LHCb MC group meeting: $B^0 \to K^{*0} \mu \mu$

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$B^0 \rightarrow K^{*0} \mu \mu$

- Decay is a FCNC
- four charged particles in final state:
- K^+ and π^- from the K^{*0} decay
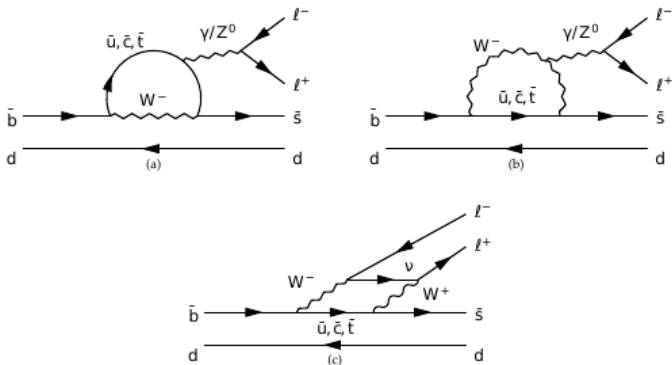- two leptons from loop or box diagrams:

Figure: Feynman diagrams for decay $B_d \rightarrow \mu^+ \mu^-$ at lowest order

$B^0 \to K^{*0} \mu \mu$

three angels define the kinematics of the decay:

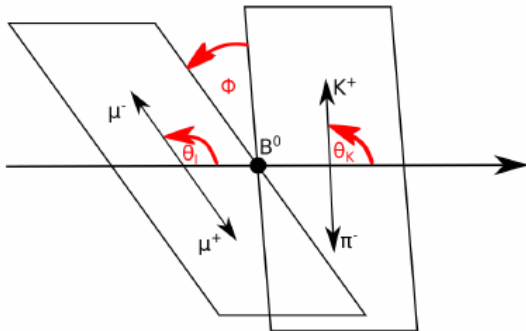- ThetaK or θ_K
- ThetaL or θ_L
- Phi or ϕ

Figure: kinematic variables of the decay $B^0 \to K^{*0} \mu \mu$

classification with Machine Learning (BDT)

- to eliminate combinatorial background, Boost Decision Trees are used as a black box to classify data into signal and background.
- They assign a 'probability' to each event
- sk bdt from the scikit-learn package is used, and uBoost from the hep ml package
- average of both gives the BDT response
- training has been performed on the Linux Cluster in Zurich

Region to train

- you want the bdt to train in the background region
- J/Psi has two resonance which will be cut off
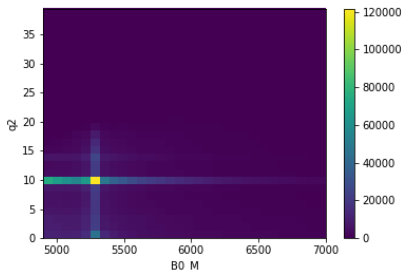
(a) Before Cut
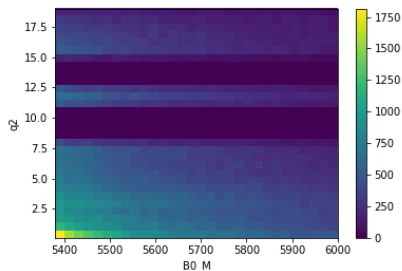
(b) After Cut

training of the BDTs
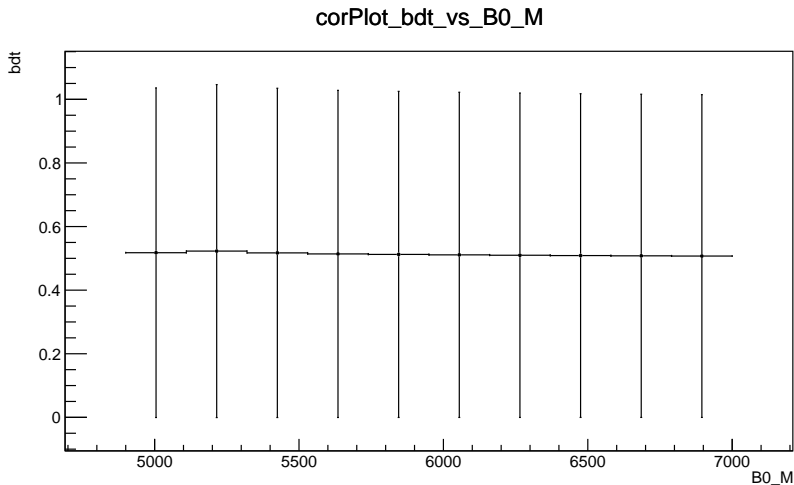
8 train parameters:

