TMVA update

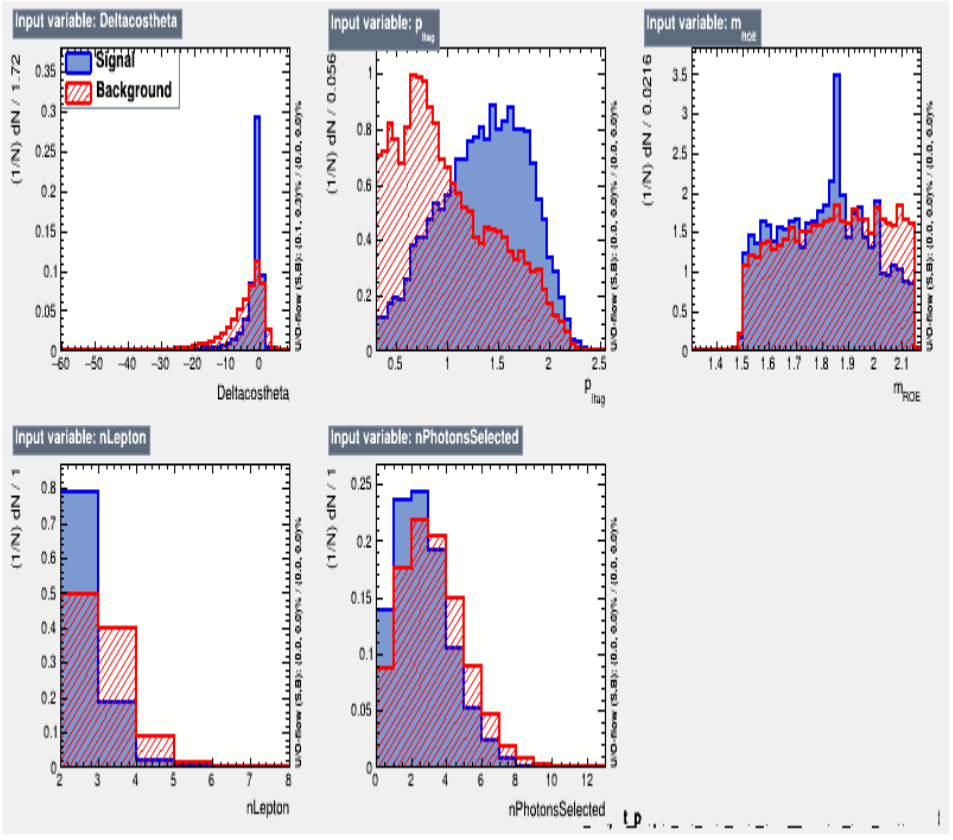
Δcosθ usage in BDT training

1- without true matching
2- with true matching

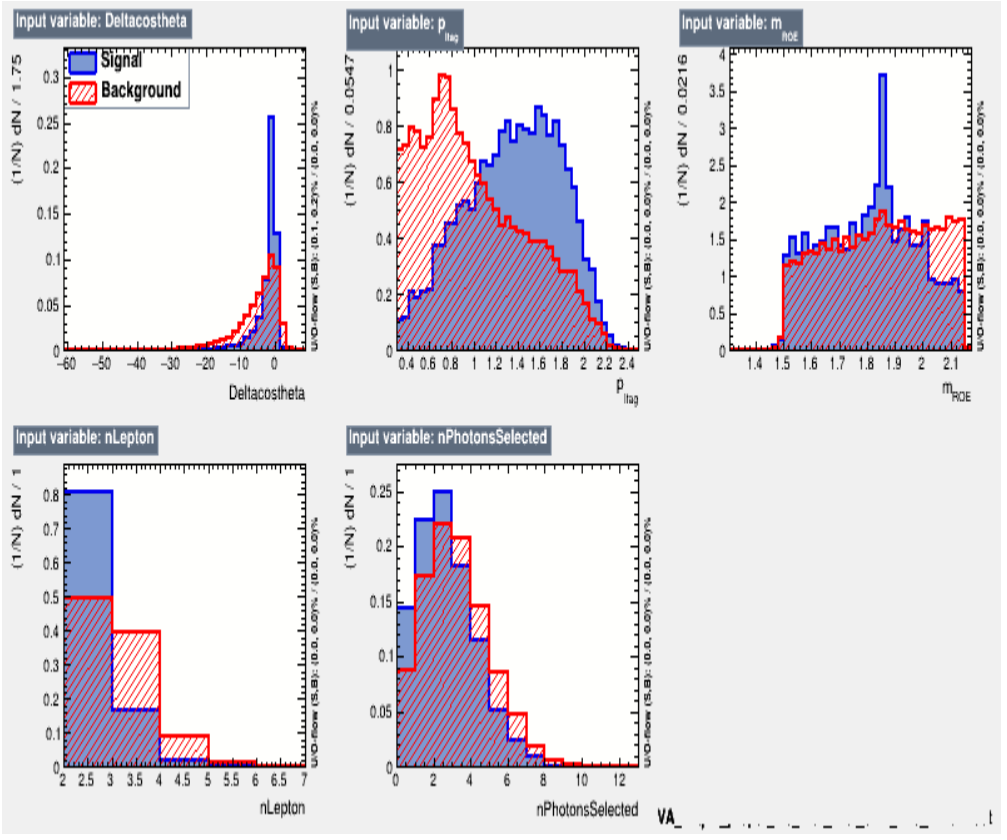
17/09/2024

Input variables

Without true match



With true match



Variables importance

Without true match

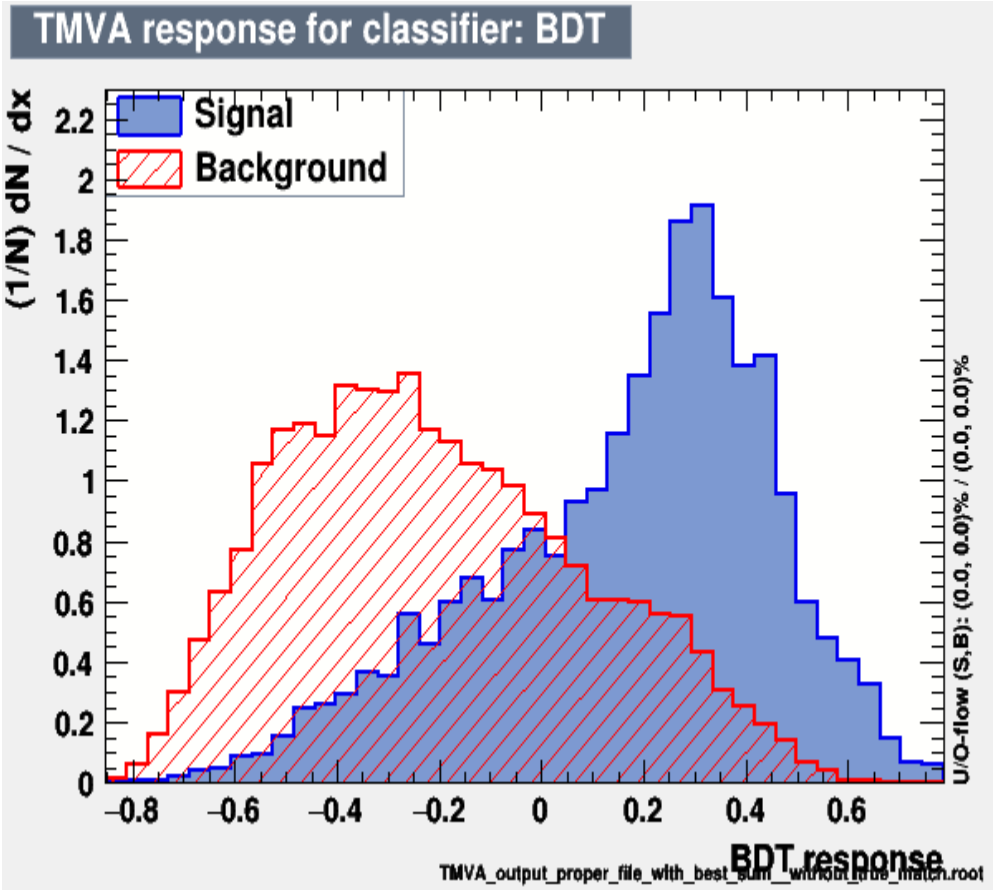
```
BDT                    : Ranking result (top variable is best ranked)
                       : ----------------------------------------------
                       : Rank : Variable         : Variable Importance
                       : ----------------------------------------------
                       :    1 : p_{ltag}         : 3.041e-01
                       :    2 : Deltacostheta    : 2.179e-01
                       :    3 : m_{ROE}          : 1.744e-01
                       :    4 : nLepton          : 1.709e-01
                       :    5 : nPhotonsSelected : 1.327e-01
                       : ----------------------------------------------
```

