



# Mapping Processes with Operators in the SMEFT

Juan Rojo

VU Amsterdam & Theory group, Nikhef

on behalf of the Area 3 subgroup: *Experimental Measurements and Observables* 

summary of contributions from FitMaker and SMEFiT groups

3rd General Meeting of the LHC Effective Field
Theory Working Group

#### our goal

To establish the **correspondence** between **processes** and **directions in the SMEFT parameter space** (``operators'') via the measurement of **specific observables** 

a general LHC cross-section in the SMEFT is written as:

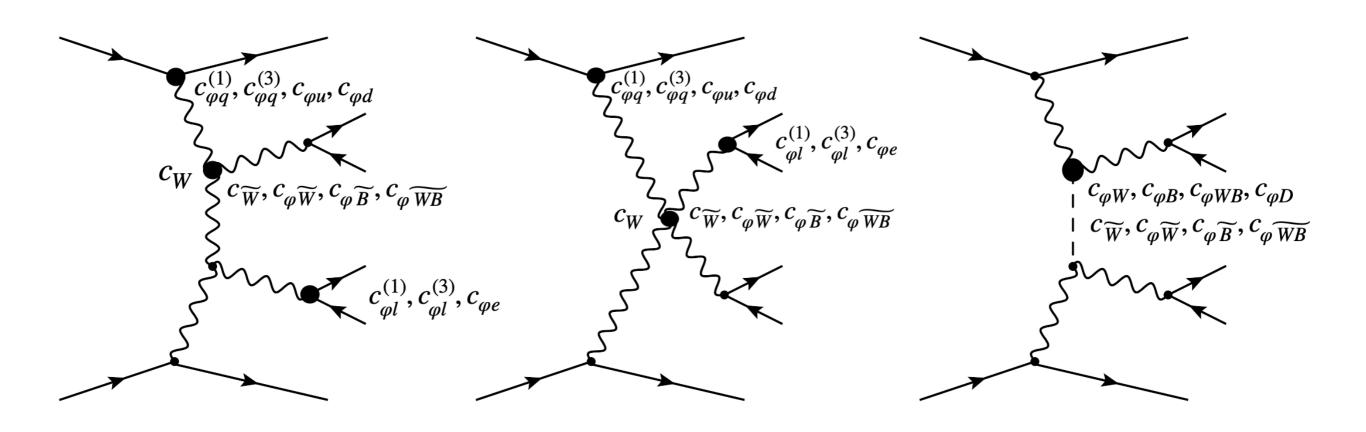
$$\sigma_{
m LHC}\left(c/\Lambda^2\right) \simeq \sigma_{
m SM} imes \left(1 + \sum_{m=1}^{N_6} c_m \frac{\kappa_m}{\Lambda^2} + \sum_{m,n=1}^{N_6} c_m c_n \frac{\kappa_{mn}}{\Lambda^4}\right)$$
**EFT coefficients**

where the sum runs over all SMEFT operators contributing to this process

- Given a physical process (*e.g.* Higgs production in gluon fusion), **which SMEFT operators** enter the theory predictions?
- Can we quantify the relative importance of each of those operators?
- Mow to assess the information that a given measurement brings in the EFT parameter space?

#### for example

Consider the vector boson scattering (VBS) process



CP properties	Operator	Coefficient	Definition
	$\mathcal{O}_W$	$c_W$	$\epsilon^{IJK}W_{\mu}^{I u}W_{ u}^{J ho}W_{ ho}^{K\mu}$
	$\mathcal{O}_{arphi W}$	$c_{arphi W}$	$(arphi^{\dagger}arphi-rac{v^2}{2})W^I_{\mu u}W^{I\mu u}$
CP-even	$\mathcal{O}_{arphi B}$	$c_{arphi B}$	$(arphi^\dagger arphi - rac{v^2}{2}) B_{\mu u} B^{\mu u}$
	$\mathcal{O}_{arphi WB}$	$c_{arphi WB}$	$\left( arphi^\dagger \sigma_I arphi  ight) W^I_{\mu  u} B^{\mu  u}$
	$\mathcal{O}_{arphi D}$	$c_{arphi D}$	$(\varphi^{\dagger}D^{\mu}\varphi)^{*}(\varphi^{\dagger}D_{\mu}\varphi)$

Inspection of **Feynman diagrams** reveals how SMEFT operators enter the VBS process...

however quantifying the **relative importance** of the various
operators is much more subtle

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#### why this is not easy

The mapping between processes and operators depends sensitively on the settings of the theory calculation, e.g. linear vs quadratic EFT

$$\sigma_{\rm LHC}\left(c/\Lambda^2\right) \simeq \sigma_{\rm SM} \times \left(1 + \sum_{m=1}^{N_6} c_m \frac{\kappa_m}{\Lambda^2}\right) \qquad \sigma_{\rm LHC}\left(c/\Lambda^2\right) \simeq \sigma_{\rm SM} \times \left(1 + \sum_{m=1}^{N_6} c_m \frac{\kappa_m}{\Lambda^2} + \sum_{m,n=1}^{N_6} c_m c_n \frac{\kappa_{mn}}{\Lambda^4}\right)$$

MET But also in the perturbative order of the EFT calculation: LO QCD vs NLO QCD

$$\sigma_{\text{LHC}}\left(c/\Lambda^{2}\right) \simeq \sigma_{\text{SM}} \times \left(1 + \sum_{m=1}^{N_{6}} c_{m} \frac{\kappa_{m}^{\text{LO}}}{\Lambda^{2}}\right) \qquad \sigma_{\text{LHC}}\left(c/\Lambda^{2}\right) \simeq \sigma_{\text{SM}} \times \left(1 + \sum_{m=1}^{N_{6}} c_{m} \frac{\kappa_{m}^{\text{NLO}}}{\Lambda^{2}}\right)$$

- Furthermore, each **bin** (or choice of selection cuts) has associated a different combination of EFT operators: cannot discuss "**processes**" without the corresponding "**observables**"
- Meedless to say, the mapping depends on the operator basis, flavour assumptions, ....

# Information geometry

One useful estimator to quantify the **relative amount of information** that is provided by a given measurement on a given EFT coefficient is provided by the **Fisher information matrix** 

$$I_{ij}(\boldsymbol{c}) = -\mathrm{E}\left[rac{\partial^2 \ln f(oldsymbol{\sigma}_{\mathrm{exp}}|oldsymbol{c})}{\partial c_i \partial c_j}
ight], \qquad i,j = 1, \dots, n_{\mathrm{op}}\,,$$

for gaussian, uncorrelated measurements:

$$f(oldsymbol{\sigma}_{ ext{exp}})|oldsymbol{c}) = \prod_{m=1}^{n_{ ext{dat}}} rac{1}{\sqrt{2\pi\delta_{ ext{exp},m}^2}} \exp\left(-rac{\left(\sigma_m^{ ext{(exp)}} - \sigma_m^{ ext{(th)}}(oldsymbol{c})
ight)^2}{2\delta_{ ext{exp},m}^2}
ight)$$

linear

$$I_{ij} = \sum_{m=1}^{n_{ ext{dat}}} rac{\sigma_{m,i}^{( ext{eft})} \sigma_{m,j}^{( ext{eft})}}{\delta_{ ext{exp},m}^2}$$

n.b. operator normalisation is arbitrary, thus **absolute**values of Fisher unphysical. Normalise to the sum over

a given operator: relative Fisher is physical

quadratic

$$I_{ij} = \mathbf{E} \left[ \sum_{m=1}^{n_{\text{dat}}} \frac{1}{\delta_{\text{exp},m}^2} \left( \sigma_{m,ij}^{(\text{th})} \left( \sigma_{m}^{(\text{th})} - \sigma_{m}^{(\text{exp})} \right) + \left( \sigma_{m,i}^{(\text{eft})} + \sum_{l=1}^{n_{\text{op}}} c_l \sigma_{m,il}^{(\text{eft})} \right) \left( \sigma_{m,j}^{(\text{eft})} + \sum_{l'=1}^{n_{\text{op}}} c_{l'} \sigma_{m,jl'} \right) \right) \right]$$

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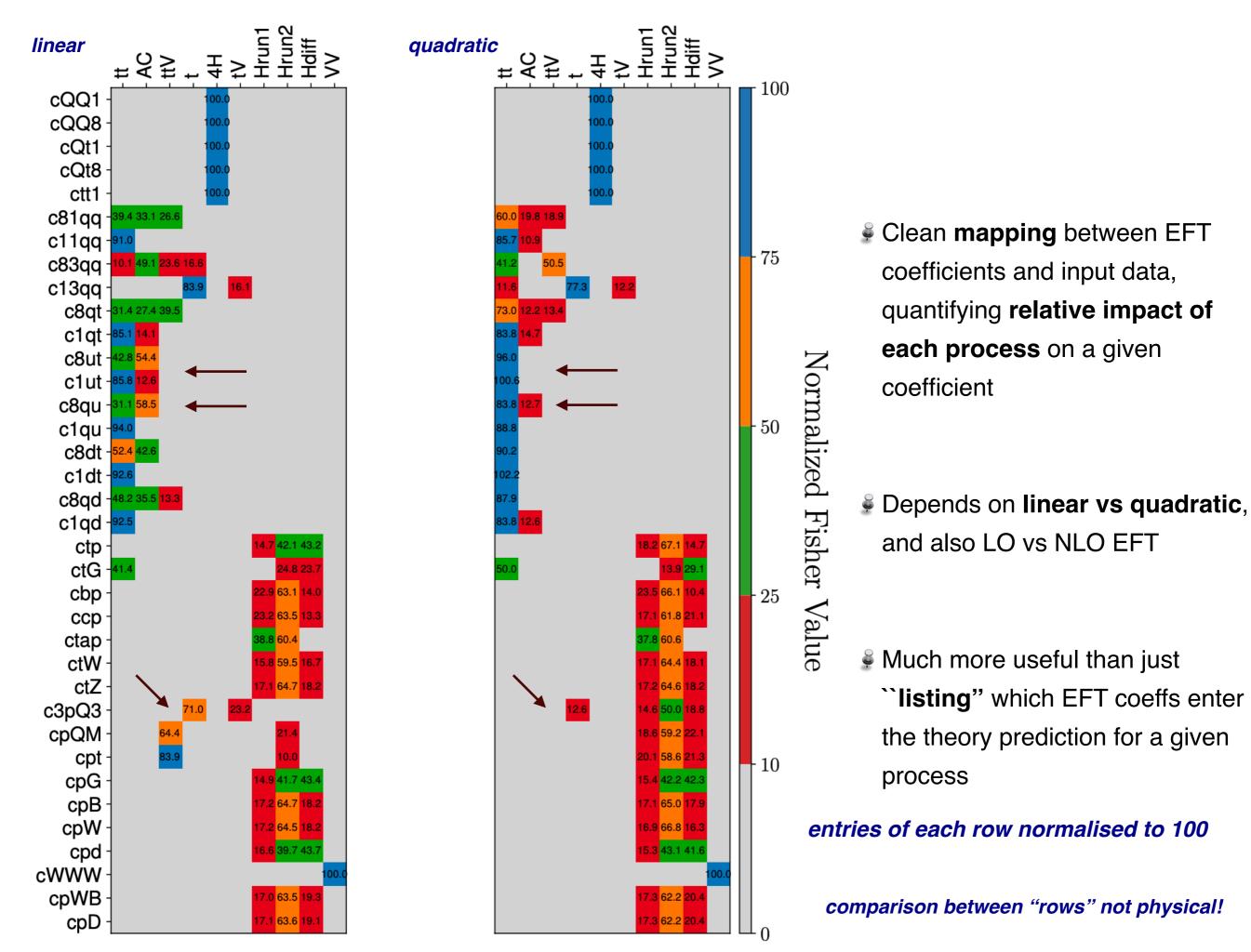
$$I_{ij} = \sum_{m=1}^{n_{
m dat}} rac{\sigma_{m,i}^{
m (eft)} \sigma_{m,j}^{
m (eft)}}{\delta_{
m exp}^2}$$

