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Measurement of the top decay spectrum in the t-channel production mechanism with the ATLAS detector

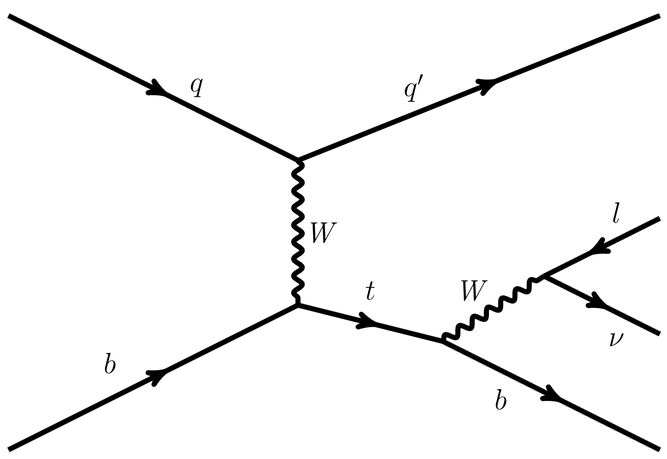
t-channel ideal to study electroweak interactions of top quarks

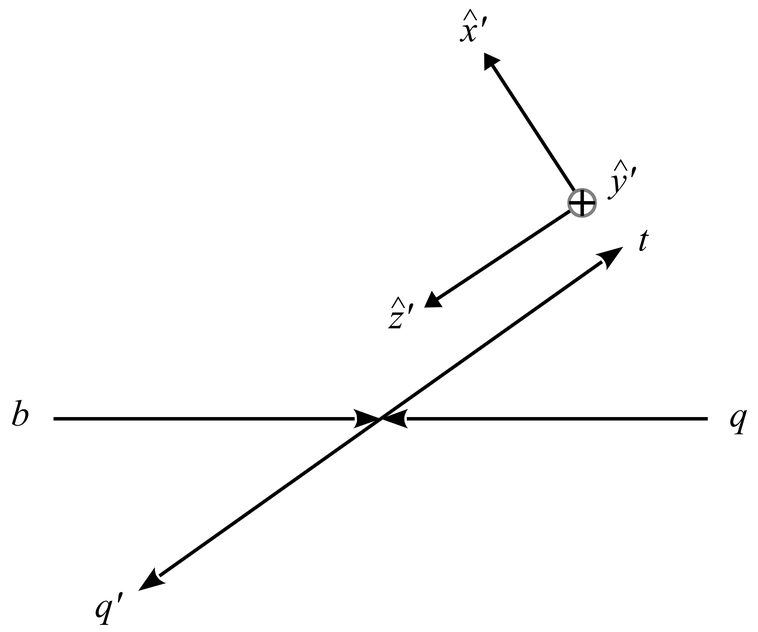
Measure angular observables:
Access to CP-violating interactions
Insights to matter-antimatter asymmetry?

