Recent measurements of top-associated cross sections in low pileup conditions in pp collisions at 5.02 TeV

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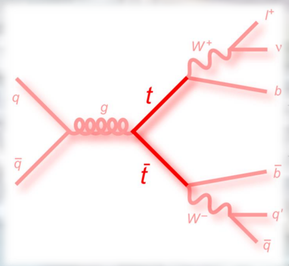
Overview

- **Low pileup** runs offer very good opportunities for measurements at the LHC.
- Their clean environment allows for **very precise measurements** with low luminosity. Especially with **dedicated object studies.**
- **Recent** measurements by the **CMS** experiment in the **top quark sector** are based on a **2017** dataset of **302 pb^{-1}** at $\sqrt{s}$ **= 5.02 TeV** with **<μ> = 2.**

$t\bar{t}$ (JHEP 04 (2025) 099)

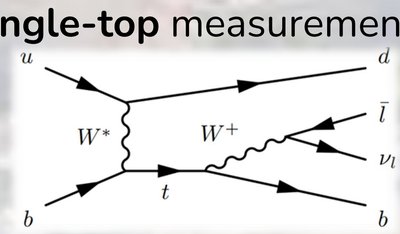
- Target the **ℓ+jets** final states.
- **Combination** with dilepton (JHEP 04 (2022) 144).



SCAN ME

t–channel (CMS-PAS-TOP-24-011)

- **Dominant** single-top production process.
- **First** CMS **single-top** measurement at **5.02 TeV**.



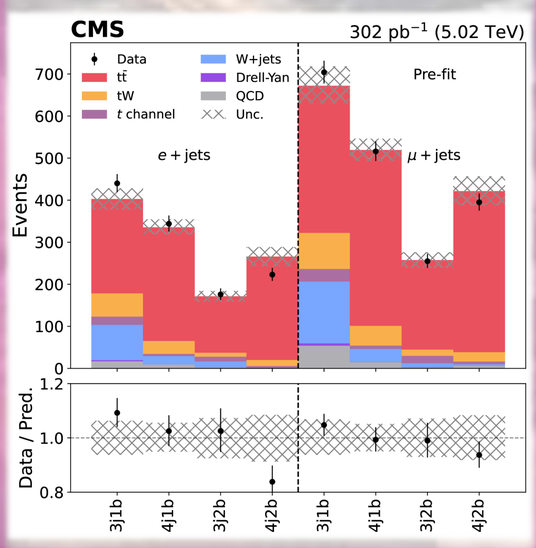
NEW

Event Selection

- Exactly **one** lepton (e or μ), p_T>20 GeV, |η|<2.4.
- At least **two** jets, **one** b-tagged jet, p_T >25 GeV.
- Categorizing in **NjMb jets** + lepton **flavour.**
- MET > 30 GeV.
- **Monte Carlo** estimated processes **but** for **QCD** multijets (**data-driven**).

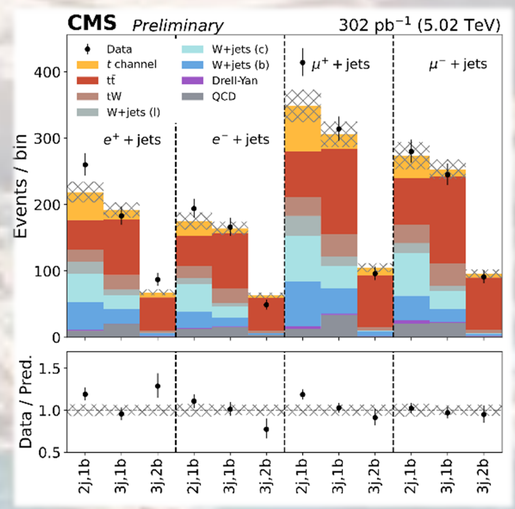
$t\bar{t}$

- Jet |η| < 2.4.
- Additional jet (**≥3j**).



t-channel

- Jet |η| < **4.7**.
- Further **categorizing** in lepton **charge.**
- m_T^W > 50 GeV.
- H_T' > 170 GeV (MET + j_{p_T} + ℓ_{p_T}).

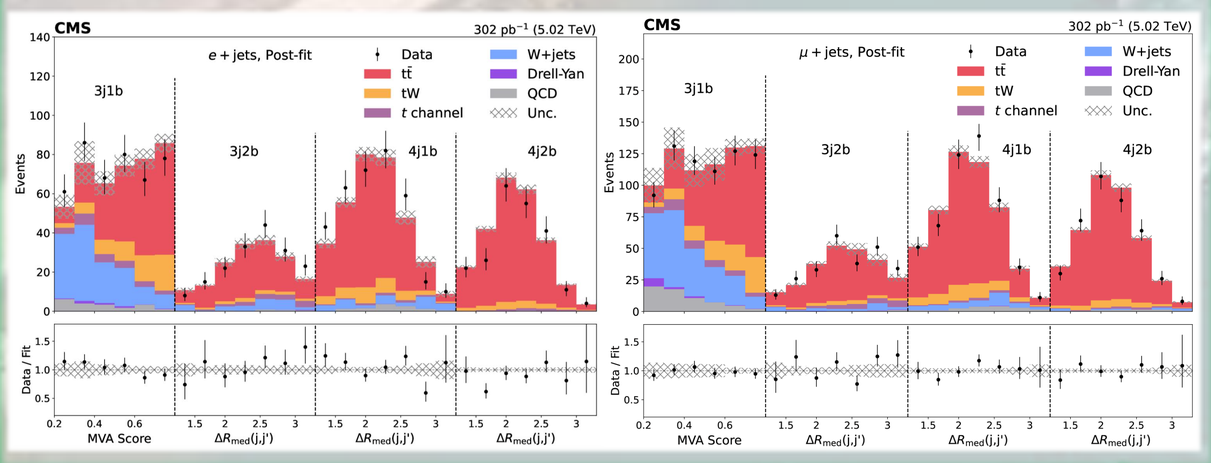


Analysis Strategy

- **Maximum likelihood fits** to extract the measurements.
- **Random Forest** (RF) training to discriminate $t\bar{t}$ (t-channel) from W+jets ($t\bar{t}$ & W+jets).
- Fits to RF output in 3j1b (2j1b) // $\Delta R_{med}(j,j')$ ($|\eta_{u_0}|$) in other categories.

