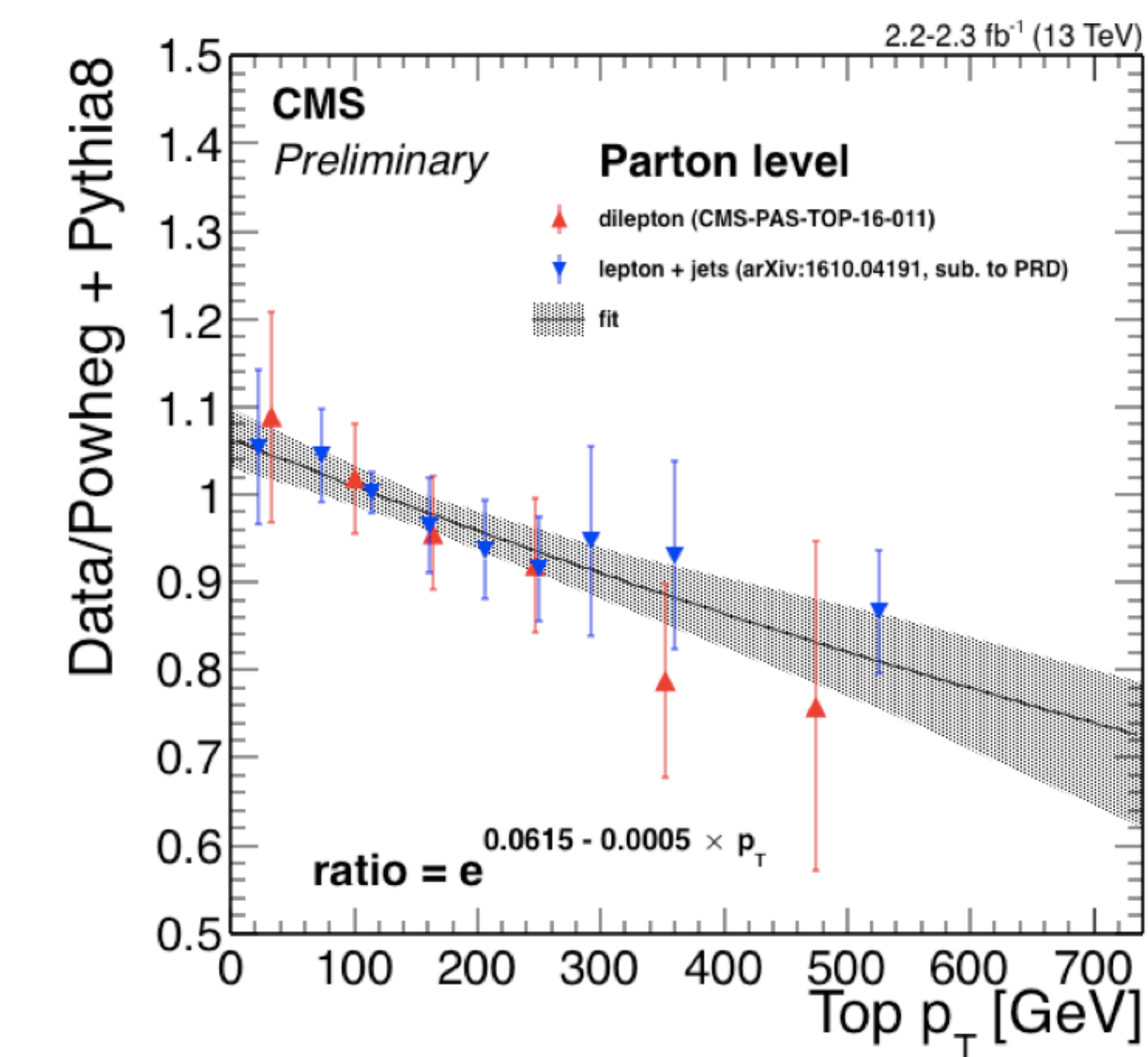


Measurement of differential $t\bar{t}$ production cross sections for high- p_T top quarks with CMS at 13 TeV

