

# Status report

Tokyo Institute of Technology

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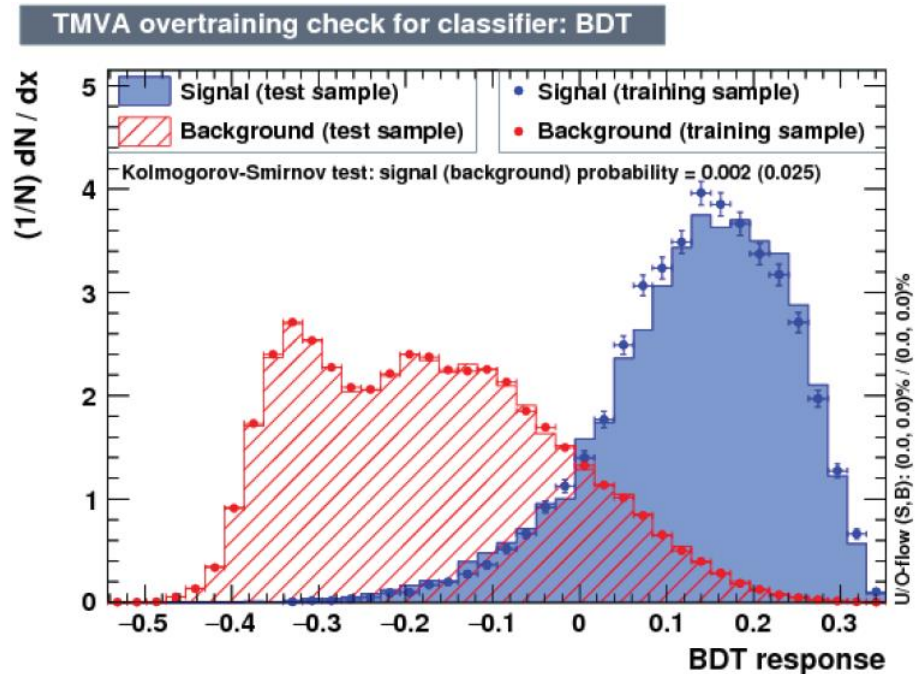
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- BDT optimization (Ntrees, MaxDepth, MinNodeSize, AdaBoostBeta) in LHeC

# Result by default BDT in LHeC

We analyzed the signal and the backgrounds by default BDT.

Score >	$N_S$	$N_B$	Br[%]
0	5218	58411	9.30
0.05	4692	34193	7.92
0.1	3853	16968	6.81
0.15	2797	7125	6.11
<b>0.2</b>	<b>1700</b>	<b>2366</b>	<b>5.84</b>
0.25	733	615	7.04
0.3	146	71	13.0

