

Update

09/09/2024

Number of candidates after all cuts

Generic B^+B^- MC

Cut list

$$\sin\phi < 1$$

$$m_{K\pi} > 1.91 \text{ GeV}$$

$$|m_{\mu\pi} - 3.1| > 0.05 \text{ \& } |m_{\mu\pi} - 3.69| > 0.05 \text{ GeV}$$

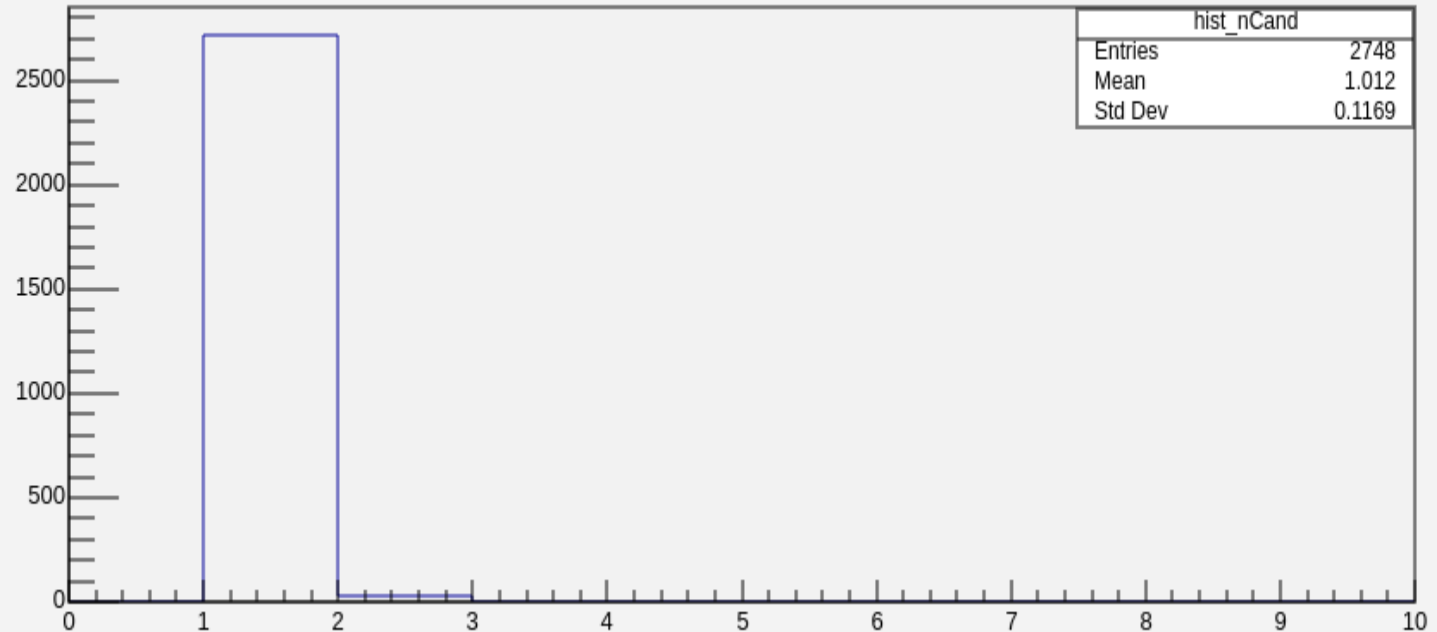
$$|m_{\mu\mu} - 3.1| > 0.05 \text{ \& } |m_{\mu\mu} - 3.69| > 0.05 \text{ GeV}$$

$$1.5 < m_{\text{ROE}} < 2.06 \text{ GeV}$$

$$p_{\text{tag}} > 1.3 \text{ GeV}$$

$$-2 < \cos\theta_{\text{tag}} < 1.1$$

number of candidates after selection



Number of candidates after all cuts

Generic $B^0\bar{B}^0$ MC

Cut list

$$\sin\phi < 1$$

$$m_{k\pi} > 1.91 \text{ GeV}$$

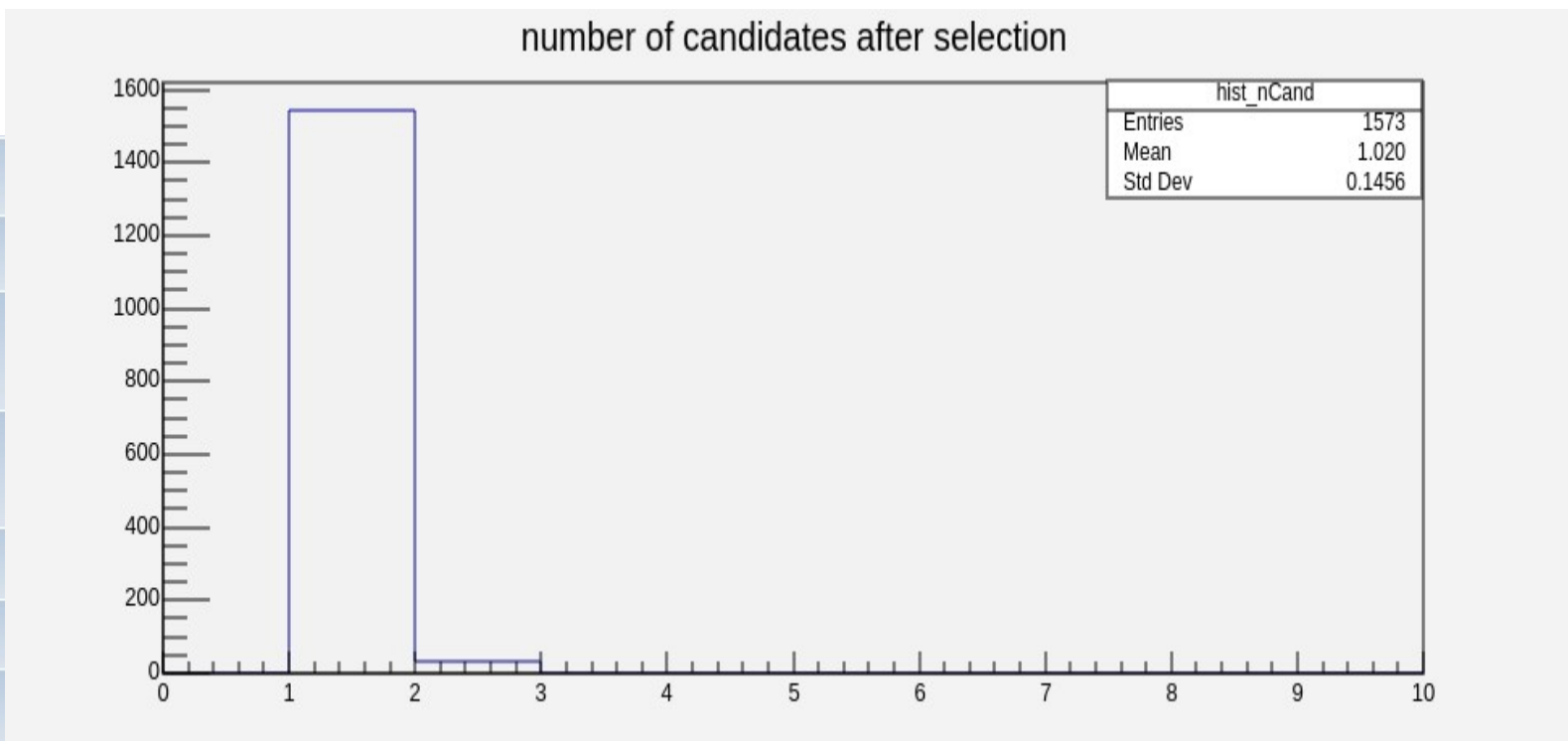
$$|m_{\mu\pi} - 3.1| > 0.05 \text{ \& } |m_{\mu\pi} - 3.69| > 0.05 \text{ GeV}$$

