CMS data analysis tutorial: Exercise 4

4 Top quark mass reconstruction

In this exercise we will reconstruct the fourvectors of the top quarks by assigning the detector objects (jets, leptons, missing energy) to the hypothetical tt decay tree. As we only consider semi-leptonic decays with muons in the final state, we expect four jets, one muon plus missing energy in the final state. Two of the four jets are b-jets (b-tagged).

- What is the mass of the top quark in MC simulation (in tt events)? Use the generator-level truth information to calculate the top quark fourvector in the hadronic and leptonic branch.

- As a next step try to use detector objects only. Find out which (not b-tagged) jets come from the hadronic W boson decay using the W boson mass.

- Combine this W boson with a b-jet. As there are two b-jets, simply use both solutions, and fill the reconstructed top quark mass in histograms, comparing data to simulation.

- Reconstruct the top quark from the leptonic branch as well. The z-component of the neutrino is not measured, as we only have transverse missing energy. You can calculate the z-component using a W mass constraint (two solutions).

4.1 Extension for very fast students

Try to resolve the ambiguity to assign the b-jet to the hadronic or leptonic branch. You can look at angular distributions and/or use the combination with the smallest difference between hadronic and leptonic top mass.

How often do you find the right combination? You can estimate this by matching the jets to the generator-level objects.