FCNC AND PROPERTIES IN TOP PHYSICS

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on behalf of the ATLAS and CMS Collaborations

PHYSICS OF TOP QUARKS

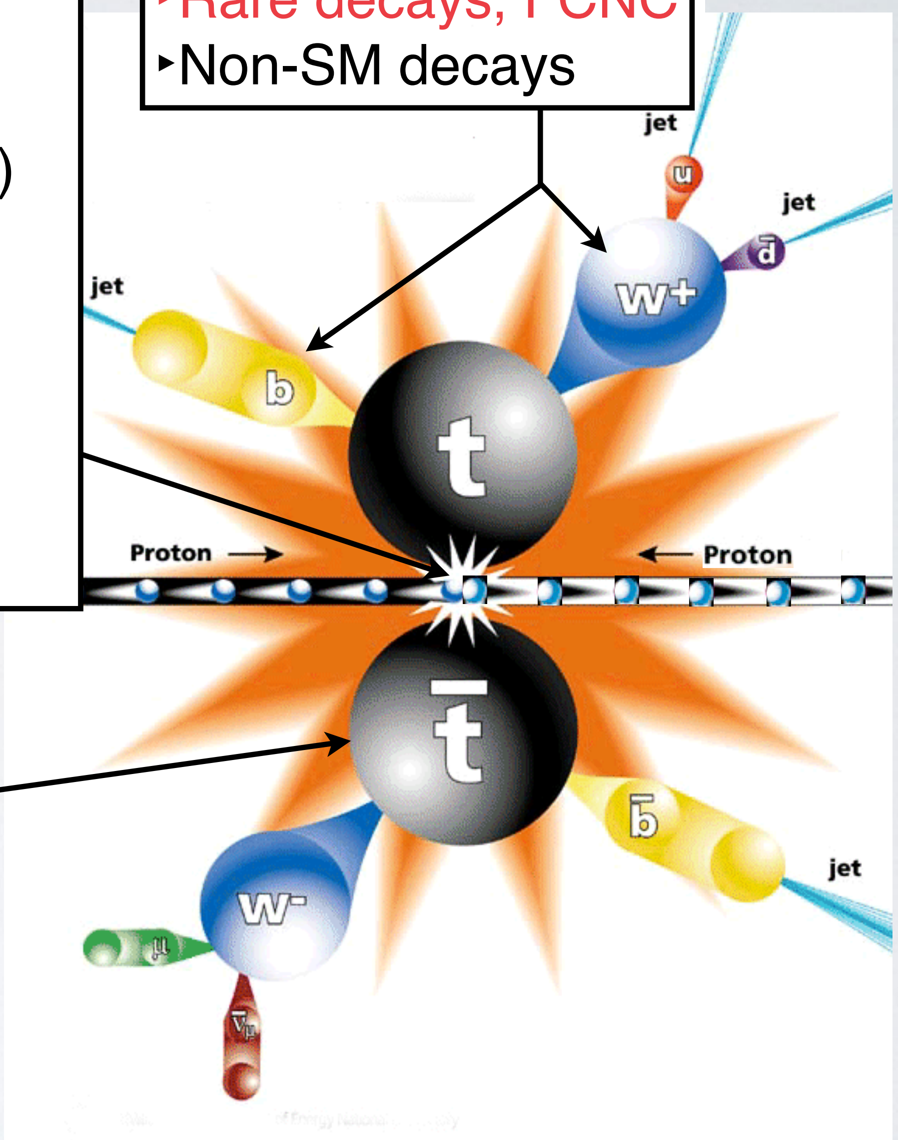
- Tests of the Standard Model (production, decay, coupling… etc)
- Top quark does not hadronize: momentum and spin transferred to decay products
- Search for processes with similar signature (VLQ, Z'...)
- Natural mass ($y_t \simeq 1$), top quark mass is a fundamental parameter of the SM, and crucial for SM constraints via loop diagrams

Production Rate
- Pair Production cross section
- Single (EWK) production, |Vtb|
- FCNC, anomalous couplings
- Differential cross sections
- Production mechanism (*gg*,*qq*)
- Associated Production

New Physics in production
- Resonant production
- Heavy Quark production
- ...

Decay
- Branching ratios
- CP asymmetries
- Rare decays, FCNC
- Non-SM decays

Properties
- Top mass
- Top charge
- Top width
- Spin correlation
- Top polarisation
- W helicity
- Charge asymmetry
- Yukawa coupling



RED: Discussed in this talk

PART 1: PROPERTIES

- Tests of the Standard Model (production, decay, coupling… etc)
- Top quark does not hadronize: momentum and spin transferred to decay products
- Search for processes with similar signature (VLQ, Z'...)
- Natural mass ($y_t \simeq 1$), top quark mass is a fundamental parameter of the SM, and crucial for SM constraints via loop diagrams

Properties
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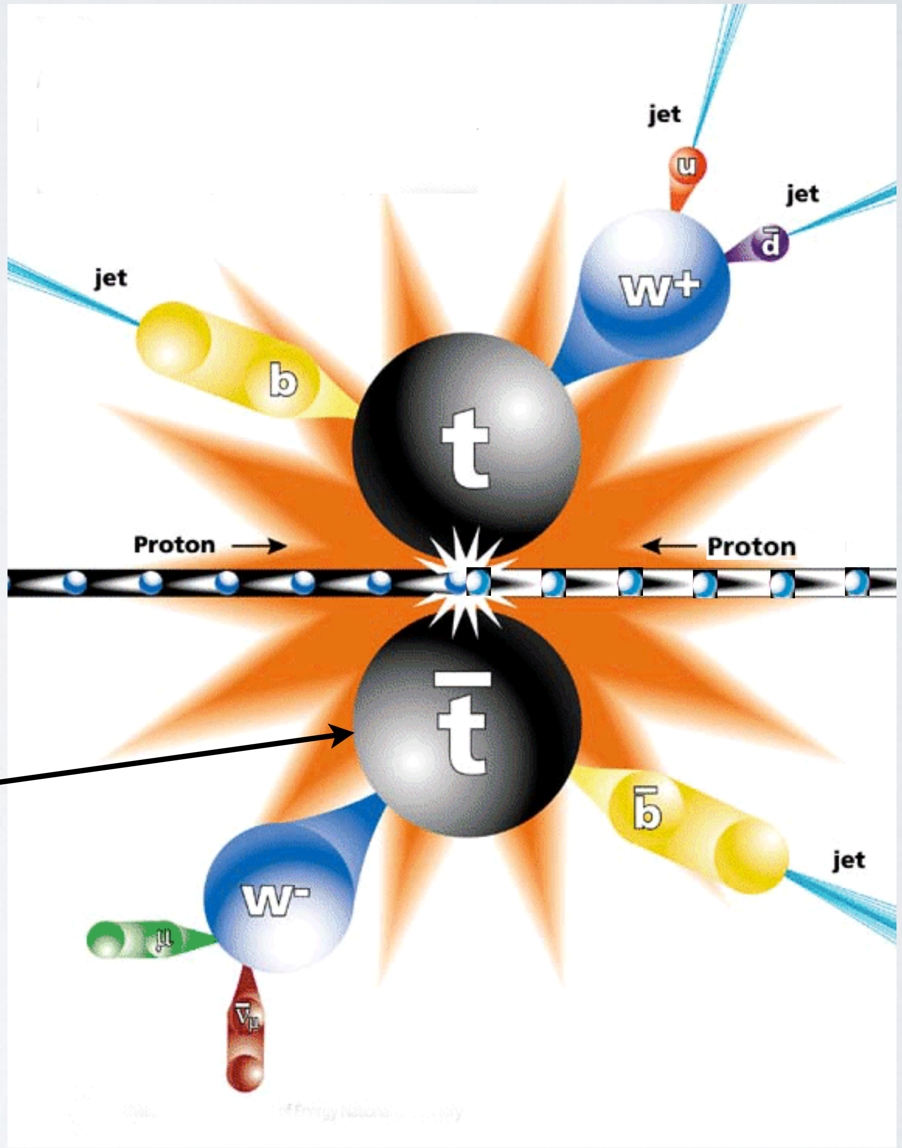


RED: Discussed in this talk

TOP PAIR QUANTUM ENTANGLEMENT

Nature, 633, 542-547 (2024)
arXiv:2311.07288 (2024)

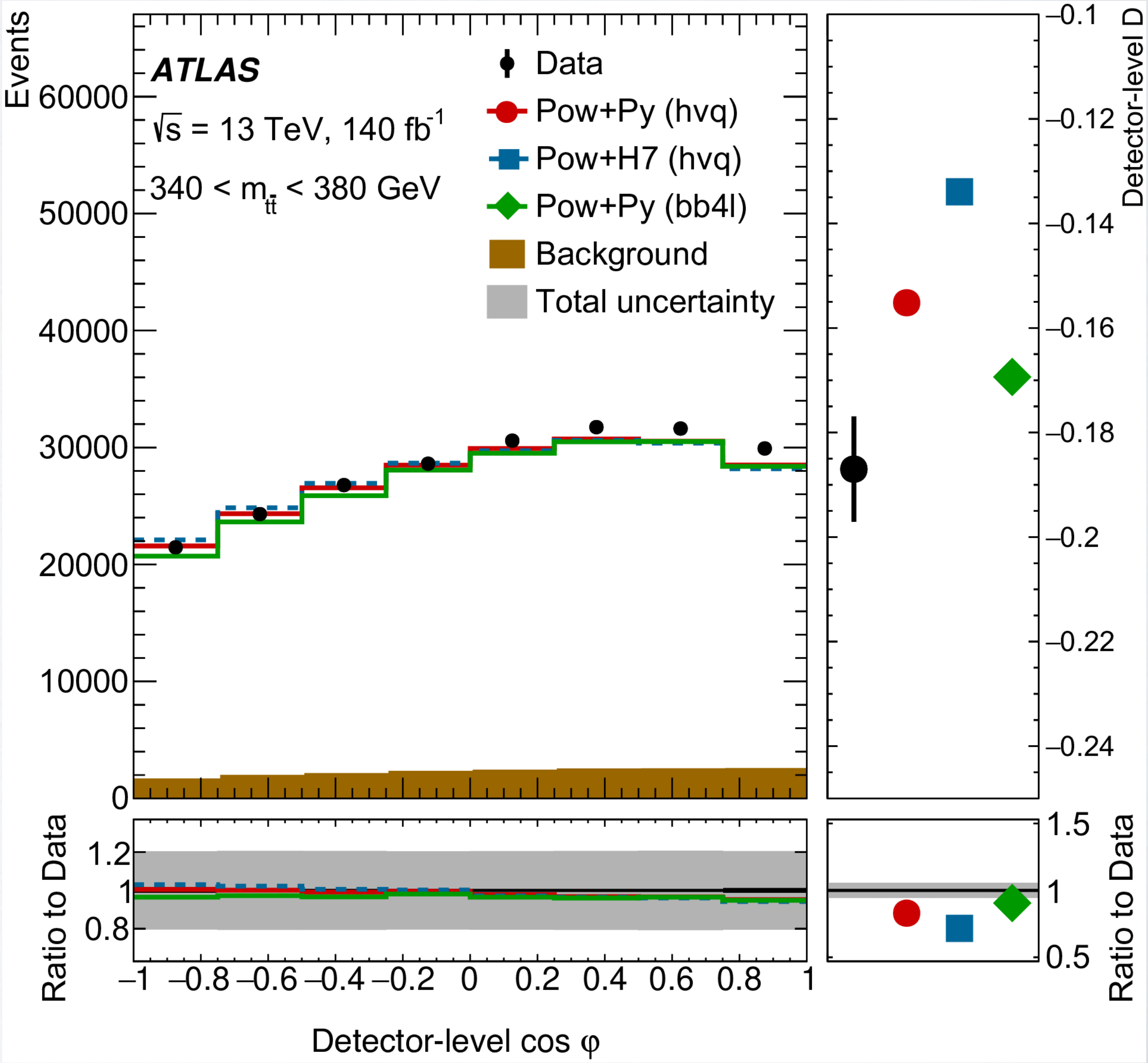
13 TeV, 140 fb^{-1}

- Spin entanglement can be observed by increase in the strength of the top and anti-top spin correlations
- Spin entanglement is inferred from the angle between the charged leptons in the parent top- antitop-quark rest frames
- Measurement targets around the top-antitop production threshold

Signature: 1 Electron and 1 Muon of opposite electric charges, 2 jets (>=1 *b*-tagged)

- Restricted phase space: 340 < $m_{t\bar{t}}$ < 380 GeV and two control region beyond 380 GeV
- Background level <10%

Detector-Level *D*



Method: Entanglement marker:

$$D = tr[C]/3 = -3 < cos\phi >$$

C: spin correlation matrix

ϕ: angle between the charged-lepton directions, in the rest frames of the parent top-quarks:

$D < -1/3$ indicates entanglement

TOP PAIR QUANTUM ENTANGLEMENT

- Calibration curve is derived to correct to particle-level D
- Parton-level bound ($-1/3$) converted to particle-level one (-0.322, Powheg+Pythia)
- SM prediction from Powheg+Pythia
- Uncertainties grouped into $t\bar{t}$ modelling, backgrounds and detector-related

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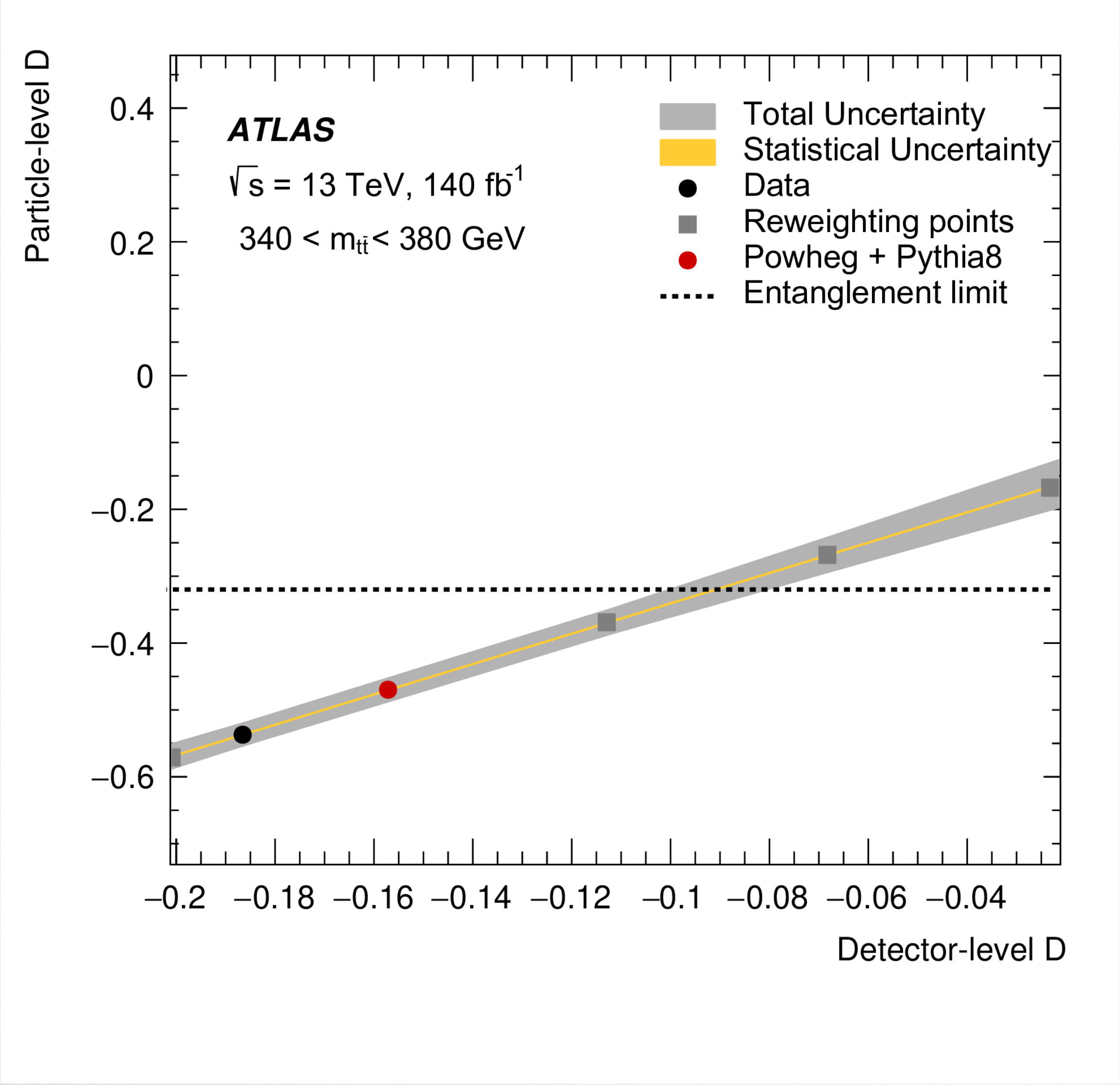
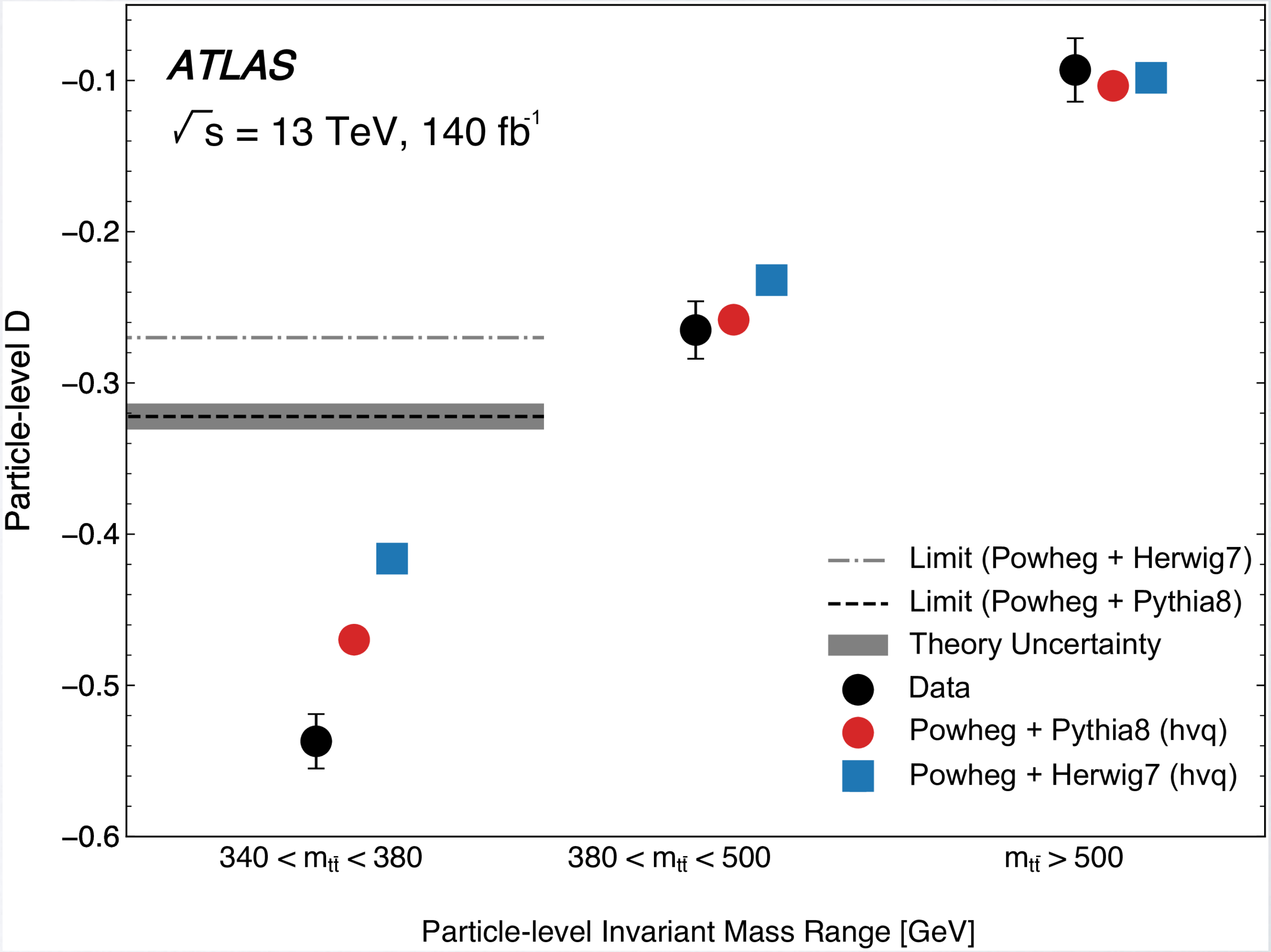
Particle-Level D calibration curve