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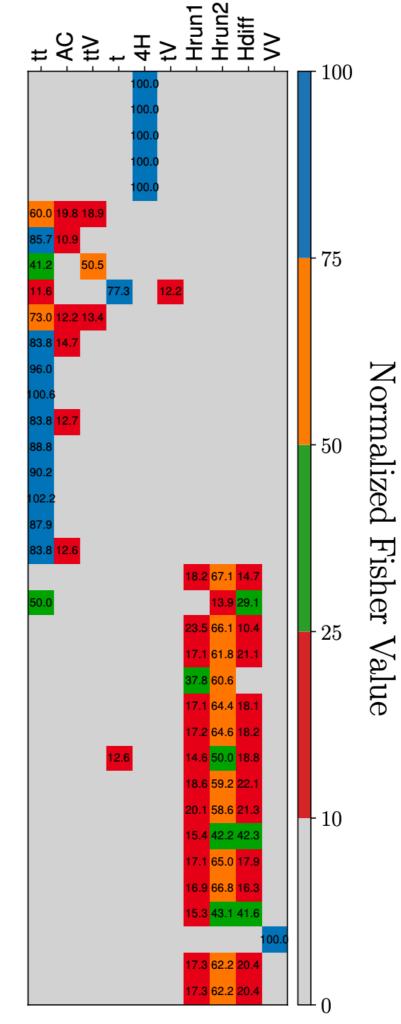
a given operator: relative Fisher is physical

$$\mathcal{L}_{\text{SMEFT}} = \mathcal{L}_{\text{SM}} + \sum_{k=1}^{n_{\text{op}}} \frac{c_k}{\Lambda^2} \mathcal{O}_k = \mathcal{L}_{\text{SM}} + \sum_{k=1}^{n_{\text{op}}} \frac{\widetilde{c_k}}{\Lambda^2} \widetilde{\mathcal{O}}_k$$

$$\widetilde{\mathcal{O}}_k = A_k \mathcal{O}_k, \quad \widetilde{c}_k = A_k^{-1} c_k$$



Class	DoF	$  t \bar{t}$	$t\bar{t}V$	t	tV	$tar{t}Qar{Q}$	$\begin{array}{ c c c c } h \ (\mu_i^f, \\ \text{Run-I}) \end{array}$		h (STXS, Run-II)	VV
2-heavy- 2-light	$ \begin{vmatrix} c_{Qq}^{1,8} \\ c_{Qq}^{1,1} \\ c_{Qq}^{1,1} \\ c_{Qq}^{1,1} \\ c_{Qq}^{2,3,8} \\ c_{Qq}^{3,1} \\ c_{Qq}^{2,3,1} \\ c_{tq}^{1} \\ c_{tq}^{1} \\ c_{tq}^{1} \\ c_{tu}^{1} \\ c_{tu}^{1} \\ c_{Qu}^{1} \\ c_{td}^{1} \\ c_{td}^{1} \\ c_{Qd}^{1} \\ c_{Qd}^{$	(v) (v) (v) (v) (v) (v) (v) (v)	(x)	(V) V	( \(  \)	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	(V) (V) (V) (V) (V) (V) (V) (V)	(v)	\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csigma}\)\(\frac{\csigma}{\csi	
4-heavy	$ \begin{vmatrix} c_{QQ}^1 \\ c_{QQ}^8 \\ c_{QQ}^1 \\ c_{Qt}^1 \\ c_{Qt}^8 \\ c_{tt}^1 \end{vmatrix} $					\frac{}{}				
4-lepton	$\mid c_{ll} \mid$			✓	✓		✓	✓	✓	✓
2-fermion +bosonic	$egin{array}{c} c_{t arphi} & c_{$	✓	✓ ✓ (b) ✓ ✓ ✓ ✓ ✓	✓			(b)  (b)  (c)  (v)  (v)  (v)  (v)  (v)  (v)  (v	(b)  (b)  (v)  (v)  (v)  (v)  (v)  (v)	✓ ✓ ✓ (b) ✓ (b) ✓ (c)	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓
purely bosonic	$egin{array}{ccc} c_{arphi G} & & & & \\ c_{arphi B} & & & & \\ c_{arphi W} & & & & \\ c_{arphi d} & & & & \\ c_{arphi D} & & & & \\ c_{arphi WW} & & & & \\ \end{array}$		<b>√</b> ✓	✓ ✓	✓ ✓		\( \lambda \)	\( \lambda \)	√ √ √ √ √ √ √	√ √ √



# Information geometry

At a finer level, compare information provided by **different datasets for the same processes**, or different bins within a given dataset, here inclusive top-quark pair in SMEFiT

