Search for Cabibbo-suppressed decay $\Lambda_b \to (J/\psi)p\pi$

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Physical context

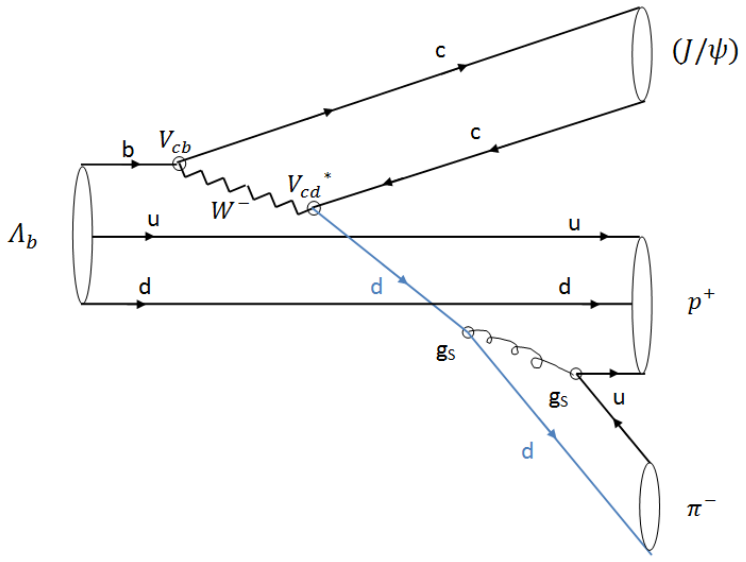

Figure: Cabibbo-suppressed decay: $\Lambda_b \to (J/\psi)p\pi$

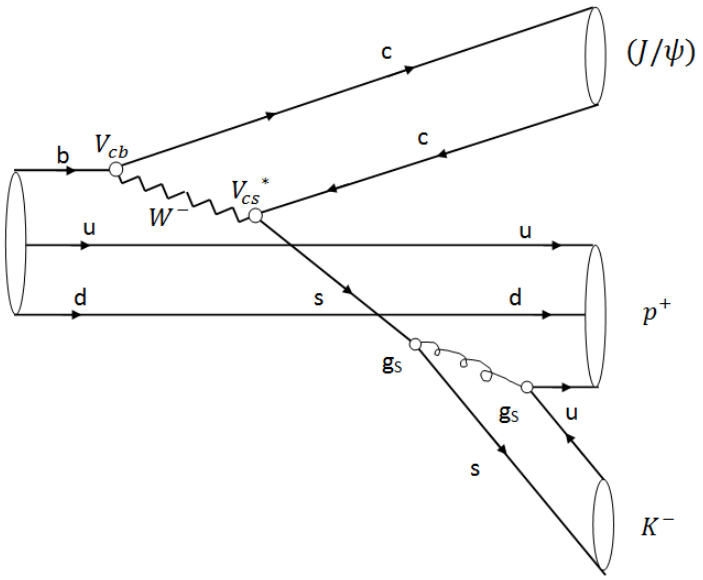

Figure: Cabibbo-favoured decay: $\Lambda_b \to (J/\psi)pK$

- interesting for CKM - physics: $\frac{|V_{cd}|^2}{|V_{cs}|^2}$

Overview of method

- MC11a-Signal tree (S)
- MC11a-Background tree (B)
  – Inclusive (J/ψ)
- Data tree (D)

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- Study variables for S and B
- Train NN on S and B
- Test NN on S and B
- Use NN on D
- Optimize NN-cut on D

