$e^+e^- \rightarrow$ ttbar Z'
Z' $\rightarrow$ *inv.*

Etat des lieux

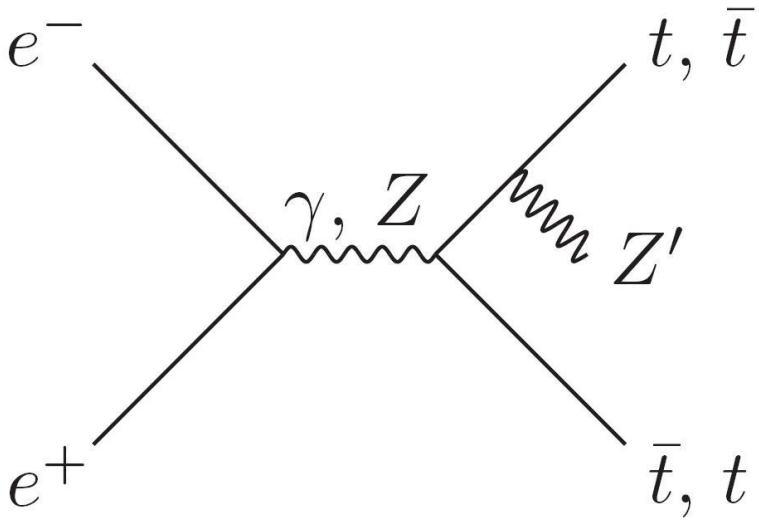
Outline

- Description du problème
- Méthode d'approche
- Résultats
- Suite de l'étude

Description du problème

- Canal : $e^+e^- \rightarrow$ ttbar Z' (Z' $\rightarrow$ *inv.*)

- Masse du Z' ? (MZp)
- Couplage ν ? (gZp)

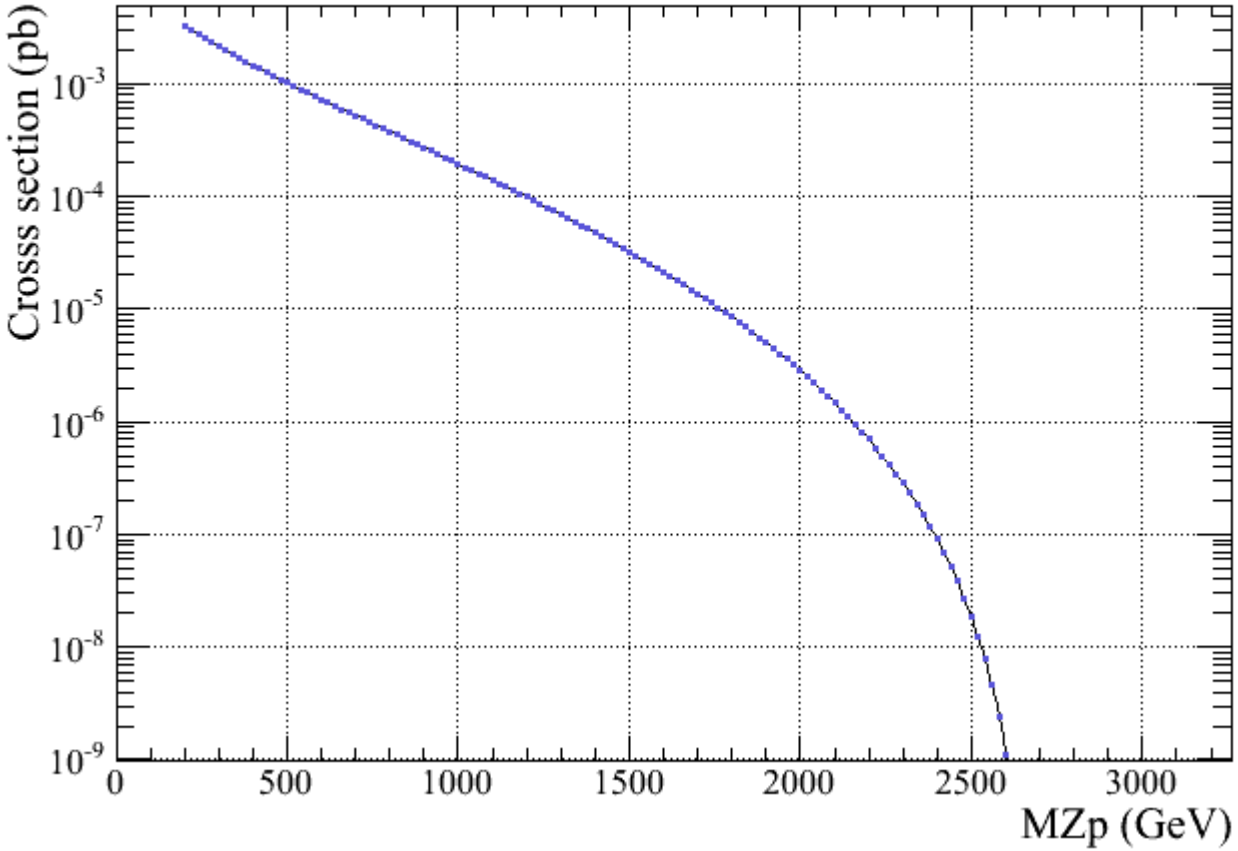


Description du problème

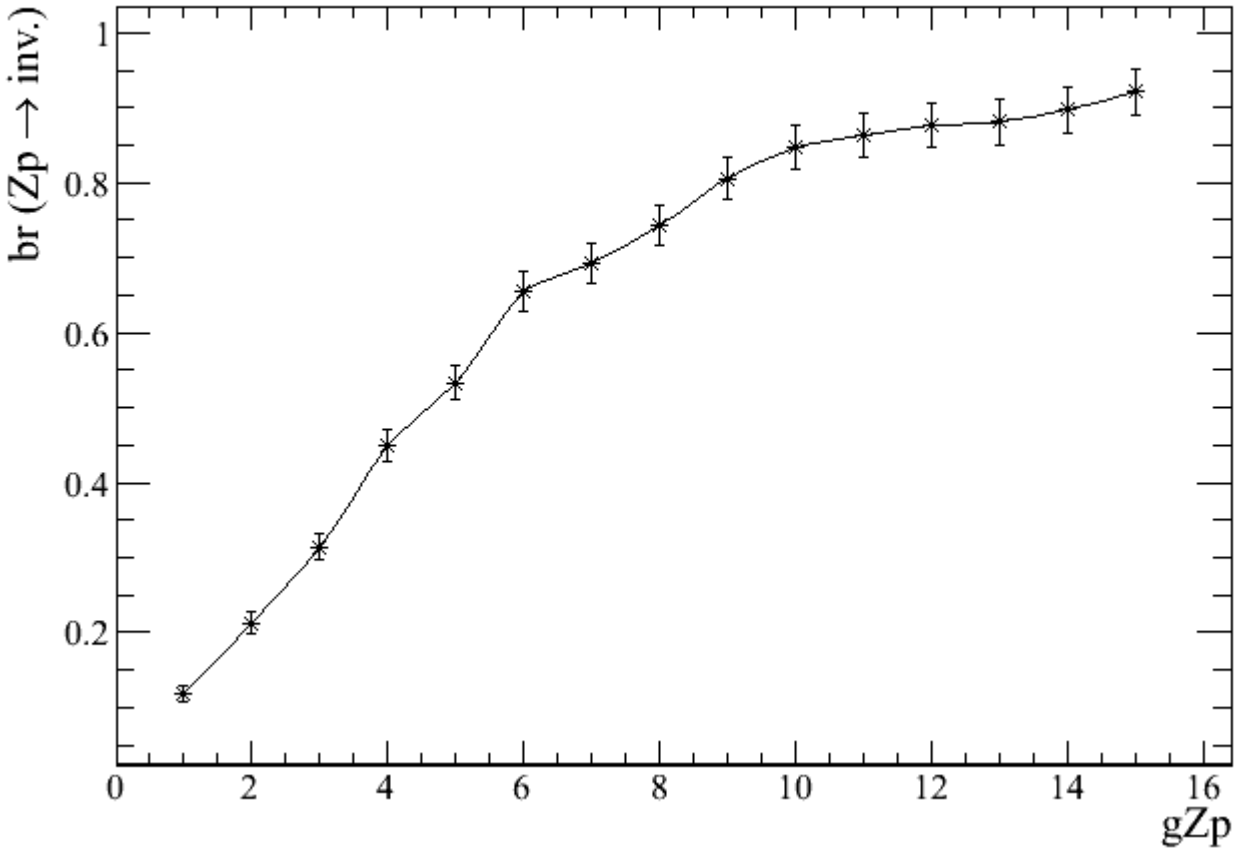
- Bruit de fond :
  - $e^+e^- \rightarrow$ ttbar (~ 20 fb)
  - $e^+e^- \rightarrow$ ttbar + *inv.* (~ 5 fb)

- Signal :
  - $e^+e^- \rightarrow$ ttbar Z' (~ 1fb) ($\Leftarrow$ MZp)
  - Br(Z' $\rightarrow$ *inv.*) ~ 10% ($\Leftarrow$ gZp)

Description du problème



Description du problème



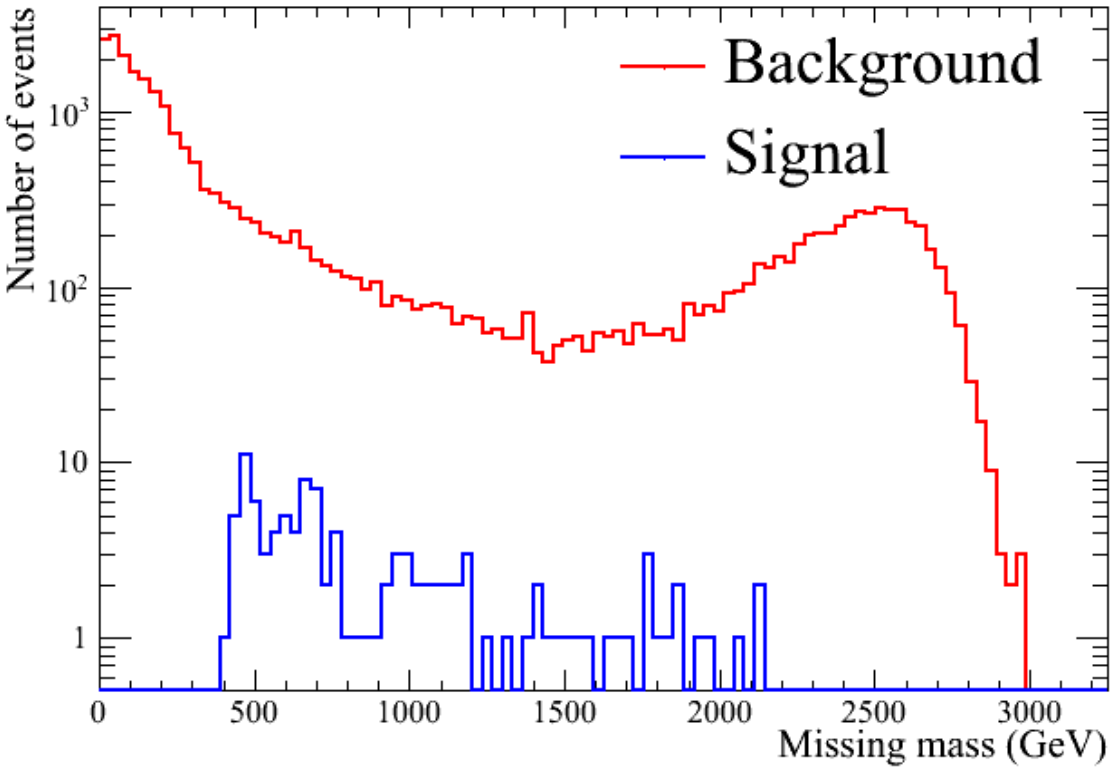
Description du problème

- Domaine (MZp,gZp) autorisé (Geneviève) ?
- Domaine (MZp,gZp) observable ?