With true match

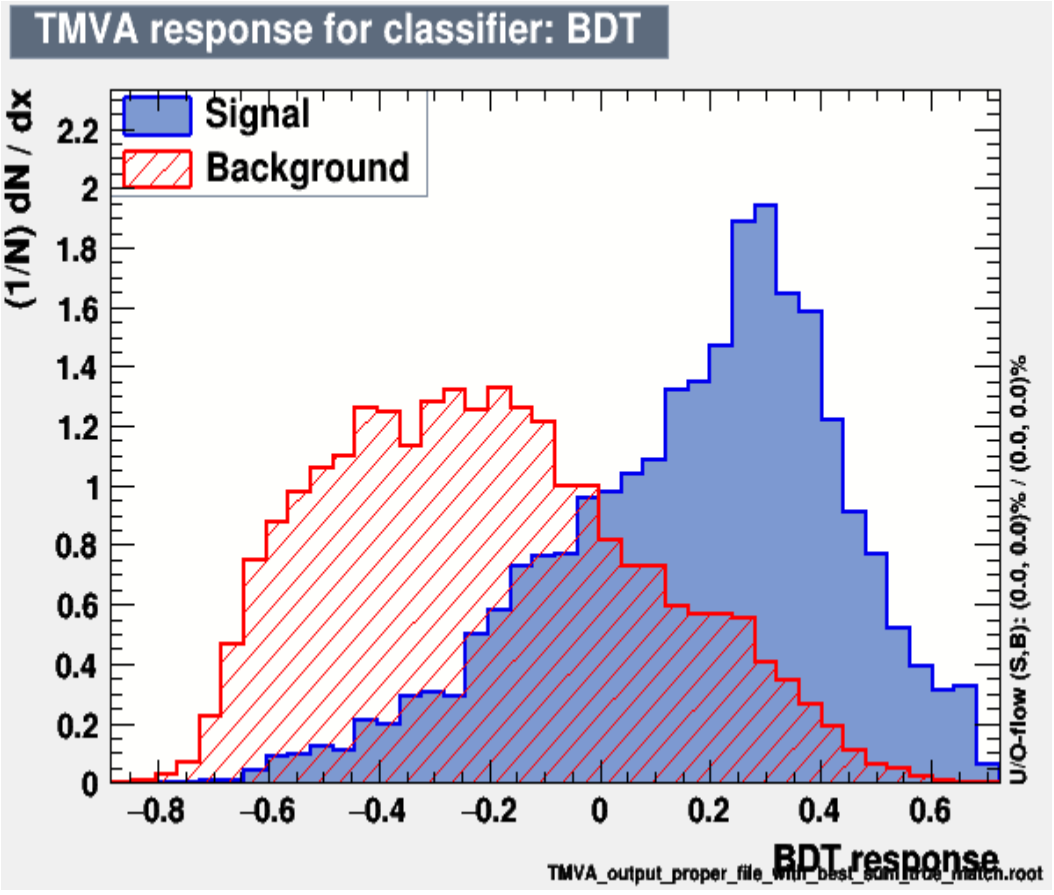
```
BDT                    : Ranking result (top variable is best ranked)
                       : ----------------------------------------------
                       : Rank : Variable         : Variable Importance
                       : ----------------------------------------------
                       :    1 : p_{ltag}         : 2.776e-01
                       :    2 : Deltacostheta    : 2.772e-01
                       :    3 : m_{ROE}          : 1.731e-01
                       :    4 : nLepton          : 1.548e-01
                       :    5 : nPhotonsSelected : 1.172e-01
                       : ----------------------------------------------
```