		ATLAS_tt_8TeV_ljets_Mtt	ATLAS_tt_8TeV_dilep_Mtt	CMS_tt_8TeV_ljets_Yt	tt CMS_tt2D_8TeV_dilep_MttY	tt		ATLAS_CMS_tt_AC_8Te	V ATLAS_tt_AC_13
	OQQ1	×(×)	×(×)	×(×)	×(×)	_   _	OQQ1	×(×)	X(X)
	OQQ8	×(×)	×(×)	X(X)	×(×)	$\dashv$ $\vdash$	OQQ8	X(X)	×(×)
4H	OQt1	X(X)	×(×)	X(X)	X(X)	4H	OQt1	×(x)	×(x)
	OQt8	X(X)	×(×)	X(X)	X(X)	-	OQt8	×(×)	×(x)
	Ott1	$\hat{\mathbf{x}}(\hat{\mathbf{x}})$	$\hat{\mathbf{x}}(\hat{\mathbf{x}})$	X(X)	X(X)	$\dashv$ $\vdash$	Ott1	×(×)	×(×)
	O81qq	0.99(0.10)	0.91(0.93)	3.94(5.00)	2.91(0.46)	$\dashv$	O81qq	3.66(1.78)	29.42(18.18)
	O11qq	2.61(-2.01)	2.83(1.15)	2.08(7.52)	7.72(-5.87)	$\rightarrow$ 1	Ollqq	1.06(-2.29)	6.57(14.86)
	O83qq	0.57(-0.79)	0.55(0.50)	2.64(3.71)	1.82(-2.42)	-	O83qq	5.42(-0.69)	43.64(5.09)
	O13qq	0.00(-0.28)	0.00(0.17)	0.00(1.06)	0.00(-0.87)	-	O13qq	0.00(-0.40)	0.00(-0.72)
					3.92(0.34)	<b>→</b> I			
	O8qt	0.97(0.01)	1.18(0.83)	6.10(4.36)		<b>→</b> I	O8qt	3.61(2.05)	23.81(10.31)
	O1qt	3.93(-1.78)	3.27(1.07)	2.27(7.19)	2.81(-5.91)	<b>—</b>	O1qt	1.67(2.99)	12.47(11.22)
2L2H	O8ut	1.32(-0.02)	1.26(0.76)	4.81(1.12)	3.46(-0.17)	2L2F	O8ut	5.78(0.30)	48.66(3.34)
	O1ut	1.99(-2.38)	2.54(1.59)	3.48(9.30)	4.28(-6.88)		Olut	1.92(-3.34)	10.71(-1.55)
	O8qu	1.74(-0.31)	1.89(2.19)	10.61(4.38)	6.91(-0.29)		O8qu	7.16(2.07)	51.37(10.53)
	O1qu	1.26(-1.00)	1.21(0.49)	2.12(3.83)	3.43(-2.91)		O1qu	0.92(1.65)	4.76(6.90)
	O8dt	1.72(-0.54)	1.77(15.63)	7.79(6.35)	5.87(-2.21)		O8dt	4.62(-0.36)	38.02(7.16)
	O1dt	1.78(-1.66)	1.58(1.36)	5.83(6.20)	5.98(-5.80)		O1dt	0.73(-2.09)	5.79(-2.69)
	O8qd	2.68(3.54)	3.06(2.98)	13.19(4.50)	8.83(-1.15)		O8qd	4.44(1.59)	31.05(6.77)
	O1qd	1.45(-1.84)	1.64(1.14)	3.55(6.90)	6.78(-6.56)	$\neg$	O1qd	1.09(2.65)	5.95(9.48)
	Otp	X(X)	×(×)	×(×)	×(×)	$\dashv \vdash \vdash$	Otp	X(X)	X(X)
	OtG	1.00(1.14)	3.02(3.60)	17.98(21.66)	10.35(11.74)	<b>─</b>	OtG	0.00(-0.00)	0.00(0.00)
	Obp	×(×)	×(×)	×(×)	×(x)	-			
	Оср					<b>─</b>	Obp	X(X)	x(x)
		×(x)	×(×)	×(×)	×(x)	<b>→</b> 1	Оср	X(X)	x(x)
PFB	Otap	×(x)	×(×)	X(X)	×(x)	2FB	Otap	X(X)	×(x)
	OtW	X(X)	×(×)	×(×)	×(x)	— I	OtW	×(×)	×(×)
	OtZ	×(×)	×(×)	×(×)	×(x)	<b>→</b> 1	OtZ	×(×)	×(×)
	O3pQ3	×(×)	×(×)	×(×)	×(×)		O3pQ3	x(x)	×(×)
	OpQM	×(×)	×(×)	×(×)	×(×)		OpQM	×(×)	×(×)
	Opt	×(×)	×(×)	×(×)	×(×)		Opt	X(X)	×(×)
	OpG	×(×)	×(×)	×(×)	×(×)	$\neg$	OpG	×(×)	×(×)
	OpB	×(×)	×(×)	×(×)	×(×)	$\dashv$ $\vdash$	OpB	×(×)	×(x)
	OpW	X(X)	×(×)	×(×)	×(×)	$\dashv$ $\vdash$	OpW	x(x)	×(x)
В	Opd	X(X)	×(×)	×(×)	×(×)	—   в	Opd		
-	owww	×(×)	×(×)	$\hat{\mathbf{x}}(\hat{\mathbf{x}})$	×(×)	—   В	OWWW	×(×)	×(×)
	OpWB	×(×)	×(×)	×(×)	×(×)	<b>─</b>		×(×)	×(×)
	OpD					1 1	OpWB	×(×)	×(×)
	0,2	X(X)	×(×)	X(X)	x(x)		О́рD	×(×)	×(x)
		CMS_tt_13TeV_ljets_20	015_Mtt   CMS_tt_13Te	eV_dilep_2015_Mtt	CMS_tt_13TeV_ljets_2016_Mtt	CMS_t	t_13TeV_dile		.tt_13TeV_ljets_2016_N
	OQQ1	CMS_tt_13TeV_ljets_20 ×(×)	015_Mtt CMS_tt_13Te	eV_dilep_2015_Mtt ×(×)	CMS_tt_13TeV_ljets_2016_Mtt ×(×)	CMS_t	t_13TeV_dile		tt_13TeV_ljets_2016_N ×(×)
4H	OQQ1 OQQ8	CMS_tt_13TeV_ljets_20	D15_Mtt CMS_tt_13Te	eV_dilep_2015_Mtt ×(×) ×(×)	CMS_tt_13TeV_ljets_2016_Mtt	CMS_t	t_13TeV_dile		tt_13TeV_ljets_2016_N ×(×) ×(×)
4H	OQQ1 OQQ8 OQt1	CMS_tt_13TeV_ljets_20	D15_Mtt CMS_tt_13Te	eV_dilep_2015_Mtt  ×(×)  ×(×)  ×(×)	CMS_tt_13TeV_ljets_2016_Mtt	CMS_t	t_13TeV_dile		tt_13TeV_ljets_2016_1 ×(×) ×(×) ×(×) ×(×)
4H	OQQ1 OQQ8 OQt1 OQt8	CMS_tt_13TeV_ljets_20	D15_Mtt CMS_tt_13Te	eV_dilep_2015_Mtt  ×(×)  ×(×)  ×(×)  ×(×)	CMS_tt_13TeV_ljets_2016_Mtt	CMS_t	t_13TeV_dile		tt_13TeV_ljets_2016_! ×(×) ×(×) ×(×) ×(×) ×(×)
4H	OQQ1 OQQ8 OQt1 OQt8 Ott1	CMS_tt_13TeV_ljets_2(	015_Mtt CMS_tt_13Te	eV_dilep_2015_Mtt  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)	CMS_tt_13TeV_ljets_2016_Mtt	CMS_t	t_13TeV_dile ×(×) ×(×) ×(×) ×(×) ×(×)	p_2016_Mtt ATLAS.	tt_13TeV_ljets_2016_1
4H	OQQ1 OQQ8 OQt1 OQt8 Ott1 O81qq	CMS_tt_13TeV_ljets_20	015_Mtt	eV_dilep_2015_Mtt  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)	CMS_tt_13TeV_ljets_2016_Mtt	CMS_t	t_13TeV_dile	p_2016_Mtt ATLAS.	tt_13TeV_ljets_2016_! ×(×) ×(×) ×(×) ×(×) ×(×)
4H	OQQ1 OQQ8 OQt1 OQt8 Ott1 O81qq	CMS_tt_13TeV_ljets_2(	015_Mtt	eV_dilep_2015_Mtt  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)	CMS_tt_13TeV_ljets_2016_Mtt	CMS_t	t_13TeV_dile ×(×) ×(×) ×(×) ×(×) ×(×)	p_2016_Mtt ATLAS.	tt_13TeV_ljets_2016_l
4H	OQQ1 OQQ8 OQt1 OQt8 Ott1 O81qq O11qq	CMS_tt_13TeV_ljets_20	0.3 0.7	eV_dilep_2015_Mtt  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  3(1.06)  9(2.93)	CMS_tt_13TeV_ljets_2016_Mtt	CMS_t	t_13TeV_dile	p_2016_Mtt ATLAS.	x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) 7.52(2.90) 12.87(-2.19)
4H	OQQ1 OQQ8 OQt1 OQt8 Ott1 O81qq O11qq O83qq	CMS_tt_13TeV_ljets_20	015_Mtt	eV_dilep_2015_Mtt  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  9(2.93)  3(1.37)	CMS_tt_13TeV_ljets_2016_Mtt	CMS_t	t_13TeV_dilej	p_2016_Mtt ATLAS.	tt_13TeV_ljets_2016_l ×(×) ×(×) ×(×) ×(×) ×(×) ×(×) 7.52(2.90) 12.87(-2.19) 0.56(-0.87)
4H	OQQ1 OQQ8 OQt1 OQt8 Ott1 O81qq O11qq O83qq O13qq	CMS_tt_13TeV_ljets_20	015_Mtt	eV_dilep_2015_Mtt  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  3(1.06)  9(2.93)  3(1.37)  10(0.42)	CMS_tt_13TeV_ljets_2016_Mtt	CMS_t	t_13TeV_diley	p_2016_Mtt ATLAS.	tt_13TeV_ljets_2016_1 ×(×) ×(×) ×(×) ×(×) ×(×) 7.52(2.90) 12.87(-2.19) 0.56(-0.87) 0.00(-0.27)
4H	OQQ1 OQQ8 OQt1 OQt8 Ott1 O81qq O11qq O83qq O13qq O8qt	CMS_tt_13TeV_ljets_20	0.3 0.7 0.1 0.0 0.4	bV_dilep_2015_Mtt  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  3(1.06)  9(2.93)  3(1.37)  10(0.42)  10(0.84)	CMS_tt_13TeV_ljets_2016_Mtt ×(×) ×(×) ×(×) ×(×) ×(×) 8.04(18.02) 33.94(40.43) 2.44(19.41) 0.01(5.59) 12.94(40.12)	CMS_t	1.13TeV_diley	p_2016_Mtt ATLAS.	x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) 7.52(2.90) 12.87(-2.19) 0.56(-0.87) 0.00(-0.27) 1.73(4.95)
4H	OQQ1 OQQ8 OQt1 OQt8 Ott1 O81qq O11qq O83qq O13qq O8qt O1qt	CMS_tt_13TeV_ljets_20	0.3 0.7 0.1 0.1 0.0 0.4 0.8	eV_dilep_2015_Mtt  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  3(1.06)  9(2.93)  3(1.37)  9(0.042)  10(0.84)  44(2.80)	CMS_tt_13TeV_ljets_2016_Mtt	CMS_t	1.13TeV_diley	p_2016_Mtt ATLAS.  4) 4) 4) (1) (2) (3) (4) (4)	x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) 7.52(2.90) 12.87(-2.19) 0.56(-0.87) 0.00(-0.27) 1.73(4.95) 9.56(-0.78)
	OQQ1 OQQ8 OQt1 OQt8 Ott1 O81qq O11qq O83qq O13qq O8qt	CMS_tt_13TeV_ljets_20	0.3 0.7 0.1 0.1 0.0 0.4 0.8	bV_dilep_2015_Mtt  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  3(1.06)  9(2.93)  3(1.37)  10(0.42)  10(0.84)	CMS_tt_13TeV_ljets_2016_Mtt ×(×) ×(×) ×(×) ×(×) ×(×) 8.04(18.02) 33.94(40.43) 2.44(19.41) 0.01(5.59) 12.94(40.12)	CMS_t	1.13TeV_diley	p_2016_Mtt ATLAS.  4) 4) 4) (1) (2) (3) (4) (4)	x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) 7.52(2.90) 12.87(-2.19) 0.56(-0.87) 0.00(-0.27) 1.73(4.95)
	OQQ1 OQQ8 OQt1 OQt8 Ott1 O81qq O11qq O83qq O13qq O8qt O1qt	CMS_tt_13TeV_ljets_20	015_Mtt CMS_tt_13Te  0.3 0.7 0.1 0.0 0.4 0.8 0.3	eV_dilep_2015_Mtt  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  3(1.06)  9(2.93)  3(1.37)  10(0.42)  10(0.84)  44(2.80)  48(0.29)	CMS_tt_13TeV_ljets_2016_Mtt	CMS_t	t=13TeV_diley	p_2016_Mtt ATLAS.  4) 4) (1) (2) (3) (4) (4) (4) (5) (6) (7) (7) (8) (9) (9) (9) (1) (1) (1) (1) (1) (1) (1) (1) (1) (1	x(x) x(x) x(x) x(x) x(x) x(x) x(x) 7.52(2.90) 12.87(-2.19) 0.56(-0.87) 0.00(-0.27) 1.73(4.95) 9.56(-0.78) 4.40(10.81)
	OQQ1 OQQ8 OQt1 OQt8 Ott1 OS1qq O11qq O83qq O13qq O8qt O1qt O8ut O1ut	CMS_tt_13TeV_ljets_20	015_Mtt CMS_tt_13Te  0.3 0.7 0.1 0.0 0.4 0.8 0.3 0.6	eV_dilep_2015_Mtt  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  3(1.06)  9(2.93)  3(1.37)  10(0.42)  10(0.84)  14(2.80)  18(0.29)  16(3.50)	CMS_tt_13TeV_ljets_2016_Mtt	CMS_t	t=13TeV_dile	p_2016_Mtt ATLAS.  4) 4) (4) (5) (7) (8) (9) (1) (1)	tt_13TeV_ljets_2016_
