Update

8912000 signal MC events
One stream of generic MC

29/11/2024

eID and μID

Previous

```
# cuts on particles ID and IP
e_cut = 'eIDBelle > 0.6 and muIDBelle < 0.98 and atcPIDBelle(3,0) < 0.98 and d0 < 1 and abs(z0) < 4 and p > 0.05'
mu_cut = 'muIDBelle > 0.6 and eIDBelle < 0.98 and atcPIDBelle(3,1) < 0.98 and d0 < 1 and abs(z0) < 4 and p > 0.05'
pi_cut = 'atcPIDBelle(3,2) < 0.6 and d0 < 1 and abs(z0) < 4 and p > 0.05 and muIDBelle < 0.98 and eIDBelle < 0.98'
K_cut = 'atcPIDBelle(3,2) > 0.6 and muIDBelle < 0.98 and eIDBelle < 0.98 and d0 < 1 and abs(z0) < 4 and p > 0.05'
p_cut = 'atcPIDBelle(4,2) > 0.6 and atcPIDBelle(4,3) > 0.6 and muIDBelle < 0.98 and eIDBelle < 0.98 and d0 < 1 and abs(z0) < 4 and p > 0.05'
```

Current

```
# cuts on particles ID and IP
e_cut = 'eIDBelle > 0.6 and muIDBelle < 0.98 and atcPIDBelle(3,0) < 0.98 and d0 < 1 and abs(z0) < 4 and p > 0.05'
mu_cut = 'muIDBelle > 0.6 and eIDBelle < 0.98 and atcPIDBelle(3,1) < 0.98 and d0 < 1 and abs(z0) < 4 and p > 0.05'
pi_cut = 'atcPIDBelle(3,2) < 0.6 and d0 < 1 and abs(z0) < 4 and p > 0.05 and muIDBelle < 0.6 and eIDBelle < 0.6'
K_cut = 'atcPIDBelle(3,2) > 0.6 and muIDBelle < 0.98 and eIDBelle < 0.98 and d0 < 1 and abs(z0) < 4 and p > 0.05'
p_cut = 'atcPIDBelle(4,2) > 0.6 and atcPIDBelle(4,3) > 0.6 and muIDBelle < 0.98 and eIDBelle < 0.98 and d0 < 1 and abs(z0) < 4 and p > 0.05'
```

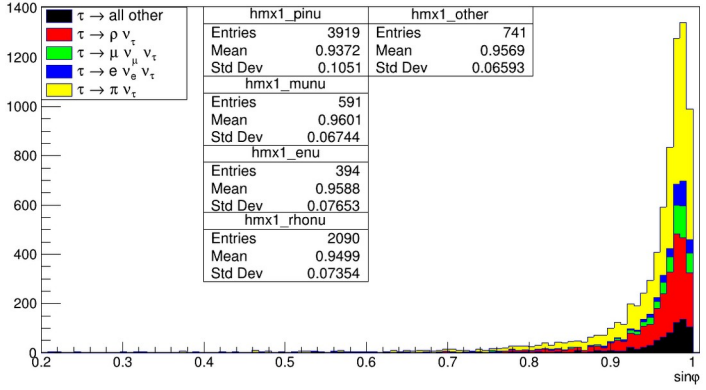
LeptonID < 0.98, 5 M sample

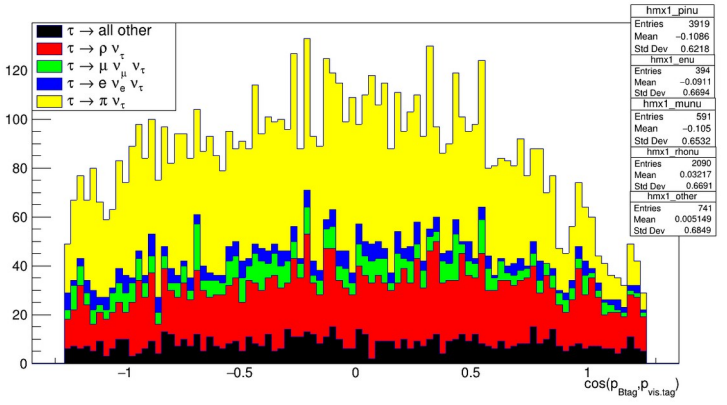
N_{pi}	2330	1
N_{e}	301	**0.13**
N_{mu}	497	**0.21**
N_{rho}	1230	0.53
N_{others}	401	0.17