Méthode d'approche

- MZp mesurée *via* la masse manquante :

$$missM = \sqrt{missE^2 - missP^2}$$



MZp = 400 GeV
gZp = 1

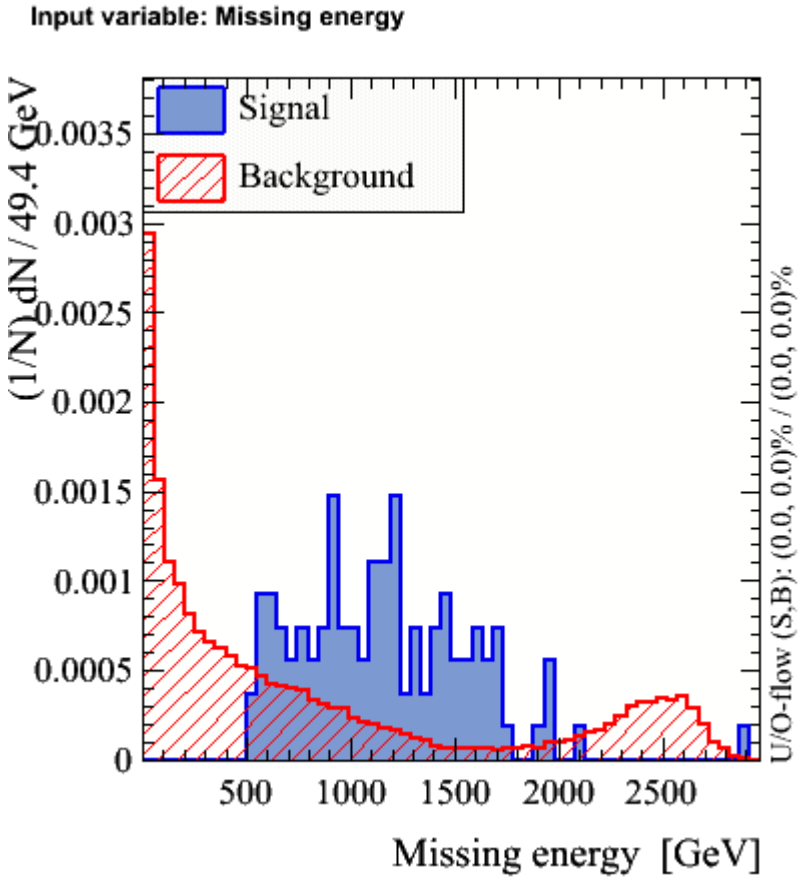
Besoin d'une coupure …

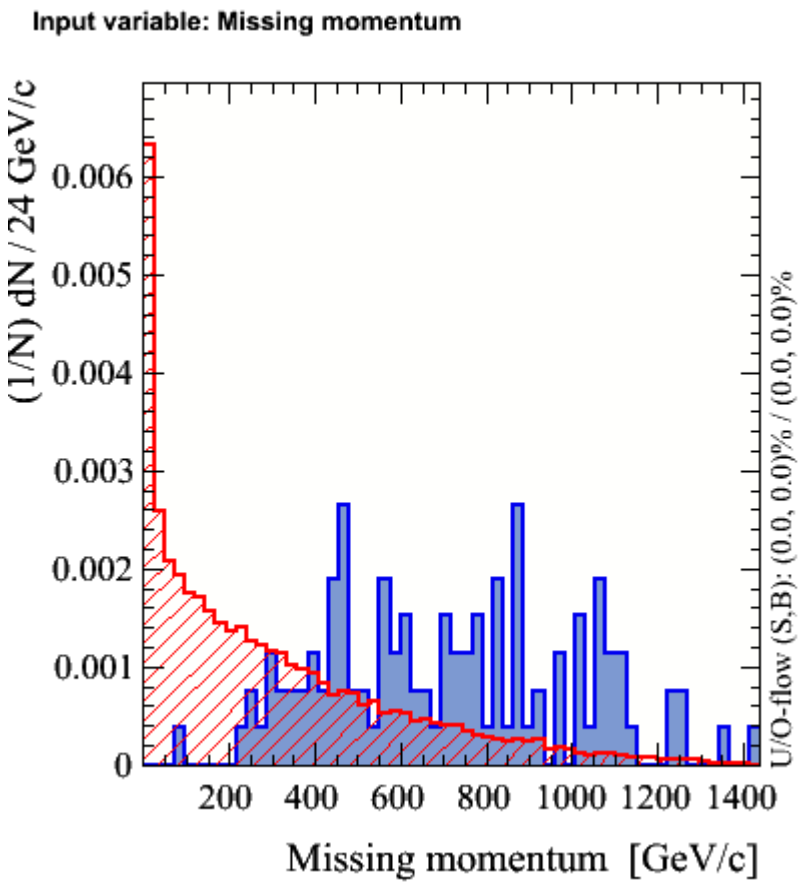
Méthode d'approche

- Couper sur des des variables discriminantes de l'état final.

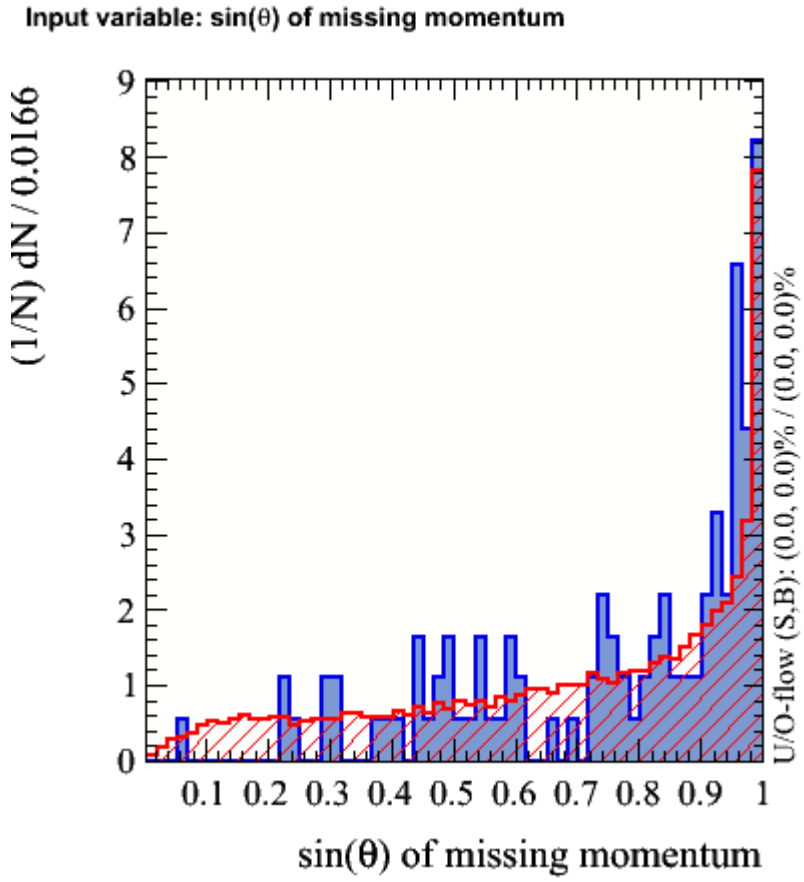
- 8 variables retenues :
  - Energie manquante
  - Impulsion manquante
  - Angle θ de l'impulsion manquante
  - Impulsion transverse manquante
  - Spéricité
  - Aplanarité
  - Energie du 1er jet
  - Impulsion transverse du 1er jet

