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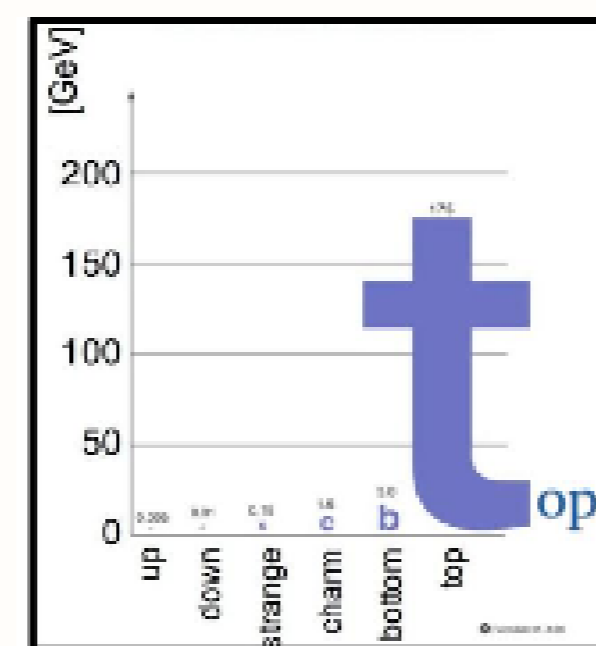
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Abstract

A study of the massive resonances decaying to top quark pairs in proton-proton collisions at the LHC at a centre-of-mass energy of 13 TeV using data collected by the ATLAS experiment during the years 2015 and 2018 is presented. Measurements are presented in the single lepton final state originating from top-pair production, and the different reconstruction methods to extract the top quark mass are discussed. Particular emphasis will be given to the Data-MC comparison. The determination of the top-pair invariant mass is also presented.

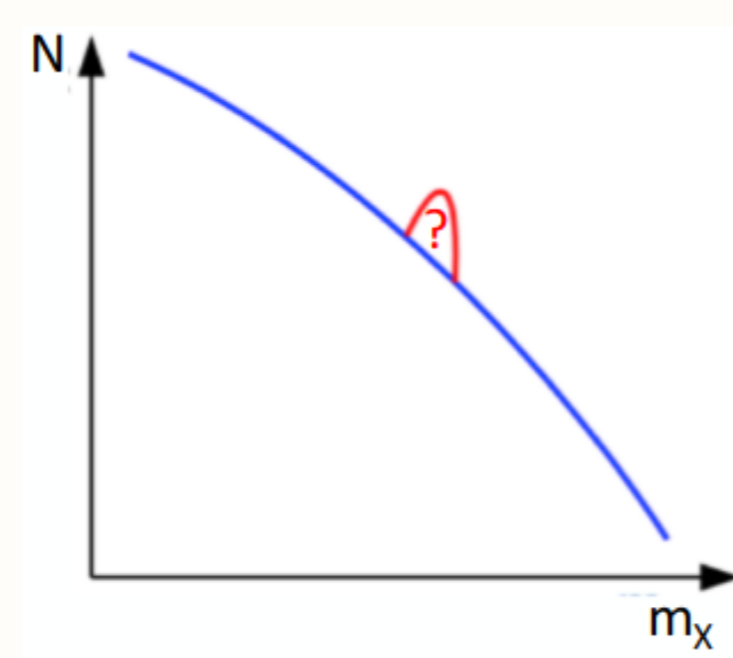
Motivation

- Top is heaviest known particle in the Standard Model (SM)
- Due proximity to Beyond the Standard Model (BSM) phenomena.
- Particularly alternative EWSB models.