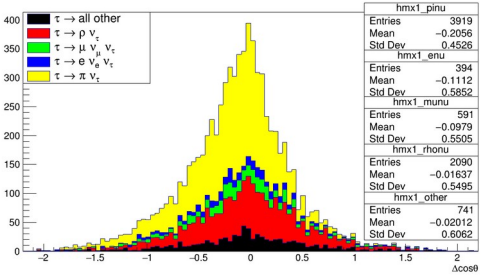
LeptonID < 0.6, 8.912 M sample

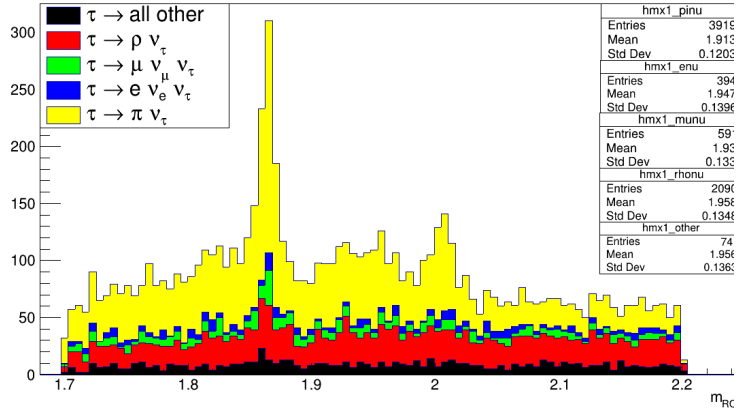
N_{pi}	3919	1
N_{e}	394	**0.10**
N_{mu}	591	**0.15**
N_{rho}	2090	0.53
N_{others}	741	0.18

