Restoration of Electroweak Symmetry in Single-Gauge Boson Production at the LHC

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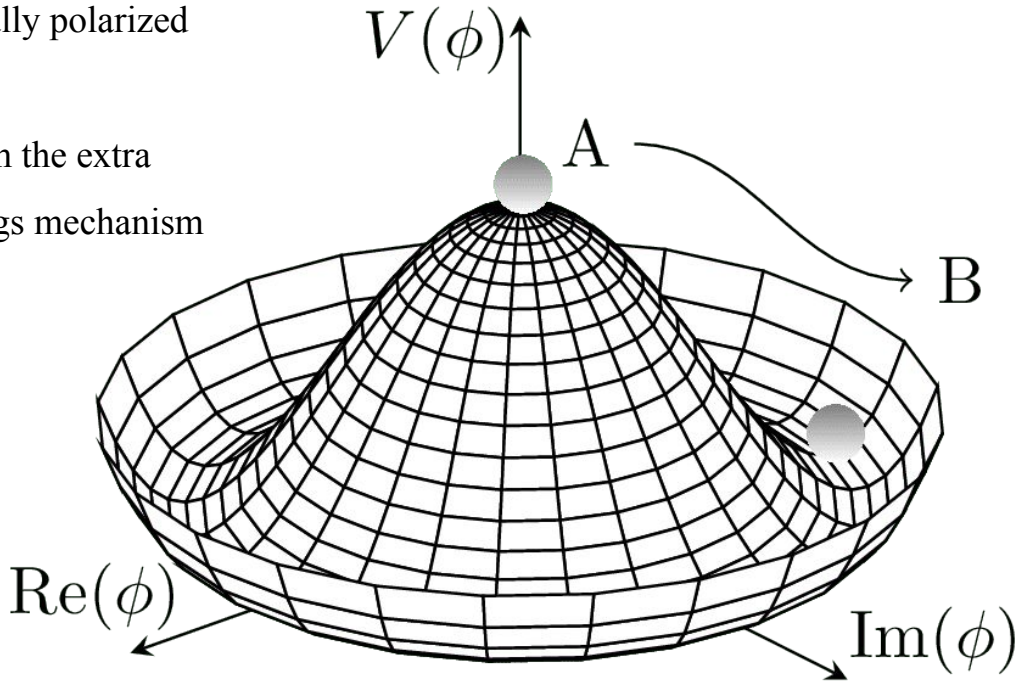
Background

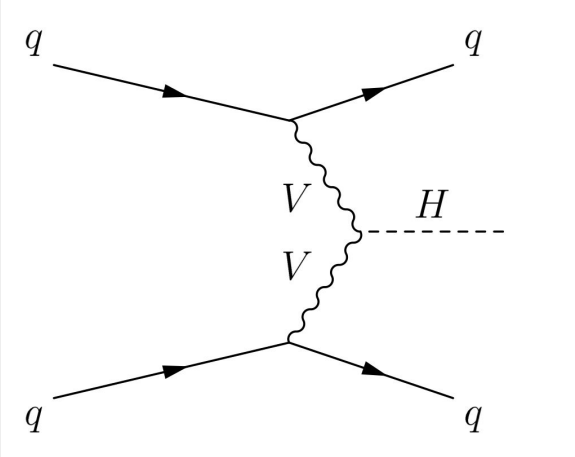
- W and Z bosons get their mass from the Higgs mechanism
- Because they have mass, they can be longitudinally polarized (spin is perpendicular to direction of motion)
  - Longitudinal polarization states come from the extra degrees of freedom introduced by the Higgs mechanism
- Studying longitudinally polarized bosons can help us understand more about boson interactions and Higgs mechanism
  - It could also point to BSM physics



