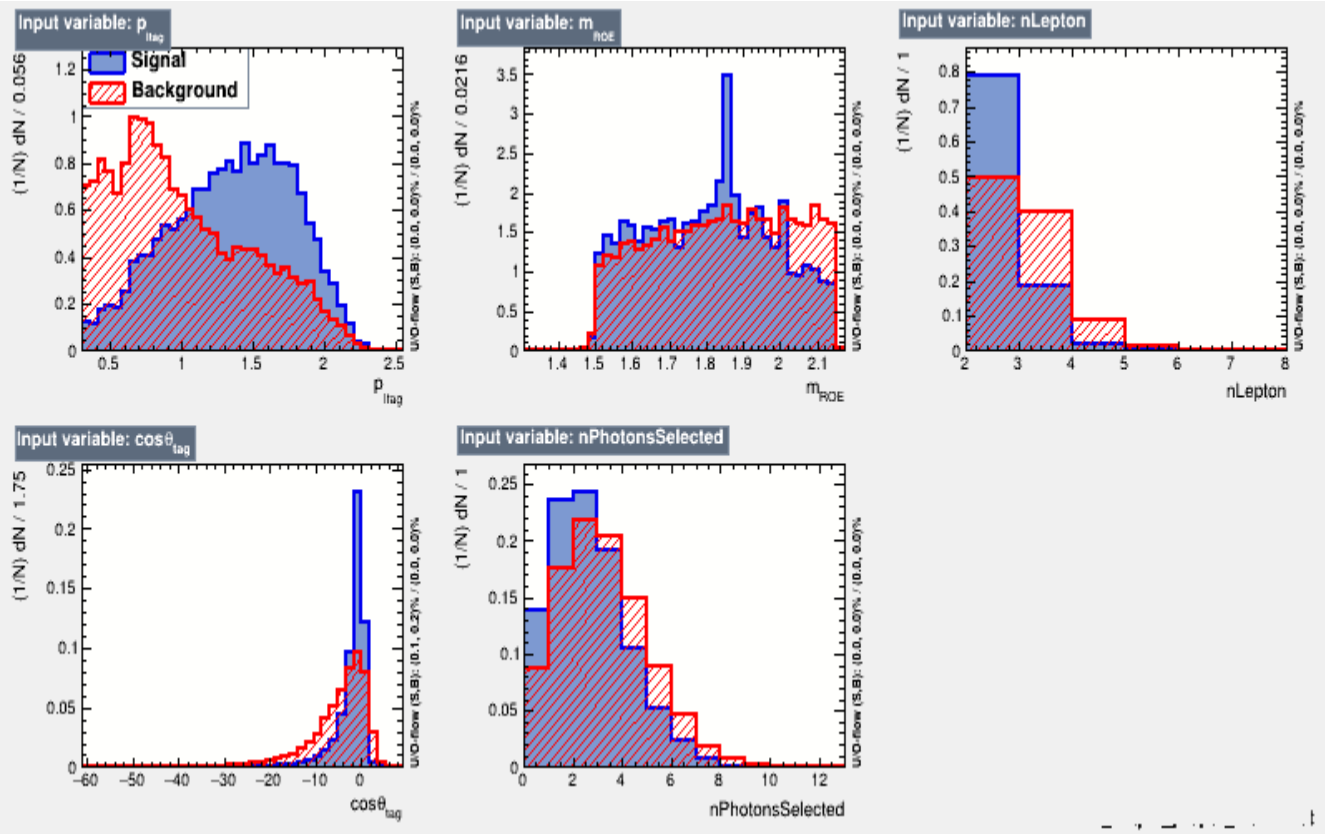
TMVA update

i) BDT response cuts to check the Δcosθ shape.
ii) Δcosθ usage in BDT training & further checks.

16/09/2024

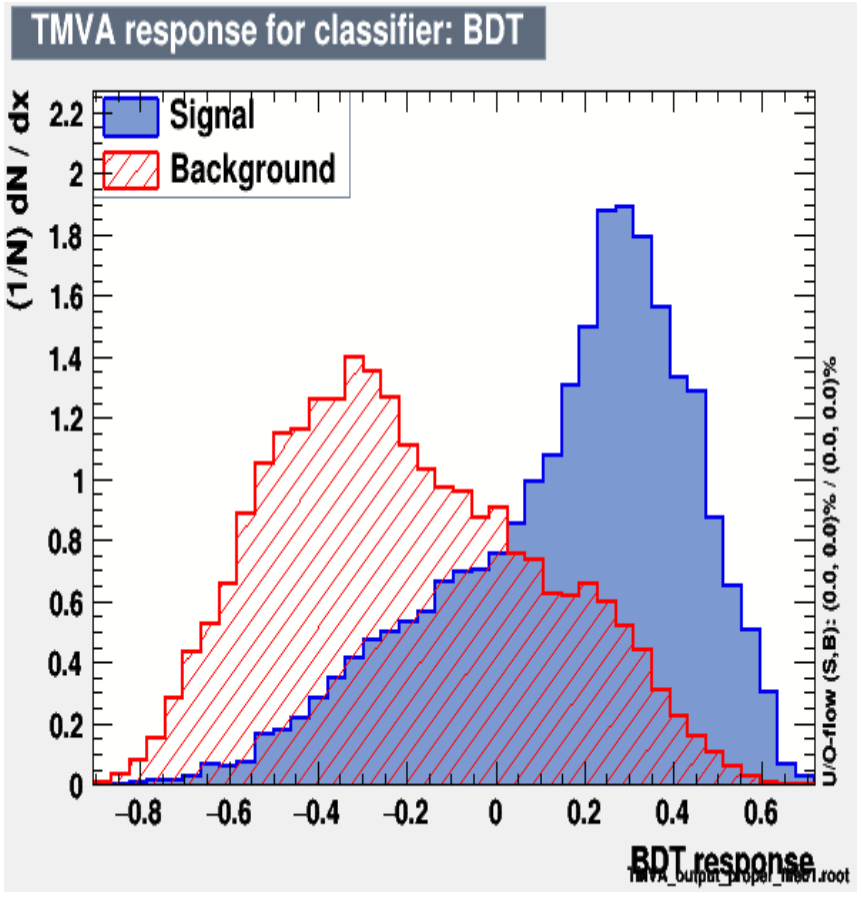
Input variables



Candidates of all ranks are included.

```
: Ranking result (top variable is best ranked)
: ----------------------------------------------------
: Rank : Variable         : Variable Importance
: ----------------------------------------------------
:    1 : p_{ltag}         : 3.040e-01
:    2 : cos#theta_{tag}  : 2.092e-01
:    3 : nLepton          : 1.881e-01
:    4 : m_{ROE}          : 1.713e-01
:    5 : nPhotonsSelected : 1.275e-01
```