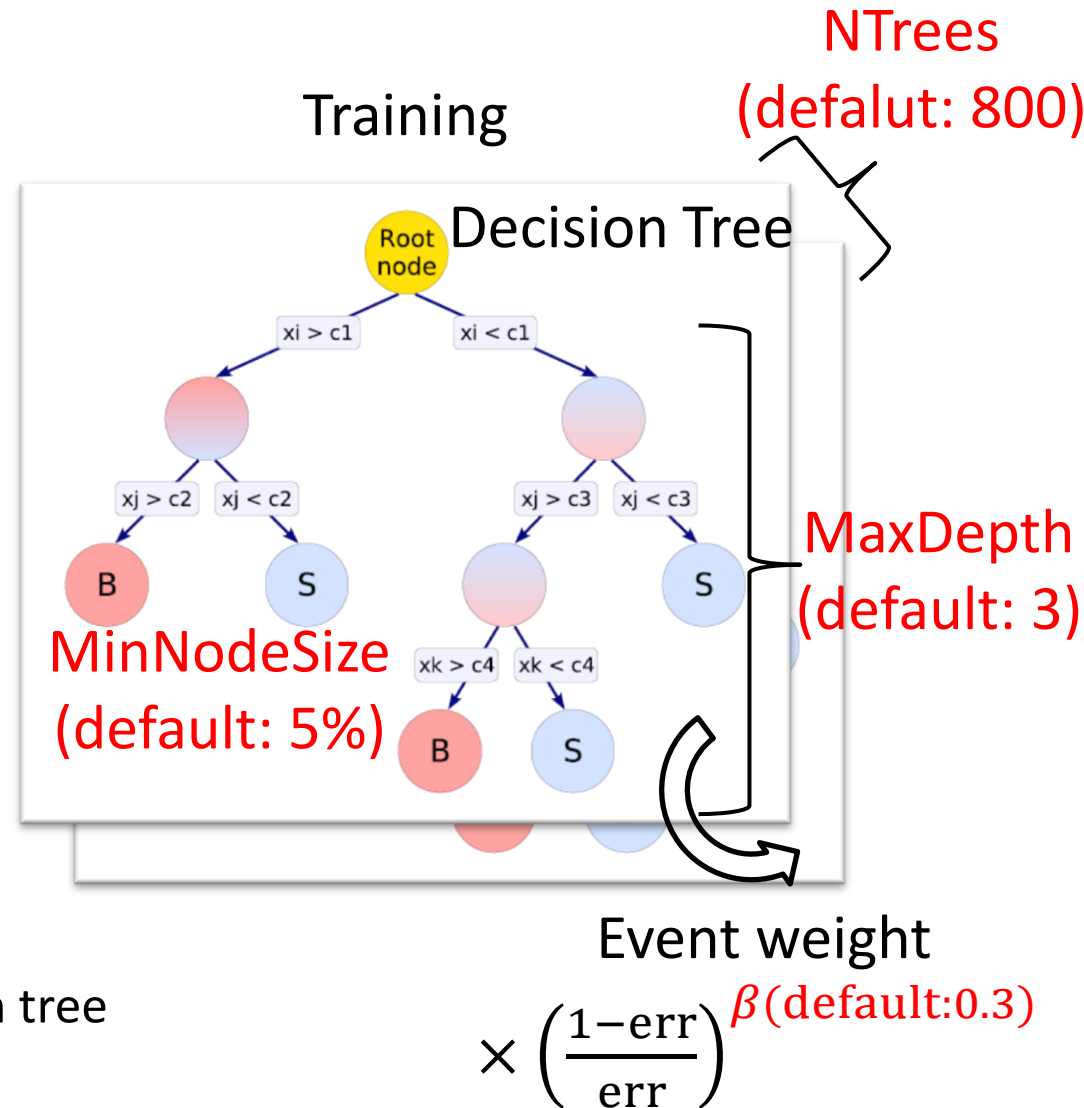


Branching ratio calculated by  $S/\sqrt{S+B}$  :

$$Z = \frac{1700 \times \text{Br}(h \rightarrow \cancel{E}_T)}{\sqrt{1700 \times \text{Br}(h \rightarrow \cancel{E}_T) + 2366}} \quad \text{In the case of } 2\sigma \quad \Rightarrow \quad \text{Br}(h \rightarrow \cancel{E}_T) \sim 5.84\%$$