Finding discriminating variables

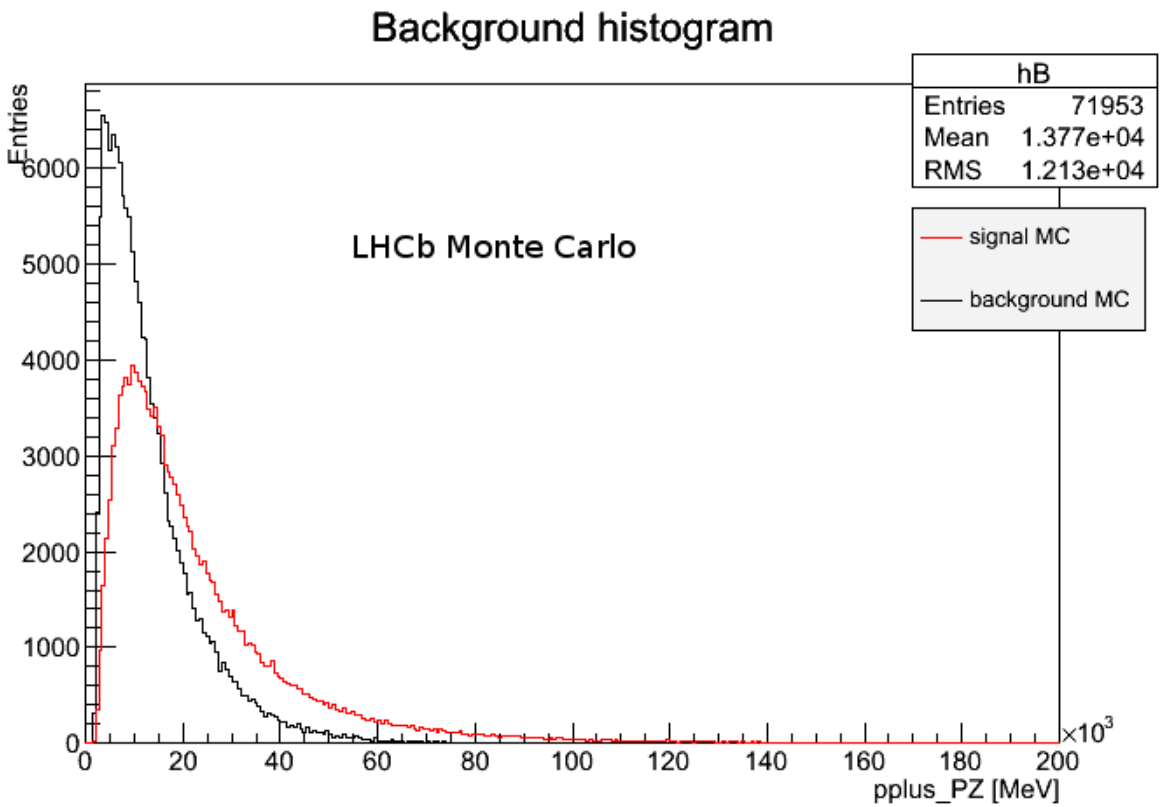