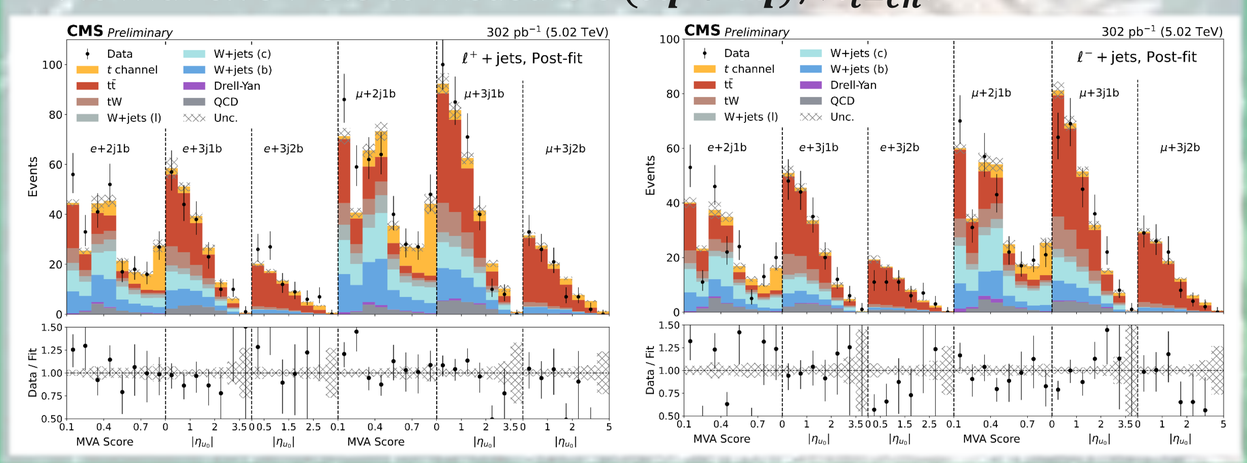
$t\bar{t}$

- **Single** fit to measure σ($t\bar{t}$) in **ℓ+jets** channel.
- **Additional** fit to **combine** with **dilepton** channel.



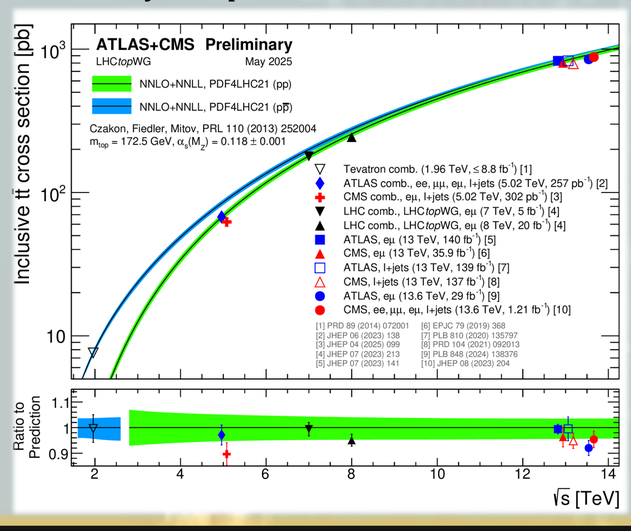
t-channel

- **Fit** with **one** parameter of interest (POI) to measure $\sigma(tq + \bar{t}q)$.
- **Fit** with **two** POIs to measure $\sigma(tq)$, $\sigma(\bar{t}q)$.
- **Fit** with **two** POIs to measure $\sigma(tq + \bar{t}q)$, $\mathcal{R}_{t-ch}$.



Results / Conclusion

- $\sigma_{t\bar{t}}^{obs,comb} = 62.3 \pm 1.5\,(stat) \pm 2.7\,(syst)\,pb$ vs
  $\sigma_{t\bar{t}}^{SM,NNLO} = 69.5 \pm 3.6\,pb.$
- **Systematically** dominated by luminosity, ME-PS matching and b-tagging efficiency.
- **Consistent** with SM pred.
- **Most precise** CMS $t\bar{t}$ measurement at 5.02 TeV.



	Measurement	SM, NNLO
$\sigma(tq + \bar{t}q)$	$30.2^{+3.7}_{-3.6}$ (stat) $^{+4.4}_{-4.2}$ (syst) ± 0.6 (lumi) pb	30.3 ± 0.6 pb
$\sigma(tq)$	$21.1^{+3.0}_{-2.8}$ (stat) $^{+2.8}_{-2.7}$ (syst) ± 0.4 (lumi) pb	20.3 ± 0.5 pb
$\sigma(\bar{t}q)$	$8.2^{+2.4}_{-2.3}$ (stat) $^{+1.9}_{-1.8}$ (syst) ± 0.2 (lumi) pb	10.0 ± 0.3 pb
R_{t-ch}	$2.58^{+1.10}_{-0.67}$ (stat) $^{+0.67}_{-0.21}$ (syst)	2.03 ± 0.05 pb

- **Systematically** dominated by b-tagging efficiency and W+jets normalization.
- **Good agreement** with SM.
- **First** CMS single-top measurement at 5.02 TeV.