	OQQ1 OQQ8 OQt1 OQt8 Ott1 OS1qq O11qq O83qq O13qq O8qt O1qt O8ut O1ut O8qu	CMS_tt_13TeV_ljets_20	015_Mtt CMS_tt_13Te  0.3 0.7 0.1 0.0 0.4 0.8 0.3 0.6 0.6	eV_dilep_2015_Mtt  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  3(1.06)  9(2.93)  3(1.37)  0(0.42)  0(0.84)  4(2.80)  88(0.29)  66(3.50)  67(1.02)	CMS_tt_13TeV_ljets_2016_Mtt	CMS_t	1.13TeV_diley	p_2016_Mtt ATLAS.  4) 4) 4) (4) (5) (6) (7) (7) (8) (8) (9) (1) (1) (1) (1) (1) (1) (1) (1) (1) (1	x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) 7.52(2.90) 12.87(-2.19) 0.56(-0.87) 0.00(-0.27) 1.73(4.95) 9.56(-0.78) 4.40(10.81) 13.98(-0.16) 1.29(3.18)
	OQQ1 OQQ8 OQt1 OQt8 Ott1 O81qq O11qq O83qq O13qq O8qt O1qt O8ut O1ut O8qu O1qu	CMS_tt_13TeV_ljets_20	0.3 0.3 0.7 0.1 0.0 0.4 0.8 0.3 0.6 0.6	eV_dilep_2015_Mtt  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  3(1.06)  9(2.93)  3(1.37)  9(0.0.42)  10(0.84)  14(2.80)  18(0.29)  16(3.50)  17(1.02)  15(1.41)	CMS_tt_13TeV_ljets_2016_Mtt	CMS_t	1.13TeV_diley	p_2016_Mtt ATLAS.  4) 4) 4) 6) 7) 1) 1) 1) 2)	x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) 7.52(2.90) 12.87(-2.19) 0.56(-0.87) 0.00(-0.27) 1.73(4.95) 9.56(-0.78) 4.40(10.81) 13.98(-0.16) 1.29(3.18) 11.16(5.26)
	OQQ1 OQQ8 OQt1 OQt8 Ott1 O81qq O11qq O83qq O13qq O8qt O1qt O8ut O1ut O8qu O1qu O8dt	CMS_tt_13TeV_ljets_20	0.3 0.3 0.7 0.1 0.0 0.4 0.8 0.6 0.6 0.6 0.3	eV_dilep_2015_Mtt  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  3(1.06)  9(2.93)  3(1.37)  90(0.42)  90(0.42)  10(0.84)  44(2.80)  18(0.29)  16(3.50)  17(1.02)  15(1.41)  18(2.12)	CMS_tt_13TeV_ljets_2016_Mtt	CMS_t	1.13TeV_diley	p_2016_Mtt ATLAS.  4) 4) 4) (1) (2) (3) (4) (4) (5) (6) (7) (7) (8) (8) (9) (9) (9) (9) (9) (9) (9) (9) (9) (9	x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) 7.52(2.90) 12.87(-2.19) 0.56(-0.87) 0.00(-0.27) 1.73(4.95) 9.56(-0.78) 4.40(10.81) 13.98(-0.16) 1.29(3.18) 11.16(5.26) 5.48(0.07)
	OQQ1 OQQ8 OQt1 OQt8 Ott1 O81qq O11qq O83qq O13qq O8qt O1qt O8ut O1ut O8qu O1qu	CMS_tt_13TeV_ljets_20	0.3 0.3 0.7 0.1 0.0 0.4 0.8 0.6 0.6 0.6 0.3	eV_dilep_2015_Mtt  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  3(1.06)  9(2.93)  3(1.37)  9(0.0.42)  10(0.84)  14(2.80)  18(0.29)  16(3.50)  17(1.02)  15(1.41)	CMS_tt_13TeV_ljets_2016_Mtt	CMS_t	1.13TeV_diley	p_2016_Mtt ATLAS.  4) 4) 4) (1) (2) (3) (4) (4) (5) (6) (7) (7) (8) (8) (9) (9) (9) (9) (9) (9) (9) (9) (9) (9	x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) 7.52(2.90) 12.87(-2.19) 0.56(-0.87) 0.00(-0.27) 1.73(4.95) 9.56(-0.78) 4.40(10.81) 13.98(-0.16) 1.29(3.18) 11.16(5.26)
	OQQ1 OQQ8 OQt1 OQt8 Ott1 O81qq O11qq O83qq O13qq O8qt O1qt O8ut O1ut O8qu O1qu O8dt O1dt	CMS_tt_13TeV_ljets_20	015_Mtt CMS_tt_13Te  0.3 0.7 0.1 0.0 0.4 0.8 0.3 0.6 0.6 0.6 0.7 0.7 0.7 0.7 0.7	eV_dilep_2015_Mtt  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  3(1.06)  9(2.93)  3(1.37)  10(0.42)  10(0.84)  44(2.80)  48(0.29)  66(3.50)  77(1.02)  75(1.41)  78(2.12)  75(2.68)	CMS_tt_13TeV_ljets_2016_Mtt	CMS_t	1.13TeV_diley	p_2016_Mtt ATLAS.  4) 4) 4) (1) (2) (3) (4) (4) (5) (6) (7) (7) (8) (8) (9) (9) (1) (9) (1)	x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) 7.52(2.90) 12.87(-2.19) 0.56(-0.87) 0.00(-0.27) 1.73(4.95) 9.56(-0.78) 4.40(10.81) 13.98(-0.16) 1.29(3.18) 11.16(5.26) 5.48(0.07) 13.15(1.39)
	OQQ1 OQQ8 OQt1 OQt8 Ott1 OS1qq O11qq O83qq O13qq O8qt O1qt O8ut O1ut O8qu O1qu O8dt O1dt O8dt	CMS_tt_13TeV_ljets_20	015_Mtt CMS_tt_13Te  0.3 0.3 0.7 0.1 0.0 0.4 0.8 0.6 0.6 0.6 0.3 0.7 0.7 1.2	eV_dilep_2015_Mtt  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  3(1.06)  9(2.93)  3(1.37)  10(0.42)  10(0.84)  14(2.80)  18(0.29)  16(3.50)  17(1.02)  15(1.41)  18(2.12)  15(2.68)  11(1.41)	CMS_tt_13TeV_ljets_2016_Mtt	CMS_t	1.13TeV_diley	p_2016_Mtt ATLAS.  4) 4) 4) (1) (2) (3) (4) (4) (5) (6) (7) (7) (7) (7) (7) (7) (7) (7) (7) (7	x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) 7.52(2.90) 12.87(-2.19) 0.56(-0.87) 0.00(-0.27) 1.73(4.95) 9.56(-0.78) 4.40(10.81) 13.98(-0.16) 1.29(3.18) 11.16(5.26) 5.48(0.07) 13.15(1.39) 4.16(0.95)
	OQQ1 OQQ8 OQt1 OQt8 Ott1 OS1qq O11qq O83qq O13qq O8qt O1qt O8ut O1ut O8qu O1qu O8dt O1qd	CMS_tt_13TeV_ljets_26	015_Mtt CMS_tt_13Te  0.3 0.7 0.1 0.0 0.4 0.8 0.3 0.6 0.6 0.3 0.7 0.7 1.2	bV_dilep_2015_Mtt  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  3(1.06)  9(2.93)  3(1.37)  9(0.42)  9(0.84)  44(2.80)  88(0.29)  66(3.50)  77(1.02)  75(2.68)  11(1.41)  17(2.96)	$\begin{array}{c} \text{CMS\_tt\_13TeV\_ljets\_2016\_Mtt} \\ \times (\times) \\ \text{8.04(18.02)} \\ 33.94(40.43) \\ 2.44(19.41) \\ 0.015.59) \\ 12.94(40.12) \\ 40.98(38.12) \\ 17.86(56.00) \\ 29.79(46.20) \\ 4.89(60.40) \\ 50.44(54.88) \\ 17.03(36.48) \\ 35.61(50.76) \\ 6.38(59.68) \\ 44.03(40.75) \end{array}$	CMS_t	1.13TeV_diley	p_2016_Mtt ATLAS.  4) 4) 4) (1) (2) (3) (4) (4) (5) (6) (7) (7) (7) (7) (7) (7) (7) (7) (7) (7	$\begin{array}{c} \text{xt}\_13\text{TeV\_ljets}\_2016\_\\ \times (\times)\\ \hline \times (\times)\\ 7.52(2.90)\\ 12.87(-2.19)\\ 0.56(-0.87)\\ 0.00(-0.27)\\ 1.73(4.95)\\ 9.56(-0.78)\\ 4.40(10.81)\\ 13.98(-0.16)\\ 1.29(3.18)\\ 11.16(5.26)\\ 5.48(0.07)\\ 13.15(1.39)\\ 4.16(0.95)\\ 10.21(-1.85)\\ \end{array}$
	OQQ1 OQQ8 OQt1 OQt8 Ott1 OS1qq O11qq O83qq O13qq O8qt O1qt O8ut O1ut O8qu O1qu O8dt O1dt O8qd O1dt O8qd O1dt O8qd O1qd Otp	CMS_tt_13TeV_ljets_20	015_Mtt CMS_tt_13Te  0.3 0.7 0.1 0.0 0.4 0.8 0.3 0.6 0.6 0.6 0.7 0.7 0.7 0.7 0.9	eV_dilep_2015_Mtt  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  3(1.06)  9(2.93)  3(1.37)  9(0.0.42)  10(0.84)  14(2.80)  18(0.29)  16(3.50)  17(1.02)  15(1.41)  18(2.12)  15(2.68)  11(1.41)  17(2.96)  ×(×)	CMS_tt_13TeV_ljets_2016_Mtt	CMS_t	t13TeV_diley	p_2016_Mtt ATLAS.  4) 4) 4) 4) 6) 7) 8) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1)	$\begin{array}{c} \text{xt}\_13\text{TeV\_ljets}\_2016\_\\ \times (\times)\\ \end{array}\\ \begin{array}{c} \times (\times)\\ \times (\times)\\ \times (\times)\\ \end{array}\\ \begin{array}{c} 7.52(2.90)\\ 12.87(-2.19)\\ 0.56(-0.87)\\ 0.00(-0.27)\\ 1.73(4.95)\\ 9.56(-0.78)\\ 4.40(10.81)\\ 13.98(-0.16)\\ 1.29(3.18)\\ 11.16(5.26)\\ 5.48(0.07)\\ 13.15(1.39)\\ 4.16(0.95)\\ 10.21(-1.85)\\ \times (\times) \end{array}$
	OQQ1 OQQ8 OQt1 OQt8 Ott1 O81qq O11qq O83qq O13qq O1qt O8ut O1ut O8qu O1qu O8qt O1qu O8qt O1qu O8qt O1qt O8dt O1qt O8qd O1qt O8qd O1qd	CMS_tt_13TeV_ljets_26	015_Mtt CMS_tt_13Te  0.3 0.7 0.1 0.0 0.4 0.8 0.3 0.6 0.6 0.6 0.7 0.7 0.7 0.7 0.9	bV_dilep_2015_Mtt  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  3(1.06)  9(2.93)  3(1.37)  9(0.42)  9(0.84)  44(2.80)  88(0.29)  66(3.50)  77(1.02)  75(2.68)  11(1.41)  17(2.96)	$\begin{array}{c} \text{CMS\_tt\_13TeV\_ljets\_2016\_Mtt} \\ \times (\times) \\ \text{8.04(18.02)} \\ 33.94(40.43) \\ 2.44(19.41) \\ 0.015.59) \\ 12.94(40.12) \\ 40.98(38.12) \\ 17.86(56.00) \\ 29.79(46.20) \\ 4.89(60.40) \\ 50.44(54.88) \\ 17.03(36.48) \\ 35.61(50.76) \\ 6.38(59.68) \\ 44.03(40.75) \end{array}$	CMS_t	1.13TeV_diley	p_2016_Mtt ATLAS.  4) 4) 4) 4) 6) 7) 8) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1)	$\begin{array}{c} \text{x.t.} -13\text{TeV\_ljets\_2016\_}\\ \times (\times)\\ \end{array}\\ \begin{array}{c} \times (\times)\\ \times (\times)\\ \times (\times)\\ \end{array}\\ \begin{array}{c} 7.52(2.90)\\ 12.87(-2.19)\\ 0.56(-0.87)\\ 0.00(-0.27)\\ 1.73(4.95)\\ 9.56(-0.78)\\ 4.40(10.81)\\ 13.98(-0.16)\\ 1.29(3.18)\\ 11.16(5.26)\\ 5.48(0.07)\\ 13.15(1.39)\\ 4.16(0.95)\\ 10.21(-1.85)\\ \end{array}$
	OQQ1 OQQ8 OQt1 OQt8 Ott1 OS1qq O11qq O83qq O13qq O8qt O1qt O8ut O1ut O8qu O1qu O8dt O1dt O8qd O1dt O8qd O1dt O8qd O1qd Otp	CMS_tt_13TeV_ljets_20	015_Mtt CMS_tt_13Te  0.3 0.7 0.1 0.0 0.4 0.8 0.3 0.6 0.6 0.6 0.7 0.7 0.7 1.2 0.9	eV_dilep_2015_Mtt  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  3(1.06)  9(2.93)  3(1.37)  90(0.42)  90(0.42)  10(0.84)  44(2.80)  18(0.29)  16(3.50)  17(1.02)  15(1.41)  18(2.12)  15(2.68)  11(1.41)  17(2.96)  17(2.96)  17(2.96)	CMS_tt_13TeV_ljets_2016_Mtt	CMS_t	t_13TeV_diley	p_2016_Mtt ATLAS.  4) 4) 4) 4) 6) 7) 8) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1)	$\begin{array}{c} \text{tt.13TeV-ljets.} = 2016.1\\ \times (\times)\\ \end{array}\\ \begin{array}{c} \times (\times)\\ \times (\times)\\ \times (\times)\\ \end{array}\\ \begin{array}{c} \times (\times)\\ \times (\times)\\ \end{array}\\ \begin{array}{c} 7.52(2.90)\\ 12.87(-2.19)\\ 0.56(-0.87)\\ 0.00(-0.27)\\ 1.73(4.95)\\ 9.56(-0.78)\\ 4.40(10.81)\\ 13.98(-0.16)\\ 1.29(3.18)\\ 11.16(5.26)\\ 5.48(0.07)\\ 13.15(1.39)\\ 4.16(0.95)\\ 10.21(-1.85)\\ \times (\times)\\ 1.21(1.46)\\ \end{array}$
