

$\Lambda \rightarrow \Lambda_c^* \mu \nu$ update



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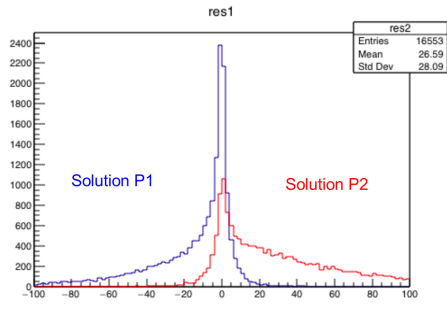


University of
Zurich ^{UZH}

$R(\Lambda_c^*)$ meeting, CERN
March 04, 2016

Reminder

⇒ People reported that in case of $\Lambda_b \rightarrow \Lambda_c \mu \nu$ decays there are asymmetric solution for the Λ_b momentum.



⇒ No one else have ever seen this in different decays so I started digging in.

How to calculate the $p(\Lambda_b)$

⇒ One just needs to solve this equation:

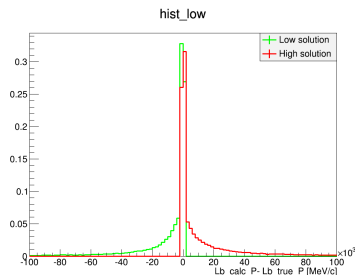
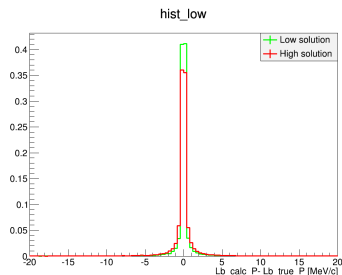
$$\begin{aligned} & \left[\left(\frac{\hat{p}(\Lambda_b) \cdot \vec{p}(\Lambda_c \mu)}{E(\Lambda_c \mu)} \right)^2 - 1 \right] p(\Lambda_b)^2 \\ & + \left[(m(\Lambda_b)^2 + m(\Lambda_c \mu)^2) \frac{\hat{p}(\Lambda_b) \cdot \vec{p}(\Lambda_c \mu)}{E(\Lambda_c \mu)^2} \right] p(\Lambda_b) \\ & + \left[\left(\frac{m(\Lambda_b)^2 + m(\Lambda_c \mu)^2}{2E(\Lambda_c \mu)} \right)^2 - m(\Lambda_b)^2 \right] = 0 \end{aligned}$$

⇒ The ambiguity comes from the fact that we do not know the direction of the ν in the Λ_b rest frame.

Generator level

⇒ Simulate stand alone Pythia + EvtGen with detector acceptance.

⇒ $\Lambda_b \rightarrow \Lambda_c \mu \nu$:

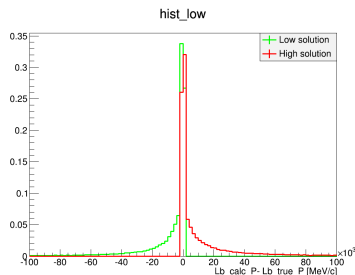
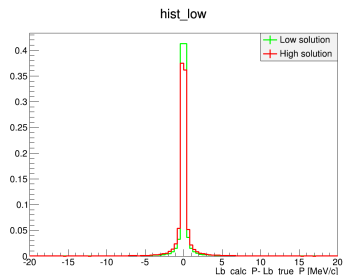


⇒ Fractions of correct solution: 0.516044, 0.483956

Generator level

⇒ Simulate stand alone Pythia + EvtGen with detector acceptance.

⇒ $\Lambda_b \rightarrow \Lambda_c(2595)\mu\nu$:

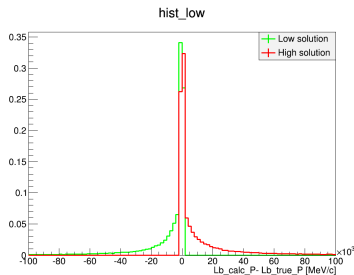
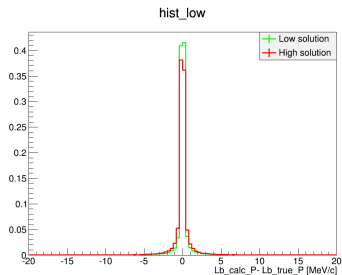


⇒ Fractions of correct solution: 0.514349, 0.48565

Generator level

⇒ Simulate stand alone Pythia + EvtGen with detector acceptance.

⇒ $\Lambda_b \rightarrow \Lambda_c(2625)\mu\nu$:

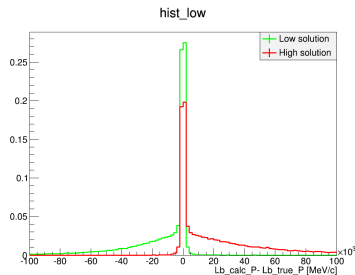
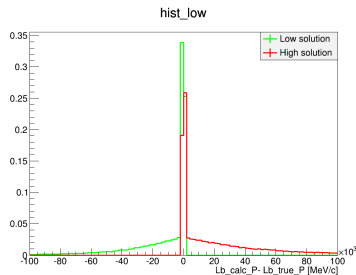


⇒ Fractions of correct solution: 0.515375 0.484625

⇒ Generator has negligible asymmetries!