Particle-Level D results, in signal and validation regions



$$D = -0.537 \pm 0.002\ (\text{stat.}) \pm 0.019\ (\text{syst.})\ (-0.470 \pm 0.002\ (\text{stat.}) \pm 0.017\ (\text{syst.})),$$

TOP PAIR QUANTUM ENTANGLEMENT

Nature, 633, 542-547 (2024)
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Source of uncertainties by group

Source of uncertainty	$\Delta D_{\text{observed}}(D = -0.537)$	ΔD [%]	$\Delta D_{\text{expected}}(D = -0.470)$	ΔD [%]
Signal modeling	0.017	3.2	0.015	3.2
Electrons	0.002	0.4	0.002	0.4
Muons	0.001	0.2	0.001	0.1
Jets	0.004	0.7	0.004	0.8
b-tagging	0.002	0.4	0.002	0.4
Pile-up	< 0.001	< 0.1	< 0.001	< 0.1
$E_{\text{T}}^{\text{miss}}$	0.002	0.4	0.002	0.4
Backgrounds	0.005	0.9	0.005	1.1
Total statistical uncertainty	0.002	0.3	0.002	0.4
Total systematic uncertainty	0.019	3.5	0.017	3.6
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$$D = -0.537 \pm 0.002\ \text{(stat.)} \pm 0.019\ \text{(syst.)}\ (-0.470 \pm 0.002\ \text{(stat.)} \pm 0.017\ \text{(syst.)}),$$

Signal modelling uncertainties

Systematic uncertainty source	Relative size (for SM D value)
Top-quark decay	1.6%
Parton distribution function	1.2%
Recoil scheme	1.1%
Final-state radiation	1.1%
Scale uncertainties	1.1%
NNLO QCD + NLO EW reweighting	1.1%
pThard setting	0.8%
Top-quark mass	0.7%
Initial-state radiation	0.2%
Parton shower and hadronization	0.2%
h_{damp} setting	0.1%

- More than 5 s.d. significance
- First observation of entanglement in quark-antiquark pair

POLARISATION & SPIN CORRELATION

- Tops from QCD $t\bar{t}$ production are unpolarised at LO. Their spins are strongly correlated
- Spin correlations depend on production mechanism, $m(t\bar{t})$ and scattering angle of top quark
- Measurement targets Polarisation vectors and Spin Matrix coefficients based on the angular distributions of $t\bar{t}$ decay products

PRD 110 (2024) 112016

13 TeV, 138 fb^{-1}

Complements analysis in dilepton channel, ROPP 87 (2024) 117801 36 fb^{-1}

Signature: 1 Electron or 1 Muon, ≥4 jets (≥1*b*); a Neural Net reconstructs $t\bar{t}$ system events from e/μ+jets seed

Method: Entanglement markers for both low- and high-mass of the $t\bar{t}$ system, i.e. for spin-singlet (D) and spin-triplet ($\widetilde{D}$) states

Differential cross-section

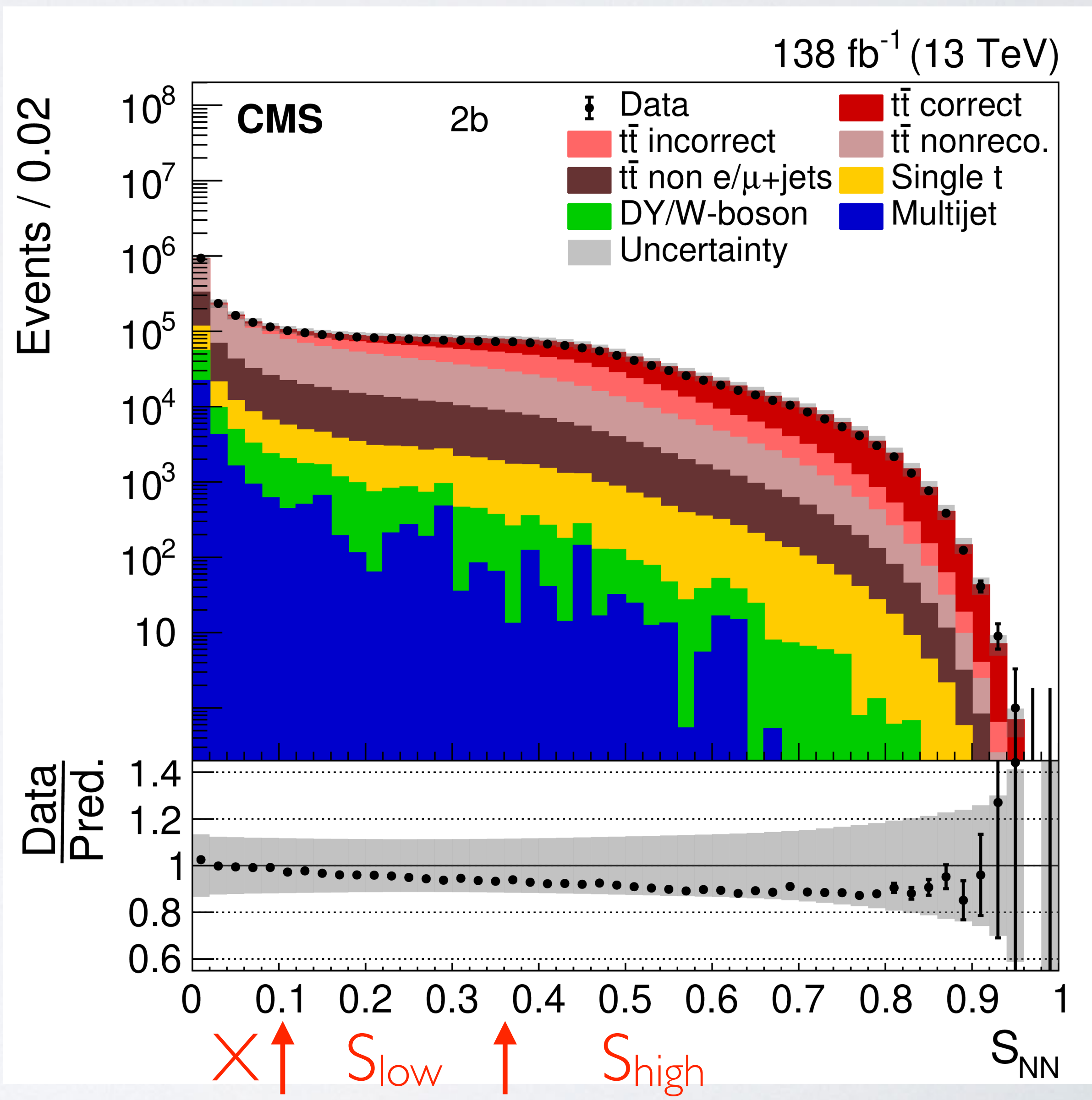
$$\Sigma_{\text{tot}}(\phi_{\text{p}(\bar{\text{p}})}, \theta_{\text{p}(\bar{\text{p}})}) = \frac{\text{d}^4\sigma}{\text{d}\phi_{\text{p}}\,\text{d}\cos(\theta_{\text{p}})\,\text{d}\phi_{\bar{\text{p}}}\,\text{d}\cos(\theta_{\bar{\text{p}}})} = \sigma_{\text{norm}}\left(1 + \kappa\mathbf{P}\cdot\mathbf{\Omega} + \bar{\kappa}\bar{\mathbf{P}}\cdot\bar{\mathbf{\Omega}} - \kappa\bar{\kappa}\mathbf{\Omega}\cdot(\text{C}\bar{\mathbf{\Omega}})\right),$$

C: spin correlation matrix

P, $\bar{P}$: polarisation vectors

Ω, $\bar{\Omega}$: direction of decay products

S_{NN} in the 2-*b* jets category



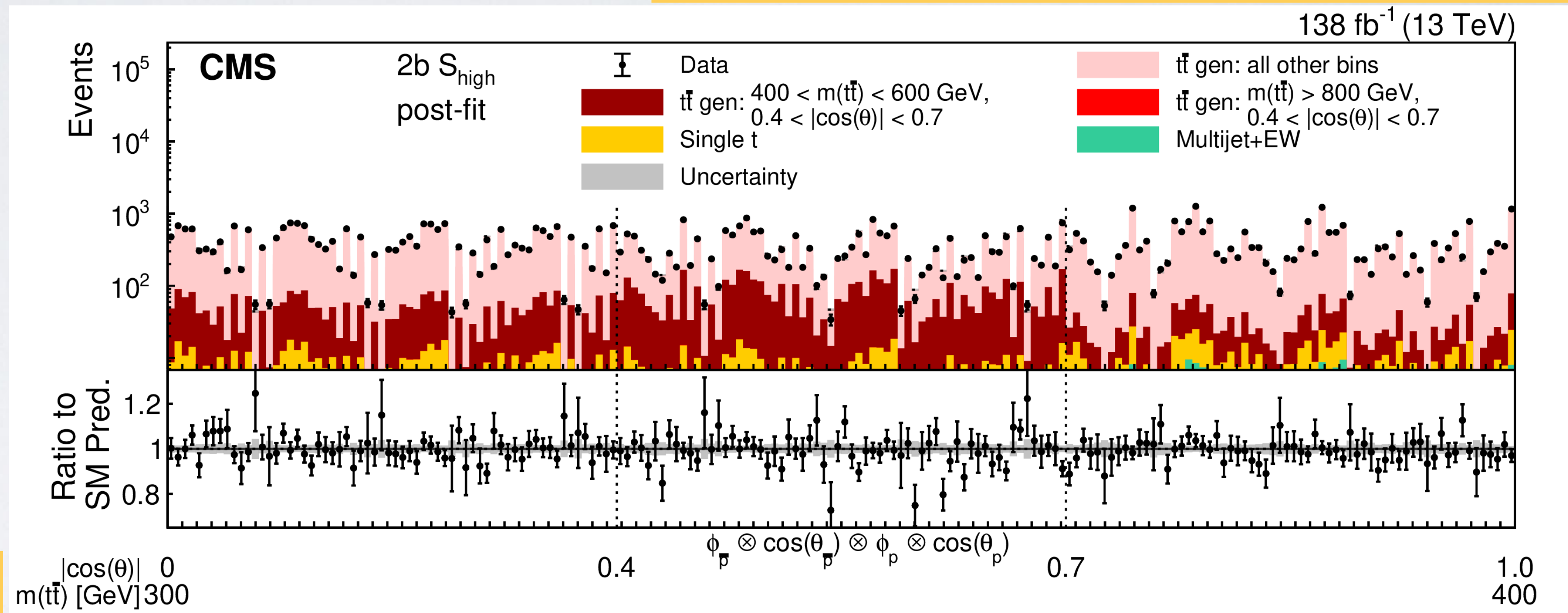
POLARISATION & SPIN CORRELATION

PRD 110 (2024) 112016

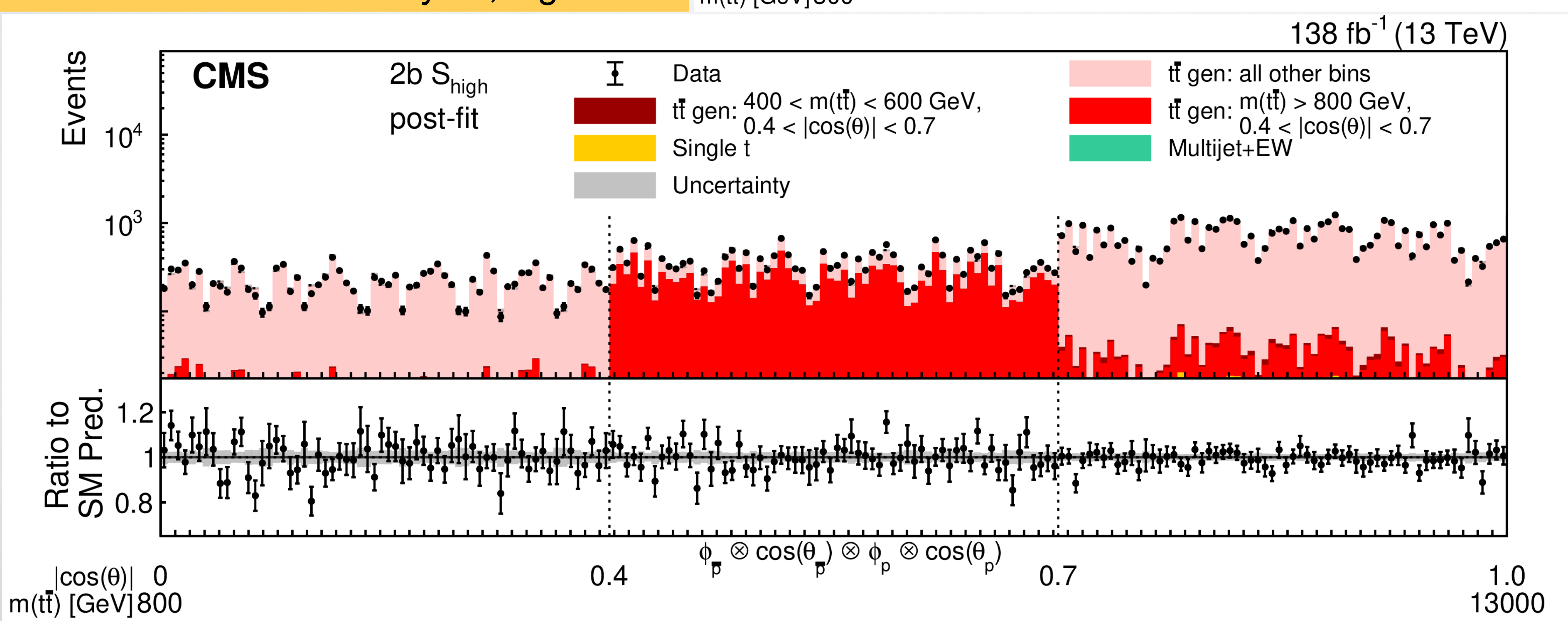
13 TeV, 138 fb^{-1}

- Differential cross section fit for the polarisation and spin correlation, in bins of $m(t\bar{t})$ vs. |cosθ| and $p_T(t)$ vs. |cosθ|
- Maximul likelihood fit of 4 selections (2*b* S_{high}, 2*b* S_{low}, 1*b* S_{high}, 1*b* S_{high}) and 4 data-taking periods
- Fit for polarisation and spin-correlation, or for entanglement markers

