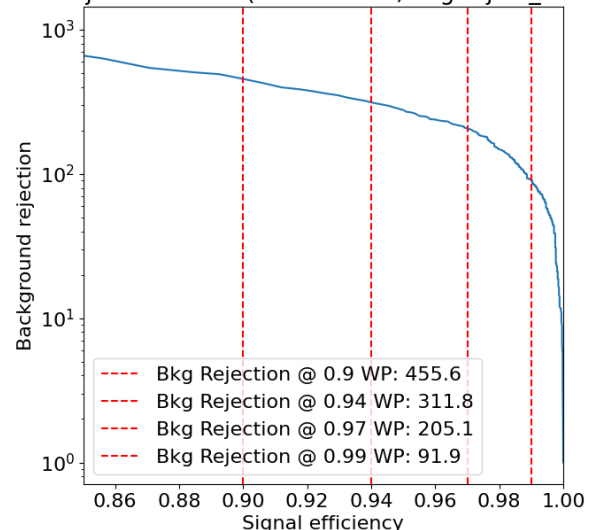


Confusion matrix (mass: 3 TeV, bkg: Zjets_Diboso)



Case 4 (all bkg types)

NN rejection curve (mass: 3 TeV, bkg: Zjets_Diboso)



Confusion matrix (mass: 3 TeV, bkg: Zjets_Diboso)

