Prompt $\Lambda_c^+ \to p^+h^+h^-$ BF Update: MVA Selection

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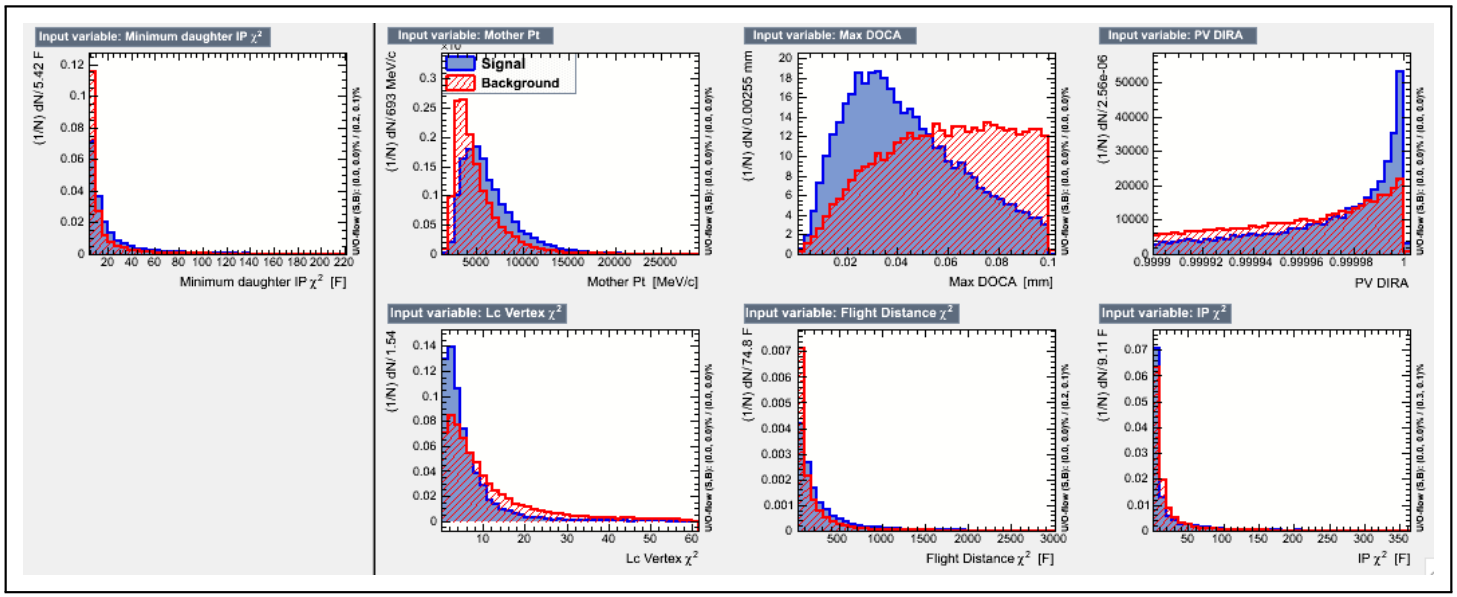
Recap

- Last time we presented a recursively optimised cut based selection for both the Cabibbo Favoured mode $\Lambda_c^+ \to p^+ K^- \pi^+$ and the unobserved DCS mode $\Lambda_c^+ \to p^+ K^+ \pi^-$.
- Trigger chain is TIS due to lack of dedicated lines for most of 2011.
- Projected significance for the DCS mode, obtained using sWeights, was 3.27.
- We have now developed an MVA selection using a BDT.

Discriminating Variables

- Have used 7 variables in the MVA training:
  - Λ_c Pt
  - Λ_c Vertex χ^2
  - Λ_c Vertex Max DOCA
  - Λ_c DIRA
  - Λ_c IP χ^2 OWN PV
  - Lowest daughter IP χ^2 OWN PV
  - Λ_c flight distance χ^2
- Want to make the selection as agnostic as possible to the daughters.