- Searches for new resonances are critical part of LHC programme

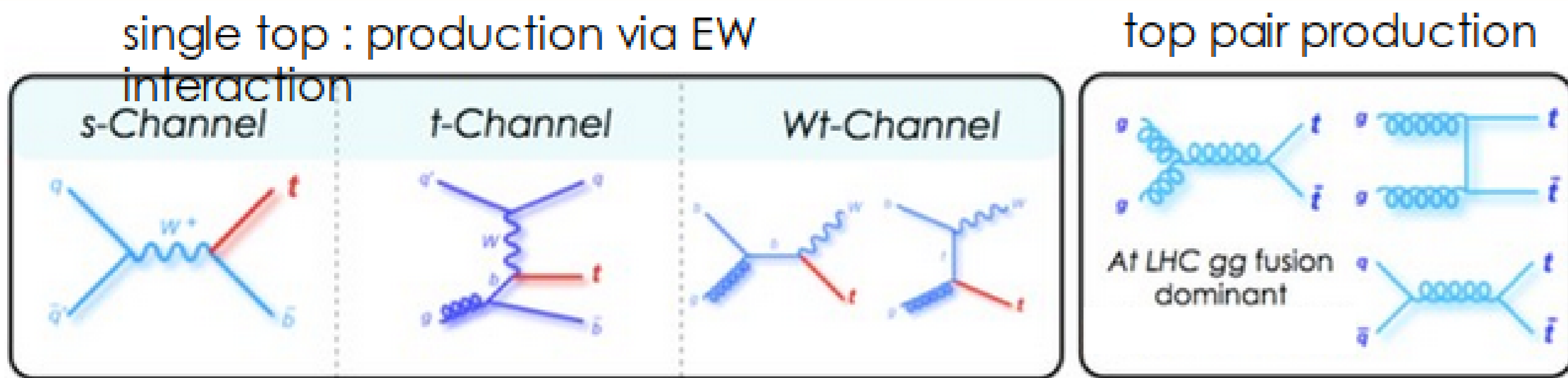
- Generic signature for many BSM physics models seeking to solve variety of open question in SM: Hierarchy problem, Dark Matter or Exotics phenomena(Focus in this study).....