- B0 P
- B0 PT
- B0 ENDVERTEX CHI2
- B0 IP OWNPV
- B0 IPCHI2 OWNPV
- B0 FD OWNPV
- B0 FDCHI2 OWNPV
- B0 relinfo VTXISOBDTHARDFIRSTVALUE
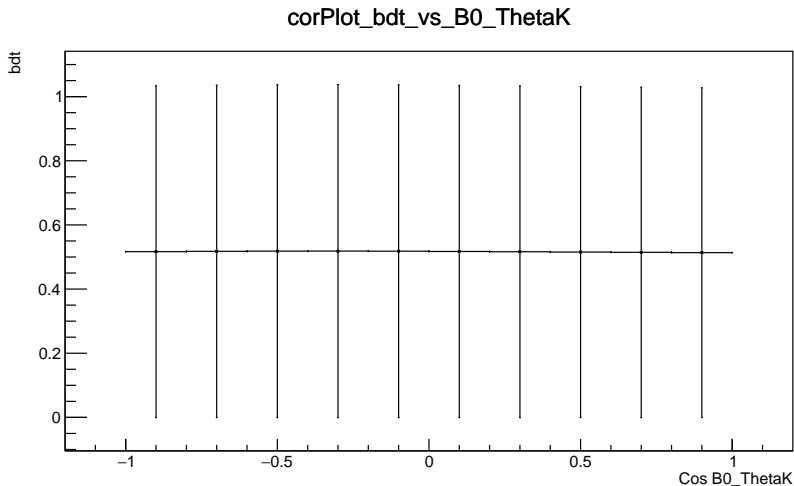
4 uniform parameters:

- B0 M
- B0 ThetaK
- B0 ThetaL
- B0 Phi

uniform parameters have to be uncorrelated since we know that from physics. But BDT might find a correlation which is bad.
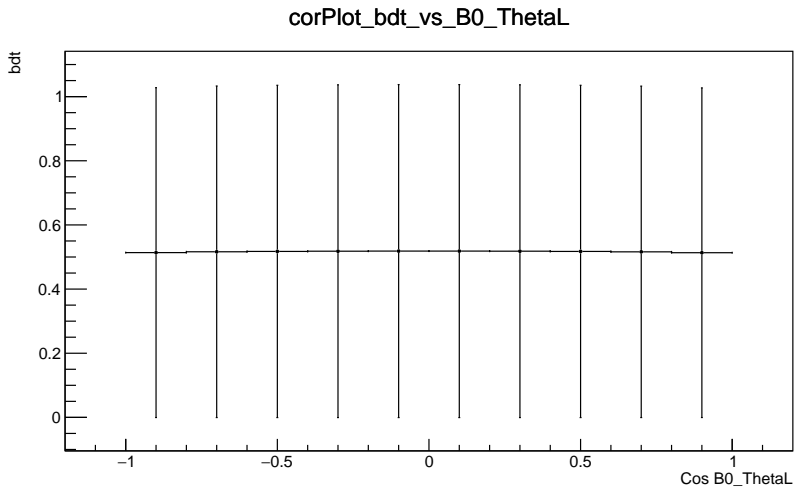
BDT correlation check

BDT correlation check

corPlot_bdt_vs_B0_ThetaK

BDT correlation check

corPlot_bdt_vs_B0_ThetaL

BDT correlation check

corPlot_bdt_vs_B0_Phi