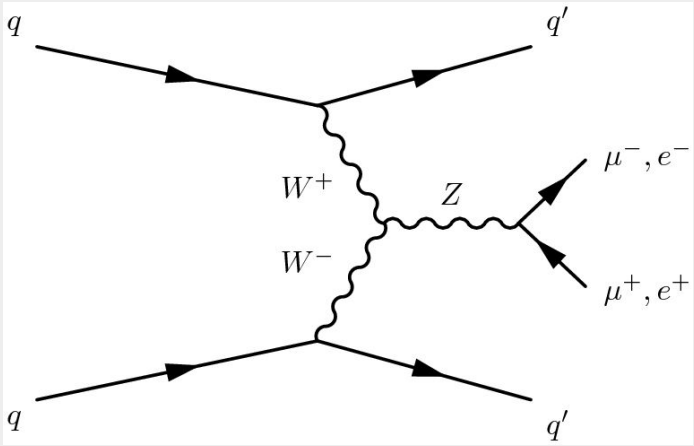
Main Premise

- Interested in studying longitudinally polarized bosons in vector boson fusion (VBF) events
- At high energy, Goldstone Boson Equivalence Theorem predict that the production cross section of a longitudinal gauge boson should converge to production of corresponding Goldstone boson

VBF H

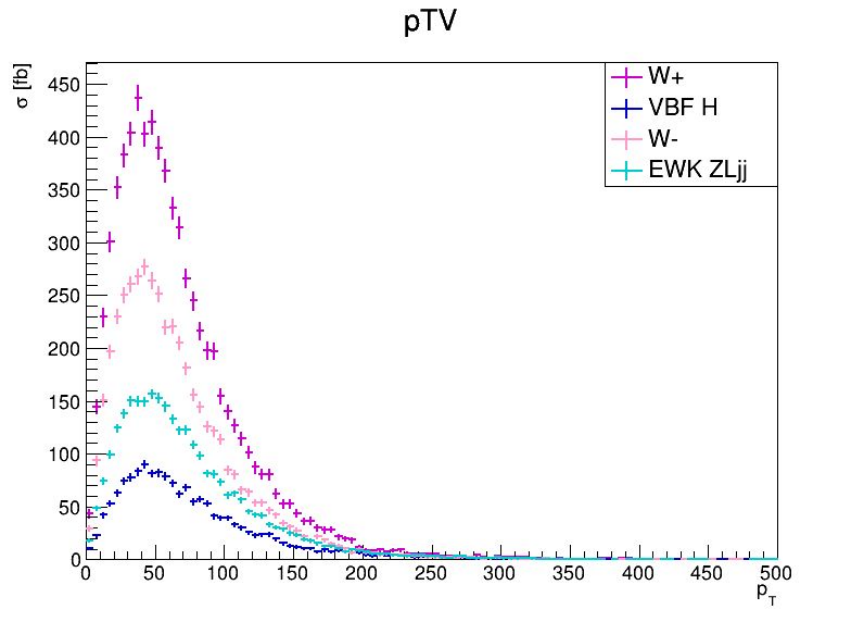


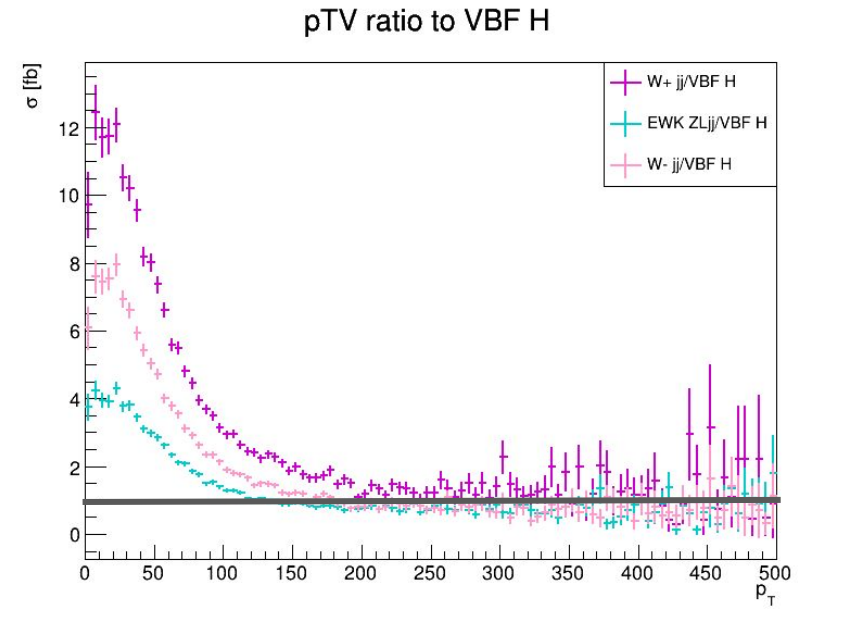