Post-fit differential event-yeld, low mass



Post-fit differential event-yeld, high mass



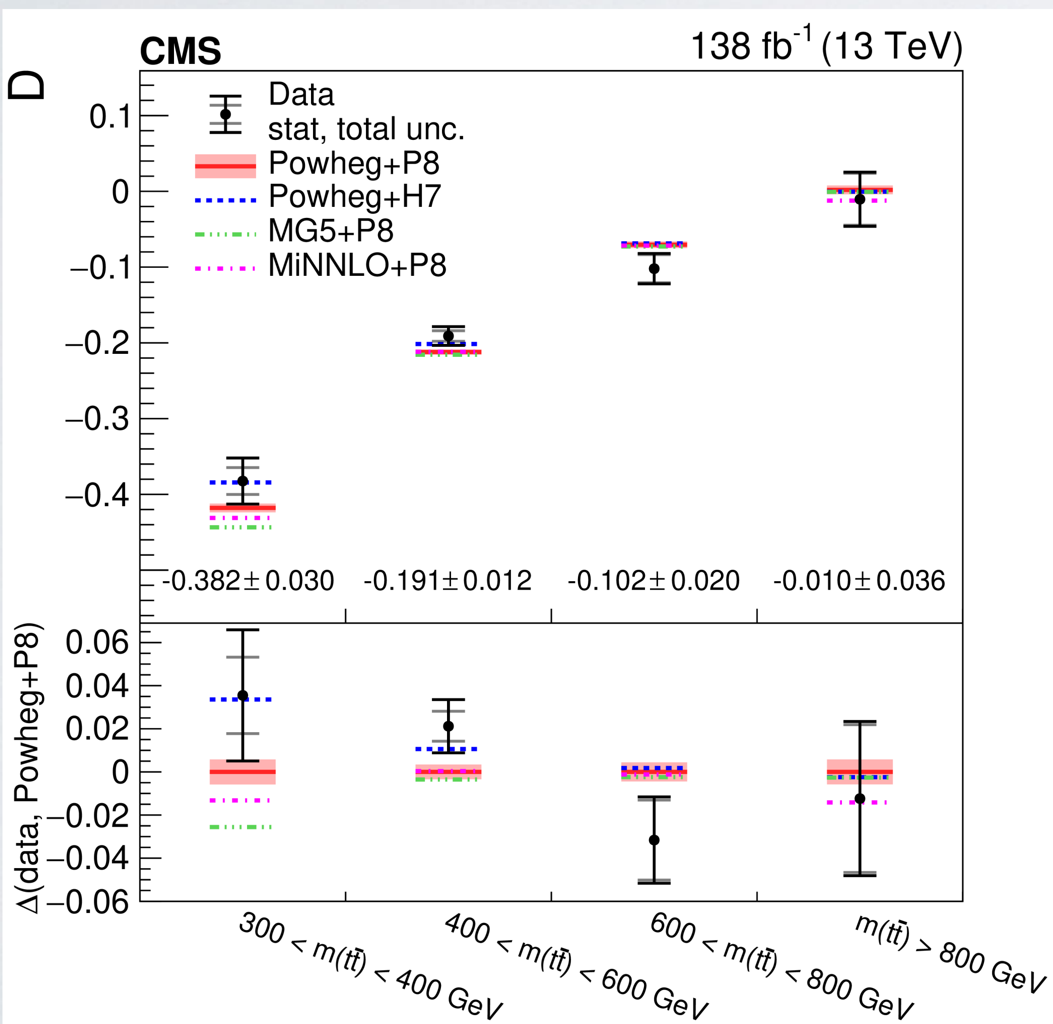
POLARISATION & SPIN CORRELATION

PRD 110 (2024) 112016

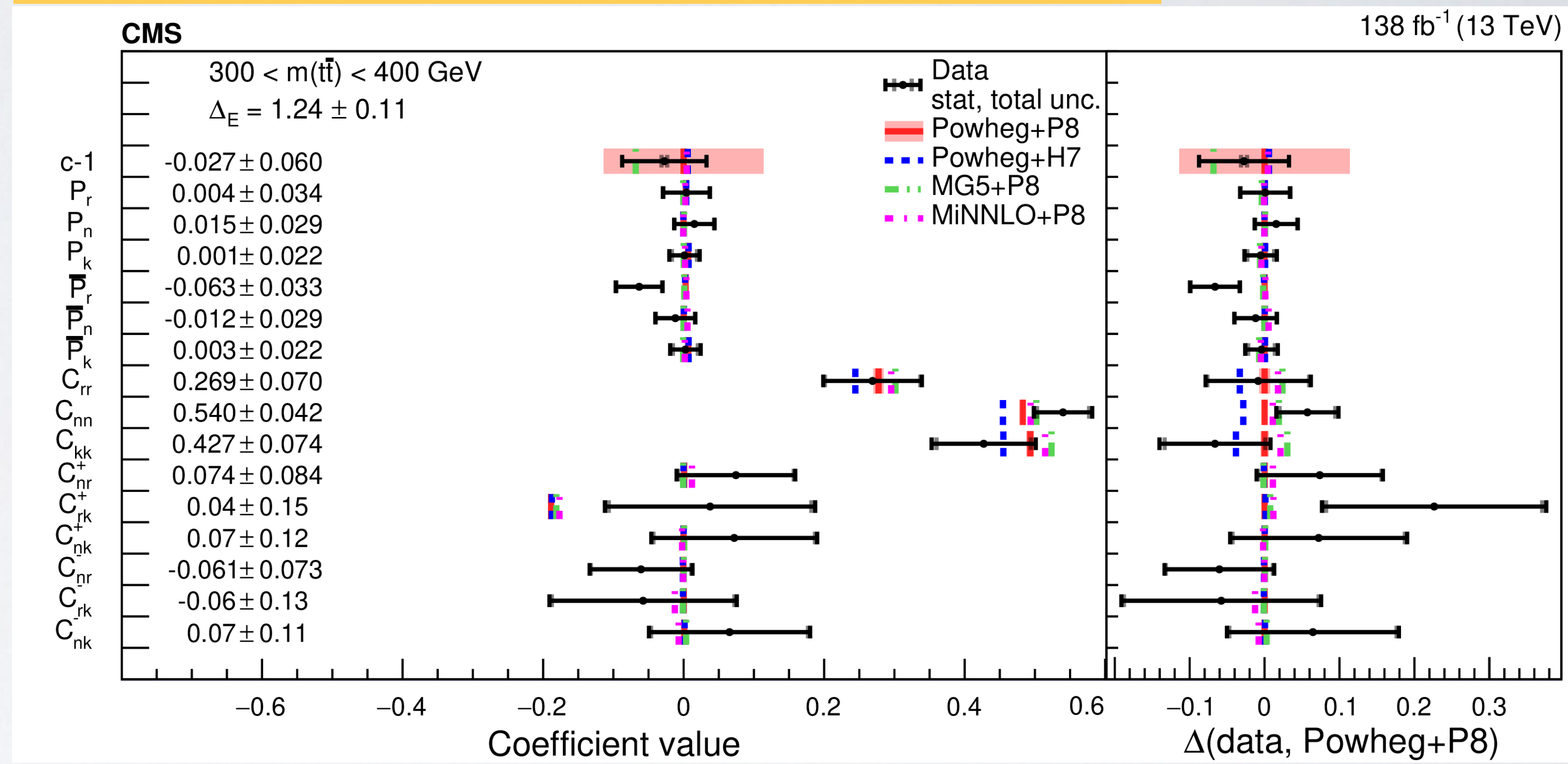
13 TeV, 138 fb^{-1}

- Polarisations compatible with zero
- Diagonal C_{nn}, C_{kk} and C_{rk} differ from zero
- Stronger entanglement in D seen for $p_T(t)<50$ GeV (3.5 s.d.) and in $\tilde{D}$ for $m_{t\bar{t}}>800$ GeV (6.7 s.d.)

D measurement in regions of m_{tt}



Full matrix measurement for low-m_{tt} showing D < -1/3

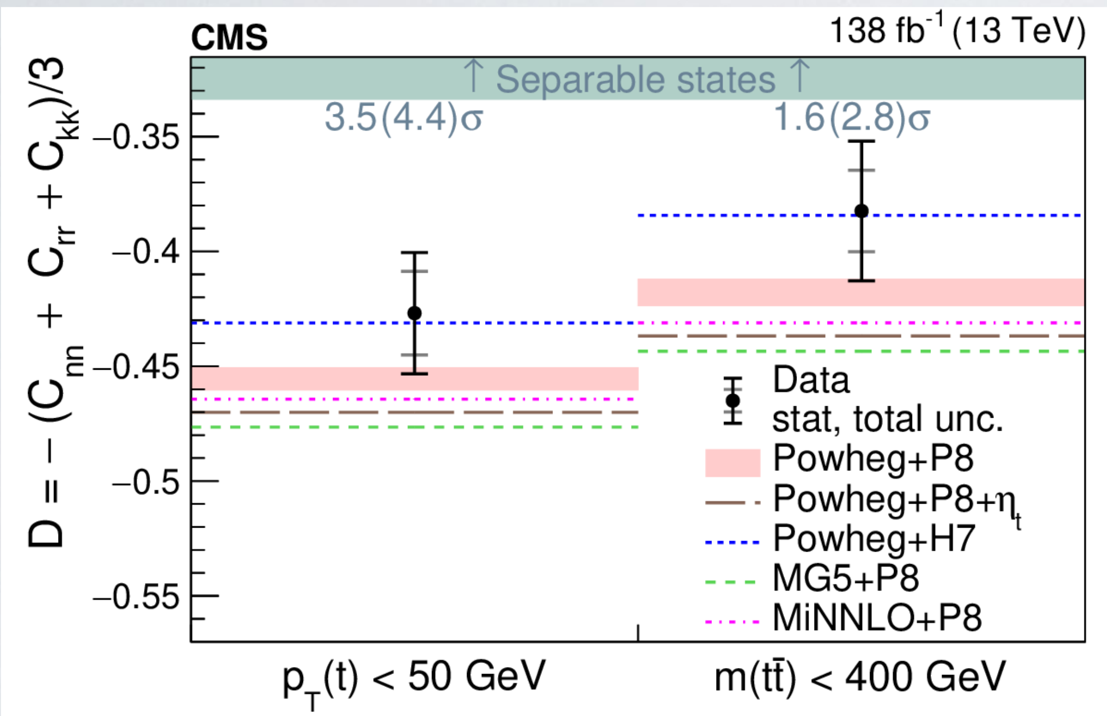


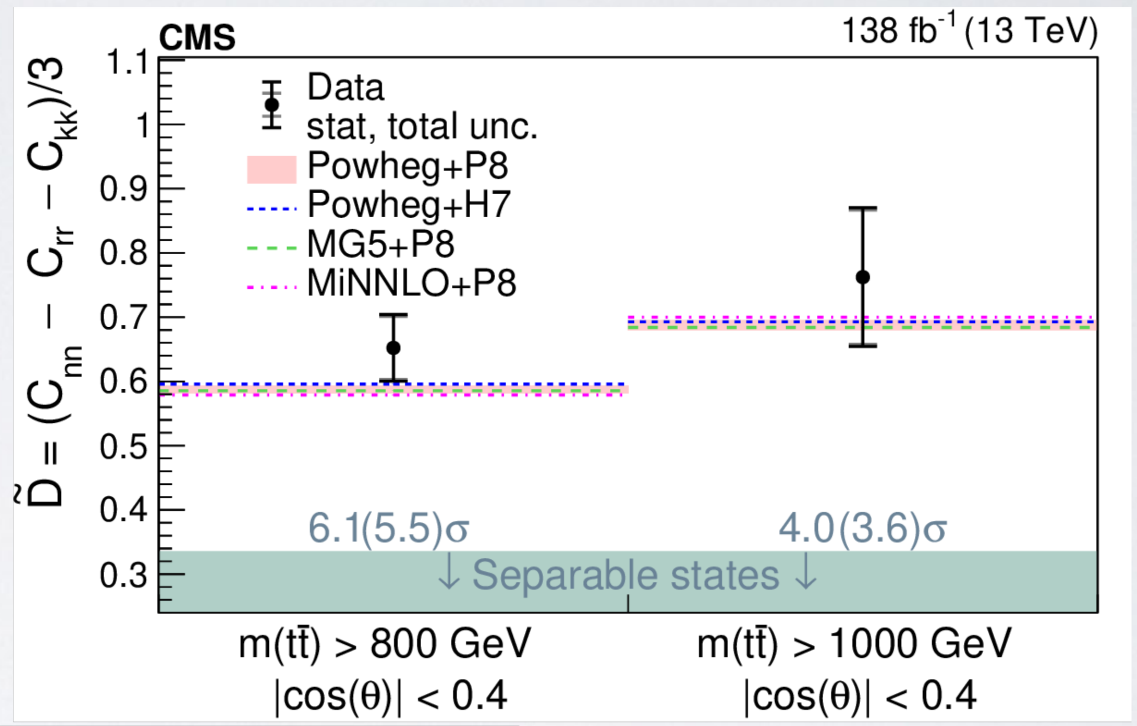
POLARISATION & SPIN CORRELATION

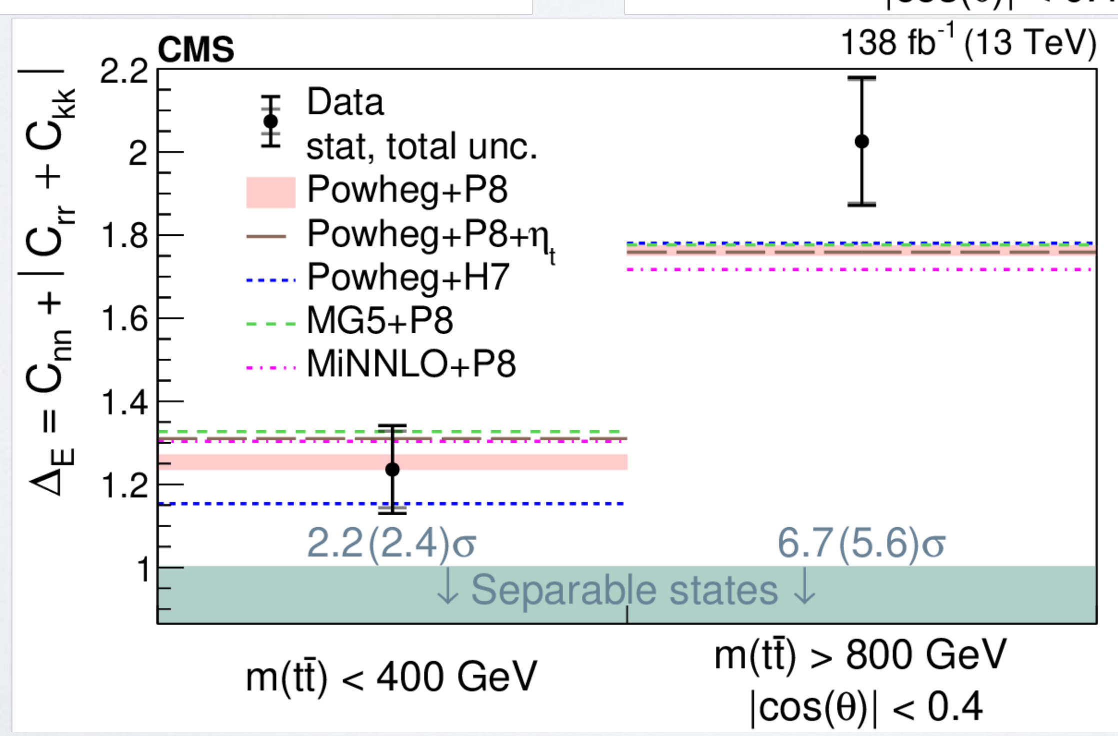
PRD 110 (2024) 112016

13 TeV, 138 fb^{-1}

Entanglement results for the D measurement in the threshold region (upper left), $\tilde{D}$ measurement in the high-m ($t\bar{t}$) region (upper right), and the full matrix measurement in different m ($t\bar{t}$) regions (lower).







- First observation of entanglement at high $t\bar{t}$ mass, as predicted by the Standard Model

INTERPRETATION of RESULTS

CMS-PAS-TOP-25-001

13 TeV, 138 fb^{-1}

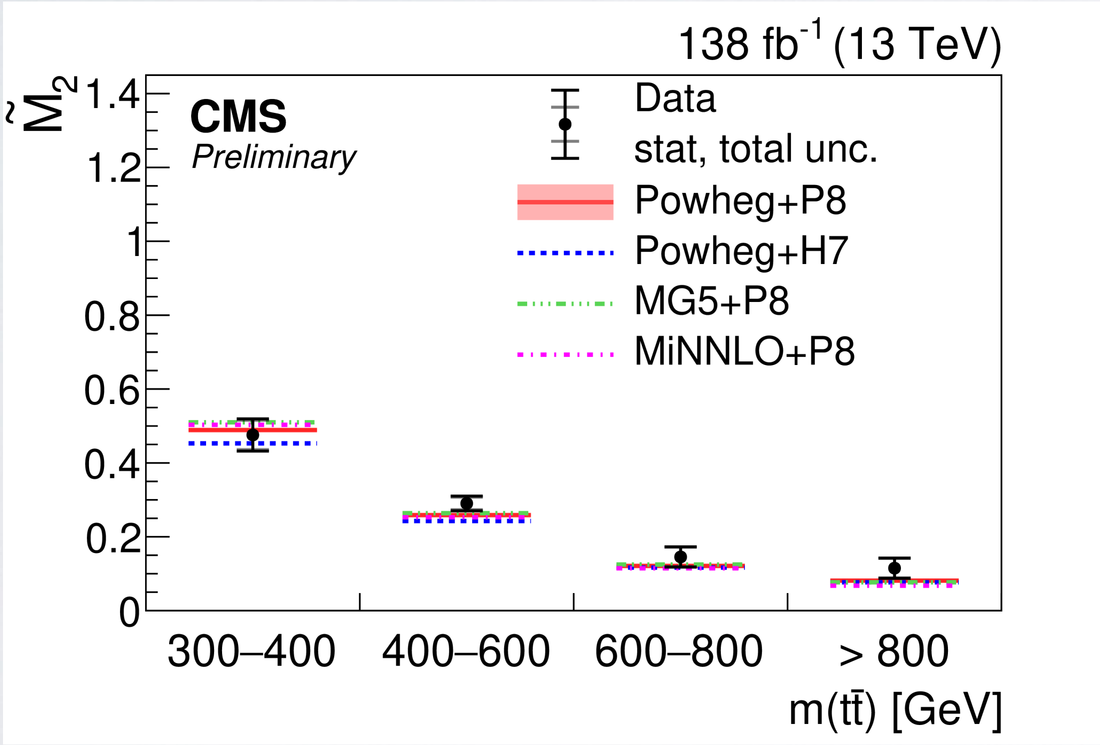
- The measurement of the top anti(quark) polarisation and their spin correlation coefficients can also be interpreted in terms of "*magic of quantum states*" (M_2)
- Property M_2 of quantum states quantifying the potential computational advantage over classical states. High M_2 indicates more advantage:

$$\tilde{M}_2 = -\log_2\left(\frac{1+\sum_{i\in n,k,r}[(P_i^4+\bar{P}_i^4)]+\sum_{i,j\in n,k,r}C_{ij}^4}{1+\sum_{i\in n,k,r}[(P_i^2+\bar{P}_i^2)]+\sum_{i,j\in n,k,r}C_{ij}^2}\right)$$

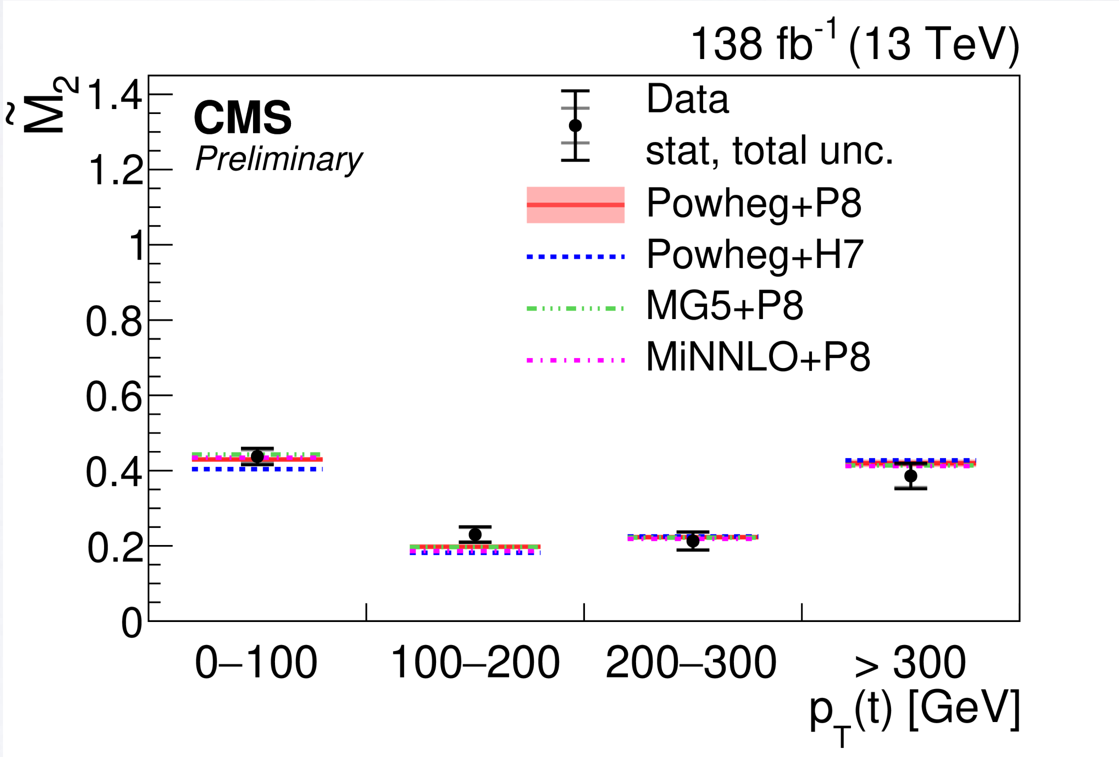
P_i: polarisation coefficients

C_{ij}: Spin correlation coefficients

M_2 in bins of $m(t\bar{t})$



M_2 in bins of p_T (top)



- Good agreement with the Standard Model
- Highest M_2 at the production threshold, while near constant with low top quark scattering angle in the $t\bar{t}$ rest frame, and variable with p_T(top)

TOP QUARK MASS: DIRECT

NEW

Submitted to PLB
arXiv:2502.18216 (2025)