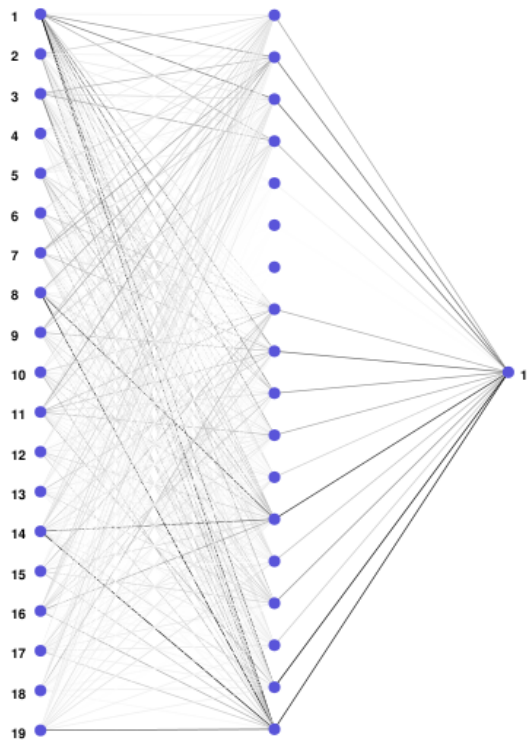
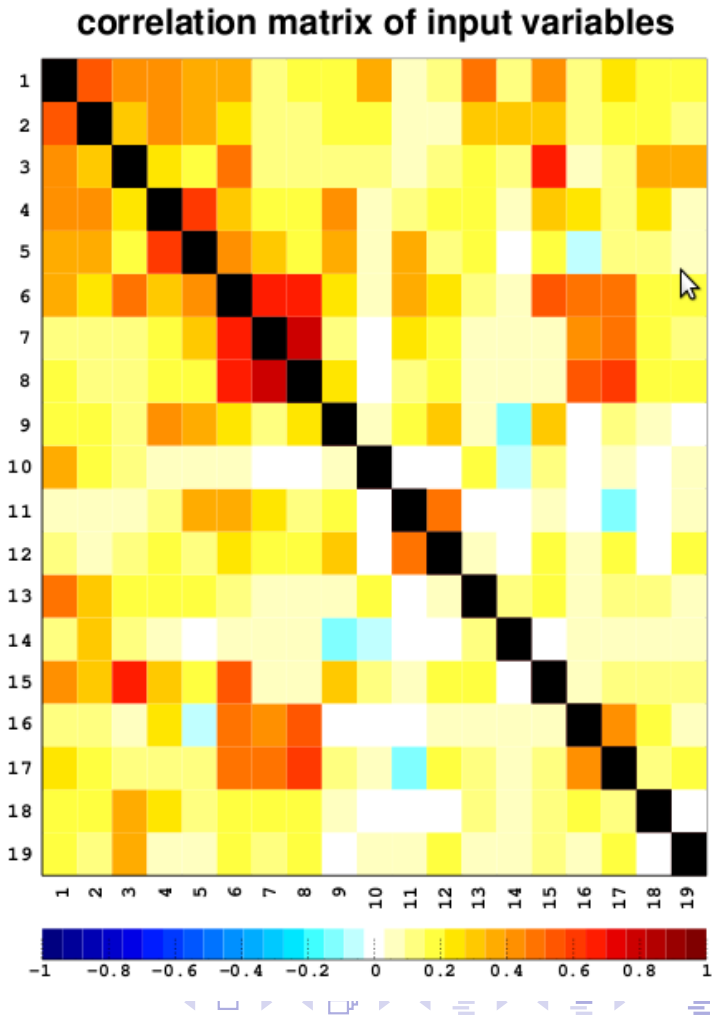