PID variables

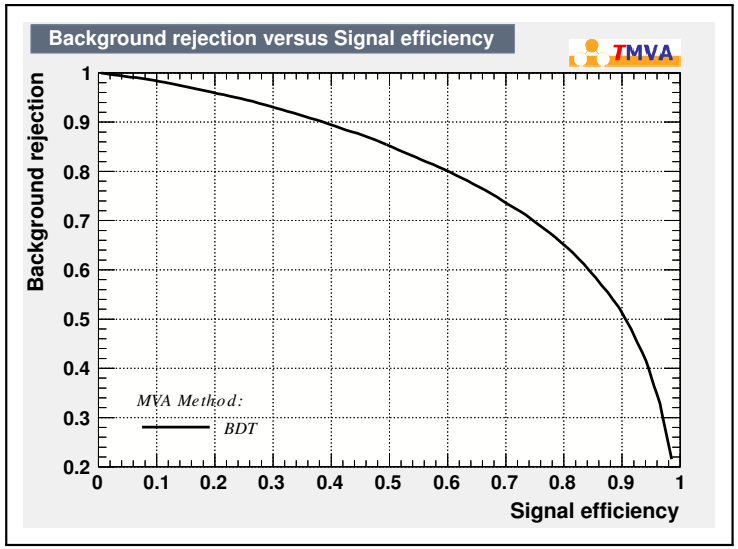
- Problems when incorporating PID variables into MVA, makes determining PID efficiencies problematic.
- Have used CROP in conjunction with TMVA to incorporate these into a selection.
- Have utilised the PID hypotheses for p, K and e for all daughter variables in optimisation, as well as (proton$_{PIDp}$-proton$_{PIDK}$).

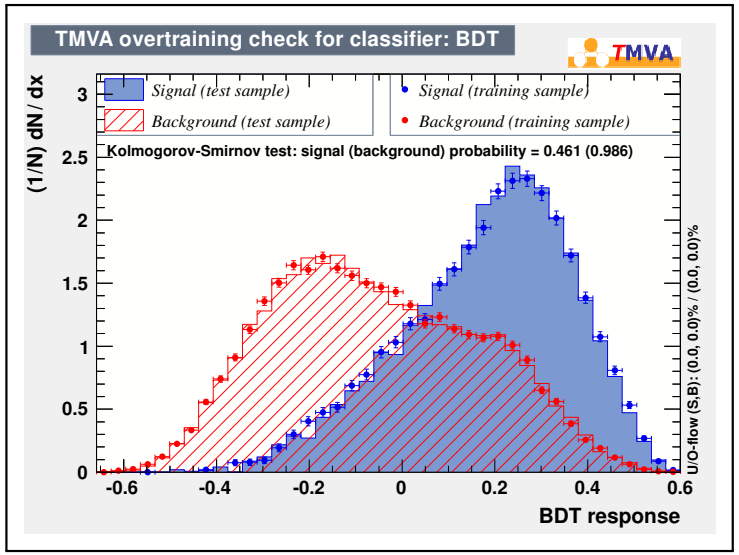
Optimisation Strategy

- For each mode initially train the BDT with no PID cuts in training.
- Then use CROP to optimise the PID variables in conjunction with the BDT response.
- Feed new PID cuts into training to acquire new BDT.
- Use CROP to optimise the new BDT responses to acquire new optimum PID cuts.
- Repeat this process until the optimum PID cuts given by CROP converge - optimum BDT and optimum PID cuts can be acquired simultaneously.