$$|m_{\mu\mu} - 3.1| > 0.05 \text{ \& } |m_{\mu\mu} - 3.69| > 0.05 \text{ GeV}$$

$$1.5 < m_{\text{ROE}} < 2.06 \text{ GeV}$$

$$p_{\text{tag}} > 1.3 \text{ GeV}$$

$$-2 < \cos\theta_{\text{tag}} < 1.1$$



Number of candidates after all cuts

Generic $c\bar{c}$ MC

Cut list

$$\sin\phi < 1$$

$$m_{k\pi} > 1.91 \text{ GeV}$$

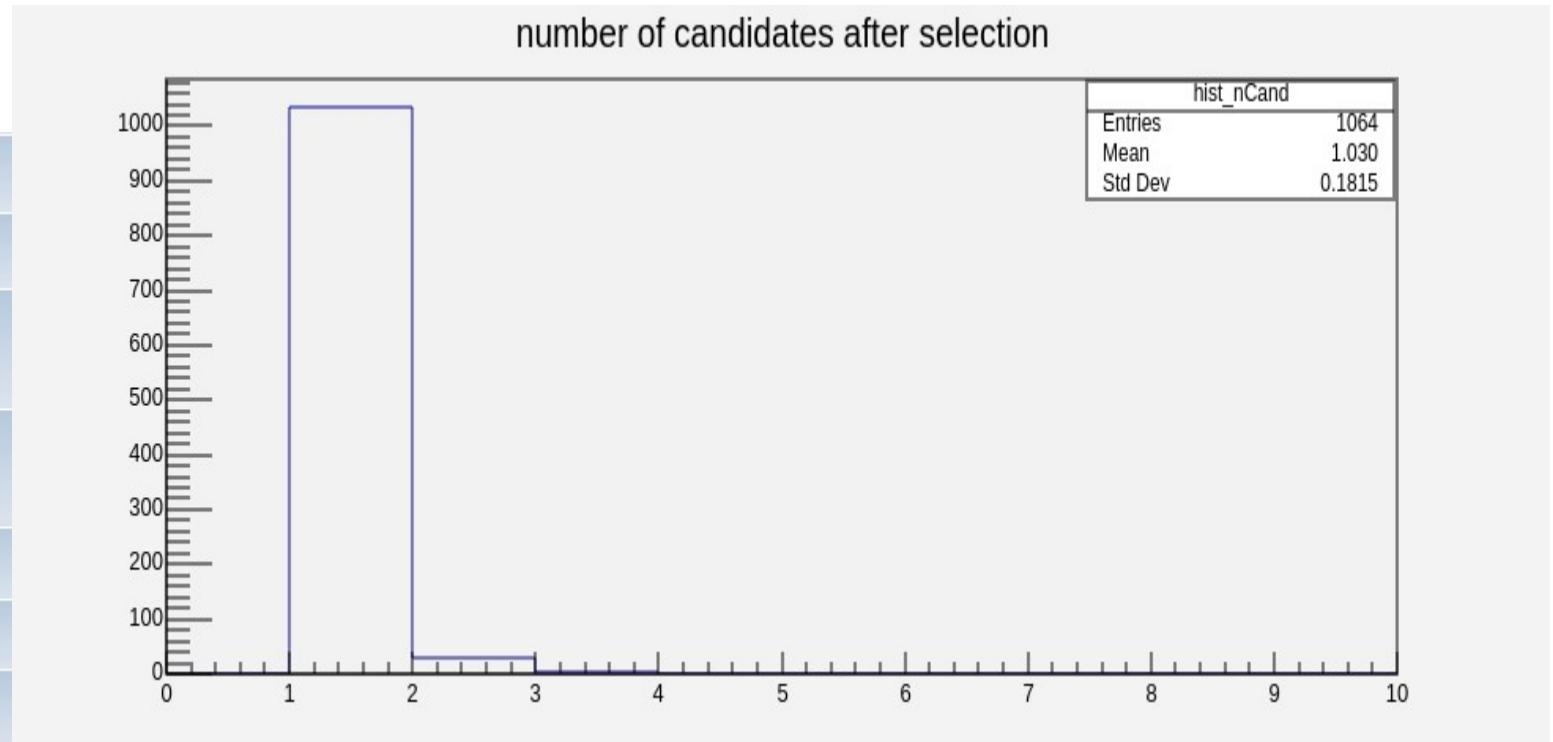
$$|m_{\mu\pi} - 3.1| > 0.05 \text{ GeV} \& \\ |m_{\mu\pi} - 3.69| > 0.05 \text{ GeV}$$

$$|m_{\mu\mu} - 3.1| > 0.05 \text{ GeV} \& \\ |m_{\mu\mu} - 3.69| > 0.05 \text{ GeV}$$

$$1.5 < m_{\text{ROE}} < 2.06 \text{ GeV}$$

$$p_{\text{tag}} > 1.3 \text{ GeV}$$

$$-2 < \cos\theta_{\text{tag}} < 1.1$$



Number of candidates after all cuts

Generic uds MC

Cut list

$$\sin\phi < 1$$

$$m_{k\pi} > 1.91 \text{ GeV}$$

$$|m_{\mu\pi} - 3.1| > 0.05 \text{ GeV} \& \\ |m_{\mu\pi} - 3.69| > 0.05 \text{ GeV}$$

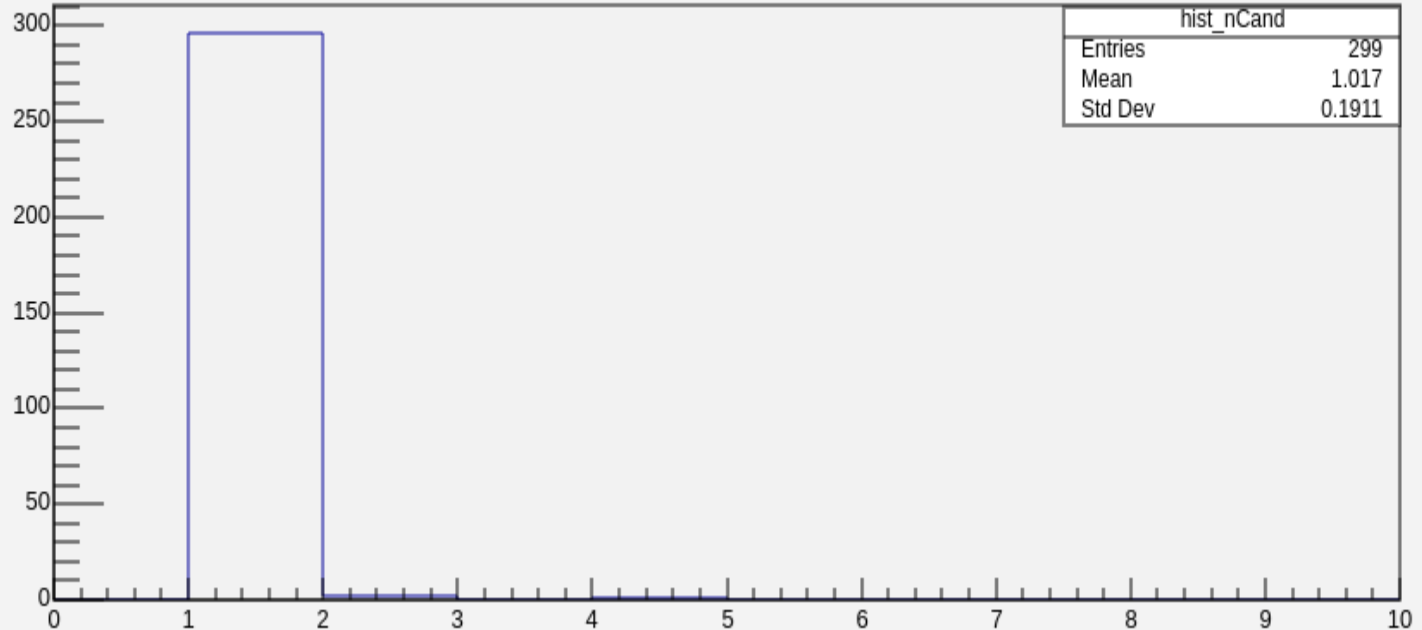
$$|m_{\mu\mu} - 3.1| > 0.05 \text{ GeV} \& \\ |m_{\mu\mu} - 3.69| > 0.05 \text{ GeV}$$