Figure: Combined S and B proton p_z histogram

Training the Neural Network (NN)

- 18 discriminating variables





Using NN on real data

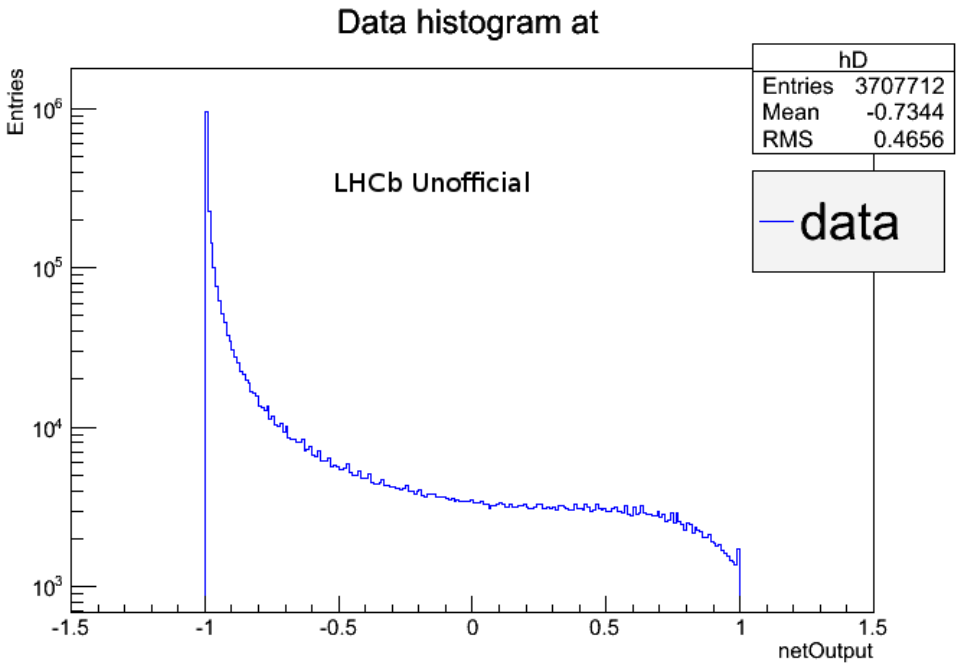


Figure: NN output distribution

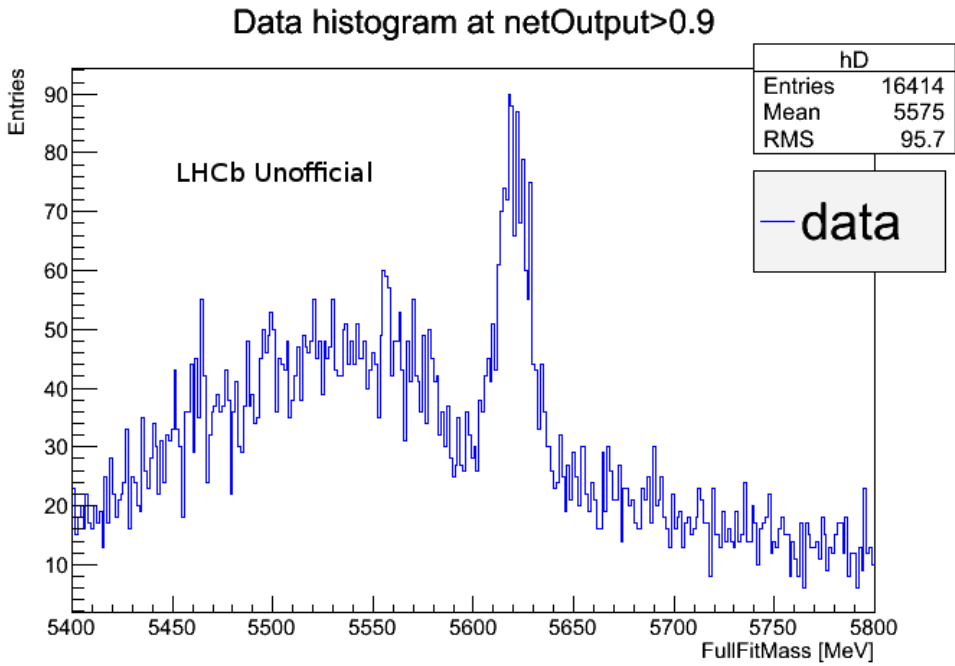


Figure: NN invariant mass distribution

- Observed peak at $M_{\Lambda_b} = 5620$ MeV !

Conclusions and Outlook

- first observation of the $\Lambda_b \to (J/\psi)p\pi$!

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- first observation of the $\Lambda_b \to (J/\psi)p\pi$!
- mass-fitting the peak
- s-plot analysis
- studying the $p\pi$ mass distribution
- extracting branching fractions ratios:
  $\Lambda_b \to (J/\psi)p\pi$: $\Lambda_b \to (J/\psi)pK$

Backup

Stripping and loose Cuts

Data: 2011 `Reco12-Stripping17b`. $1\,\mathrm{fb}^{-1}$.

Stripping line: `BetaSLambdab2JpsippiDetachedLine` based on `StdLooseProtons`, `NoPIDPions` and `StdMassConstrainedJpsi2MuMu`. Vertex $\chi^2/\mathrm{dof} < 5$ and $\tau_{\Lambda_b} > 0.2\,\mathrm{ps}$.

Candidates are filled in `DecayTreeTuple`. Several instances of `DecayTreeFitter` are run with various mass hypotheses.