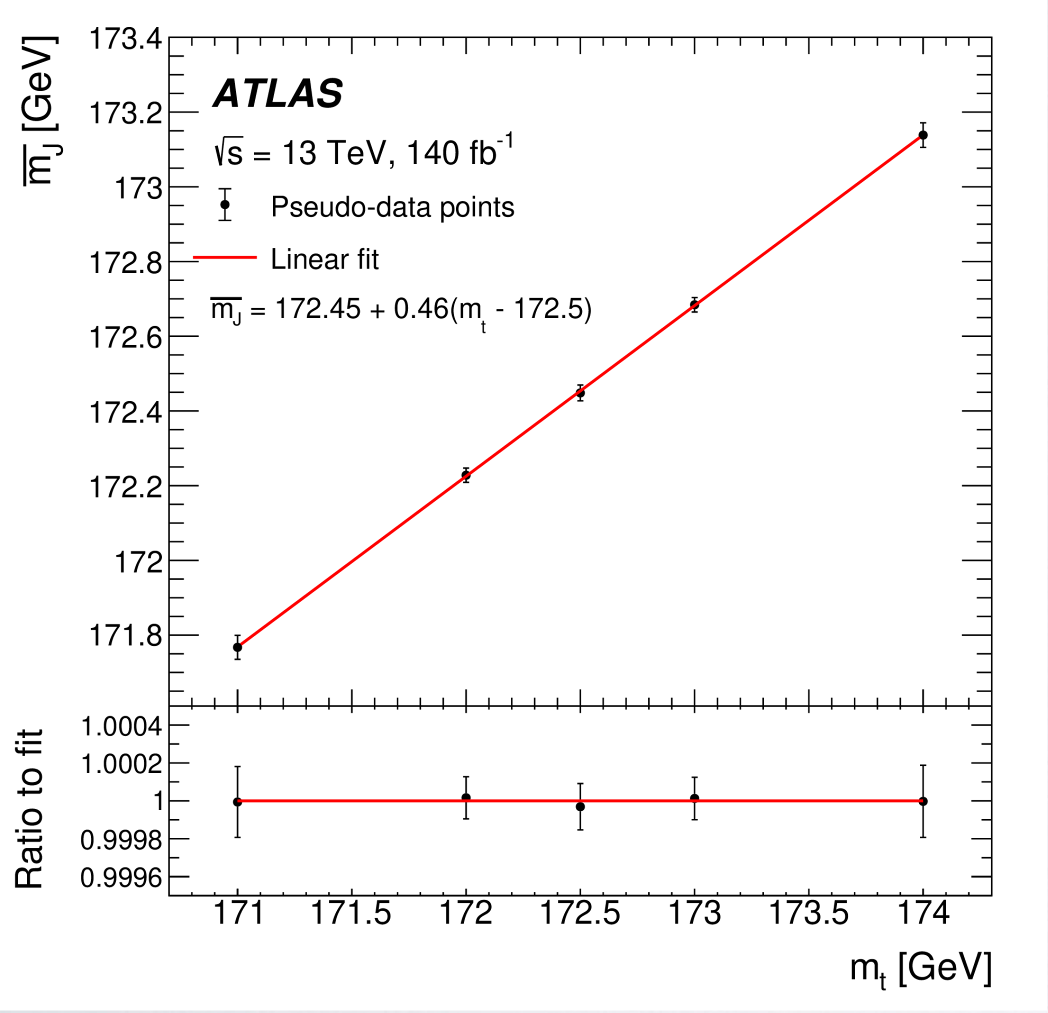
13 TeV, 140 fb^{-1}

- Direct top mass measurement in events with high transverse momentum of the top quark
- Uses hadronically decaying top quark to a large-radius jet ("top-jet")

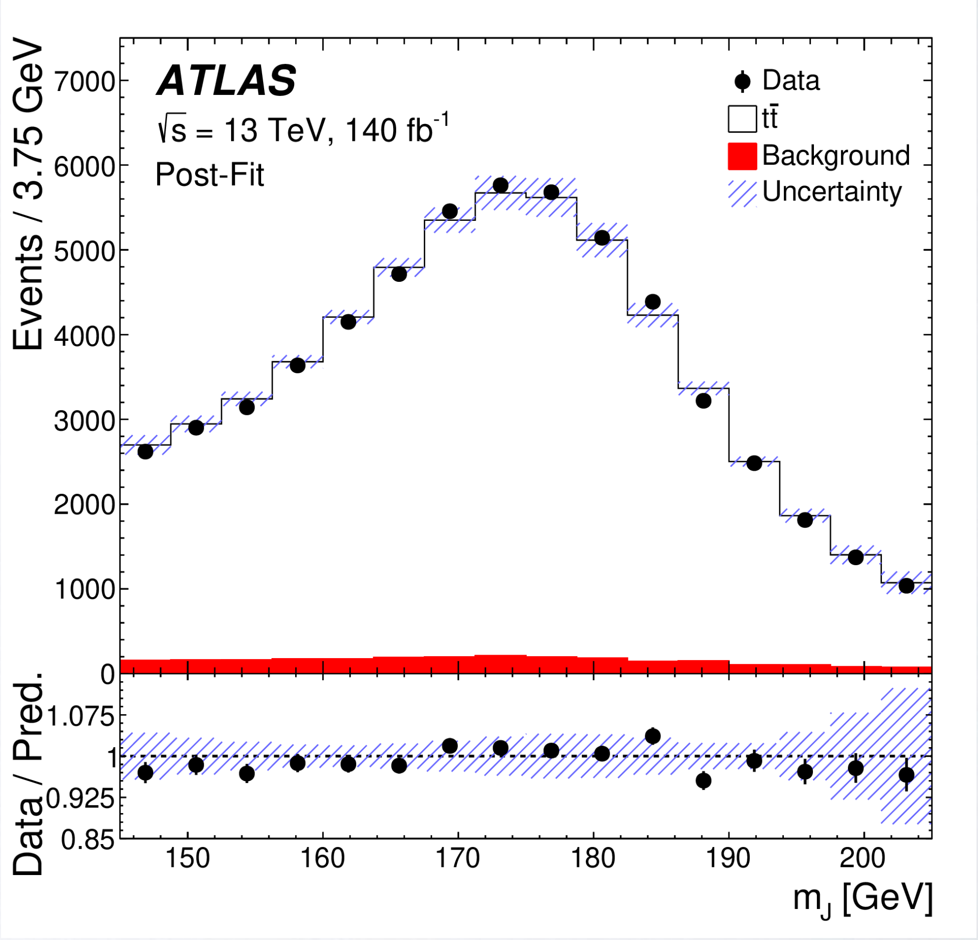
Signature: 1 lepton (e or μ) + large-R jet + ≥1 b-jet. $\Delta R(e, J) > 1.0$

Method: Fit to mean value of invariant mass of the large-R (top) jet. Profile likelihood to 2 other variables to limit systematic uncertainties, m_{jj} and m_{tj}

Dependence of large-R jet mass on top quark mass



Post-fit expectation for the m_J distribution



TOP QUARK MASS: DIRECT

- Significant improvement over previous ATLAS measurements
- Good agreement with other measurements
- Non-negligible statistical uncertainty

NEW

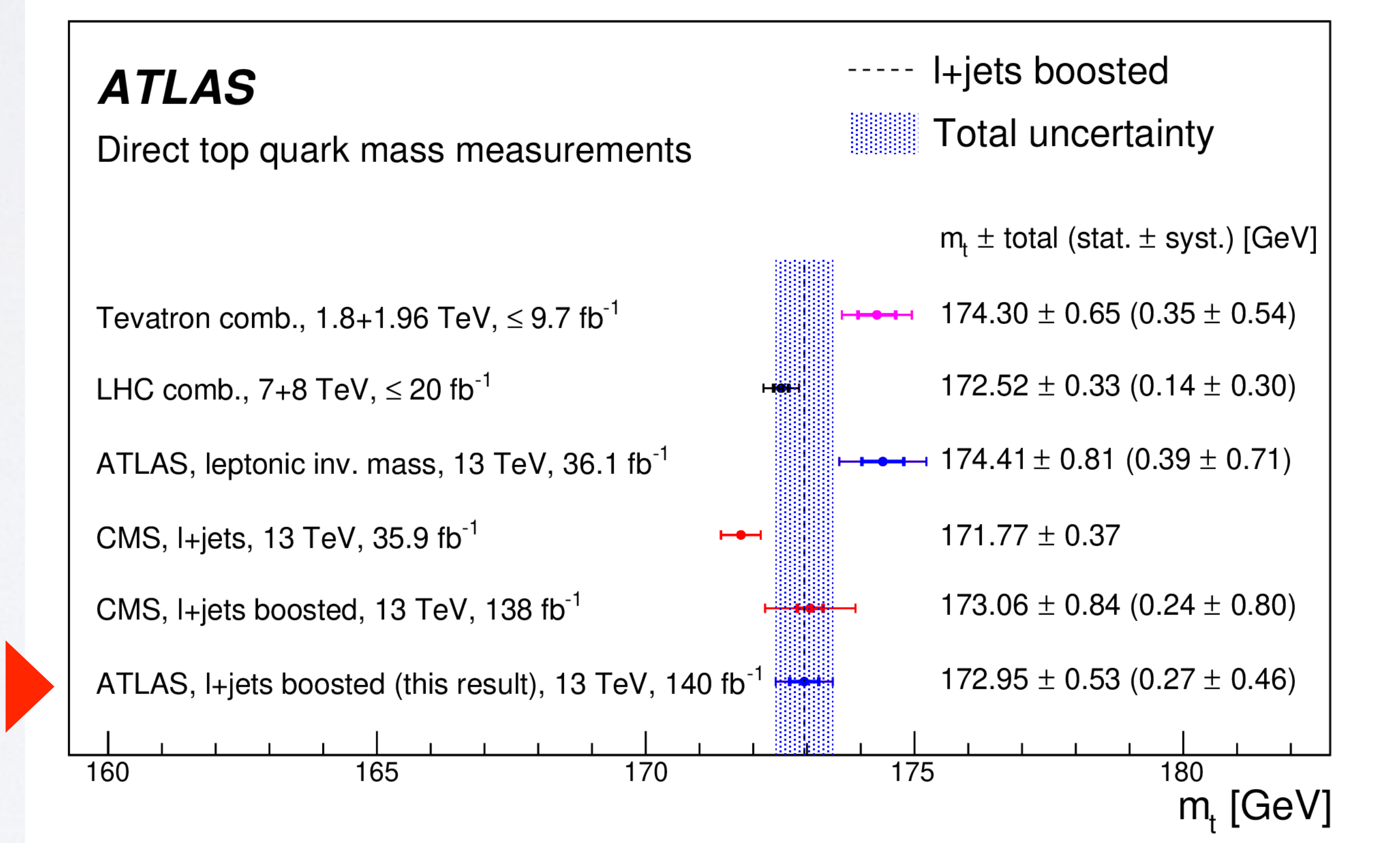
Submitted to PLB
arXiv:2502.18216 (2025)

13 TeV, 140 fb^{-1}

Grouped breakdown of the uncertainty sources

Source	Uncertainty [GeV]
JES	± 0.29
Radiation (ISR and FSR)	± 0.17
Colour reconnection (CR1 and CR2)	± 0.15
JES heavy flavour	± 0.14
Parton shower and hadronisation model	± 0.14
JER	± 0.10
MC statistics	± 0.08
Underlying event	± 0.08
Recoil	± 0.07
Fit closure	± 0.07
Background modelling	± 0.05
Matrix element matching ($p_T^{hard} = 1$)	± 0.04
b-tagging	± 0.04
Higher-order corrections	± 0.02
E_T^{miss}	± 0.02
Pileup	± 0.01
JVT	± 0.01
PDF	± 0.01
Leptons	± 0.01
Luminosity	< 0.01
Total statistical	± 0.27
Total systematic	± 0.46
Total	± 0.53

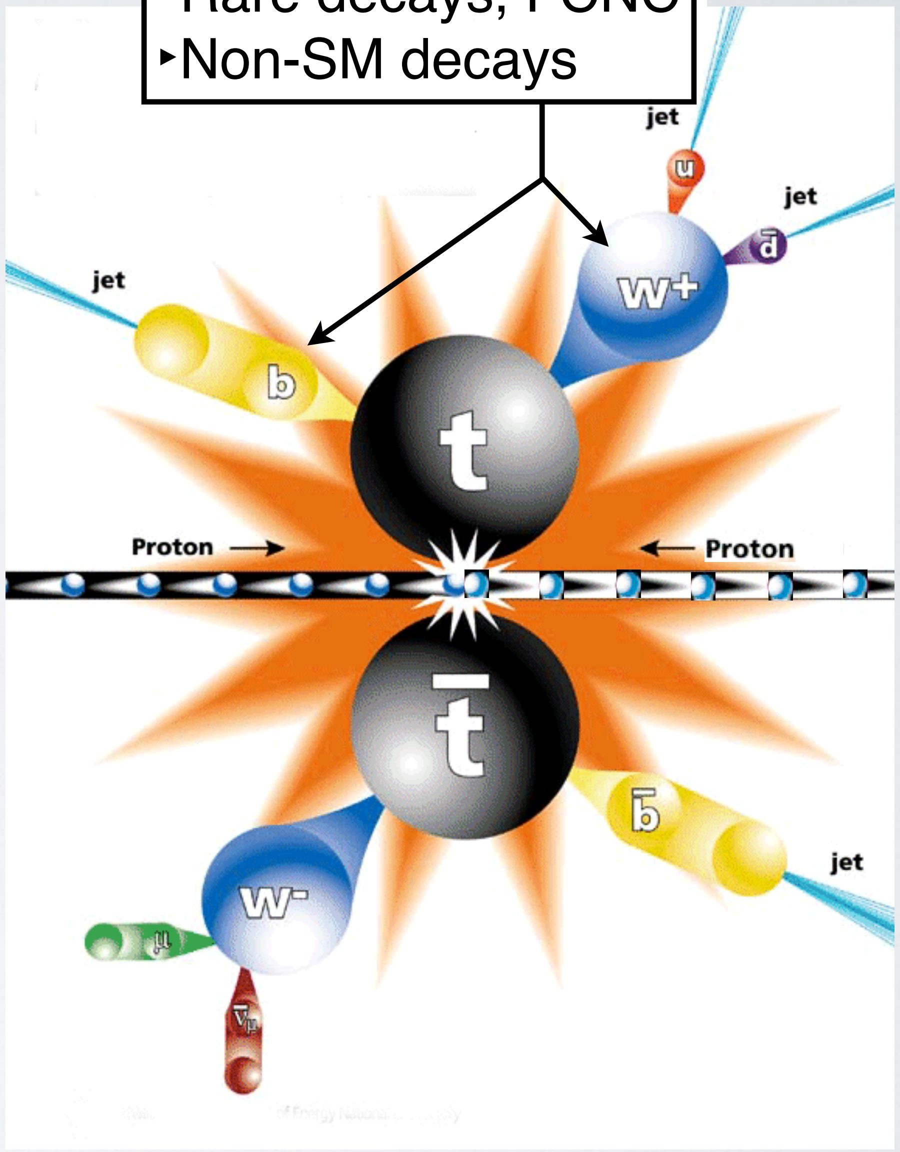
This measurement, compared to selected m_t determinations



PART 2: DECAY

- Test of SM (production, decay, coupling....etc)
- Top quark does not hadronize: momentum and spin transferred to decay products
- Search for processes with similar signature (VLQ, Z'...)
- Natural mass ($y_t \simeq 1$), top quark mass is a fundamental parameter of the SM, and crucial for SM constraints via loop diagrams

Decay
- Branching ratios
- CP asymmetries
- Rare decays, FCNC
- Non-SM decays



RED: Discussed in this talk

LFU IN W-BOSON TO e/μ FROM TOP DECAY

- Lepton Flavour Universality (LFU) is a key axiom of the S.M.
- Measurement of the $t\bar{t}$ production cross section in ee, eμ, $\mu\mu$ final states allows LFU test, to address "anomalies" reported in *b*-hadron decays
- Determines the ratio of BR's: $R_W^{\mu/e} = B(W \to \mu\nu)/B(W \to e\nu)$
- In PDG: $R_W^{\mu/e} = 1.002 \pm 0.006$

EPJ C 84 (2024) 993
arXiv:2403.02133 (2024)

13 TeV, 140 fb^{-1}

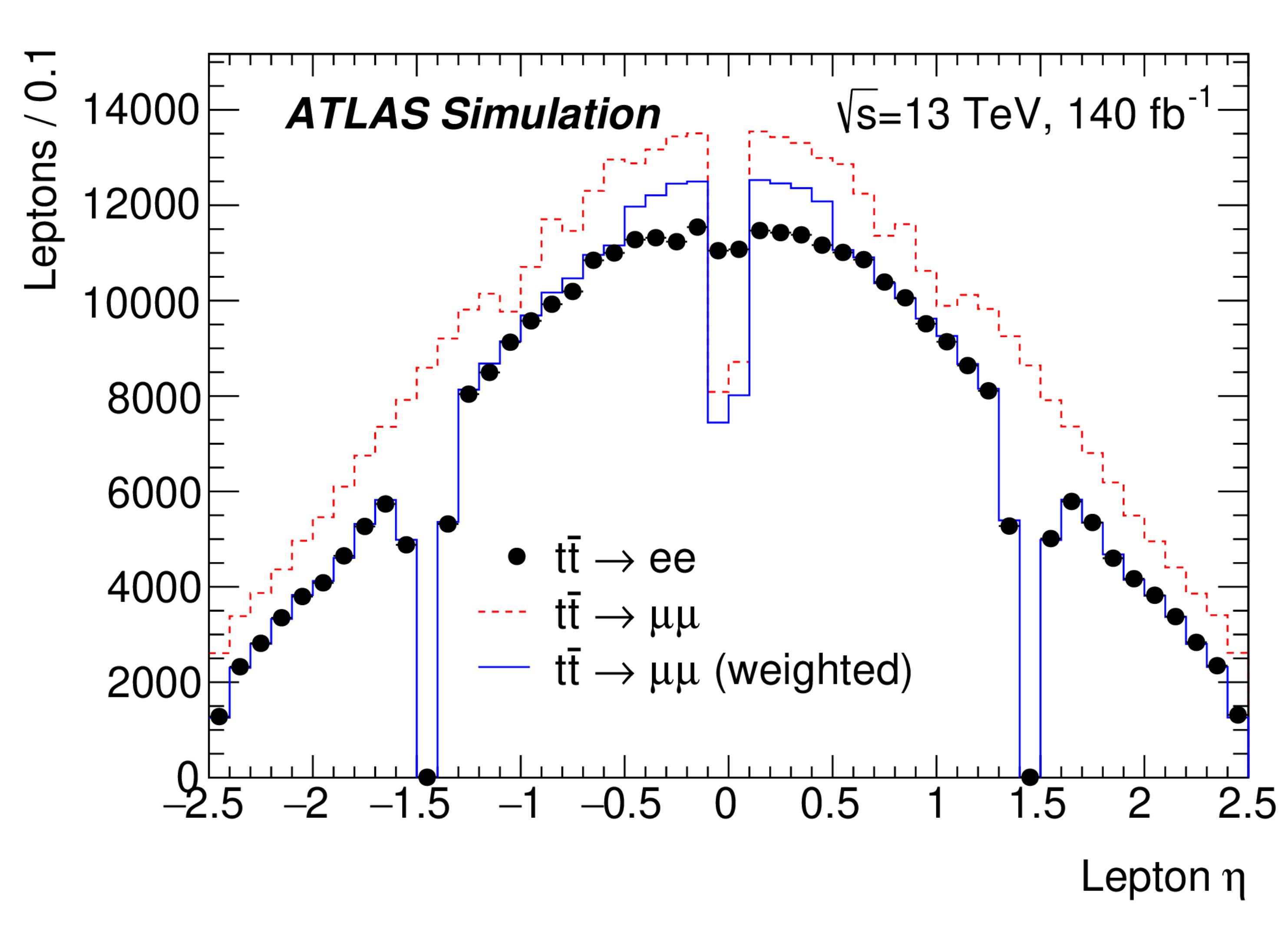
Signature: Two electrons and muons of opposite electric charges: ee, $\mu\mu$, eμ