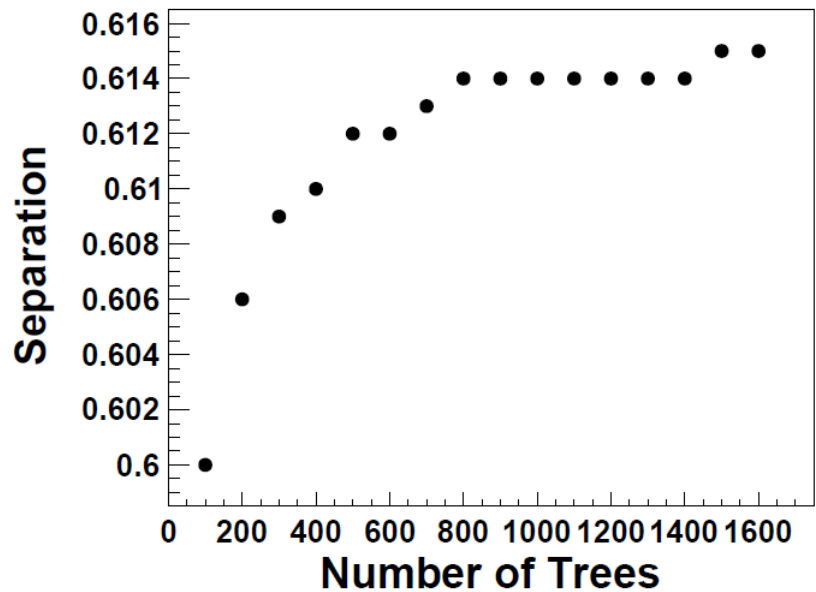
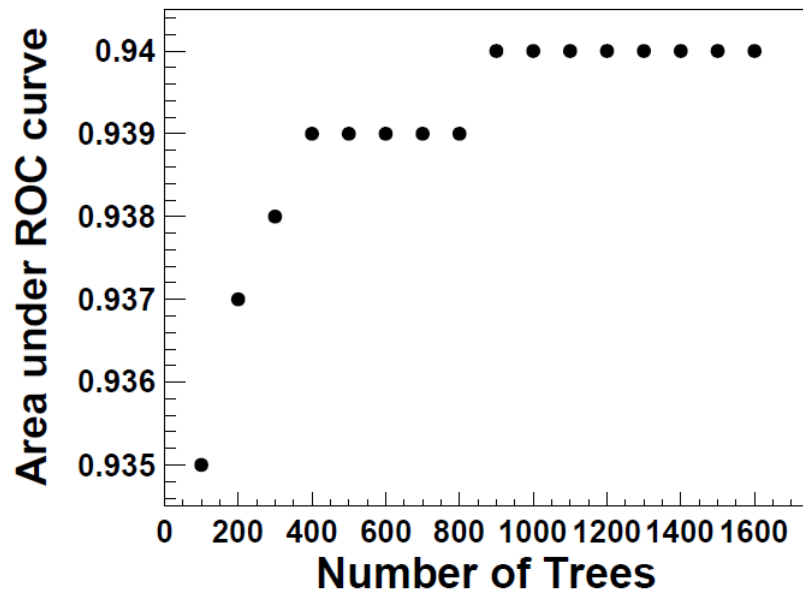
# BDT optimization

- **NTrees(100-1600)**  
→ Number of trees in the forest
- **MaxDepth(1-25)**  
→ Maximum depth of decision trees allowed
- **MinNodeSize(0.5-9.5%)**  
→ Minimum percentage of training events in a leafnode
- **AdaBoostBeta(0.1-2.5)**  
→ Learning rate for each decision tree