BDT response



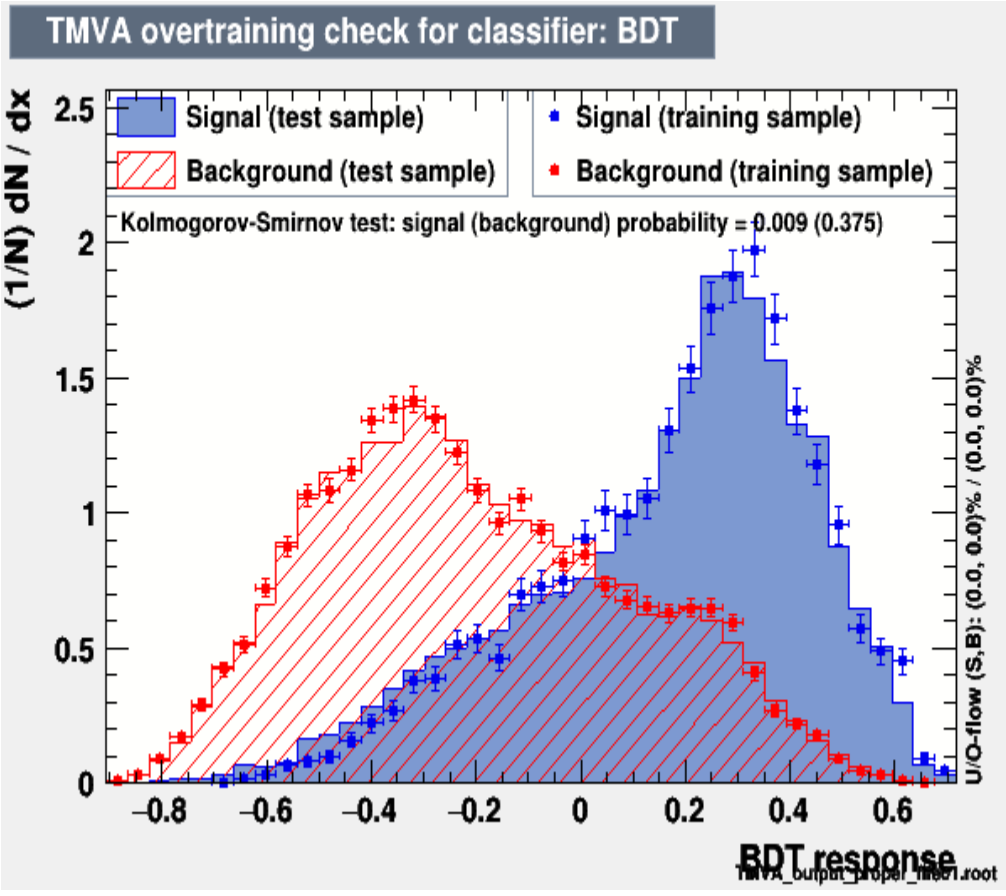
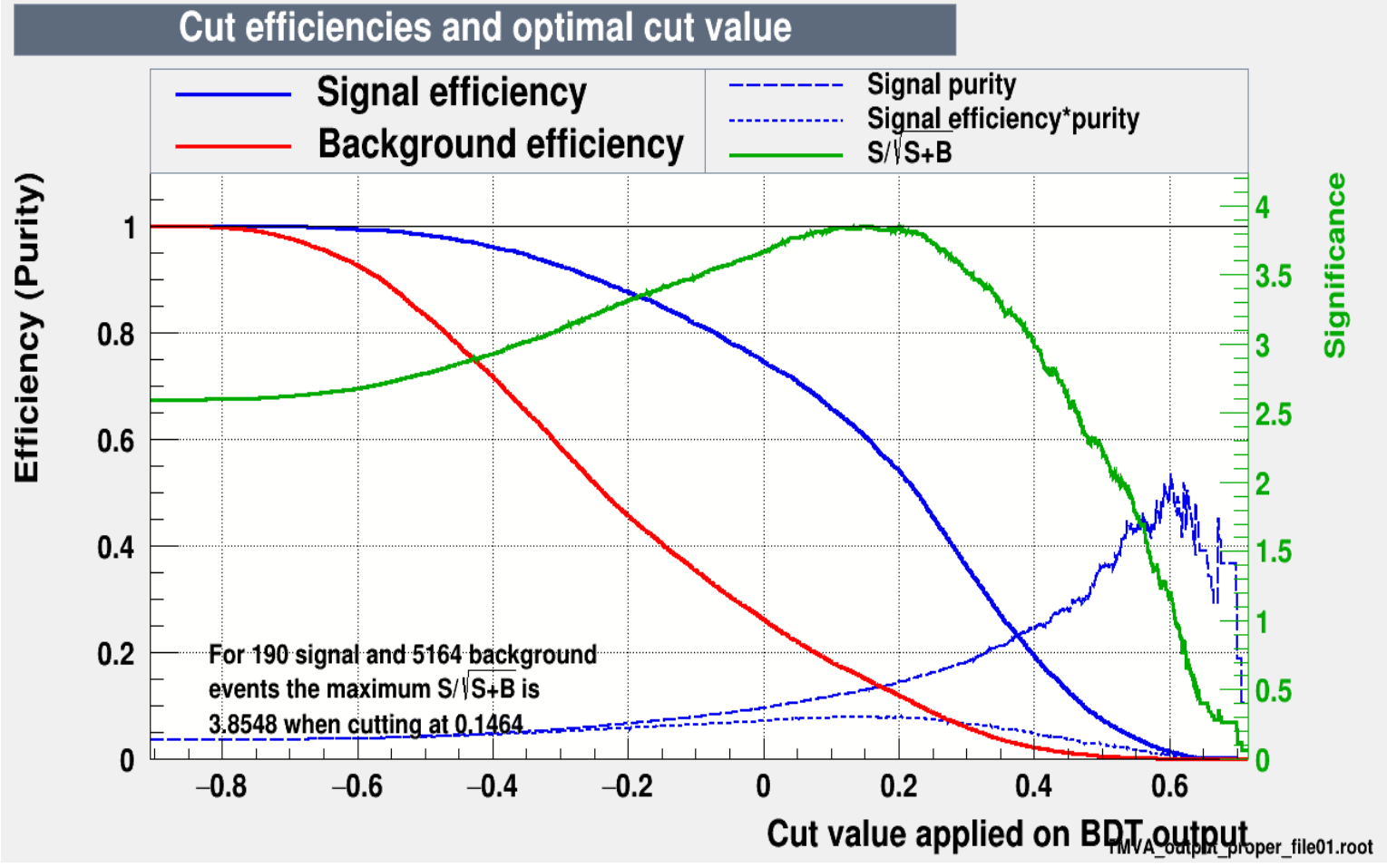
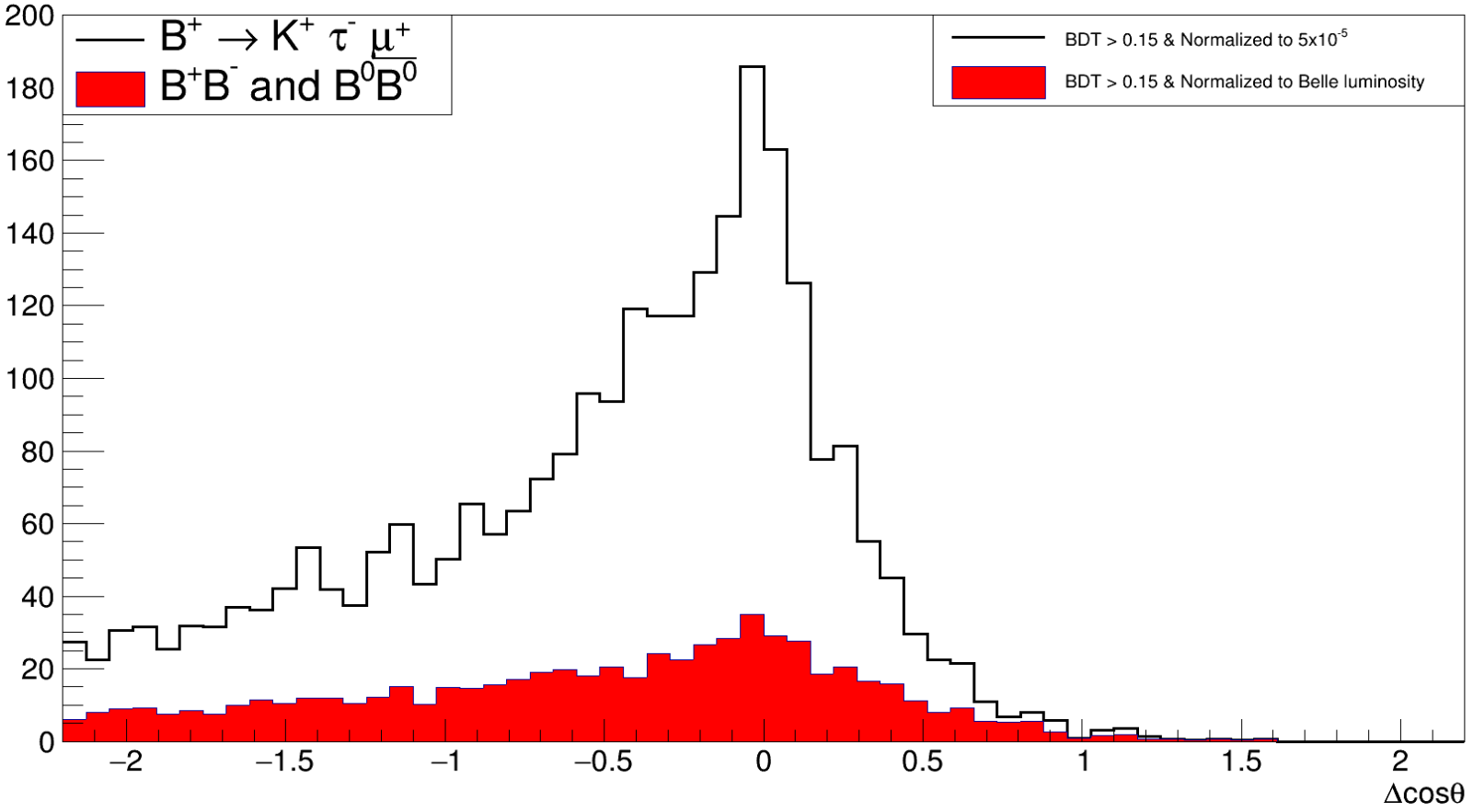