BDT Parameters

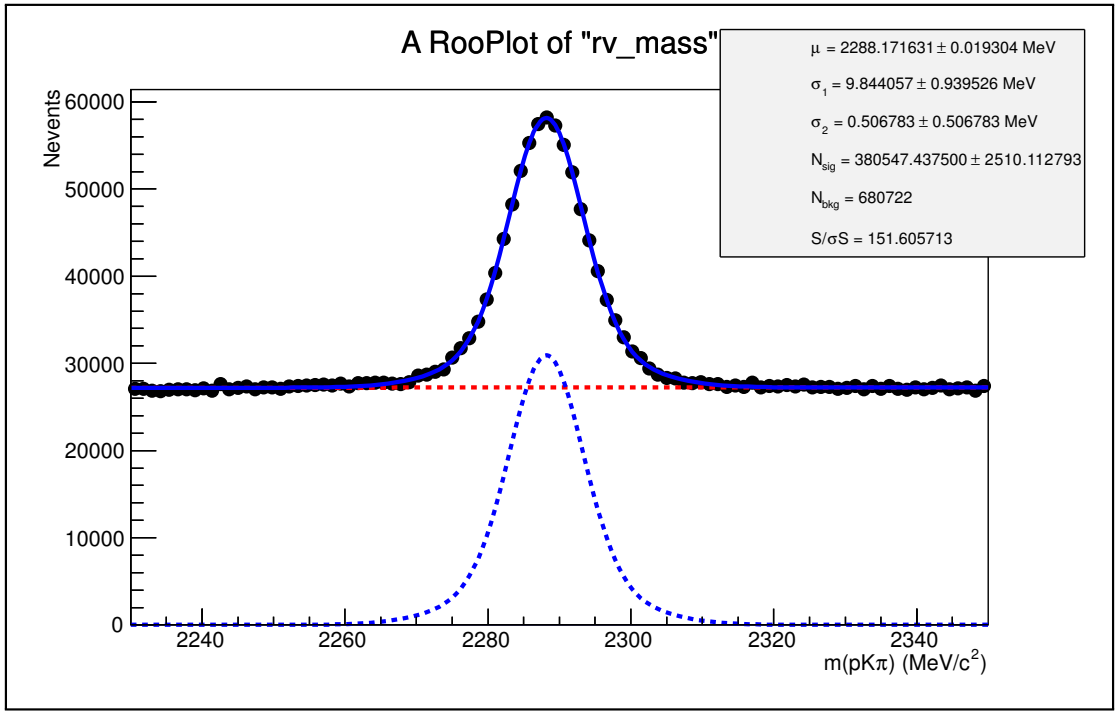
- Examined a variety of forest construction/training parameters to maximise selection and suppress overtraining.
- Final training parameters:
  - Adaptive boosting used, ADABoost $\beta = 0.5$
  - Number of trees $= 150$
  - Tree max depth $= 3$
  - Number of steps during node optimisation $= 16$
- Final ROC curve and overtraining check for the CF BDT below.

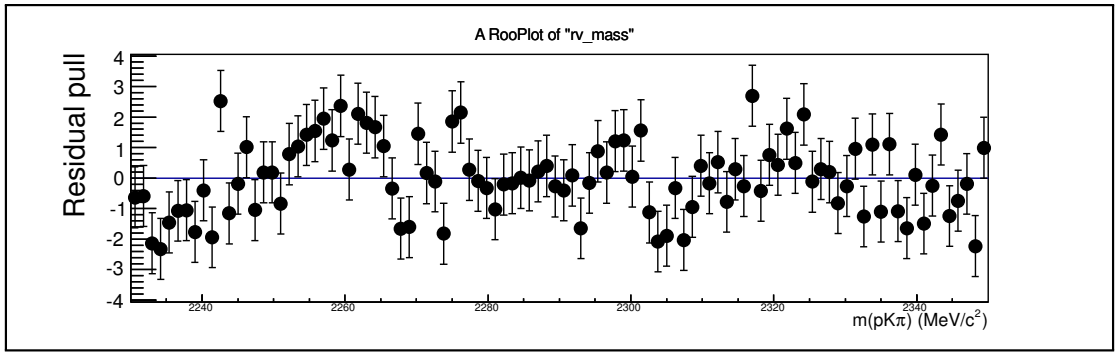




TIS Output

Reminder: raw TIS output mass plot. Fit is double gaussian signal, linear background. Nsig = 380.5k, Nbkg = 680.7k.