Ioannis Papakrivopoulos on behalf of the CMS collaboration



INTRODUCTION / MOTIVATION



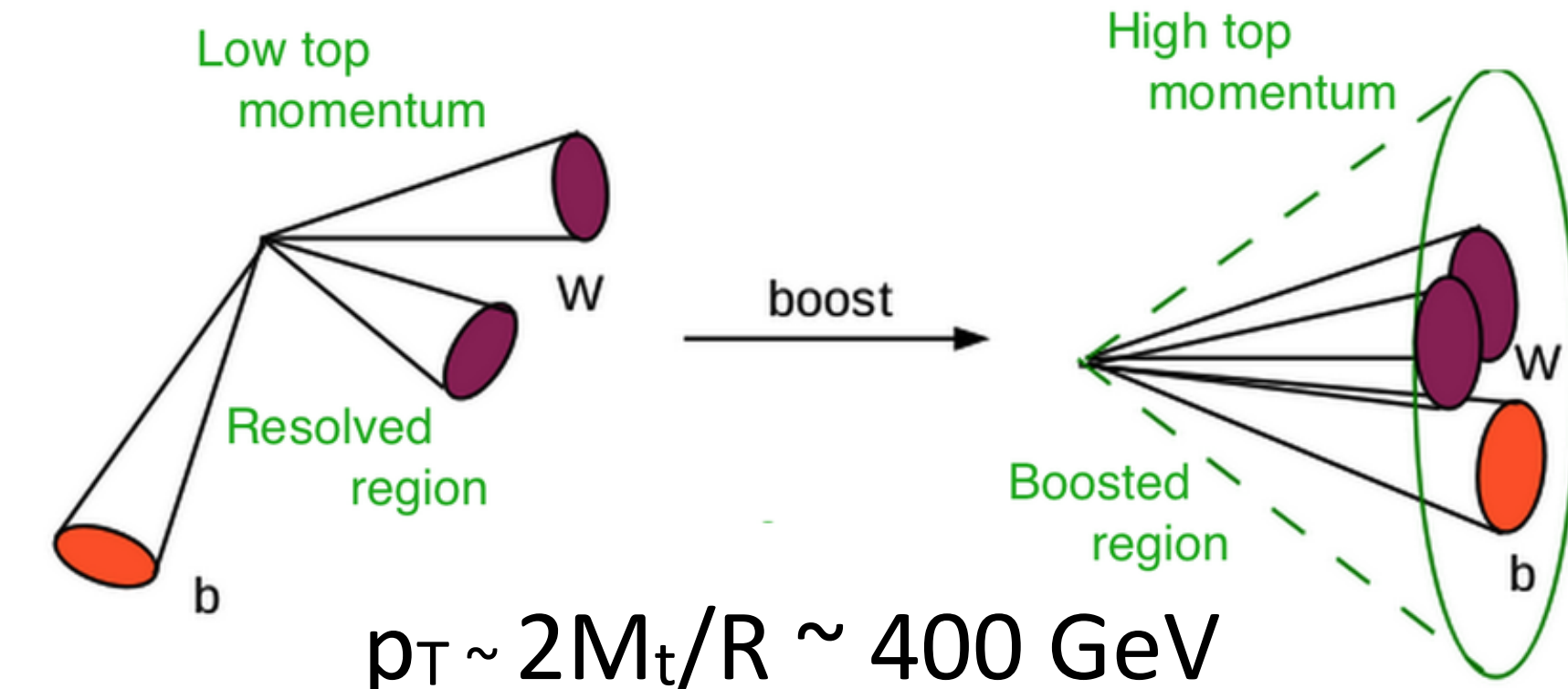
