Search for resonant production of new particles decaying to $t\bar{t}$ pairs at ATLAS

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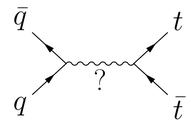
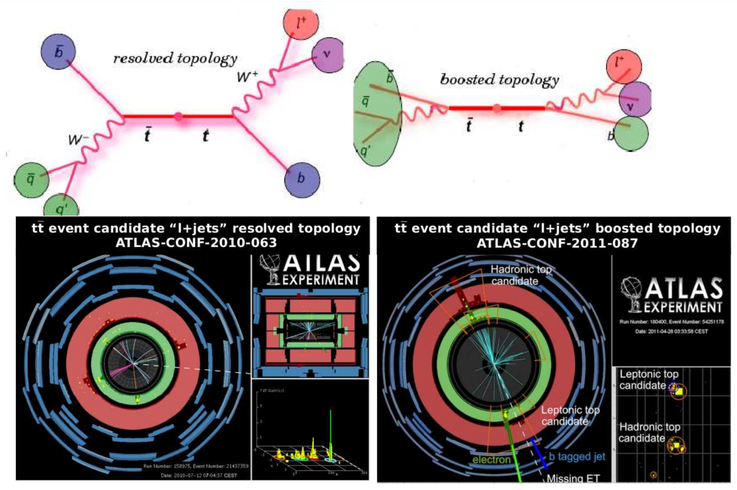
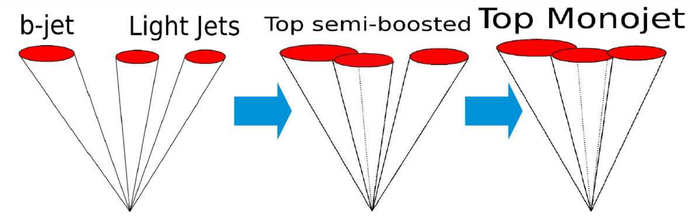
Motivation

Theoretical shortcomings and experimental results have motivated extensions to the Standard Model. Several scenarios beyond the Standard Model predict new heavy states coupling primarily to the top quark. These states manifest themselves as resonances in the in the $t\bar{t}$ invariant mass spectrum, $m_{t\bar{t}}$. Different schemes to reconstruct $m_{t\bar{t}}$ are designed to take advantage of the detector resolution as well as large invariant mass topologies where the decay products of the top are highly collimated. Merging these schemes into a single one might give improvements in background rejection and signal sensitivity.



Methods: resolved and semi-boosted $t\bar{t}$ reconstruction





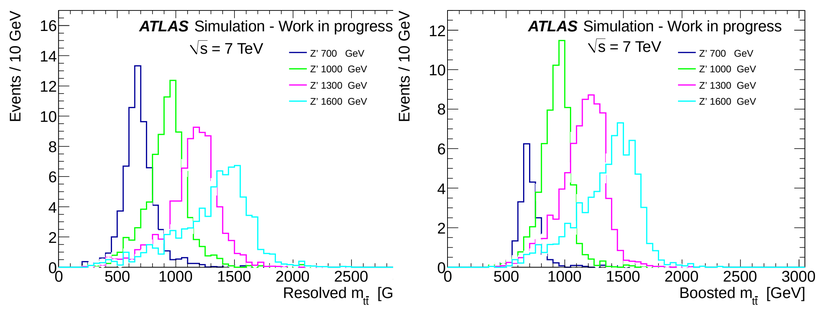
- exactly 1 isolated lepton, cuts on $E_{\mathrm{T}}^{\mathrm{miss}}$ and $m_T(\mathrm{lepton}, \mathrm{E}_{\mathrm{T}}^{\mathrm{miss}})$ against QCD background
- $\geq$ 4 jets of radius $R = 0.4$, $\mathrm{jet}_{p_T}^{\mathrm{lead}} > 60$ GeV, $\geq$ 1 b-tagged jet
- two of the jets from the hadronic top decay can be merged, if one of the jets has a mass larger than 60 GeV $\Rightarrow$ require only $\geq$ 3 jets.