Figure of merit

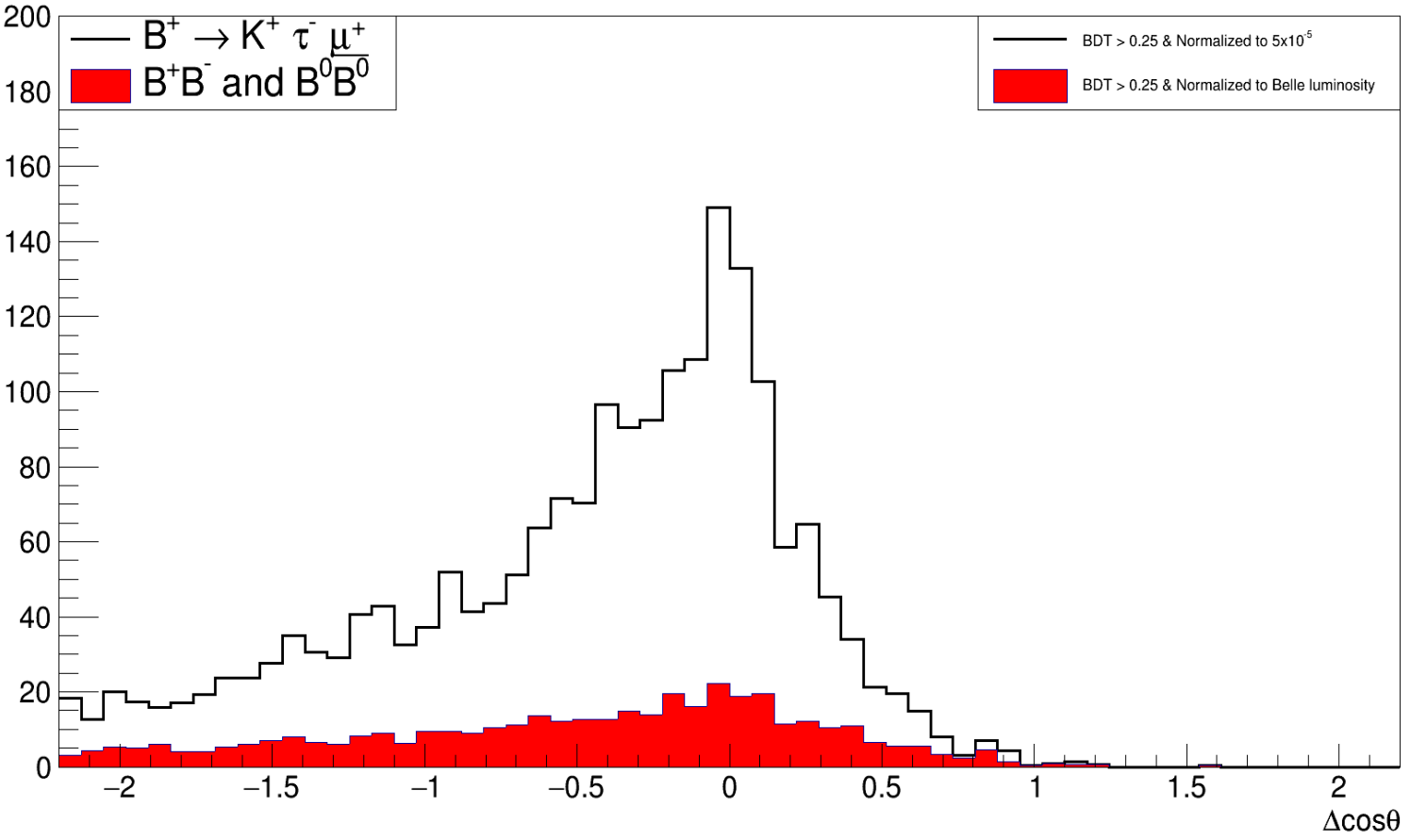


For BF of 5×10^{-5} and our corresponding efficiency, we are expecting 190 signal events.