	OQQ1 OQQ8 OQt1 OQt8 Ott1 O81qq O11qq O83qq O13qq O8qt O1qt O8ut O1ut O8qu O1qu O1qu O8dt O1dt O8qd O1dd O8pd Otp	CMS_tt_13TeV_ljets_26	015_Mtt CMS_tt_13Te  0.3 0.7 0.1 0.0 0.4 0.8 0.3 0.6 0.6 0.6 0.7 0.7 0.7 0.7 0.7 0.7 0.9	eV_dilep_2015_Mtt  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  3(1.06)  9(2.93)  3(1.37)  10(0.42)  10(0.84)  44(2.80)  18(0.29)  16(3.50)  17(1.02)  15(1.41)  18(2.12)  15(2.68)  11(1.41)  17(2.96)  ×(×)  2(1.81)	CMS_tt_13TeV_ljets_2016_Mtt	CMS_t	t=13TeV_diley	p_2016_Mtt ATLAS.  4) 4) 4) 4) 6) 7) 8) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1)	x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) 7.52(2.90) 12.87(-2.19) 0.56(-0.87) 0.00(-0.27) 1.73(4.95) 9.56(-0.78) 4.40(10.81) 13.98(-0.16) 1.29(3.18) 11.16(5.26) 5.48(0.07) 13.15(1.39) 4.16(0.95) 10.21(-1.85) x(x) 121(1.46) x(x)
-2Н	OQQ1 OQQ8 OQt1 OQt8 Ott1 OS1qq O11qq O83qq O13qq O8qt O1qt O8ut O1qt O8qu O1qu O8dt O1qd Otp Otd Otp Otg Otp	CMS_tt_13TeV_ljets_26	015_Mtt CMS_tt_13Te  0.3 0.7 0.1 0.0 0.4 0.8 0.3 0.6 0.6 0.6 0.3 0.7 1.2 0.9	bV_dilep_2015_Mtt  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  3(1.06)  9(2.93)  3(1.37)  9(0.42)  10(0.84)  14(2.80)  18(0.29)  16(3.50)  17(1.02)  15(1.41)  18(2.12)  15(2.68)  11(1.41)  17(2.96)  ×(×)  2(1.81)  ×(×)  ×(×)	$\begin{array}{c} \text{CMS\_tt\_13TeV\_ljets\_2016\_Mtt} \\ \times (\times) \\ \end{array}$ $\begin{array}{c} \times (\times) \\ \times (\times) \\ \times (\times) \\ \end{array}$ $\begin{array}{c} 8.04(18.02) \\ 33.94(40.43) \\ 2.44(19.41) \\ 0.015.59 \\ 12.94(40.12) \\ 40.98(38.12) \\ 17.86(56.00) \\ 29.79(46.20) \\ 4.89(60.40) \\ 50.44(54.88) \\ 17.03(36.48) \\ 35.61(50.76) \\ 6.38(59.68) \\ 44.03(40.75) \\ \times (\times) \\ \end{array}$ $\begin{array}{c} \times (\times) \\ \times (\times) \end{array}$	CMS_t	1.13TeV_diley	p_2016_Mtt ATLAS.  4) 4) 4) 4) 6) 7) 8) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1)	x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) 7.52(2.90) 12.87(-2.19) 0.56(-0.87) 0.00(-0.27) 1.73(4.95) 9.56(-0.78) 4.40(10.81) 13.98(-0.16) 1.29(3.18) 11.16(5.26) 5.48(0.07) 13.15(1.39) 4.16(0.95) 10.21(-1.85) x(x) 1.21(1.46) x(x) x(x)
-2Н	OQQ1 OQQ8 OQt1 OQt8 Ott1 OS1qq O11qq O83qq O13qq O8qt O1qt O8ut O1ut O8qu O1qu O8dt O1dt O8qd O1dt O8qd O1dt Osqd Otp Otp Otp Otp Otp Otp Otp	CMS_tt_13TeV_ljets_20	0.3 0.3 0.7 0.1 0.0 0.4 0.8 0.3 0.6 0.6 0.3 0.7 0.7 0.7	eV_dilep_2015_Mtt  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  3(1.06)  9(2.93)  3(1.37)  9(0.42)  10(0.84)  14(2.80)  18(0.29)  16(3.50)  17(1.02)  15(1.41)  18(2.12)  15(2.68)  11(1.41)  17(2.96)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)	CMS_tt_13TeV_ljets_2016_Mtt	CMS_t	1.13TeV_diley	p_2016_Mtt ATLAS.  4) 4) 4) 4) 6) 7) 8) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1)	x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) 7.52(2.90) 12.87(-2.19) 0.56(-0.87) 0.00(-0.27) 1.73(4.95) 9.56(-0.78) 4.40(10.81) 13.98(-0.16) 1.29(3.18) 11.16(5.26) 5.48(0.07) 13.15(1.39) 4.16(0.95) 10.21(-1.85) x(x) 1.21(1.46) x(x) x(x) x(x)
L2H	OQQ1 OQQ8 OQt1 OQt8 Ott1 OS1qq O11qq O83qq O13qq O8qt O1qt O8ut O1ut O8qu O1qu O8dt O1dt O8qd O1dd Otp OtG Obp Ocp Otap Otw	CMS_tt_13TeV_ljets_26	0.3 0.7 0.1 0.8 0.3 0.6 0.6 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.9 0.9 0.9 0.9 0.9 0.9 0.9 0.9 0.9 0.9	eV_dilep_2015_Mtt  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  3(1.06)  9(2.93)  3(1.37)  9(0.042)  9(0.042)  9(0.042)  10(0.84)  4(2.80)  8(0.29)  16(3.50)  17(1.02)  15(1.41)  18(2.12)  17(2.68)  11(1.41)  17(2.96)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)	CMS_tt_13TeV_ljets_2016_Mtt	CMS_t	t_13TeV_diley	p_2016_Mtt ATLAS.  4) 4) 4) 4) 6) 7) 8) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1)	x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) 7.52(2.90) 12.87(-2.19) 0.56(-0.87) 0.00(-0.27) 1.73(4.95) 9.56(-0.78) 4.40(10.81) 13.98(-0.16) 1.29(3.18) 11.16(5.26) 5.48(0.07) 13.15(1.39) 4.16(0.95) 10.21(-1.85) x(x) 1.21(1.46) x(x) x(x) x(x) x(x)
L2H	OQQ1 OQQ8 OQt1 OQt8 Ott1 OS1qq O11qq O83qq O13qq O8qt O1qt O8ut O1ut O8qu O1qu O8dt O1dt O8qd O1dt O8qd O1dt Osqd Otp Otp Otp Otp Otp Otp Otp	CMS_tt_13TeV_ljets_20	0.3 0.7 0.1 0.8 0.3 0.6 0.6 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.9 0.9 0.9 0.9 0.9 0.9 0.9 0.9 0.9 0.9	eV_dilep_2015_Mtt  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  3(1.06)  9(2.93)  3(1.37)  9(0.42)  10(0.84)  14(2.80)  18(0.29)  16(3.50)  17(1.02)  15(1.41)  18(2.12)  15(2.68)  11(1.41)  17(2.96)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)	CMS_tt_13TeV_ljets_2016_Mtt	CMS_t	1.13TeV_diley	p_2016_Mtt ATLAS.  4) 4) 4) 4) 6) 7) 8) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1)	x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) 7.52(2.90) 12.87(-2.19) 0.56(-0.87) 0.00(-0.27) 1.73(4.95) 9.56(-0.78) 4.40(10.81) 13.98(-0.16) 1.29(3.18) 11.16(5.26) 5.48(0.07) 13.15(1.39) 4.16(0.95) 10.21(-1.85) x(x) 1.21(1.46) x(x) x(x) x(x)
.2Н	OQQ1 OQQ8 OQt1 OQt8 Ott1 O81qq O11qq O83qq O13qq O8qt O1qt O8ut O1ut O8qu O1qu O8qd O1qd Otp Otg Otg Otp Otb	CMS_tt_13TeV_ljets_26	0.3 0.3 0.7 0.1 0.0 0.4 0.8 0.3 0.6 0.6 0.3 0.7 0.7 0.7	eV_dilep_2015_Mtt  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  3(1.06)  9(2.93)  3(1.37)  9(0.42)  9(0.42)  9(0.42)  10(0.84)  44(2.80)  18(0.29)  16(3.50)  17(1.02)  15(1.41)  18(2.12)  15(2.68)  11(1.41)  17(2.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  1	CMS_tt_13TeV_ljets_2016_Mtt	CMS_t	t_13TeV_diley	p_2016_Mtt ATLAS.  4) 4) 4) 4) 6) 7) 8) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1)	x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) 7.52(2.90) 12.87(-2.19) 0.56(-0.87) 0.00(-0.27) 1.73(4.95) 9.56(-0.78) 4.40(10.81) 13.98(-0.16) 1.29(3.18) 11.16(5.26) 5.48(0.07) 13.15(1.39) 4.16(0.95) 10.21(-1.85) x(x) 1.21(1.46) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x)
L2H	OQQ1 OQQ8 OQt1 OQt8 Ott1 ORS Ott1 OS1qq O13qq OSqt O1qt OSut O1qt OSqu O1qd O1qd Otp OtG Obp Ocp Otap OtZ O3pQ3	CMS_tt_13TeV_ljets_26	0.3 0.3 0.7 0.1 0.0 0.4 0.8 0.3 0.6 0.6 0.3 0.7 0.7 0.7	eV_dilep_2015_Mtt  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  3(1.06)  69(2.93)  3(1.37)  10(0.42)  10(0.84)  44(2.80)  18(0.29)  16(3.50)  17(1.02)  15(1.41)  18(2.12)  15(2.68)  11(1.41)  17(2.96)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)	CMS_tt_13TeV_ljets_2016_Mtt	CMS_t	t_13TeV_diley	p_2016_Mtt ATLAS.  4) 4) 4) 4) 6) 7) 8) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1)	x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) 0.00(-0.87) 0.00(-0.27) 1.73(4.95) 9.56(-0.78) 4.40(10.81) 13.98(-0.16) 1.29(3.18) 11.16(5.26) 5.48(0.07) 13.15(1.39) 4.16(0.95) 10.21(-1.85) x(x) 1.21(1.46) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x)
L2H	OQQ1 OQQ8 OQt1 OQt8 Ott1 OS1qq OS3qq OSqt O1qt OSqt O1qt OSqt O1qt OSqu O1qu OSqu O1qu OSqt O1qt OSqt O1qt OSqt O1qt OSqt O1qt OSqt O1qt OSqt O1qt OSqd O1qd Otp Otc Otp Otc Otp Otap Otap Otap Otap Otap Otap Otap	CMS_tt_13TeV_ljets_26	0.3 0.3 0.7 0.1 0.0 0.4 0.8 0.3 0.6 0.6 0.3 0.7 0.7	bV_dilep_2015_Mtt  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  3(1.06)  9(2.93)  3(1.37)  9(0.42)  10(0.84)  14(2.80)  18(0.29)  16(3.50)  17(1.02)  15(1.41)  18(2.12)  15(2.68)  11(1.41)  17(2.96)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)	CMS_tt_13TeV_ljets_2016_Mtt	CMS_t	t_13TeV_diley	p_2016_Mtt ATLAS.  4) 4) 4) 4) 6) 7) 8) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1)	x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) 7.52(2.90) 12.87(-2.19) 0.56(-0.87) 0.00(-0.27) 1.73(4.95) 9.56(-0.78) 4.40(10.81) 13.98(-0.16) 1.29(3.18) 11.16(5.26) 5.48(0.07) 13.15(1.39) 4.16(0.95) 10.21(-1.85) x(x) 1.21(1.46) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x)
