Search for a New Heavy Charged Gauge Boson with ATLAS

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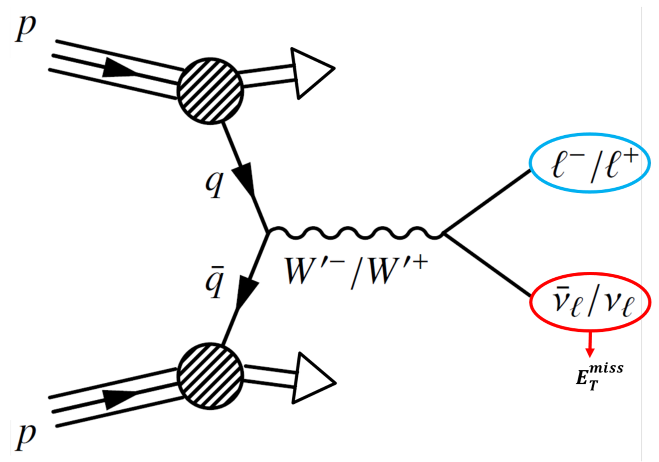
1 Introduction

- The W' is a new gauge boson arising from extensions of electroweak symmetry.
- Predicted in a wealth of BSM theories:
  - Little Higgs (hierarchy problem)
  - Left-Right Symmetric (GUT)
  - 331 Models (3 quark families)



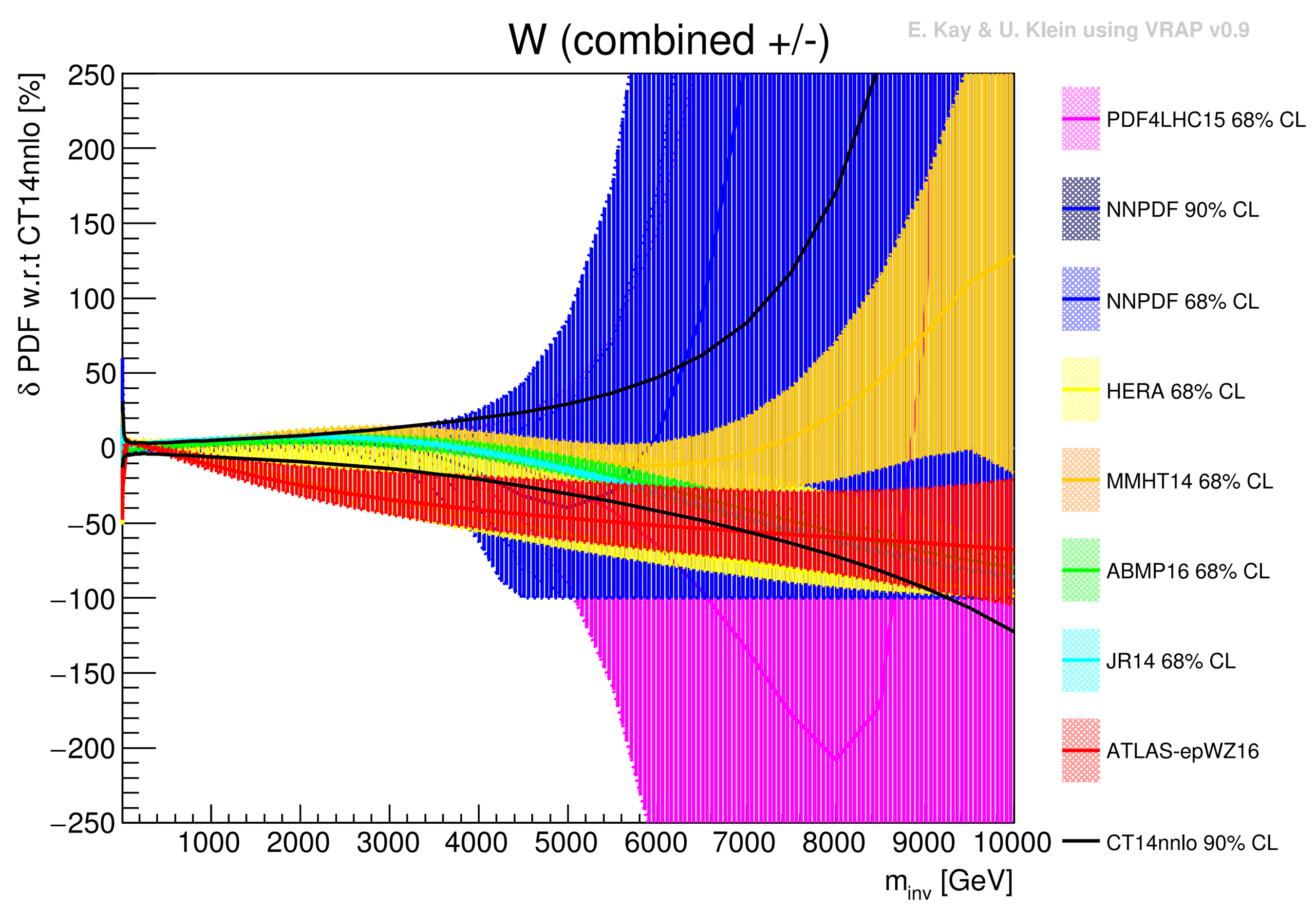
- We consider spin-1 s-channel W' resonances in the context of the Sequential Standard Model (SSM) [?].
  - Same couplings to fermions as the SM W, TeV scale mass.