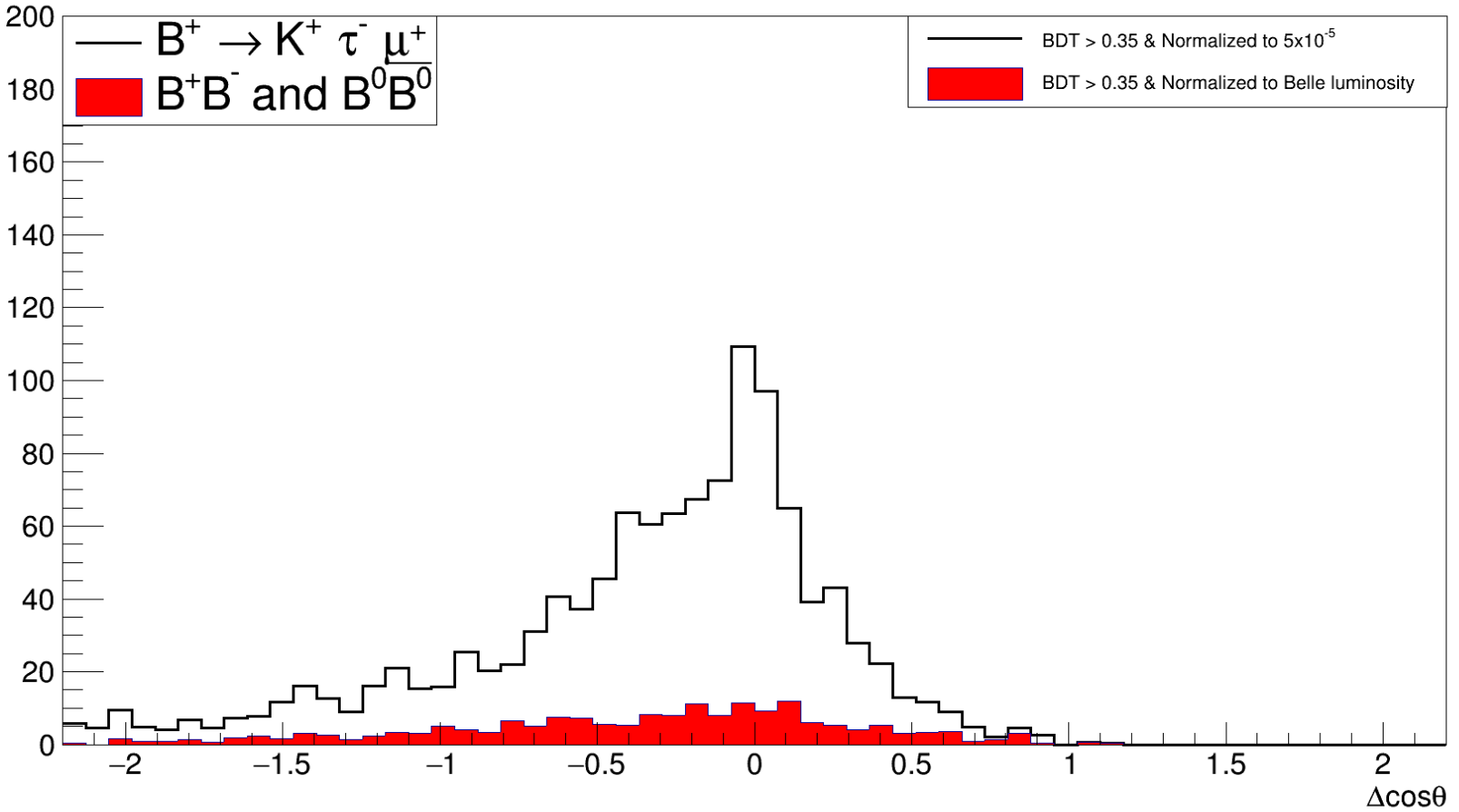
Δcosθ with BDT score > 0.15



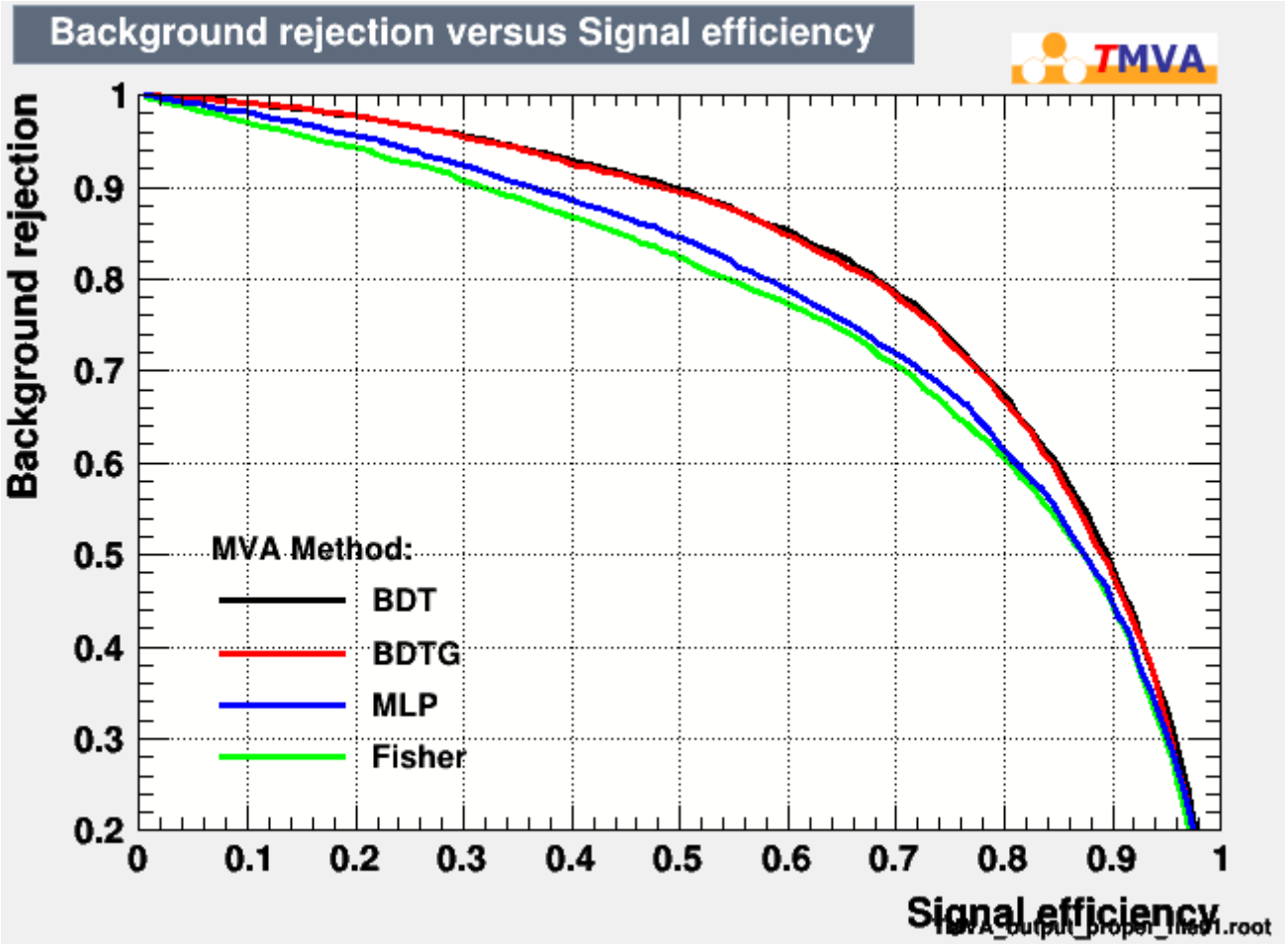
Δcosθ with BDT score > 0.25



Δcosθ with BDT score > 0.35

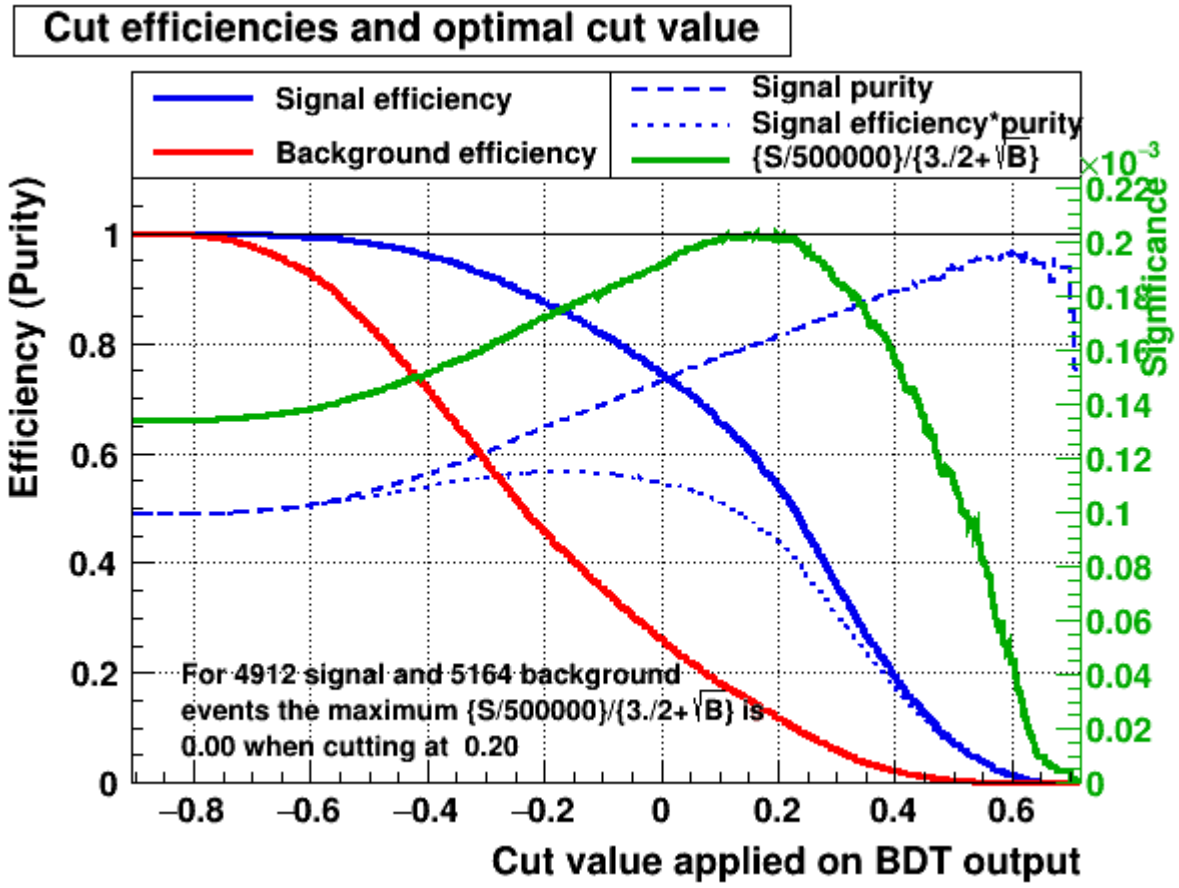


ROC



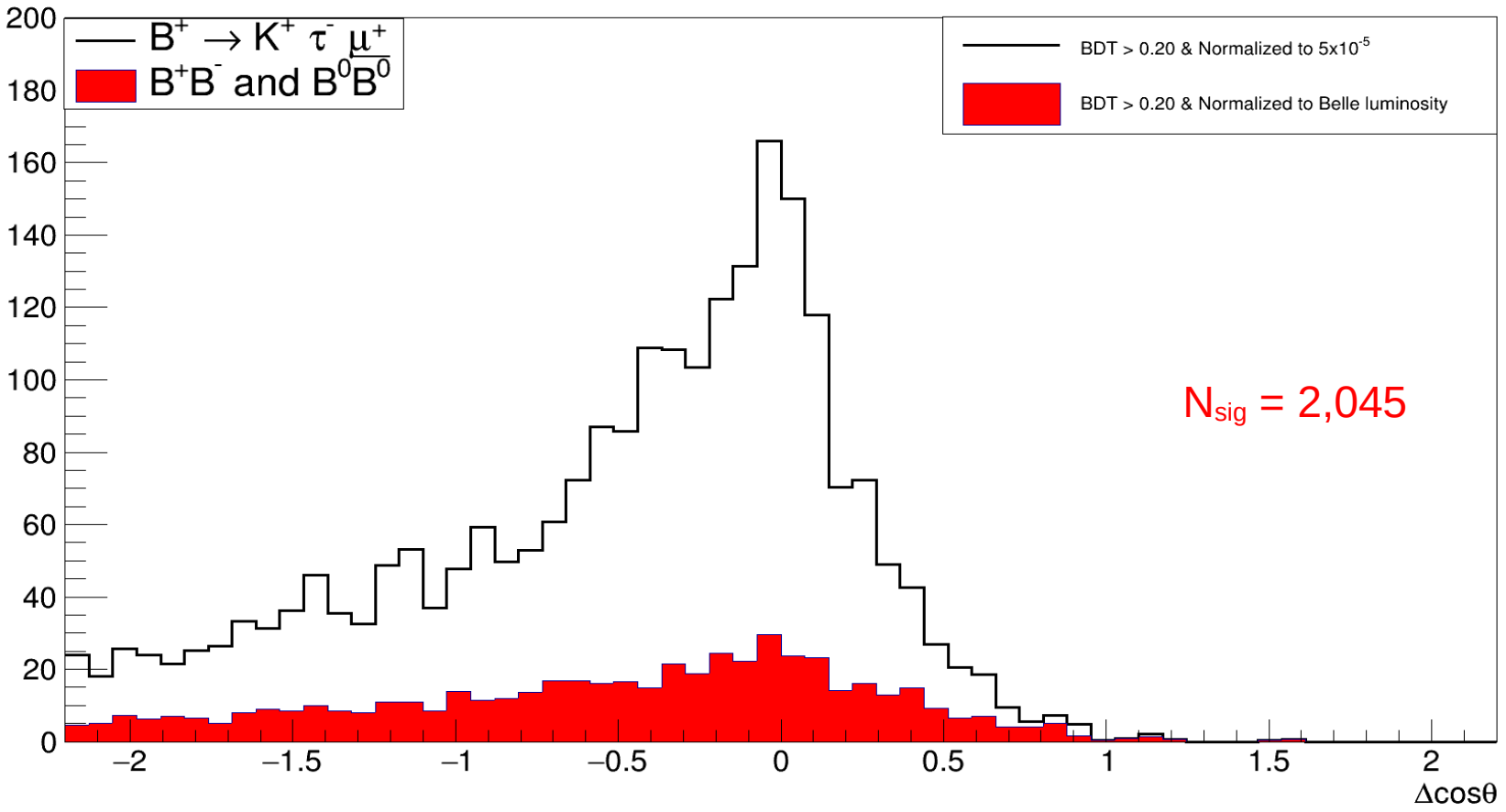

```
------------------------------------------------------------------------------
: DataSet       MVA
: Name:         Method:          ROC-integ