# NTrees (default: 800)

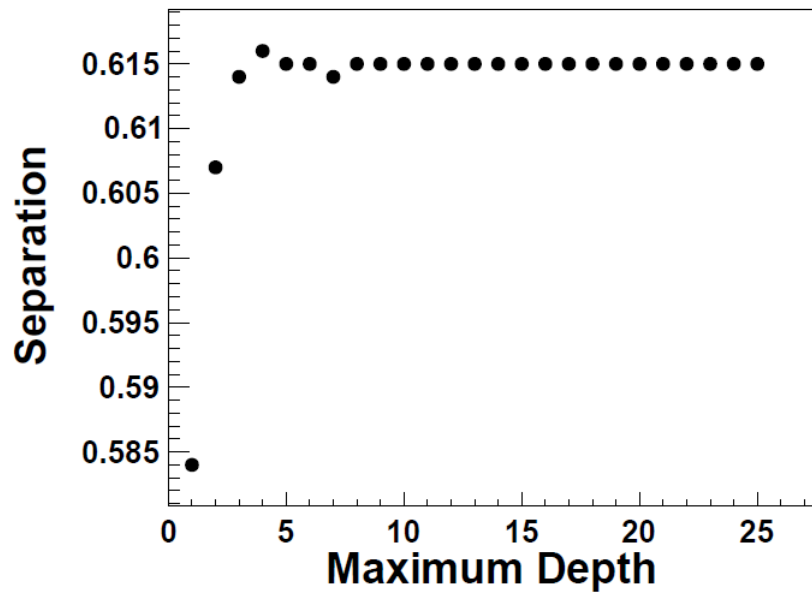
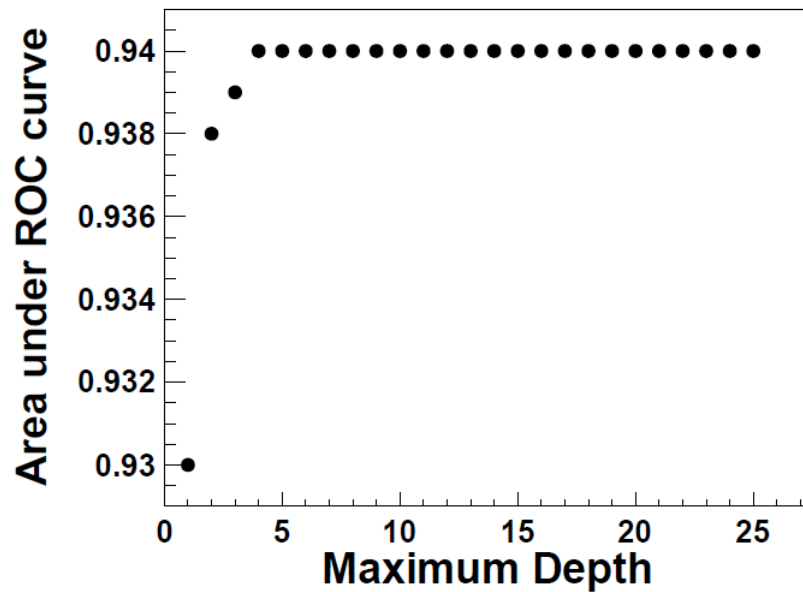
Training MC events changing NTrees between 100 and 1600



From these plots and the BDT speed, we use NTrees = 900.

# MaxDepth (default: 3)

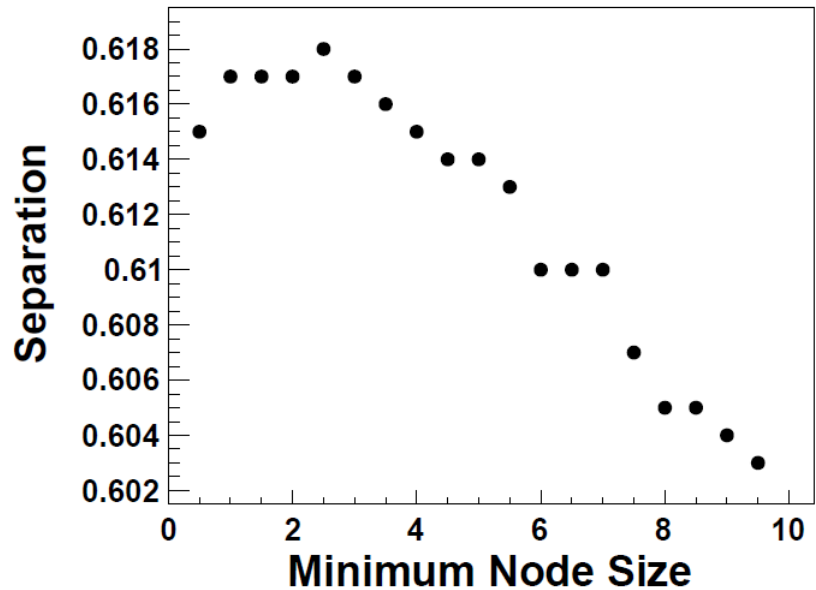
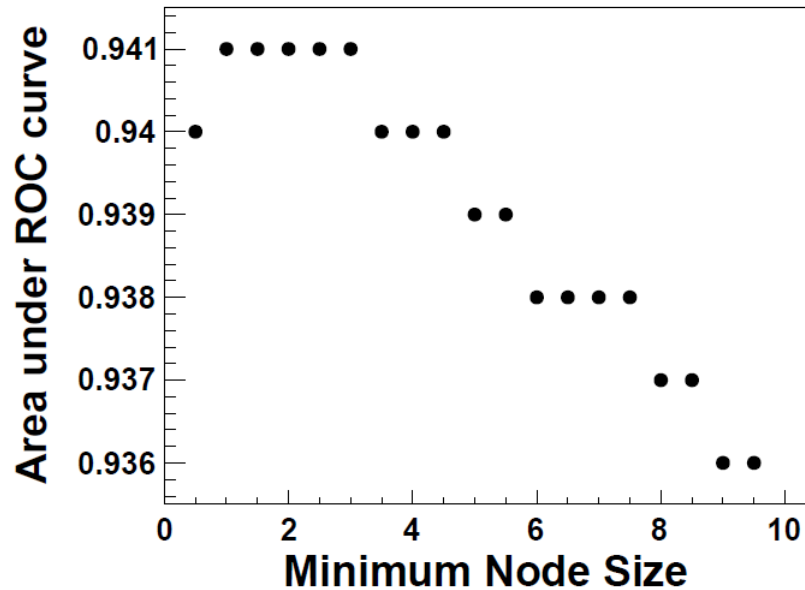
Training MC events changing MaxDepth between 1 and 25



