

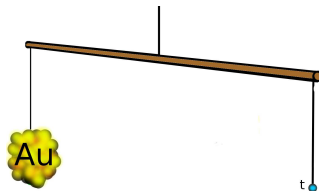
# Top Quark Cross Section Measurements at ATLAS

Jacob Searcy

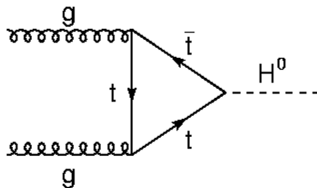
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# Top Quarks

- The top quark is the most massive fundamental particle



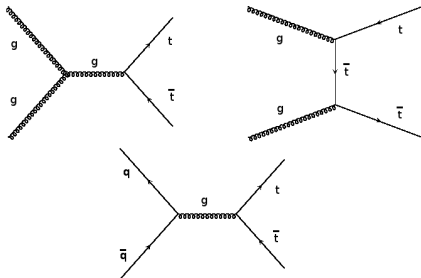
- It plays a unique role in Standard Model Higgs physics



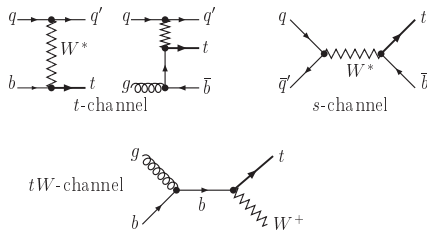
- We better understand its production and decay

# Introduction

- $t\bar{t}$  cross section
  - Overview
  - $l + \tau$  cross section
  - Differential cross section



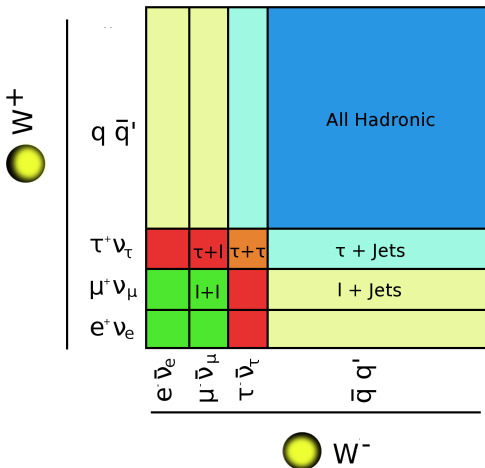
- Single top cross section
  - Overview



Figures from arXiv:hep-ex/0605034

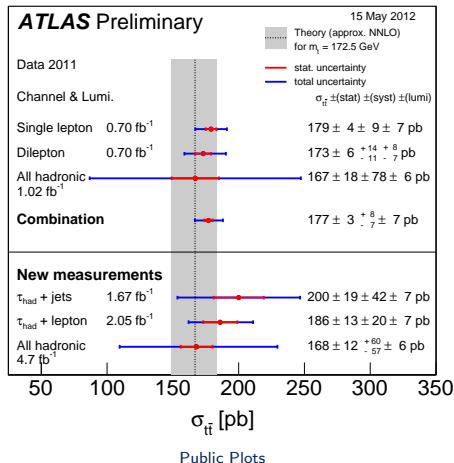
# Top Decays

- Once top quarks are produced they decay immediately ( $3 \cdot 10^{-25}\text{s}$ )
- The SM predicts the top quark will decay through  $t \rightarrow bW^+$   $\sim 100\%$  of the time
- A pair of top quarks decay into
  - $t\bar{t} \rightarrow W^+bW^-\bar{b}$
  - $W^+$  decays into a pair of particles
- The final states are categorized based on the  $W^+W^-$  final states



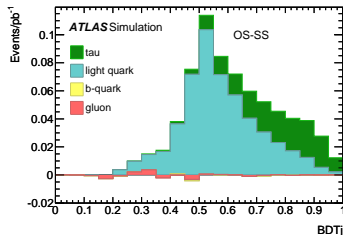
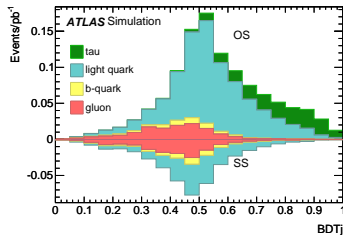
# $t\bar{t}$ Overview

- All channels but  $\tau + \tau$  have been studied
- Combined cross section is:  
 $177 \pm 3^{+8}_{-7} \pm 7 \text{ pb}$ 
  - Largely similar in precision to CMS
- ATLAS does particularly well in the  $l + \tau$  channel



## $l + \tau$ channel

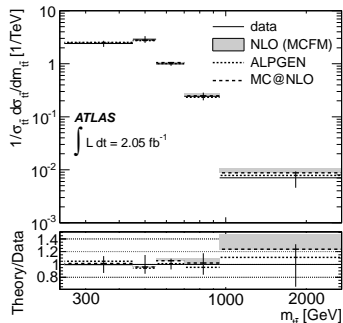
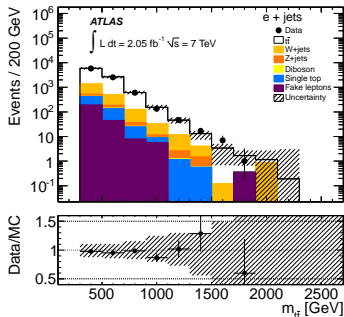
- Jet composition greatly effects  $\tau$  fake rate
  - Major uncertainty in CMS's analysis
- Trick: subtract same sign (SS) events from opposite sign (OS) ones
  - Outgoing quarks have opposite sign of lepton (OS > SS)
  - Gluon have no charge (OS = SS)
  - $b$  quarks come in pairs (OS = SS)
- Best CMS measurement:  
 $143 \pm 14 \pm 22 \pm 3 \text{ pb}$   
 $\frac{\Delta\sigma}{\sigma} = 18\% (2 \text{ fb}^{-1})$
- Best ATLAS measurement:  
 $186 \pm 13 \pm 20 \pm 7 \text{ pb}$   
 $\frac{\Delta\sigma}{\sigma} = 13\% (2 \text{ fb}^{-1})$



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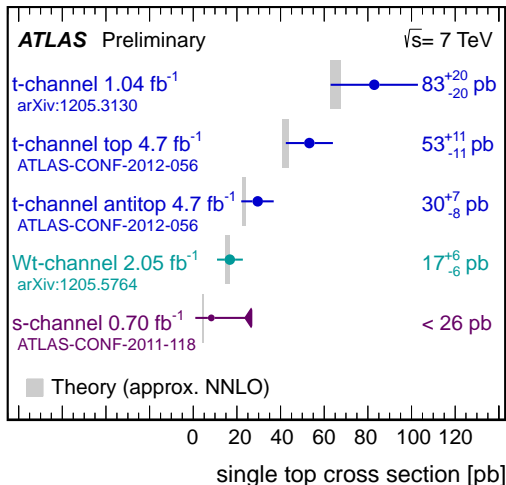
# Differential Cross Section

- [arxiv:1207.5644](https://arxiv.org/abs/1207.5644)
- New physics that could explain the TeVatron forward backward asymmetry could be observed at high  $m_{t\bar{t}}$



# Single Top Summary

- Measurements or search for all single top production channels
- Single  $t$  and  $\bar{t}$  production in agreement with the SM
- All agree with SM predictions





## Conclusions

- ATLAS has studied the top quark in great detail
- $t\bar{t}$  production is consistent with the Standard Model inclusively and differentially
- Single top production also in agreement with Standard Model
- Focus now on 8 TeV data and s channel single top production

**Thank You**