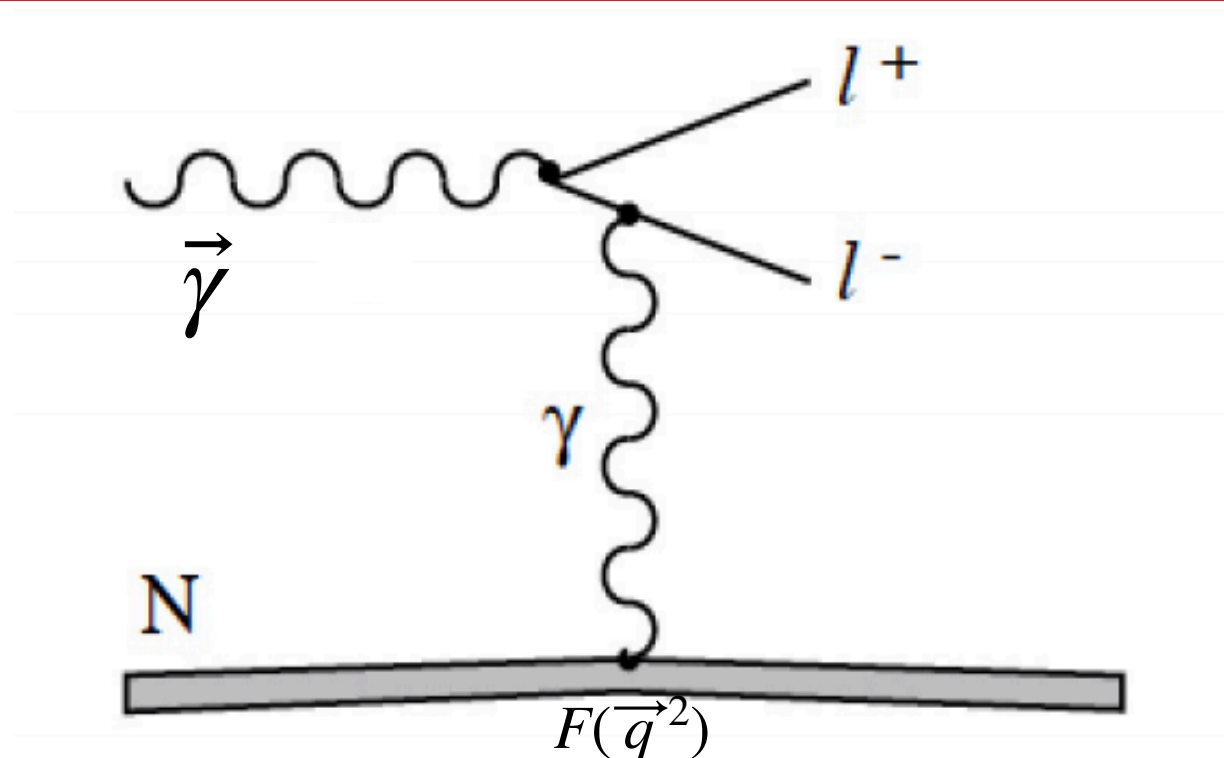


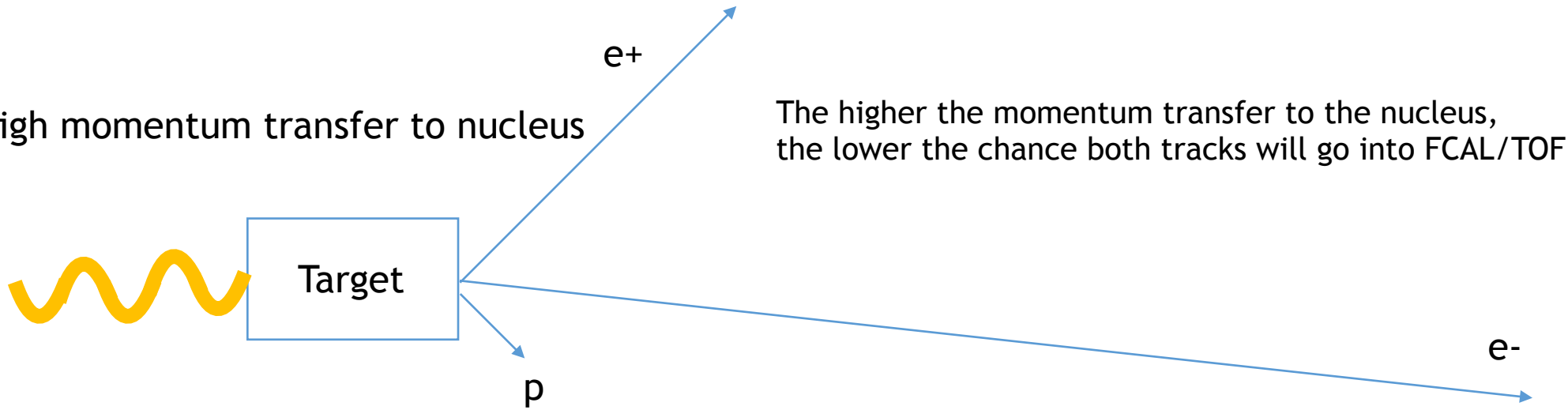
MVA to Remove Pion Contamination in Bethe-Heitler Study $\gamma p \rightarrow e^+e^-(p)$