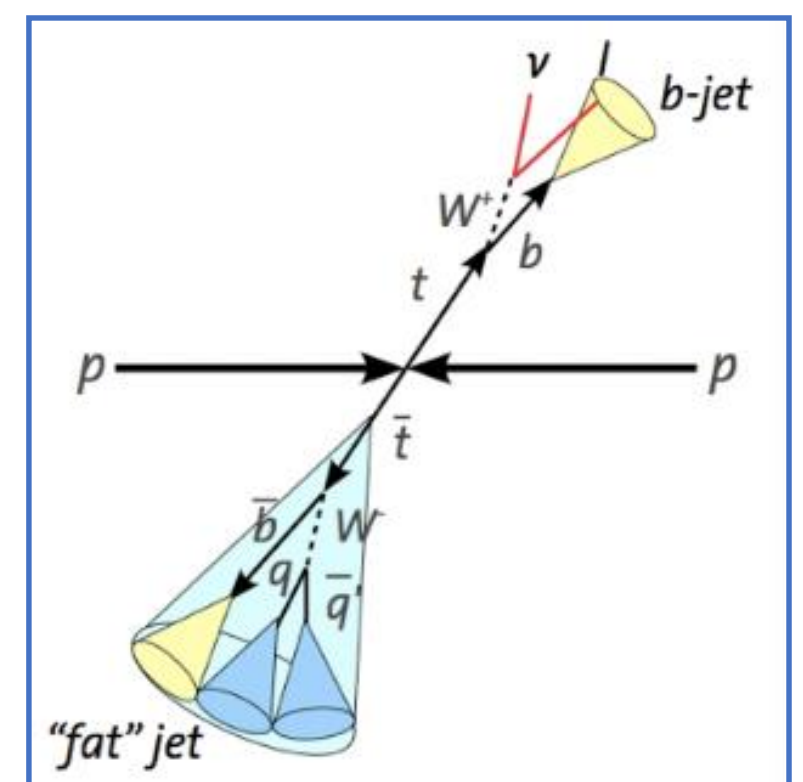
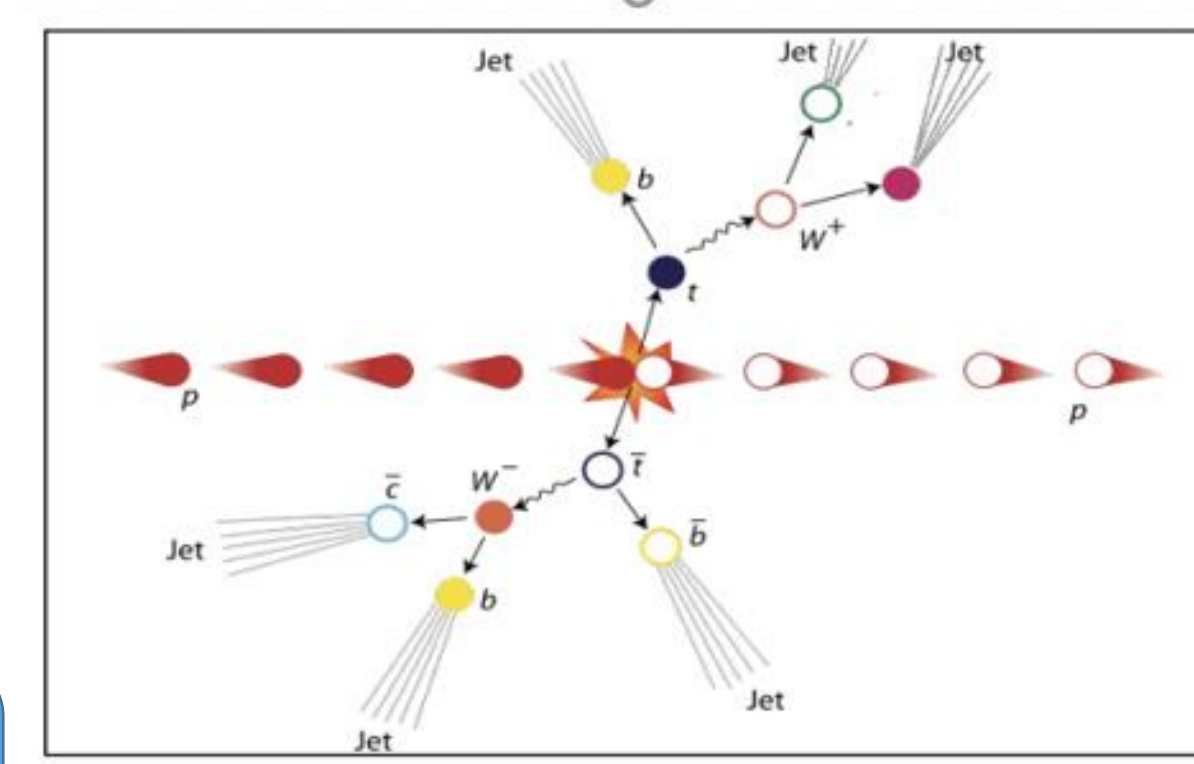
Explore the kinematic regions beyond the reach of the resolve analyses ($p_T > 400$ GeV)