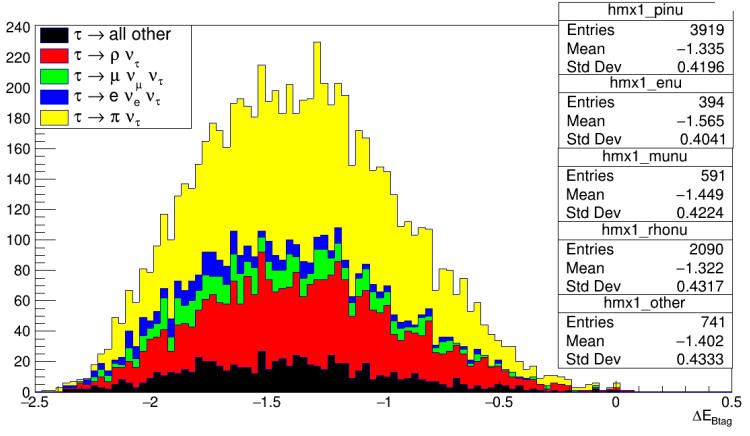
Basic distributions





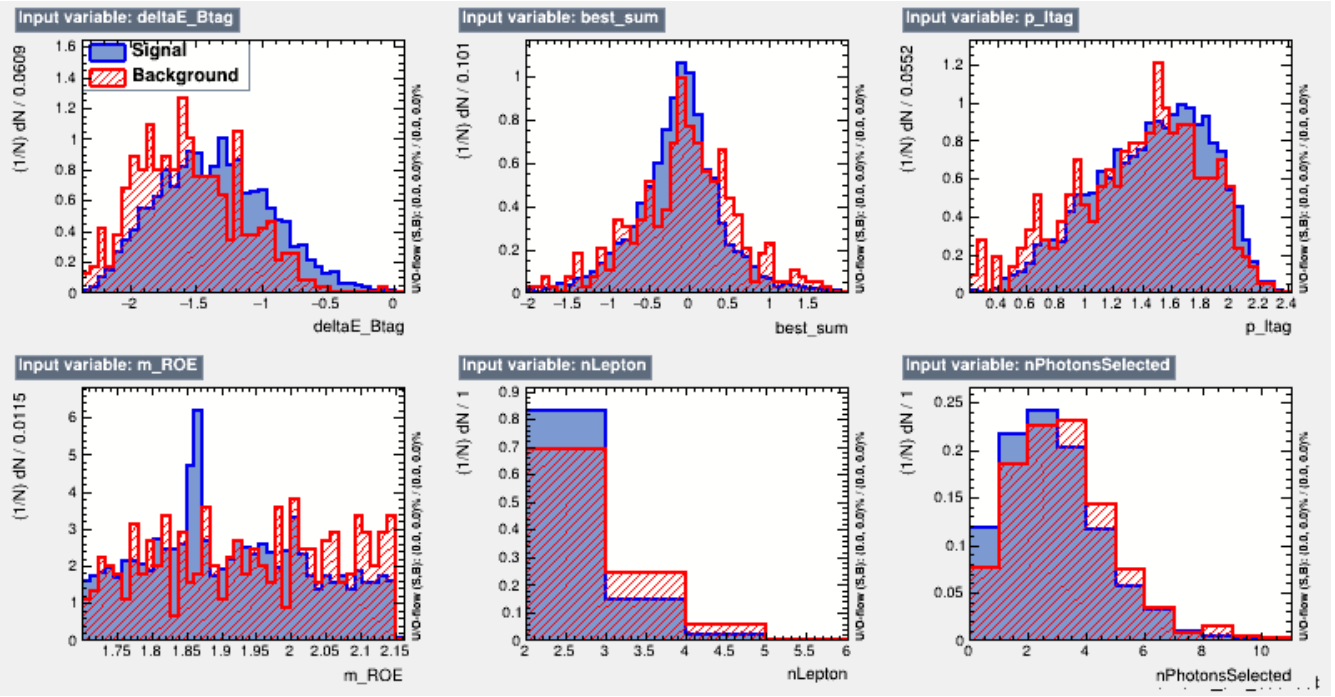






BDT

- BDT training, testing and application is done on the same (8.912M signal) sample.