Andrew Schick

Wednesday, January 8 2020

High momentum transfer to nucleus

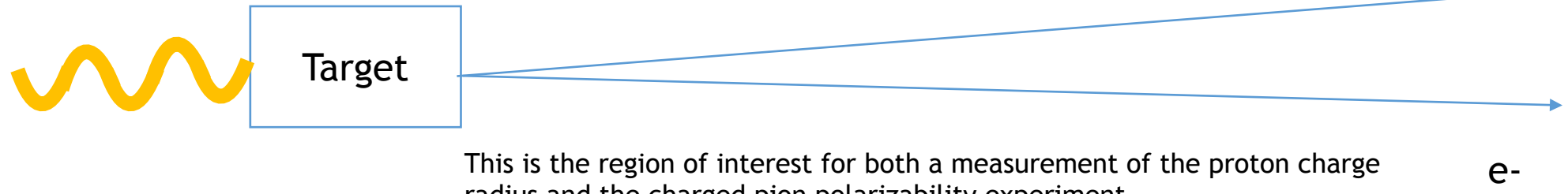


The higher the momentum transfer to the nucleus, the lower the chance both tracks will go into FCAL/TOF

T
O
F

T
O
F

Low momentum transfer to nucleus, proton doesn't even make it out of target



This is the region of interest for both a measurement of the proton charge radius and the charged pion polarizability experiment