$$1.5 < m_{\text{ROE}} < 2.06 \text{ GeV}$$

$$p_{\text{tag}} > 1.3 \text{ GeV}$$

$$-2 < \cos\theta_{\text{tag}} < 1.1$$

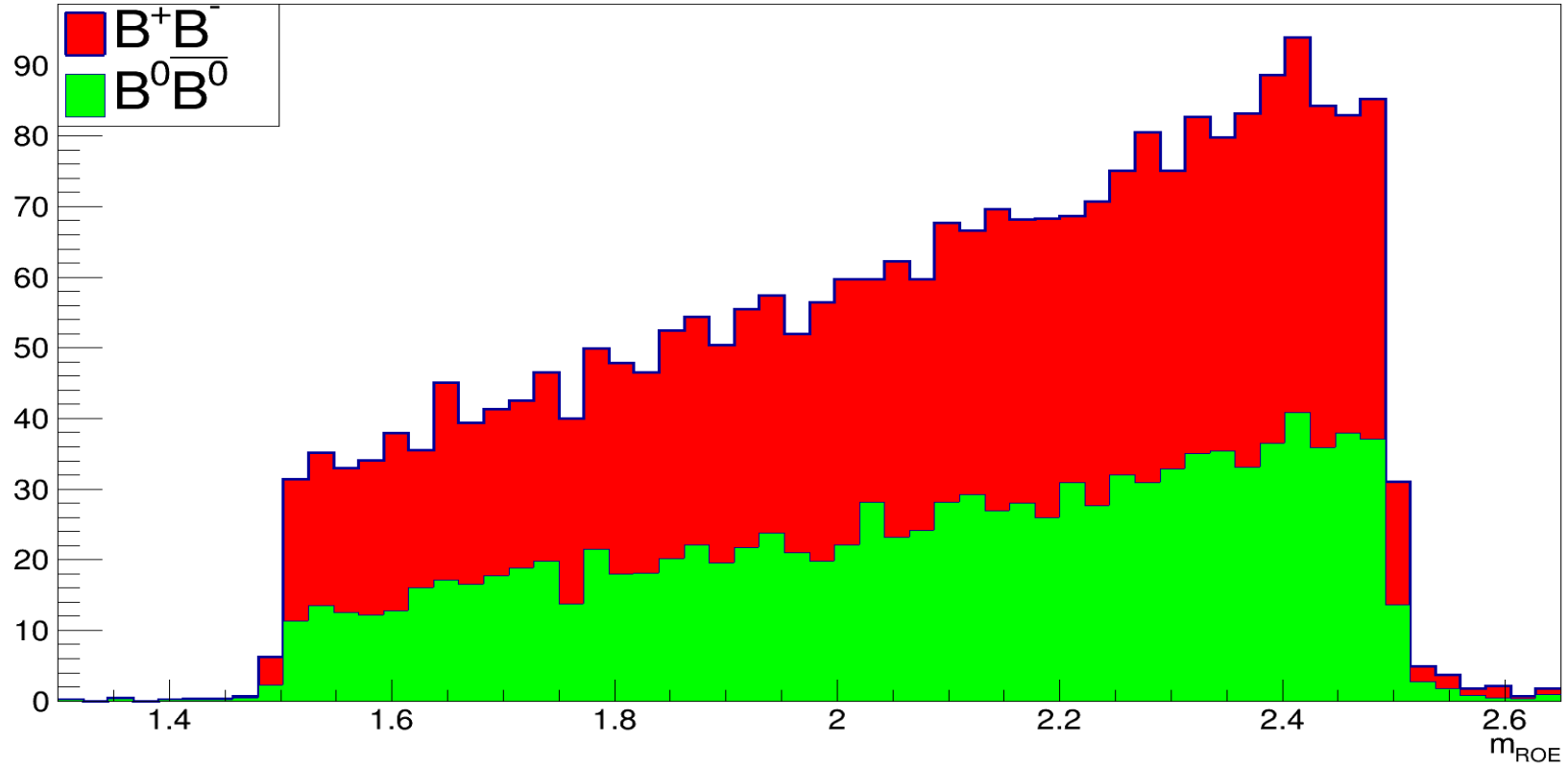
number of candidates after selection



Detailed cut flow

| Cut no. | Cut | N_{sig} | N_{B+B^-} | $N_{B_0\bar{B}_0}$ | $N_{c\bar{c}}$ | N_{uds} |
|---------|--|--|--|--|--|--|
| | Rec. events | 98880 | 6537405 | 5896560 | 665398 | 2157507 |
| c1 | $\sin\phi < 1$ | 28734 | 75557 | 52295 | 3943 | 14170 |
| c2 | $m_{k\pi} > 1.91 \text{ GeV}$ | 13979 | 8574 | 5911 | 1752 | 4494 |
| c3 | $ m_{\mu\pi} - 3.1 > 0.05 \&$ $ m_{\mu\pi} - 3.69 > 0.05 \text{ GeV}$ | 13443 | 7558 | 5267 | 1708 | 4425 |
| c4 | $ m_{\mu\mu} - 3.1 > 0.05 \&$ $ m_{\mu\mu} - 3.69 > 0.05 \text{ GeV}$ | 13294 | 7315 | 5128 | 4374 | 1701 |
| c5 | $1.5 < m_{\text{ROE}} < 2.06 \text{ GeV}$ | 9349 | 3762 | 2501 | 1855 | 674 |
| c6 | $-2 < \cos\theta_{\text{tag}} < 1.1$ | 5728 | 974 | 573 | 419 | 161 |
| c7 | $p_{\text{tag}} > 1.3 \text{ GeV}$ | 3933 | 463 | 266 | 182 | 51 |
| c8 | $R_2 < 0.3$ | 3111 | 357 | 203 | 16 | 6 |
| c9 | $n_{\text{Leptons}} = 2$ | 2573 | 238 | 130 | 12 | 5 |
| c10 | Rank 1 | 2300 | 134 | 72 | 8 | 4 |
| | Final efficiency | 2.3×10^{-3} | 3.4×10^{-7} | 1.8×10^{-7} | 7.8×10^{-9} | 2.4×10^{-9} |

m_{ROE}



TMVA

- Using the following input variables.
 p_{ltag} , m_{ROE} , $\cos(p_{Btag}, p_{vis.tag})$, $nLeptons$
- Applied some loose selections on tag side
 - $p_{ltag} > 0.3 \text{ GeV} \ \&\& \ p_{ltag} < 2.5 \text{ GeV}$
 - $1.3 < m_{ROE} < 2.1 \text{ GeV}$