BDT response

Without true match

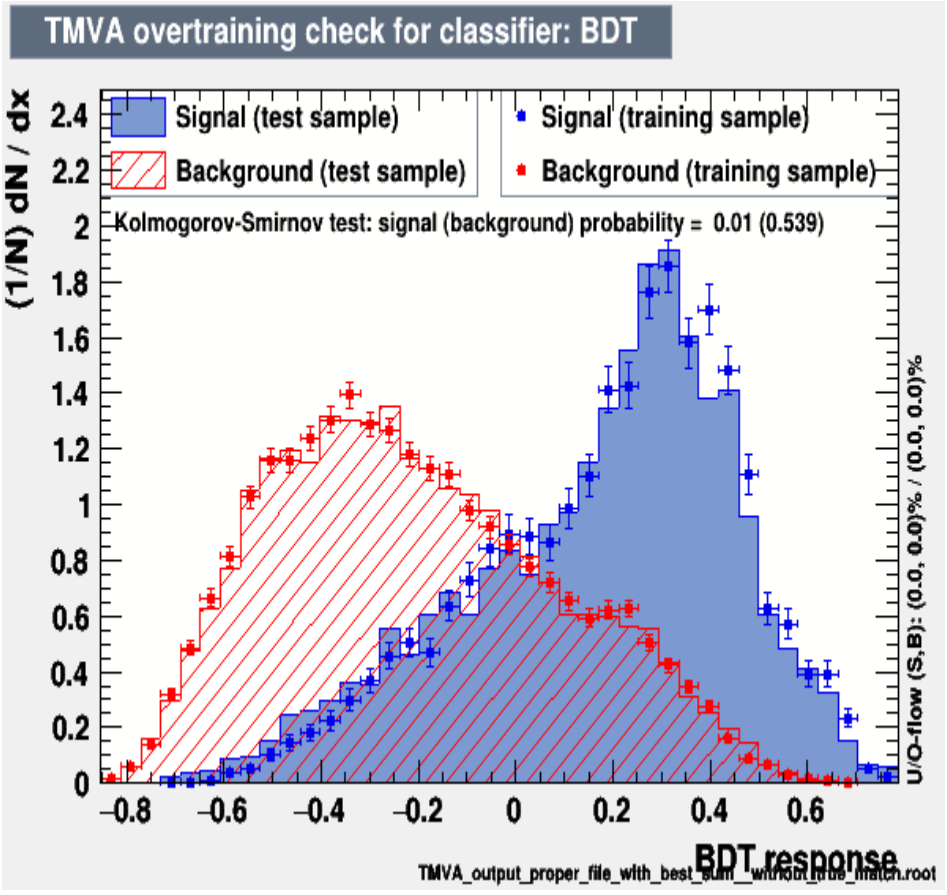


With true match



BDT response

Without true match