T
O
F

T
O
F

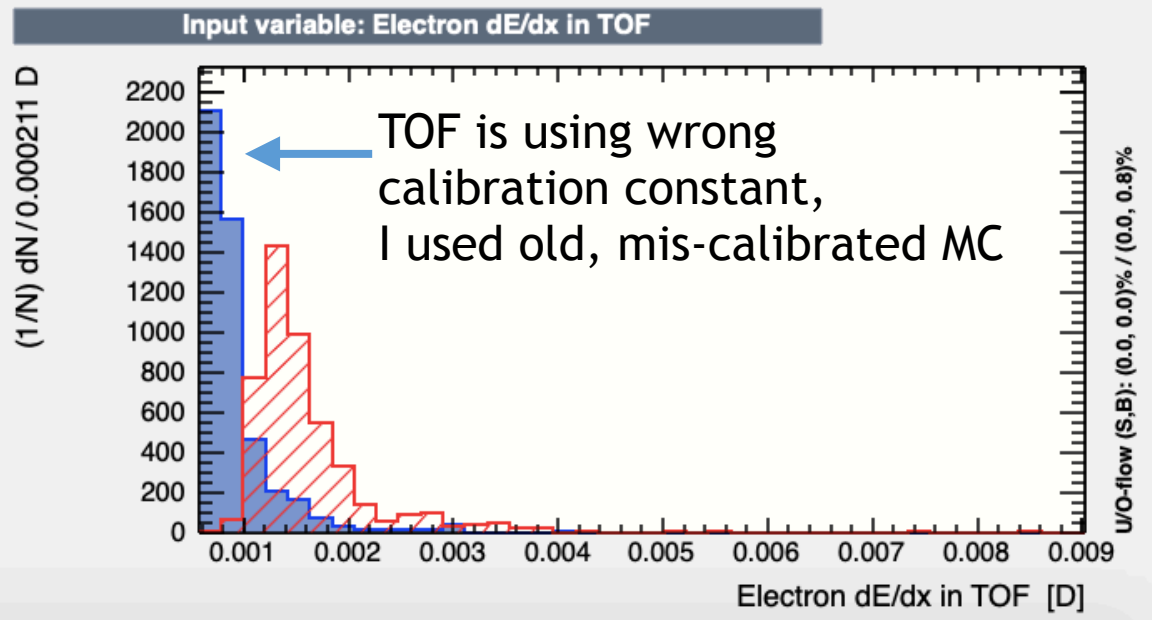
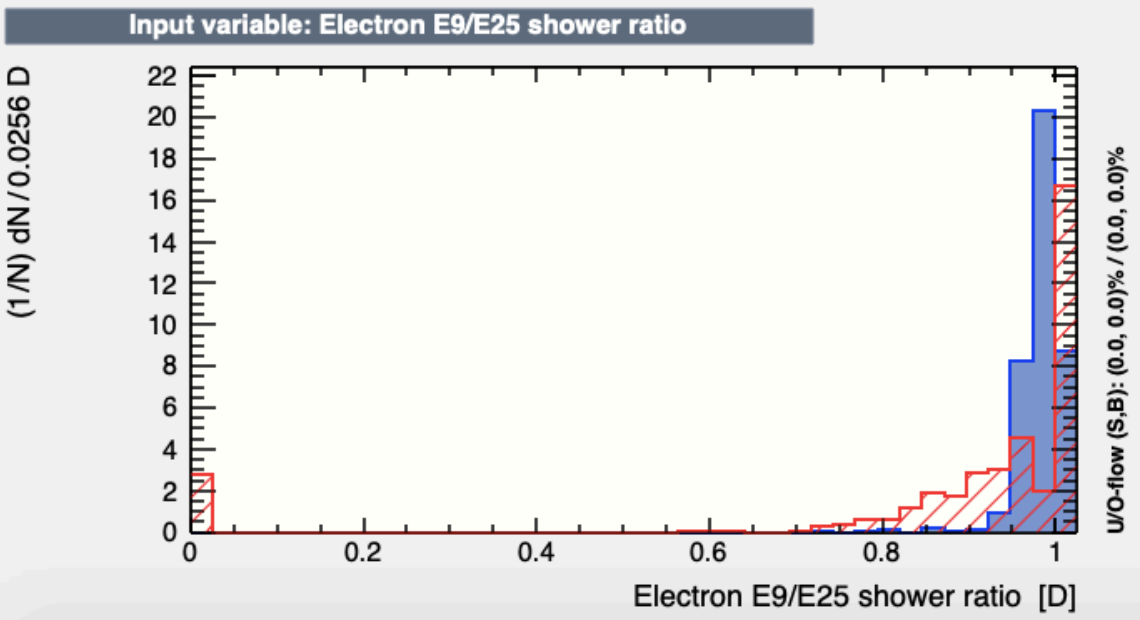
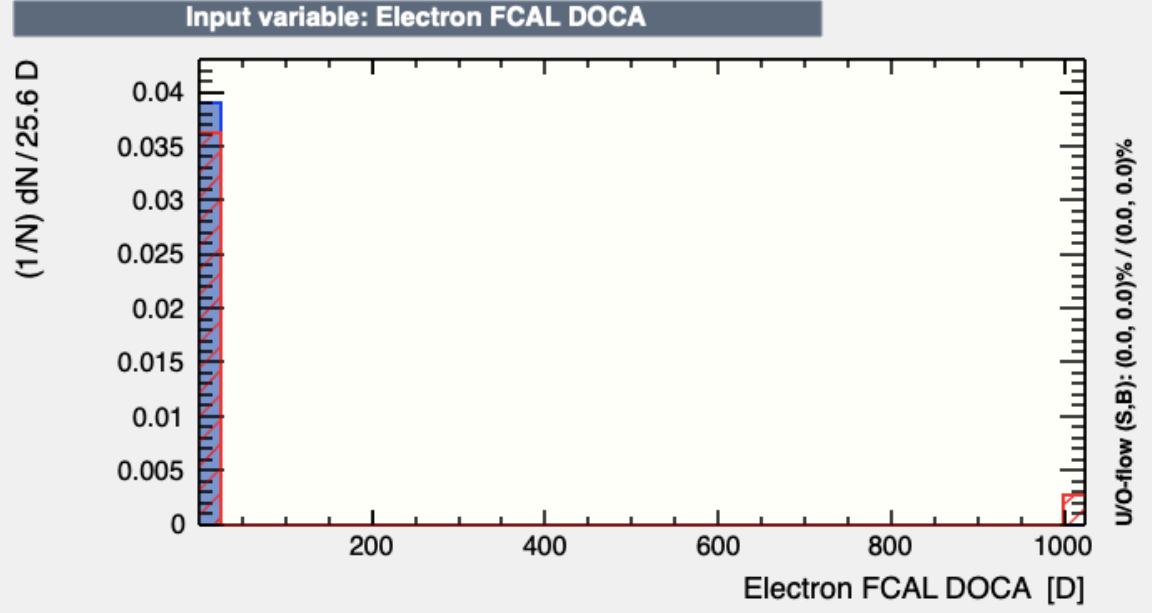
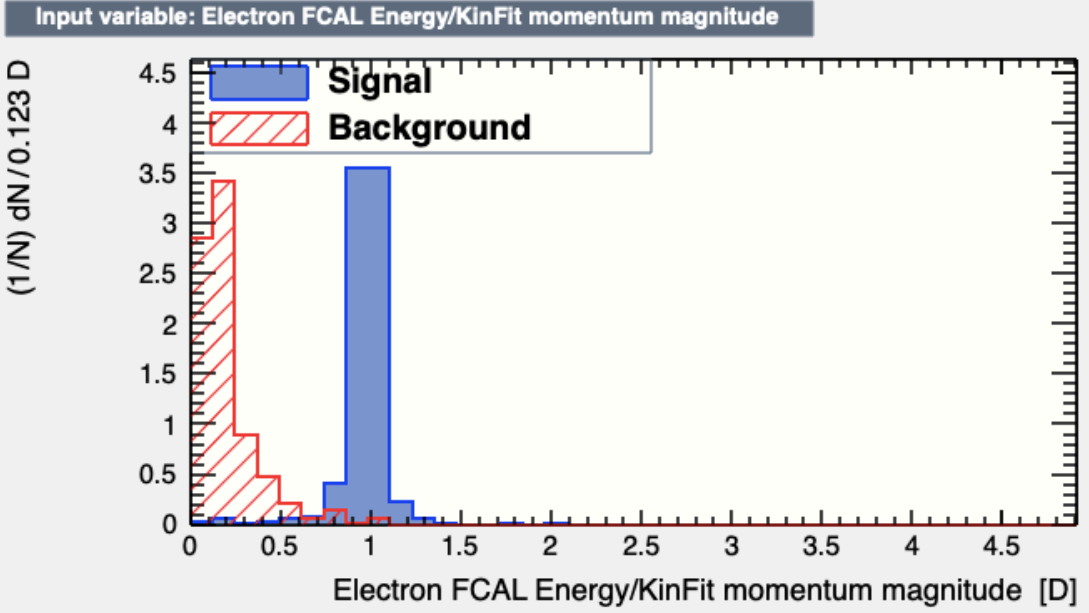
How to do the MVA?