Signal side cuts

$$\sin\phi < 1$$

$$m_{k\pi} > 1.91 \text{ GeV}$$

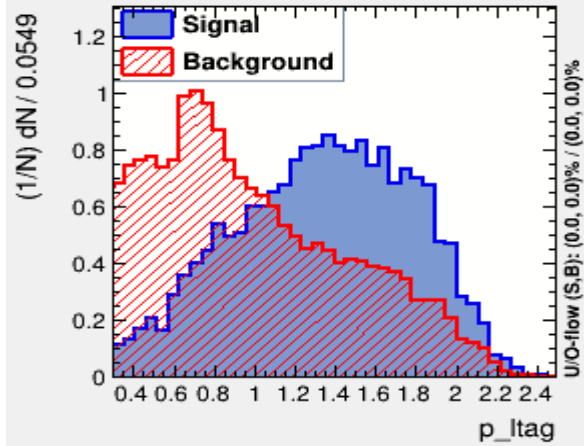
$$|m_{\mu\pi} - 3.1| > 0.05 \ \&\& \ |m_{\mu\pi} - 3.69| > 0.05 \text{ GeV}$$

$$|m_{\mu\mu} - 3.1| > 0.05 \ \&\& \ |m_{\mu\mu} - 3.69| > 0.05 \text{ GeV}$$

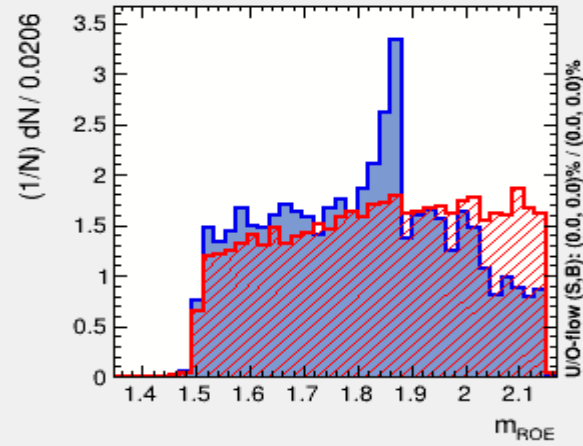
$$N_{sig} = 9414, N_{bg} = 8043$$

Input variables

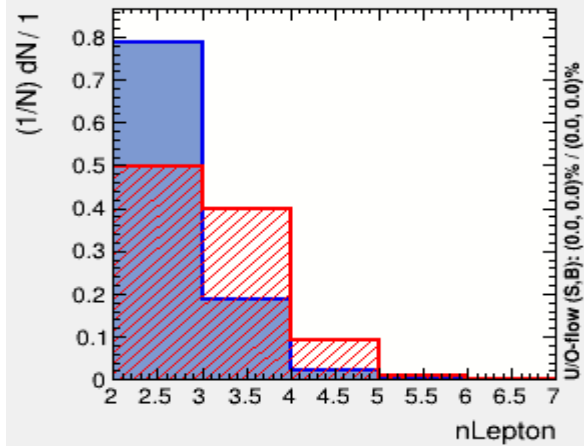
Input variable: p_{ltag}



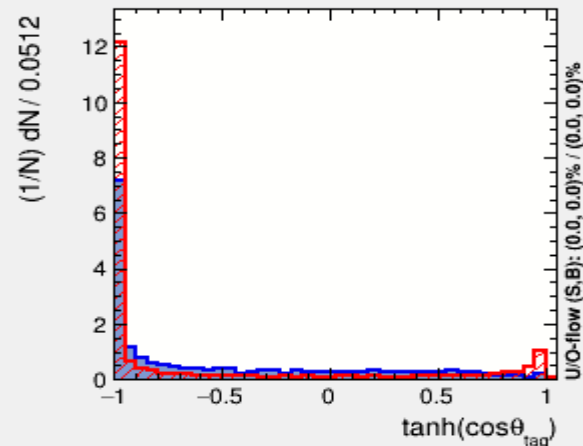
Input variable: m_{ROE}



Input variable: n_{Lepton}

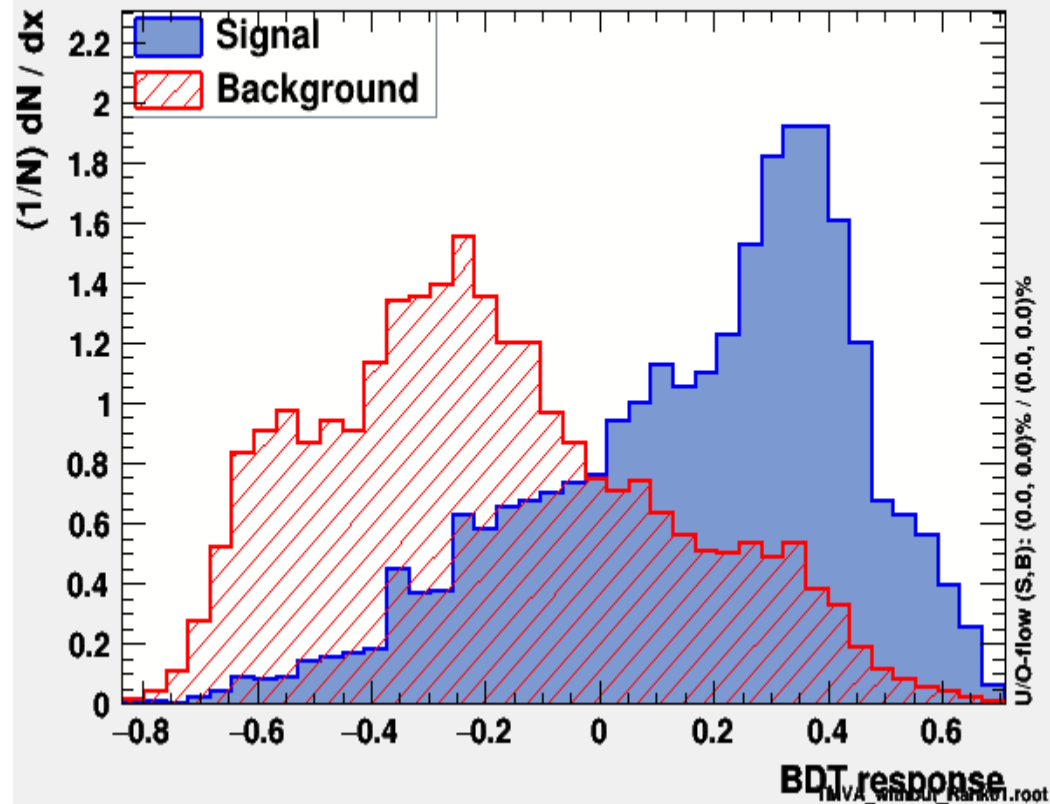