From these plots and the BDT speed, we use MaxDepth = 4.

# MinNodeSize (default: 5%)

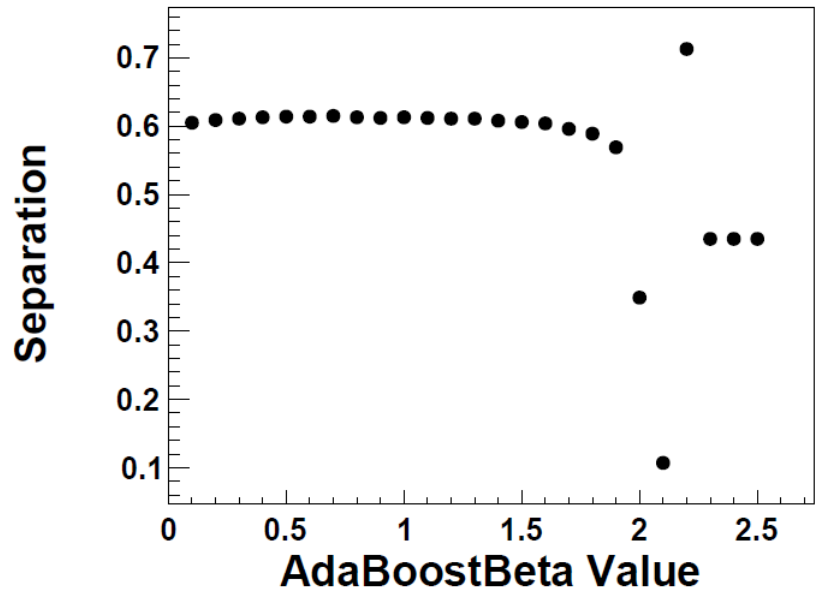
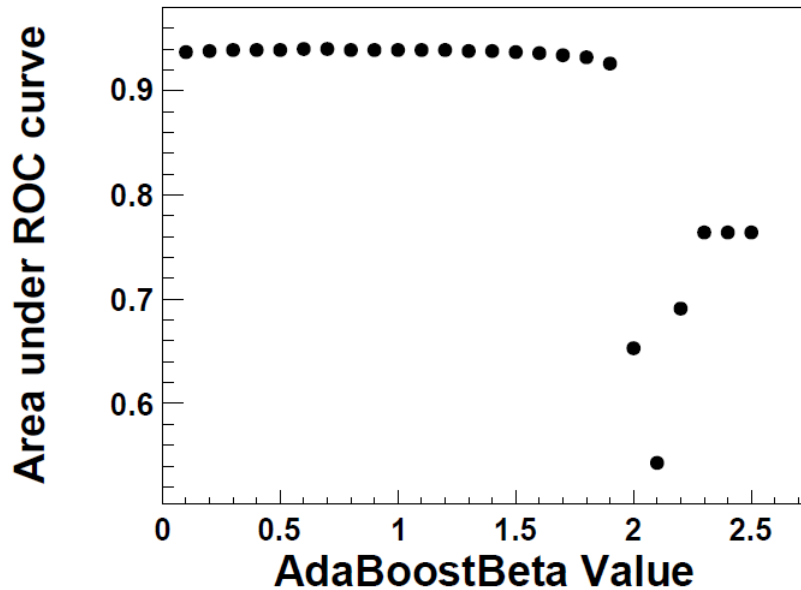
Training MC events changing MinNodeSize between 0.5 and 9.5