- Use Electron MC and Pion data.
- Require at least one of the tracks goes into the TOF (this also guarantees a hit in FCAL).
- Fill one tree with all the events where it was the π^+/e^+ that went into the TOF. Run the classification and apply cuts.
- Fill another tree with all the events where it was the π^-/e^- that went into the TOF. Run the classification and apply cuts on what remains after the first running.

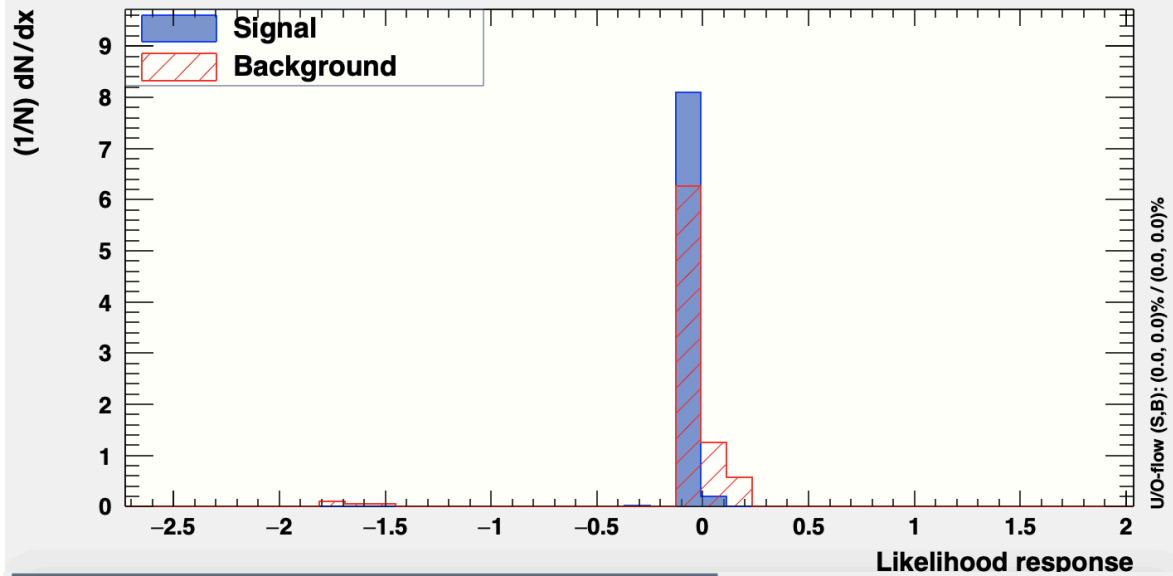
So let's look at MVA on electron MC and pion data