Jets are reconstructed using the anti-k_T algorithm.

Methods: boosted and $t\bar{t}$ mass

- lepton selection similar to resolved analysis: exactly 1 isolated lepton with same criteria for selection and veto,
- same cuts on $E_{\mathrm{T}}^{\mathrm{miss}}$ and $m_T(\mathrm{lepton}, \mathrm{E}_{\mathrm{T}}^{\mathrm{miss}})$ as for the resolved multi-jet rejection
- leptonic top reconstruction $\Rightarrow$ 1 jet ($R = 0.4$) close to the lepton: $0.4 < \Delta R(\mathrm{jet}, \mathrm{lepton}) < 1.5$
- $\geq$ 1 jet of radius $R = 1.0$ back-to-back to the previous jet: $\Delta R(\mathrm{jet}\ R = 1.0\ , \mathrm{jet}\ R = 0.4) > 1.5$
- cut on the last splitting scale of the jet constituents
- the leading p_T of the R=1.0 jet is taken as the hadronic top candidate
- no b-tagging requirement

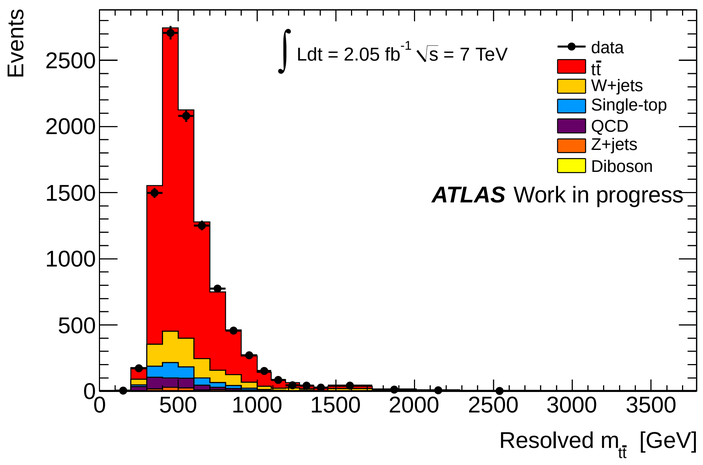
Discriminant variable: $t\bar{t}$ invariant mass: $m_{t\bar{t}}$



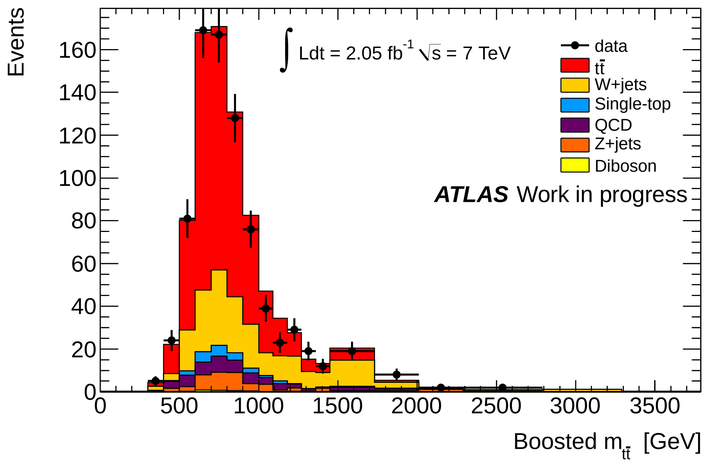
Left: Resolved $m_{t\bar{t}}$ $\Rightarrow$ summing up the 4-momenta of the 4(3) jets + lepton $+\nu$
Right: Boosted $m_{t\bar{t}}$ $\Rightarrow$ adding the 4-momenta of the top hadronic candidate (R=1.0 jet) and the top leptonic candidate: + lepton $+\nu$ + jet closest to the lepton