- Provide precision in that region
- Sensitivity to new physics
- Test for perturbative QCD

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Two distinct final states:

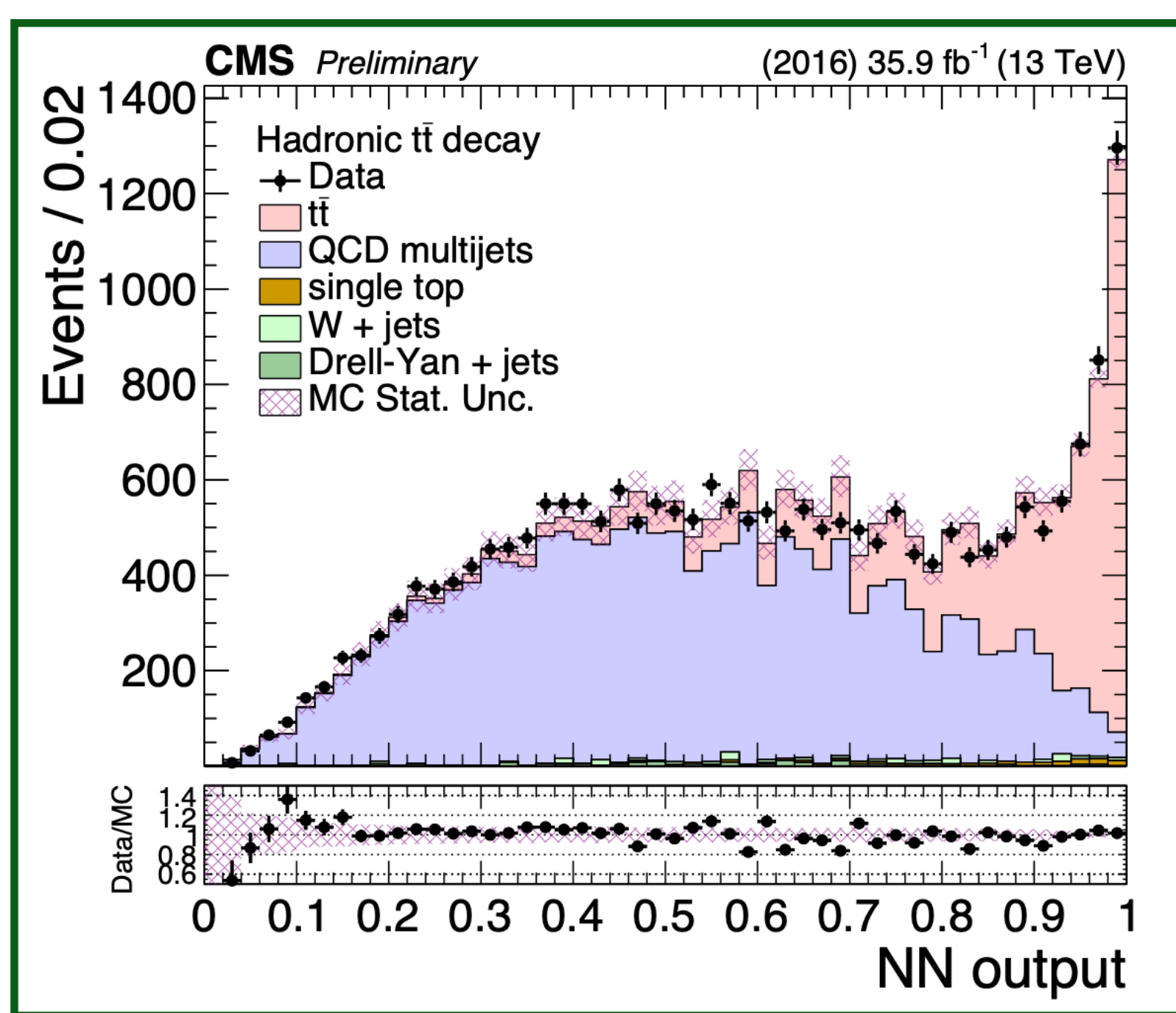
- l + jets (boosted hadronically decaying top quark and resolved leptonically decaying top quark)
 - Hadronic (both boosted top quarks decaying hadronically)
- Compatible results with other analyses



