# Electroweak Restoration at the LHC and Beyond

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# Introduction

The LHC is exploring the nature of a spontaneously broken symmetry at and above its breaking scale. At sufficiently high energies, electroweak (EW) scale particles are essentially massless in hard process. In the standard model (SM) this is equivalent to the limit where the Higgs vacuum expectation value (vev), v, goes to zero and the EW symmetry is restored. When it happens, longitudinal gauge bosons are replaced with Goldston bosons. Hence, to observe the restoration, we want to measure the convergence of Goldstone boson equivalence theorem, and we propose di-boson final processes: $q\bar{q}^{'} \rightarrow VV^{'}/Vh$.

# Theory

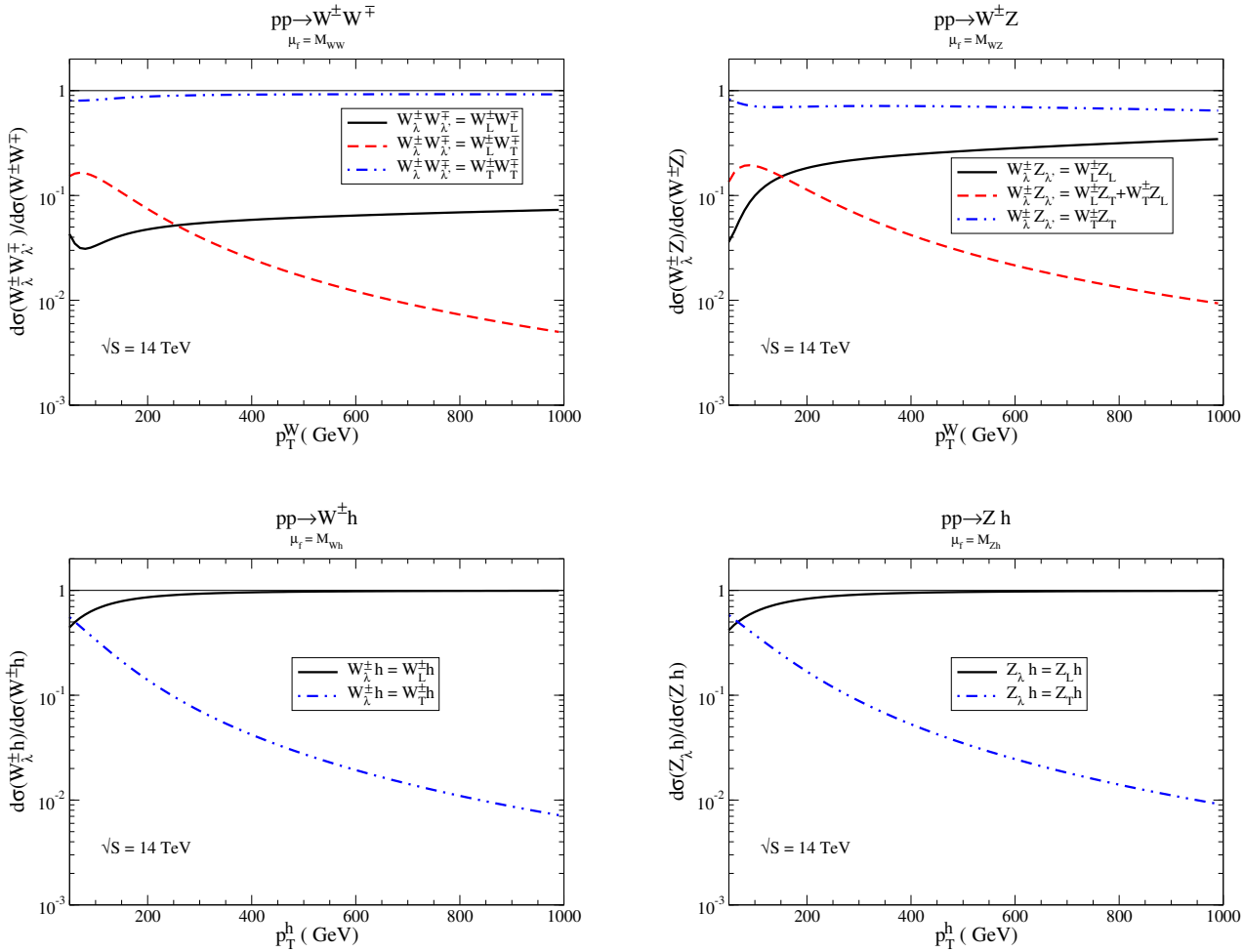



Figure: Ratio of $p_T$ distributions of different polarized gauge bosons to the total distrbution summed over polarizations for (a) $W^{\pm}W^{\mp}$, (b) $W^{\pm}Z$, (c) $W^{\pm}h$, and (d) $Zh$ production in $\sqrt{S} = 14$ TeV.