Comparison of the data and the Standard Model prediction

Resolved reconstruction



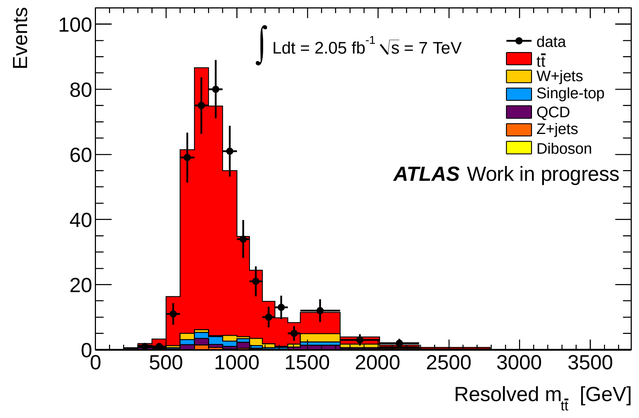
Boosted reconstruction



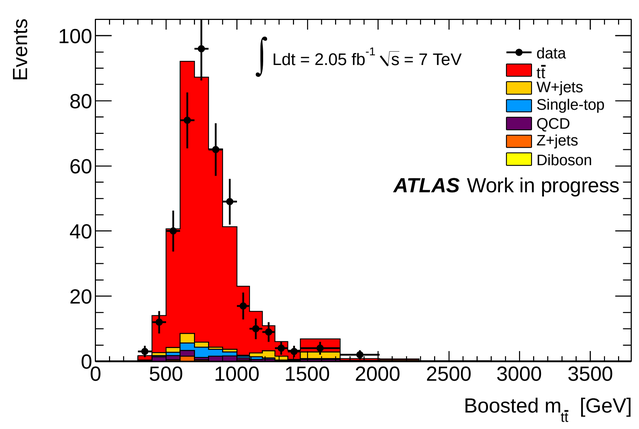
Combined selection: overlap channel

- events passing resolved & boosted selections

Overlap channel - Resolved $m_{t\bar{t}}$



Overlap channel - Boosted $m_{t\bar{t}}$



Selected Publications

1. Eur.Phys.J. C72 (2012) 2083.
2. JHEP 1205 (2012) 128.
3. JHEP 1209 (2012) 041.
4. Eur.Phys.J.C 71 (2011) 1763.
5. ATL-COM-PHYS-2012-797.
6. ATL-COM-PHYS-2012-1356.
7. ATL-COM-PHYS-2011-1598.
8. ATL-COM-PHYS-2011-259.
9. ATL-COM-PHYS-2011-1392.

Jet Trigger Studies

Signals from the ATLAS calorimeters are used to build level-1 jet trigger algorithms responsible to reject the background without biasing the selection of interesting events. High jet trigger performance is fundamental for physics analyses in ATLAS, since jet triggers are the primary means for selecting events containing high-energy jets. These events are required for instance, in Standard model production and background studies. The performance of the jet and multi-jet triggers is evaluated in terms of their efficiency turn-on curves as shown in the plot.

Efficiency for a trigger selecting 2-jet events with a transverse energy of 10 GeV.

Selected Talks

- "Multi-jet triggers with the ATLAS detector" DESY-HU Winter seminar. DESY, Zeuthen 02/2011.
- "Jet Selection in Multi-Jets Analysis with the ATLAS detector" DPG Karlsruhe, 03/2011.
- "Jet triggers on 7 TeV runs with the ATLAS detector" GK Blockkurs Rathen, 03/2011.

Profit form the GK

- 2012 Hadron Collider Physics Summer Symposium, Fermilab 2012.
- Schools participation and support: BND, GK Blockkurs. Interdisciplinary learning within high energy physics.
- CERN expense allowance 2010.

Contact Details and further Information

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