With true match

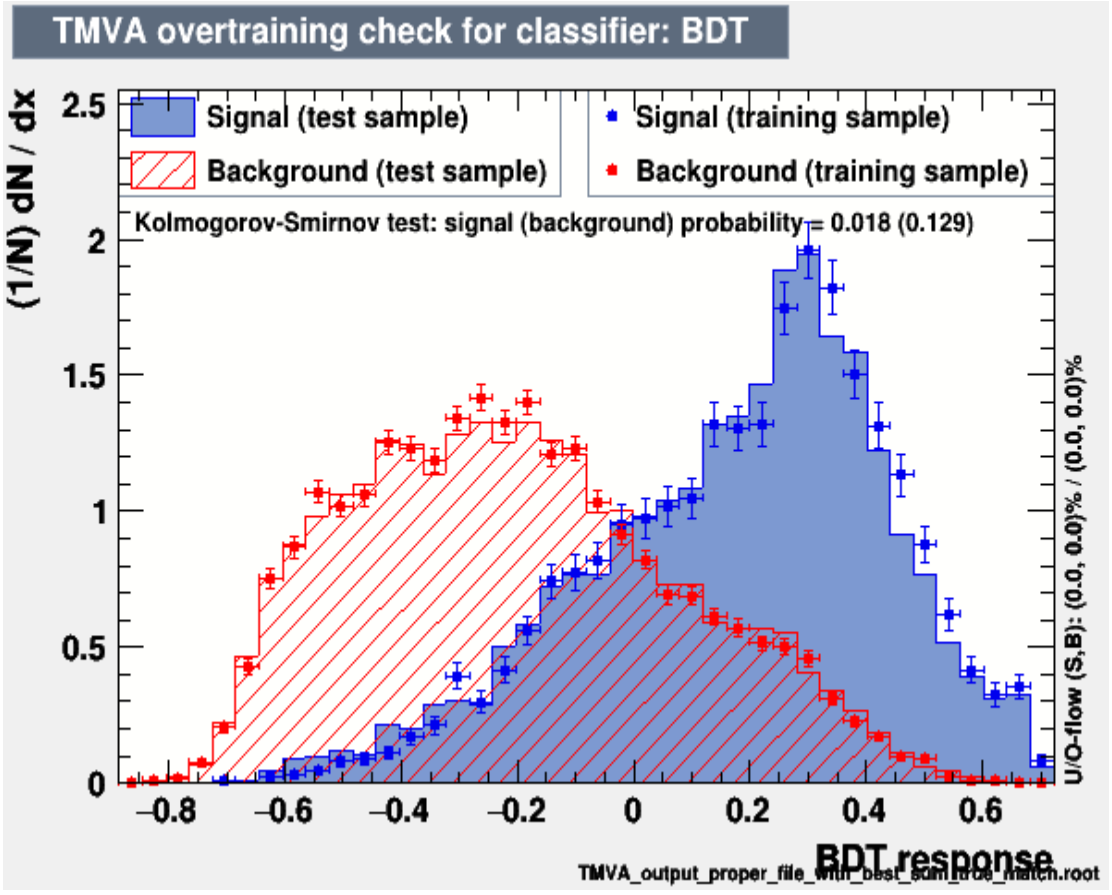
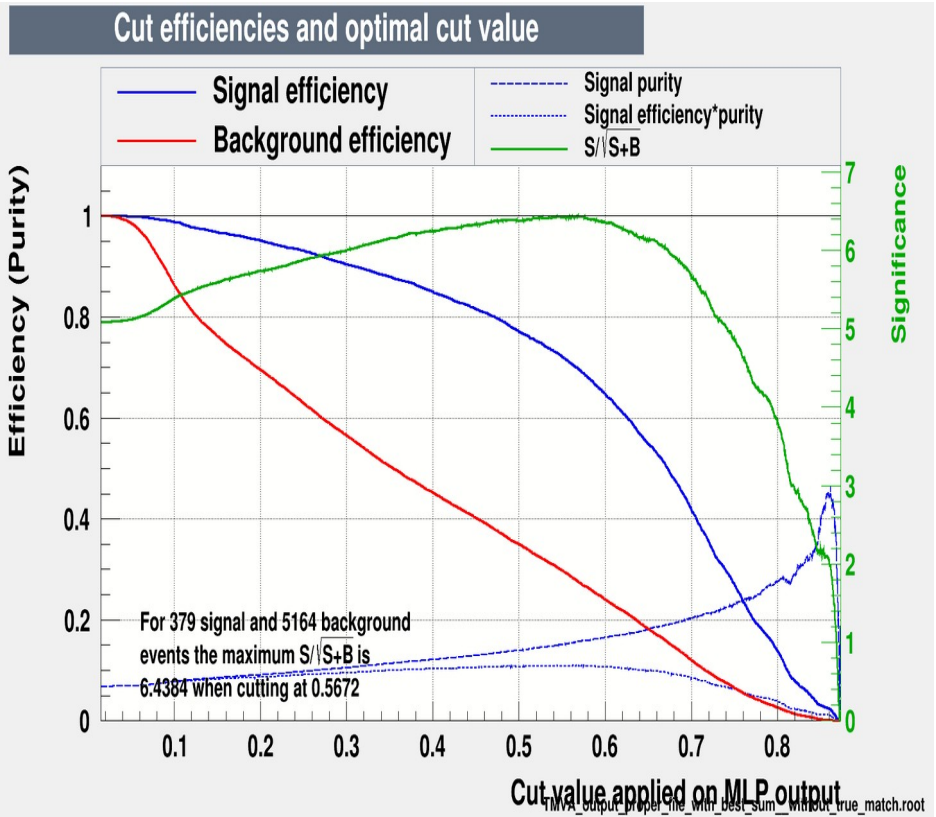
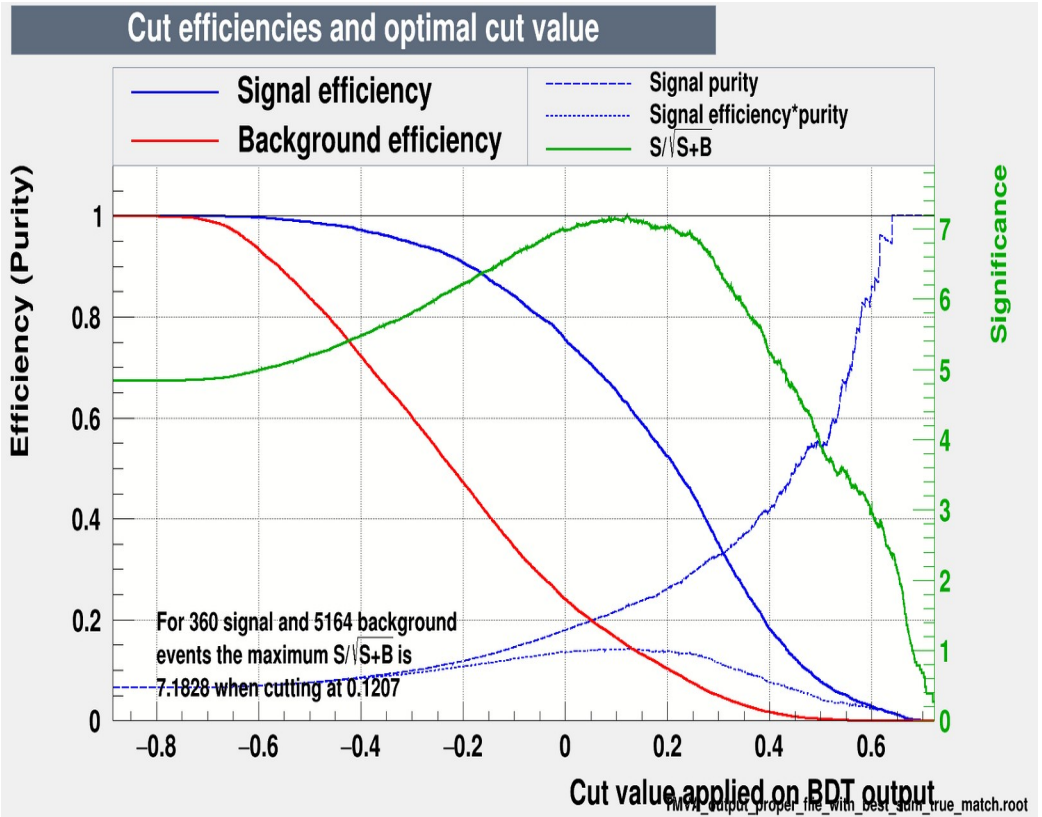