VBF Z



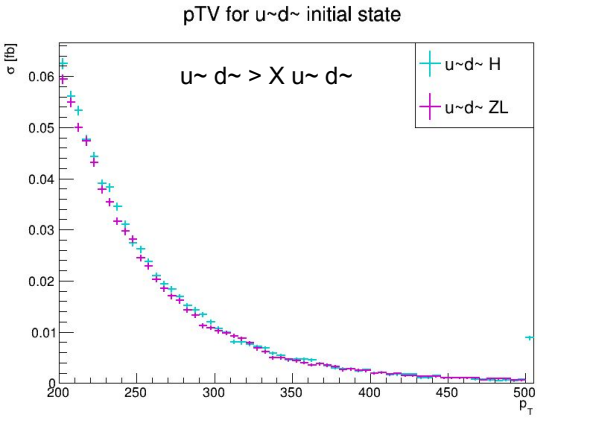
Energy Dependance Studies

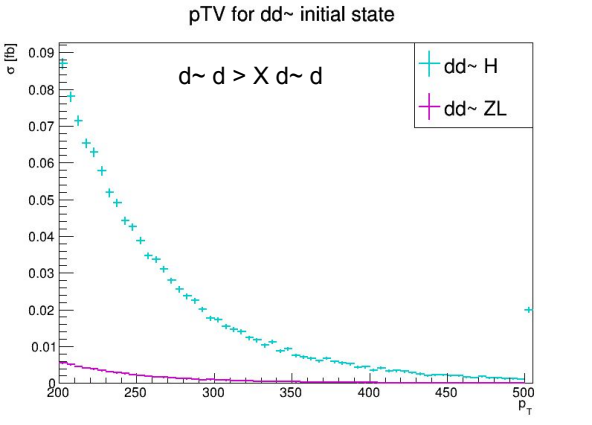
The First pT plots





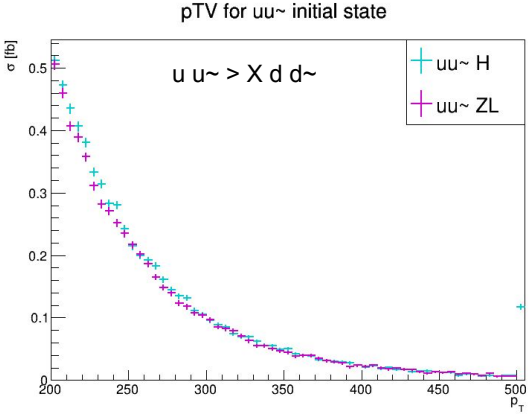
Initial/Final State Checks

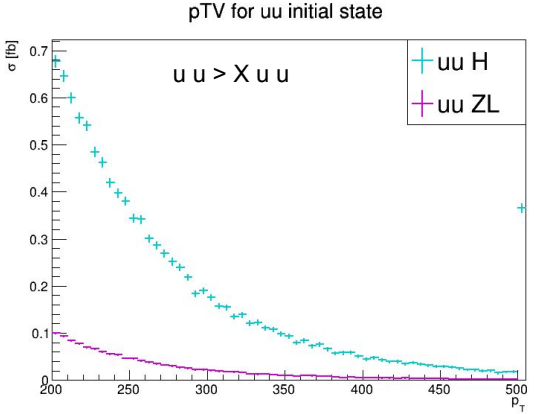




Doesn't converge

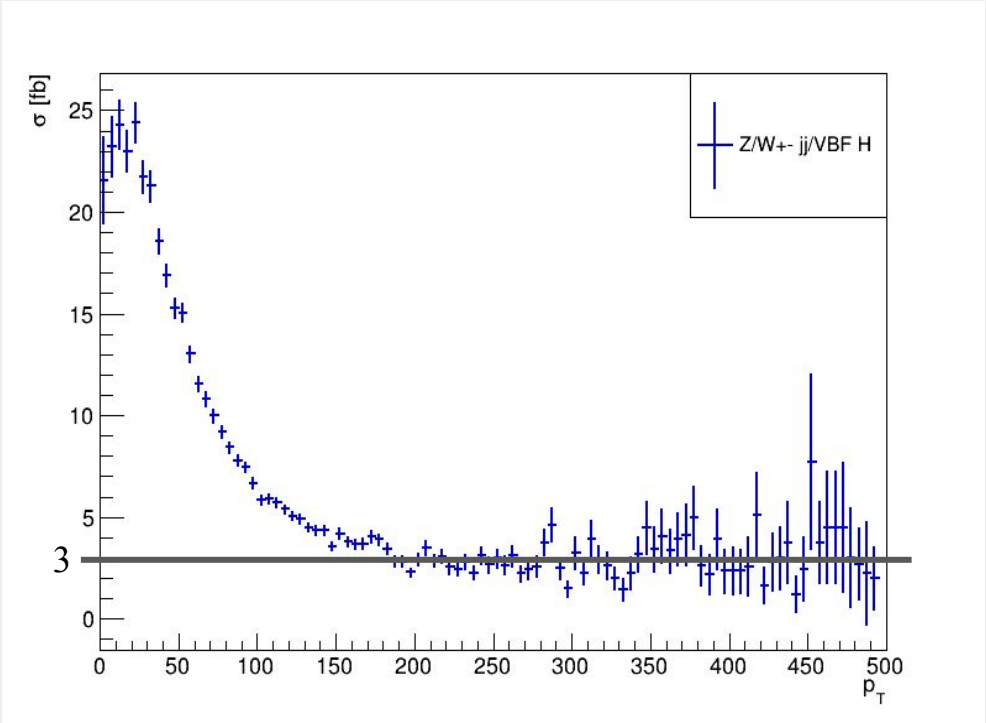
Converges





Sum of W and Z Production

- In a measurement, we would ideally measure the sum of W and Z cross section