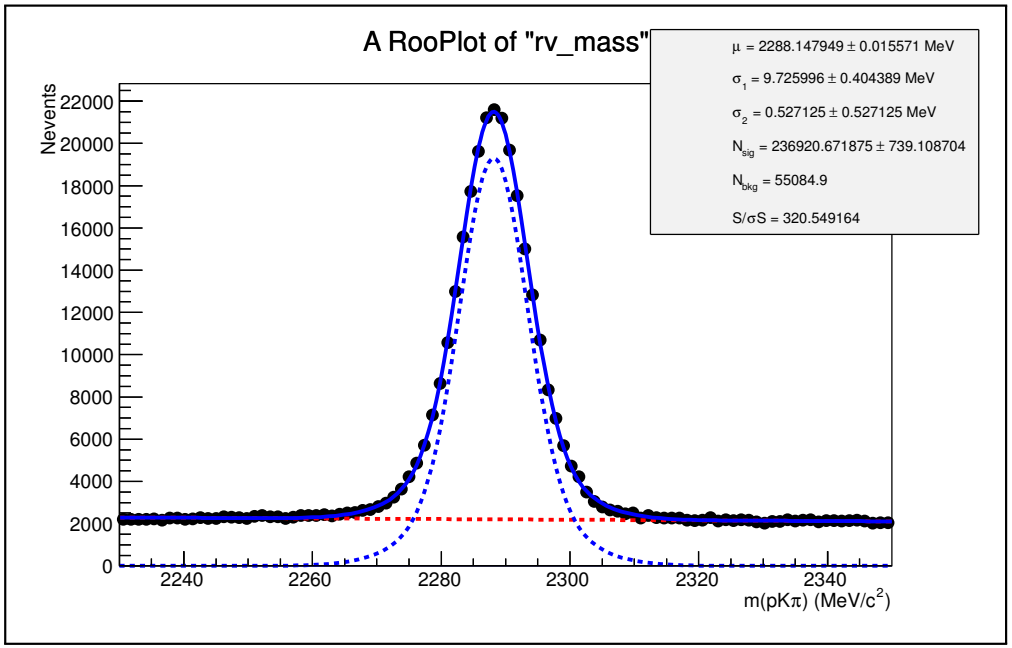


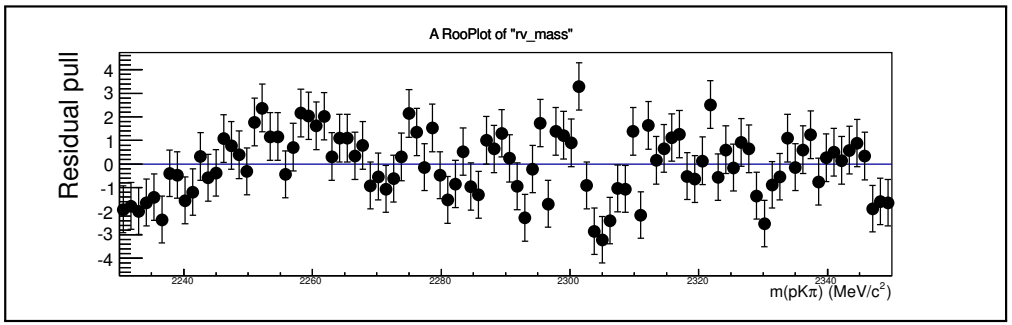


Final CF selection

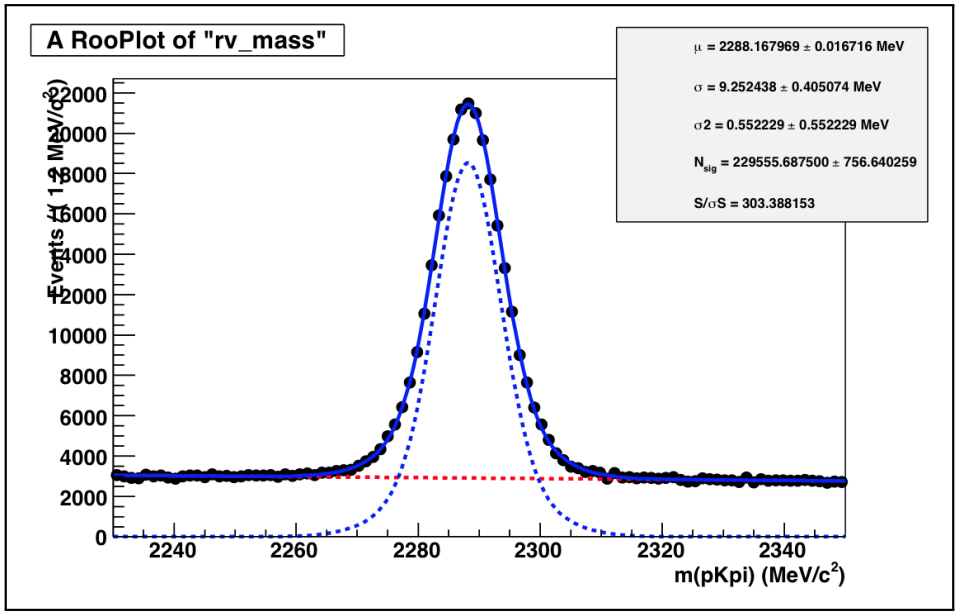
- Optimum Cuts:
- (proton$_{PIDp}$-proton$_{PIDK}$) >5
- BDT response> -0.05
- proton$_{PIDp} > 15$
- Kaon$_{PIDK} > 7$
- Kaon$_{PIDe} < 4$
- proton$_{PIDe} < 3$