- 1 or 2 *b*-tagged jets from the $t\bar{t}$ production

Method: Simultaneous measurement of the ratio of BR's for Z→$\mu\mu$ and Z→ee

$$R_{WZ}^{\mu/e} = \frac{R_W^{\mu/e}}{\sqrt{R_Z^{\mu\mu/ee}}} = \frac{\mathcal{B}(W \to \mu\nu)}{\mathcal{B}(W \to e\nu)} \cdot \sqrt{\frac{\mathcal{B}(Z \to ee)}{\mathcal{B}(Z \to \mu\mu)}}$$

Number of leptons in simulated selected $t\bar{t}$ events



LFU IN W-BOSON TO e/μ FROM TOP DECAY

- Single maximum likelihood fit with Gaussian formulation to the observed event counts
- 10 free parameters: 4 parameters of interest, plus 3 b-tag jet efficiencies, 2 Zj backgrounds and 1 Zj isolation efficiency propagated to $t\bar{t}$

EPJ C 84 (2024) 993
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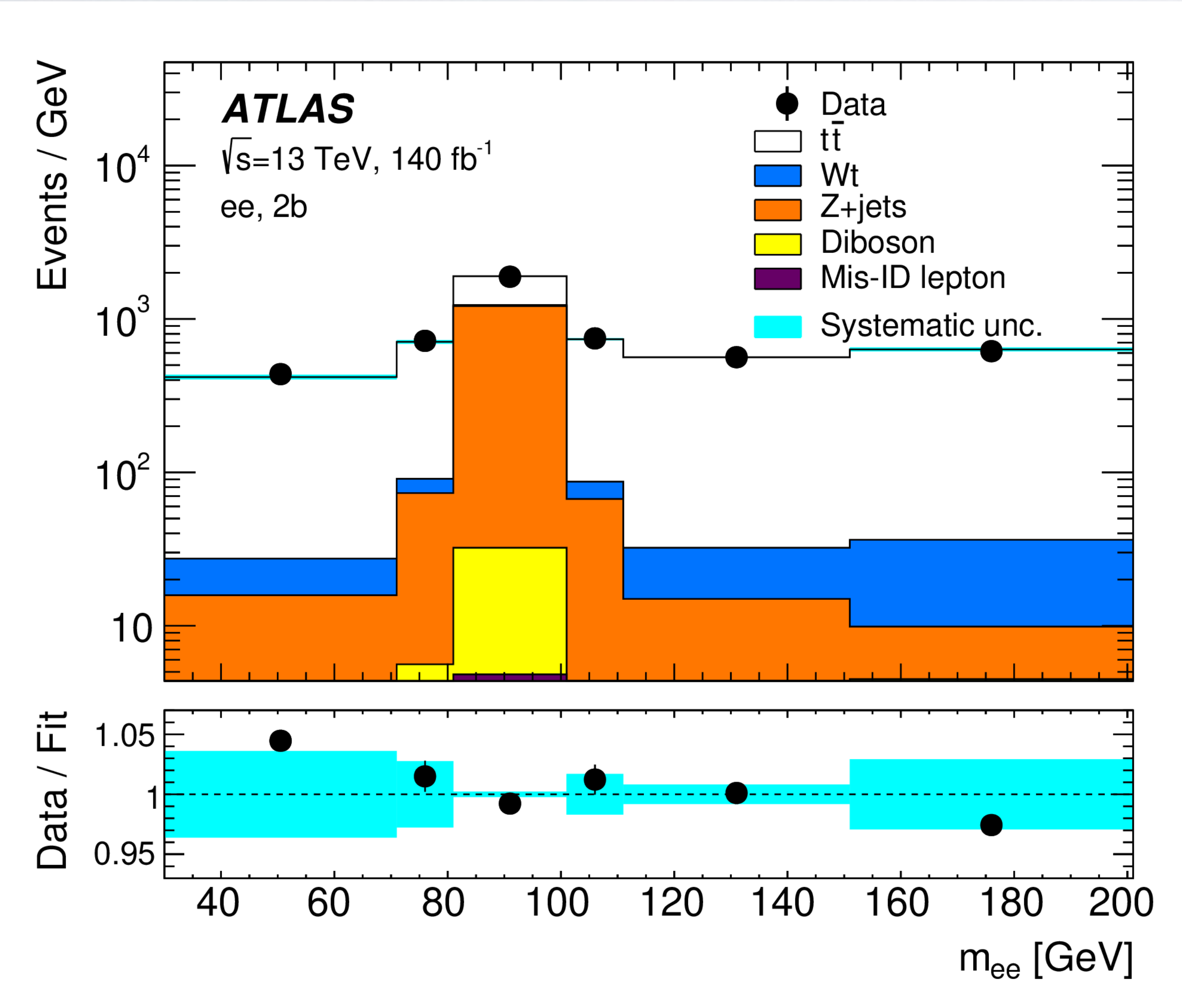
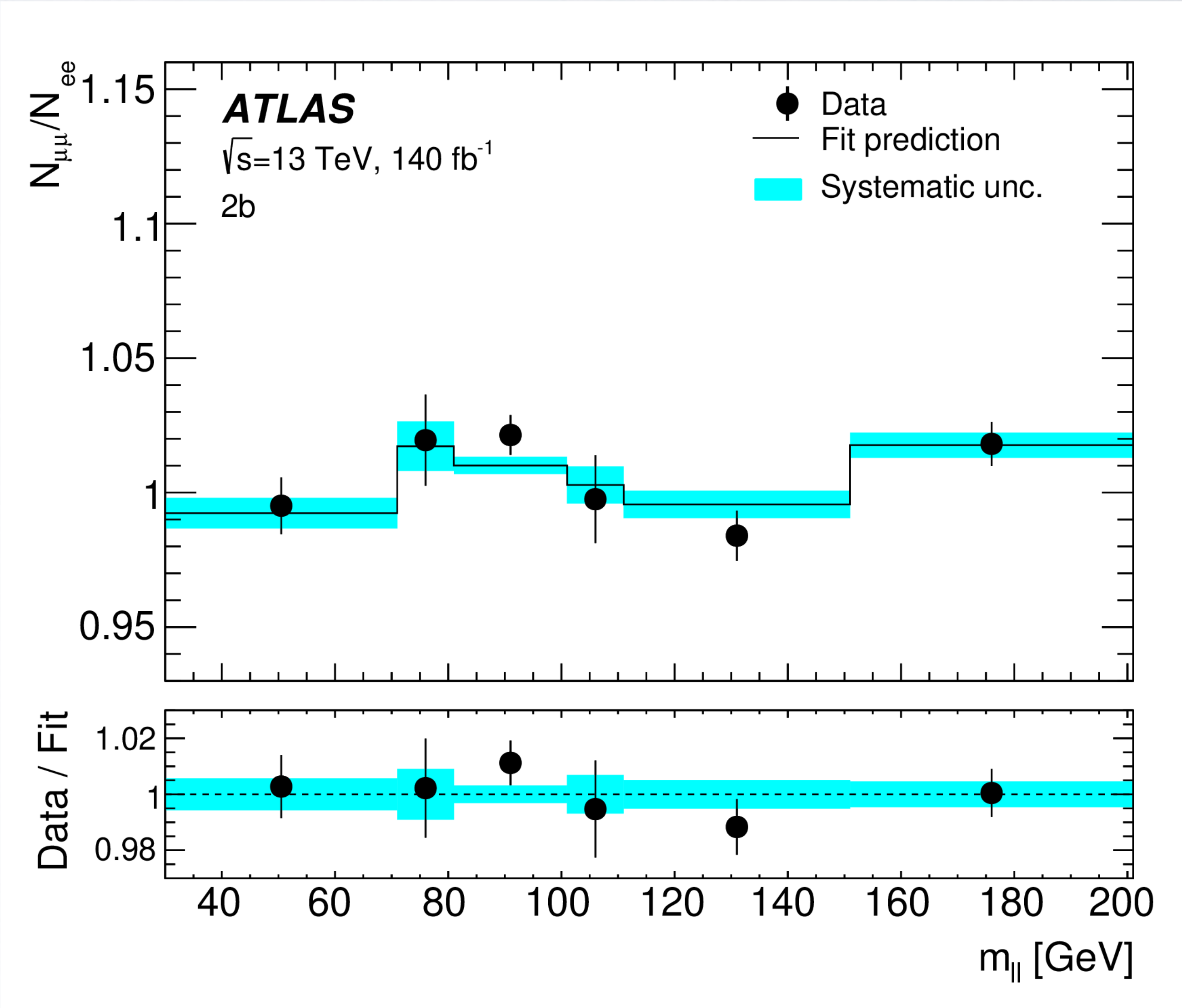
13 TeV, 140 fb^{-1}

Fit to data, invariant mass distribution



Ratio of the number of events in the $\mu\mu$ channel divided by that in the ee channel



LFU IN W-BOSON TO e/μ FROM TOP DECAY

EPJ C 84 (2024) 993
arXiv:2403.02133 (2024)

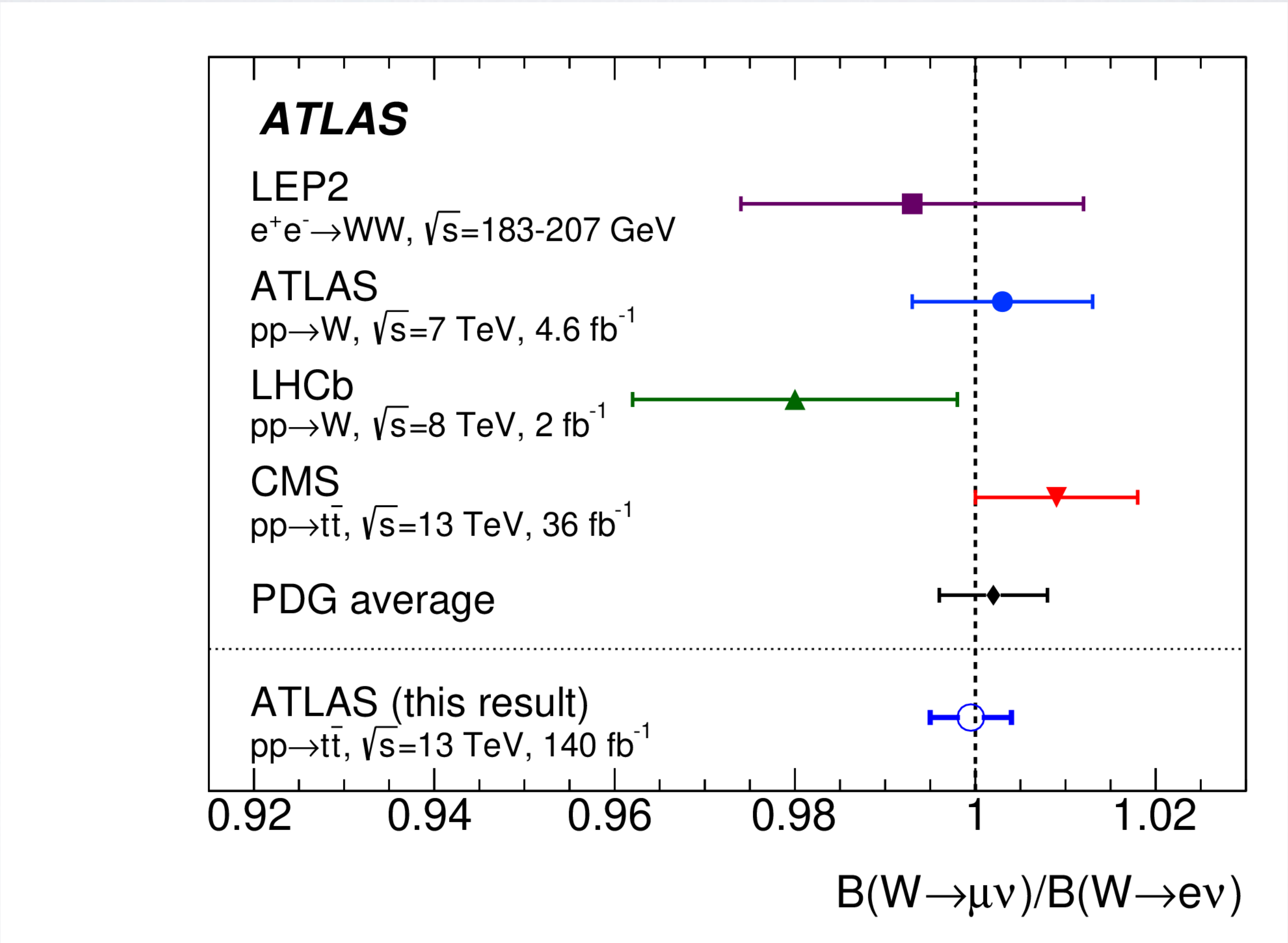
13 TeV, 140 fb^{-1}

- Measured value of $R_{WZ}^{\mu/e}$ converted to $R_W^{\mu/e}$ using $R_{Z-ext}^{\mu\mu/ee} = 1.0009 \pm 0.0028$

$$R_W^{\mu/e} = R_{WZ}^{\mu/e}\sqrt{R_{Z-\text{ext}}^{\mu\mu/ee}} = 0.9995 \pm 0.0022\,(\text{stat}) \pm 0.0036\,(\text{syst}) \pm 0.0014\,(\text{ext})$$

- Limited by lepton ID, Z+jets modelling, and Parton Density Functions
- Higher precision than the previous World Average

Measurement of $R_W^{\mu/e}$ from this analysis compared to previous results



LFU IN W-BOSON TO e/τ FROM TOP DECAY

Submitted to JHEP
arXiv:2412.11989 (2024)

13 TeV, 140 fb^{-1}

Complements $R_{\tau/\mu}$ and $R_{\mu/e}$

- Measurement of the $t\bar{t}$ production cross section, distinguishing
  $W \rightarrow \tau\nu_\tau$ (with $\tau \rightarrow e\nu_e\nu_\tau$) and $W \rightarrow e\nu_e$
- Determines the ratio of BR's: $R_{\tau/e} = B(W \rightarrow \tau\nu)/B(W \rightarrow (e\nu)$
- Combined LEP: $R_{\tau/e} = 1.063 \pm 0.027$

Signature: One tag electron or muon and one probe electron from $W\rightarrow e$ (prompt) or $W\rightarrow\tau\rightarrow e$

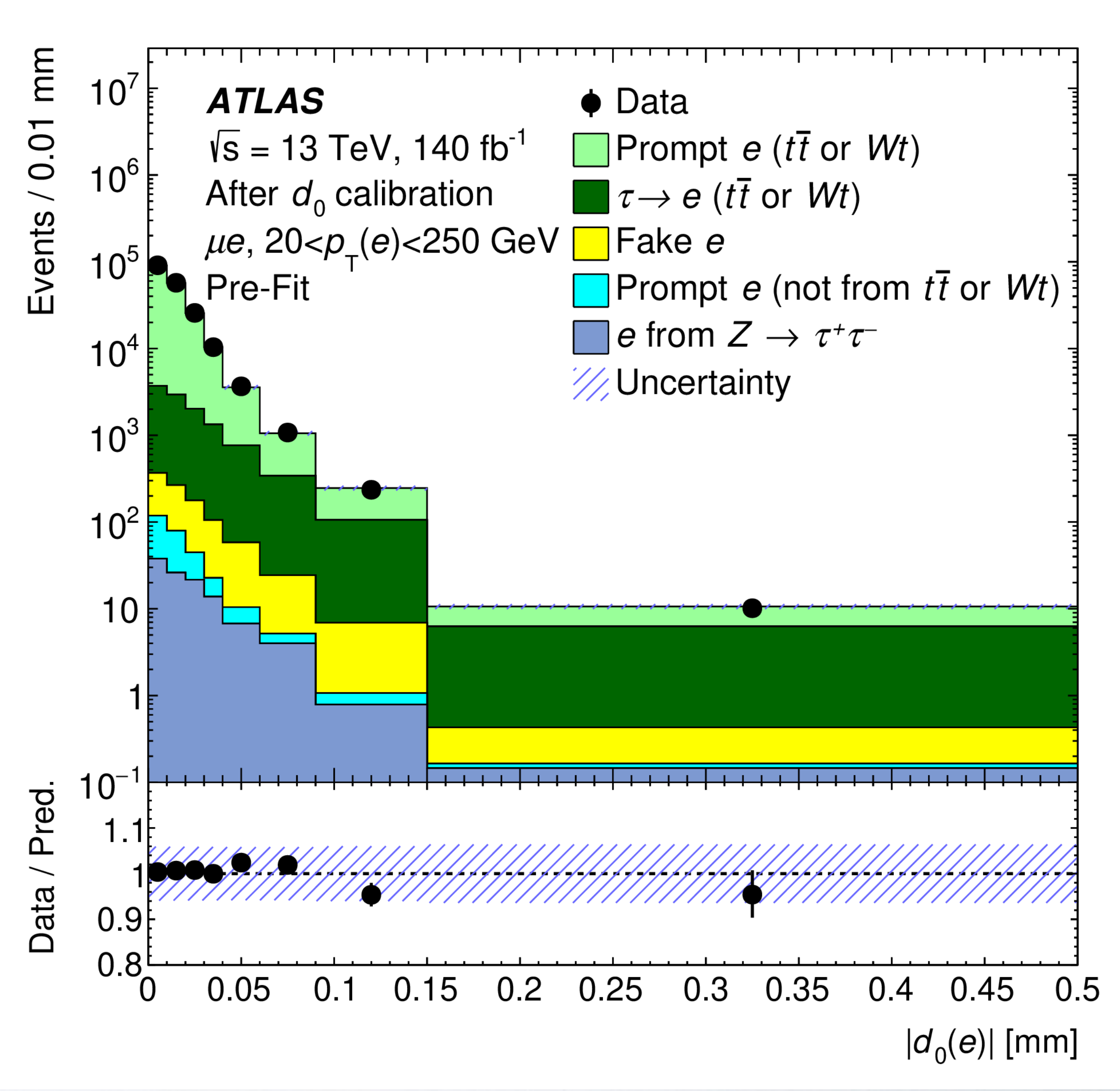
- Prompt case distinguished from τ with electron p_T and displacement of track
- ≥ 2 b-tag jets

Method:

-Calibration of d_0 in MC simulation from data $Z\rightarrow e^+e^-$ events

- Two-dimensional binned templated likelihood fit to the p_T and $|d_0|$ distributions

$|d_0(e)|$ distribution after calibration



LFU IN W-BOSON TO e/τ FROM TOP DECAY

Submitted to JHEP
arXiv:2412.11989 (2024)

