

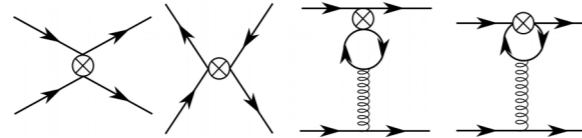
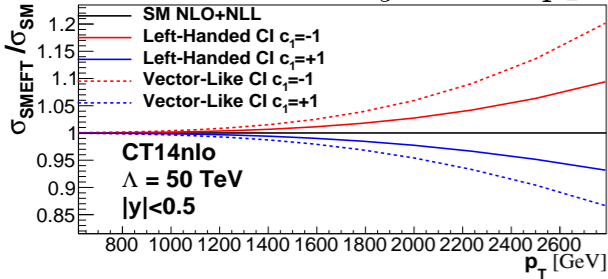
Inclusive jets as probe of BSM

The most fundamental process for studying QCD: possible to improve precision of proton structure and extract QCD parameters

Probe new physics: 4-quark Contact interactions (CI)
extend the SM with effective operators allowing 4-quark vertices

$$\mathcal{L}_{\text{SMEFT}} = \mathcal{L}_{\text{SM}} + \frac{4\pi}{2\Lambda^2} \sum_n c_n O_n$$

If there, the CI are expected to appear as deviations from the SM spectrum in jet cross-sections at low- γ and high- p_T

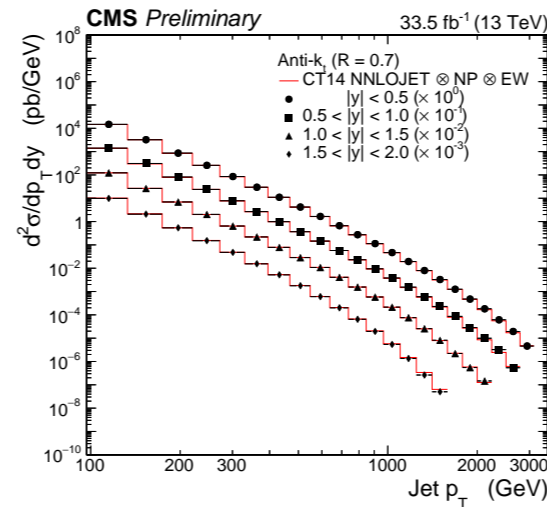


CIJET: CI @ NLO
Operators relevant for quark substructure, Z' or extra dimension models

Type of CI	c_1	c_3	c_5
Purely left-handed:	free	0	0
Vector-like:	free	$2c_1$	c_1
Axial-vector-like:	free	$-2c_1$	c_1

CMS Data in QCD analysis

CMS 13 TeV inclusive jet cross section



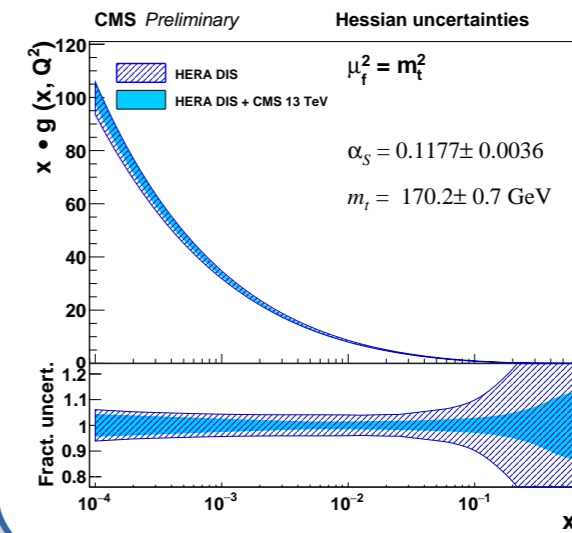
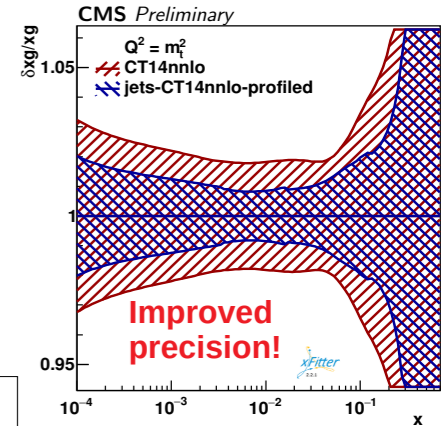
CMS 13 TeV triple-differential $t\bar{t}$ cross-section [Eur. Phys. J. C 80 (2020), no. 7, 658]

HERA inclusive Deep Inelastic Scattering in $e^\pm p$ (Neutral and Charged Current cross-sections) [Eur. Phys. J. C 75 (2015), no. 12, 580]

QCD analysis platform <https://www.xfitter.org/xFitter>

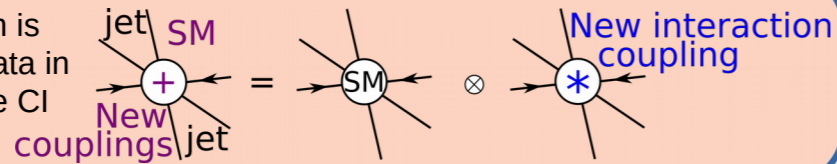
Impact on PDFs

- Impact in a global PDF assessed through a **profiling** procedure
- Profiling performed with CT14 at NLO and NNLO



- Combined fit of PDF, α_S and m_t based on HERA DIS data
- Improved precision and removed correlations when including CMS data

The problem: The SM prediction is based on PDFs obtained from data in the same kinematic region where CI are searched



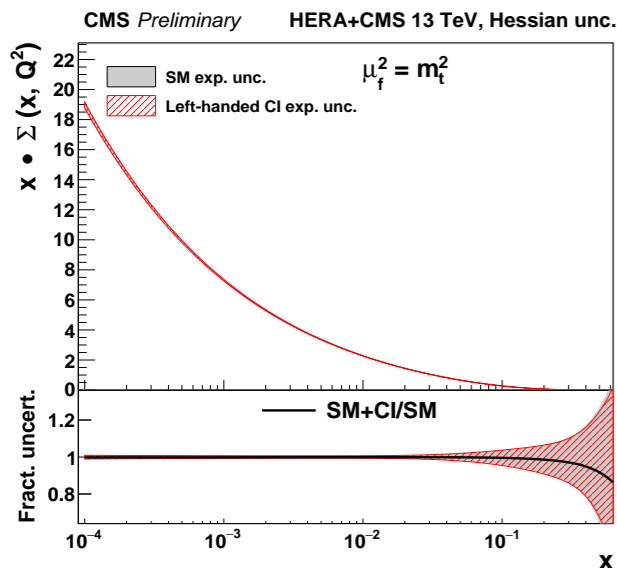
SMEFT analysis strategy for a non-biased search

Fit the CI Wilson coefficient c_1 , PDFs, strong coupling α_S and top mass m_t simultaneously

Use SM or, alternatively, SM+CI theory predictions. Results:

$$\alpha_S = 0.1187 \pm 0.0016(\text{fit}) \pm 0.0030(\text{model \& par})$$

$$m_t^{\text{pole}} = 170.4 \pm 0.6(\text{fit}) \pm 0.3(\text{model \& par}) \text{ GeV}$$

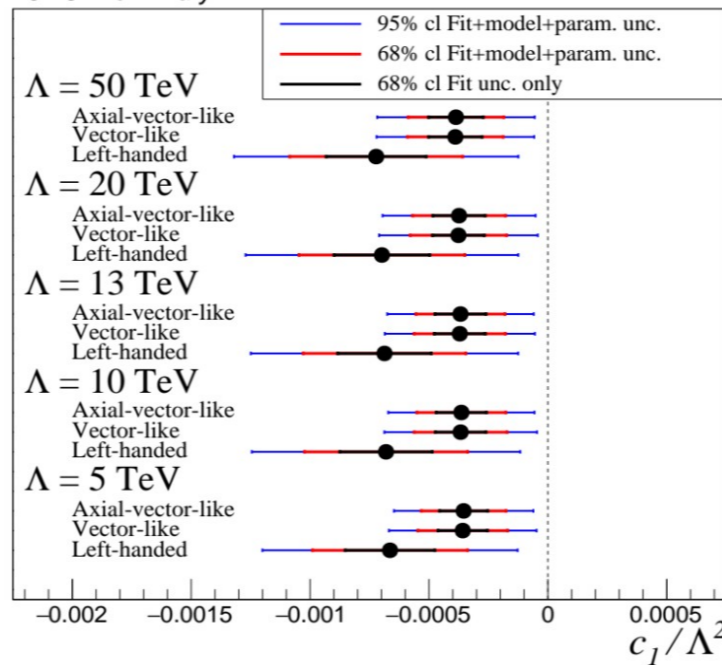


The SM and SMEFT fits result in similar PDFs: differences within fit uncertainties

No risk of absorbing BSM effects in the PDF fit

The SMEFT fits are sensitive to the ratio c_1/Λ^2 . The fits favor a constructive interference with the SM gluon exchange, but no significant deviation from the SM is observed

CMS Preliminary



Interpretation as exclusion limits

- Limit for CI obtained for the first time via a SMEFT fit
- Conventional studies scan for Λ , fixing Wilson coefficient to ± 1

$\Lambda = 50 \text{ TeV}$	c_1	Tot. unc.	95% CL on Λ with $c_1 = -1$	
Left-handed	-1.8	± 0.9		24 TeV
Vector-like	-1.0	± 0.5		32 TeV
Axial-vector-like	-1.0	± 0.6		31 TeV

Most stringent comparable result from ATLAS 13 TeV dijet cross-sections: 22 TeV for left-handed CI (constructive interference) [arXiv:1703.09127]

Novelty of this analysis

CI limits obtained in an unbiased way for the first time using CMS inclusive jet cross-section data