Figure of merit

Without true match



With true match

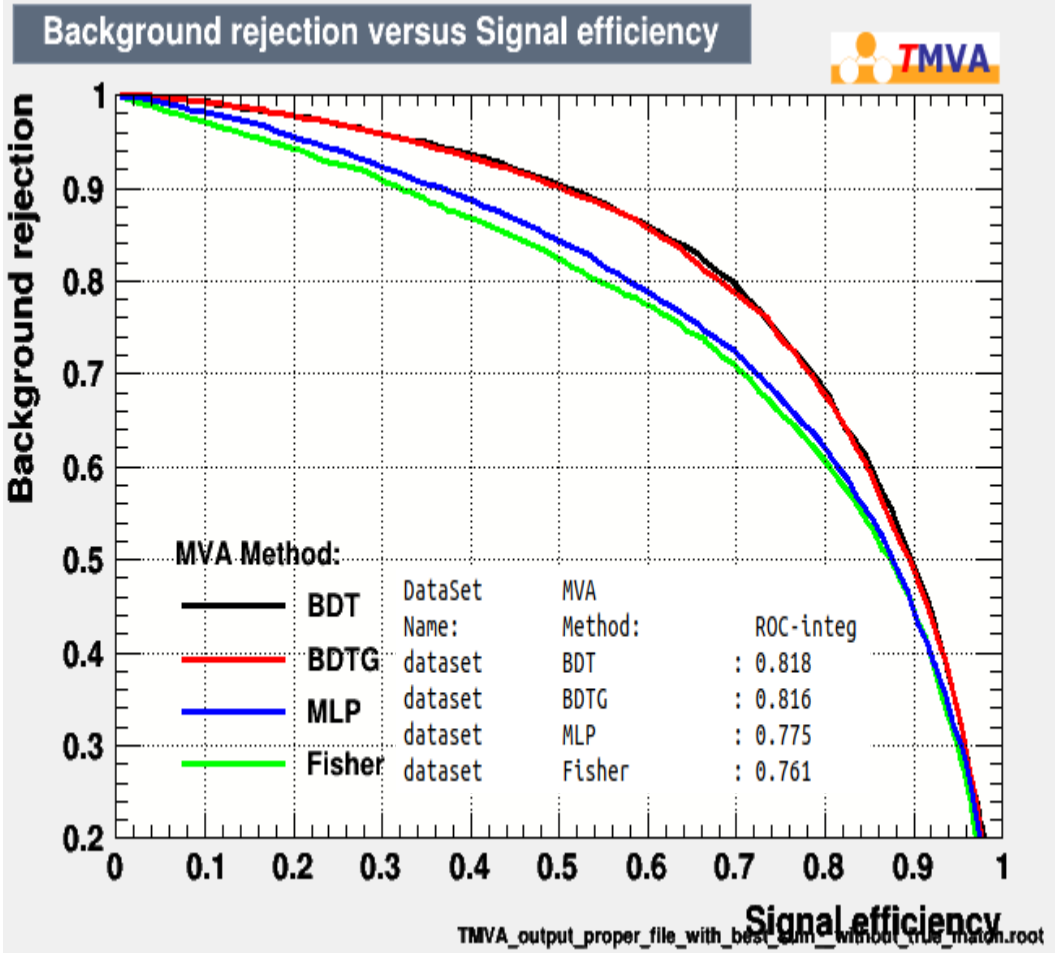


True match: For BF of 5×10^{-5}, we are expecting 360 signal events.

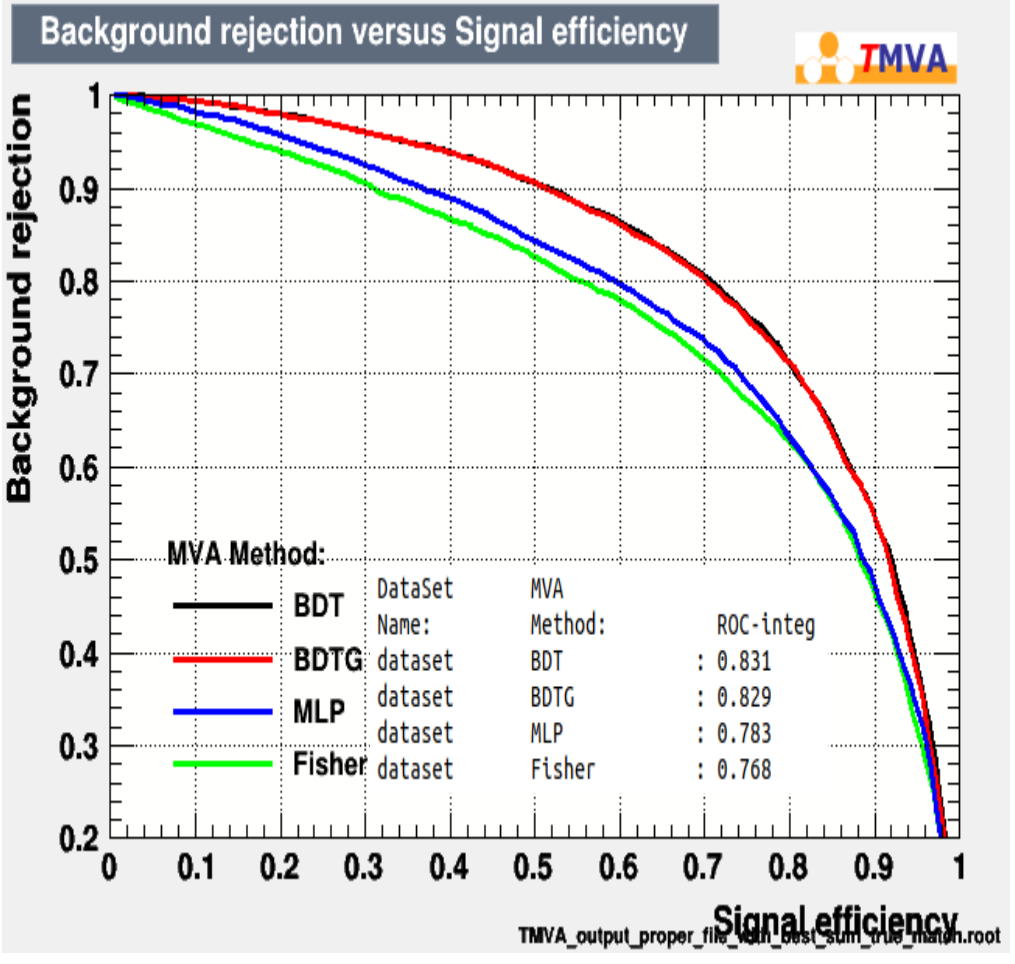
Without true match: For BF of 5×10^{-5}, we are expecting 379 signal events.

