Regression analysis to determine ν p_z in $W \rightarrow \ell\nu$ decay

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Inputs

Lepton p_T, η, Φ, E
MET magnitude, Φ, resolution

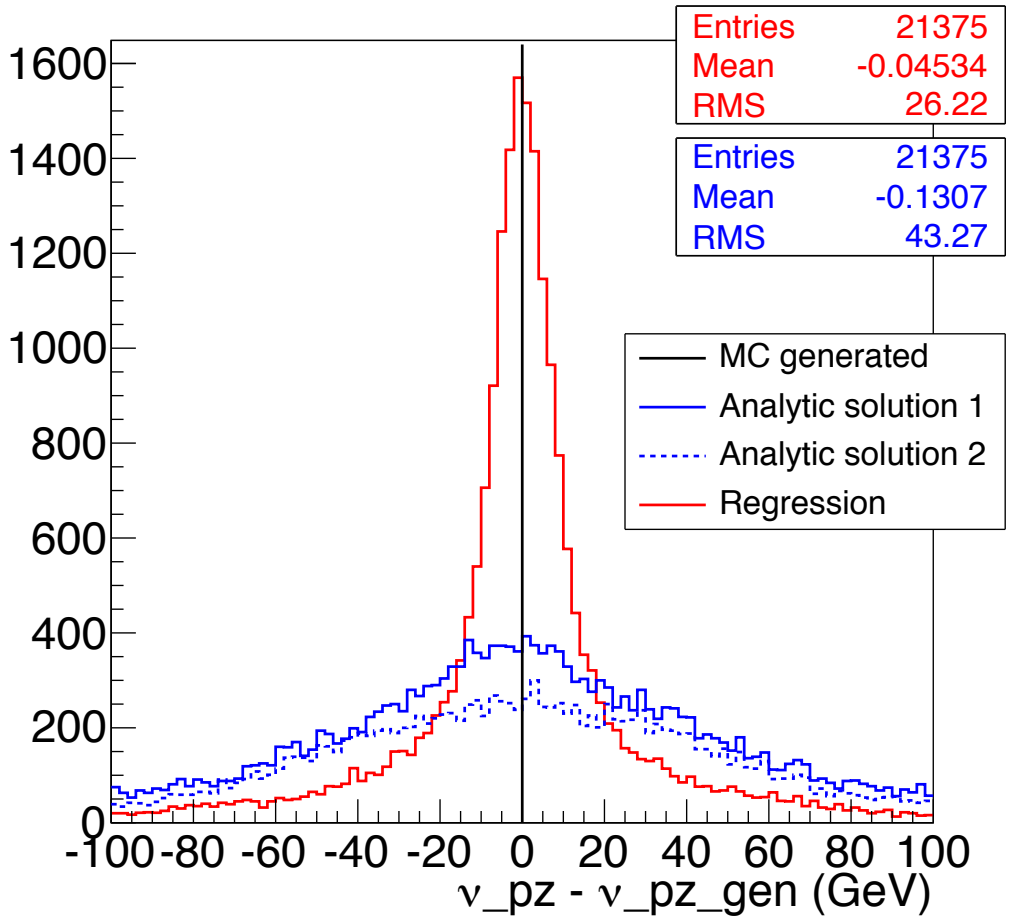
Sum ET in the event
W p_T, rapidity

Target: generated neutrino p_z
Discriminant: Boosted Decision Tree (ada boost)

The regression results are applicable to any event containing $W \rightarrow \ell\nu$ because I used only lepton and MET related inputs.