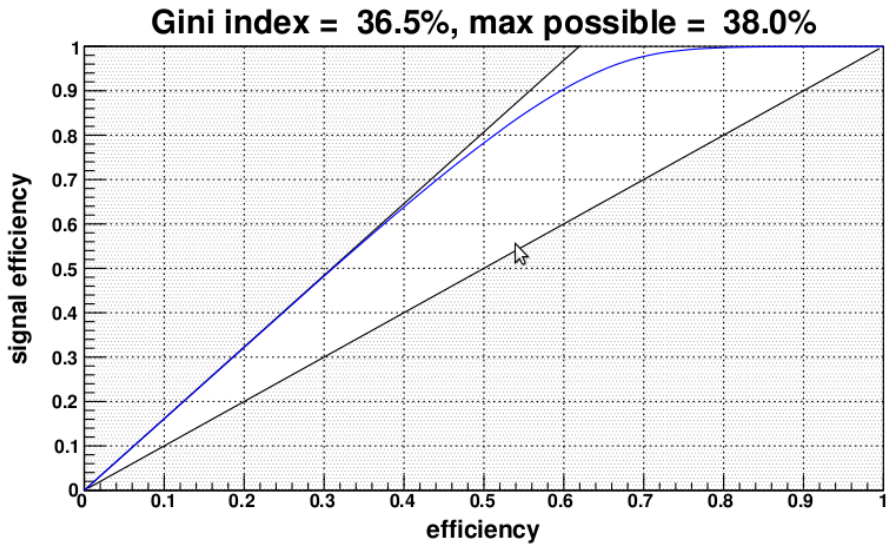
Trigger: No trigger requirements are made yet. This will be studied later.

List of discriminating variables

- B_FullFit_chi2_B
- acos(B_DIRA_OWNPV)
- B_FDCHI2_OWNPV
- B_FullFit_ctauErr
- B_MINIP
- pplus_PT
- pplus_PZ
- pplus_PIDp
- pplus_PIDK
- pplus_IPCHI2_ORIVX
- pplus_MINIPCHI2
- piminus_PZ
- piminus_PT
- piminus_PIDK
- piminus_IPCHI2_ORIVX
- piminus_MINIPCHI2
- Psi_FD_OWNPV
- nLongTracks

More on the Neural Network

- 5 Λ_b variables
- 6 p variables
- 5 π variables
- 1 (J/ψ) variable and 1 global event variable



Testing NN on MC-background (combinatorial)