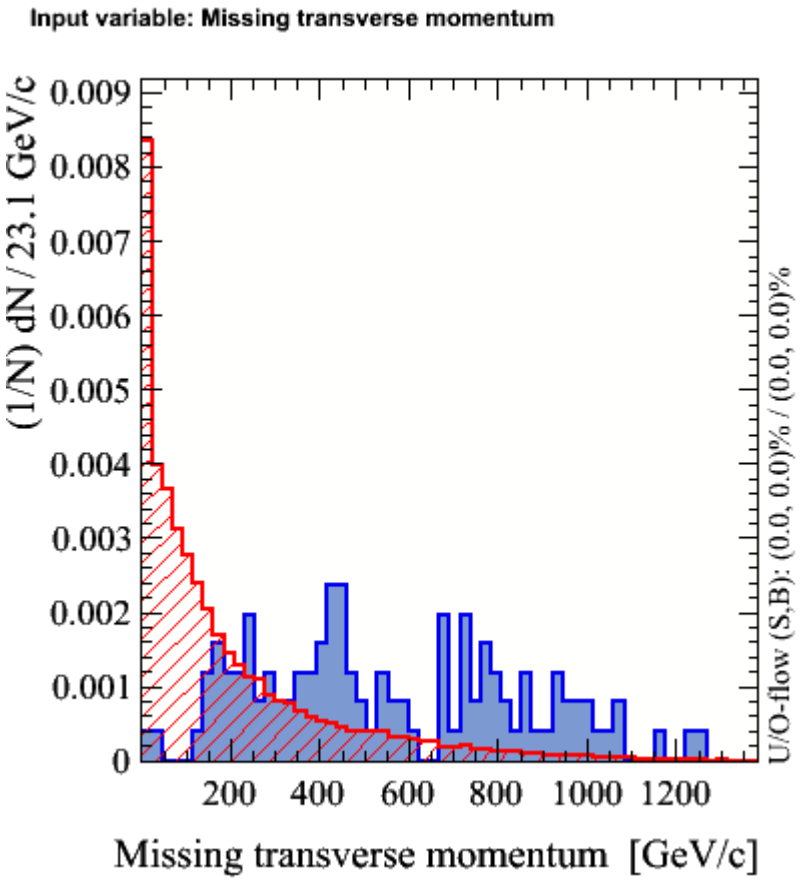
Variables Discriminantes



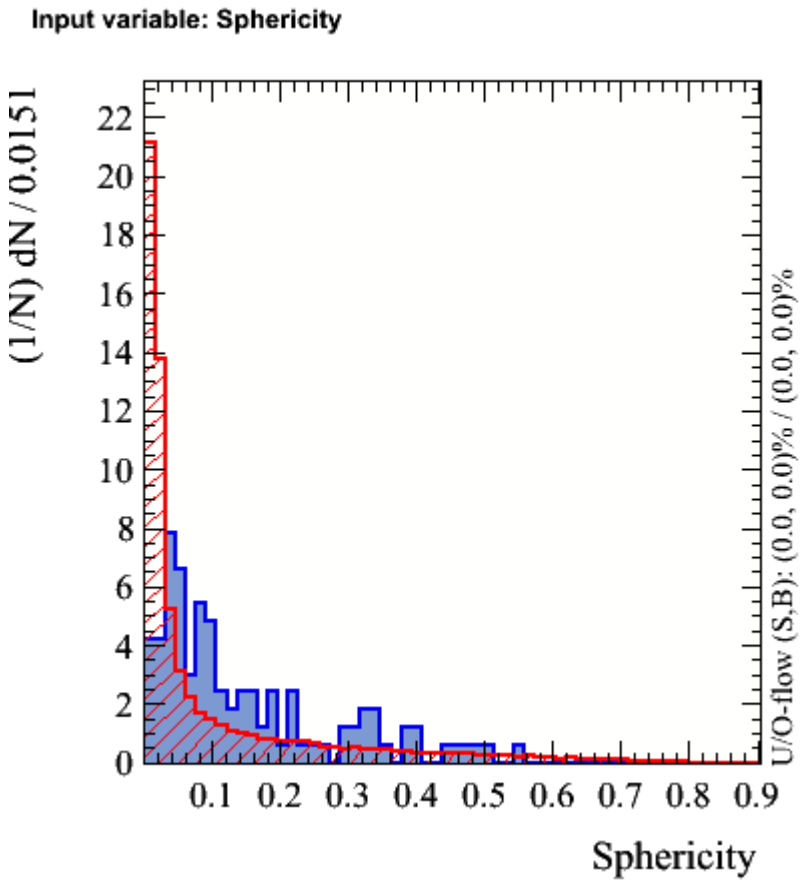


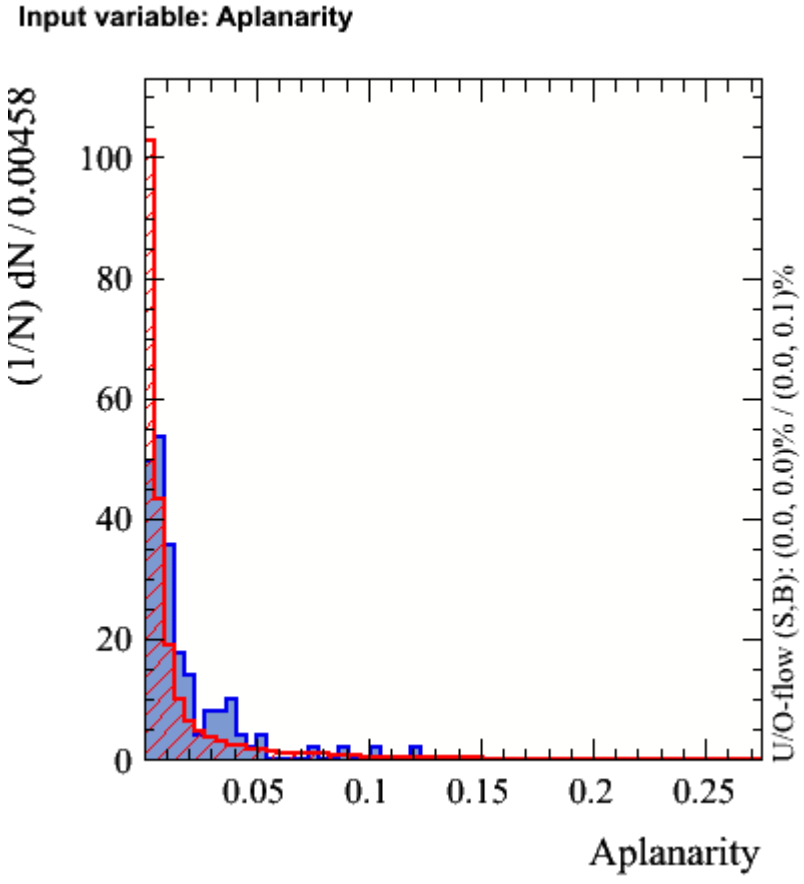
Variables Discriminantes



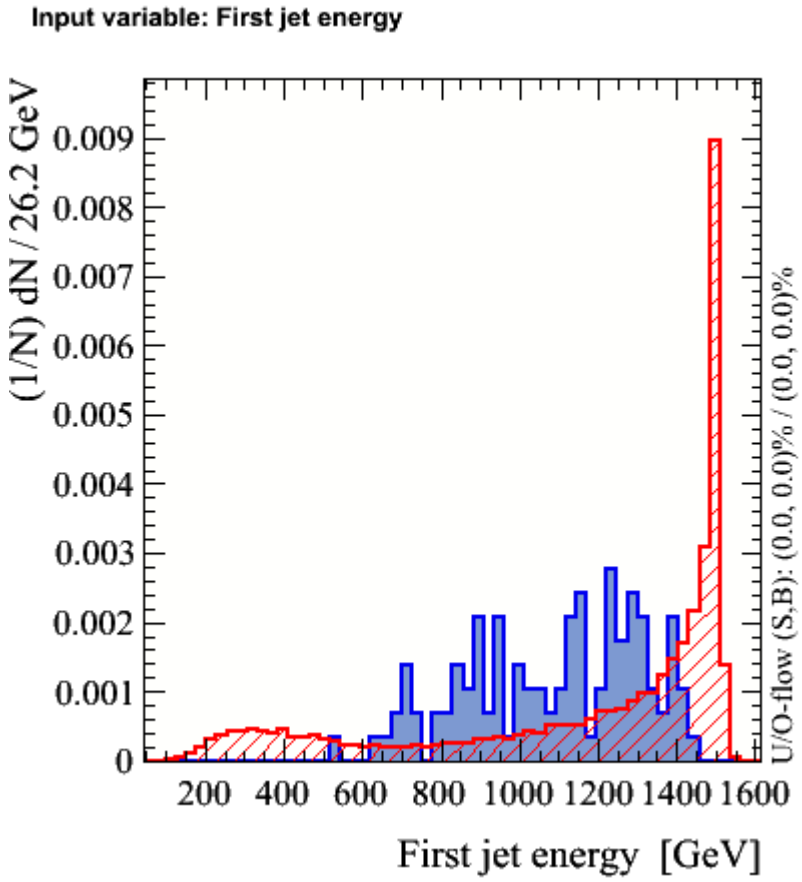


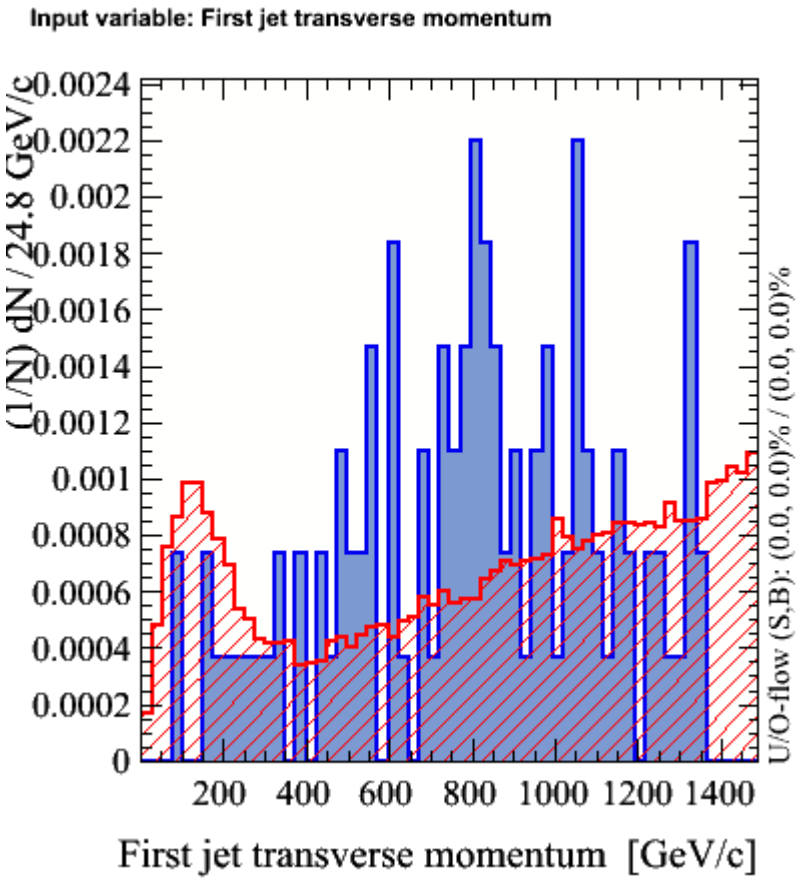
Variables Discriminantes





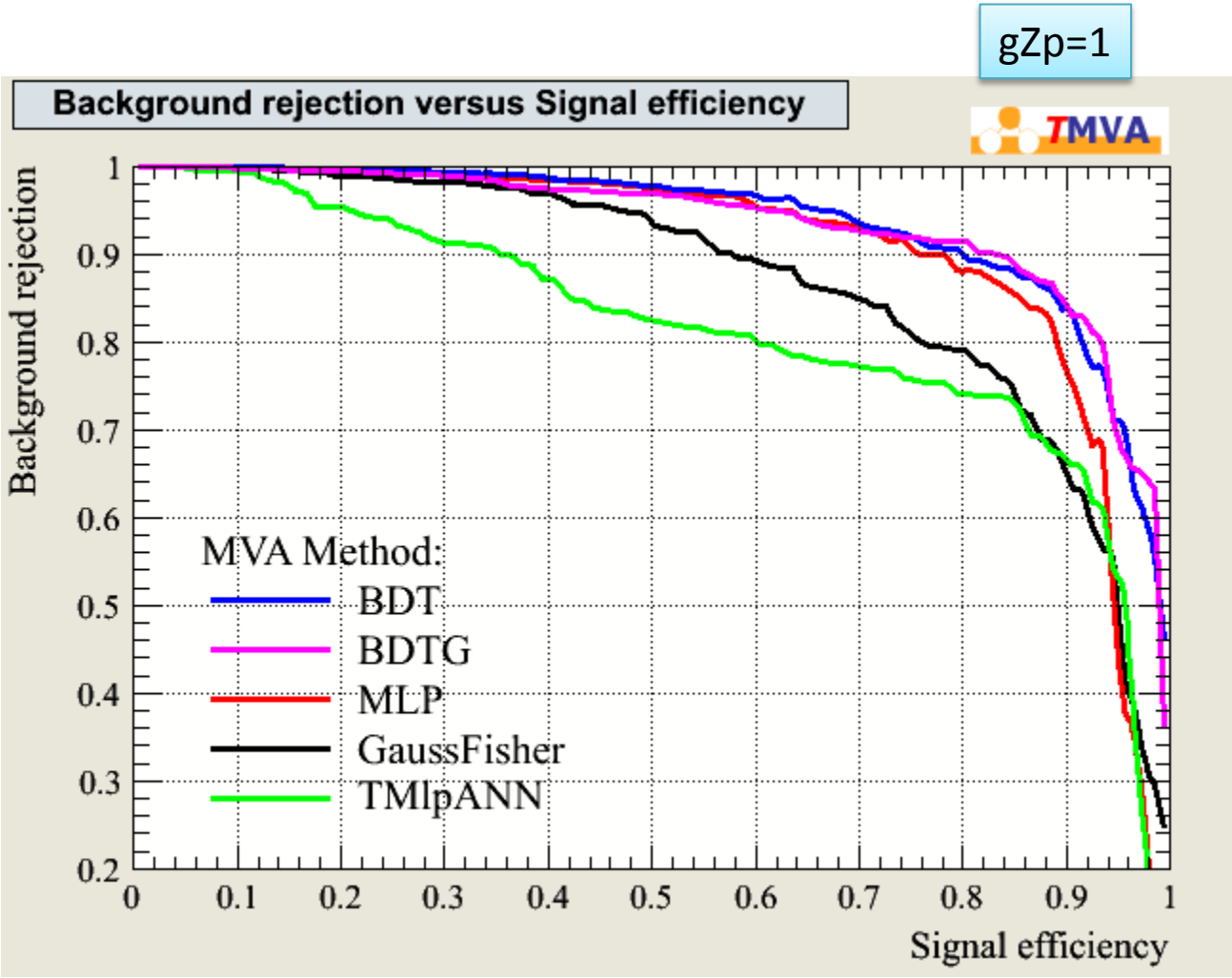
Variables Discriminantes