- Pion data is obtained with $\gamma p \rightarrow \pi^+ \pi^- p$ reaction filter.
- Electron MC is from Rory's generated 4-vectors.

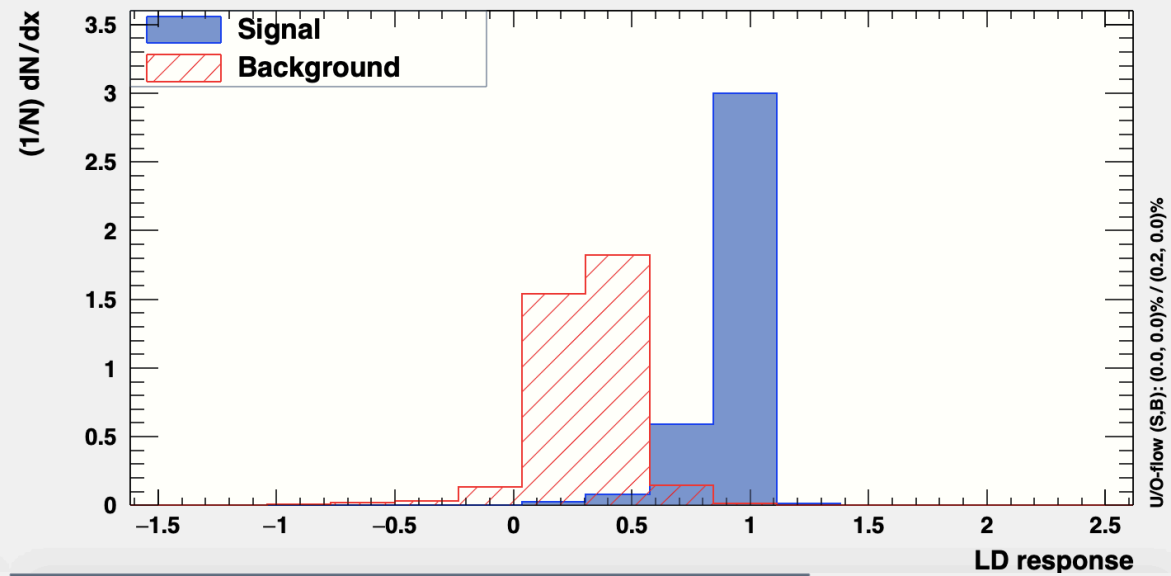
- 4 methods looked at:
 - Likelihood
 - Linear Discriminant
 - Boosted Decision Tree
 - Neural Net (MLPBNN)