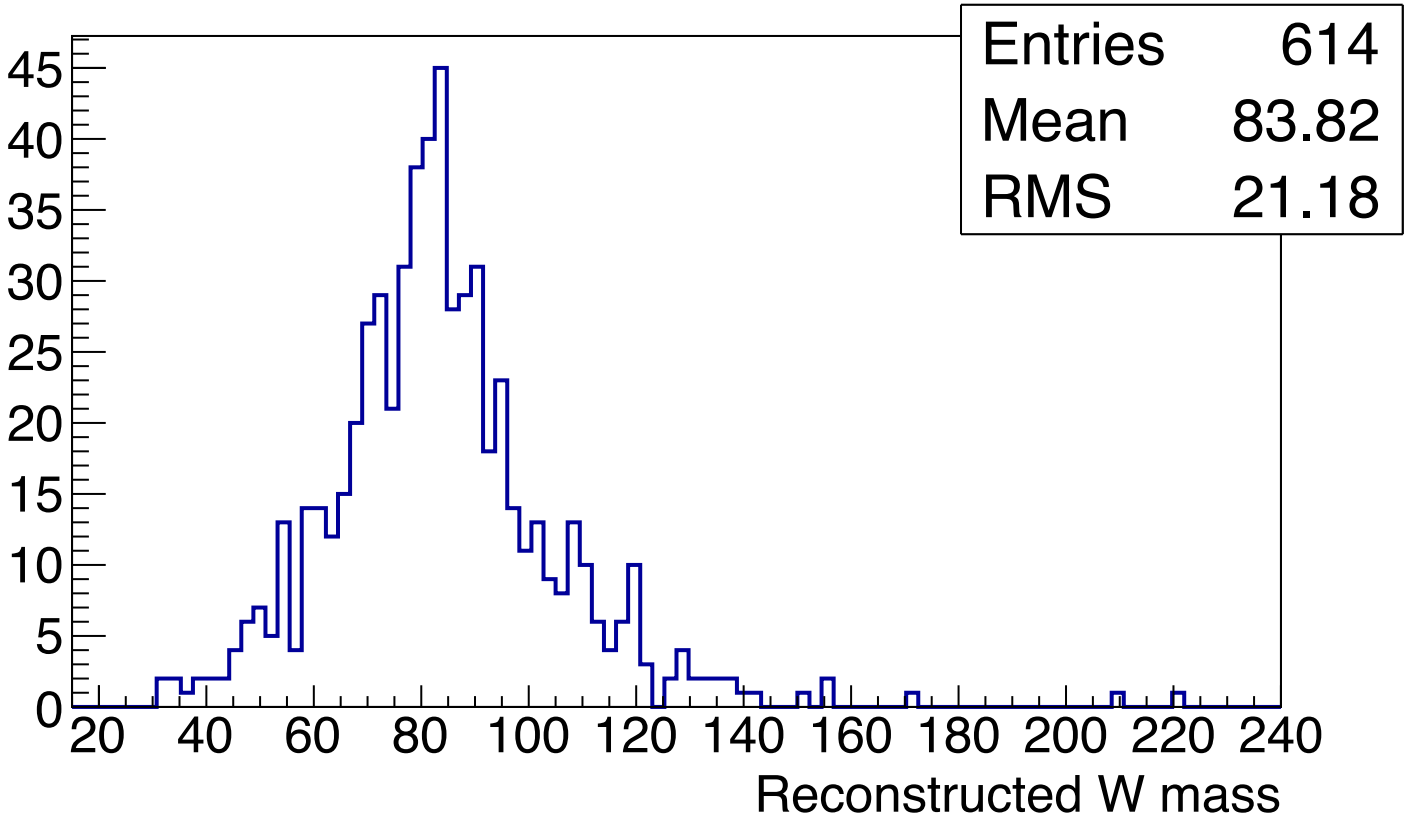
Output: ν pz

Tested and validated on WW→ℓνqq sample with the requirement |m(ℓν) − 80.4| < 10 GeV at generator level