ROC

Without true match

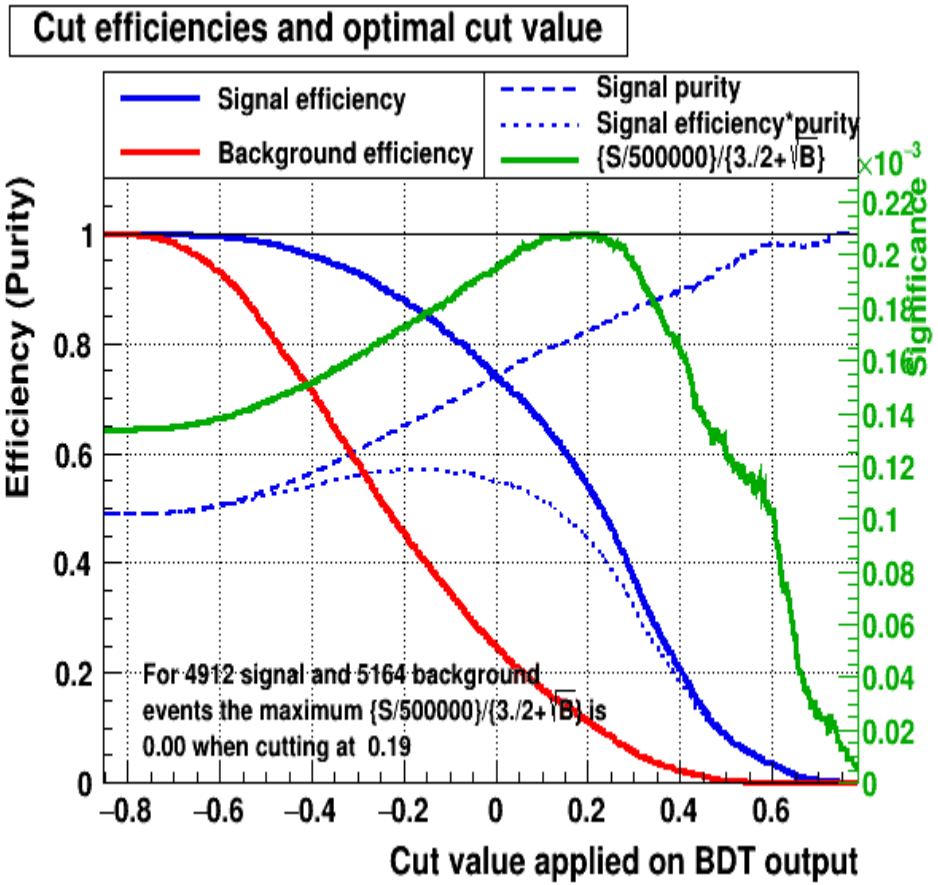


With true match

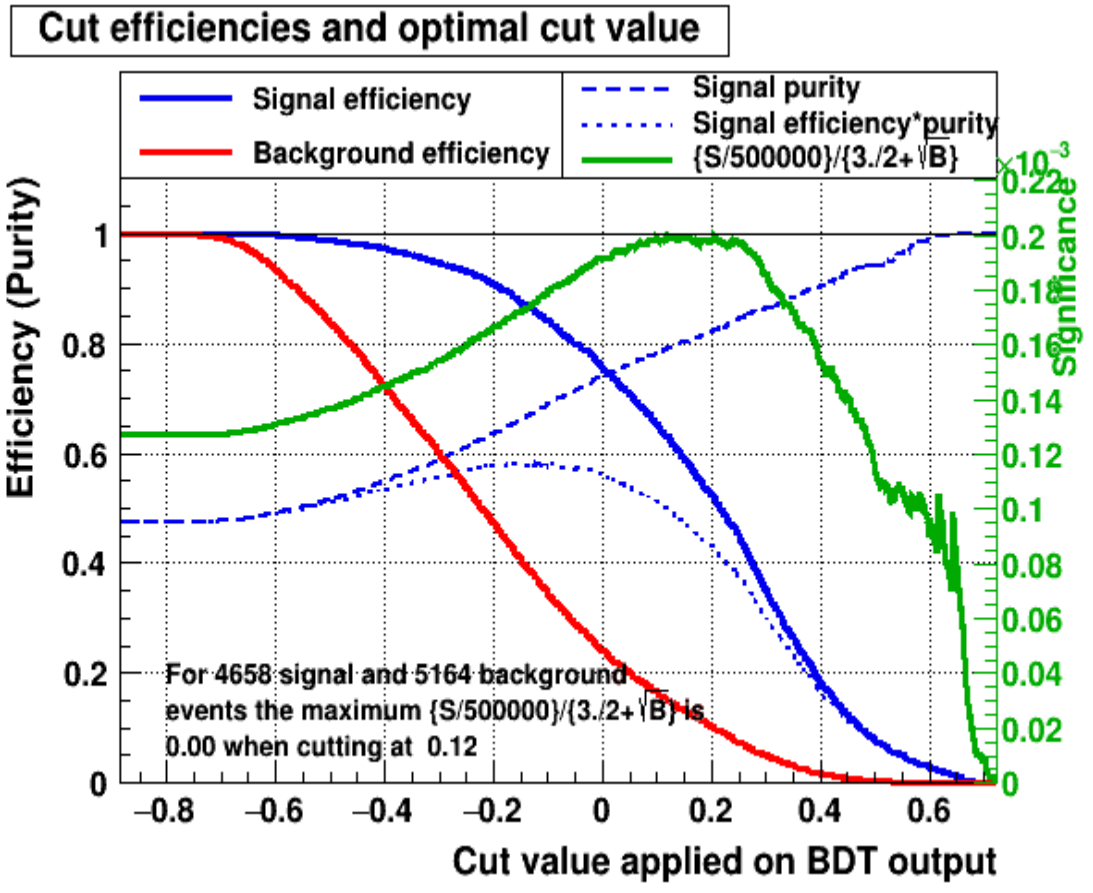


Punzi FOM

Without true match



With true match



Back up

FOM efficiencies

Without true match

```
-- ============================================================================================
-- Classifier   (  #signal, #backgr.)  Optimal-cut  S/sqrt(S+B)      NSig      NBkg   EffSig   EffBkg
-- --------------------------------------------------------------------------------------------
--        BDT:  (      379,     5164)       0.1251      7.40455  239.5755  807.2812   0.6321   0.1563
--       BDTG:  (      379,     5164)       0.3230      7.37374  222.6779  689.2888   0.5875   0.1335
--     Fisher:  (      379,     5164)       0.0230      6.30845  271.7504  1583.898    0.717   0.3067
--        MLP:  (      379,     5164)       0.5672      6.43844  265.2691  1432.241   0.6999   0.2774
-- --------------------------------------------------------------------------------------------
```

With true match

```
Classifier   (  #signal, #backgr.)  Optimal-cut  S/sqrt(S+B)      NSig      NBkg   EffSig   EffBkg
--------------------------------------------------------------------------------------------
       BDT:  (      360,     5164)       0.1207      7.18283  227.0674  772.2835   0.6307   0.1496