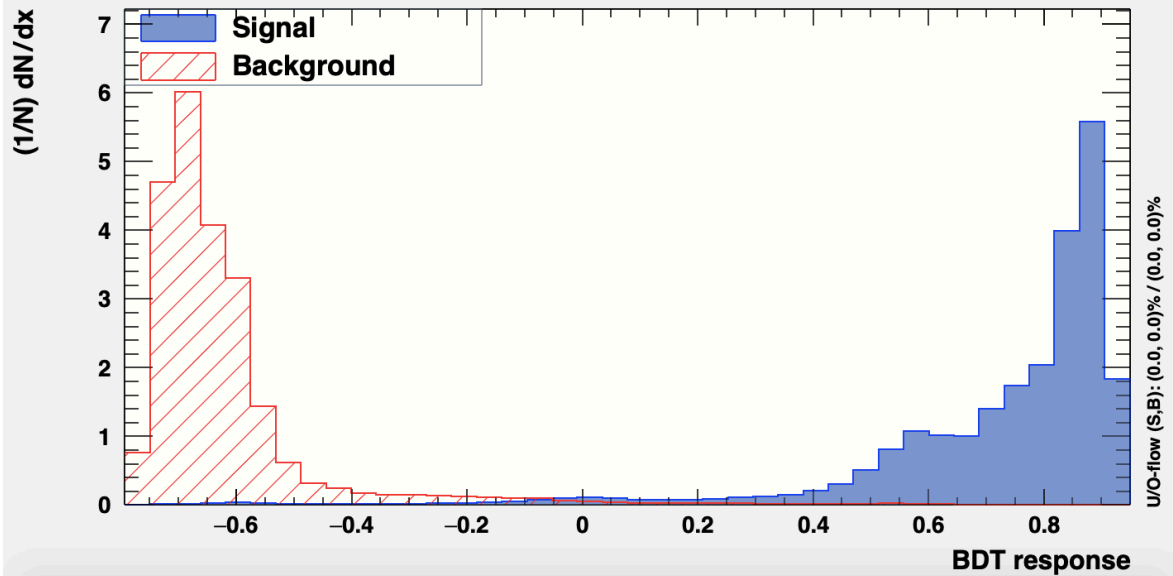
TMVA response for classifier: Likelihood