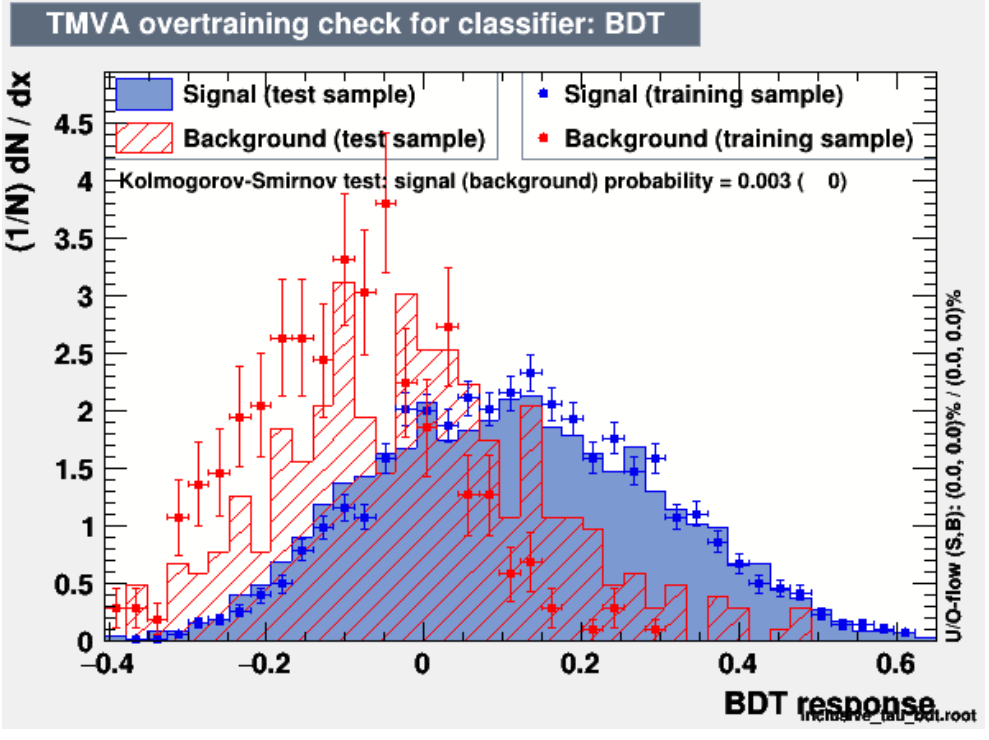


Variable importance

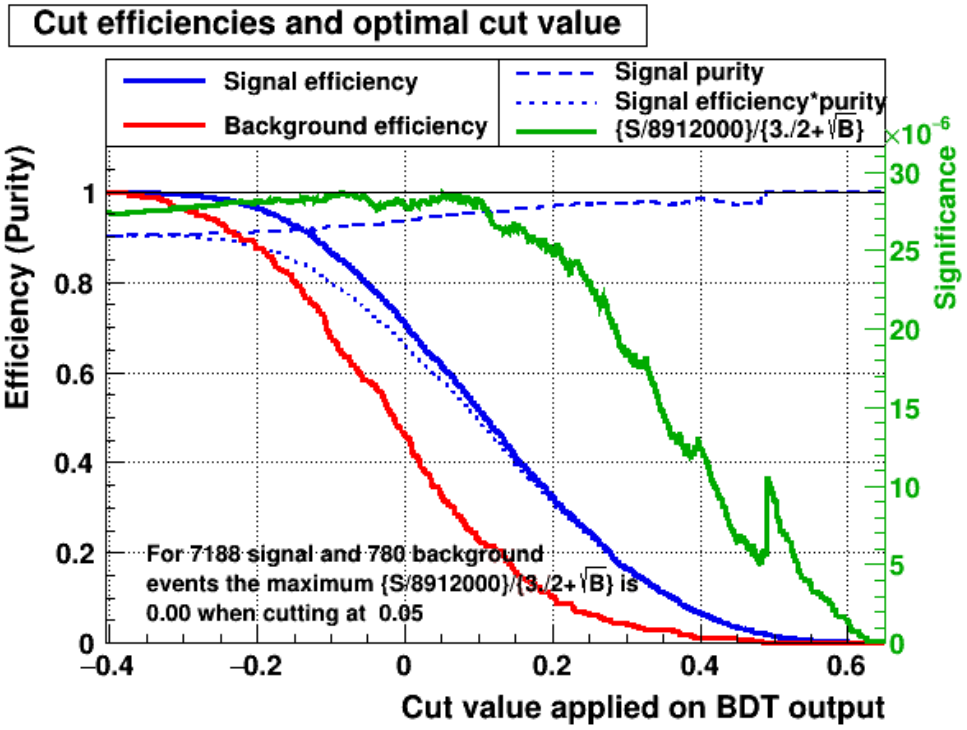
```
Ranking result (top variable is best ranked)
-----------------------------------------------
Rank : Variable          : Variable Importance
-----------------------------------------------
   1 : deltaE_Btag       : 2.412e-01
   2 : m_ROE             : 2.122e-01
   3 : p_ltag            : 1.953e-01
   4 : best_sum          : 1.700e-01
   5 : nPhotonsSelected  : 1.164e-01
   6 : nLepton           : 6.488e-02
```

BDT performance

- For the background, probably need to use more streams of MC.