From these plots, we use MinNodeSize = 2.5.

# AdaBoostBeta (default: 3)

Training MC events changing AdaBoostBeta between 0.1 and 2.5



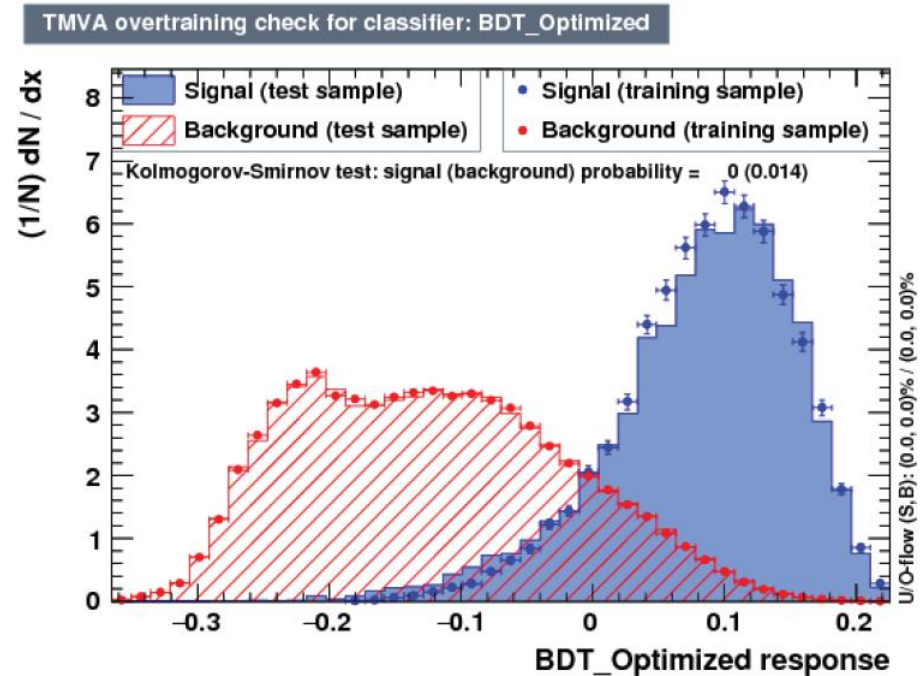
From these plots, we use AdaBoostBeta = 1.7.



# Result by optimized BDT in LHeC

We analyzed the signal and the backgrounds by optimized BDT.

Score >	$N_s$	$N_B$	Br[%]
0	5200	53661	8.99
0.05	4279	21662	6.93
<b>0.1</b>	<b>2662</b>	<b>5610</b>	<b>5.70</b>
0.15	955	782	6.07
0.2	44	23	26.8
0.25	0	0	-
0.3	0	0	-



Branching ratio calculated by  $S/\sqrt{S+B}$  :

$$Z = \frac{2662 \times \text{Br}(h \rightarrow \cancel{E}_T)}{\sqrt{2662 \times \text{Br}(h \rightarrow \cancel{E}_T) + 5610}} \quad \text{In the case of } 2\sigma \quad \Rightarrow \quad \text{Br}(h \rightarrow \cancel{E}_T) \sim \mathbf{5.70\%}$$

✱Default BDT: 5.84%

# Summary

- We optimized BDT using the 4 parameters.
- After the BDT optimization, the branching ratio became **5.70%** from **5.84%** at  $2\sigma$  level.