

Updates on the $B^\pm \rightarrow K^\pm \tau^\pm \ell^\mp$

Inclusion of $\tau \rightarrow \rho \nu_\tau$ mode

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Selection criteria

Charged tracks

- Impact parameters: $|dr| < 1 \text{ cm}$ & $|dz| < 4 \text{ cm}$.
- Track momentum $p > 50 \text{ MeV}/c$.
- *electrons* : $e_{\text{ID}} > 0.6, \mu_{\text{ID}} < 0.98$,
 $\text{atcPIDBelle}(K, e) < 0.98$
- *muons* : $\mu_{\text{ID}} > 0.6, e_{\text{ID}} < 0.98$,
 $\text{atcPIDBelle}(K, \mu) < 0.98$
- *pions* : $\mu_{\text{ID}} < 0.6, e_{\text{ID}} < 0.6$,
 $\text{atcPIDBelle}(\pi, K) > 0.4$
- *Kaons* : $\mu_{\text{ID}} < 0.98, e_{\text{ID}} < 0.98$,
 $\text{atcPIDBelle}(K, \pi) > 0.6$

ECL Clusters, π^0 , & ρ^+

- goodBelleGamma: $E_{\gamma}^{\text{FE}} > 100 \text{ MeV}$, $E_{\gamma}^{\text{BR}} > 50 \text{ MeV}$, $E_{\gamma}^{\text{BE}} > 150 \text{ MeV}$.
- FakePhoton > 0.3 , BeamBackground > 0.3
- π^0 : $80 < M_{\gamma\gamma} < 180 \text{ MeV}/c^2$ & $\text{chiProb} > 0.001$
- ρ^+ : $570 < M_{\pi^+\pi^0} < 970 \text{ MeV}/c^2$.

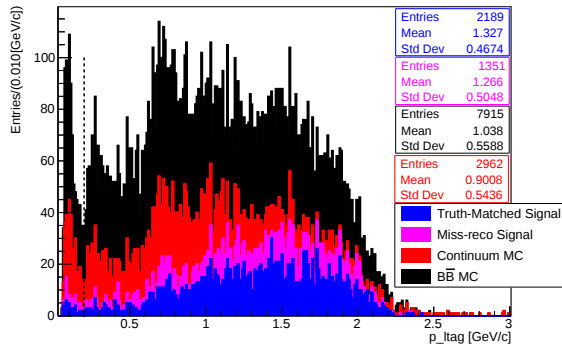
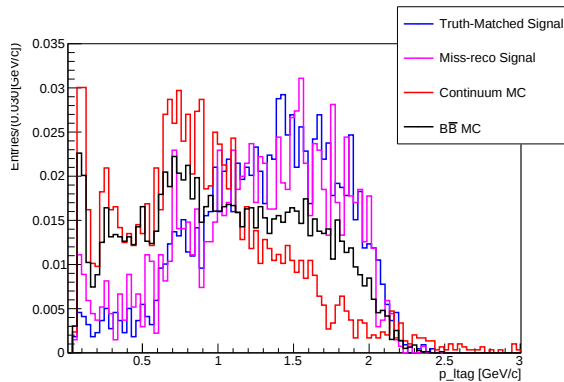
$B^\pm$ signal and ROE side

- $m_{D^{0(*)} \text{ inclusive}} < 2.15 \text{ GeV}/c^2$, $|M_{\gamma\gamma} - m_{\pi^0}| < 20 \text{ MeV}/c^2$, & $|\sin \phi| < 1.0$.

Veto conditions

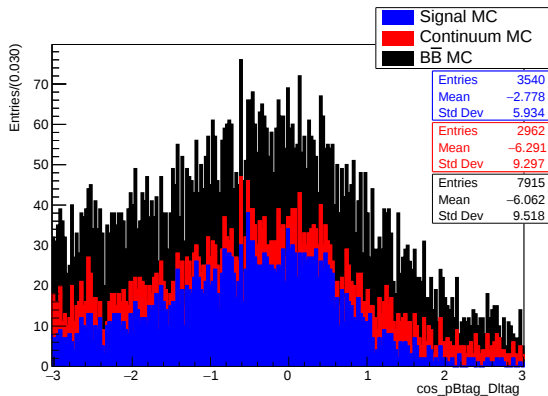
- $|m_{K^+\pi^-} - m_{D^0}| > 200 \text{ MeV}/c^2$ for the $B^+ \rightarrow K^+\tau^-[\pi^-\pi^0\nu_\tau]\ell^+$ system.
- $m_{K^+\rho^-} > 1.95 \text{ GeV}/c^2$ for the $B^+ \rightarrow K^+\tau^-[\rho^-\nu_\tau]\ell^+$ system.
- $m_{e_{\text{sig}}^\pm e_{\text{tag}}^\mp} > 100 \text{ MeV}/c^2$.