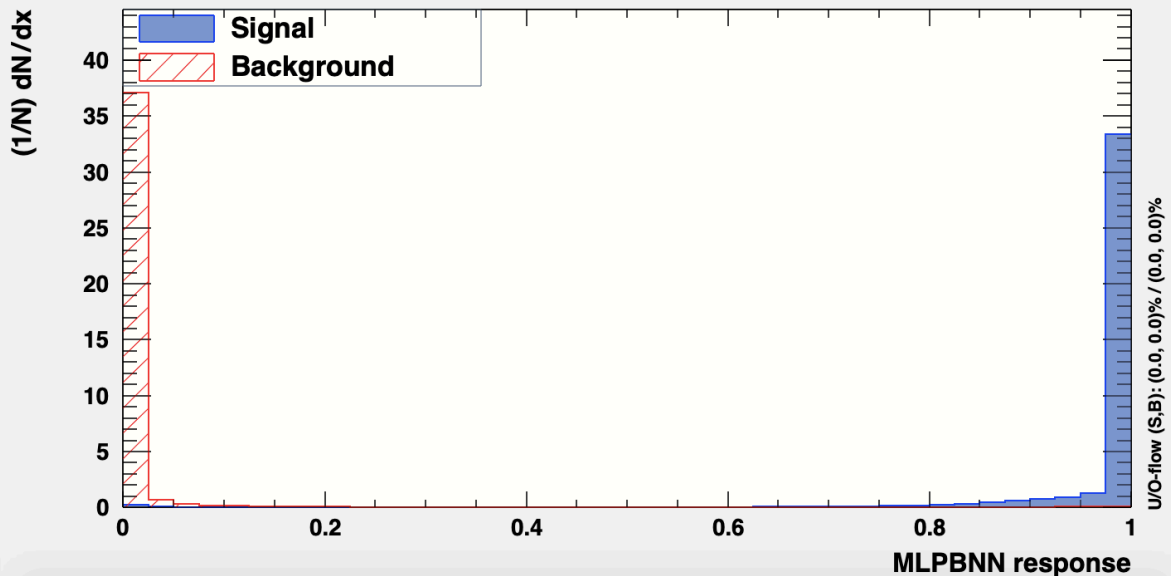
TMVA response for classifier: LD



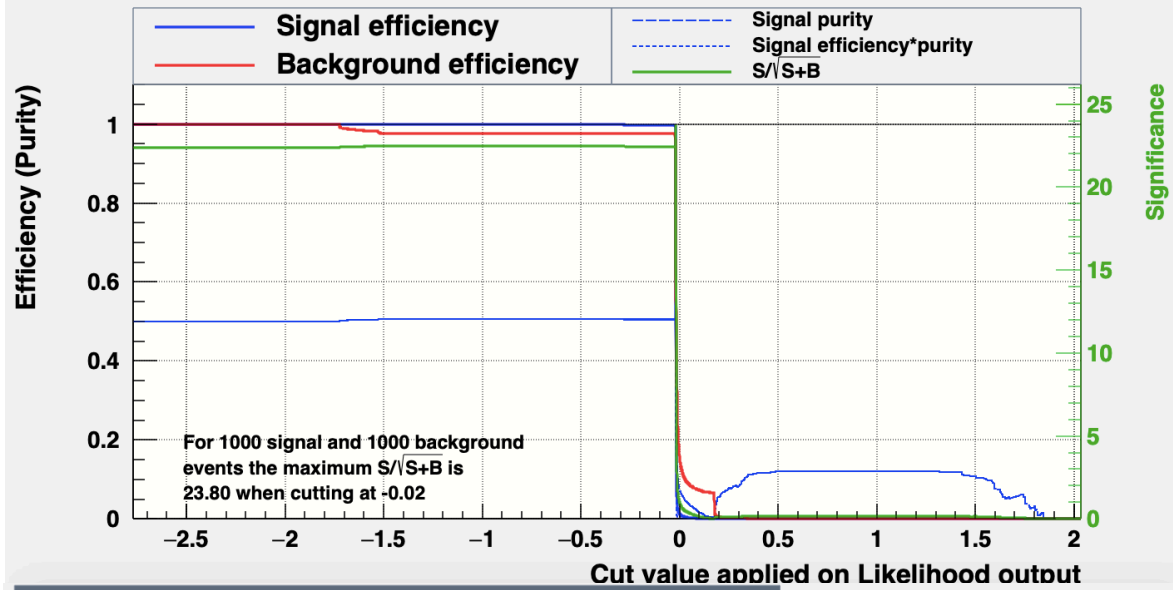
TMVA response for classifier: BDT



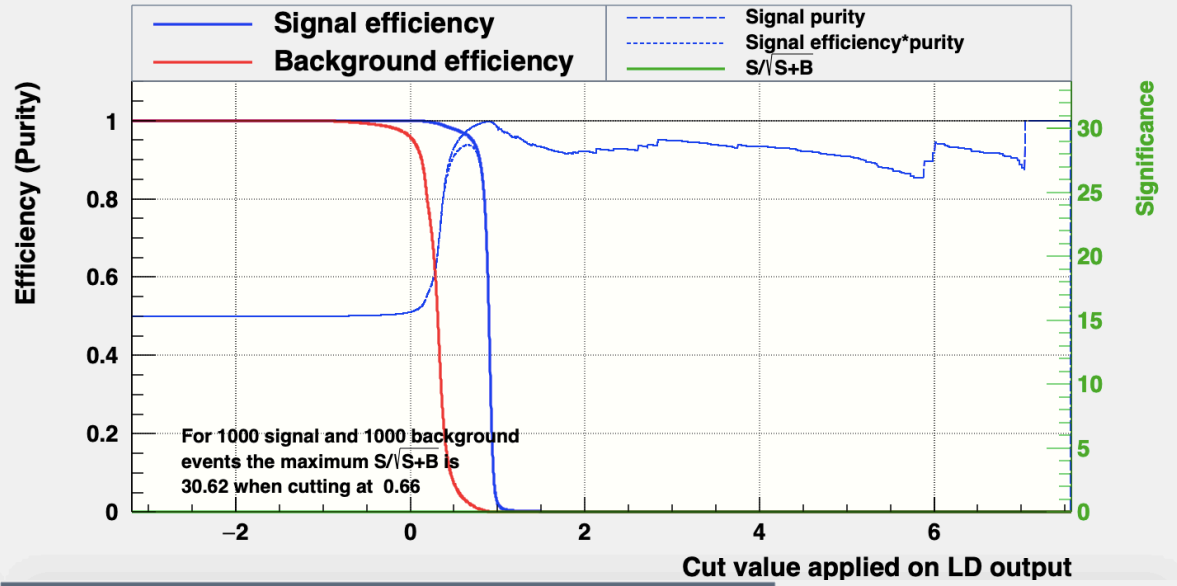
TMVA response for classifier: MLPBNN



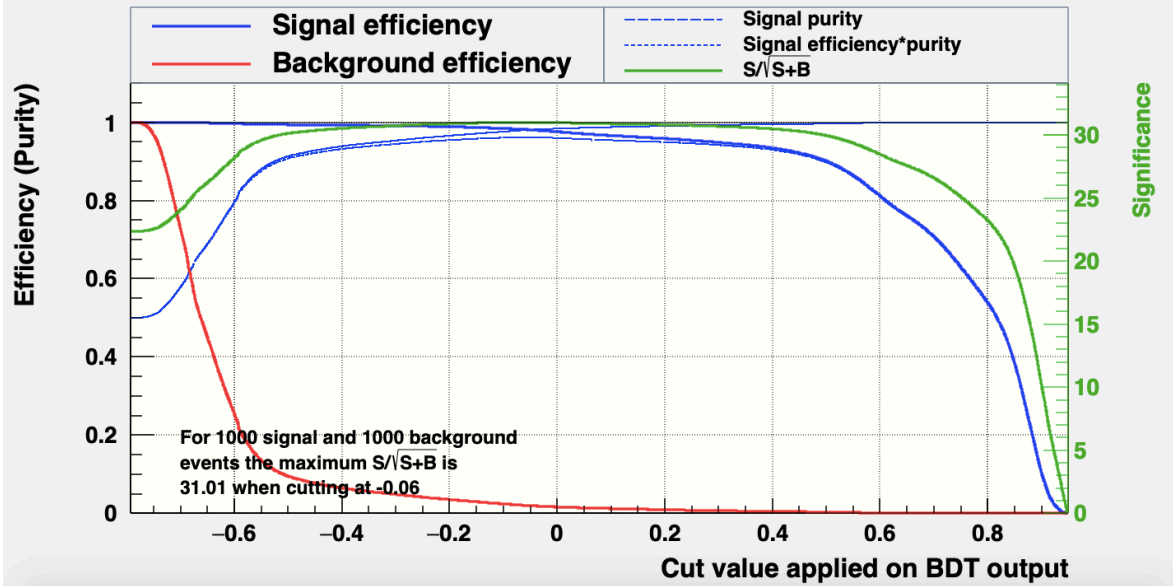
Cut efficiencies and optimal cut value