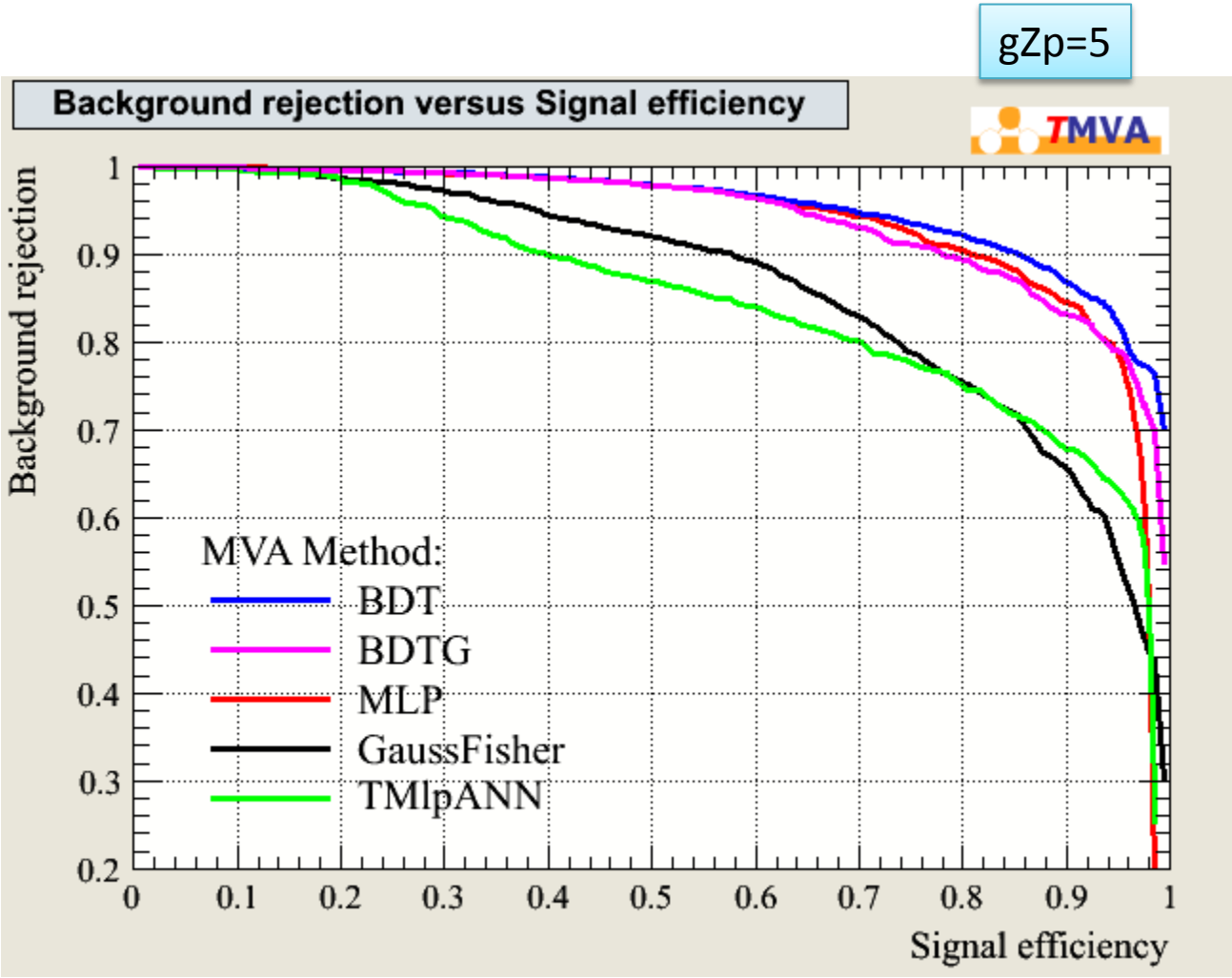
Méthode d'approche

- Coupure "à la main" imprécises
- Outils d'analyse multivariable (TMVA)



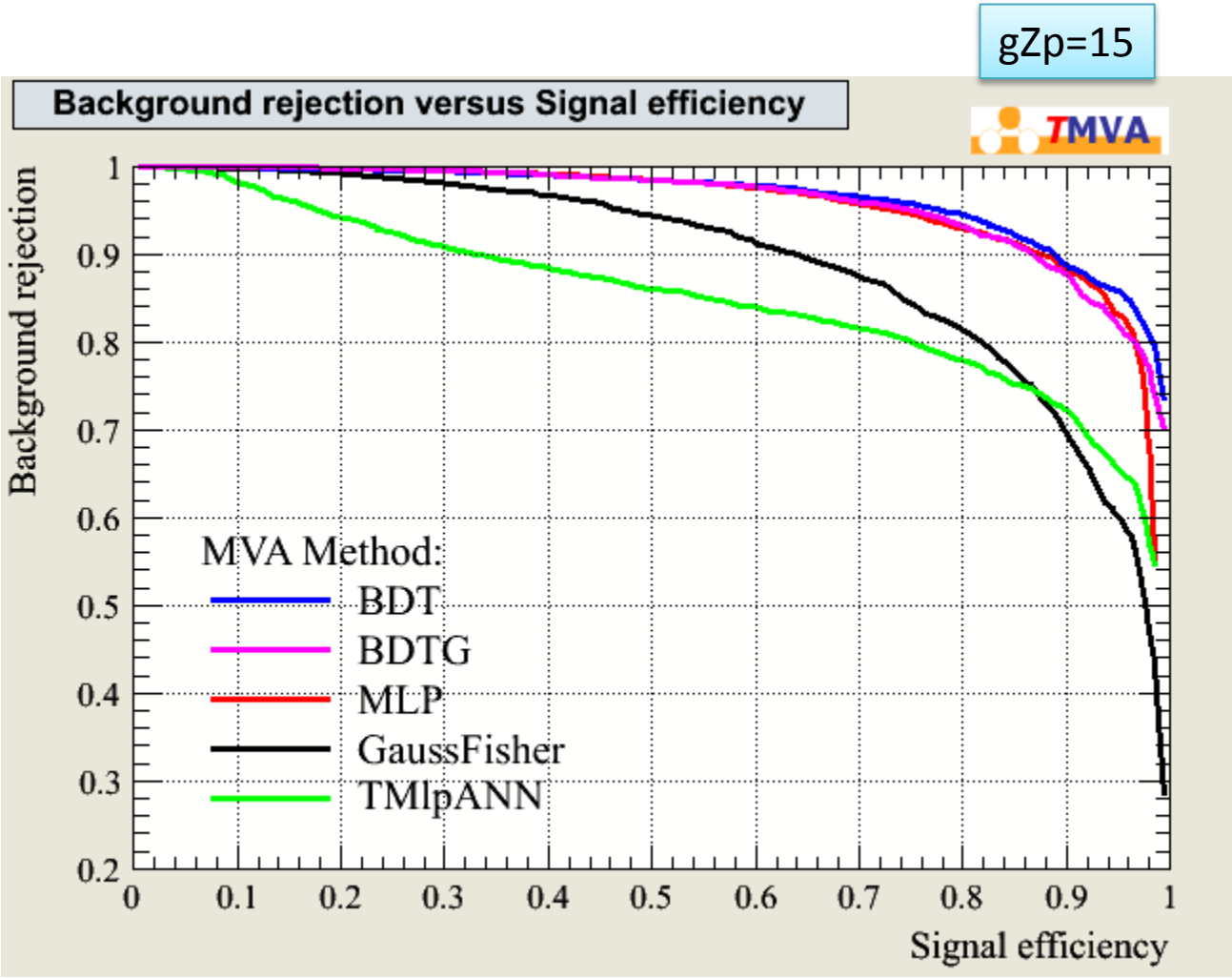
Méthode d'approche

- Coupure "à la main" imprécises
- Outils d'analyse multivariable (TMVA)



Méthode d'approche

- Coupure "à la main" imprécises
- Outils d'analyse multivariable (TMVA)