2 Analysis Strategy & Sample Modelling

- Identify events with one high-p_T lepton and large E_T^{miss}.
- Search for deviations from SM in $m_T = \sqrt{2p_T E_T^{miss}(1-\cos\phi_{\ell\nu})}$
- "Flat" W' signal samples are reweighted to the desired pole mass.
- Monte Carlo Backgrounds include:
  - Charged Current Drell-Yan $W \rightarrow e\nu$ (mass-binned) (DOMINANT)
  - Neutral Current Drell-Yan $Z \rightarrow \ell\ell$ (mass-binned)
  - Top ($t\bar{t}$ & single top) (inclusive)
  - Diboson (inclusive)

3 Higher-Order Corrections

- For searches at the TeV scale, understanding of the parton structure of the proton becomes a dominant source of uncertainty.
- Signal & dominant background samples are corrected to best theory knowledge:
  - Signal $\rightarrow$ NNLO$_{QCD}$
  - Background $\rightarrow$ NNLO$_{QCD}$ & NLO$_{EW}$
- Additional theoretical uncertainties for background:
  - PDF & α_S for nominal PDF
  - PDF choice uncertainty



Ratios of the central values and uncertainties for all modern PDF sets to the CT14 (nominal) central values.

4 "Fake" Lepton Background

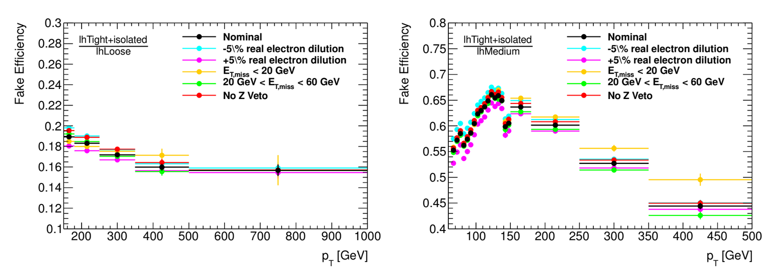
- QCD jet production ($\rightarrow$ "fake" leptons) ill described by MC
- Instead use a data-driven Matrix Method
  - exploits the different probabilities for "real" and "fake" leptons to pass from "loose" to "tight" cuts

$$\begin{pmatrix} N_T \\ N_L \end{pmatrix} = \begin{pmatrix} \epsilon_R & \epsilon_F \\ 1-\epsilon_R & 1-\epsilon_F \end{pmatrix} \begin{pmatrix} N_R \\ N_F \end{pmatrix}$$

$$\epsilon_F \equiv \frac{N^{fake}_{tight}}{N^{fake}_{loose}}, \quad \epsilon_R = \frac{N^{real}_{tight}}{N^{real}_{loose}}$$

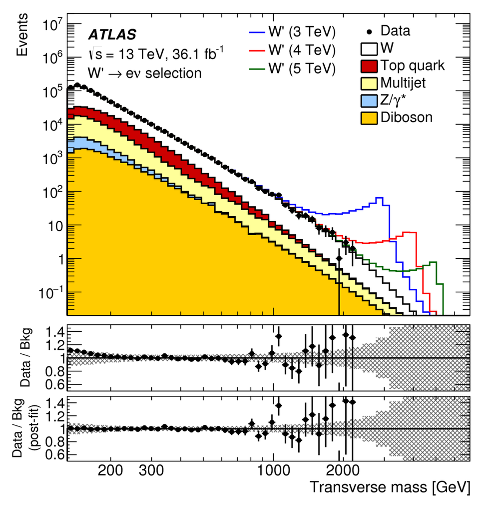
- Inverting matrix yields "fake" component in data (tight selection):

$$\epsilon_F N_F = \frac{\epsilon_F}{\epsilon_R - \epsilon_F}\left[\epsilon_R(N_L + N_T) - N_T\right]$$

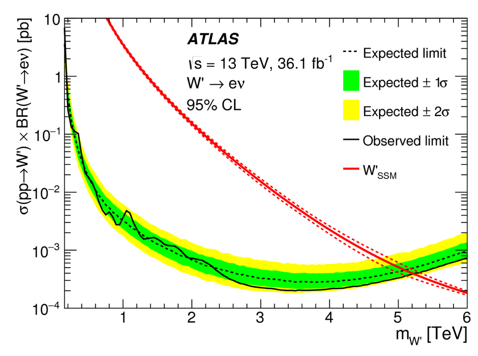


- The cuts which define the QCD control region for ϵ_F are varied to obtain a systematic uncertainty on this background.

5 Results



- Limits are set using the Bayesian Analysis Toolkit [?].
- W' masses below 5.2 TeV are excluded at 95% confidence level for the electron channel.
- No significant excess above the SM is observed.
- Work is in progress to also set frequentist limits
  - This would facilitate combination with other analyses such as diboson searches.



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