- => BSM theories predict new heavy particles which could couple strongly with the top quark.
- Resonant production of heavy particle new particle (Z', G_{kk} and g_{kk}) should be visible in the tt mass spectrum

TOP QUARK PRODUCTION

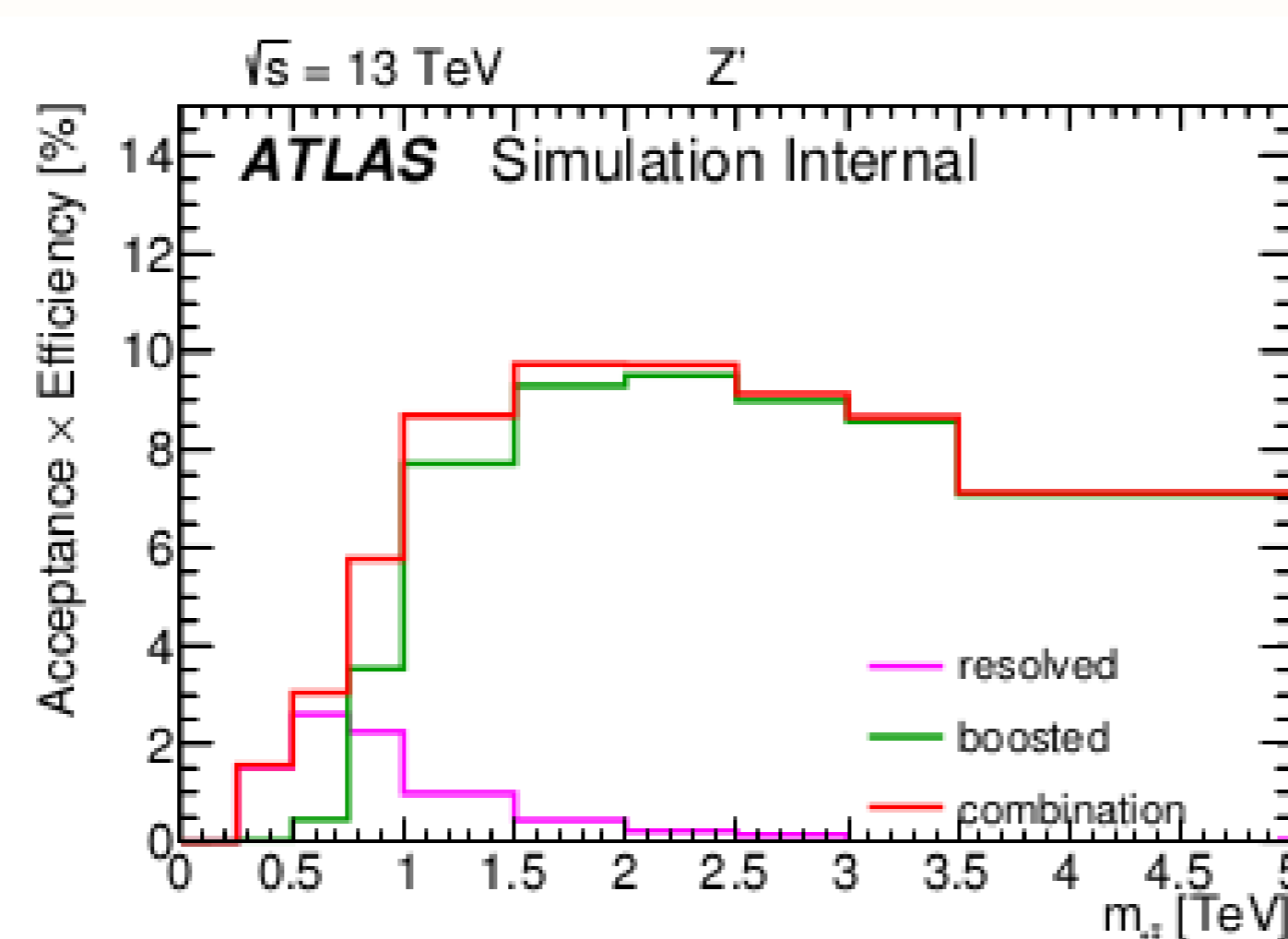
- Top quark decays : BR(t → wb ~ 100%)