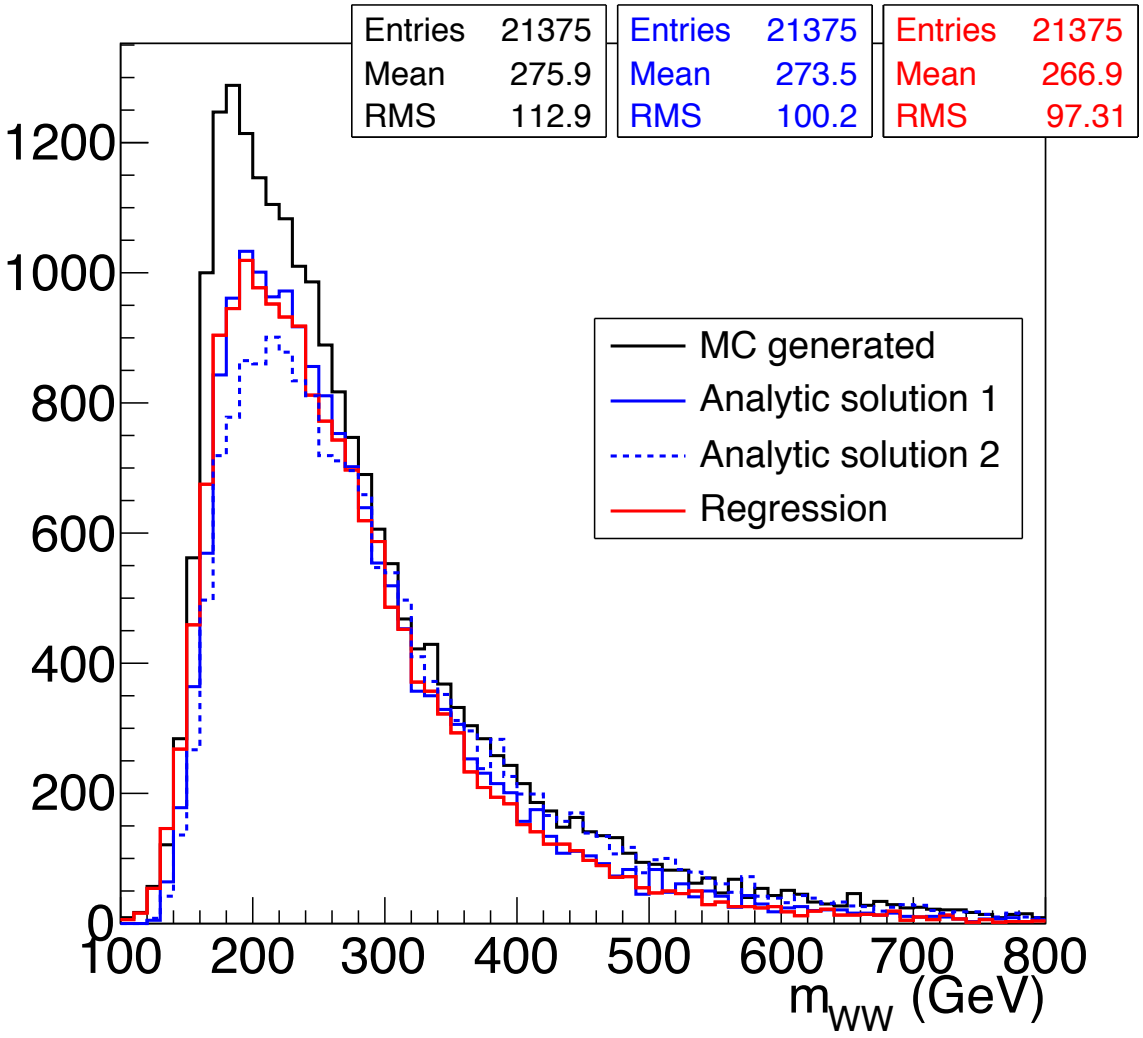


- The regression clearly gives a better behaved solution.
- With regression, we never run into imaginary values (unlike in the case of analytic solution), so the angular quantities shouldn't have weird features.

Reconstructed W mass using ν p_Z from regression



Reconstructed WW mass



- Here we do not see much difference among the three solutions.
- So, switching over to regression for neutrino pz will make no significant difference in the lvjj analyses, but will likely help WH→lvbb analysis.
- The resolution is about 15% in the entire plot range, varying from 17% to 13% as one goes up in mass.

Code and regression kernel

https://github.com/kalanand/NeutrinoPzRegression

Drop me a line if you have questions

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