Input variable: $\tanh(\cos\theta_{ltag})$

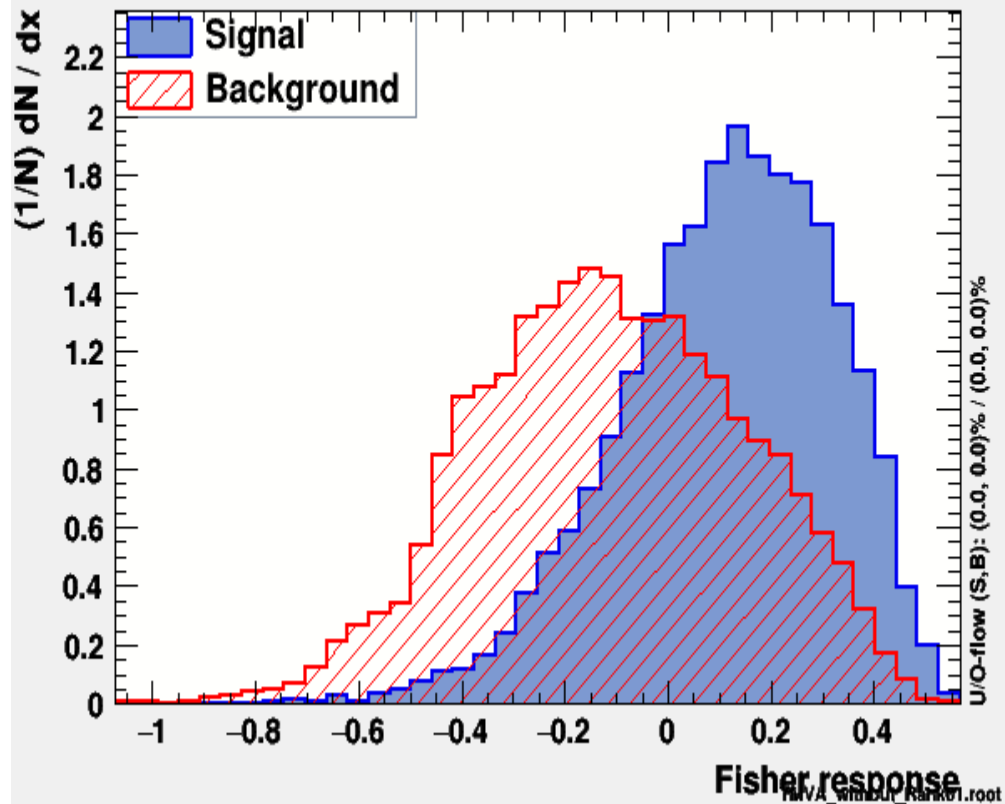


TMVA response

TMVA response for classifier: BDT

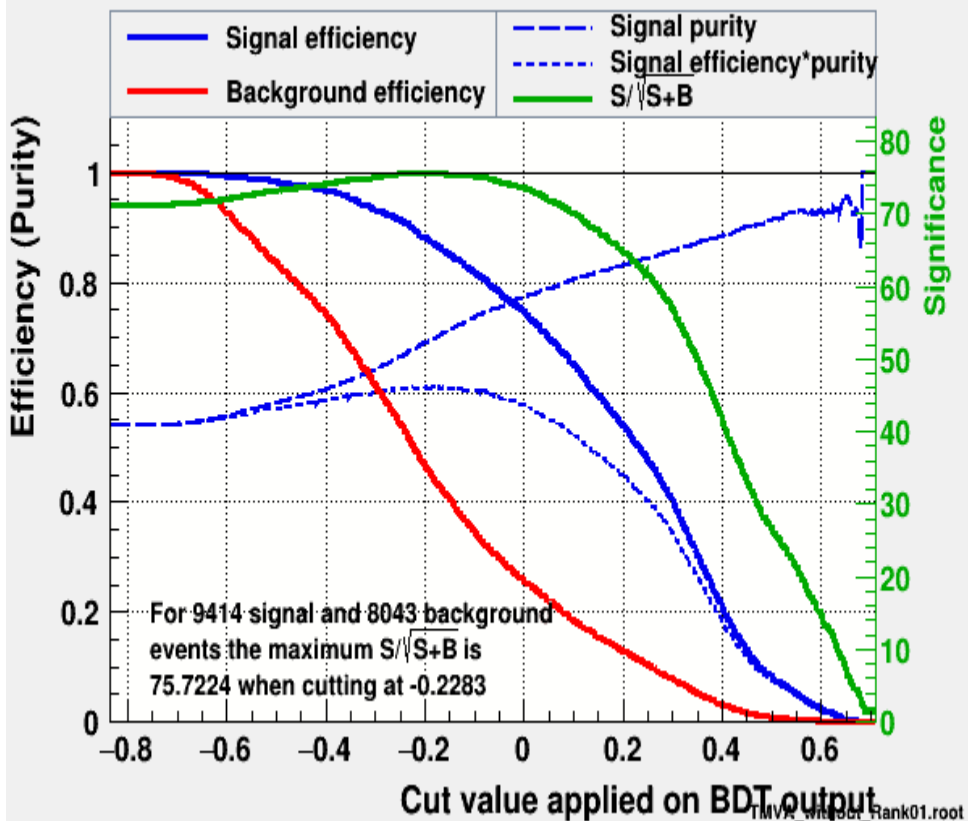


TMVA response for classifier: Fisher

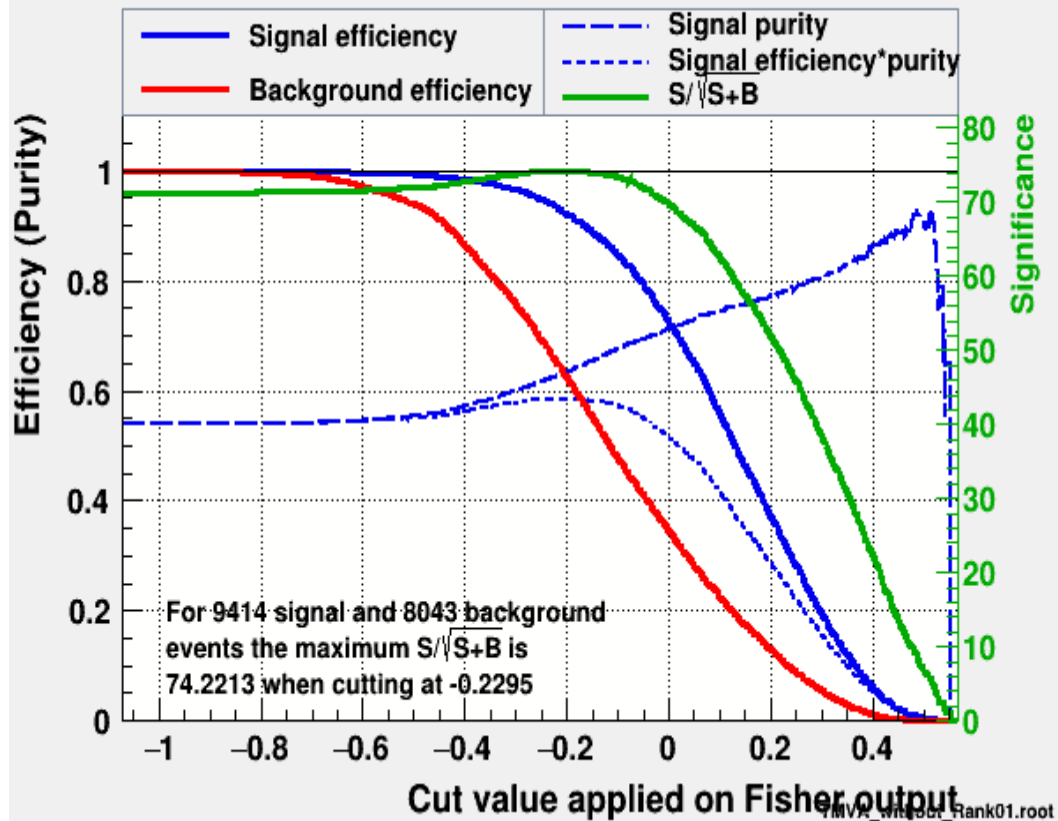


TMVA FOM

Cut efficiencies and optimal cut value

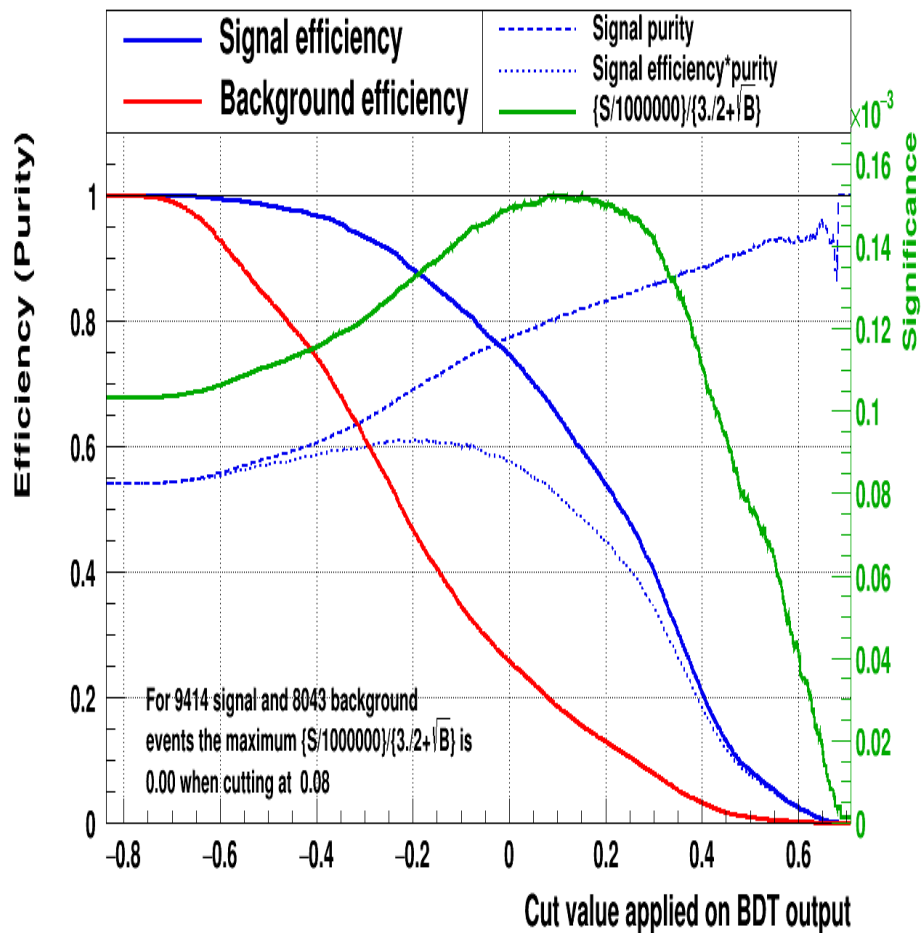


Cut efficiencies and optimal cut value

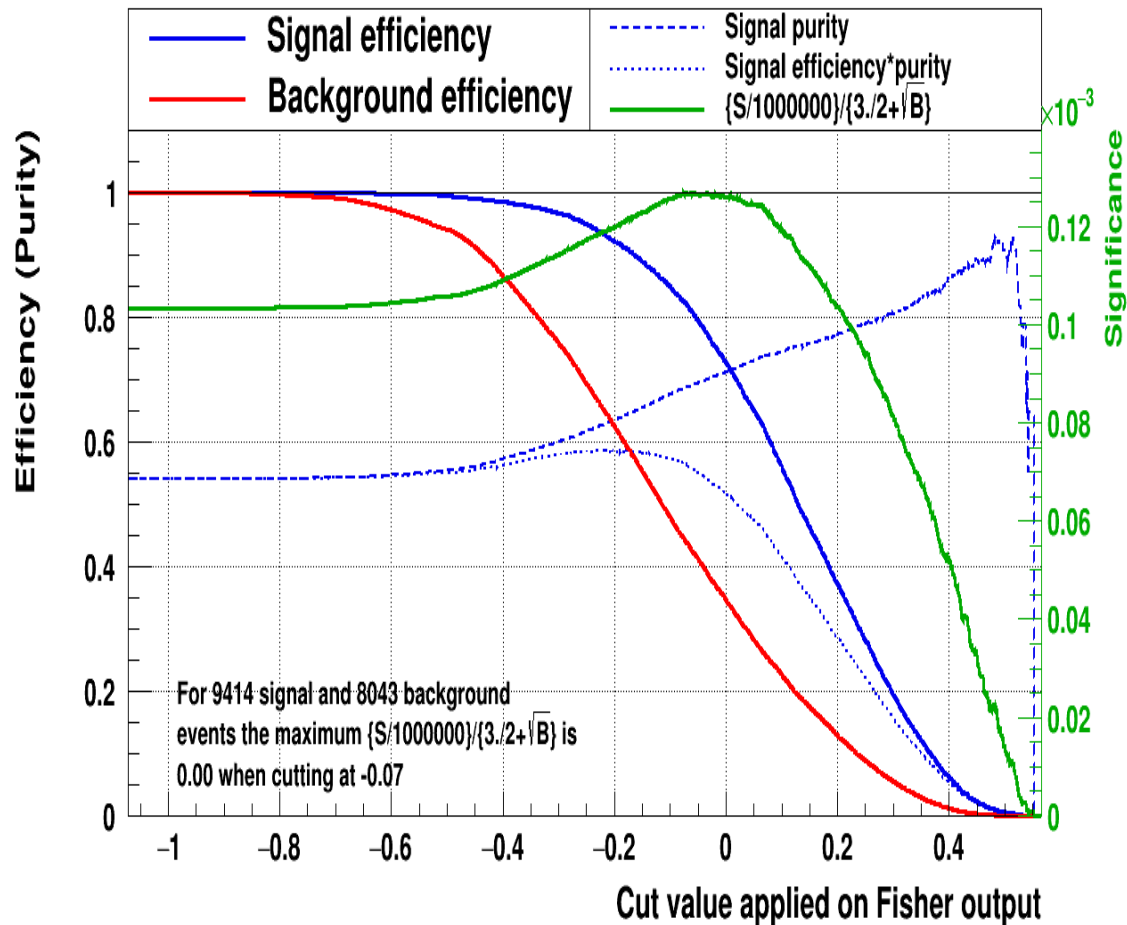


TMVA Ponzi FOM

Cut efficiencies and optimal cut value



Cut efficiencies and optimal cut value



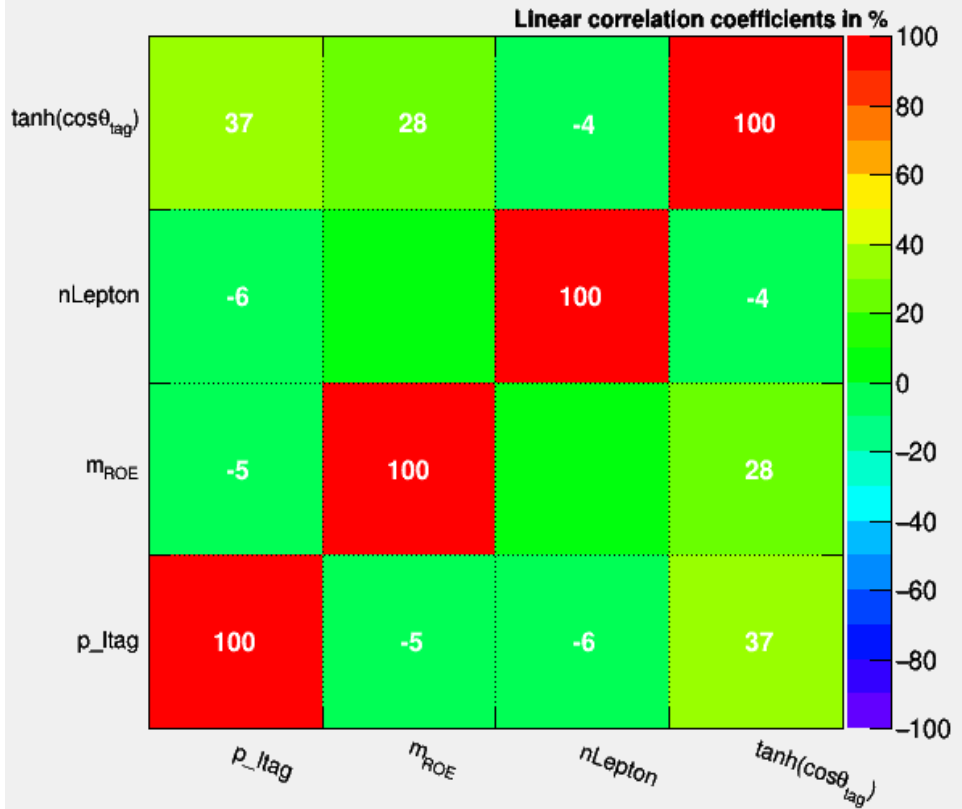
Back up

Detailed cut flow