Reconstructed MC

⇒ Full simulation after the stripping: ⇒ $\Lambda_b \rightarrow \Lambda_c \mu \nu$:



⇒ Left: using stripped events but with true informations.

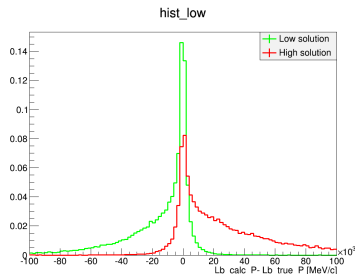
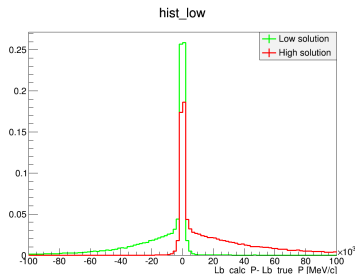
⇒ Right: using stripped events with true information besides Λ_c momentum

⇒ Fractions of correct solution: 60 – 40%

Reconstructed MC

⇒ Full simulation after the stripping:

⇒ $\Lambda_b \rightarrow \Lambda_c \mu \nu$:



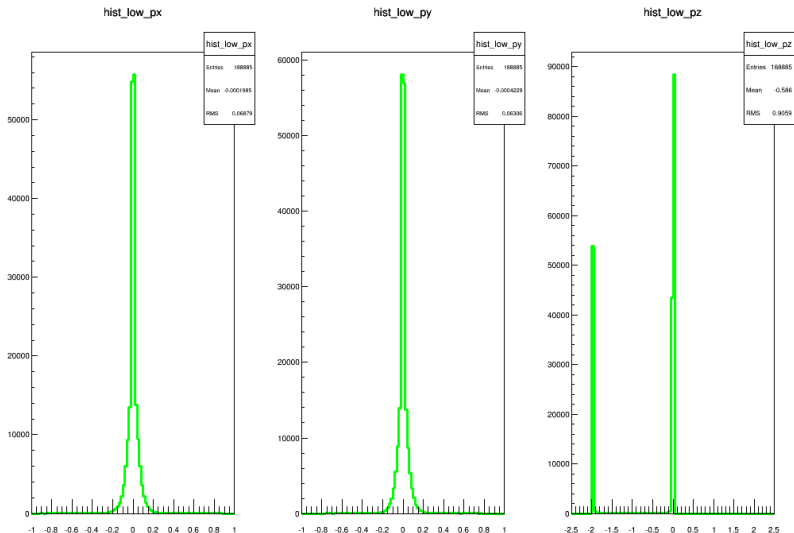
⇒ Left: using stripped events with true information besides Λ_c , μ momentum

⇒ Right: using stripped events with true information besides Λ_c , μ momentum and Λ_b direction.

⇒ Fractions of correct solution: 60 – 40%

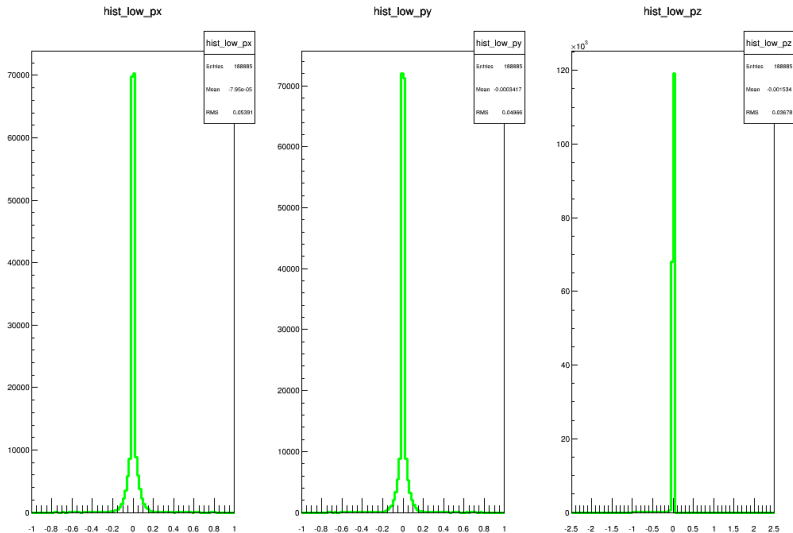
Warning on Λ_b direction

\Rightarrow The Λ_b direction vector is calculated connecting the closest PV with the Λ_b vertex^a



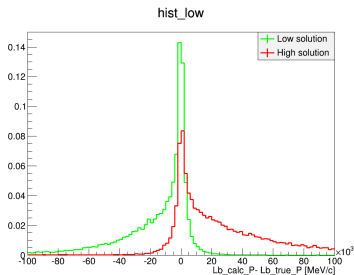
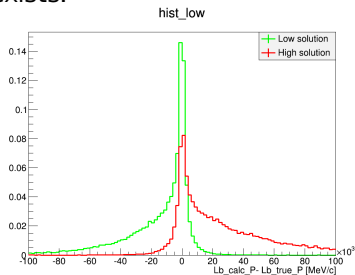
Warning on Λ_b direction

⇒ One should instead use the closes PV that is "behind" the Λ_b vertex.
This increases the number of solutions by 25%.