: dataset       BDT            : 0.813
: dataset       BDTG           : 0.810
: dataset       MLP            : 0.774
: dataset       Fisher         : 0.761
:
------------------------------------------------------------------------------
```

Ponzi FOM



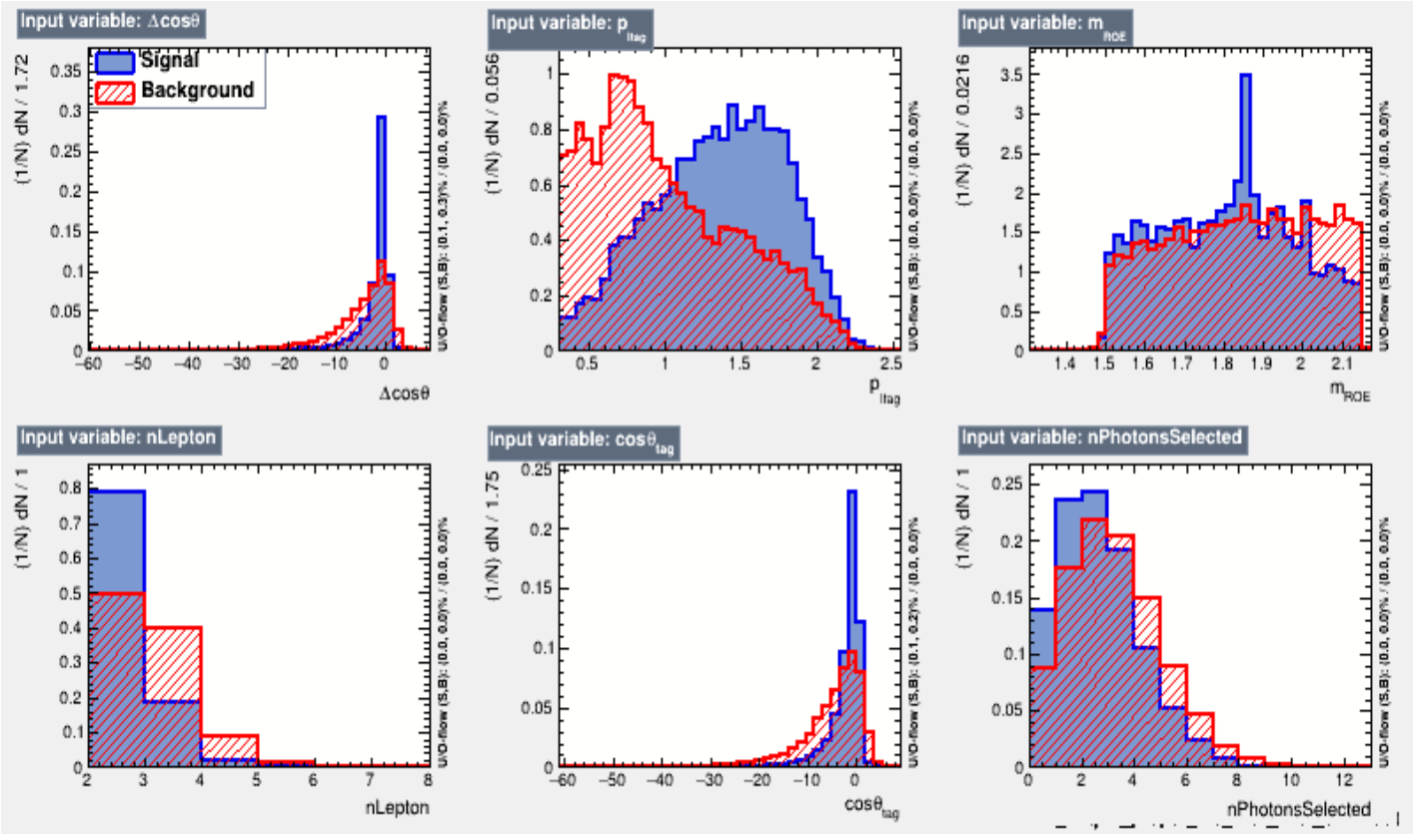
As our test and training samples are (50-50)% of the sample so in the definition, 500,000 is used as total number of generated events.

