Argonne NATIONAL LABORATORY

Search for W' → tb with the ATLAS Detector

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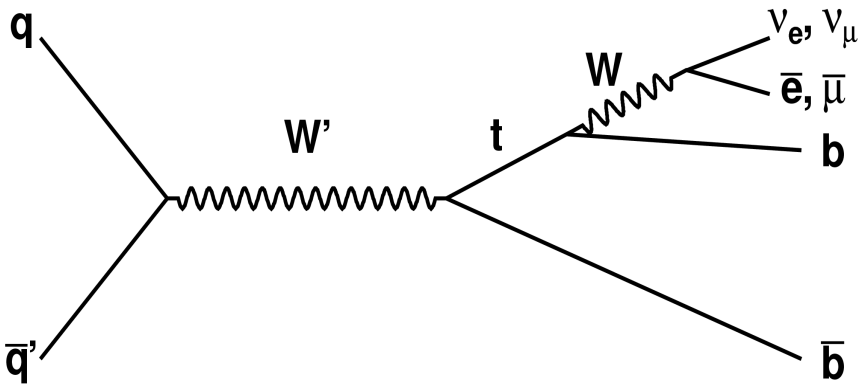
Motivation

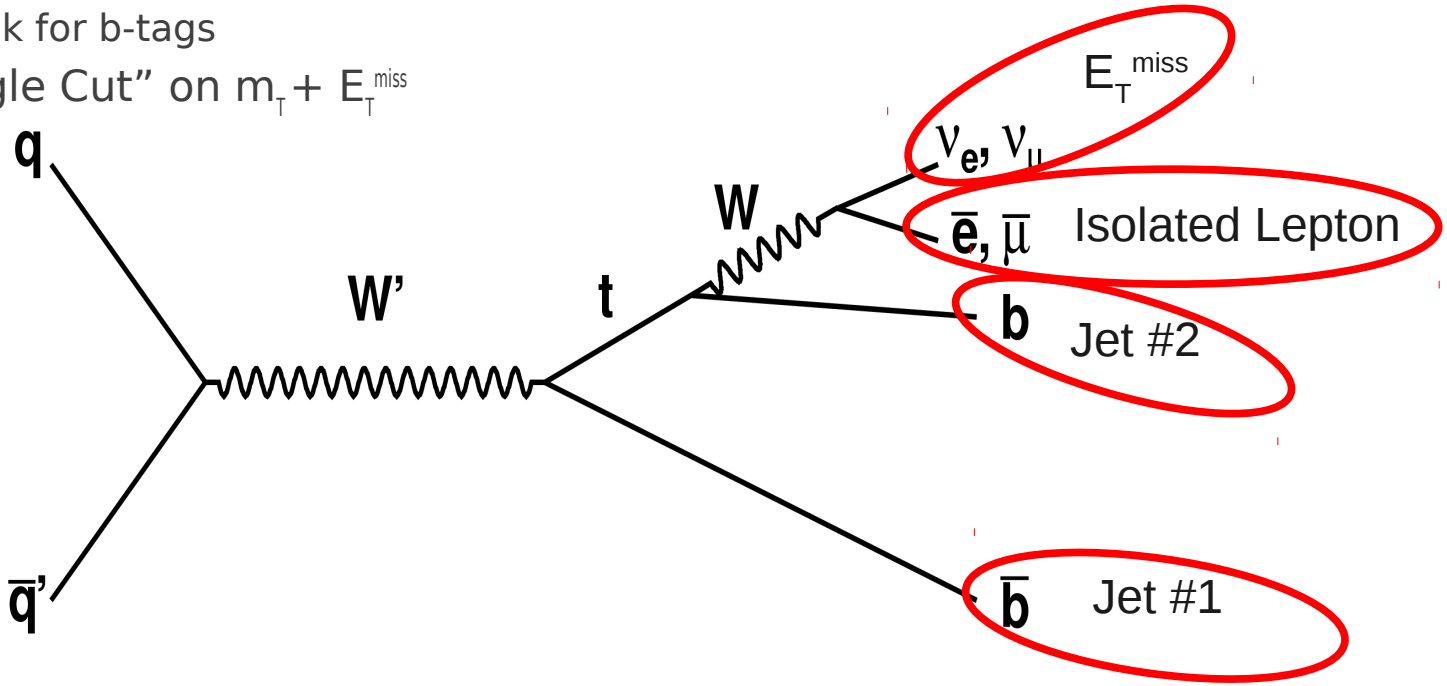
- The Standard Model is a very accurate effective theory but open questions remain, despite the discovery of a Higgs-like Boson
  - Examples: Fine tuning of the Higgs-like boson's mass, fermion mass hierarchy, the Flavor Puzzle, CP violation...
  - Is the answer new Physics?