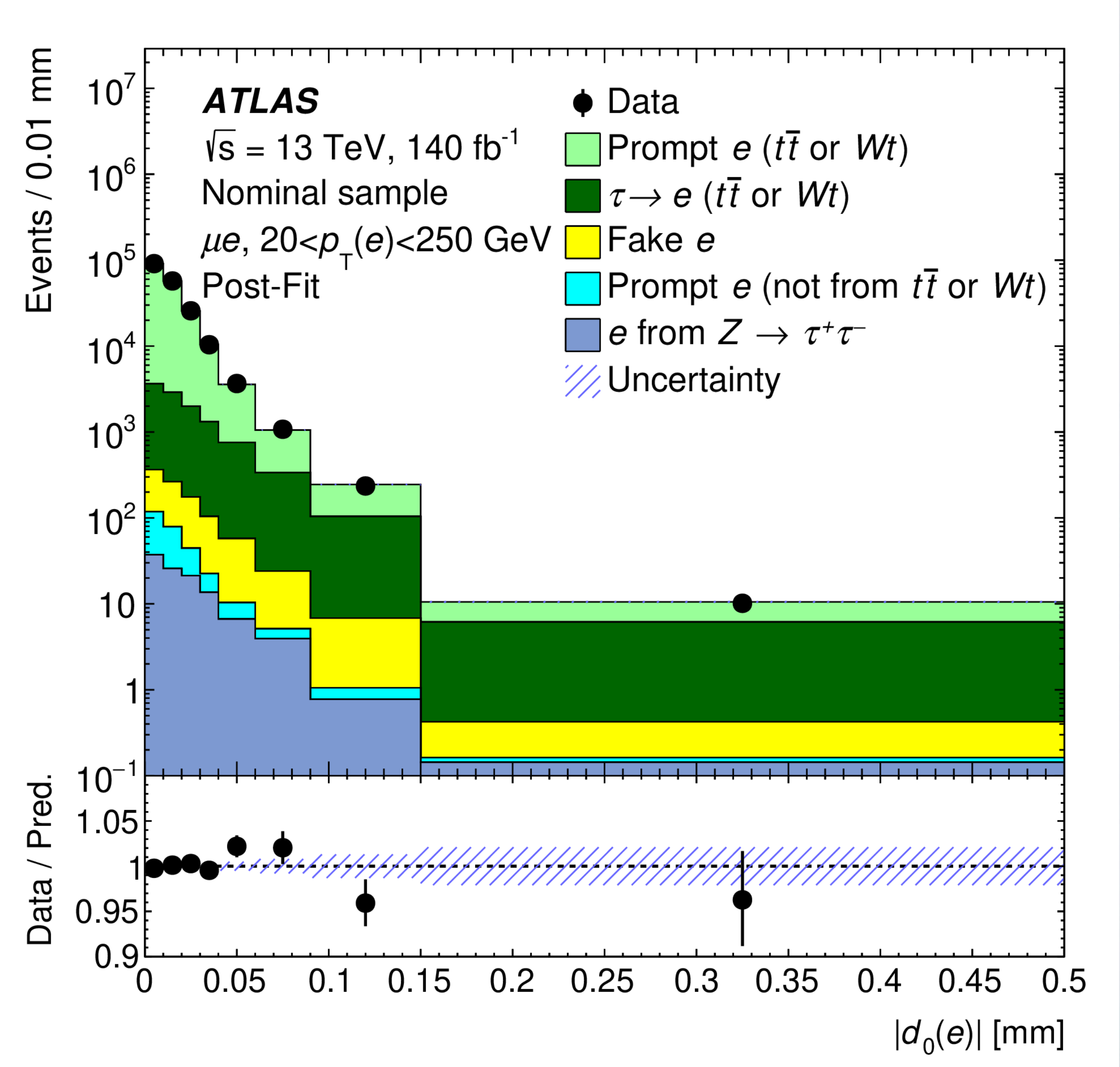
13 TeV, 140 fb^{-1}

- Number of events in simulation agrees with data across channels (μe and ee) and p_T bins
- Good agreement between data and simulation, both in total yield and shape

Number of events in the μe channel from different sources, as estimated by the fit to the data

	μe $7 < p_T < 10$ GeV	μe $10 < p_T < 20$ GeV	μe $20 < p_T < 250$ GeV
Prompt $e(t\bar{t})$	1278 ± 28	13370 ± 150	178000 ± 1000
e from τ $(t\bar{t})$	1092 ± 32	4490 ± 100	11670 ± 290
Prompt $e(Wt)$	34 ± 6	340 ± 60	5300 ± 900
e from τ (Wt)	28.0 ± 2.5	119 ± 16	380 ± 110
Prompt e (not from $t\bar{t}$ or Wt)	5.2 ± 1.5	23 ± 7	180 ± 50
e from $Z \to \tau^+\tau^-$	19.9 ± 0.4	85.4 ± 1.4	132.9 ± 2.2
Fake e	317 ± 22	380 ± 33	840 ± 60
Total predicted	2770 ± 40	18880 ± 120	196500 ± 400
Data	2768	18783	196552

Distribution of $|d0|$ in data and simulation after fit, μe



LFU IN W-BOSON TO e/τ FROM TOP DECAY

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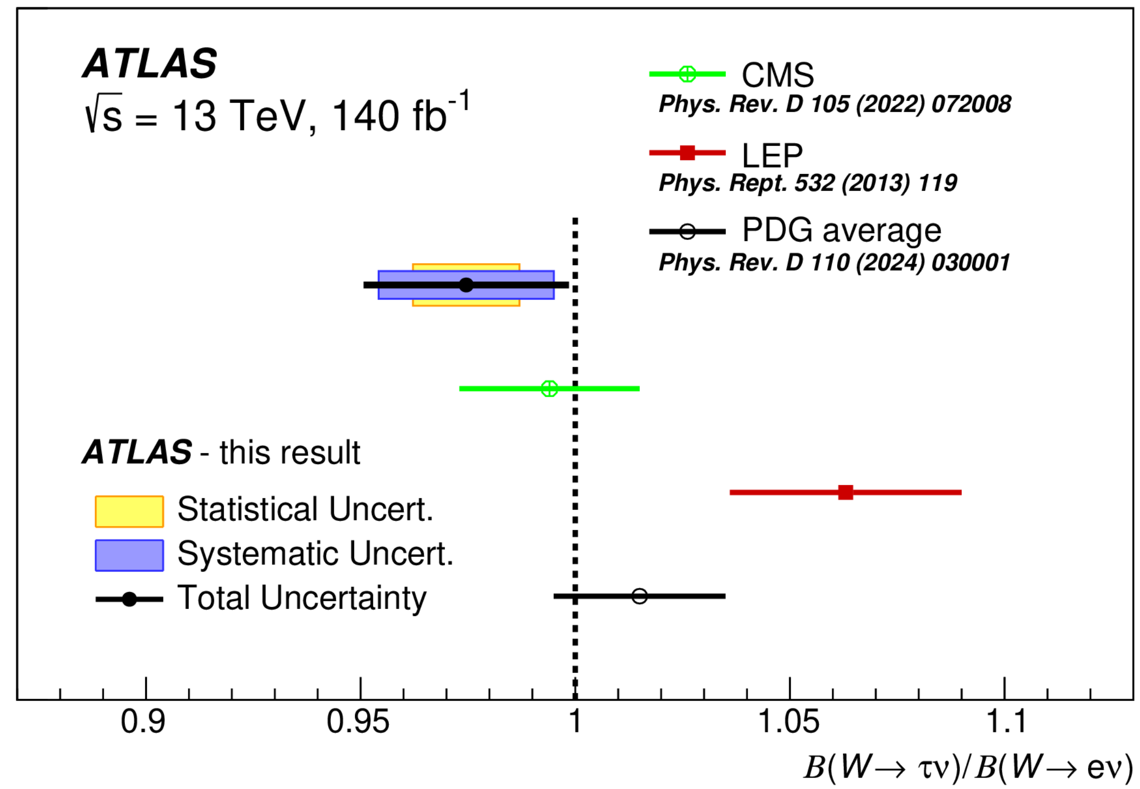
Breakdown of statistical and systematic uncertainties

Uncertainty group	$\sigma(R_{\tau/e})$
Modelling of $t\bar{t}$ and Wt	0.011
d_0 calibration	0.006
Background estimation	0.005
Electron reconstruction, identification, and isolation	0.005
Electron energy scale	0.003
Electron energy resolution	0.002
Jet energy resolution	0.004
Jet energy scale	0.003
Jet b-tagging	0.002
Muon reconstruction, identification, and isolation	0.001
Other sources	0.002
Variation of k_{sig} and $k(\mu/e)$	0.003
Finite size of simulated samples	0.003
$B(W \to \tau\nu_\tau \to e\nu_e\nu_\tau\nu_\tau)$	0.002
Total systematical uncertainty	0.020
Data statistical uncertainty	0.012
Total uncertainty	0.024

Summary of measurements of $R_{\tau/e}$



Measured value:

$$R_{\tau/e} = 0.975 \pm 0.012\ (\text{stat.}) \pm 0.020\ (\text{syst.}).$$

Measured values of $R_{\tau/e}$ in different p_T bins

p_T bin	$R_{\tau/e}$
$7 < p_T < 10$ GeV	1.13 ± 0.11 (stat) ± 0.07 (syst)
$10 < p_T < 20$ GeV	0.93 ± 0.04 (stat) ± 0.02 (syst)
$20 < p_T < 250$ GeV	0.98 ± 0.04 (stat) ± 0.02 (syst)

PART 3: FCNC IN PRODUCTION AND DECAY

- Test of SM (production, decay, coupling....etc)
- Top quark does not hadronize: momentum and spin transferred to decay products
- Search for processes with similar signature (VLQ, Z'...)
- Natural mass ($y_t \simeq 1$), top quark mass is a fundamental parameter of the SM, and crucial for SM constraints via loop diagrams

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- Differential cross sections
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New Physics in production
- Resonant production
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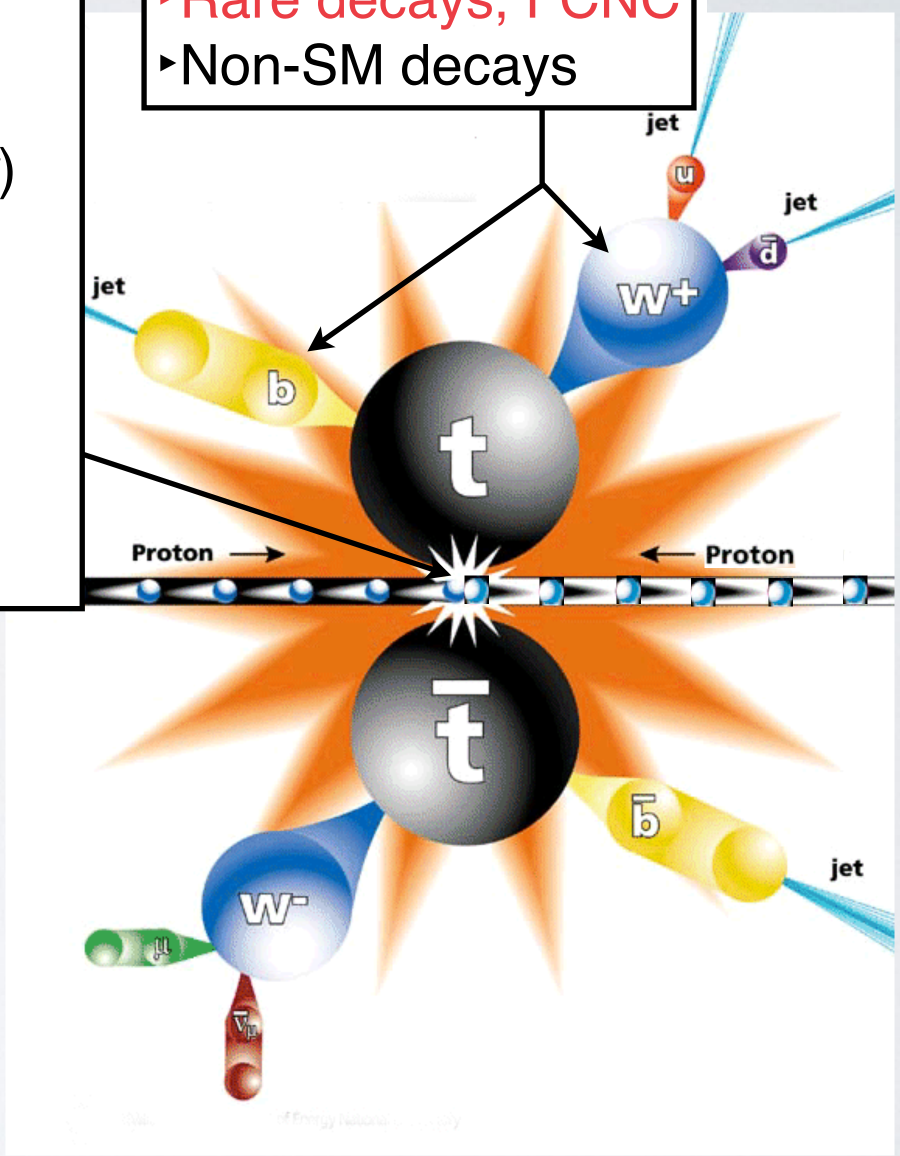
Decay
- Branching ratios
- CP asymmetries
- Rare decays, FCNC
- Non-SM decays



RED: Discussed in this talk

FCNC OF TOP MEDIATED BY HIGGS BOSON

- Search for Flavour Changing Neutral Current in tHq and $t\bar{t}$ with $t \rightarrow Hq$ $(q=u,c)$
- Considers Higgs to WW, ZZ or $\tau\tau$
- SM predictions for these FCNC are of order $\mathcal{O}(\leq 10^{-15})$

EPJ C 84 757 (2024)
arXiv:2404.02123 (2024)

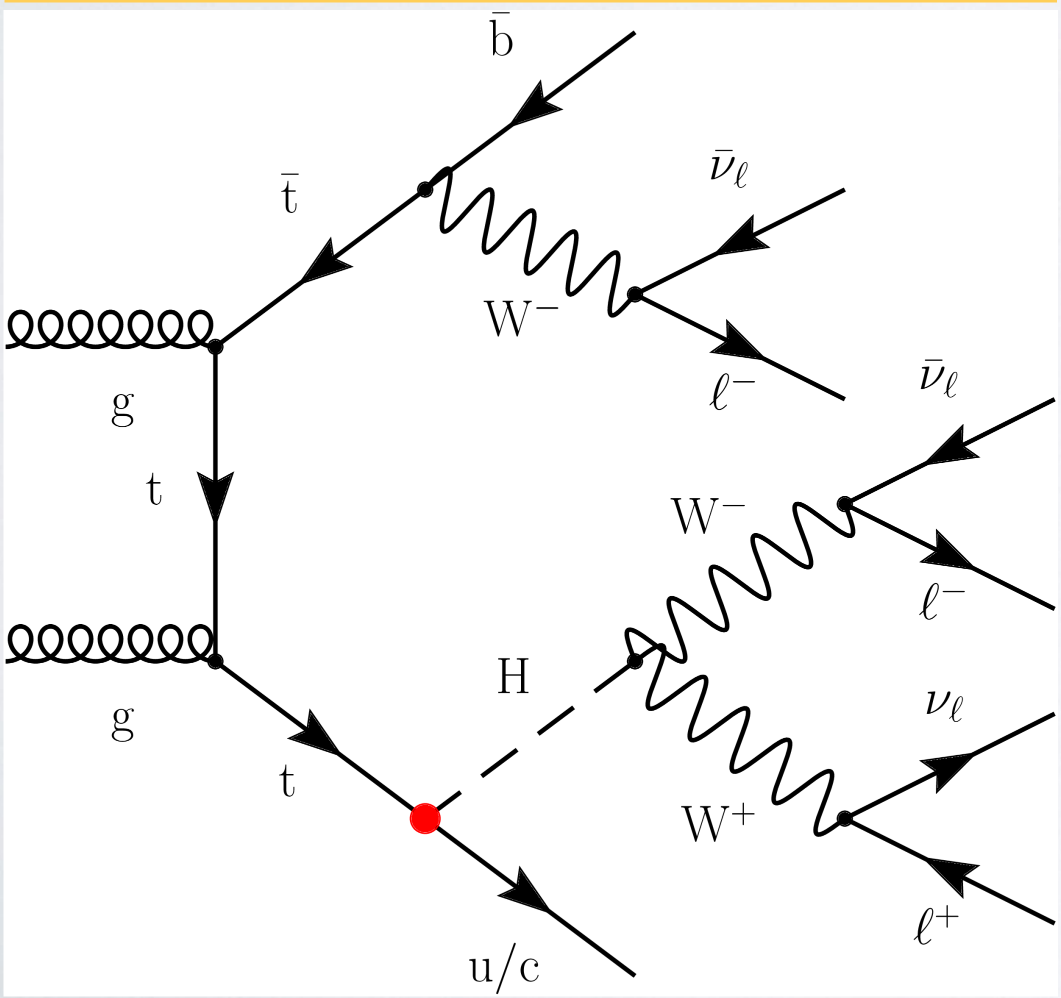
13 TeV, 140 fb^{-1}

Updates an earlier analysis with 36.1 fb^{-1}

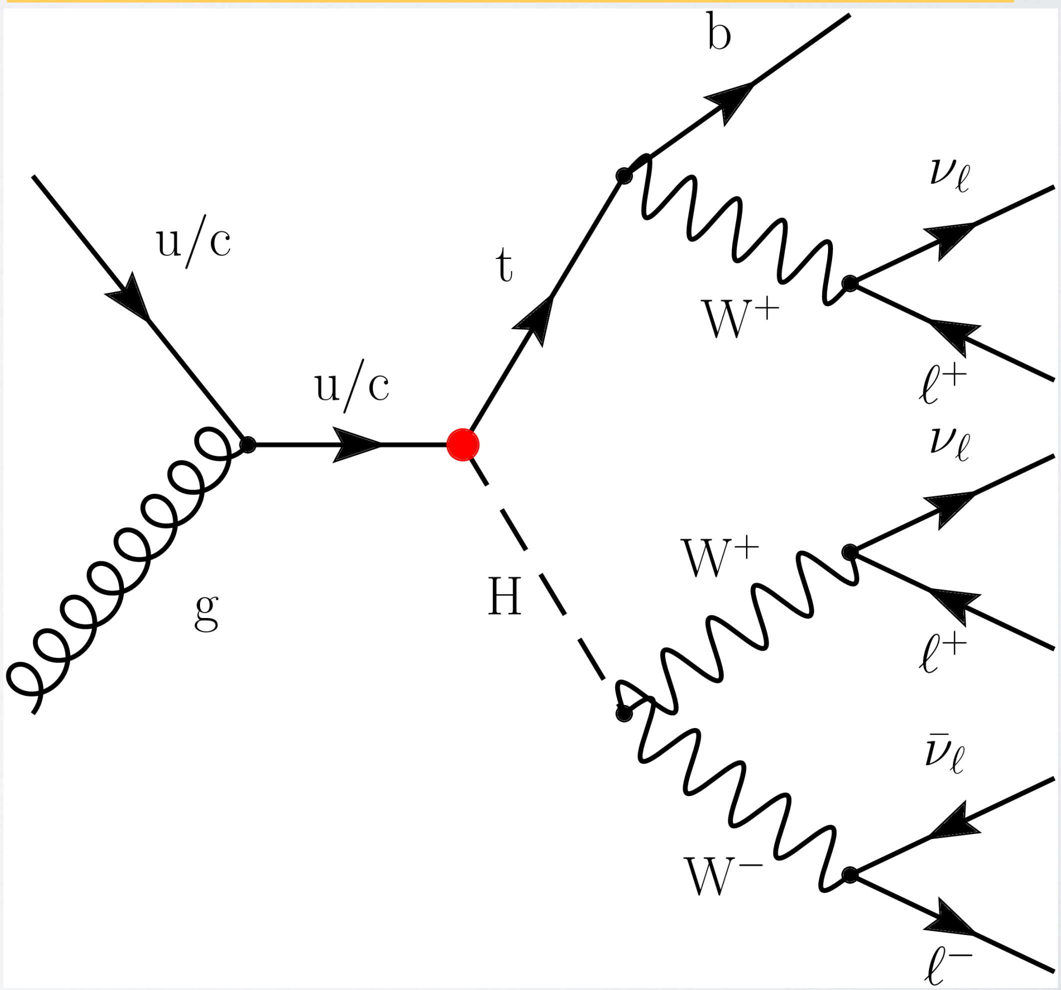
Signature: 2 leptons Same Sign or 3 leptons; ≥ 1jet (≥1 b-jet)

Method: Single discriminant using feed-forward neural network in signal region, then maximum-likelihood fit

Feynman diagrams of the $t\bar{t}(t\rightarrow Hq)$ decay signal process resulting in the 3ℓ final state



Feynman diagrams of the $gq\rightarrow Ht$ production signal process resulting in the 3ℓ final state.