- If we plot the pT of the sum, we see that it converges to three times H production
- When we sum W and Z production, processes have isospin doublet initial/final states
- Because W and Z are electroweak, they are symmetric in isospin



Polarization Fraction Studies

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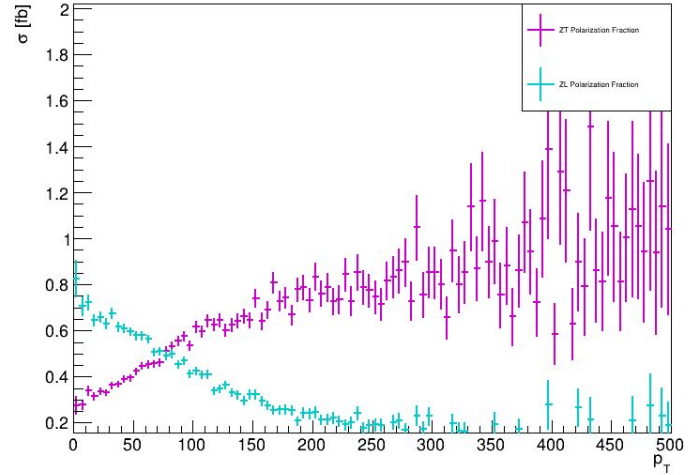
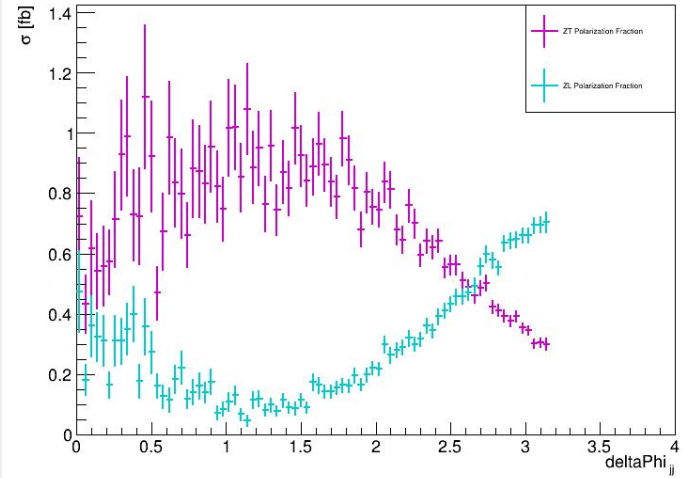
PF = Z{L or T}/Z