- Look for W' decaying to top and bottom pair
  - Same final state as S-Channel Single Top
    - Would result in a resonance in the tb invariant mass spectrum
    - Cross section times branching fraction 2.92 pb for 1 TeV W_R'
  - The search to quarks is more general than leptons
  - Sensitive to both W_R' and W_L' over a broad range of couplings
  - 3rd generation

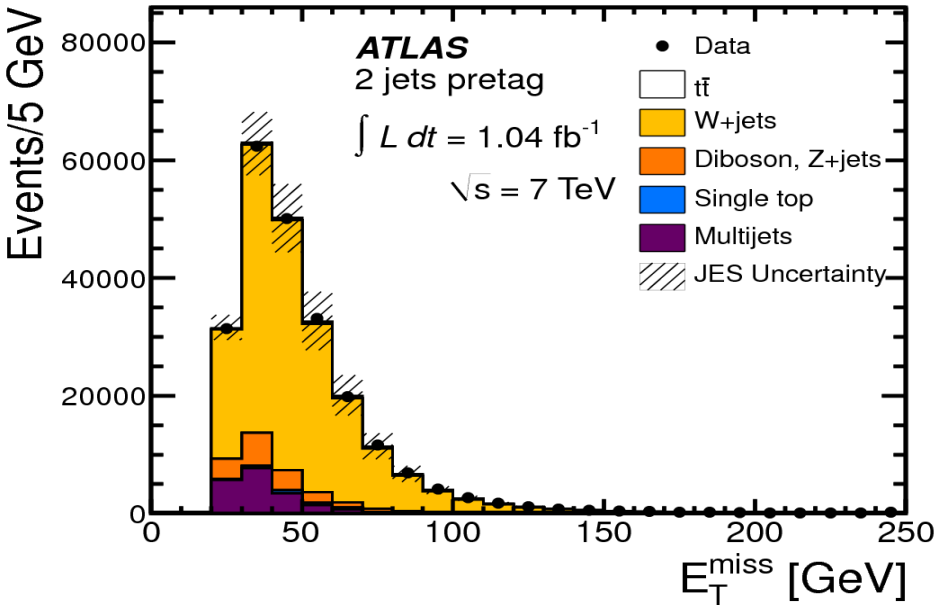
Analysis Method

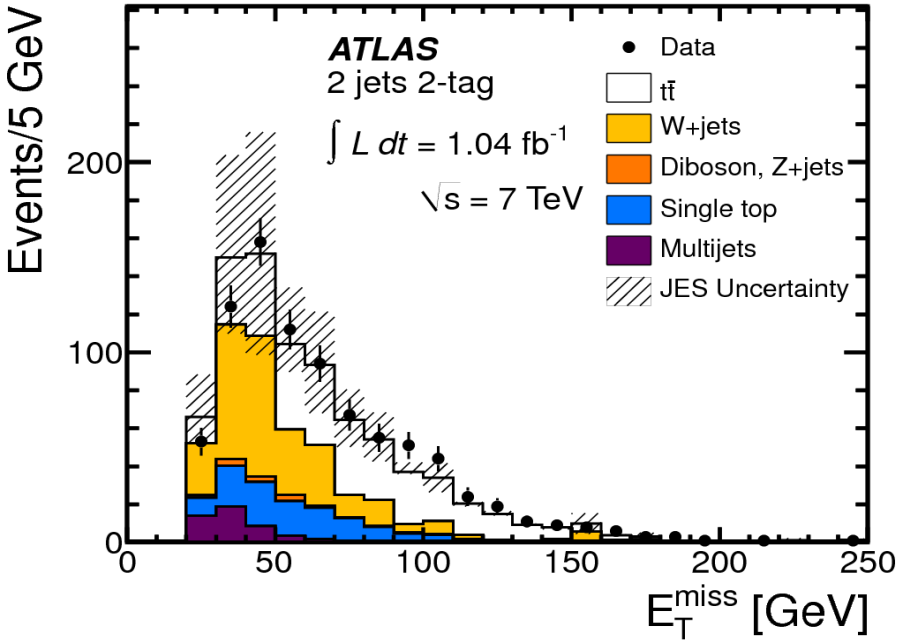
- Using 1.04 fb^{-1} of 7 TeV data
  Phys. Rev. Lett. 109, 081801 (2012)
- Candidate events
  - Triggered on high p_T lepton
    - Leptons must be isolated
  - Require E_T^{miss}
  - Require exactly 2 jets
    - Look for b-tags
  - "Triangle Cut" on $m_T + E_T^{miss}$
- Plot invariant mass
  - For number of b-tags
- Search above 500 GeV
- Combine 1 b-tag and 2 b-tag distributions
  - 1 TeV signal efficiency of 1.38(0.49)% for one (two) tags



