EXCLUSION LIMITS OF CHARGED HIGGS PARTICLES

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BACKGROUND

- The existence of charged Higgs boson(s) is a consequence of models with two (or more) Higgs doublets
- Properties of the charged Higgs are unknown
  - Mass
  - Tan(β)
- The existence of charged Higgs would provide evidence of physics beyond the Standard Model
- Can ATLAS data from the LHC experiment be used to exclude models with heavy charged Higgs (M(H+)>500 GeV) ?

METHODS

- Use ATLAS exclusion limits on heavy resonances decaying to dijets in events with leptons
- Compare such limits with cross sections predicted by Monte Carlo models for the following production of charged Higgs bosons
  - $H^+t \rightarrow tb$
  - $H^+t \rightarrow hW \rightarrow bbWW$
  - $H^+W \rightarrow tb$
  - $H^+W \rightarrow hw \rightarrow bbWW$
- Reconstruct invariant masses of two jets from Monte Carlo models and calculate cross sections for cases when dijet mass width is similar to that used for published ATLAS limits
- Cross sections of the channels for different values of tan(β) and mass were compared to the expected limits
- Cross sections of mass and tan(β) above the limits could be excluded

RESULTS

Gaussian Width after Jet Reconstruction				
Mass [TeV]	$H^+W \rightarrow hW \rightarrow bbWW$	$H^+W \rightarrow tb$	$H^+W \rightarrow hW \rightarrow bbWW$	$H^+T \rightarrow tb$
0.5	0.2611	0.2477	0.3246	0.2603
1.0	0.3926	0.2512	0.4150	0.2587
1.5	0.0975	0.2201	0.1129	0.4167
2.0	0.0755	0.1077	0.0790	0.1191
2.5	0.0664	0.0879	0.0717	0.1054
3.0	0.0609	0.0827	0.0658	0.0898
3.5	0.0583	0.0772	0.0611	0.0863
4.0	0.0548	0.0846	0.0570	0.0869
4.5	0.0534	0.0738	0.0531	0.0758
5.0	0.0499	0.0734	0.0548	0.0766

Table 1: The histogram of masses of the charged Higgs after jet reconstruction were fitted to a Gaussian and the width was used to determine what exclusion limits to use for each mass. Despite the Higgs' mass being a delta function, reconstruction of the jets causes the mass to spread out.