Ponzi FOM

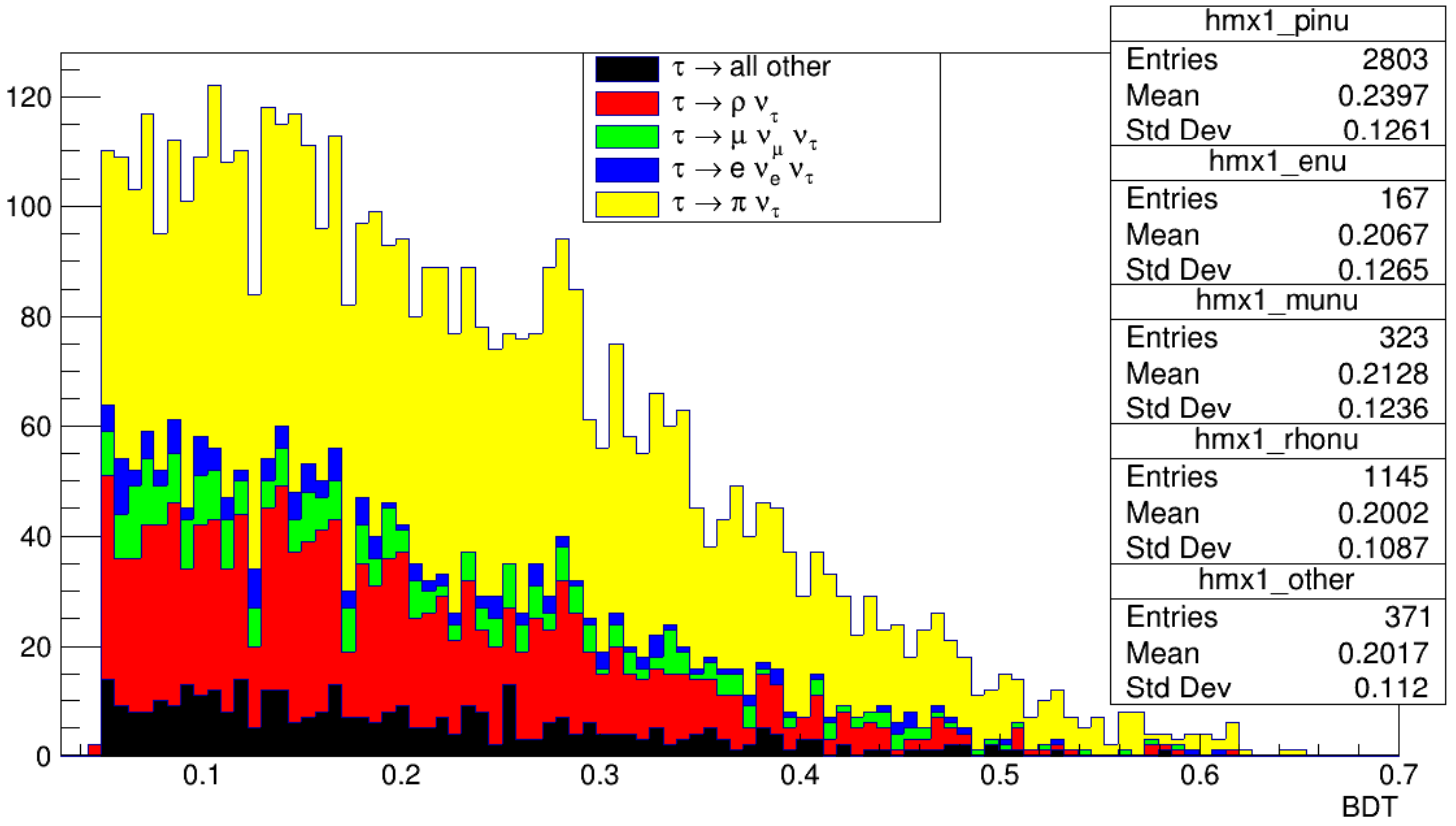


BDT > 0.05

Classifier	(#signal, #backgr.)	Optimal-cut	(S/8912000)/(3./2+sqrt(B))	NSig	NBkg	EffSig	EffBkg
BDT:	(7188, 780)	0.0535	2.87329e-05	4384	244	0.6099	0.3128
BDTG:	(7188, 780)	-0.2283	2.77114e-05	6460	608	0.8987	0.7795
Fisher:	(7188, 780)	-0.0840	2.92748e-05	5570	394	0.7749	0.5051
MLP:	(7188, 780)	0.5450	3.12446e-05	4316	196	0.6004	0.2513

BDT application

Corresponding to BF of 5 x10^{-5}, the total number of expected signal events are 31 and for only pi mode the total number of expected signal events are 12.