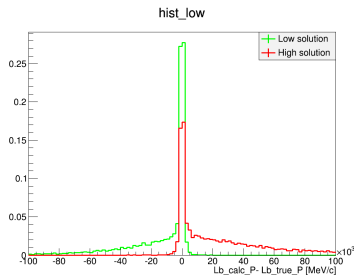
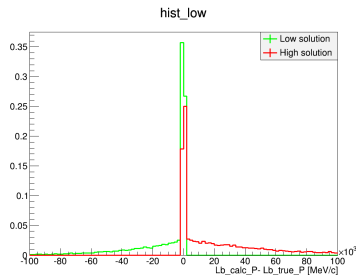
Warning on Λ_b direction

⇒ This requirement does not change the resolution when the solution exists.



Reconstructed MC

⇒ Full simulation after the stripping: ⇒ $\Lambda_b \rightarrow \Lambda_c(2595)\mu\nu$:



⇒ Left: using stripped events but with true informations.

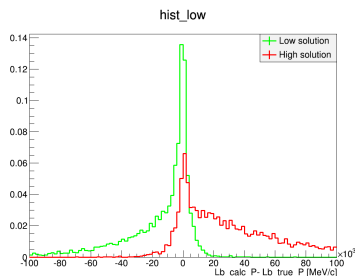
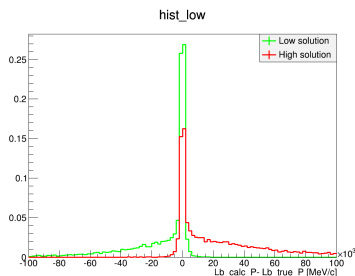
⇒ Right: using stripped events with true information besides Λ_c momentum

⇒ Fractions of correct solution: 60 – 40%

Reconstructed MC

⇒ Full simulation after the stripping:

⇒ $\Lambda_b \rightarrow \Lambda_c(2595)\mu\nu$:



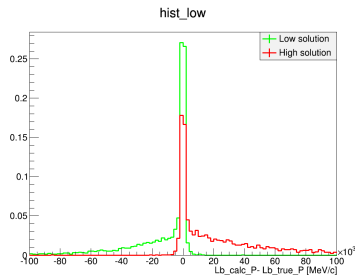
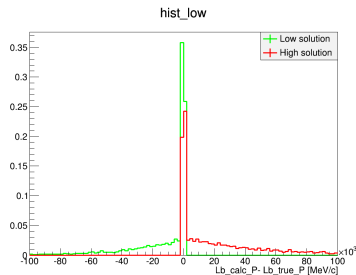
⇒ Left: using stripped events with true information besides Λ_c , μ momentum

⇒ Right: using stripped events with true information besides Λ_c , μ momentum and Λ_b direction.

⇒ Fractions of correct solution: 60 – 40%

Reconstructed MC

⇒ Full simulation after the stripping: ⇒ $\Lambda_b \rightarrow \Lambda_c(2625)\mu\nu$:



⇒ Left: using stripped events but with true informations.

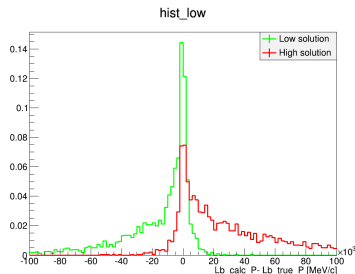
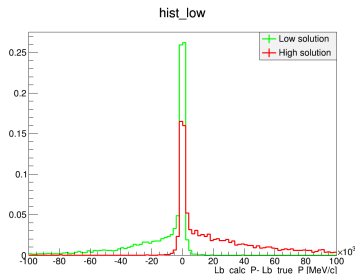
⇒ Right: using stripped events with true information besides Λ_c momentum

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Reconstructed MC

⇒ Full simulation after the stripping:

⇒ $\Lambda_b \rightarrow \Lambda_c(2625)\mu\nu$:



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⇒ Right: using stripped events with true information besides Λ_c , μ momentum and Λ_b direction.

⇒ Fractions of correct solution: 60 – 40%

Conclusions

- The MC generator is ok.
- There is a constant (within 1%) 60:40 fraction in preferring the lower solution.
- So it can be either reconstruction or stripping.
- I think the stripping as when I replace the reconstructed quantity with the truth one I am getting a constant fraction of 60:40.
- The only way to know is to run a cheated selection on MC and discover some idiot fuc.. the stripping line ;)