FCNC OF TOP MEDIATED BY HIGGS BOSON

EPJ C 84 757 (2024)
arXiv:2404.02123 (2024)

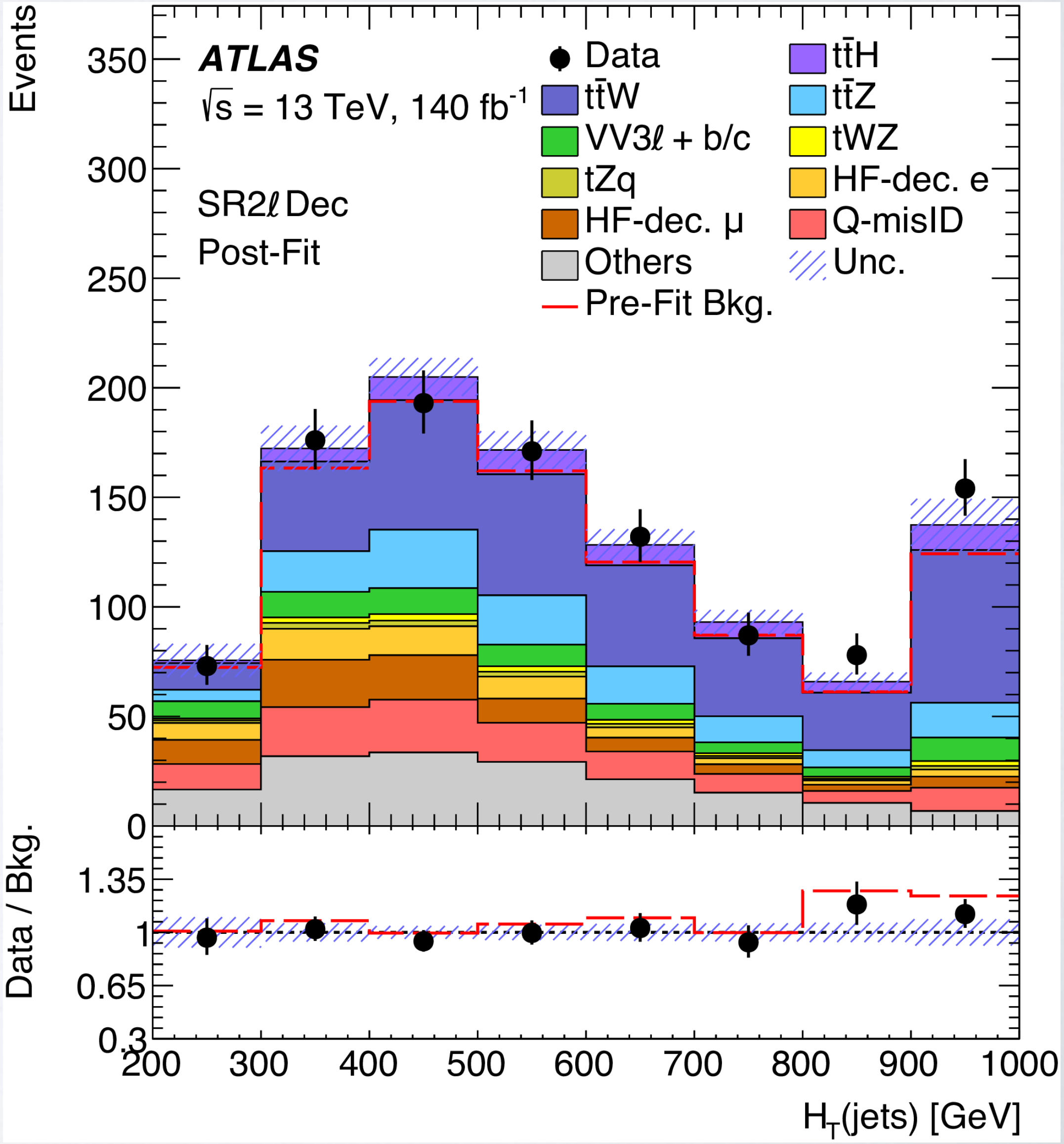
13 TeV, 140 fb^{-1}

- Four signal regions (2 each for production and decay); 7 control regions for backgrounds
- Combinatorics addressed with Recursive Jigsaw Reconstruction and Neutrino estimator
- NeuroBayes implementation for a discriminant D_{NN} = [0,1]

Definition of signal regions

	SR2ℓDec	SR2ℓProd	SR3ℓDec	SR3ℓProd
N_{jets}	≥ 4	≤ 3	≥ 3	≤ 2
$N_{b\text{-tags}}$	$= 1$	$= 1$	$= 1$	$= 1$
$p_{\text{T}}(\ell_1)$	≥ 12 GeV	≥ 16 GeV	≥ 20 GeV	≥ 20 GeV
$p_{\text{T}}(\ell_2)$	–	–	≥ 16 GeV	≥ 16 GeV
$\lvert m(e,e) - m_Z \rvert$	≥ 10 GeV	≥ 10 GeV	–	–

Distribution of the most important NN input variable, H_T(jets) for the SR2ℓDec



FCNC OF TOP MEDIATED BY HIGGS BOSON

- Fit for normalisation parameter of the signal

EPJ C 84 757 (2024)
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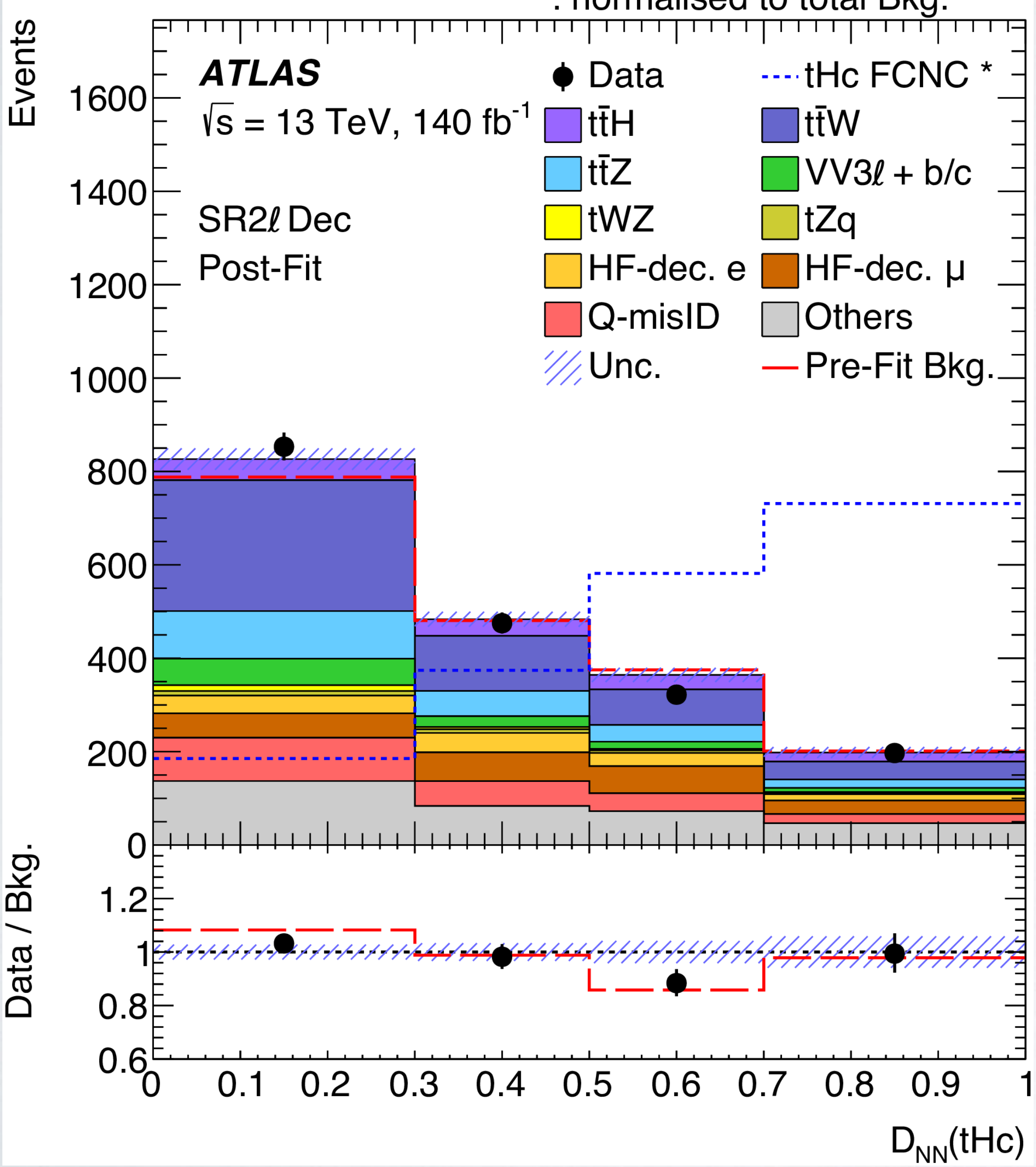
The D_{NN} distribution in the SR2ℓDec, obtained from the signal-plus-background fit to data in the *tHc* channel.

*: normalised to total Bkg.



Best fit value of the *tHu (tHc)* signal:

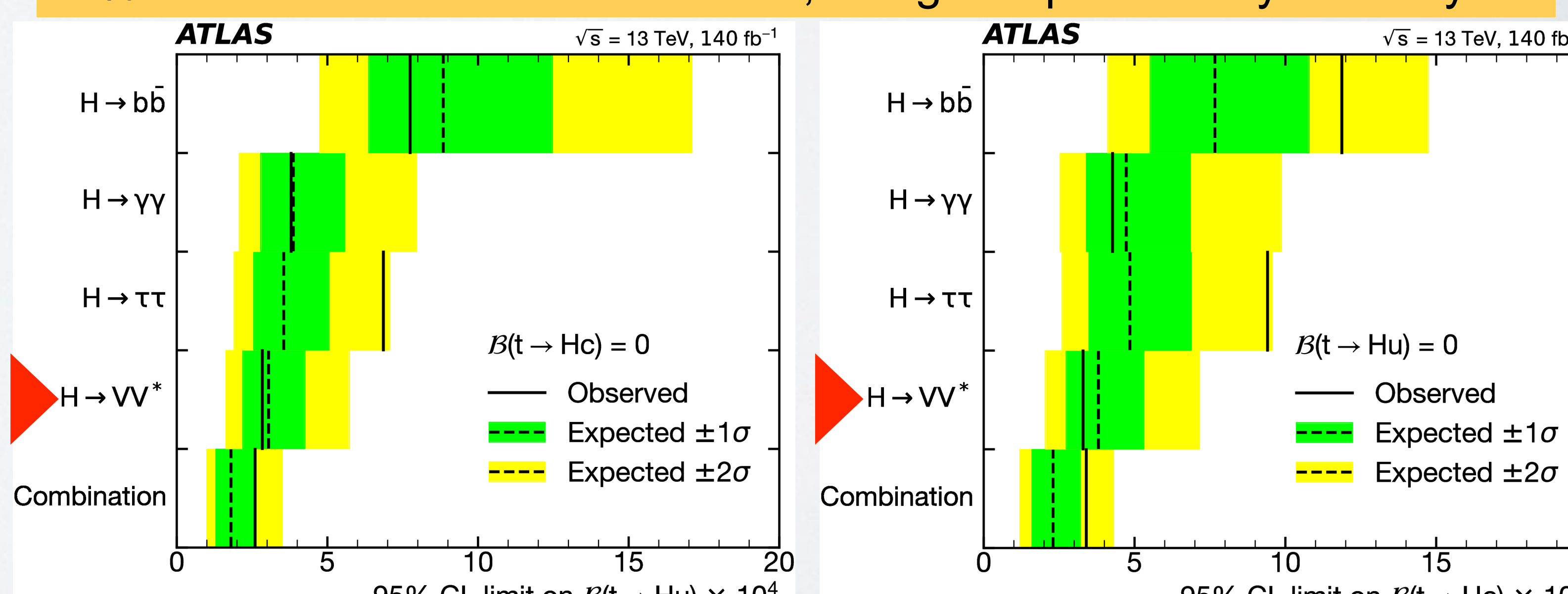
$$\mu_{tHq} = -0.03 \pm 0.15(-0.08 \pm 0.19).$$

CLs method limits derived. Systematics cause a 20% degradation of the limits

95% C.L. limits

Signal	Observed (expected) 95% CL upper limits $\mathcal{B}(t \to Hq)$	$\lvert C_{u\phi}^{qt,tq} \rvert$
tHu	$2.8\,(3.0) \times 10^{-4}$	0.71 (0.73)
tHc	$3.3\,(3.8) \times 10^{-4}$	0.76 (0.82)

95% C.L. combined limits to *u* and *c*, using complementary *H* decays



FCNC OF TOP MEDIATED BY HIGGS BOSON

- Search for Flavour Changing Neutral Current in *tHq* and $t\bar{t}$ with $t \rightarrow Hq$ ($q=u,c$)
- Considers Higgs to *WW*, *ZZ* or $\tau\tau$
- SM predictions for these FCNC are of order 10^{-15} to 10^{-17}

Submitted to PRD
arXiv:2407.15172 (2024)

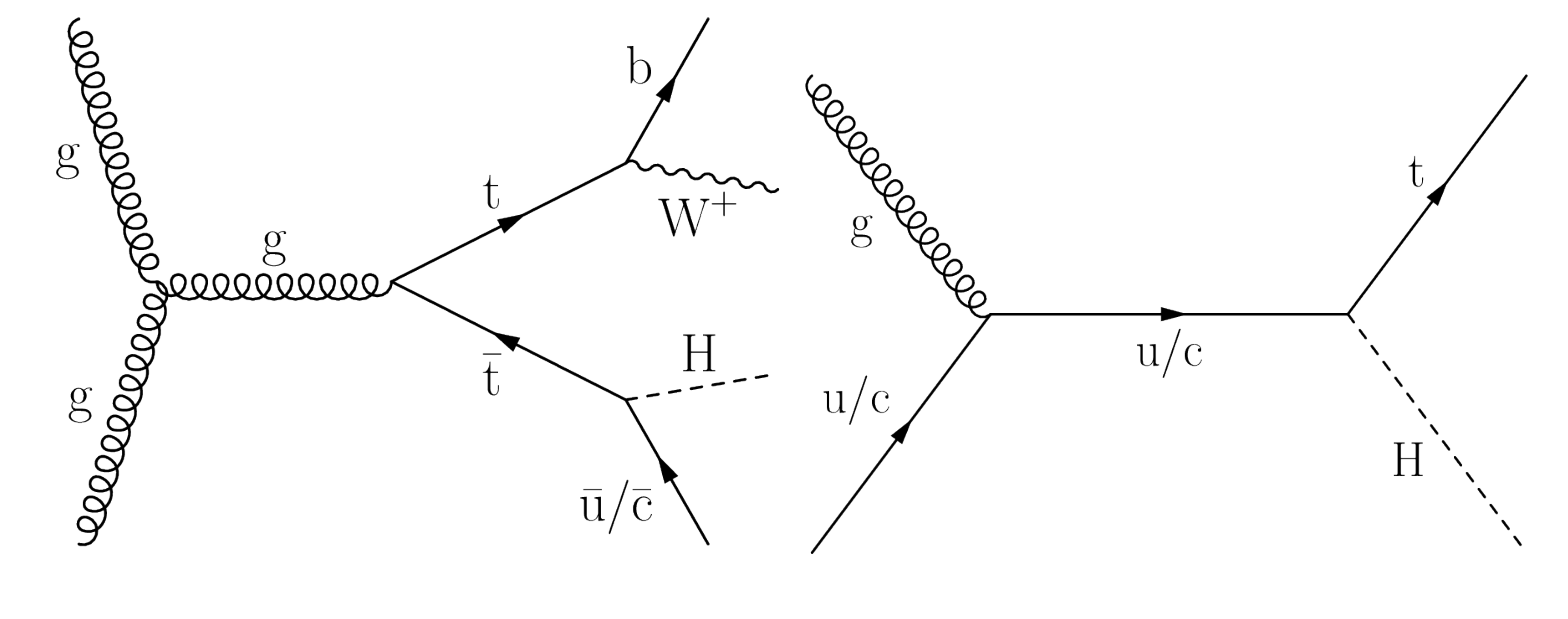
13 TeV, 138 fb^{-1}

Complements analyses with different final states or smaller datasets

Signature: ≥2 leptons (e/μ) Same Sign; ≥ 1jet (≥1 b-jet)

Method: Boosted Decision Tree event classification for signal and background, with 33 input features and output in BDT discriminator value. Then a binned likelihood fit.