- At the LHC, top pair production (LO):
- **80% Gluon fusion**
- **20% quark-antiquark annihilation**

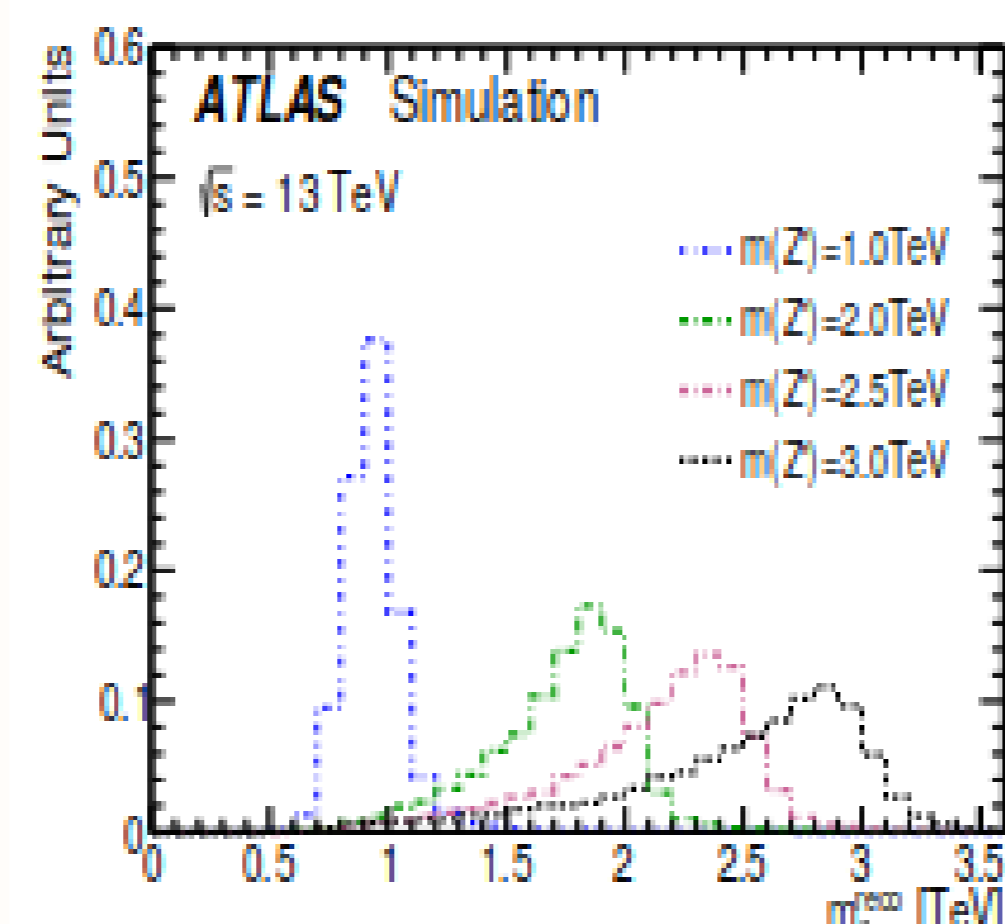
Topology for ttbar Resonance

- Two different decay topologies can be exploited in the lepton plus jets decay channel
- Boosted (high mass) :quark top produced with a high boost → high p_T
 - ≥ 1 anti-kt R=1.0 jets with Pt > 300 GeV and top-tagged
 - ΔR(JET₁, j_{se}) > 1.5 and Δφ > 2.3
 - ≥ 1b-tagged track jet.
 - Well isolated lepton
- Resolved (low mass)
 - ≥ 4 small R jets with (Pt > 25GeV)
 - Anti-kt with radius R = 0.4
 - ≥ 1 b tagged track jet → Events Reconstruction:
 - ≥ jets assignment to W and top: log(χ²) < 0.9
 - Well isolated lepton



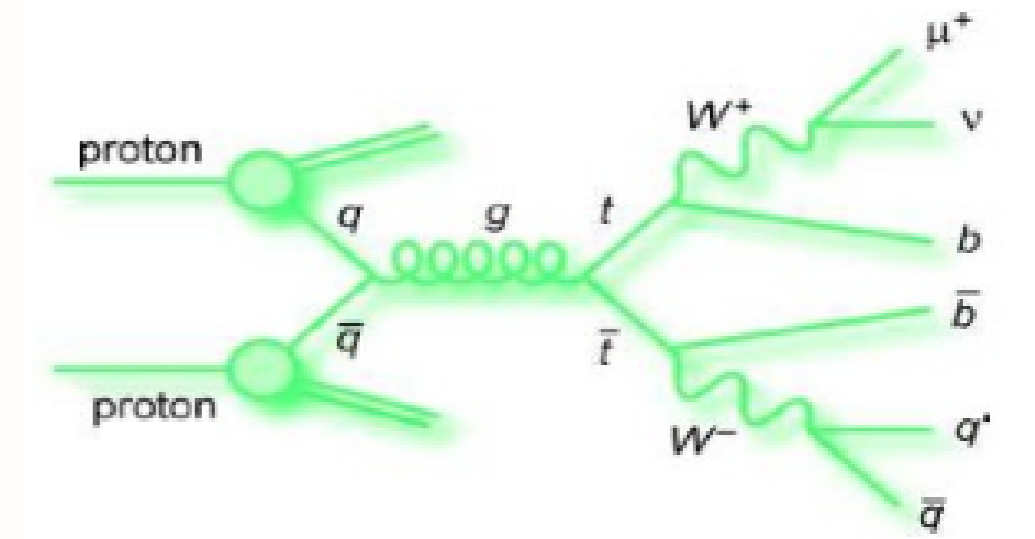
$$\chi^2 = \frac{(m_{jj} - m_W)^2}{\sigma_W} + \frac{(m_{jjb} - m_{jj} - m_b - W)^2}{\sigma_{th-W}} + \frac{(m_{jlv} - m_{tl})^2}{\sigma_{tl}} + \frac{((p_{T,jjb} - p_{T,jlv}) - (p_{T,jb} - p_{T,jl}))^2}{\sigma_{diff p_T}}$$