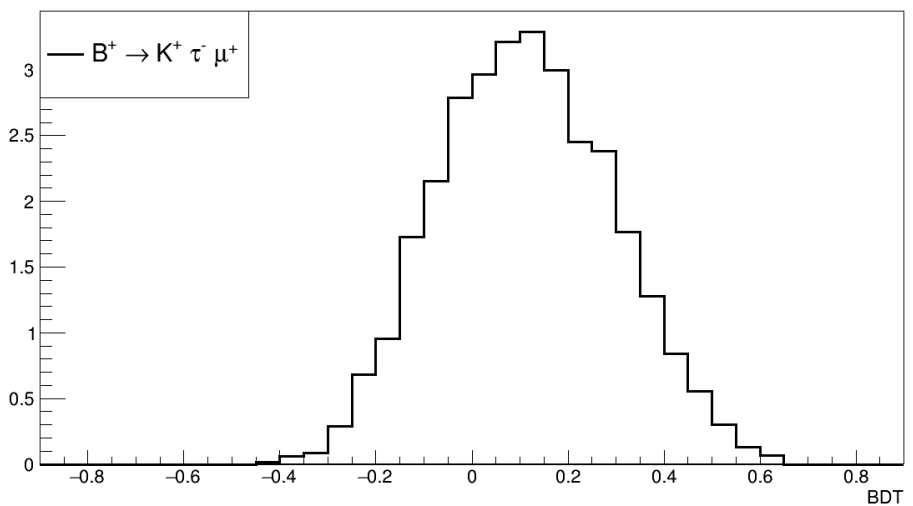


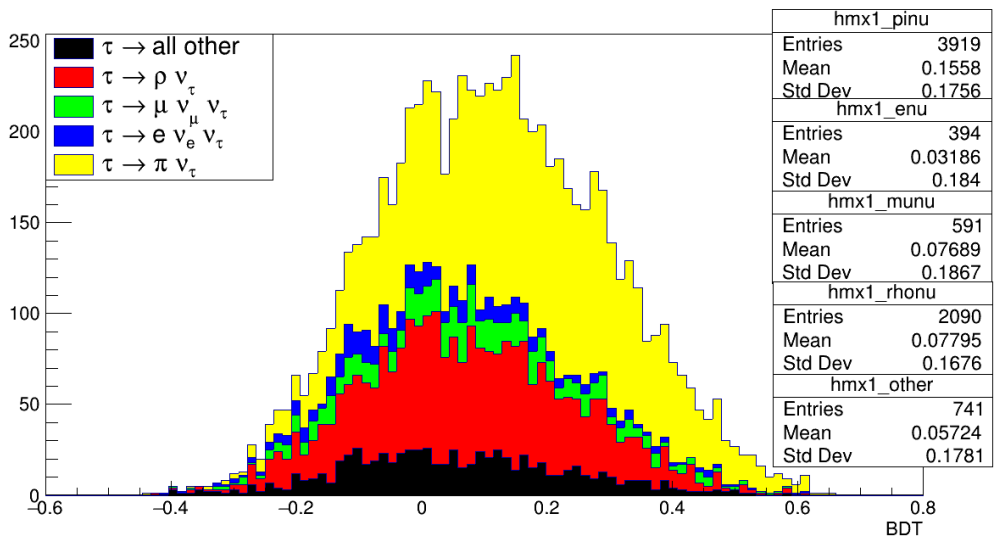
Back up

Basic distributions cont.