Representative Feynman diagrams for the production modes considered: FCNC decay and FCNC-associated production



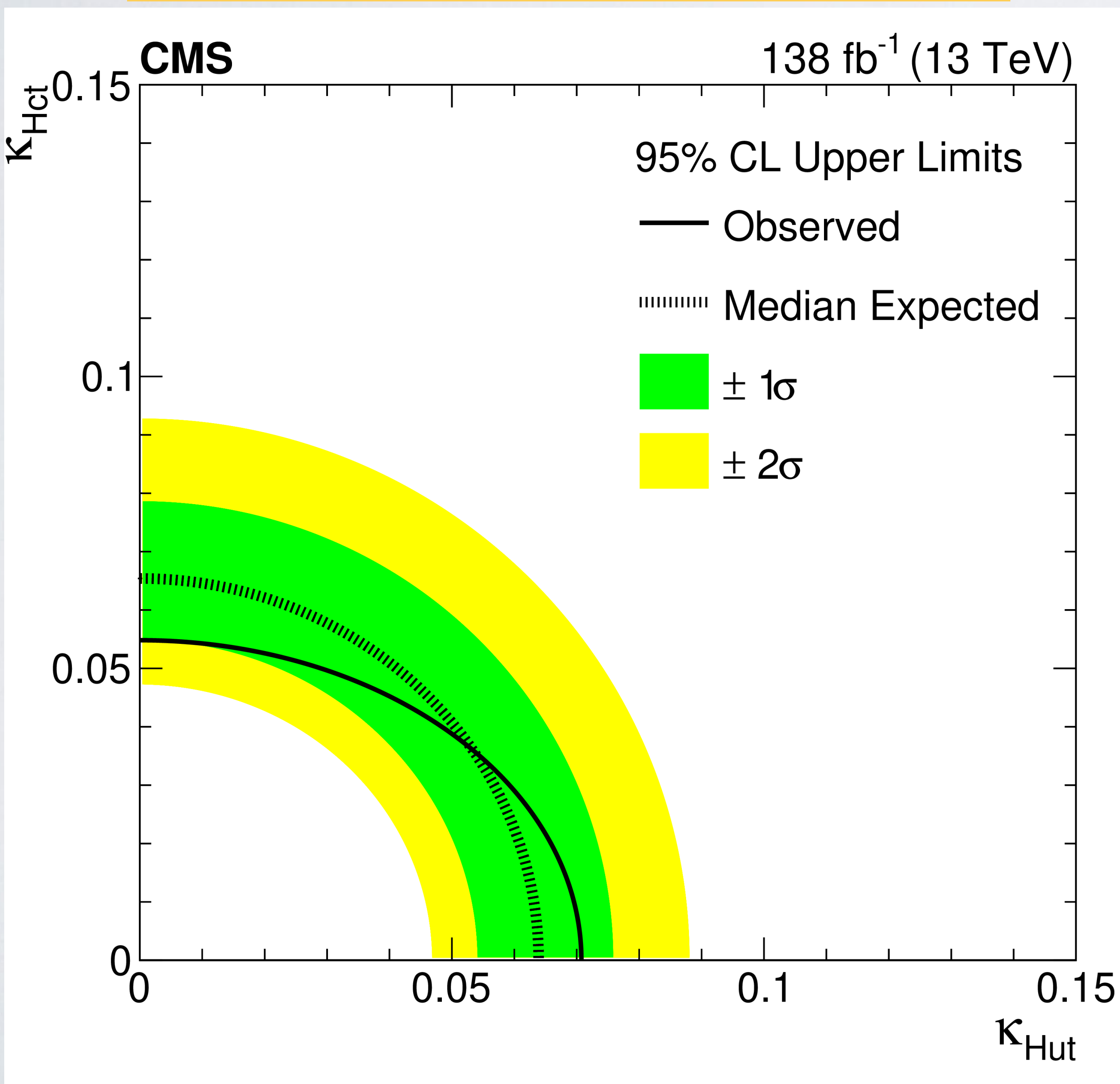
FCNC OF TOP MEDIATED BY HIGGS BOSON

Submitted to PRD
arXiv:2407.15172 (2024)

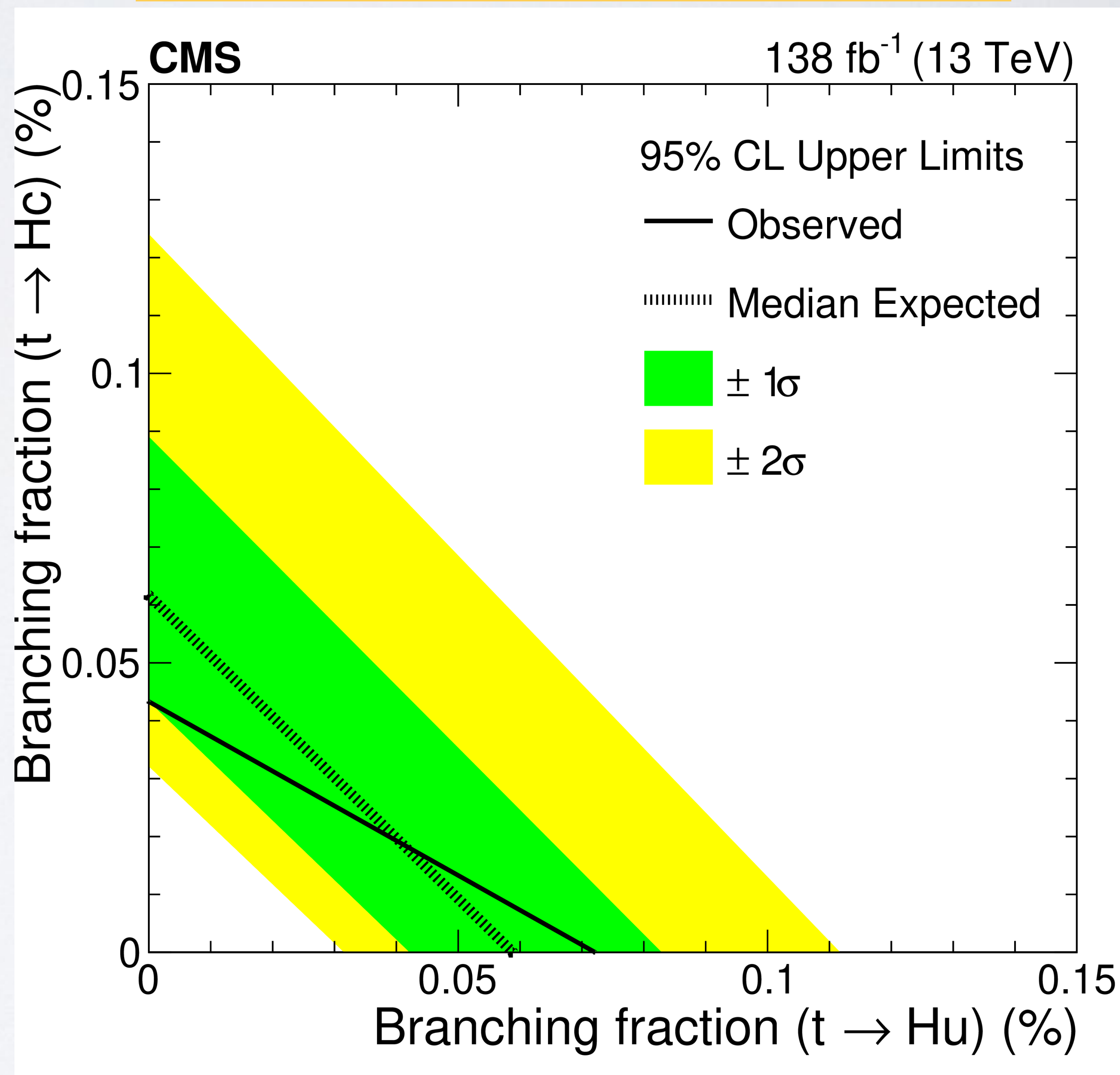
13 TeV, 138 fb^{-1}

- The largest uncertainties are statistical and from systematics of lepton charge-ID and non-prompt leptons

Measured limits on the coupling strength



Measured limits on the branching fraction



FCNC OF TOP MEDIATED BY HIGGS BOSON

Submitted to PRD
arXiv:2407.15172 (2024)

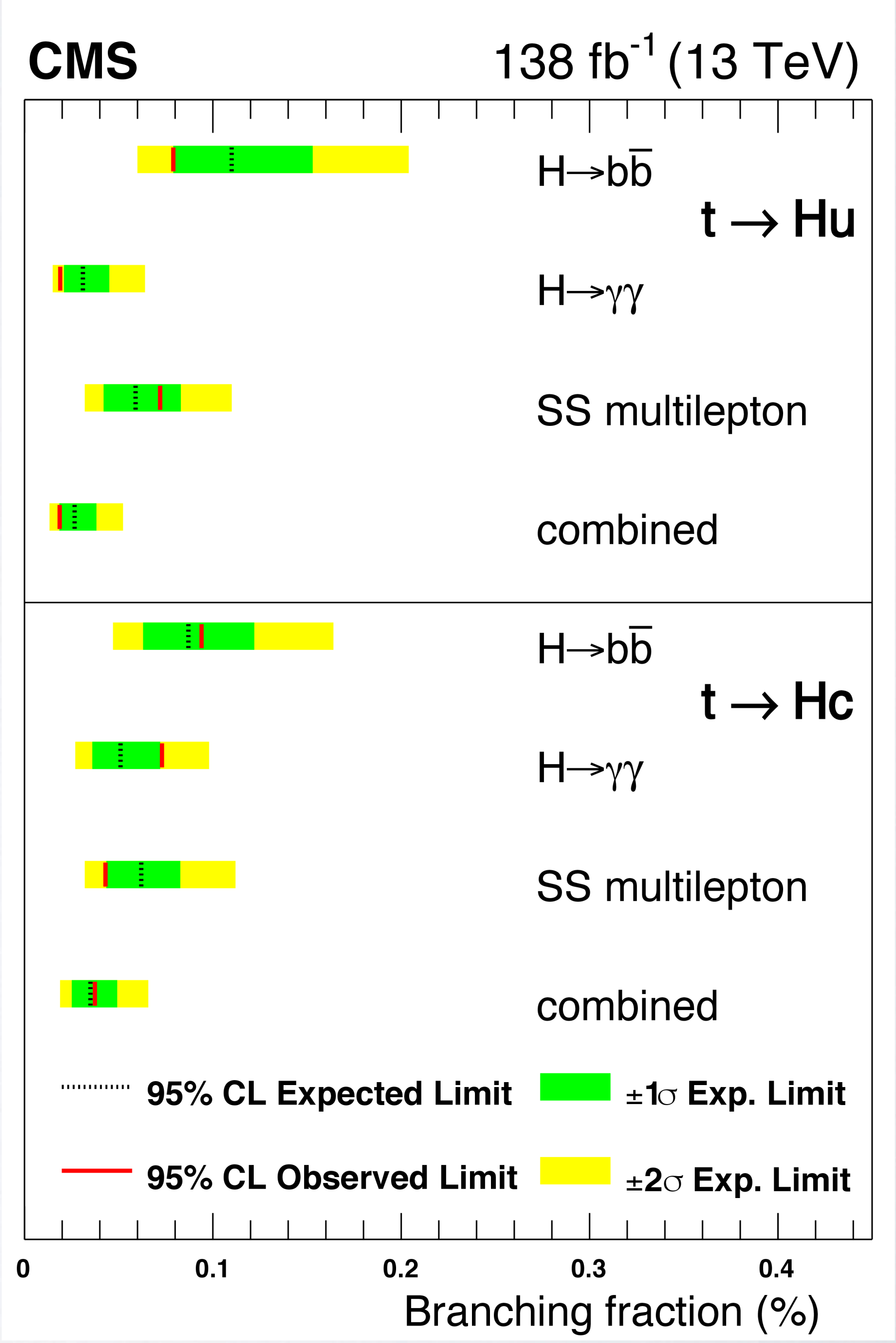
13 TeV, 138 fb^{-1}

- Combination with 2 earlier analyses with Higgs decaying to bottom quarks or photons

Observed and Expected limits, and Combination

Analysis	$\mathcal{B}(t \to Hu)$ observed (expected)	$\mathcal{B}(t \to Hc)$ observed (expected)
$H \to b\bar{b}$ [24]	0.079 (0.11)%	0.094 (0.086)%
$H \to \gamma\gamma$ [25]	0.019 (0.031)%	0.073 (0.051)%
Leptonic (this analysis)	0.072 (0.059)%	0.043 (0.062)%
Combination	0.019 (0.027)%	0.037 (0.035)%

Summary of observed and expected results

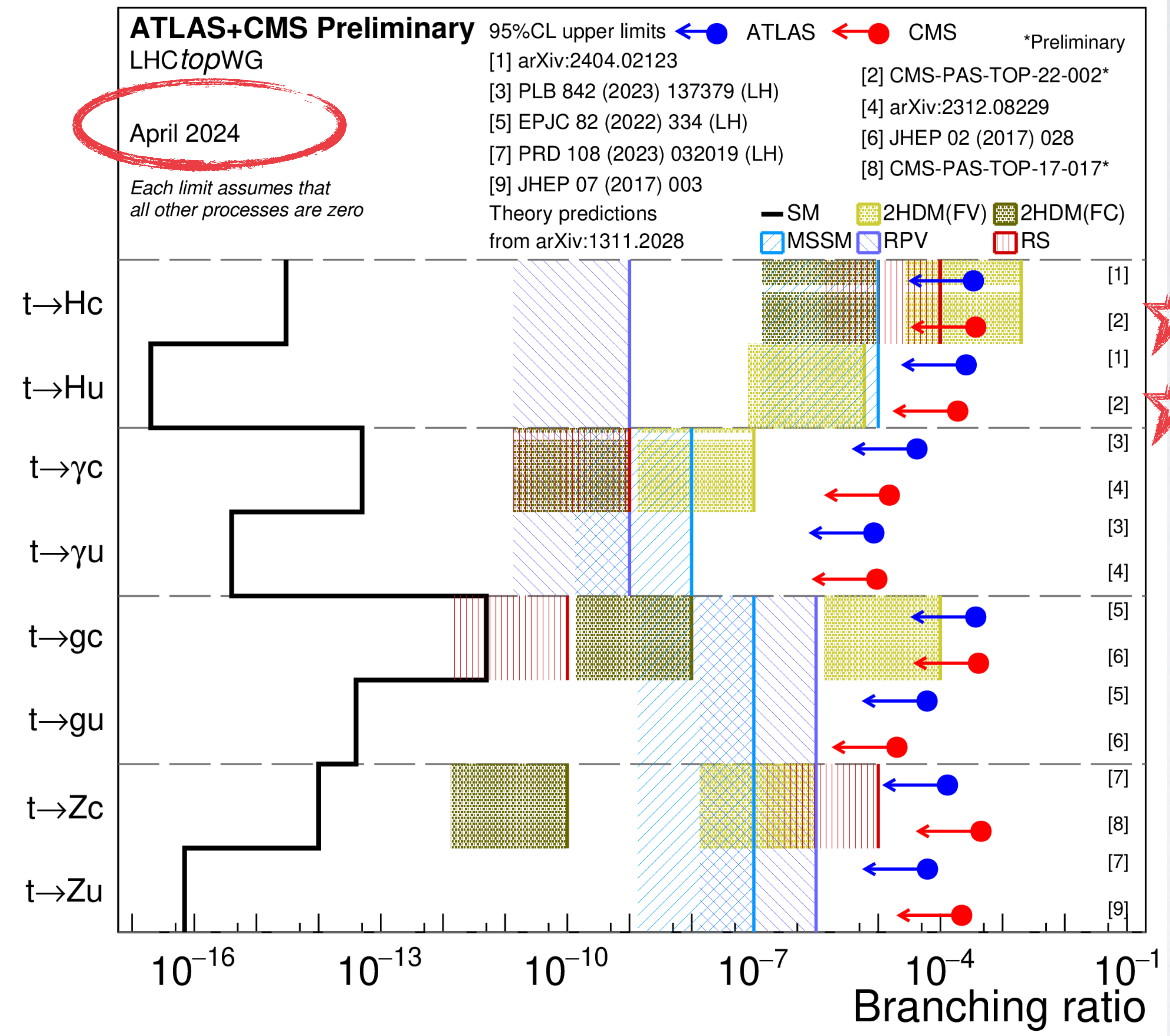


- No excess over the SM is observed

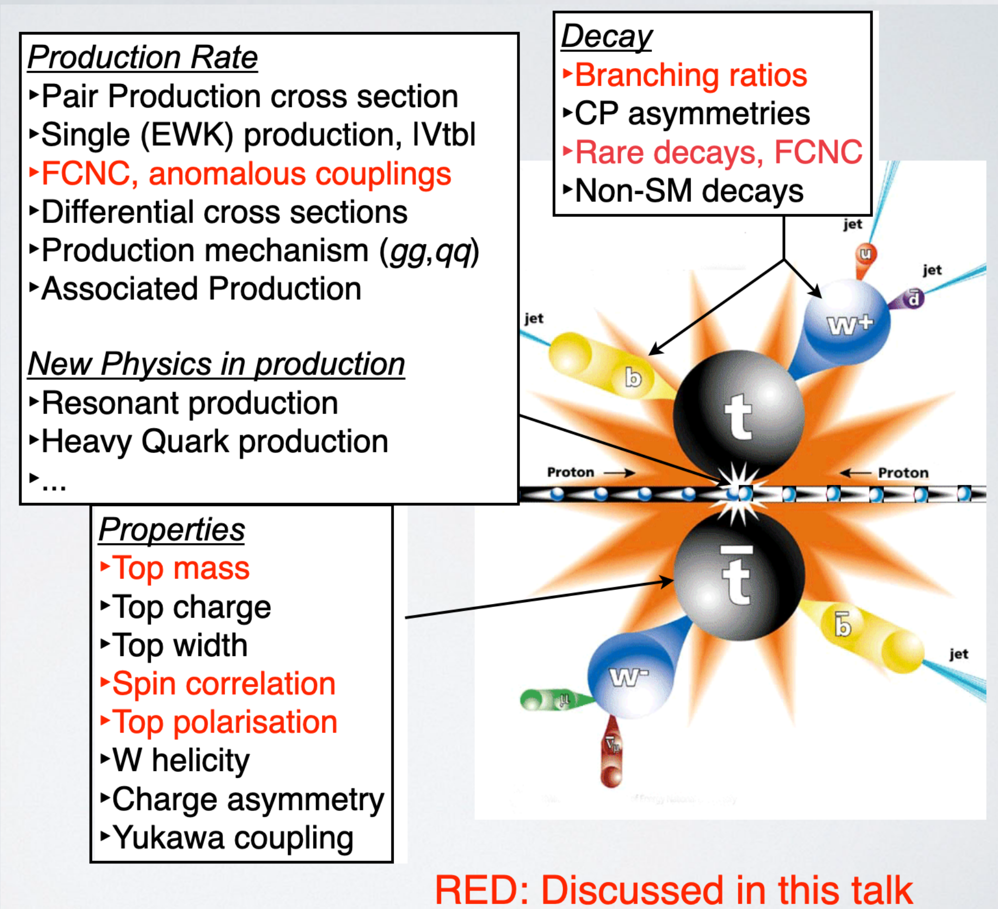
Summary of Other FCNC Measurements

Summary of the current 95% confidence level observed limits on the branching ratios of the top quark decays via flavour changing neutral currents (FCNC) to a quark and a neutral boson $t \to Xq$ ($X = g, Z, \gamma$ or H; q=u or c) **ATL-PHYS-PUB-2024-005**

: new, shown today



SUMMARY



- I presented 8 new measurements from last year
- All using full Run 2 datasets
- Chance to study rare top processes
- Spin correlation and polarisation tested in different kinematic regions of low- and high-m_{tt}
- New top mass measurement using boosted tops
- LFU improved in W decay to 0.44% (μ/e) and 2.3% (τ/e)
- FCNC Higgs-mediated improved to $O(10^{-4})$

Find out more at:

https://twiki.cern.ch/twiki/bin/view/AtlasPublic/TopPublicResults

http://cms-results.web.cern.ch/cms-results/public-results/publications/TOP/index.html
http://cms-results.web.cern.ch/cms-results/public-results/preliminary-results/TOP/index.html