- Combination of both regimes:
- Events that fail boosted selection are considered by resolved selection
- Increased efficiency in the intermediat regime where the both selections are sensitive.
- Exactly one electron (muon) with Pt > 30 GeV and isolated matched to single lepton trigger.
- MET > 20 GeV and (MET + m_{tt}) > 60 GeV

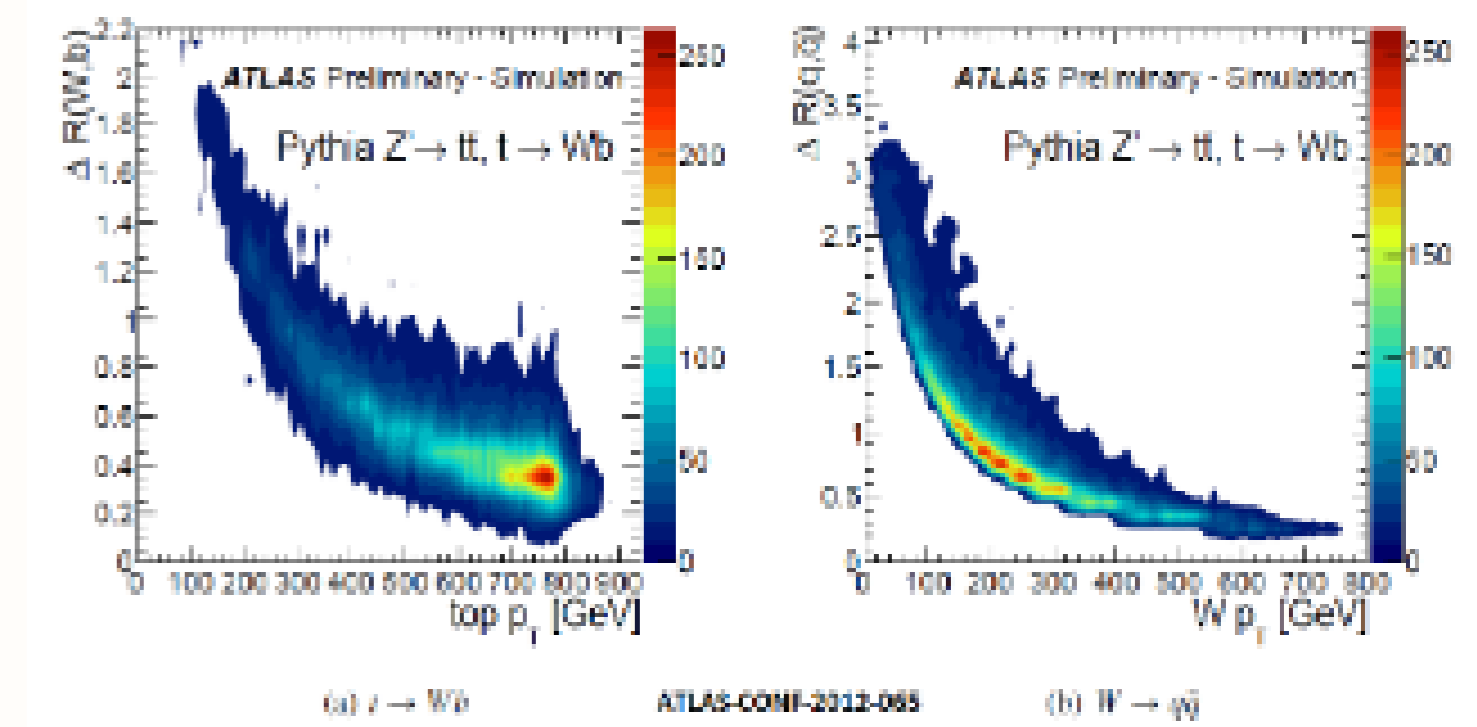


Final Stat Topology

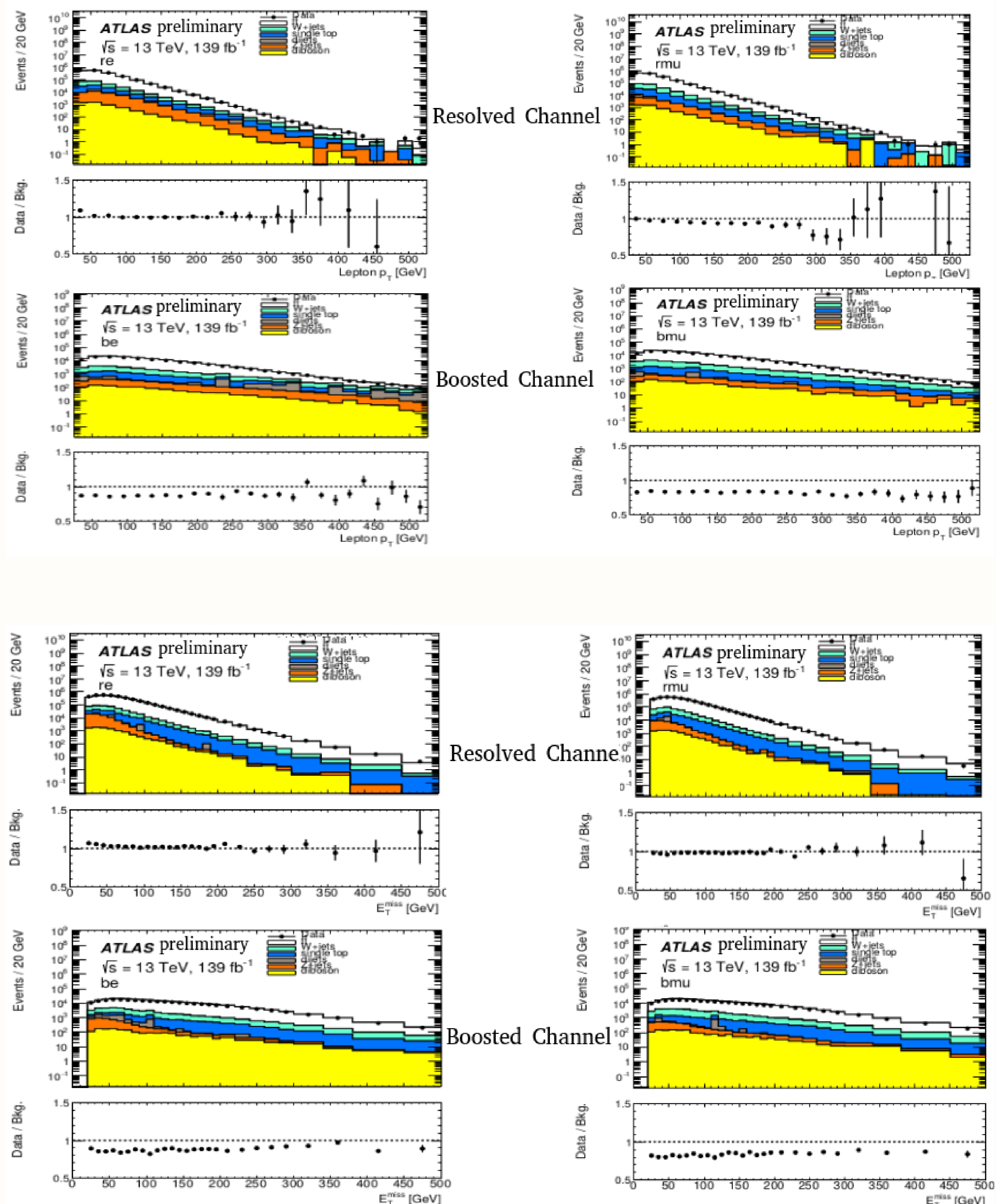
- Study of the semi leptonic channel:
 - branching fraction (e or muon channels)
 - 4 partons among wich 2 are b quarks



- different final state topology for increasing m_{tt}:
 - resolved topology for low m_{tt} masses.
 - Boosted topology for m_{tt} > 1TeV



Results



Summary

- Study of data-MC comparison is performed using 139fb⁻¹
 - Resolved Channel shows Good agreement between data and MC Whiles Boosted channel shows Worse disagreement
- We are working to understand the differences between channels and periods

References

[1] ATL-COM-PHYS-2016-1036