Object selection / reconstruction

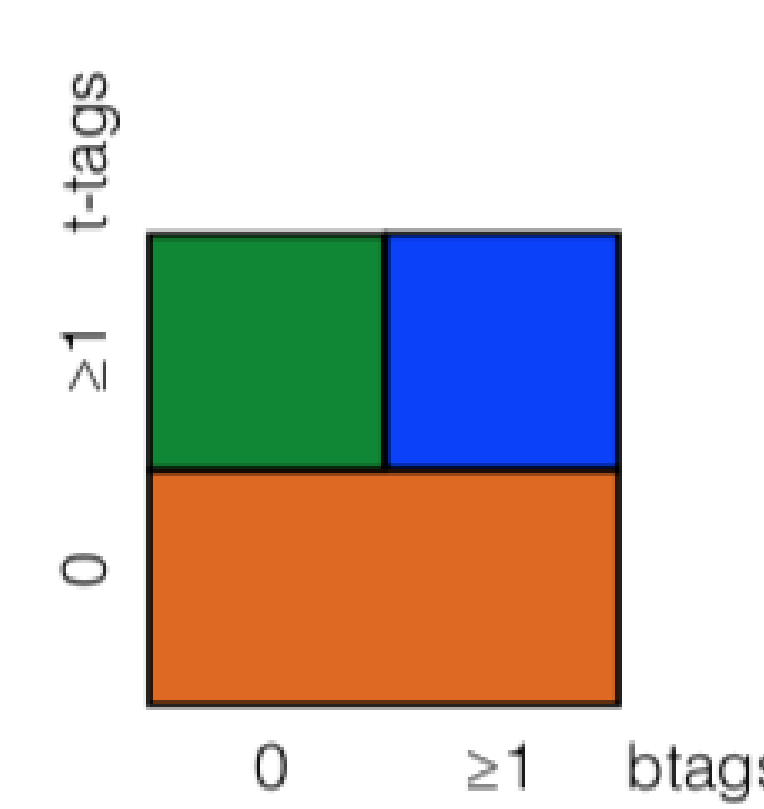
Hadronic channel selection:

- Trigger selects two AK8 (anti-kt, R=0.8) jets and b-tagging @ HLT level
- Two AK8 (anti-kt, R=0.8) jets with $p_T > 400$ GeV
- $t\bar{t}$ event tagging with NN using jet substructure variables as inputs
- Selection split in categories based on the b-tagging requirements. 2b Signal Region (SR) 0b Control Region (CR)



l + jets channel:

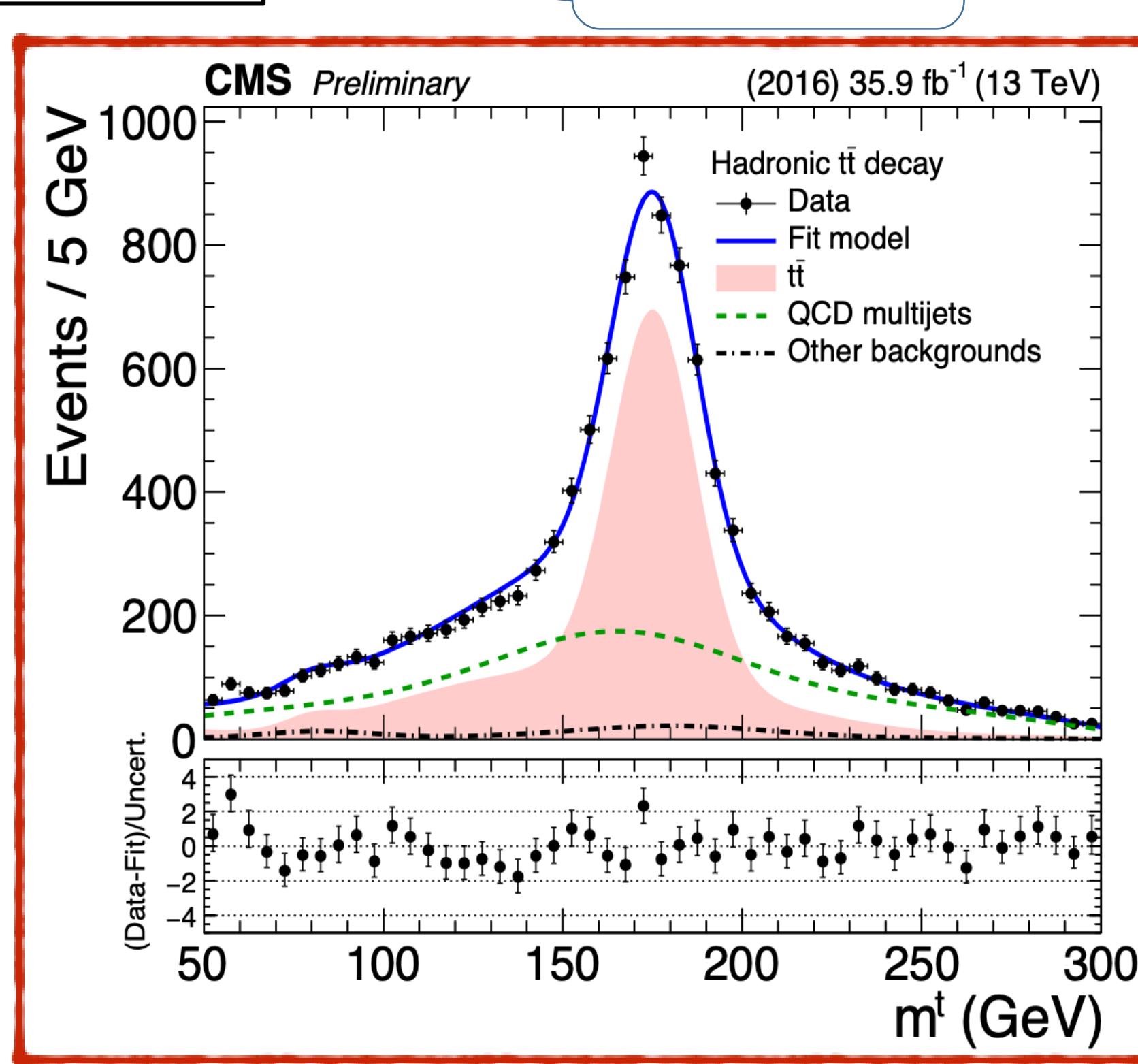
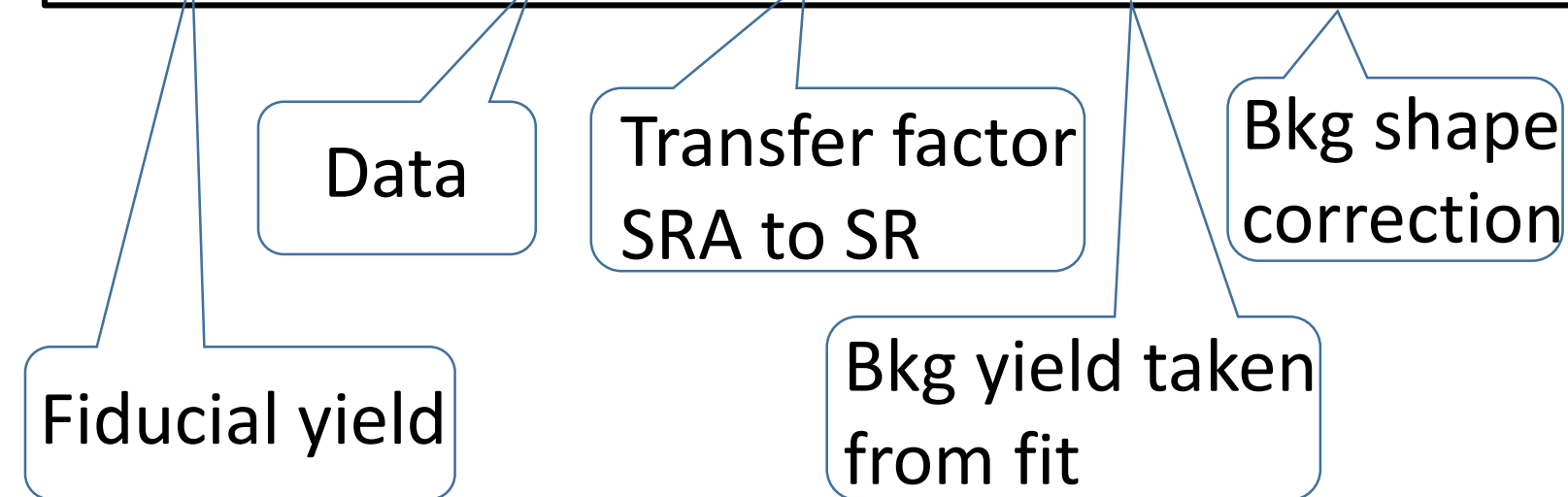
- Final state a lepton + b jet + MET + t jet
- Trigger selects a single lepton and two small R jets
- Selection:
 - Exactly 1 lepton e/ μ
 - ≥ 1 small R jet (anti-kt, R = 0.4, leptonic top decay)
 - ≥ 1 large R jet (anti-kt, R = 0.8, hadronic top decay)
 - E_T^{Miss}
 - b tagging AK4 jet, medium WP
 - t tagging \rightarrow AK8 jet, $105 < m_{top} < 220$ GeV, N subjetiness $\tau_{32} < 0.81$, No b tagging for better acceptance
- Categories 0t, 1t0b 1t1b



Signal extraction / Background rejection

Hadronic channel: $D(m^t) = N_{t\bar{t}} T(m^t; k_{scale}, k_{res}) + N_{qcd} (1 + k_{slope} m^t) Q(m^t) + N_{bkg} B(m^t)$

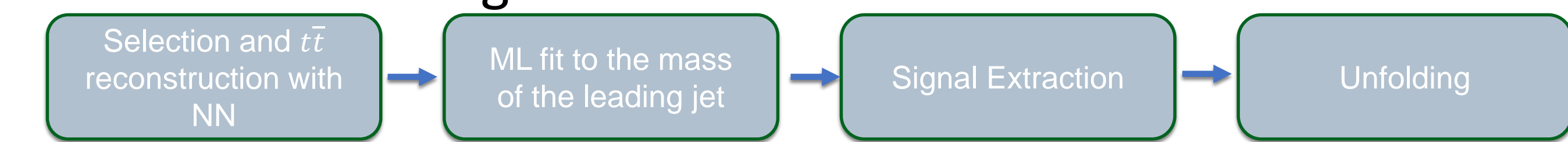
$$S_{fid}(x_{reco}) = D(x_{reco}) - C_{bkg}^{yield} \cdot N_{bkg}^{fit} \cdot C_{bkg}^{shape}(x_{reco}) \cdot B(x_{reco})$$



Hadronic channel:

Deploy a ML fit in the mass of the leading jet using the first equation in order to calculate the number of QCD events.

Use the second formula to extract the fiducial level signal.