      BDTG:  (      360,     5164)       0.2400      7.11284  232.8639  838.9458   0.6468   0.1625
    Fisher:  (      360,     5164)      -0.0107      6.13376  278.0764  1777.219   0.7724   0.3442
       MLP:  (      360,     5164)       0.5554      6.28696  258.2911  1429.574   0.7175   0.2768
--------------------------------------------------------------------------------------------

--------------------------------------------------------------------------------------------
```

Punzi FOM efficiencies

Without true match

Classifier	(#signal, #backgr.)	Optimal-cut	(S/500000)/(3./2+sqrt(B))	NSig	NBkg	EffSig	EffBkg
BDT:	(4912, 5164)	0.1863	0.000208144	2746	619.2934	0.559	0.1199
BDTG:	(4912, 5164)	0.3243	0.000207988	2881	686.6223	0.5865	0.133
Fisher:	(4912, 5164)	0.0308	0.00017061	3474	1538.567	0.7072	0.2979
MLP:	(4912, 5164)	0.5737	0.000174788	3392	1392.243	0.6906	0.2696

With true match

Classifier	(#signal, #backgr.)	Optimal-cut	(S/500000)/(3./2+sqrt(B))	NSig	NBkg	EffSig	EffBkg
BDT:	(4658, 5164)	0.1207	0.000200615	2938	772.2835	0.6307	0.1496
BDTG:	(4658, 5164)	0.3293	0.000198544	2759	691.2887	0.5923	0.1339
Fisher:	(4658, 5164)	-0.0107	0.00016483	3598	1777.219	0.7724	0.3442
MLP:	(4658, 5164)	0.5554	0.000170034	3342	1429.574	0.7175	0.2768