Top cross-section measurements with early ATLAS data

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(3rd International Workshop on Top Quark Physics – TOP2010)  
May31 – June04, 2010, Bruges - Belgium

Single Lepton + Jets Signal Signature\(^1\)

**Event Selection and Reconstruction:**

1. Exactly one lepton (e or µ – depending on the channel) with \(p_T > 200 \text{ GeV}, |\eta|<2.5\) and missing energy (MET) > 200 GeV (Not used in HT2 analysis – explained below).

2. at least 4 jets with \(p_T > 200 \text{ GeV}, 3 \text{ of which with } p_T > 400 \text{ GeV}\).

3. The hadronic top quark candidate is defined as the combination of 3 jets whose total \(p_T\) is greatest in among all the 3 jet combinations.

4. No b-tagging required

**Backgrounds:**

- W+jets dominant expected background, although Z+jets and WW and WZ are also expected to be significant (signal to background ratio after all these contributions is ~2). For the W+jets, \(p_T\) cut (as explained below)

**Cut and Count Method:**

- Total number of events passing the selection criteria are counted
- Expected backgrounds are subtracted to calculate the cross-section:
  - The MC uncertainty for production of W+jets events is large, but W to Z ratio uncertainty is smaller.
  - One can estimate the number of W+jets contribution by measuring this ratio in a control region with 0 or 1 jet and extrapolate this to the top signal region with 4 or more jets.

**The Hadronic Top mass fit method:**

In this method the cross-section is extracted by fitting the 3 jet invariant mass, using a binned maximum likelihood fit, to extract the signal yield after applying the M_{W,J}\(_{cut}\) cut.

**Systematic and Results:**

The possible sources of systematic uncertainties for each method and their values:

<table>
<thead>
<tr>
<th>Source</th>
<th>Reason</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Luminosity</td>
<td>At a design Luminosity of 10^{33} cm^{-2}s^{-1} 25 ns bunch crossing rate.</td>
<td>initial energy at 7 TeV</td>
</tr>
<tr>
<td>MC samples</td>
<td>All the uncertainties were combined by constructing a likelihood function for each channel. They were fit on the profile likelihood.</td>
<td></td>
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<tr>
<td>Signal normalization</td>
<td>From the simulated ATLAS MC samples and final results</td>
<td></td>
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</tbody>
</table>

**References:**


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Di-lepton Signal Signature\(^2\)

**Event Selection and Reconstruction:**

1. Exactly 2 Opposite sign leptons (e or µ – depending on the channel) with \(p_T > 200 \text{ GeV}, |\eta|<2.5\)

2. Z veto applied

3. \(h > 250 \text{ GeV}\) for ee and \(h > 100 \text{ GeV}\) for ee events

4. at least 3 jets with \(p_T > 200 \text{ GeV}\) and \(|\eta|<2.5\)

**Backgrounds:**

- Real di-leptons:
  - Leptonically decaying Z, reducible by cut on MET and Z veto

- WW, WZ, very similar signature, but low cross-section

- Missidentified (fake) lepton, dependent on misidentification-rate

**Backgrounds:**

- Semi-leptonic top pair events, \(W+jets\) (one real and one fake lepton contribute to the signal) . Single top QCD multijets (contributes through fake leptons to the signal events)

**MET (top – shows DY is dominant at low MET) and Jet multiplicity distributions:**

**Systematic and Results:**

The possible sources of systematic uncertainties and their contribution to the cross-section measurement are shown in the table: