Optimisation of isolation and binning for $\tau \to 3\mu$.

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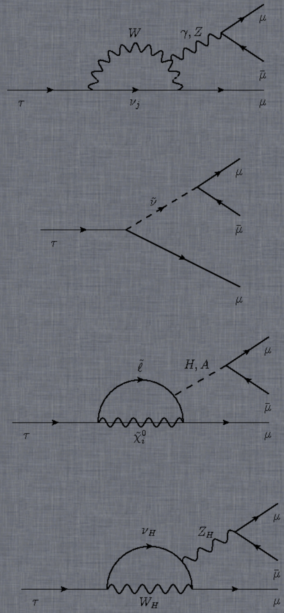
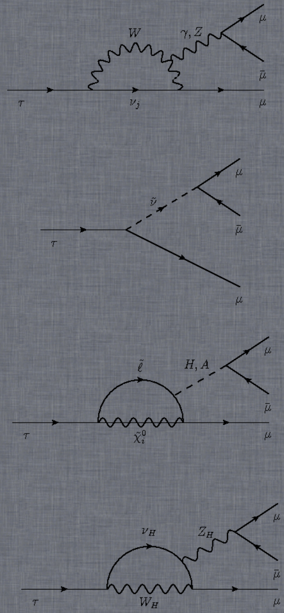


Binning

Binning optimisation

Isolation

Isolation optimisation



Binning optimisation

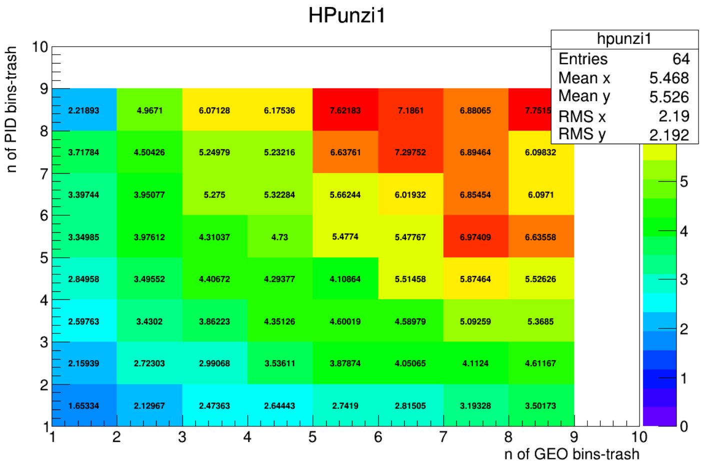
For 2011 we did 2 times one dimensional binning optimisation. This method has disadvantages:

- The best bin of one classifier is split to very small pieces by the other optimisation.
- You end up having best bins in the middle. See Pauls presentation.

How to fix?

- Perform a simultaneous optimisation in 2D.
- Brutal force method is not good enough, cuz number of combination explodes.
- Use MC methods for optimisation.
- Takes 3 hours to optimise.
- Use Punzi FOM instead of Cls method.
- Use 2011 data to optimise.
- Apply Fine-tuning. You need a given number of events to perform a stable fit etc.

How to fix?



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Iso optimisation

Till now every analysis that used track isolation parameter used the ones develeloped and optimised for $B_s \to \mu\mu$. This is based on an abstract definitions of isolating and non-isolating tracks:

- Non-isolating track to a given track(μ from $B_s \to \mu\mu$ for example) will be a track that has the same primary mother as muon.
- Isolating is the negation of non-isolating.

Many thanks to Giampi for discussion and advises !

Iso optimisation

This definition has potentially dangerous implications.

- Imagine a long chain of decays. Every of this decay is non-isolating.
- Why very long living particles (Λ, K_s) have to be considered non-isolating?
- When we do our analysis we are operating on basis of signal and bck hypothesis.
- There isnt a 1:1 correspondence between isolating and bck etc.
- $B_s \to \mu\mu$ does not really suffer from this.

How to train?

1. The main point of isolation variable is to fight again combinatorial bck.(example two decays trees are close and one picks something from the other).
2. We build our bck sample taking from MC truth the candidates that are combinatorial bck.

How to train?

Now I will loose you all :P

1. We need to swap our signal and bck sample.
2. Why? Our signal sample contains: signal candidate(3 tracks)+ tracks surrounding this candidate. Our selection should be optimised in a way that we should end up with our single signal candidate without any tracks nearby.
3. That is why our signal sample is our background sample.

How to train?

1. We define the training variables as Giampi did:+tckchi2+IP.
2. We put everything inside tmva.
3. Then we scan the BDT response space and write how many tracks survive the cut.
4. Optimisation of the cut has to be done inside the BDT that we will use.

How to train?

1. In practice what we do is to scan BDT form 0. to 0.5 and count the tracks for each of the BDT value.
2. Then our new ntuple will have like 100 isolation parameters.
3. How to choose the best one?
4. Well isolation parameter on its own is useless. It has to be combined with other variables in TMVA. Than you can choose the best cut on the BDT.

$\tau \to 3\mu$ specifics

In case of $\tau \to 3\mu$ we want different isolation parameters for different kinds of decays:

- $D \to \tau$
- $Ds \to \tau$
- $B \to D \to \tau$
- $B \to Ds \to \tau$
- $B \to \tau$

$\tau \to 3\mu$ specifics

1. Does it make any sense to make my life so complicated?
2. YES!
3. Example: $B \to \tau$ is in 99% $B \to D\tau X$.
4. This means we if you have D and tau close to each other track from D can go to τ etc.
5. In their approach this truck would be considered non-isolating which is nonsense because it forms a bck candidate!
6. From first looks the problem can be reduced to 3 chains: $B \to \tau$, $B \to Dx \to \tau$, $D \to \tau$.

$\tau \to 3\mu$ specifics