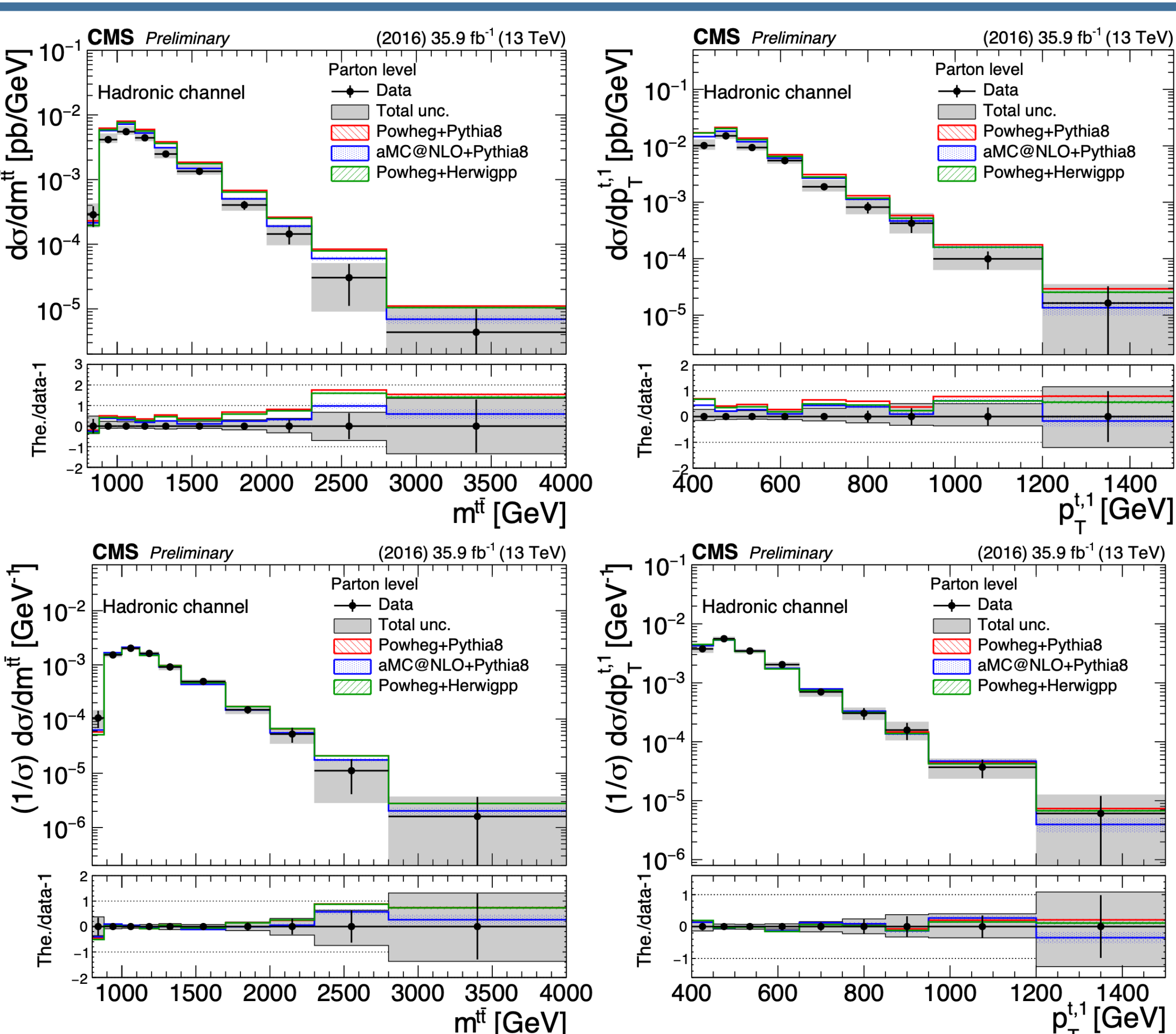
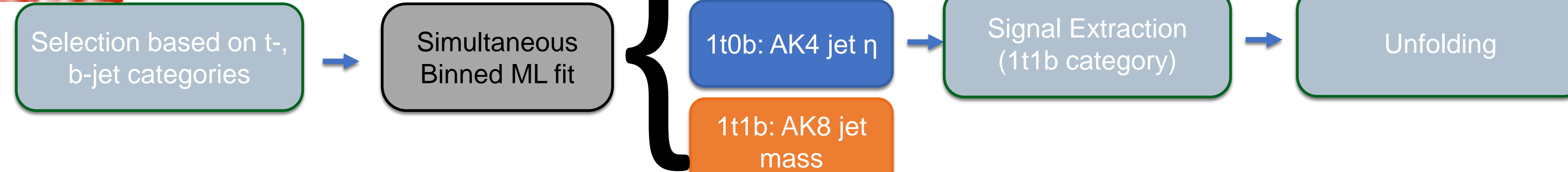
l + jets channel:

- Bkg sources: non signal $t\bar{t}$, single top quark, W+jets, diboson, QCD
- All modelled by MC except QCD which is modelled with a data driven technique

QCD:

- Define a QCD dominated sideband by inverting the requirement on the lepton i.e. exactly one lepton with $0.1 < \text{minilso}^* < 0.2$
- Subtract expected non-QCD contributions
- Shape comparison between data and MC shows good agreement
- Simultaneous fit in 3 categories
- QCD well modelled

*mini isolation algorithm: the fraction of the sum of p_T tracks around the lepton over the p_T of the lepton



Hadronic channel

Results

l+ jets channel

Absolute

Results using unfolding with simple matrix inversion without regularization for both channels

Hadronic:

- Shapes overall compatible with theory
- Overall shift of 35% in the total cross section

l + jets:

- Differential distributions generally well described
- All models overpredict the absolute cross section

More data is needed in order to enhance the statistical significance and investigate the severity of this discrepancy.