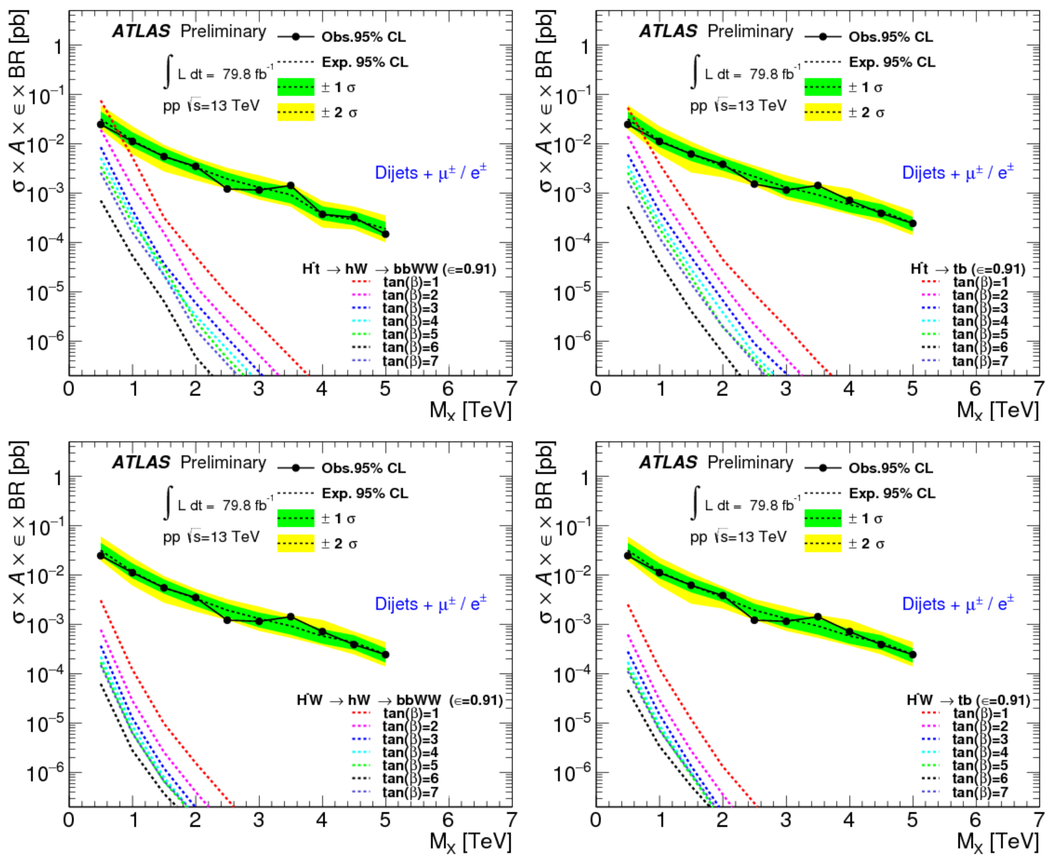

Figure 1-4: Each graph shows cross section verses mass of different tan(β) values for each decay channel. Any point located above the expected limits (green-yellow band) and be excluded. At this luminosity, not very many points can be excluded but

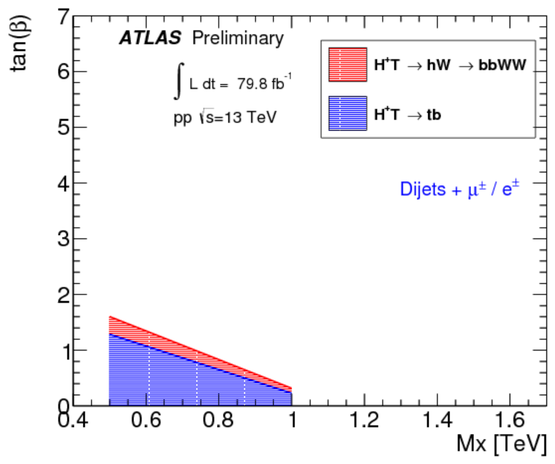

Figure 5: For each mass, the tan(β) values were fitted to a function to get a more accurate value for the exclusion limit. The graph shows the combinations of tan(β) and mass that can be excluded with this luminosity.

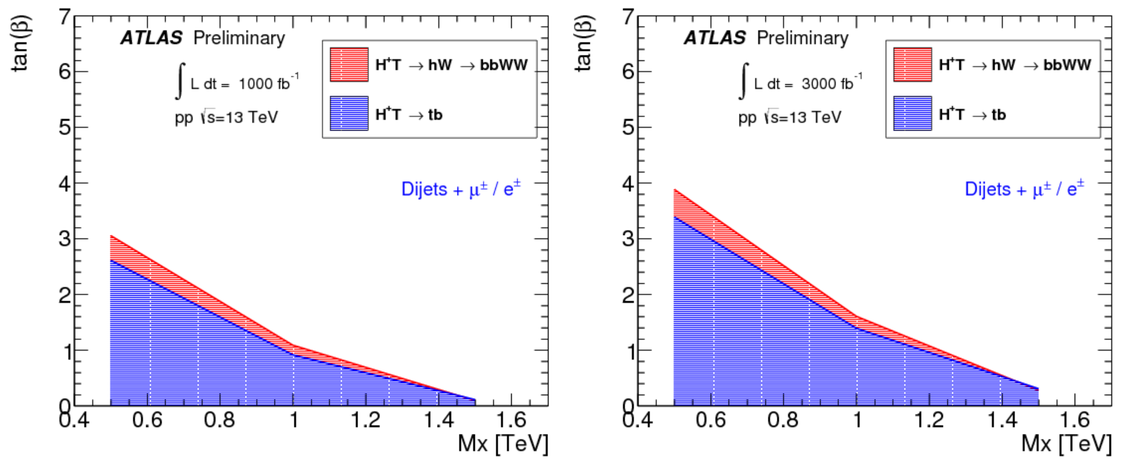

Figure 6-7: By fitting the background Monte Carlo data (not charged Higgs signals) exclusion limits versus luminosity to a function, the limits for charged Higgs can be approximated for higher luminosity. As shown in the graphs, even more points can be excluded at higher luminosity.

CONCLUSION

- A region of the parameter space M(H+)-tan(beta) that can be excluded by the existing ATLAS data was calculated
- As we reach higher and higher luminosity, a larger parameter space can be excluded

REFRENCES

- A.G. Akeroyd, M. Aoki, A. Arhrib, L. Basso, I.F. Ginzburg, J. Hernandez-Sanchez,… E. Yildirim, *Prospects for charged Higgs searches at the LHC,* Eur. Phys. J. C (2017) 77:276
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