Continued Analysis of HL-LHC Simulation Data for Phase 2 Upgrades

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- A remembering from last time: MET is short for missing energy that is found in the transverse plane, the x-y direction that is perpendicular to the beam path.
- The 4-vectorial sum of the momentum (energy) should be conserved in the transverse plane, except in cases of neutrinos and BSM physics. However, you can get fake MET that comes from misidentified particles/isolation issues.
- In our Z->ll events, we're looking for a small MET that might be faked (less than 10 GeV of it on average).

Base analysis

- Our first approach builds the MET from three sources: Jet Energies, Entire Particle Flow Energies, and the Tracker Energy.

- The base cuts are only made on the jet: Jet pt > 30 GeV/c
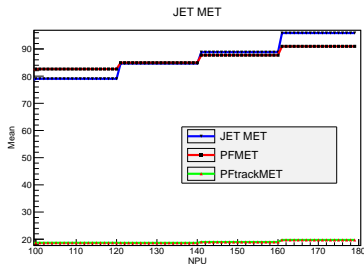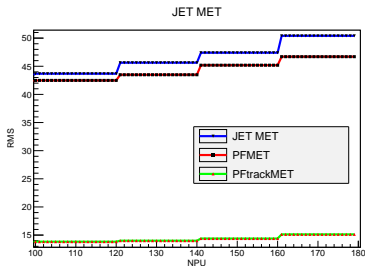
- These plots do not seem promising for the Jet construction of MET approach.

- Several approaches are now being done though, including identifying electrons and muons and using their increased energy resolution in addition to the jets that are not stemming from these particles in order to increase the energy resolution. Will be implemented on later NTuples. And has been. But, we won't see them today.

- Also, the fact remains that we have not included our Jet Energy Corrections. The inclusion of these corrections does not help the case, however, as it spreads the energy out even more.
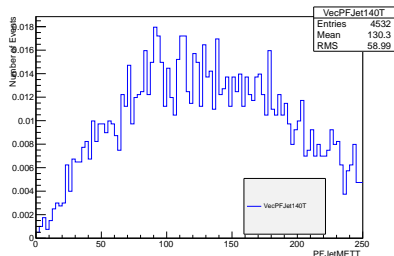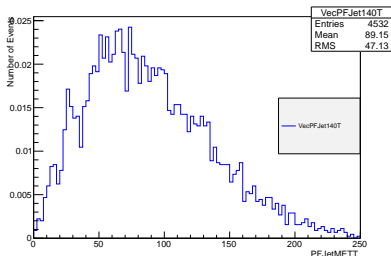

- These energy corrections do not perform like this on Summer 2012 or other low pileup data.
- Possibly not unexpected, given that these corrections are tuned to 2012 data.

- We're now looking into the isolation of electrons in these samples, in an attempt to see if we can fix the matching issues we've had with the vertices exceeding pileup.
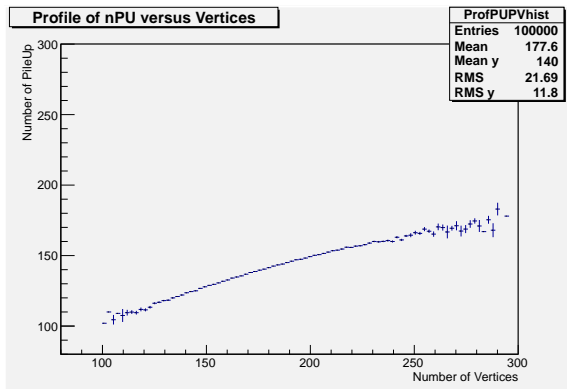
- Quite Preliminary, working out some of the details with Si at the moment. (There's a problem with the background statistics, which is the reason why the Low PU samples look incorrect).
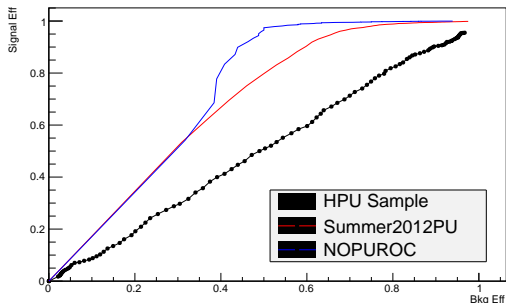
- We have a few ideas on how to improve the efficiency, such as matching the particle flow charged particles by matching near the electron's true z position, and also by fixing the pileup corrections in the way we analyze these NTuples.

- I've only made it through efficiency plots for the smallest samples for test purposes. Need to run them on the larger NTuples.
- Need to continue the study of these vertex issues. Working with Si in an attempt to see if we can fix the issues on our end for the time being and may find possible solutions to the simulation group.
- **UPDATE**: Si Xie and I have cut the run time of these samples down and have run over the large samples. We've also changed the background to ZvvHbb samples, which give absolutely no signal (neutrinos are the output from the Z decay).
- Need to do further MET studies where we are looking at real MET. Only have been looking at Z decays to electrons and muons. Generation of NTuples for W events with neutrinos will give us further insight into these problems.

So, What Do They Look Like?

- Right away we notice an issue with the ROC curve. It deviates greatly from the efficiencies previously seen in Summer 2012.
- We find that indeed, the vertex matching approach is a detriment to our efficiency, because the background is overweighing the

Summary
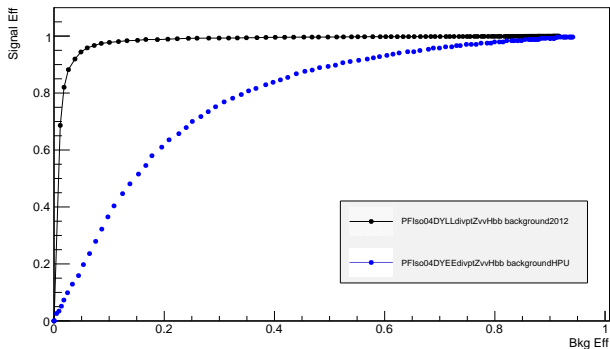
- Preliminary results seem to suggest that we may not be able to resolve the MET using the Jet MET.
- The track MET seems to not change that much from the low pileup samples to the high pileup samples. May help in future analysis to look at these variables.
- For some reason, the jet corrections do not work in the High PU case. This will require more study.
- We have now reached the point where our ROC curves are matching the typical Summer 2012 efficiencies, but this means that the HPU data is still quite wrong. This requires more studies of the components of the isolation.

A visit to CMS!!!! Inside the Prison at Chateau de Chillon in Montreaux