Master plan for a super awesome LHC measurement

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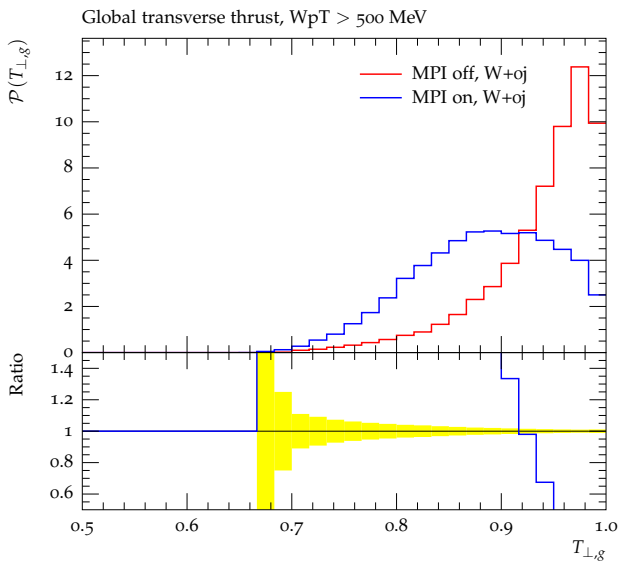
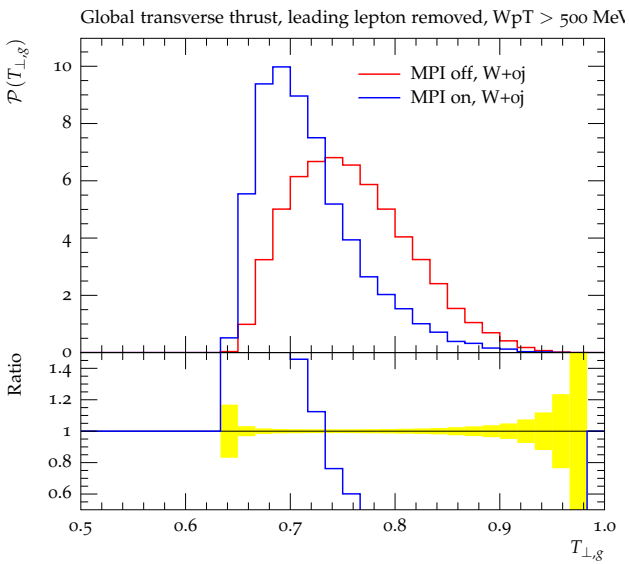
What we want to measure

- Transverse event shapes in W+0jet events
- Why? They are sensitive to multiple parton interactions (MPI) happening or not
- I think, the ultimate goal is to extract the mean number of MPI happening at the LHC using a template method (which I don't understand and only heard of)
- We need the W and its $p_\perp$ for the event selection. If the W has a $p_\perp$ compatible with zero (or promodrial $k_\perp$), then we are almost sure that the W has no recoil jet and all other activity is MPI related, e.g. additional back to back jet pairs
- The event shapes are calculated from transverse momenta of *charged* particles ($\vec{p}_{\perp,i}$) no jets neccessary to extract information about hardness of processes happening

Eventshape example

- E.g. transverse thrust $T_\perp = \max_{\vec{u}_\perp} \dfrac{\sum_{i \in \mathcal{C}} |\vec{p}_{\perp,i} \cdot \vec{u}_\perp|}{\sum_{i \in \mathcal{C}} |\vec{p}_{\perp,i}|}$
- We would calculate this thing on an event by event basis using all charged tracks (Except the lepton from the W-decay), the Thrust axis $\vec{u}_\perp$ is a unit vector that maximises above expression– needs to be found iteratively
- $T_\perp$ lives between 0.5 and 1, where 0.5 is achieved for perfectly spherical events while 1.0 is in the case of pencil-like events (left plot). Things look different if lepton is removed (right plot)





What we will need

- Ws $\rightarrow$ start with baseline-selection
  - $\not{E}_\perp$??? here we suppress shitloads of QCD background
  - μs and electrons $\rightarrow$ we need to find out how the lepton $p_\perp$ cuts affect the W $p_\perp$
- Track $p_\perp$s need to be corrected for detector effects
- How low can we go in W-$p_\perp$?
- What is the resolution for W-$p_\perp$? We want to make sure that high $p_\perp$ Ws don't migrate into low $p_\perp$ bins
- We might want some kind of jets which are good in finding back to back topologies for more complicated things but this is not our primary interest

As a bonus: traditional UE

- We can also divide the event plane in Φ-regions (away, toward, transverse) with respect to e.g. the Thrust axis and measure quantities like number of charged particles and scalar $p_\perp$-sum, we could do this as function of of the W-$p_\perp$, which would be our scale of hardness or something
- Not the most important thing but probably easy to do

Summary

- We want to measure event shapes in W events
- We need transverse momenta of charged particles
- Full W-reco for W-$p_\perp$ (electrons and muons, but not combined)
- W-$p_\perp$ resolution could be problematic
- There are quite a lot of event shapes we can try out (arXiv:1001.4082)
- Back to back jets ???
- Does not sound too complicated, does it?
- Does anyone know how the template method works?
- These measurements will test the MC models of MPI, especially the assumption that the MPIs happen independent from one another, so beam remnant things can be checked
- UE has never been measured in W events