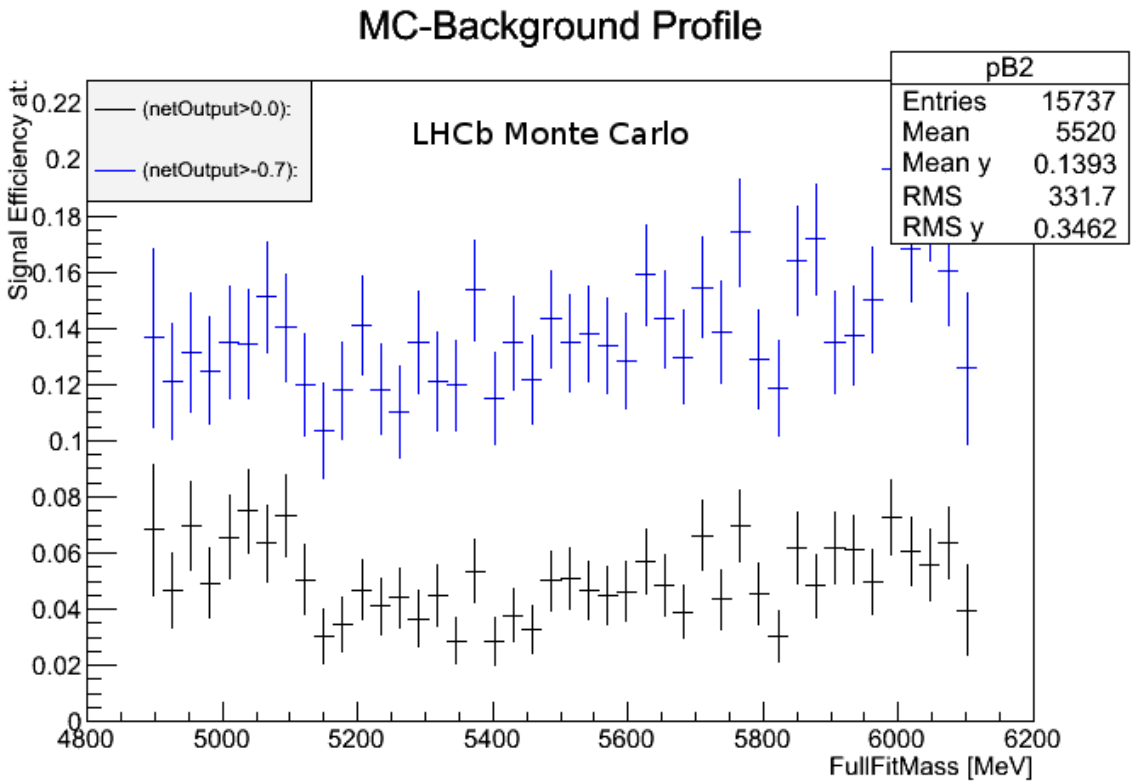


Figure: NN efficiency function of (total) invariant mass

Testing NN on MC-signal

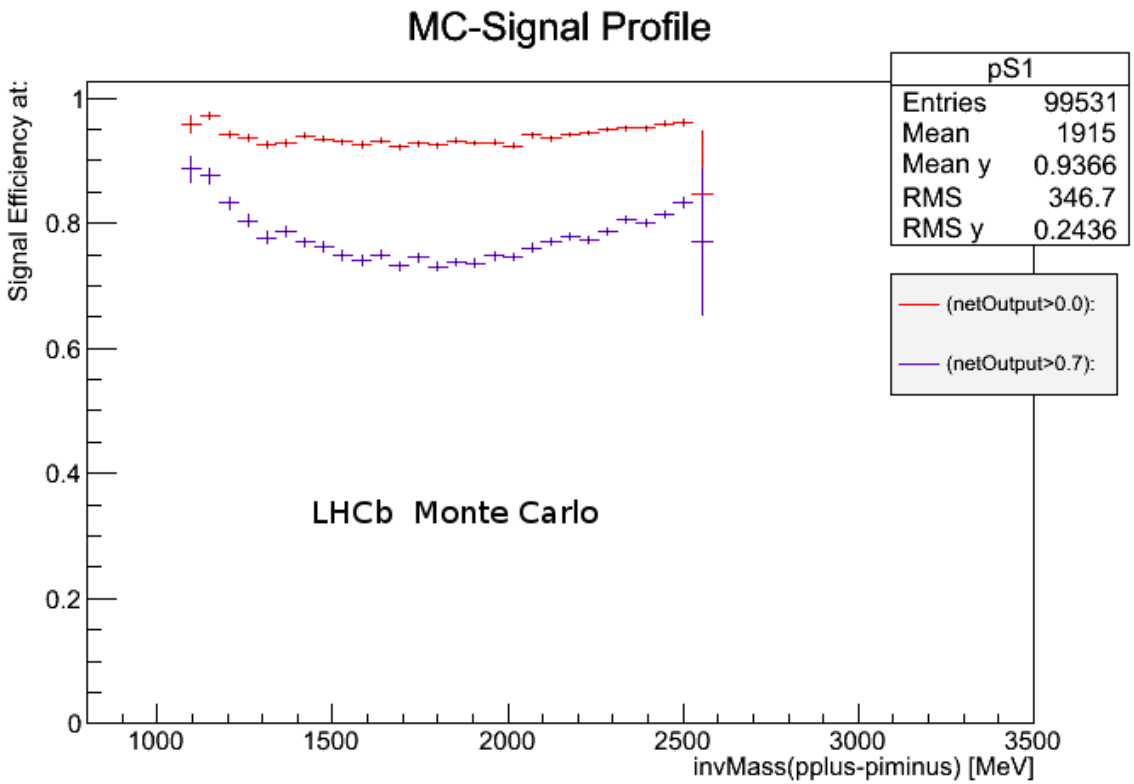


Figure: NN efficiency function of $p\pi$ invariant mass

Optimizing the NN output

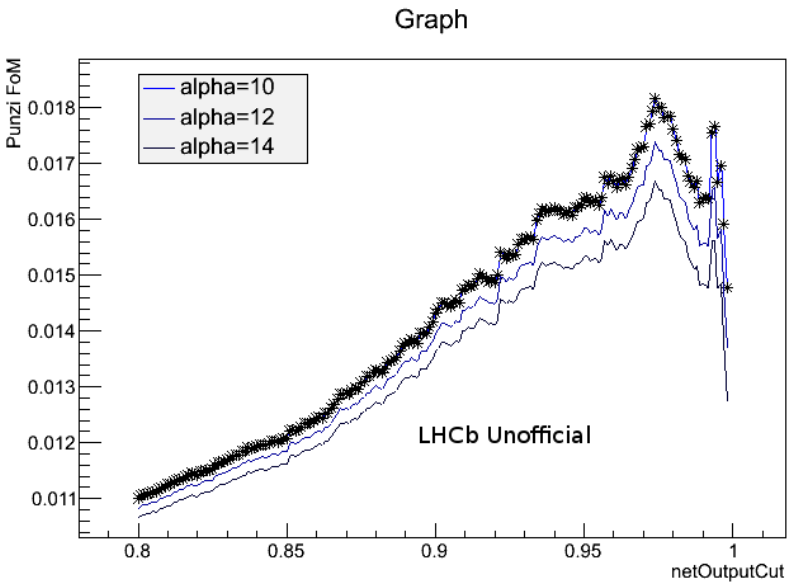


Figure: Maximising Punzi FoM on Signal (MC) and Data sidebands