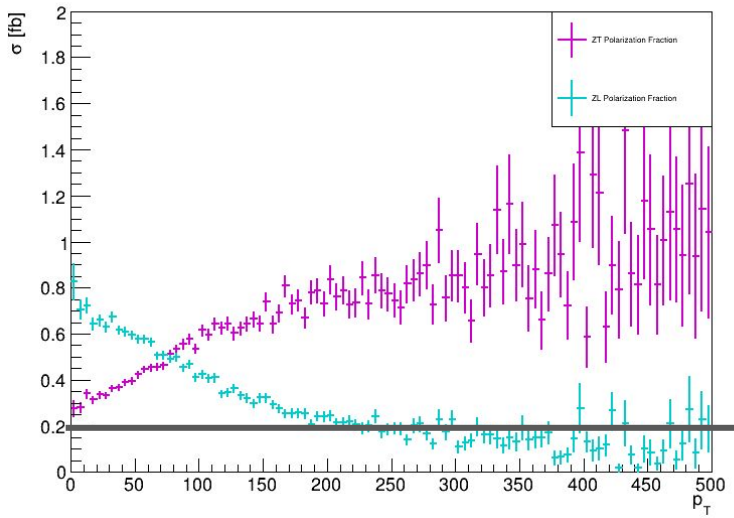
ZL production decreases as a function of pT

ZL production increases as a function of Δφ

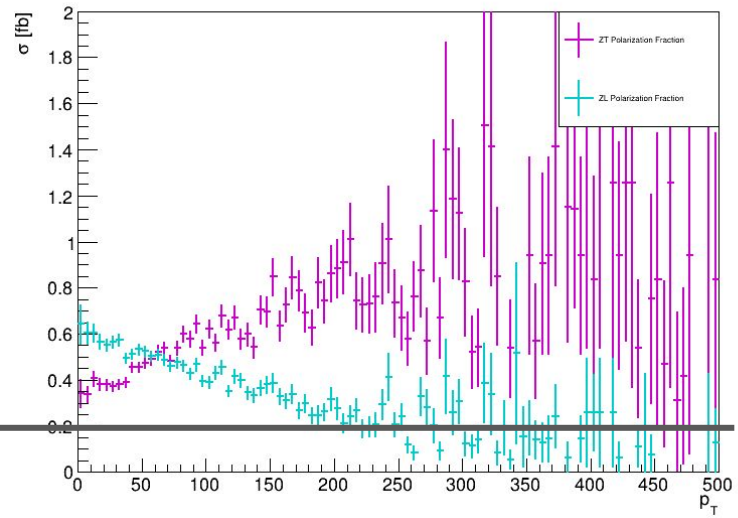


Can Delta Phi cut improve PF?

Before Δφ cut



After Δφ cut



Effective Field Theory Studies

EFT Predictions

- Finally, we want to look at EFT effects to see if any operators have a significant effect on the production cross sections
- This will tell us if H, ZL, or ZT production depends on BSM physics
- The output of this analysis is just a very VERY long table
    - There are several operators that are partial to ZL production, meaning that a ZL measurement would tell us about those BSM effects

Thank you!!