# Signal Strength

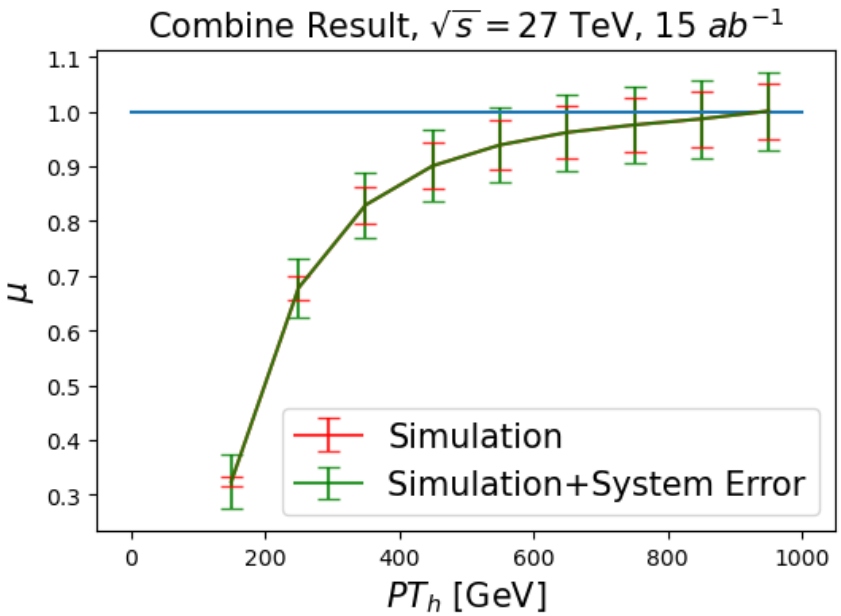
To observe how quickly the Goldstone boson equivalence theorem converges in $Vh$ production, we define signal strength as ratios of $p_T^h$ distributions:

$$\mu_{Vh} = \frac{d\sigma(pp \to Vh)/dp_T^h}{d\sigma(pp \to Gh)/dp_T^h} \tag{1}$$

# Signal Strength

- Using simulation packages to simulate signal events as $h \to bb$ and $V$ decays into 0, 1, 2-lepton and background events,
- Using data analysis include deep neural network for signal/background classification,
- For signal events after cuts, define efficiency matrix $\epsilon_{ij} = \frac{N_i}{\sigma_j^{hV} \times Lum}$,
- For signal and background events after cuts, using its $p_T^h$ distribution to generate pseudo-experiments data, $N^{pseudo}$,
- Using binned likelihood $L_i = Pois\left(N_i^{psudo}, \sigma_{hV}^j \times \epsilon_{ij} \times Lum\right) Pois\left(N_i^{pseudo}, N_i\right)$ to find all the $\sigma_{hV}^j$ in 68% C.L.

# Result




Finish up 14 TeV and also do 100 TeV for the Snowmass process.

# Thank You