E_T^{miss} And Background

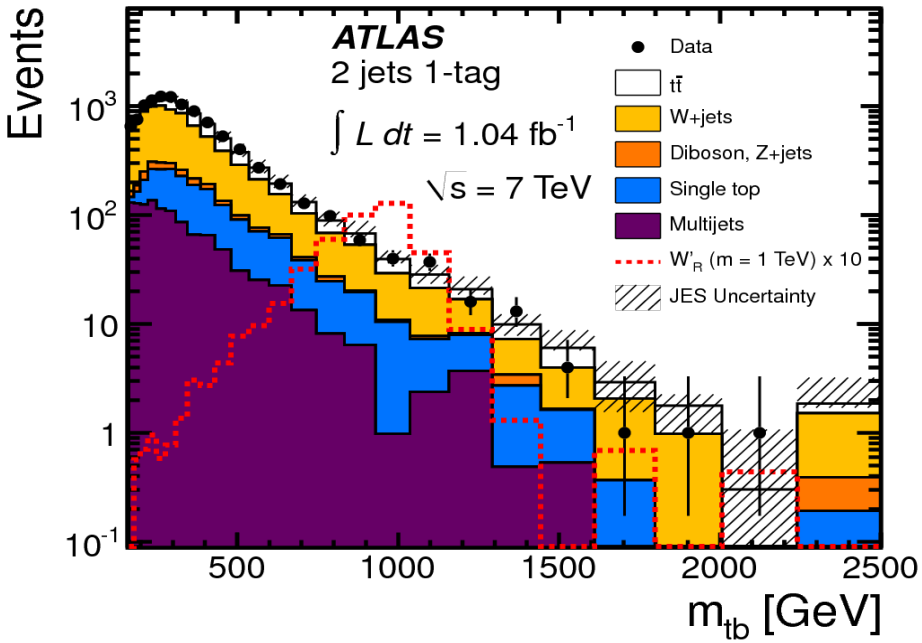
- Most backgrounds are taken from MC
  - W+jets scaling and flavor content
    - Looking in non-search region M_{tb} < 500 GeV
  - QCD where normalization is estimated from a binned likelihood fit to the E_t^{miss} distribution
    - Taking the shape from QCD rich sample selecting a jet instead of an electron
- Largest background W+jets ($t\bar{t}$) for one (two) tagged events