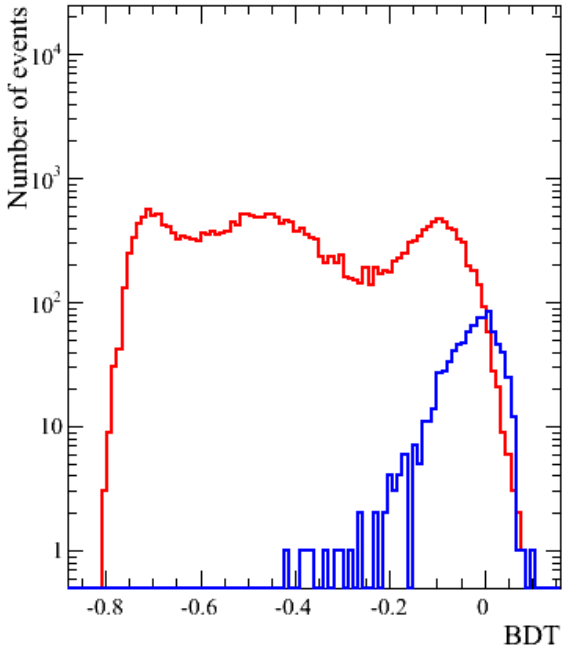
Méthode d'approche

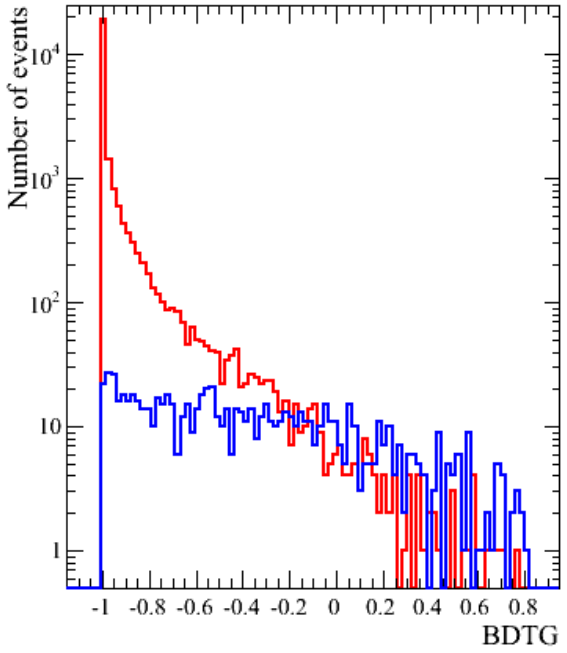
- 3 algorithmes retenus:
  - Boosted Decision Tree (BDT)
  - Gradient Bosted Decision tree (BDTG)
  - Multi Layer Perceptron (MLP)

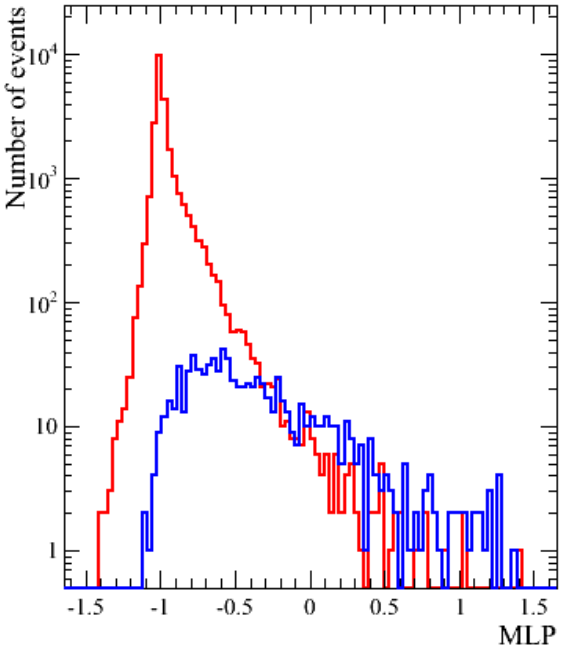
Méthode d'approche

- Variables de sortie :

MZp = 400 GeV
gZp = 10

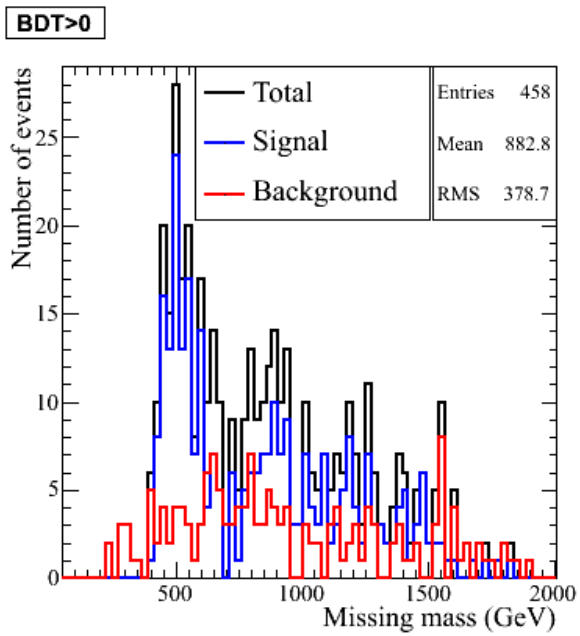


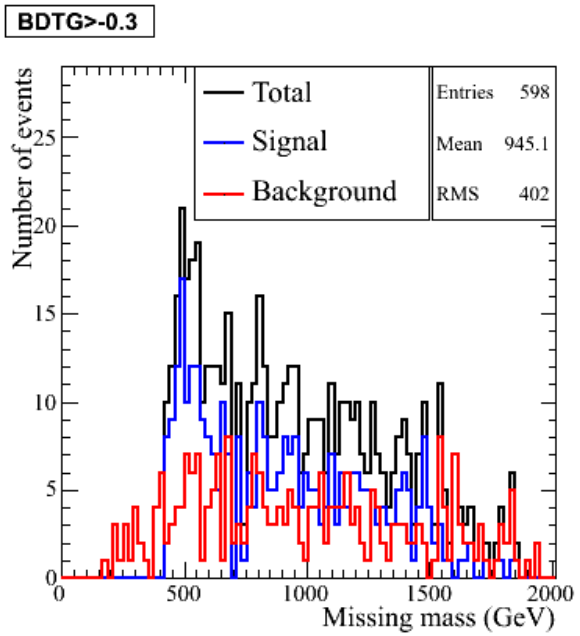


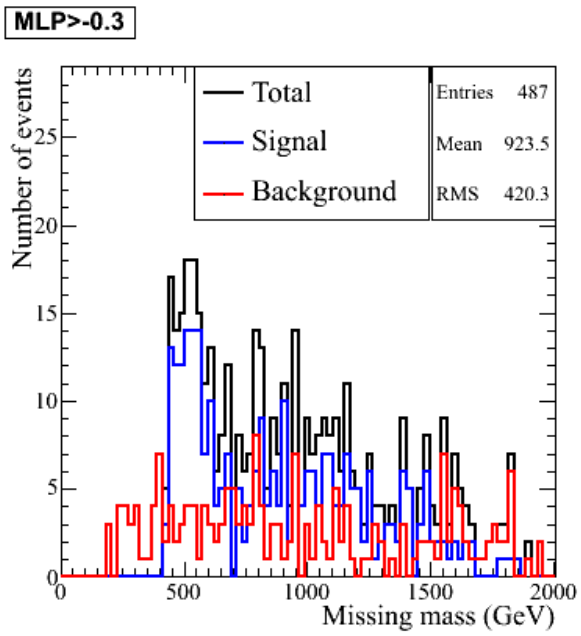


Méthode d'approche

- Coupure grossière (exemple)







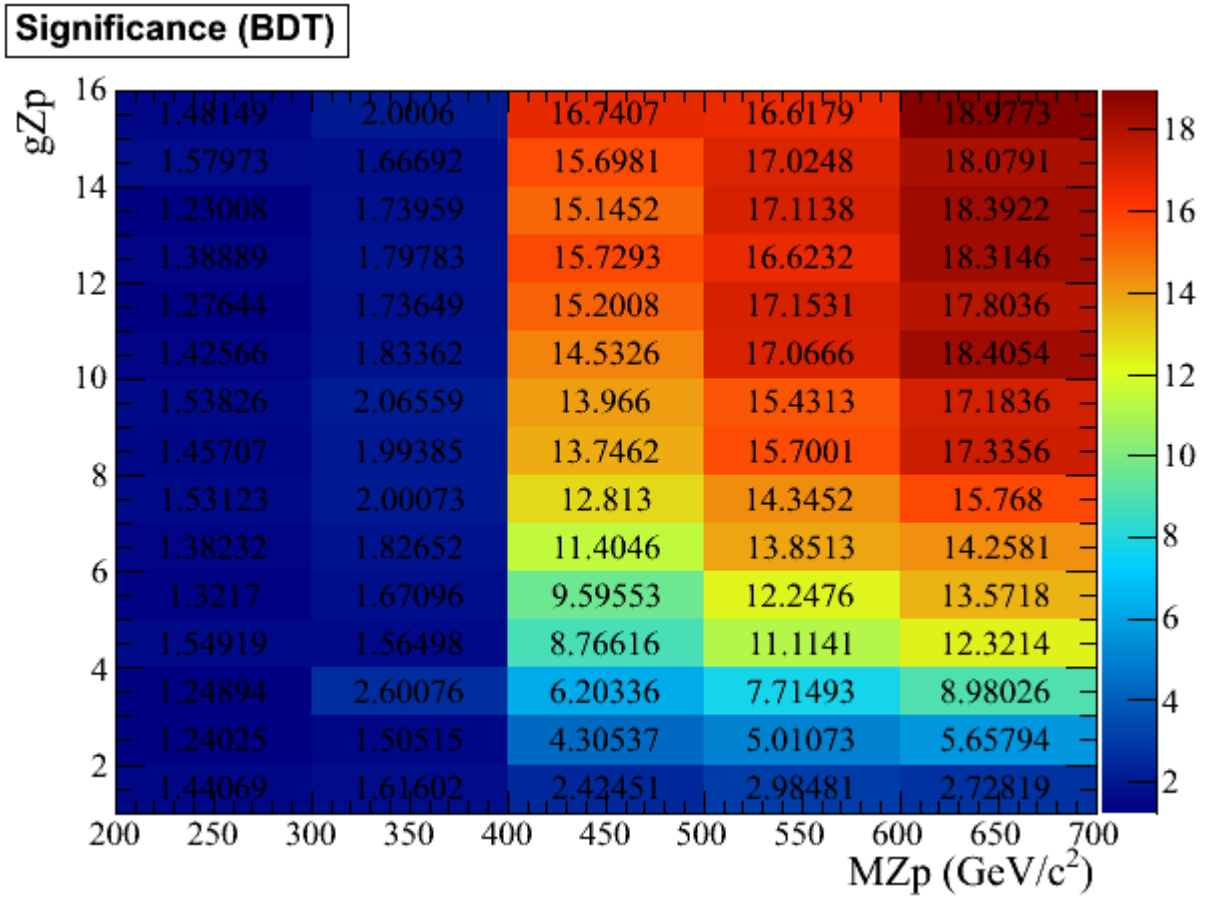
Méthode d'approche

- Pertinence de la coupure :