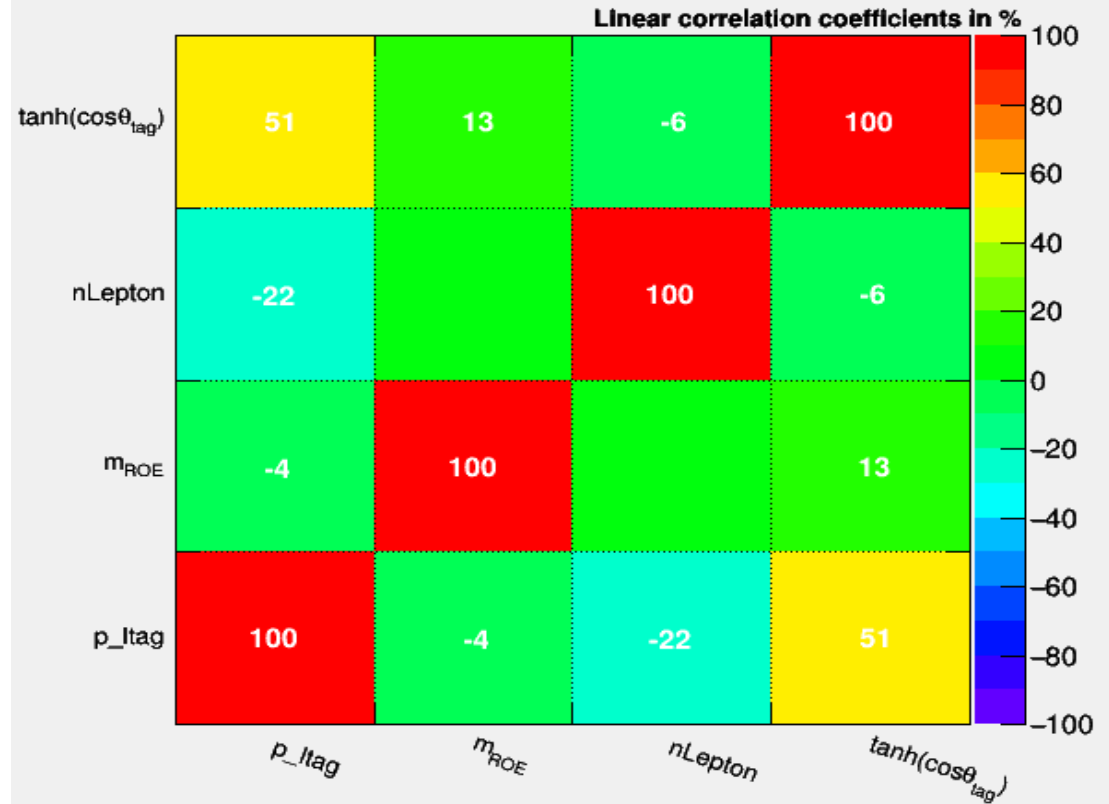
| Cut no. | Cut | N_{sig} | $N_{B^+B^-}$ | $N_{B^0\bar{B}^0}$ | $N_{c\bar{c}}$ | N_{uds} |
|---------|---|----------------------|----------------------|----------------------|----------------------|----------------------|
| | Rec. events | 98880 | 6537404 | 5869560 | 2157507 | 665398 |
| c1 | Best candidate selection | 58391 | 3137578 | 2586635 | 1106785 | 363015 |
| c2 | $\sin\phi < 1$ | 22268 | 42377 | 27537 | 8375 | 2472 |
| c3 | $m_{K\pi} > 1.91$ GeV | 11687 | 4572 | 3152 | 2765 | 1243 |
| c4 | $ m_{\mu\pi} - 3.1 > 0.05$ & $ m_{\mu\pi} - 3.69 > 0.05$ GeV | 11217 | 3973 | 2812 | 2720 | 1208 |