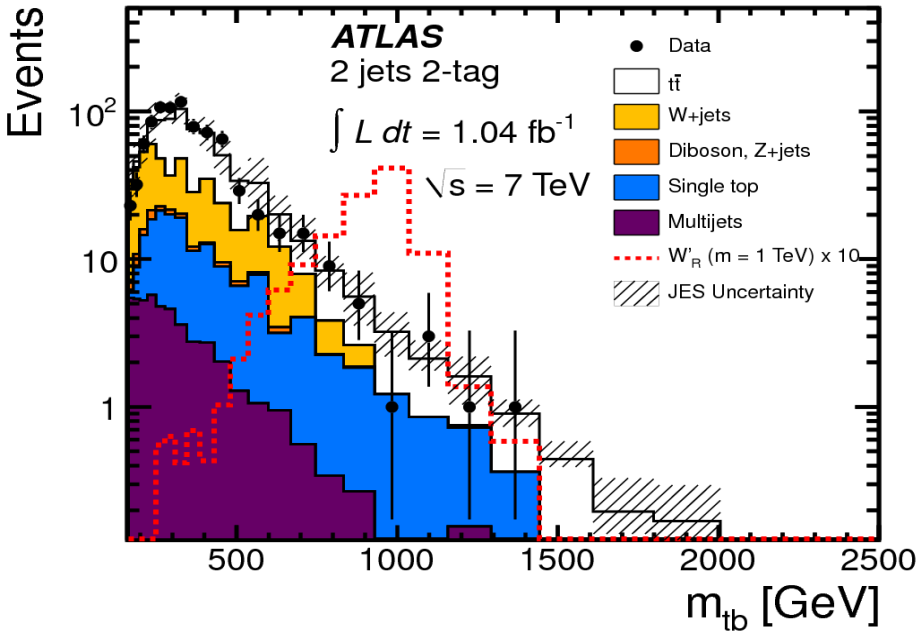




M_{tb} Distribution

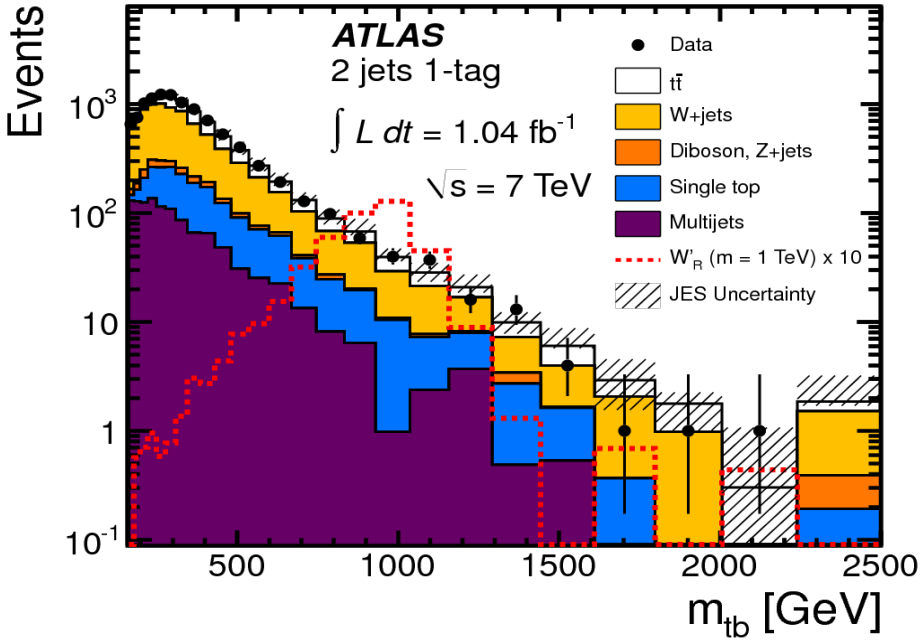
- Search the M_{tb} distribution for events with both one and two b-tags
  - Above 500 GeV using the BUMPHUNTER Tool
  - Find most discrepant point