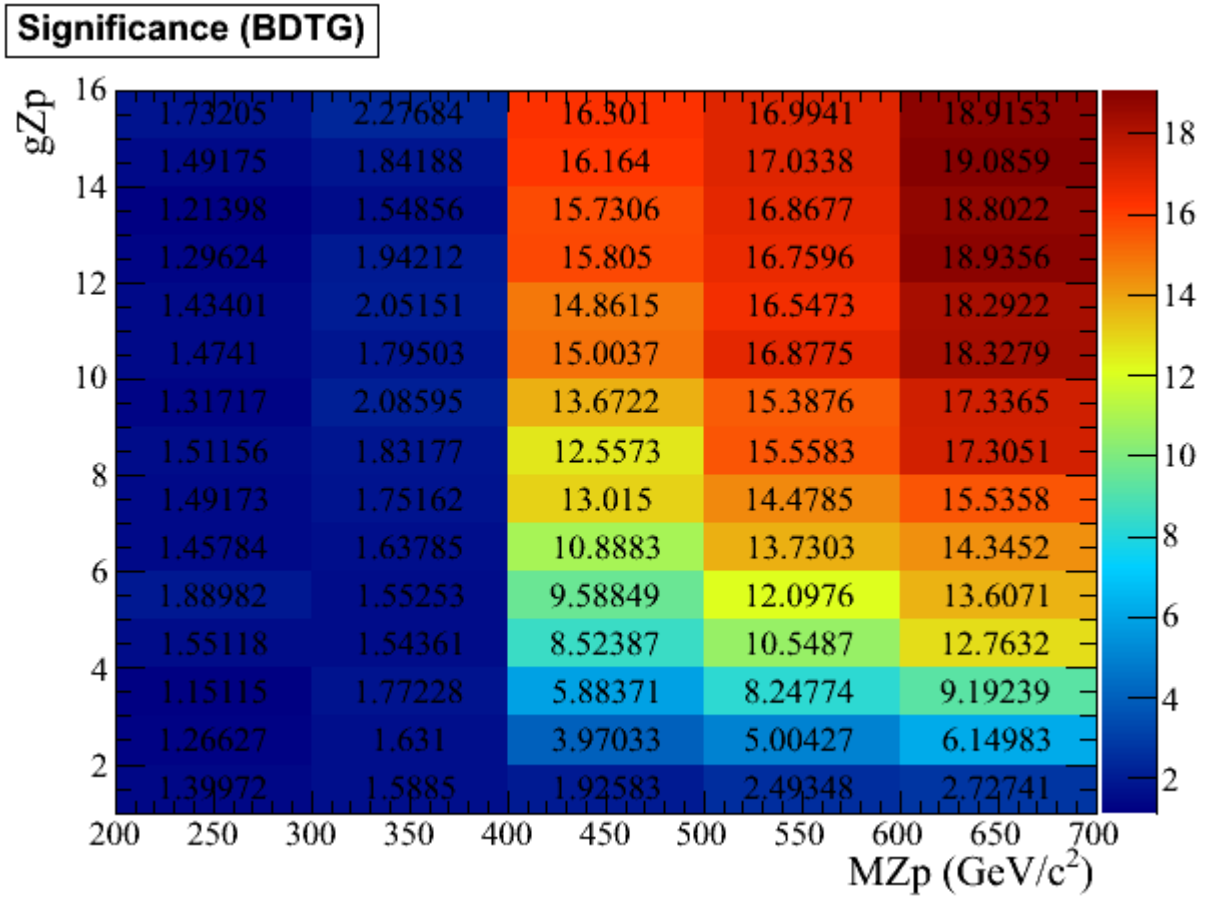
  Significance = S/sqrt(S+B)

- Optimiser Coupure $\Leftrightarrow$ maximiser Significance
- Scanner (MZp;gZp)

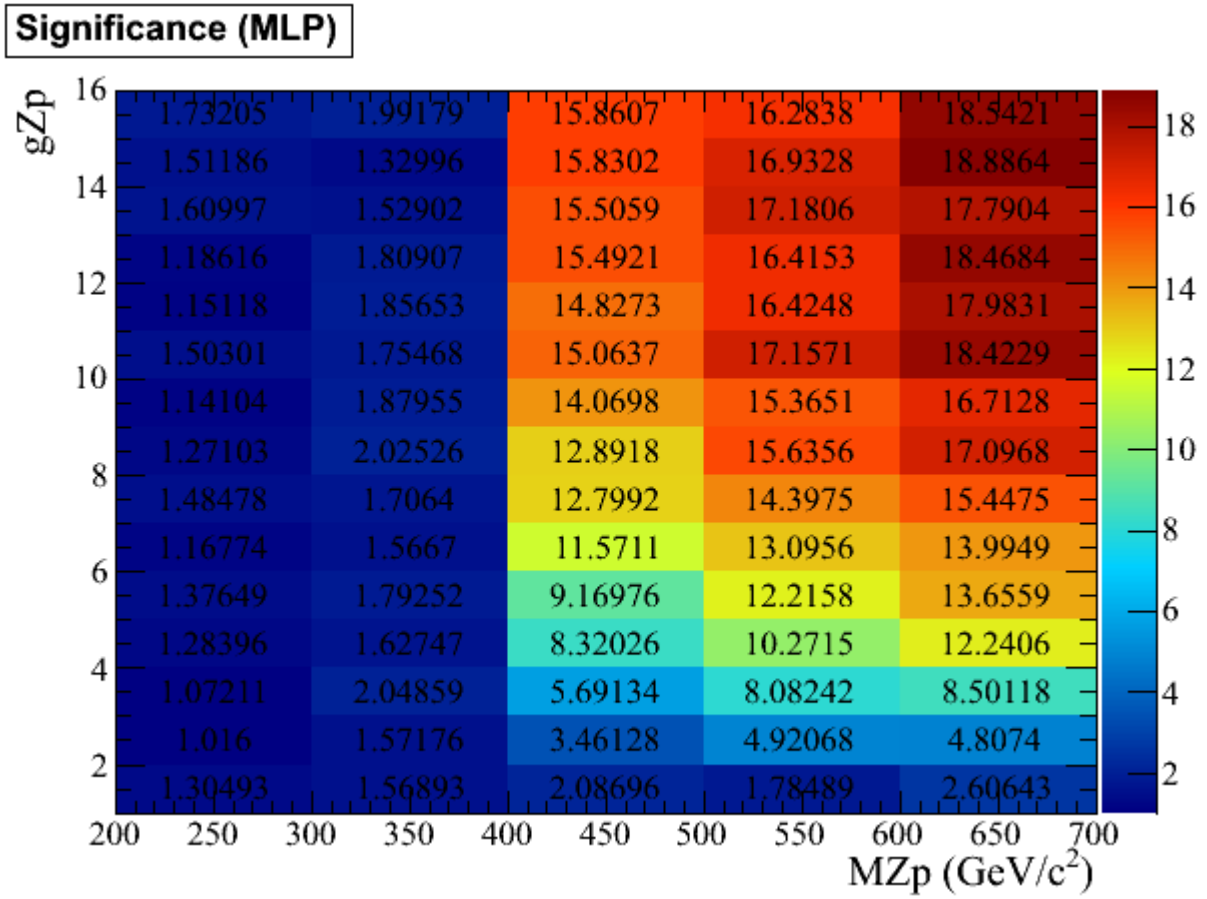
Résultats


Significance (BDT)
gZp
MZp (GeV/c²)
16
14
12
10
8
6
4
2
200 250 300 350 400 450 500 550 600 650 700
1.48149 2.0006 16.7407 16.6179 18.9773
1.57973 1.66692 15.6981 17.0248 18.0791
1.23008 1.73959 15.1452 17.1138 18.3922
1.38889 1.79783 15.7293 16.6232 18.3146
1.27644 1.73649 15.2008 17.1531 17.8036
1.42566 1.83362 14.5326 17.0666 18.4054
1.53826 2.06559 13.966 15.4313 17.1836
1.45707 1.99385 13.7462 15.7001 17.3356
1.53123 2.00073 12.813 14.3452 15.768
1.38232 1.82652 11.4046 13.8513 14.2581
1.3217 1.67096 9.59553 12.2476 13.5718
1.54919 1.56498 8.76616 11.1141 12.3214
1.24894 2.60076 6.20336 7.71493 8.98026
1.24025 1.50515 4.30537 5.01073 5.65794
1.44069 1.61602 2.42451 2.98481 2.72819
18
16
14
12
10
8
6
4
2

Résultats

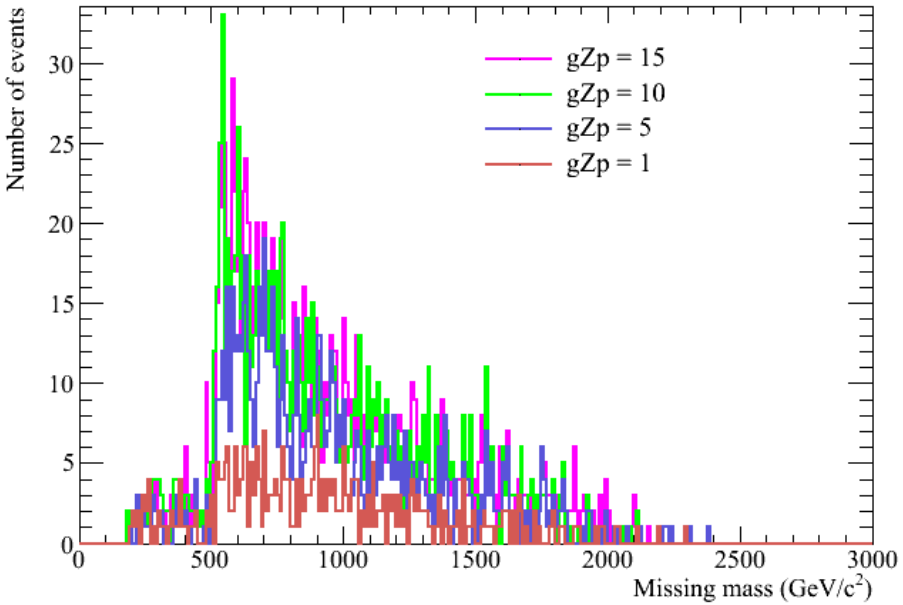

Significance (BDTG)
gZp
MZp (GeV/c²)
1.73205 2.27684 16.301 16.9941 18.9153
1.49175 1.84188 16.164 17.0338 19.0859
1.21398 1.54856 15.7306 16.8677 18.8022
1.29624 1.94212 15.805 16.7596 18.9356
1.43401 2.05151 14.8615 16.5473 18.2922
1.4741 1.79503 15.0037 16.8775 18.3279
1.31717 2.08595 13.6722 15.3876 17.3365
1.51156 1.83177 12.5573 15.5583 17.3051
1.49173 1.75162 13.015 14.4785 15.5358
1.45784 1.63785 10.8883 13.7303 14.3452
1.88982 1.55253 9.58849 12.0976 13.6071
1.55118 1.54361 8.52387 10.5487 12.7632
1.15115 1.77228 5.88371 8.24774 9.19239
1.26627 1.631 3.97033 5.00427 6.14983
1.39972 1.5885 1.92583 2.49348 2.72741