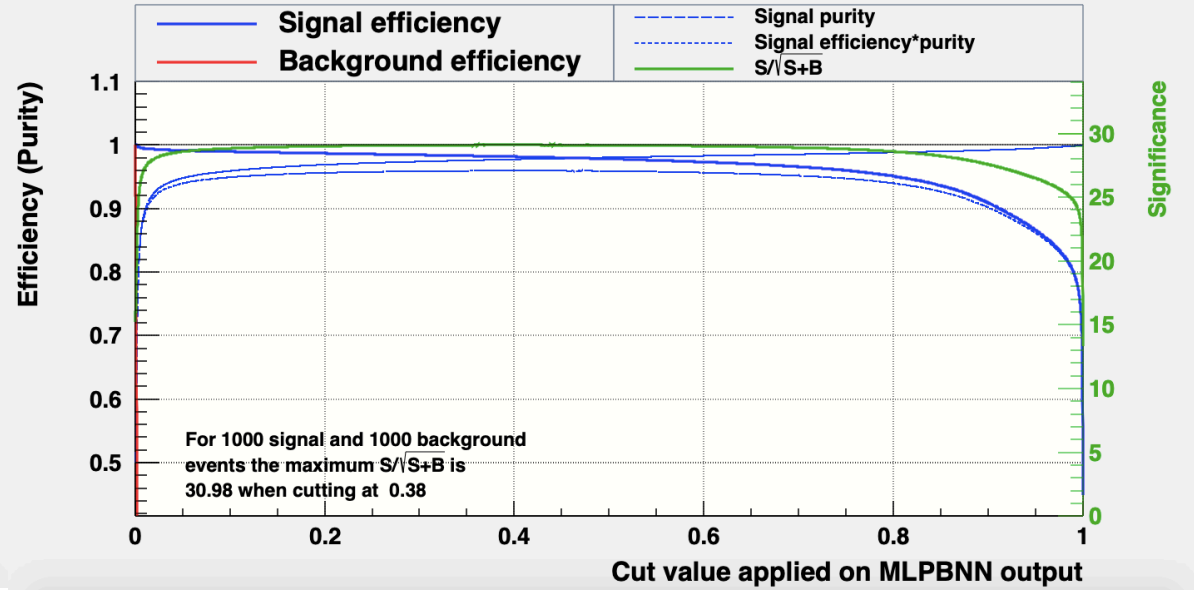
Cut efficiencies and optimal cut value



Cut efficiencies and optimal cut value



Cut efficiencies and optimal cut value



Electron FCAL Energy/KinFit momentum magnitude :

Electron FCAL DOCA :

Electron E9/E25 shower ratio :

Electron dE/dx in TOF :

Bias node :