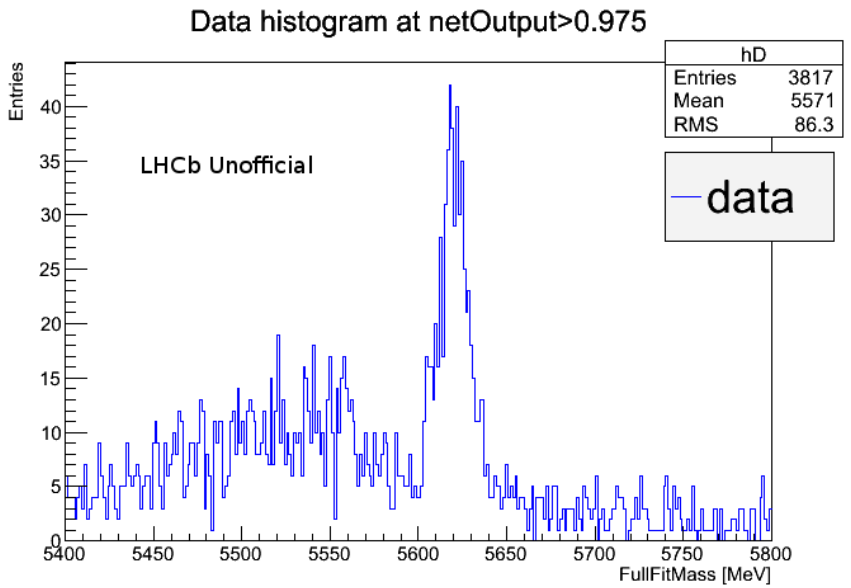


Figure: Optimal NN Inv. mass distrib.

- NN efficiency for netOutput > 0.975: $\epsilon_{NN} = 0.41$

Punzi Figure of Merit

- $\frac{\epsilon_{NN}}{\frac{\alpha}{2}+\sqrt{B_{NN}}}$
- ϵ_{NN}, B_{NN} defined within $[5600, 5640]$
- B_{NN} from linear extrapolation from $[5640, 5800]$ to $[5600, 5640]$
- ϵ_{NN} obtained from S