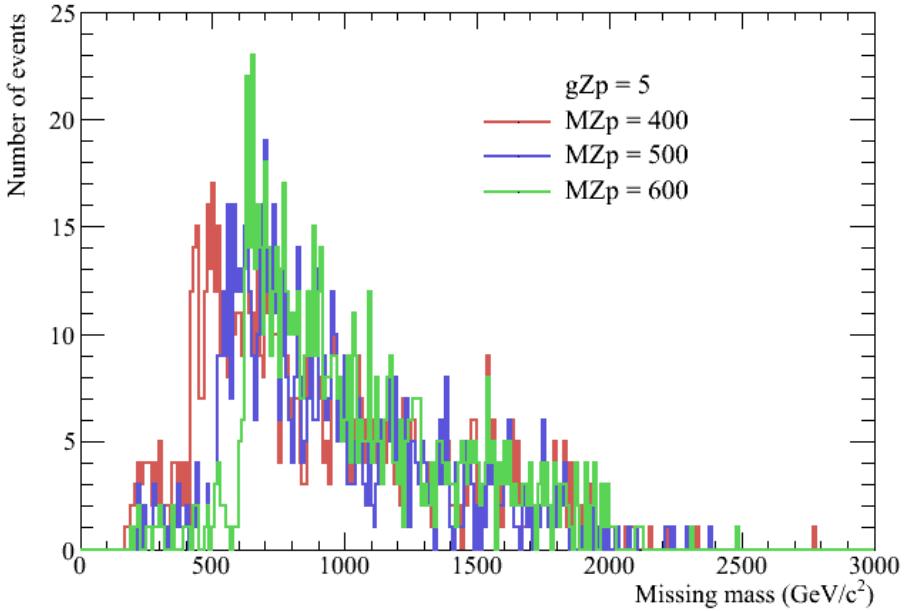
Résultats


Significance (MLP)
gZp
MZp (GeV/c²)
16
14
12
10
8
6
4
2
200
250
300
350
400
450
500
550
600
650
700
1.73205 1.99179 15.8607 16.2838 18.5421
1.51186 1.32996 15.8302 16.9328 18.8864
1.60997 1.52902 15.5059 17.1806 17.7904
1.18616 1.80907 15.4921 16.4153 18.4684
1.15118 1.85653 14.8273 16.4248 17.9831
1.50301 1.75468 15.0637 17.1571 18.4229
1.14104 1.87955 14.0698 15.3651 16.7128
1.27103 2.02526 12.8918 15.6356 17.0968
1.48478 1.7064 12.7992 14.3975 15.4475
1.16774 1.5667 11.5711 13.0956 13.9949
1.37649 1.79252 9.16976 12.2158 13.6559
1.28396 1.62747 8.32026 10.2715 12.2406
1.07211 2.04859 5.69134 8.08242 8.50118
1.016 1.57176 3.46128 4.92068 4.8074
1.30493 1.56893 2.08696 1.78489 2.60643
18
16
14
12
10
8
6
4
2

Résultats

- Spectres en masse manquante, après coupure :





Suite de l'étude

- "Initial state radiation"

  $\Rightarrow$ Regénérer les données …
- Résolution détecteur

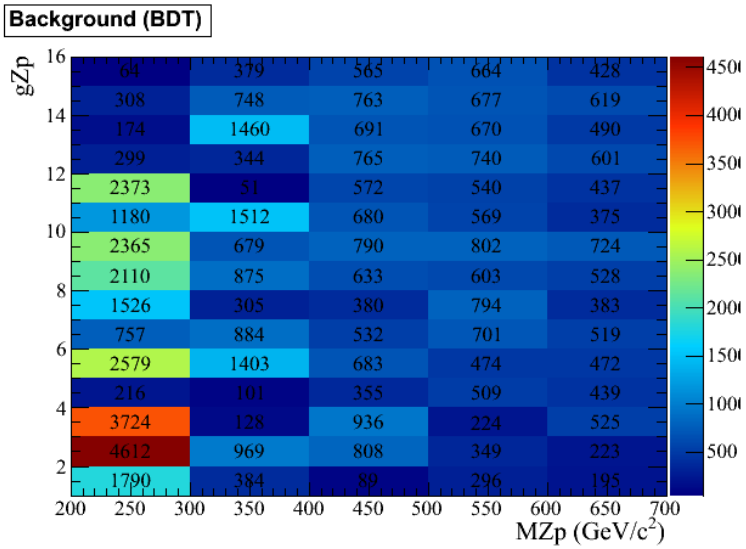
  $\rightarrow$ Contraintes …

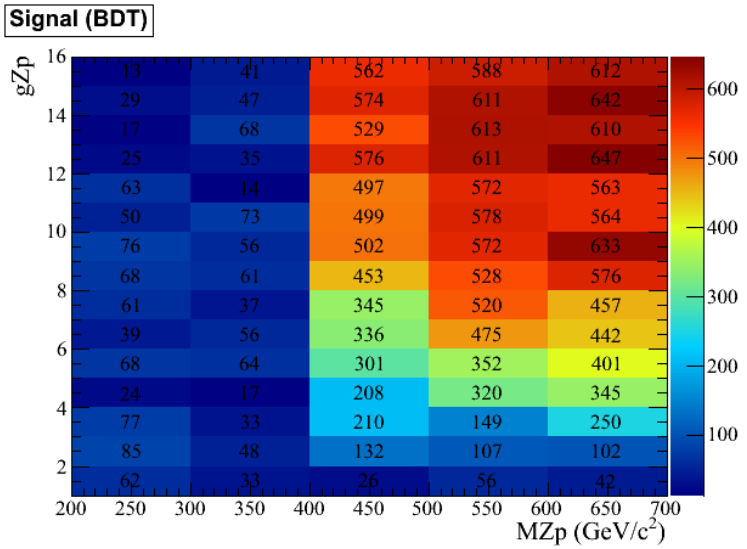
Discussion

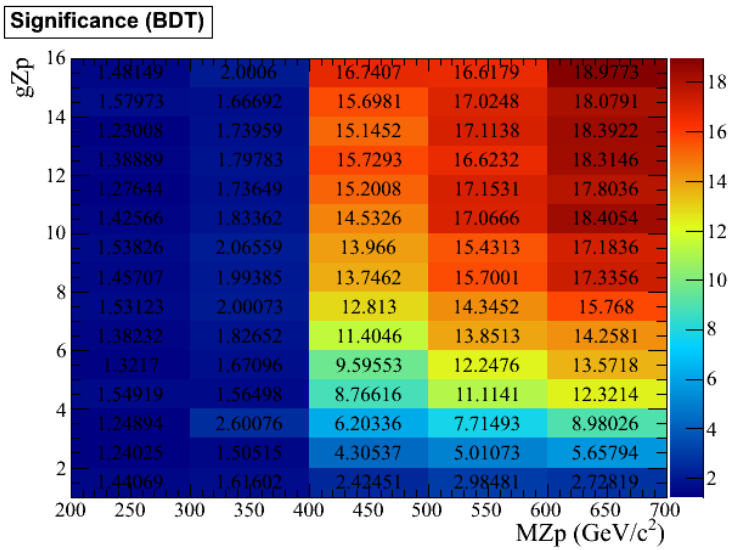
- TMVA ?
- Fit signal et bruit de fond
- Coupures optimisées / coupure unique
- Parametre ajustable ? (gZp, MLZP …)

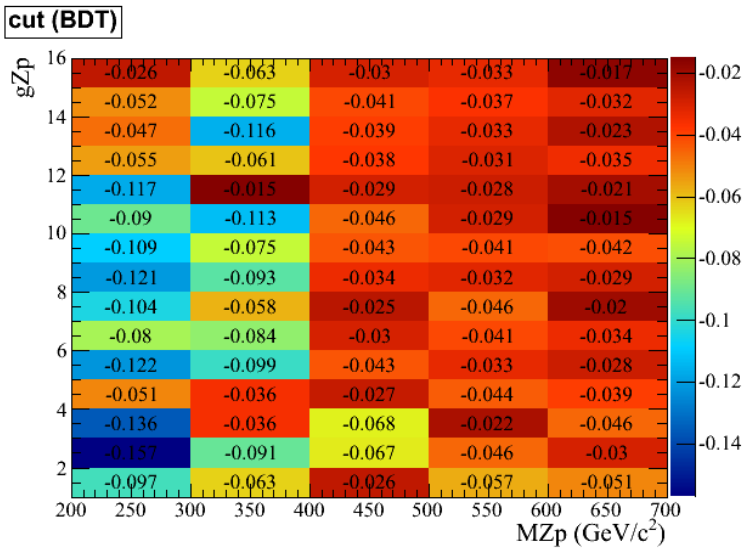
- CDR CLIC?