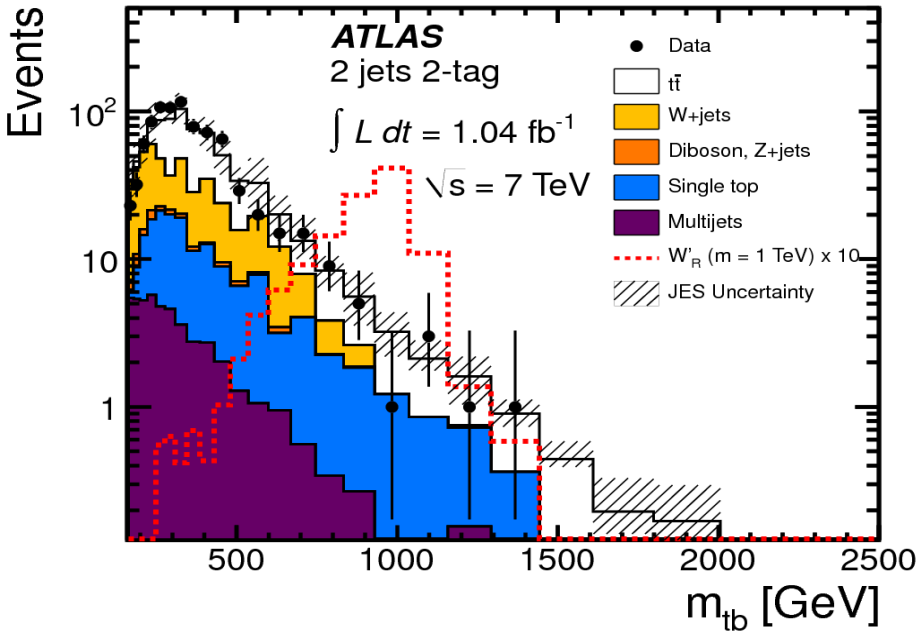




M_{tb} Distribution

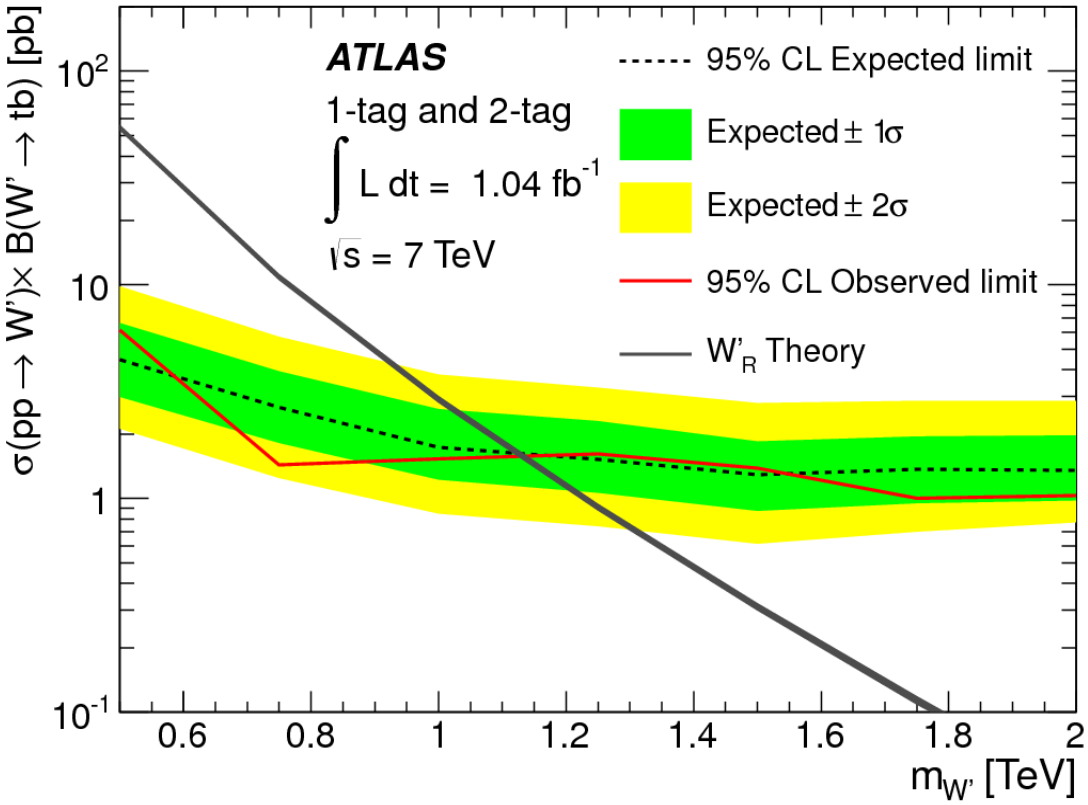
- No significant discrepancy was found
  - Highest data-background differences
    - One-tag: 1024 – 1129 GeV
      - Probability of background fluctuation 66%
    - Two-tag: 764 – 842 GeV
      - Probability of being a background fluctuation 72%
- Combine one tag and two tag distributions to set limits





Search Limits

- 95% Confidence Level Limits were set on $m(W'_R) > 1.13$ TeV
  - Using Bayesian approach with flat priors



Conclusion

- Despite the recent discovery of the Higgs-like Boson searches for Beyond the Standard Model Physics are well motivated
  - One generic search is to look for new massive gauge bosons decaying to tb
- Using 1.04 fb^{-1} of 7 TeV data ATLAS searched for $W'_R \rightarrow tb$
  - Observing no excess, 95% Confidence Level Limits were set on $m(W'_R) > 1.13$ TeV
- Work is on going to analyze the full 7 + 8 TeV data with new techniques
  - Increasing sensitivity to low cross sections with a Boosted Decision Tree analysis
  - Studies on going to increase high mass reach using boosted top decays

Thank you

Back up material

Previous Experimental Results $W'_{R/L} \rightarrow tb$

	$W' \rightarrow e,\nu_e$ / μ, ν_μ	$W' \rightarrow tb$
CDF	1.12 TeV (5.3 fb^{-1})	800 GeV (1.9 fb^{-1})
DØ	1.00 TeV (1.0 fb^{-1})	885 GeV (2.3 fb^{-1})