| c5 | $ m_{\mu\mu} - 3.1 > 0.05$ & $ m_{\mu\mu} - 3.69 > 0.05$ GeV | 11089 | 3840 | 2735 | 2690 | 1204 |
| c6 | $1.5 < m_{\text{ROE}} < 2.06$ GeV | 7752 | 1726 | 1150 | 1022 | 433 |
| c7 | $p_{\text{tag}} > 1.3$ GeV | 4389 | 470 | 264 | 221 | 79 |
| c8 | $-2 < \cos\theta_{\text{tag}} < 1.1$ | 3401 | 239 | 130 | 102 | 34 |
| | Final efficiency | 3.4×10^{-3} | 6.1×10^{-7} | 3.3×10^{-7} | 1.0×10^{-7} | 2.0×10^{-8} |

Correlation Matrix

Correlation Matrix (signal)

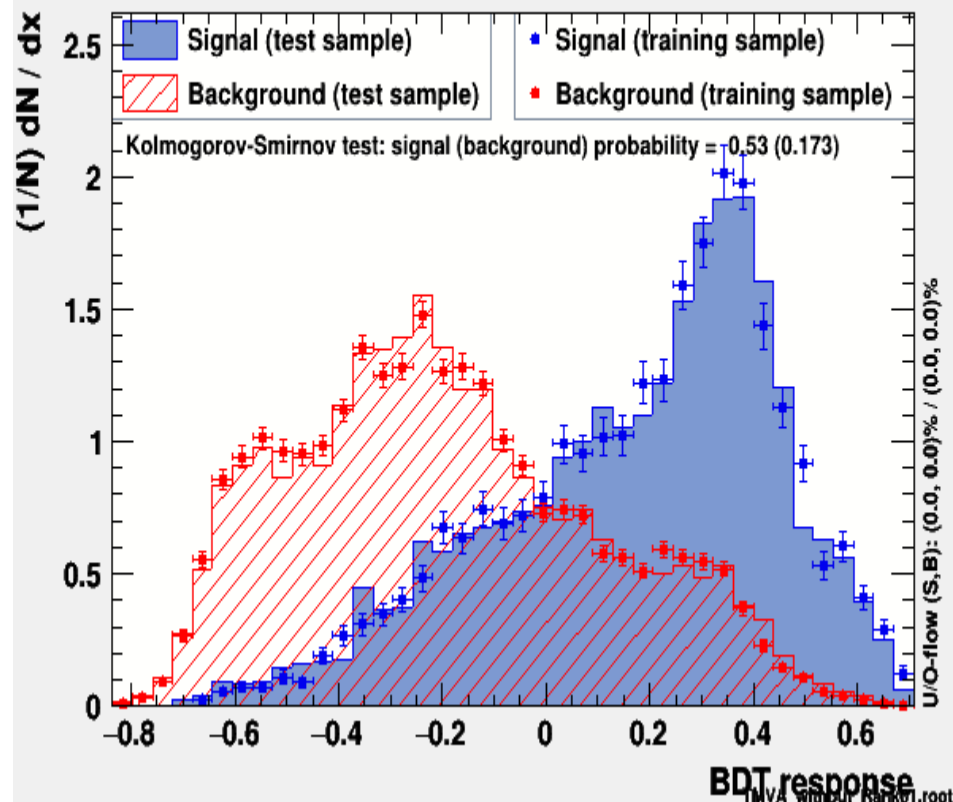


Correlation Matrix (background)