Backup

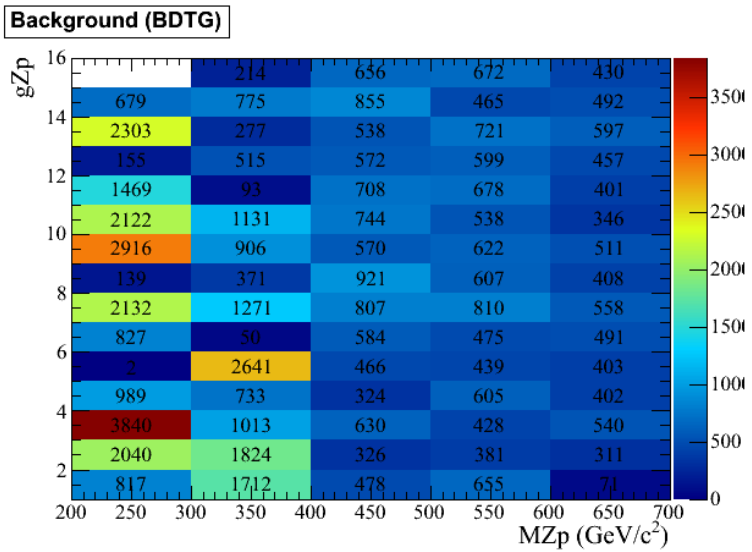

Background (BDT)
gZp
MZp (GeV/c²)

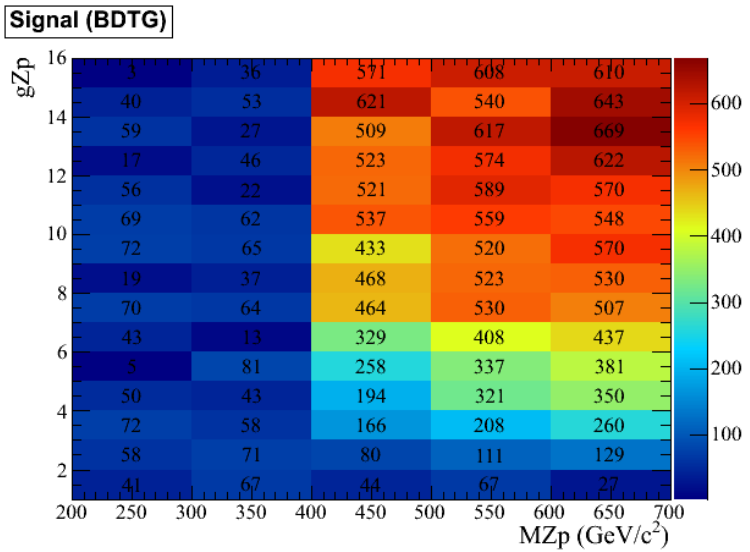

Signal (BDT)
gZp
MZp (GeV/c²)

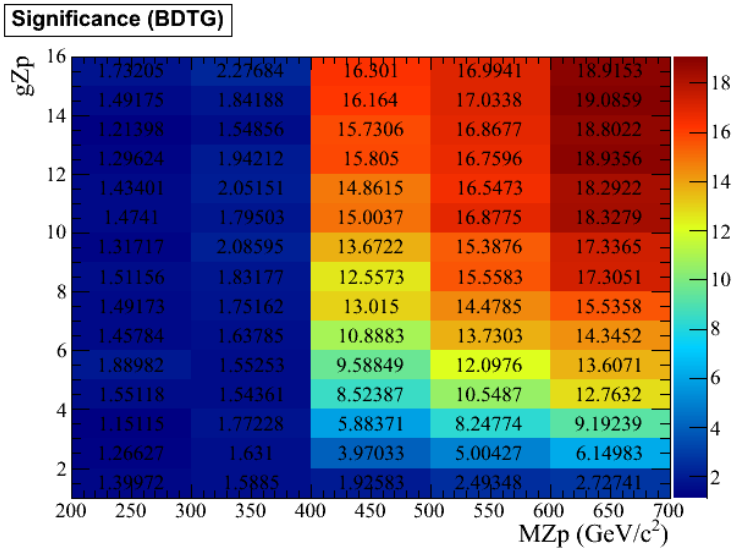

Significance (BDT)
gZp
MZp (GeV/c²)

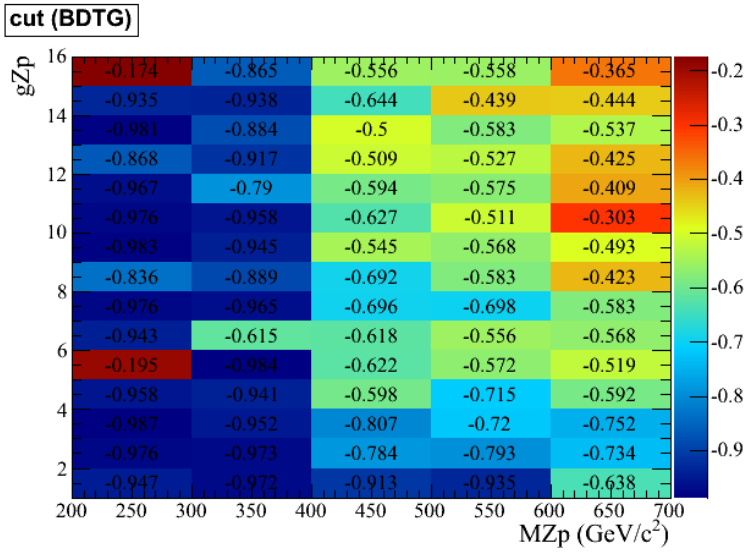

cut (BDT)
gZp
MZp (GeV/c²)

Backup

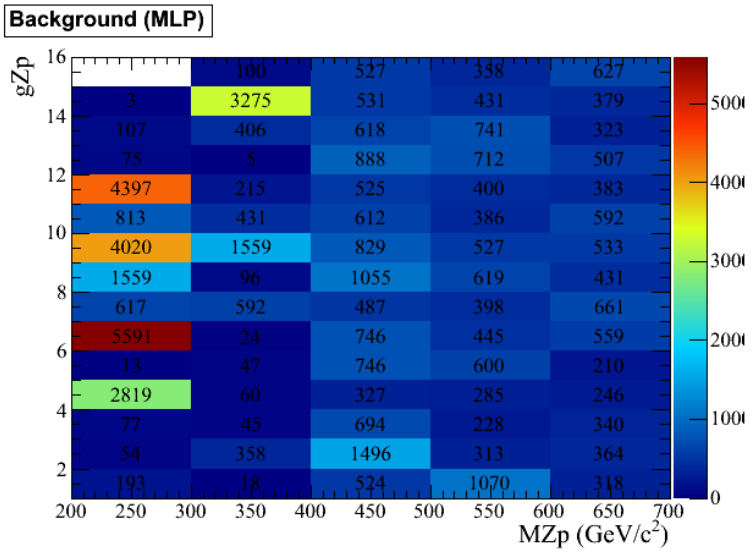

Background (BDTG)
gZp
MZp (GeV/c²)

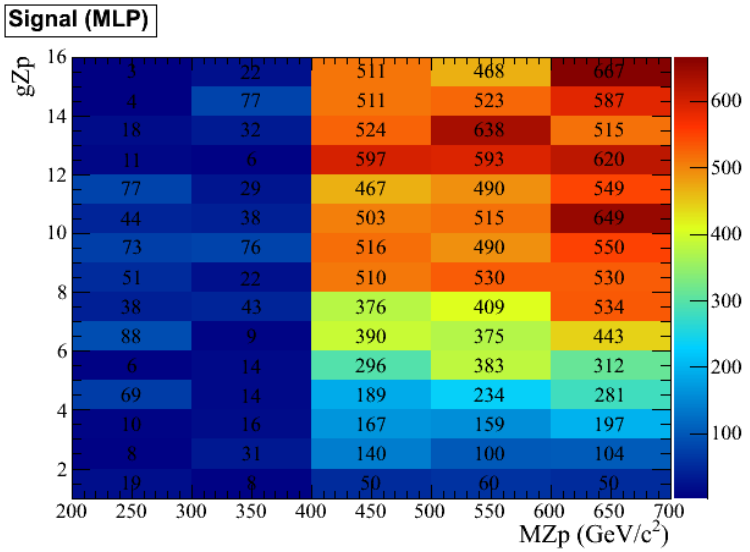

Signal (BDTG)
gZp
MZp (GeV/c²)

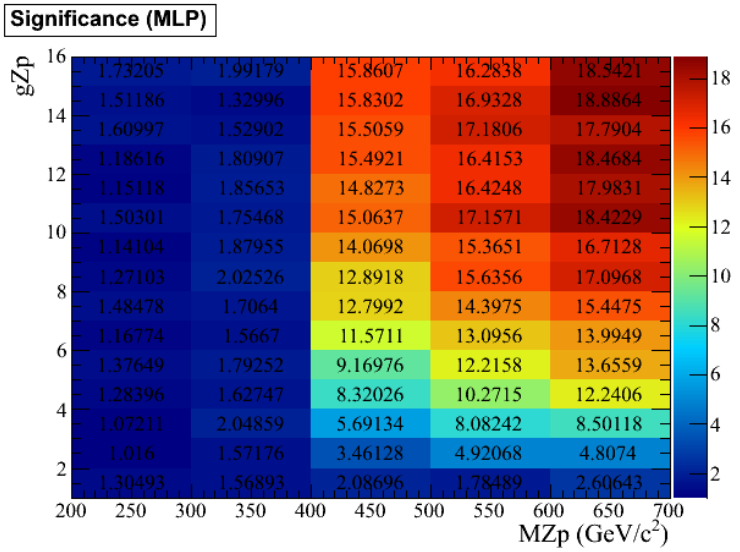

Significance (BDTG)
gZp
MZp (GeV/c²)

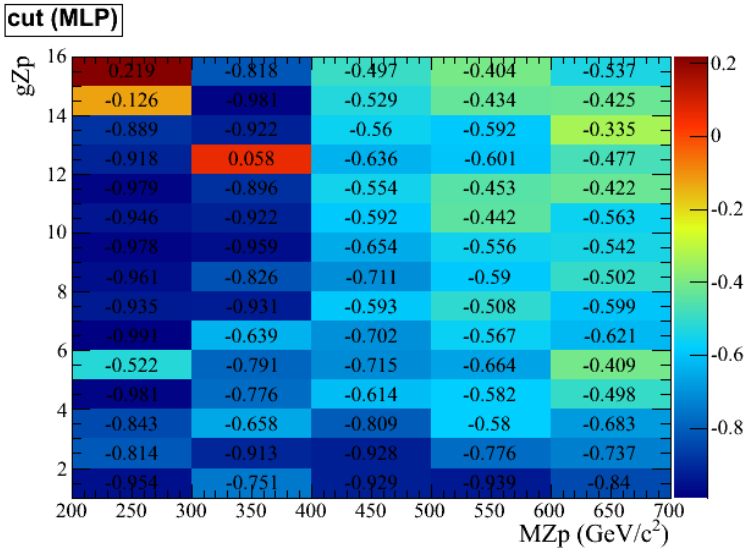

cut (BDTG)
gZp
MZp (GeV/c²)

Backup


Background (MLP)
gZp
MZp (GeV/c²)


Signal (MLP)
gZp
MZp (GeV/c²)


Significance (MLP)
gZp
MZp (GeV/c²)


cut (MLP)
gZp
MZp (GeV/c²)