- $\pi_{PIDe} < 5$
- Kaon$_{PIDp} < 50$
- proton$_{PIDK} < 50$
- $\pi_{PIDK} < 0$

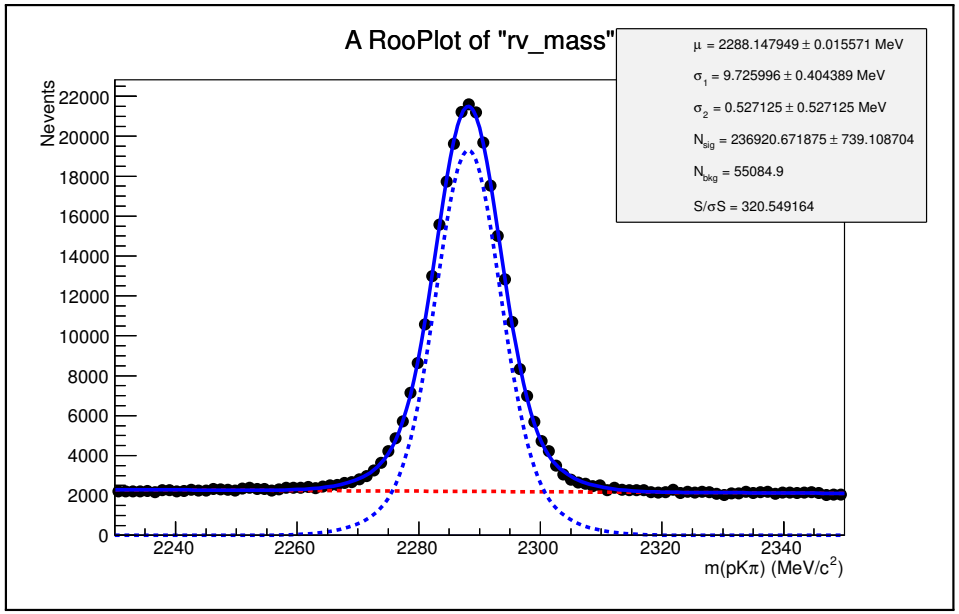
Mass plot with optimum CF cuts:
Nsig = 236.9k, Nbkg = 55k.





Comparison with Cut-based Selection





Nsig = , Nbkg = .
S/B = .

Nsig = 236.9k, Nbkg = 55k.
S/B = 4.30.