L2H	OQQ1 OQQ8 OQt1 OQt8 OQt1 OQt8 Ott1 OS1qq O11qq OS3qq O13qq O8qt O1qt O8ut O1qt O8qt O1qt O8dt O1qt Otp Otc	CMS_tt_13TeV_ljets_20	0.3 0.3 0.7 0.1 0.0 0.4 0.8 0.3 0.6 0.6 0.3 0.7 0.7 0.7	eV_dilep_2015_Mtt  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  3(1.06)  9(2.93)  3(1.37)  9(0.042)  10(0.84)  14(2.80)  18(0.29)  16(3.50)  17(7(1.02)  15(1.41)  18(2.12)  15(2.68)  11(1.41)  17(2.96)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)	CMS_tt_13TeV_ljets_2016_Mtt	CMS_t	t13TeV_diley	p_2016_Mtt ATLAS.  4) 4) 4) 4) 6) 7) 8) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1)	x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) 7.52(2.90) 12.87(-2.19) 0.56(-0.87) 0.00(-0.27) 1.73(4.95) 9.56(-0.78) 4.40(10.81) 13.98(-0.16) 1.29(3.18) 11.16(5.26) 5.48(0.07) 13.15(1.39) 4.16(0.95) 10.21(-1.85) x(x) 1.21(1.46) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x)
L2H	OQQ1 OQQ8 OQt1 OQt8 Ott1 OS1qq OS3qq OSqt O1qt OSqt O1qt OSqt O1qt OSqu O1qu OSqu O1qu OSqt O1qt OSqt O1qt OSqt O1qt OSqt O1qt OSqt O1qt OSqt O1qt OSqd O1qd Otp Otc Otp Otc Otp Otap Otap Oty Otap Oty Otap Oty Otap Oty	CMS_tt_13TeV_ljets_26	0.3 0.3 0.7 0.1 0.0 0.4 0.8 0.3 0.6 0.6 0.3 0.7 0.7 0.7	bV_dilep_2015_Mtt  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  3(1.06)  9(2.93)  3(1.37)  9(0.42)  10(0.84)  14(2.80)  18(0.29)  16(3.50)  17(1.02)  15(1.41)  18(2.12)  15(2.68)  11(1.41)  17(2.96)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)	CMS_tt_13TeV_ljets_2016_Mtt	CMS_t	t_13TeV_diley	p_2016_Mtt ATLAS.  4) 4) 4) 4) 6) 7) 8) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1)	x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) 7.52(2.90) 12.87(-2.19) 0.56(-0.87) 0.00(-0.27) 1.73(4.95) 9.56(-0.78) 4.40(10.81) 13.98(-0.16) 1.29(3.18) 11.16(5.26) 5.48(0.07) 13.15(1.39) 4.16(0.95) 10.21(-1.85) x(x) 1.21(1.46) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x)
L2H	OQQ1 OQQ8 OQt1 OQt8 Ott1 OS1qq O11qq O83qq O13qq O8qt O1qt O8qt O1qt O8qt O1qt O8qt O1qt O8qt O1qt O8qt O1qt O8dt O1qt O8qt O1qt Opp Otcp Otcp Otap Oty OtZ O3pQ3 OpQM Opt Opc	CMS_tt_13TeV_ljets_26	0.3 0.3 0.7 0.1 0.0 0.4 0.8 0.3 0.6 0.6 0.3 0.7 0.7 1.2	eV_dilep_2015_Mtt  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  3(1.06)  9(2.93)  3(1.37)  9(0.042)  9(0.042)  9(0.042)  9(0.084)  4(2.80)  88(0.29)  6(3.50)  97(1.02)  97(1.02)  97(1.02)  97(1.02)  97(1.02)  97(1.02)  97(1.02)  97(1.02)  97(1.03)  97(1.04)  97(1.04)  97(1.04)  97(1.04)  97(1.04)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)  97(1.05)	CMS_tt_13TeV_ljets_2016_Mtt	CMS_t	t_13TeV_diley	p_2016_Mtt ATLAS.  4) 4) 4) 4) 6) 7) 8) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1)	x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) 7.52(2.90) 12.87(-2.19) 0.56(-0.87) 0.00(-0.27) 1.73(4.95) 9.56(-0.78) 4.40(10.81) 13.98(-0.16) 1.29(3.18) 11.16(5.26) 5.48(0.07) 13.15(1.39) 4.16(0.95) 10.21(-1.85) x(x) 1.21(1.46) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x)
L2H	OQQ1 OQQ8 OQt1 OQt8 Ott1 OS1qq O11qq O83qq O13qq O8qt O1qt O8qt O1qt O8qt O1qu O8qt O1qu O8qt O1qt O8qt O1qt O8qt O1qt O8qt O1qt Otp Otc Otp Otc Otp	CMS_tt_13TeV_ljets_26	0.3 0.3 0.7 0.1 0.0 0.4 0.8 0.3 0.6 0.6 0.3 0.7 0.7 1.2	eV_dilep_2015_Mtt  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  3(1.06)  9(2.93)  3(1.37)  9(0.42)  9(0.42)  9(0.42)  10(0.84)  44(2.80)  18(0.29)  16(3.50)  17(1.02)  15(1.41)  18(2.12)  15(2.68)  11(1.41)  17(2.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  17(1.96)  1	CMS_tt_13TeV_ljets_2016_Mtt	CMS_t	t_13TeV_diley	p_2016_Mtt ATLAS.  4) 4) 4) 4) 6) 7) 8) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1)	x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x)
L2H	OQQ1 OQQ8 OQt1 OQt8 Ott1 OS1qq OS3qq OSqt Olqt OSqd Olqt Otp Otp Otp Otp Otp Otp Otp Otp Otp Ot	CMS_tt_13TeV_ljets_26	0.3 0.3 0.7 0.1 0.0 0.4 0.8 0.3 0.6 0.6 0.3 0.7 0.7	bV_dilep_2015_Mtt  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  3(1.06)  9(2.93)  3(1.37)  9(0.42)  9(0.84)  4(2.80)  8(0.29)  6(3.50)  7(1.02)  7(1.02)  75(2.68)  11(1.41)  7(2.96)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)	CMS_tt_13TeV_ljets_2016_Mtt	CMS_t	t_13TeV_diley	p_2016_Mtt ATLAS.  4) 4) 4) 4) 6) 7) 8) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1)	x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x)
L2H	OQQ1 OQQ8 OQt1 OQt8 Ott1 OS1qq O11qq O83qq O13qq O8qt O1qt O8ut O1ut O8qu O1qu O8dt O1dt O8qu O1qd Otp OtG Obp Ocp Otap Oty OtZ O3pQ3 OpQM Opt OpG OpB	CMS_tt_13TeV_ljets_2(	0.3 0.3 0.7 0.1 0.0 0.4 0.8 0.3 0.6 0.6 0.3 0.7 0.7 1.2 0.9	eV_dilep_2015_Mtt  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  3(1.06)  9(2.93)  3(1.37)  9(0.42)  10(0.84)  14(2.80)  18(0.29)  18(0.29)  18(1.21)  18(2.12)  18(2.12)  18(2.12)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)	CMS_tt_13TeV_ljets_2016_Mtt	CMS_t	t13TeV_diley	p_2016_Mtt ATLAS.  4) 4) 4) 4) 6) 7) 8) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1)	x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) 0.00(-0.87) 0.00(-0.27) 1.73(4.95) 9.56(-0.78) 4.40(10.81) 13.98(-0.16) 1.29(3.18) 11.16(5.26) 5.48(0.07) 13.15(1.39) 4.16(0.95) 10.21(-1.85) x(x) 1.21(1.46) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x)
L2H	OQQ1 OQQ8 OQt1 OQt8 OQt1 OQt8 Ott1 OS1qq O11qq O83qq O13qq O13qq O8qt O1qt O8qd O1qd Otp Otp Ocp Ocp Otap Oty OpQM OpQM Opt OpG OpB OpW Opd	CMS_tt_13TeV_ljets_26	0.3 0.3 0.7 0.1 0.0 0.4 0.8 0.3 0.6 0.6 0.3 0.7 0.7 1.2 0.9	eV_dilep_2015_Mtt  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  3(1.06)  9(2.93)  3(1.37)  9(0.042)  9(0.042)  9(0.042)  9(0.042)  9(0.05)  10(0.84)  14(2.80)  18(0.29)  16(3.50)  17(1.02)  15(1.41)  17(2.96)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)	CMS_tt_13TeV_ljets_2016_Mtt	CMS_t	t_13TeV_diley	p_2016_Mtt ATLAS.  4) 4) 4) 4) 6) 7) 8) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1)	x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) 7.52(2.90) 12.87(-2.19) 0.56(-0.87) 0.00(-0.27) 1.73(4.95) 9.56(-0.78) 4.40(10.81) 13.98(-0.16) 1.29(3.18) 11.16(5.26) 5.48(0.07) 13.15(1.39) 4.16(0.95) 10.21(-1.85) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x)
L2H	OQQ1 OQQ8 OQt1 OQt8 Ott1 OS1qq O11qq O83qq O13qq O8qt O1qt O8ut O1ut O8qu O1qu O8dt O1dt O8qu O1qd Otp OtG Obp Ocp Otap Oty OtZ O3pQ3 OpQM Opt OpG OpB	CMS_tt_13TeV_ljets_2(	0.3 0.3 0.7 0.1 0.0 0.4 0.8 0.3 0.6 0.6 0.3 0.7 0.7 1.2 0.9	eV_dilep_2015_Mtt  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  3(1.06)  9(2.93)  3(1.37)  9(0.42)  10(0.84)  14(2.80)  18(0.29)  18(0.29)  18(1.21)  18(2.12)  18(2.12)  18(2.12)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)  18(2.13)	CMS_tt_13TeV_ljets_2016_Mtt	CMS_t	t13TeV_diley	p_2016_Mtt ATLAS.  4) 4) 4) 4) 6) 7) 8) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1)	x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) 0.00(-0.87) 0.00(-0.27) 1.73(4.95) 9.56(-0.78) 4.40(10.81) 13.98(-0.16) 1.29(3.18) 11.16(5.26) 5.48(0.07) 13.15(1.39) 4.16(0.95) 10.21(-1.85) x(x) 1.21(1.46) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x)
4H L2H B	OQQ1 OQQ8 OQt1 OQt8 OQt1 OQt8 Ott1 OS1qq O11qq O83qq O13qq O13qq O8qt O1qt O8qd O1qd Otp Otp Ocp Ocp Otap Oty OpQM OpQM Opt OpG OpB OpW Opd	CMS_tt_13TeV_ljets_26	0.3 0.3 0.7 0.1 0.0 0.4 0.8 0.3 0.6 0.6 0.3 0.7 0.7 1.2 0.9	eV_dilep_2015_Mtt  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  3(1.06)  9(2.93)  3(1.37)  9(0.042)  9(0.042)  9(0.042)  9(0.042)  9(0.05)  10(0.84)  14(2.80)  18(0.29)  16(3.50)  17(1.02)  15(1.41)  17(2.96)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)  ×(×)	CMS_tt_13TeV_ljets_2016_Mtt	CMS_t	t_13TeV_diley	p_2016_Mtt ATLAS.  4) 4) 4) 4) 6) 7) 8) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1) 1)	x(x) x(x) x(x) x(x) x(x) x(x) x(x) x(x)

#### Linear EFT cross-sections

In the linear EFT approximation, one can express the dependence on the Wilson coeffs as

$$\mu_X\left(c/\Lambda^2\right) = \sigma_{X,EFT}\left(c/\Lambda^2\right)/\sigma_{X,SM} = 1 + \sum_{m=1}^{N_6} c_m \frac{\kappa_m^X}{\Lambda^2}$$

As mentioned before, overall normalisation of EFT coeffs (or EFT cross-section) is arbitrary

to quantify which processes have the strongest linear dependencies in which EFT coefficients, plot:

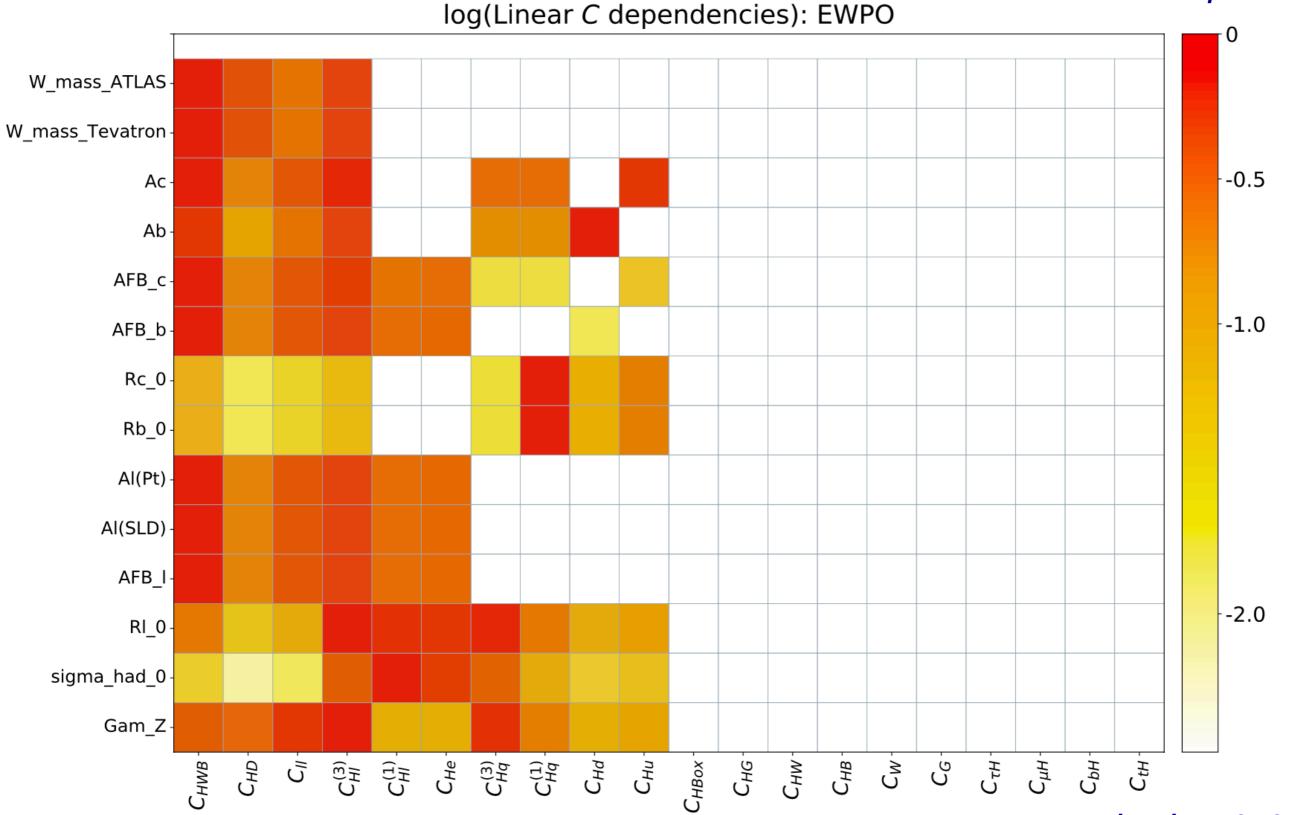
$$\ln\left(\kappa_m^X/\max_{\in X}\left(\kappa_m^X\right)\right)$$

normalised to largest linear EFT cross-section within the given measurement X

This estimator is closely related to the **Fisher information** but without the experimental covariance matrix accounted for. It measures the **size of the EFT cross-section** in a given process, normalised to the largest one

# Linear EFT analysis

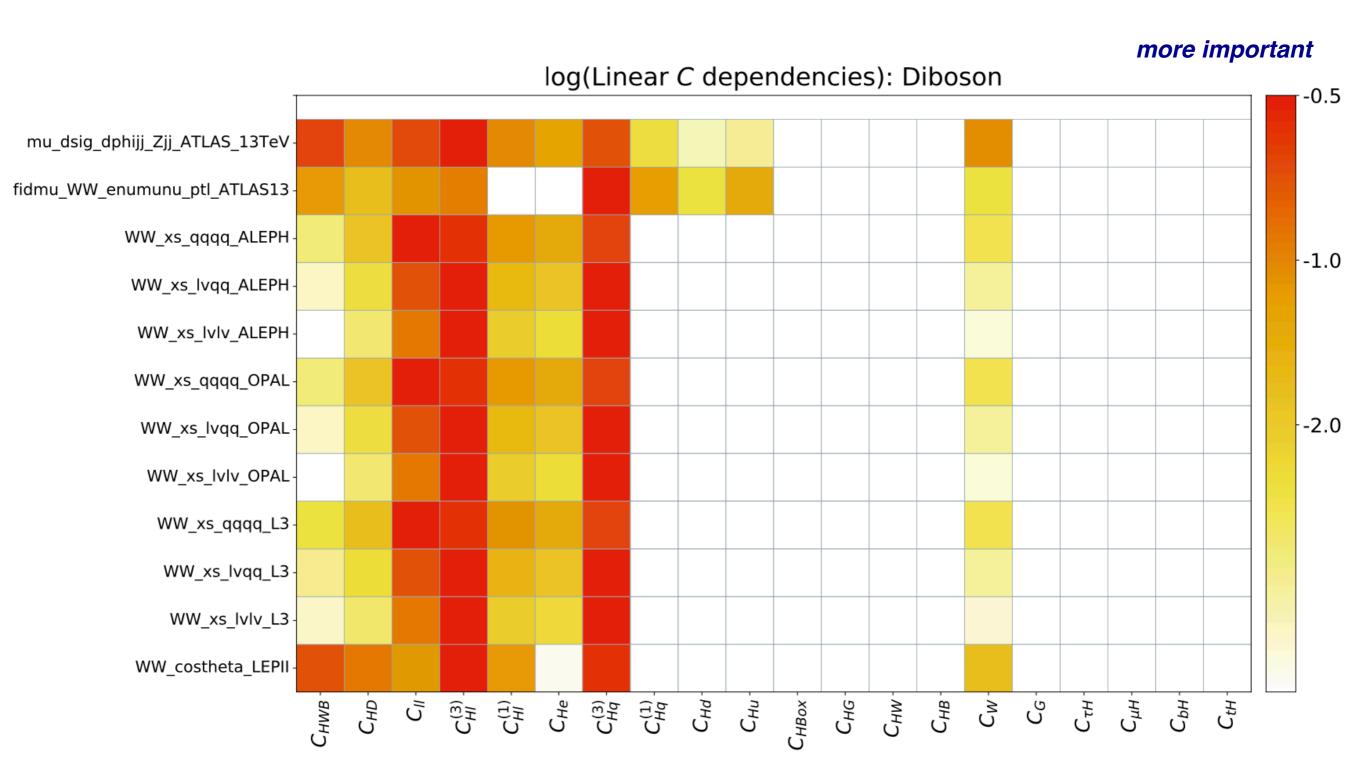
more important



As for the Fisher, the information is the change of colour ("sensitivity") in each column comparison between ``columns" unphysical

less important

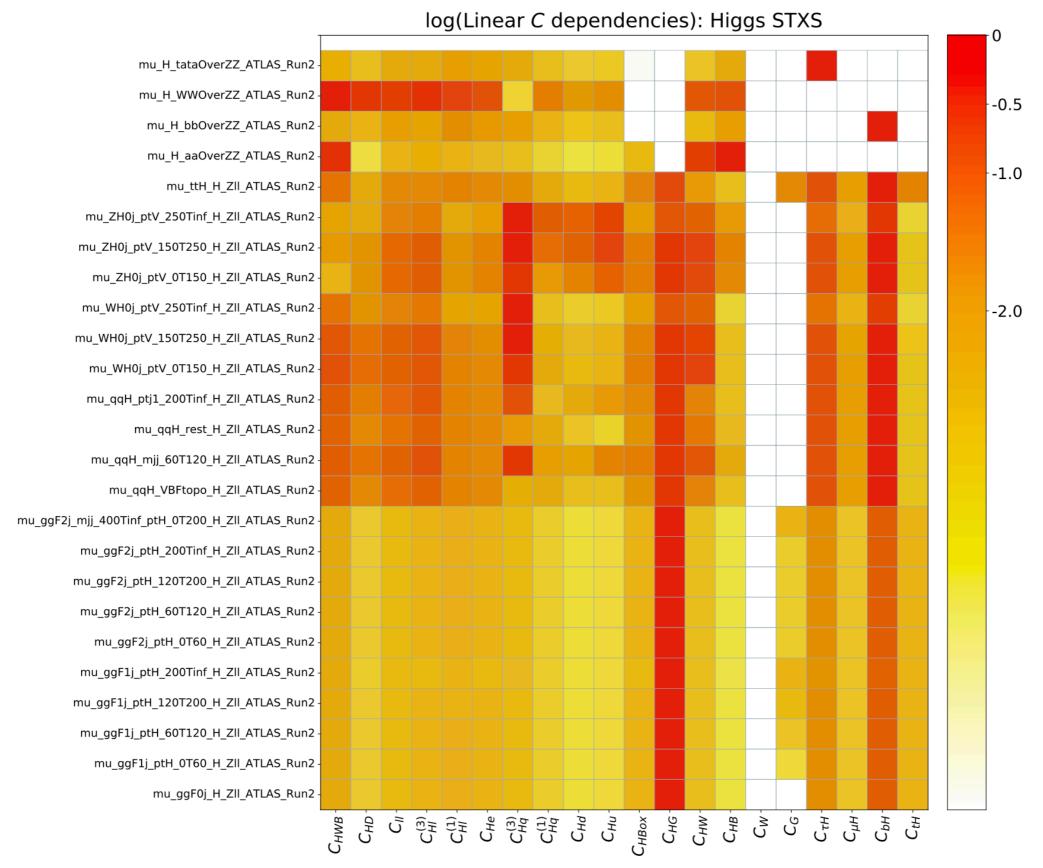
# Linear EFT analysis



less important

As for the Fisher, the information is the change of colour ("sensitivity") in each column