Δcosθ with BDT score > 0.20



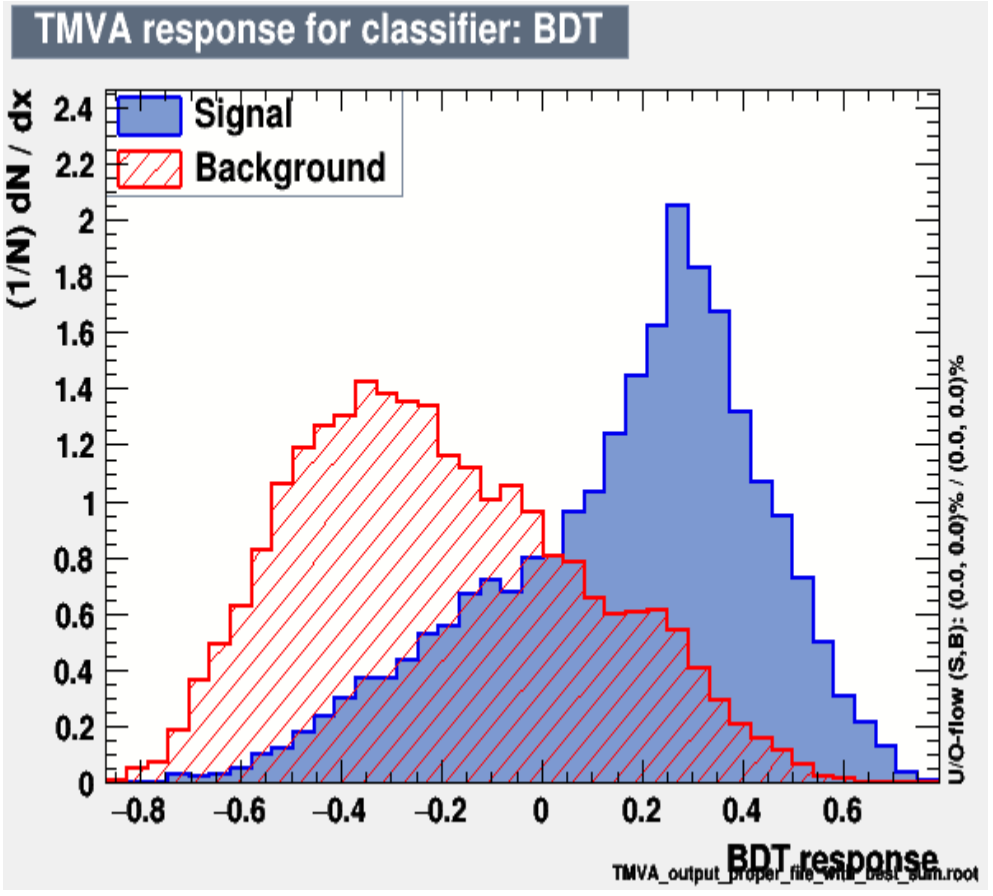
Usage of Δcosθ in BDT training

Input variables




```
: Ranking result (top variable is best ranked)
: ----------------------------------------------
: Rank : Variable         : Variable Importance
: ----------------------------------------------
:    1 : p_{ltag}         : 2.586e-01