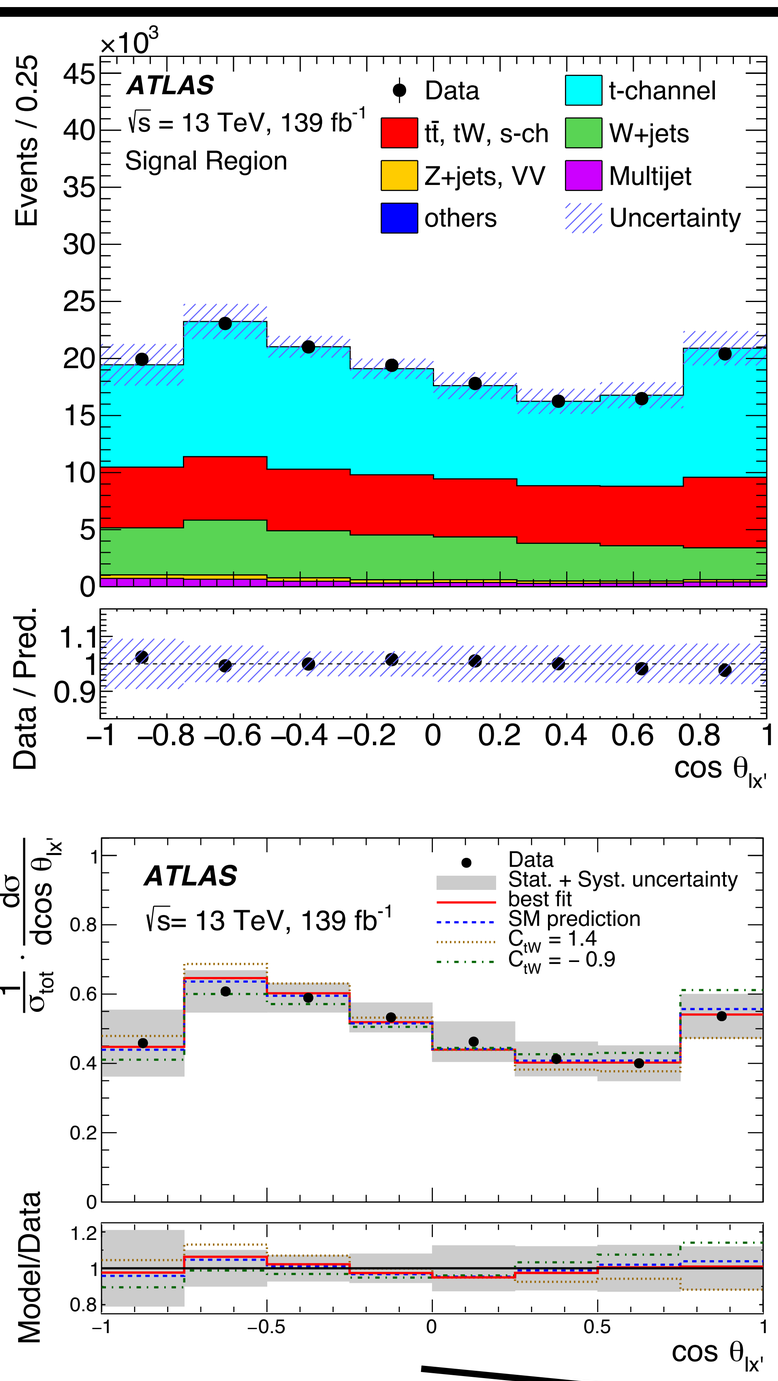
Construct 3 polarization directions:

$$\hat{z}' = \frac{\vec{p}_{q'}}{|\vec{p}_{q'}|}, \quad \hat{y}' = \frac{\vec{p}_{q'} \times \vec{p}_{q}}{|\vec{p}_{q'} \times \vec{p}_{q}|}, \quad \hat{x}' = \hat{y}' \times \hat{z}'$$

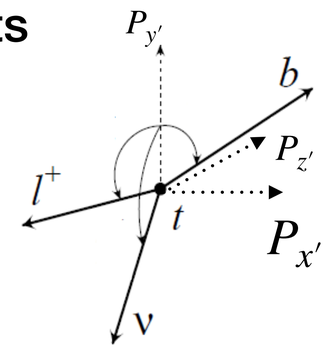
Maximally parity violating
Spin top quark polarized in t-channel

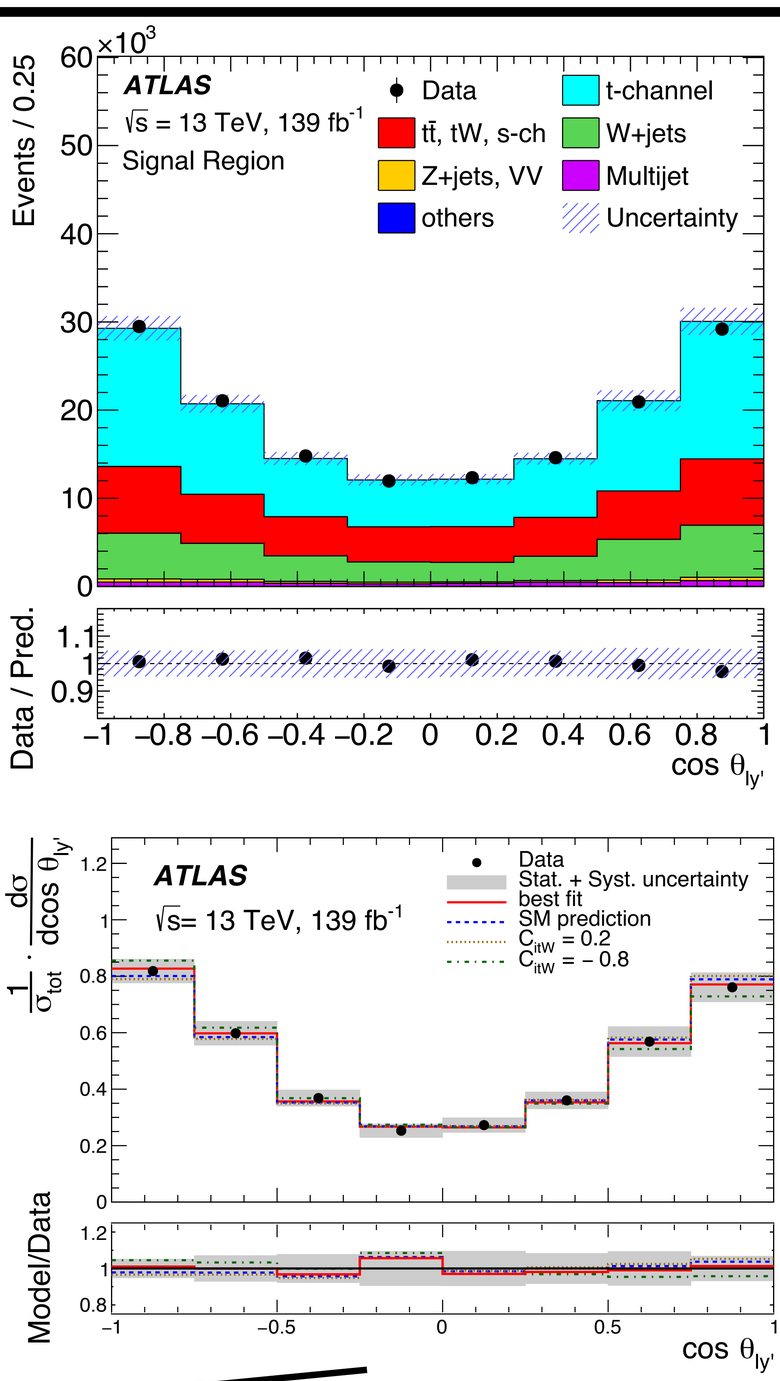






- Select lepton, light-jet and b-jet
- Isolate t-channel events
- Measure angle with charged lepton and x' and y'
- Measure polarization
- Control $t\bar{t}$ and W+jets background in dedicated regions
- Unfold to particle level





Search for new physics via EFT

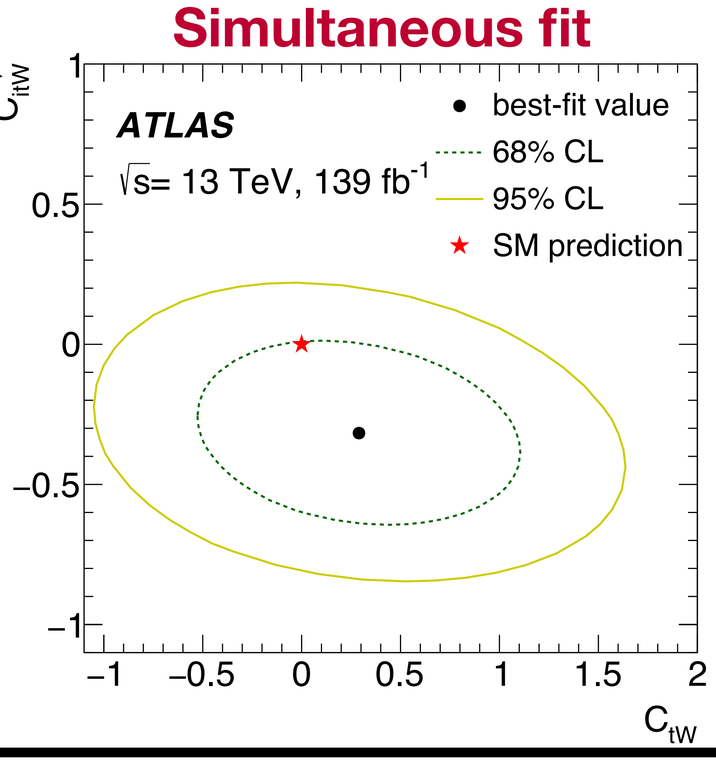
$$\mathscr{L} = \mathscr{L}_{SM} + \sum_i \frac{c_i}{\Lambda^2} O_i^6$$

$$O_{tW} = (\bar{Q}\sigma^{\mu\nu}t)\tau^I\tilde{\phi}W^I_{\mu\nu}$$

Real (c_{tW}) + Imaginary (c_{itW}) coupling
Imaginary coupling is CP-violating

c_{tW}

Simultaneous fit



c_{itW}

Limits (95%CL):

$$c_{tW} = [-0.9, 1.4]$$
$$c_{itW} = [-0.8, 0.2]$$

Most stringent constraint on c_{itW}

Systematically limited:

Jet related uncertainties
Modeling uncertainties

Potential Improvements:

1. Energy scale dependency
Enhanced EFT sensitivity
Access to EFT operator $c_{qQ}^{3,1}$

2. EFT in background
Decay of $t\bar{t}$ also affected by same EFT operators

3. Improve reconstruction
Reduce mis-reconstructed *events*
Use kinematic constraints in reconstruction

Angular measurements key to search for new physics interactions

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