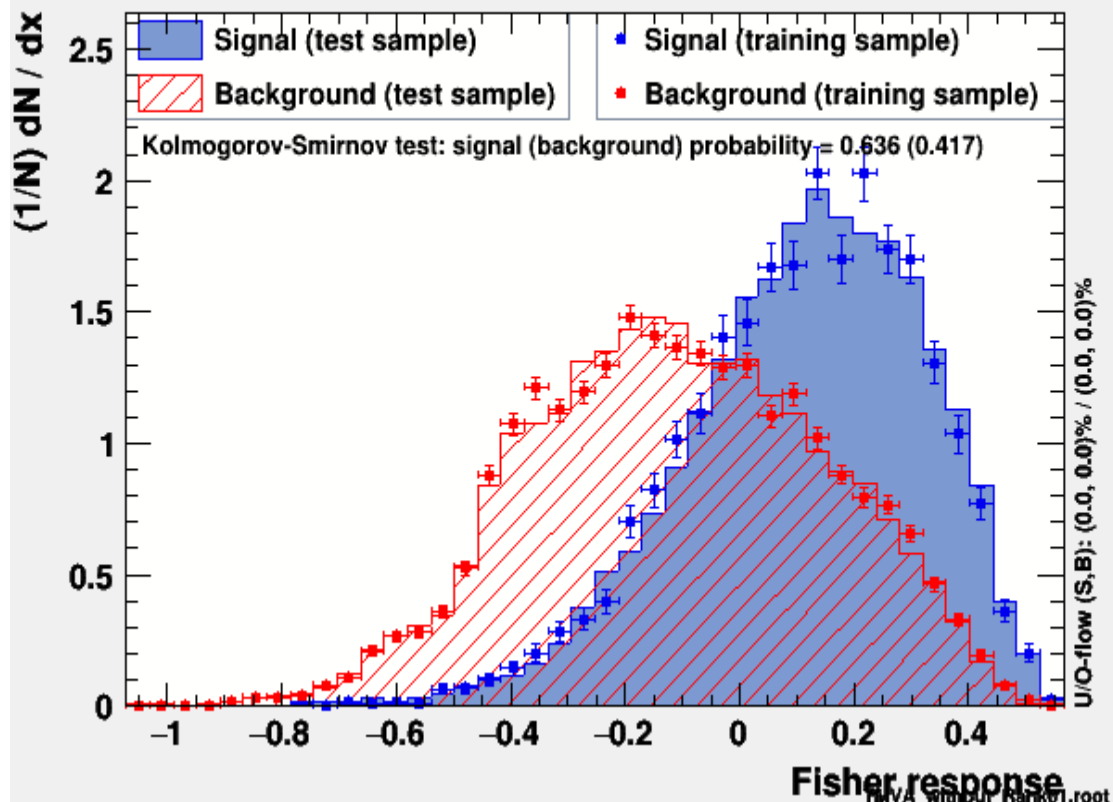


TMVA training

TMVA overtraining check for classifier: BDT

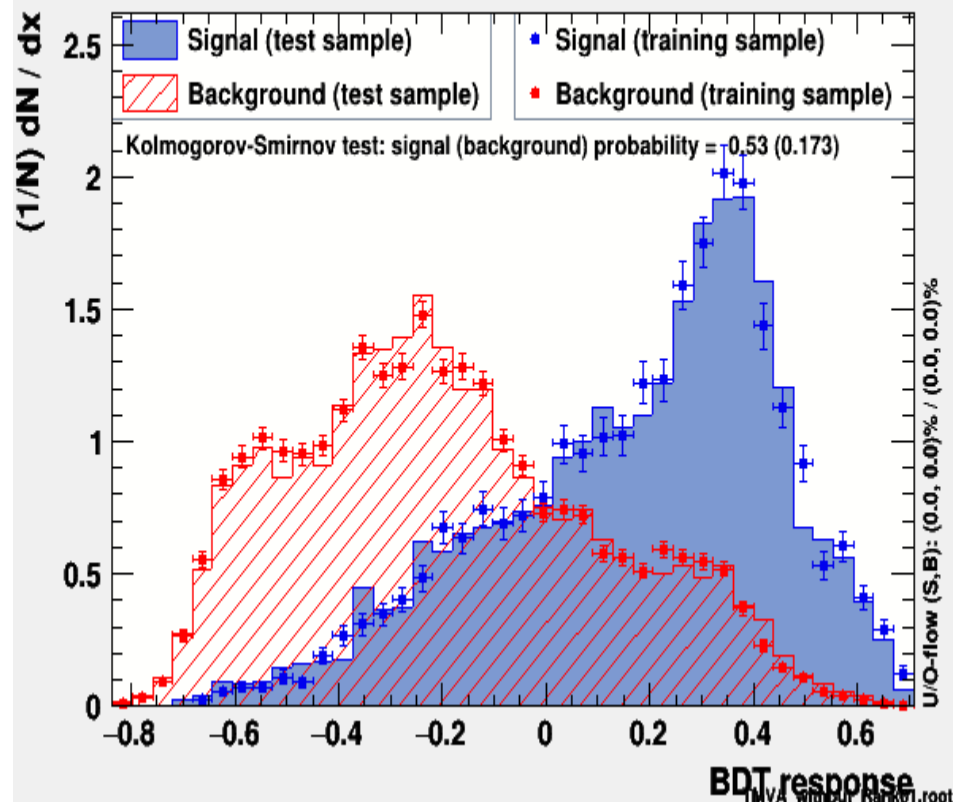


TMVA overtraining check for classifier: Fisher

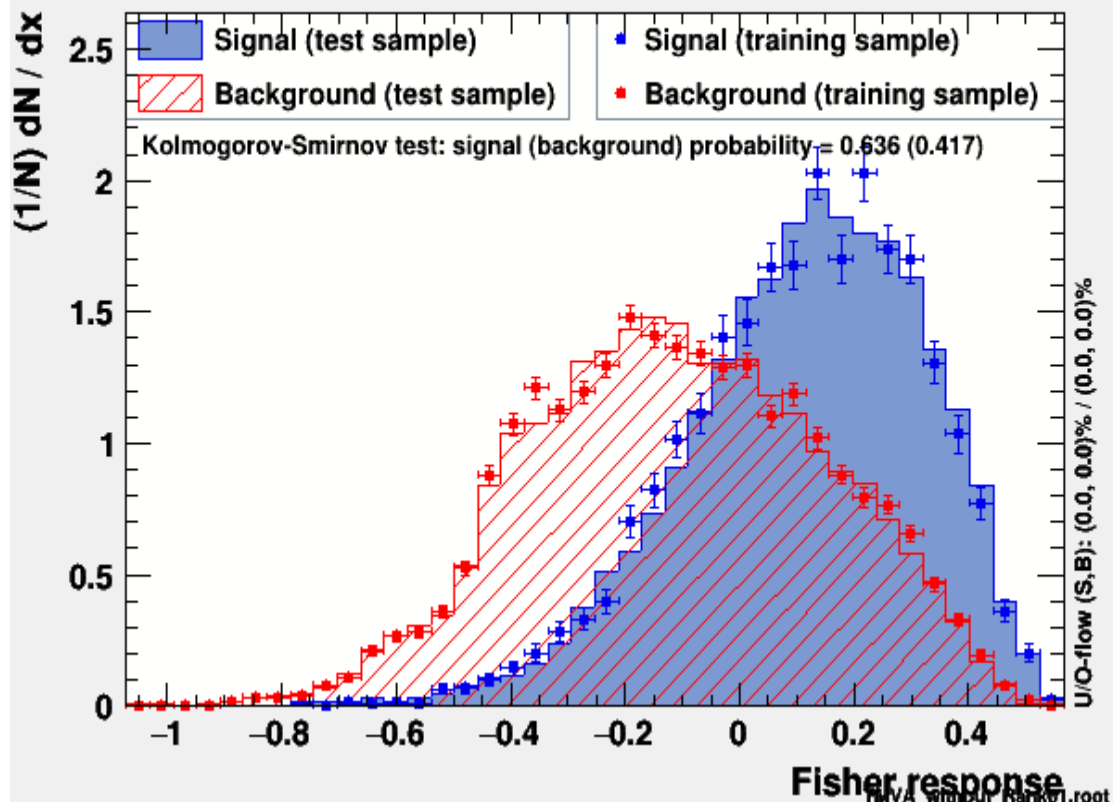


TMVA training

TMVA overtraining check for classifier: BDT



TMVA overtraining check for classifier: Fisher



ROC and Control plot