:    2 : #Deltacos#theta  : 1.659e-01
:    3 : m_{ROE}          : 1.646e-01
:    4 : nLepton          : 1.615e-01
:    5 : cos#theta_{tag}  : 1.274e-01
:    6 : nPhotonsSelected : 1.219e-01
: ----------------------------------------------
```

BDT response



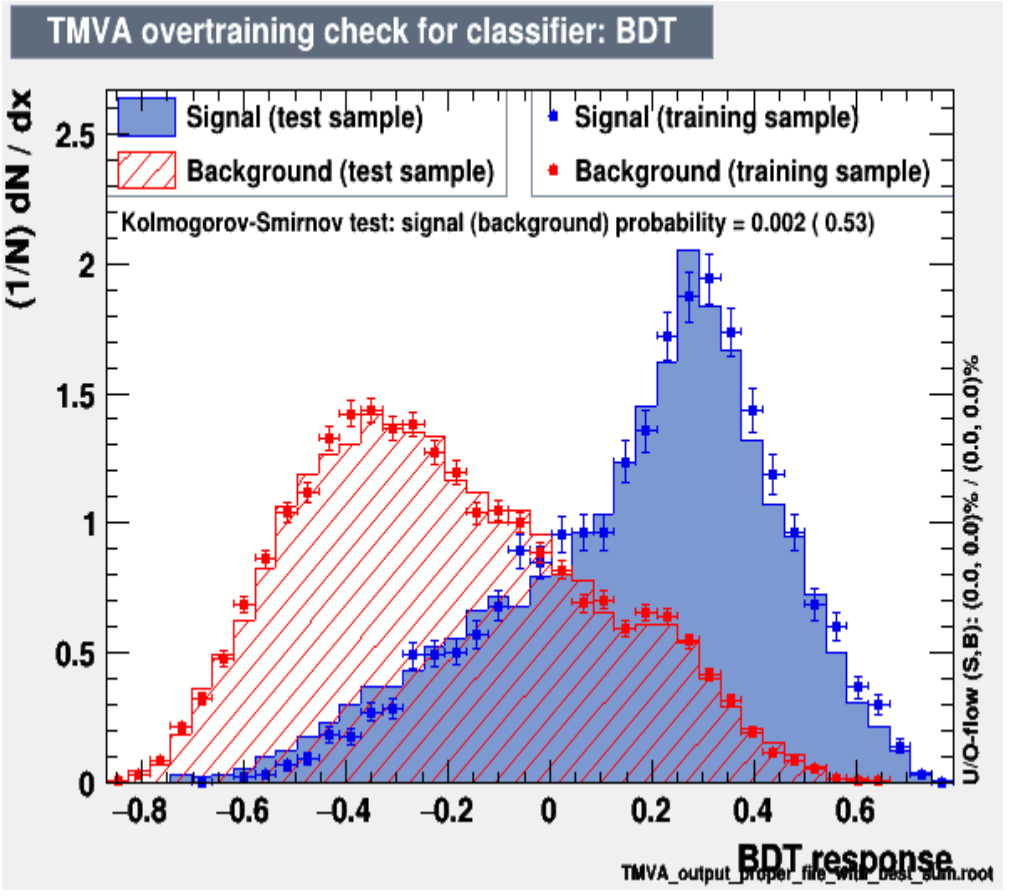
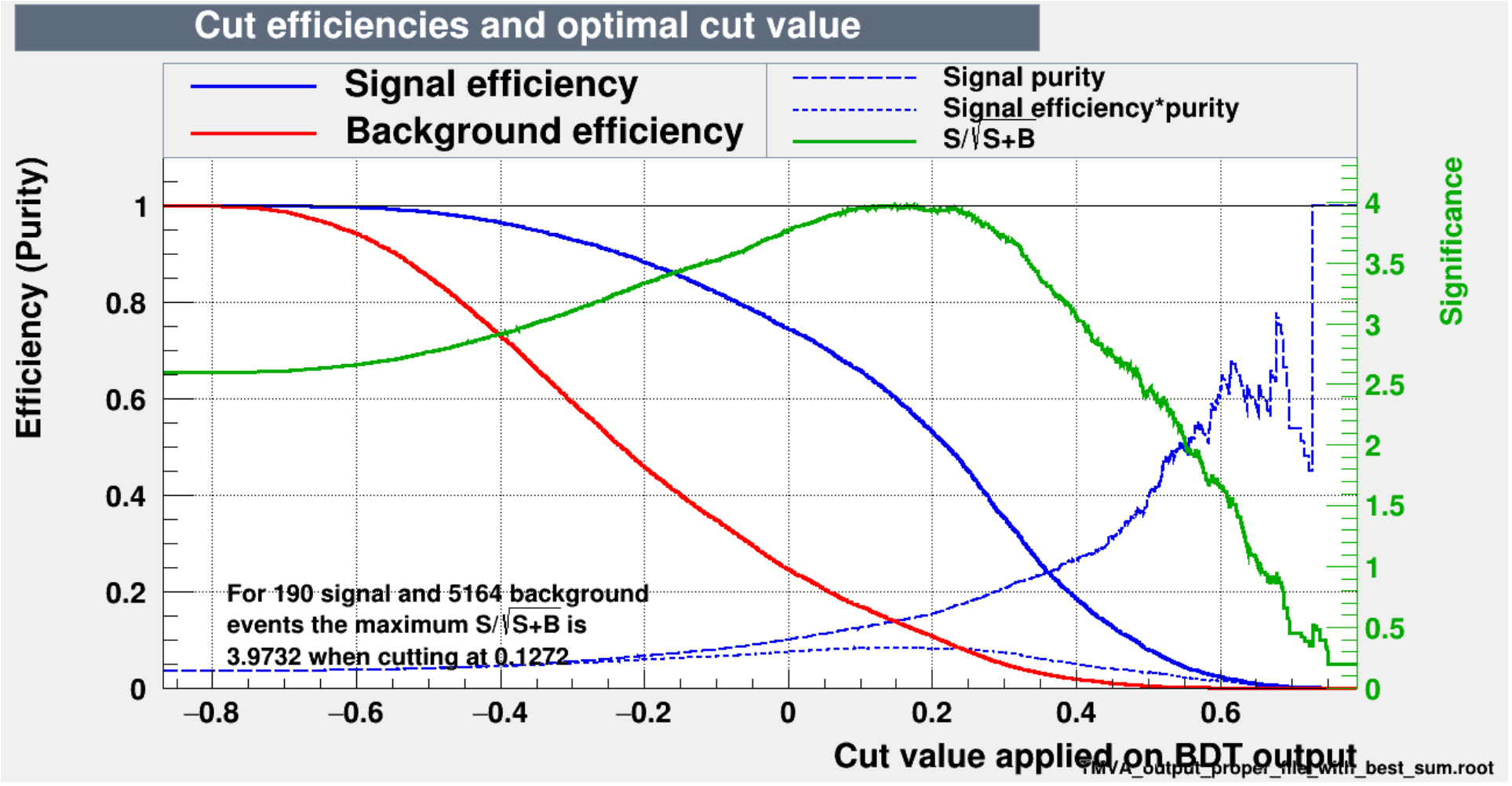
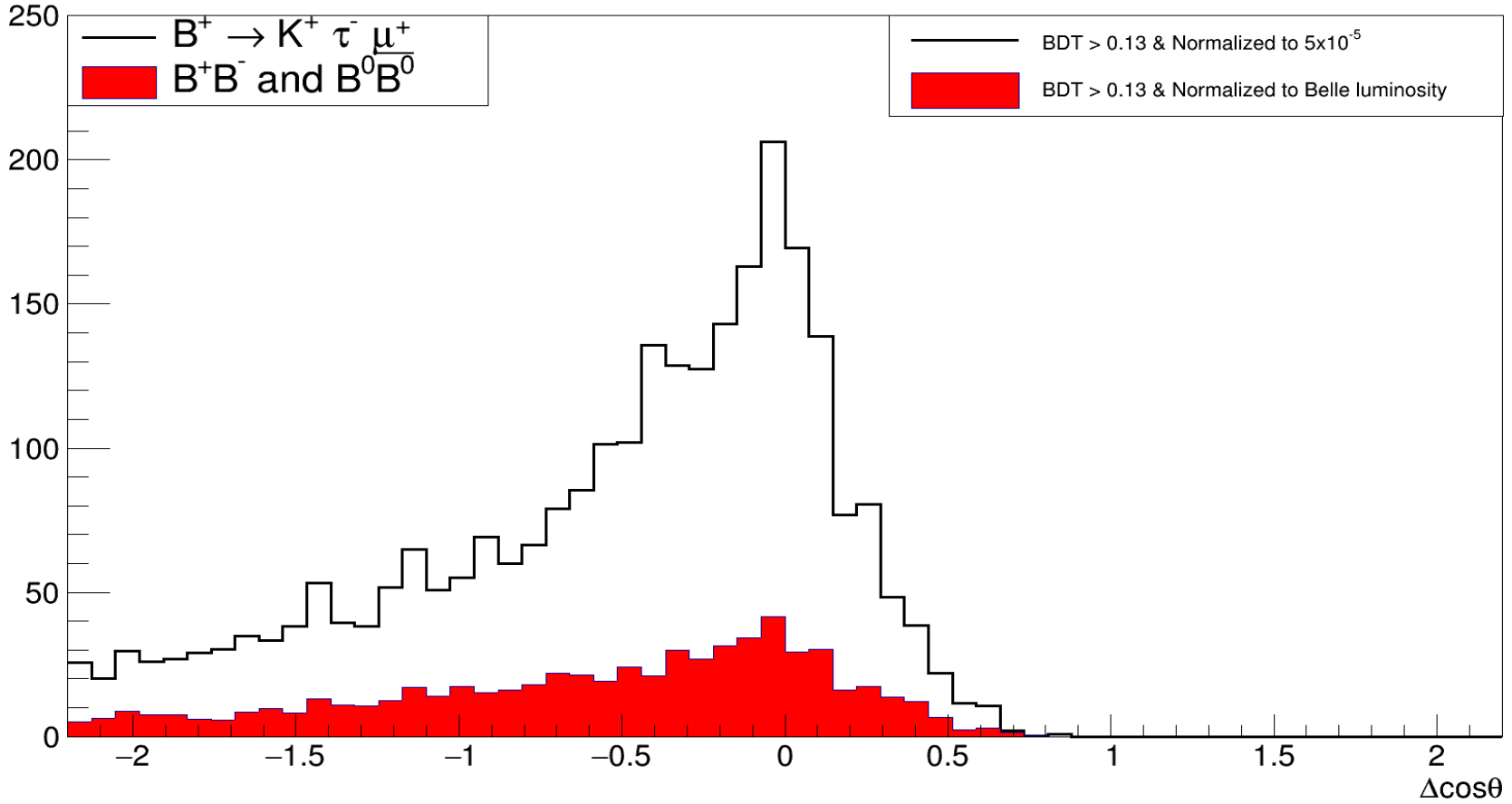