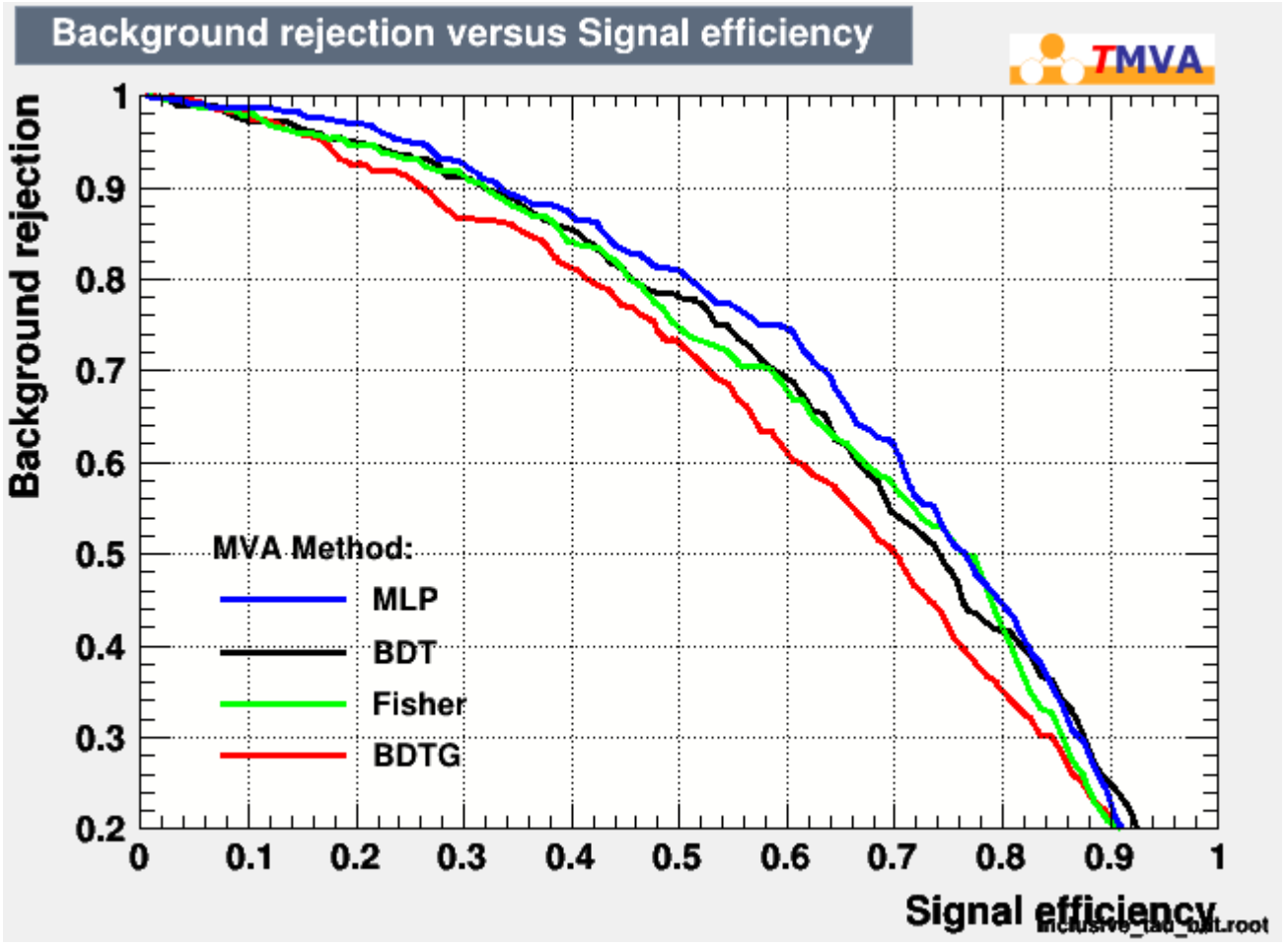
```
--- ==========================================================================================
--- Classifier   (  #signal, #backgr.)  Optimal-cut  S/sqrt(S+B)      NSig      NBkg    EffSig    EffBkg
--- ------------------------------------------------------------------------------------------
---         BDT:  (     7188,      780)      -0.4048      80.5255      7188       780         1         1
---        BDTG:  (     7188,      780)      -0.9514      80.5255      7188       780         1         1
---      Fisher:  (     7188,      780)      -0.6682      80.5255      7188       780         1         1
---         MLP:  (     7188,      780)       0.0422      80.5255      7188       780         1         1
--- ------------------------------------------------------------------------------------------
```

Normalized to N_{sig} = 31 or BF of 5×10^{-5}





BDT plots


Background rejection versus Signal efficiency
TMVA
Background rejection
Signal efficiency
MVA Method:
MLP
BDT
Fisher
BDTG
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1