p_ℓ -tag side



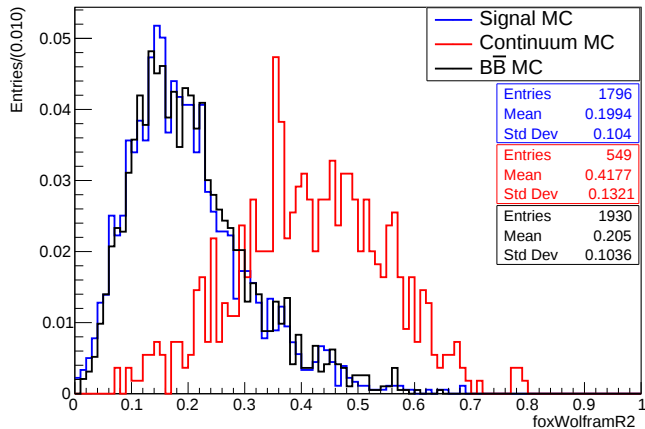
- Loose cut of $p > 200$ MeV/c for the tag side lepton.

Cosine of the angle between B_{tag} and visible momentum on tag side



- Requirement: $|\cos_{pB_{\text{tag}} D_{\text{ltag}}}| < 1.25$.

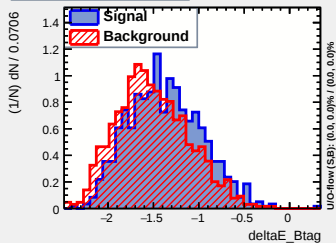
Reduced Fox-Wolframe variable R_2



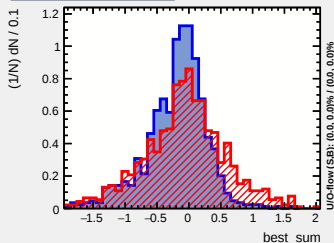
- Requirement: $R_2 < 0.4$.

BDT training variables: Signal vs Generic- $B\bar{B}$ MC

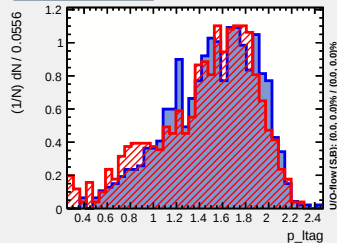
Input variable: deltaE_Btag



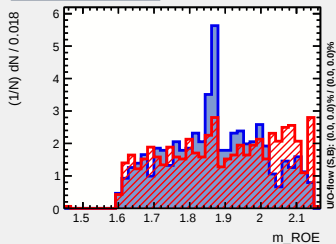
Input variable: best_sum



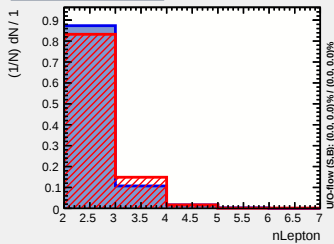
Input variable: p_ltag



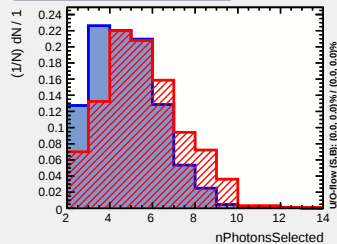
Input variable: m_ROE



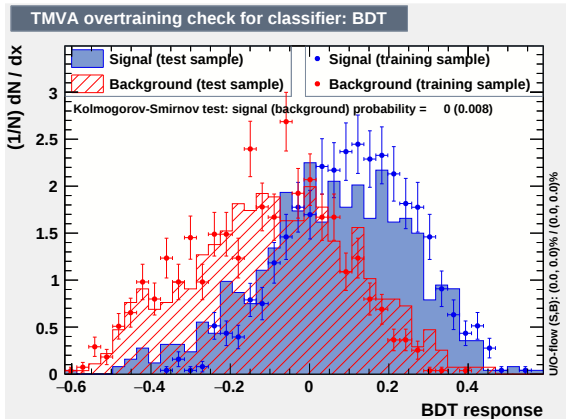
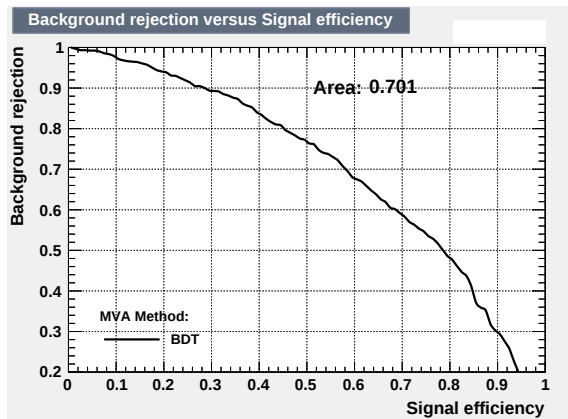
Input variable: nLepton



Input variable: nPhotonsSelected



BDT training variables: Signal vs Generic- $B\bar{B}$ MC



BDT validation