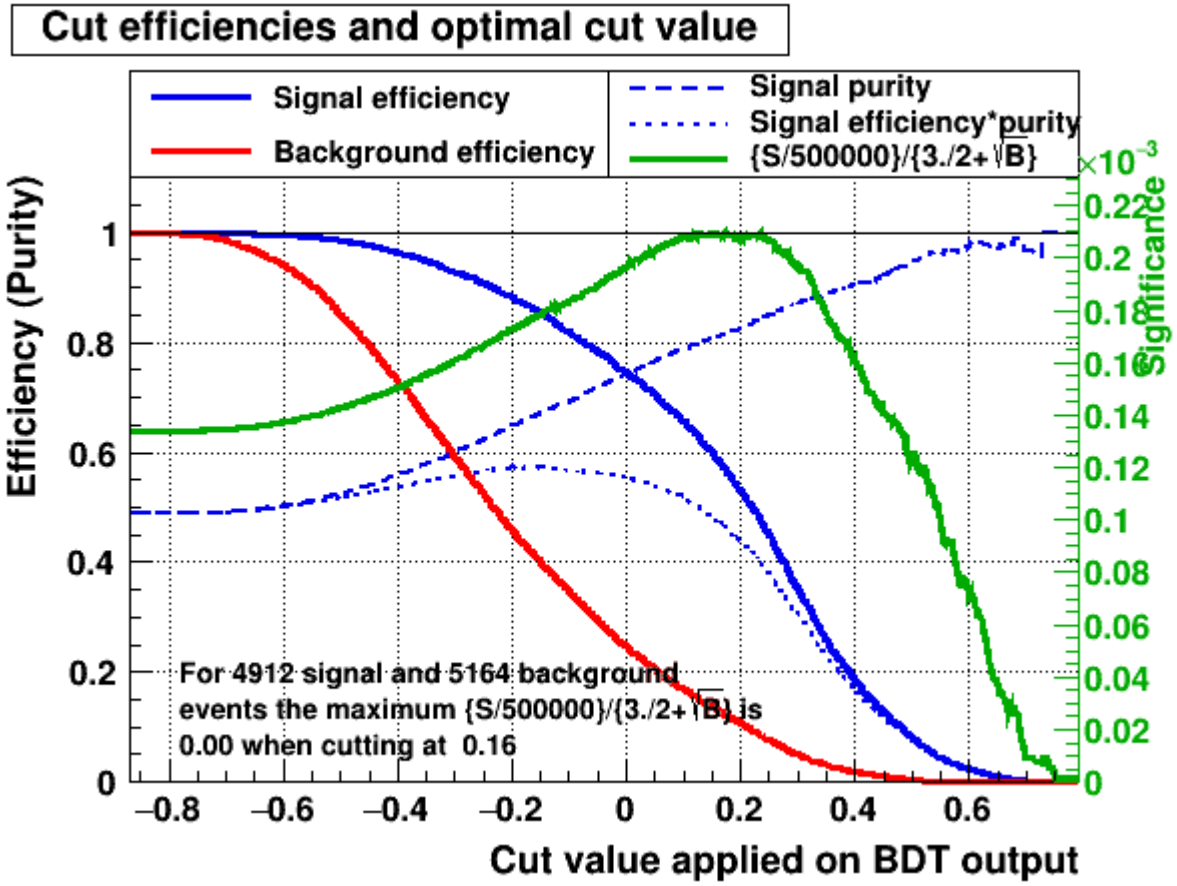
Figure of merit



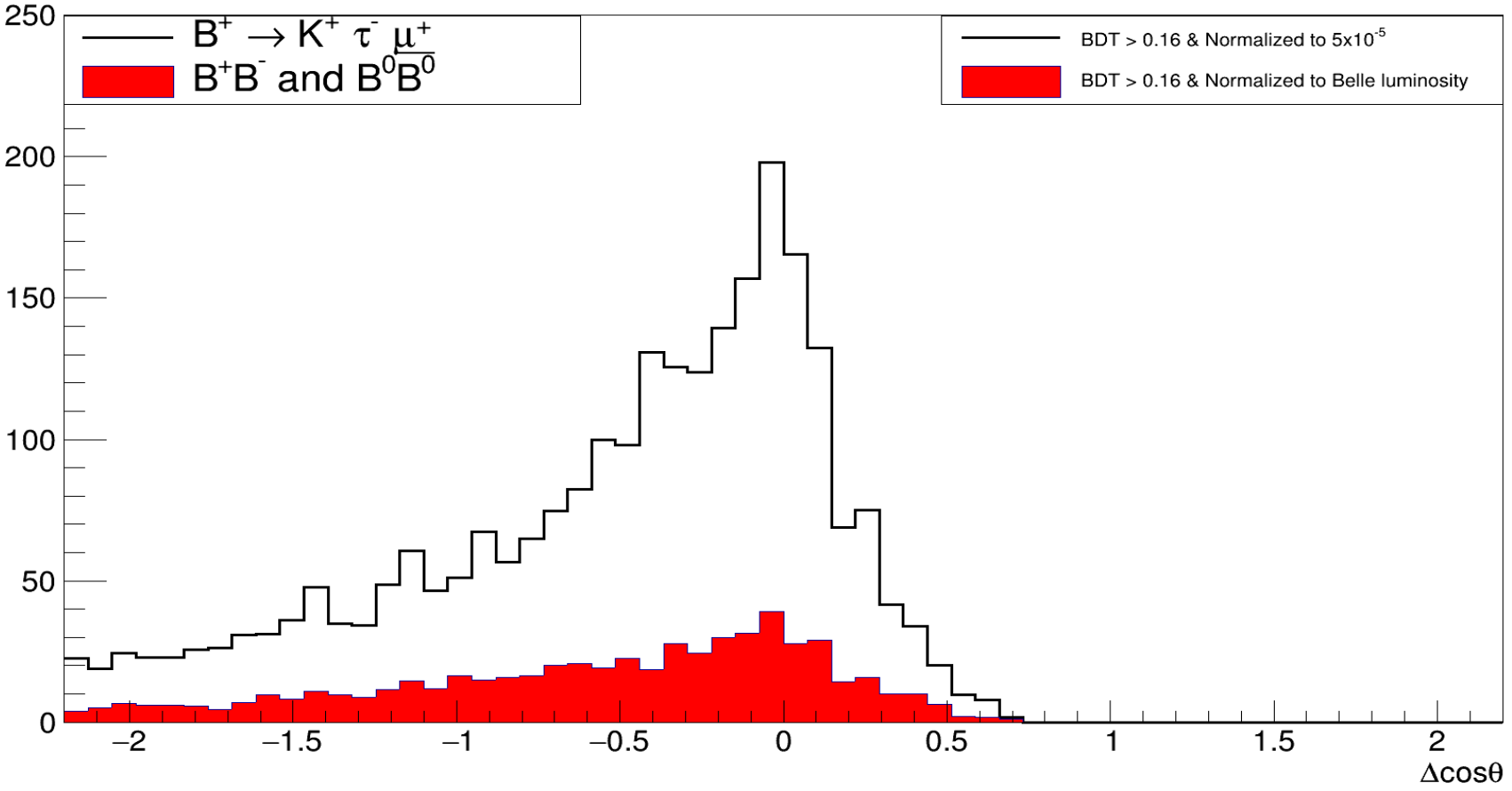
Δcosθ with BDT score > 0.13



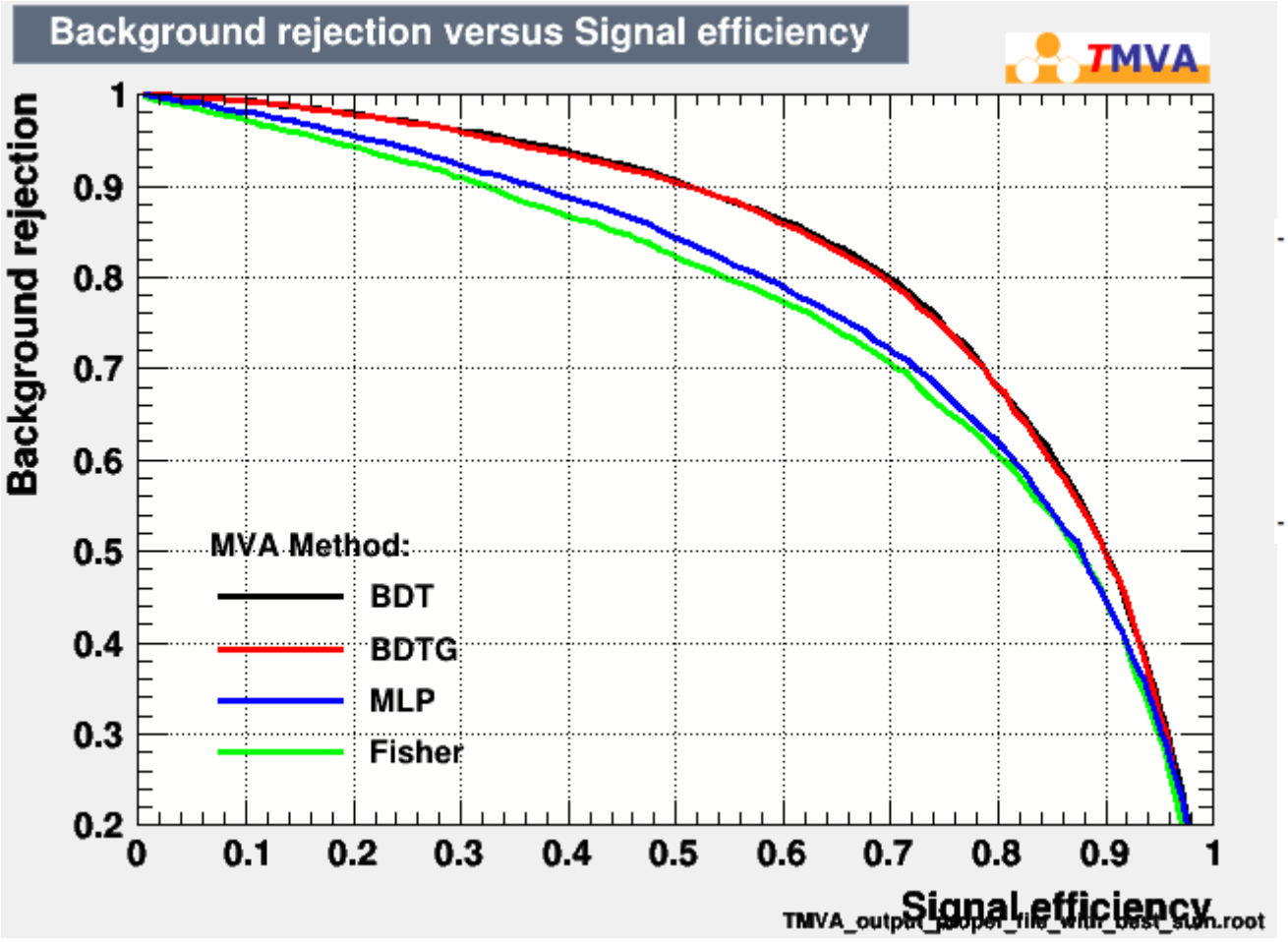
Ponzi Figure of merit



Δcosθ with BDT score > 0.16



ROC




```
: DataSet       MVA
: Name:         Method:          ROC-integ
: dataset       BDT            : 0.820
: dataset       BDTG           : 0.817
: dataset       MLP            : 0.775
: dataset       Fisher         : 0.761
:
```