#### Linear EFT analysis



#### Principal Component Analysis

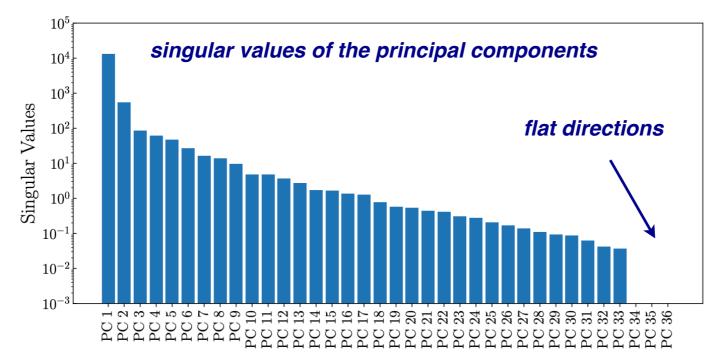
PCA provides another useful handle to understand the relationship between **processes/ observables** and **directions in the EFT parameter space** 

restricted to the linear EFT approximation

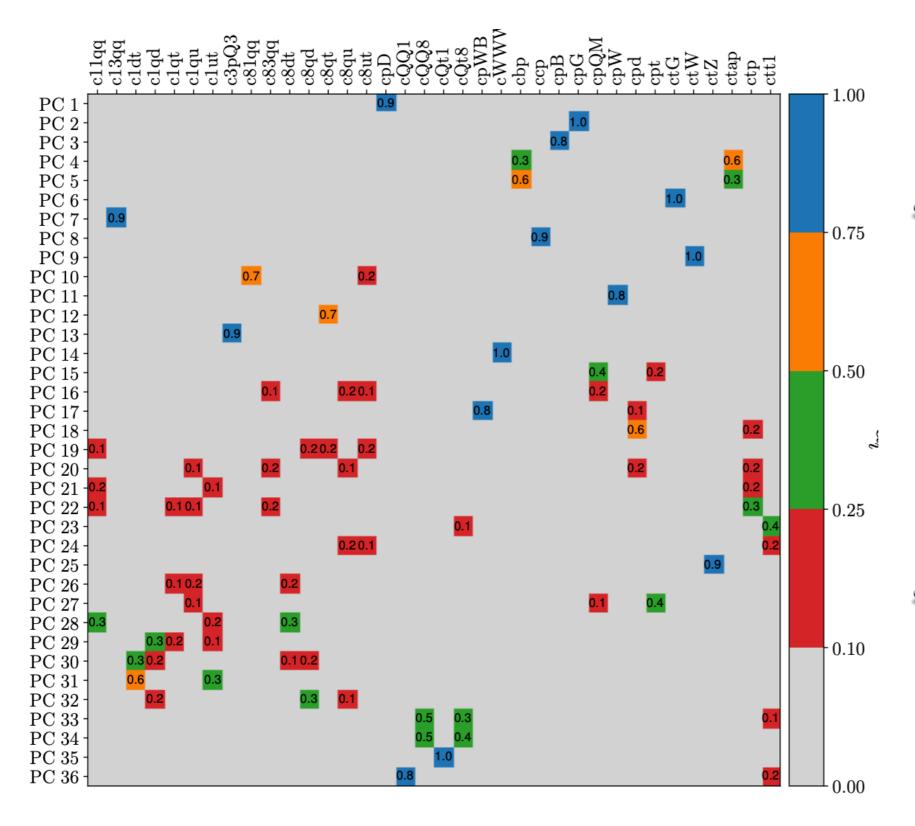
$$\sigma_m^{ ext{(th)}}(oldsymbol{c}) = \sigma_m^{ ext{(sm)}} + \sum_{i=1}^{n_{ ext{op}}} c_i \sigma_{m,i}^{ ext{(eft)}}$$
  $K = UWV^{\dagger}$   $K_{mi} = \sigma_{m,i}^{ ext{(eft)}} / \delta_{ ext{exp,m}},$   $ext{PC}_k = \sum_{i=1}^{n_{ ext{op}}} a_{ki} c_i \,, \quad k = 1, \dots, n_{ ext{op}} \,, \qquad \left( \begin{array}{c} \sum_{i=1}^{n_{ ext{op}}} a_{ki}^2 = 1 \end{array} \ orall k 
ight)$ 

determine most sensitive directions and identify possible flat directions using PCA

#### n.b. flat directions are not necessarily a problem!



#### Principal Component Analysis



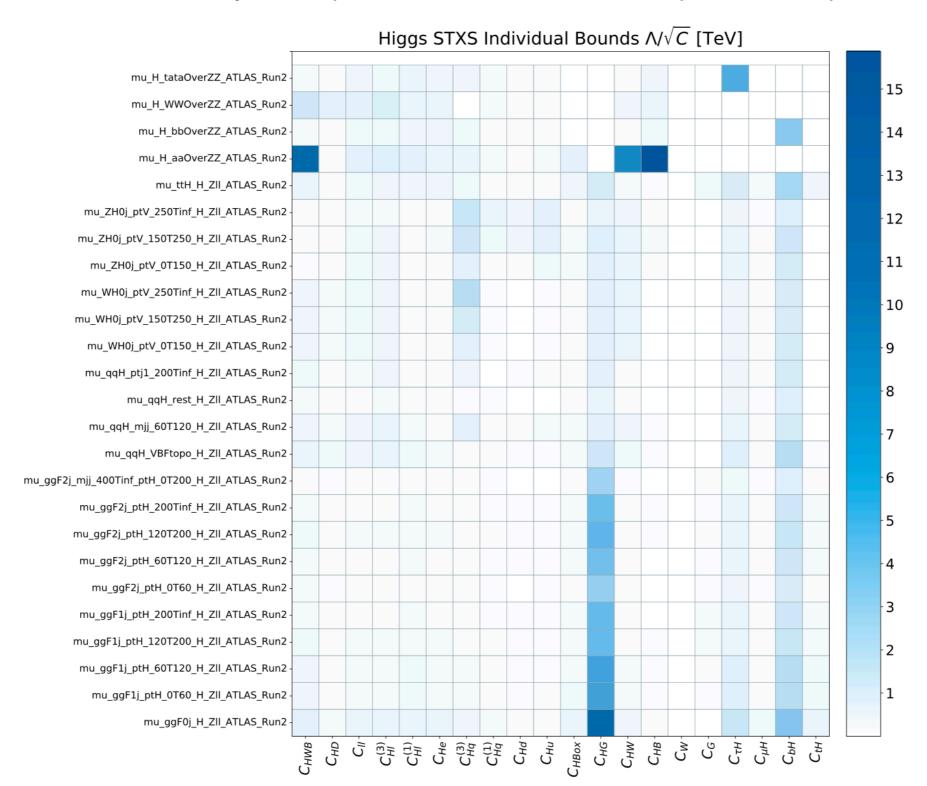
Determine which coefficients are determine by one or a few processes, and which ones only enter at the level of linear combinations of many coefficients

e.g. most four-fermion operators in Warsaw are not ``natural" directions

Powerful tool to understand fit results, eventually could be used to fit in the PCA basis (though this is not required)

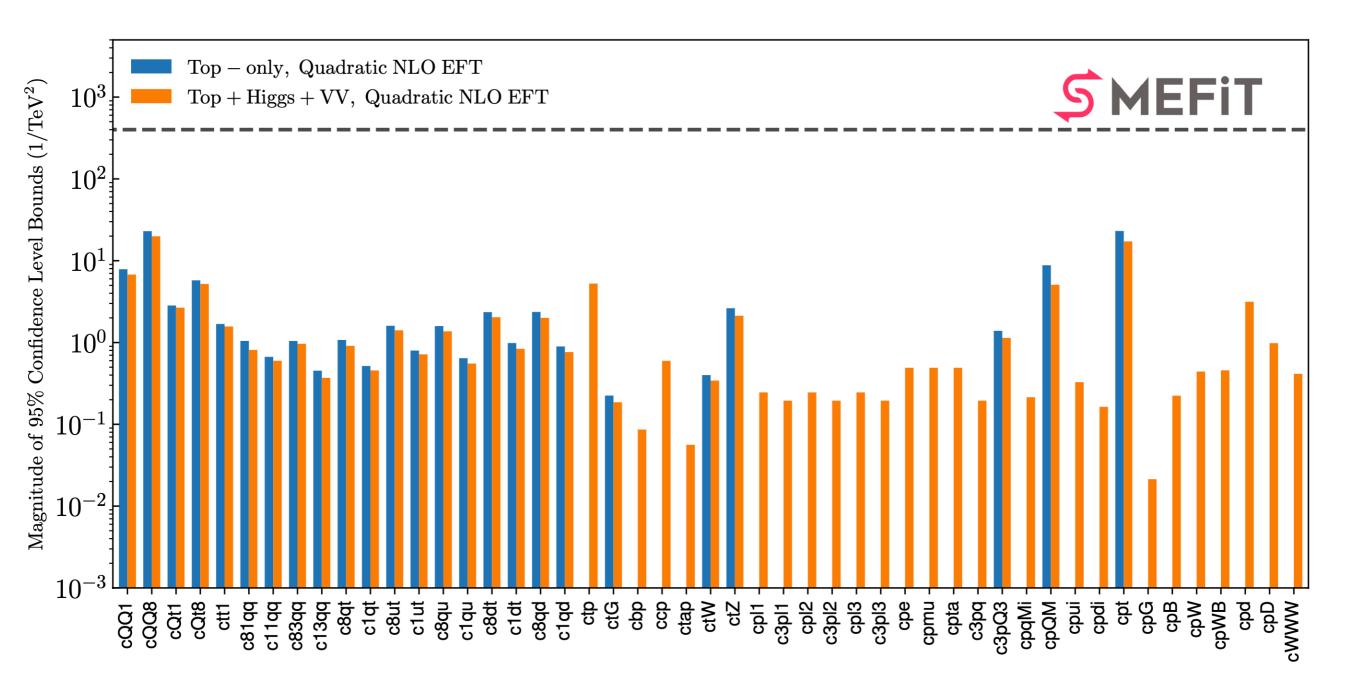
#### One-parameter fits

The sensitivity of a given dataset to specific EFT coefficient can also be quantified by **individual (1-parameter) fits**, which provide by construction, maximal sensitivity on a specific direction on the EFT parameter space



#### Global fits

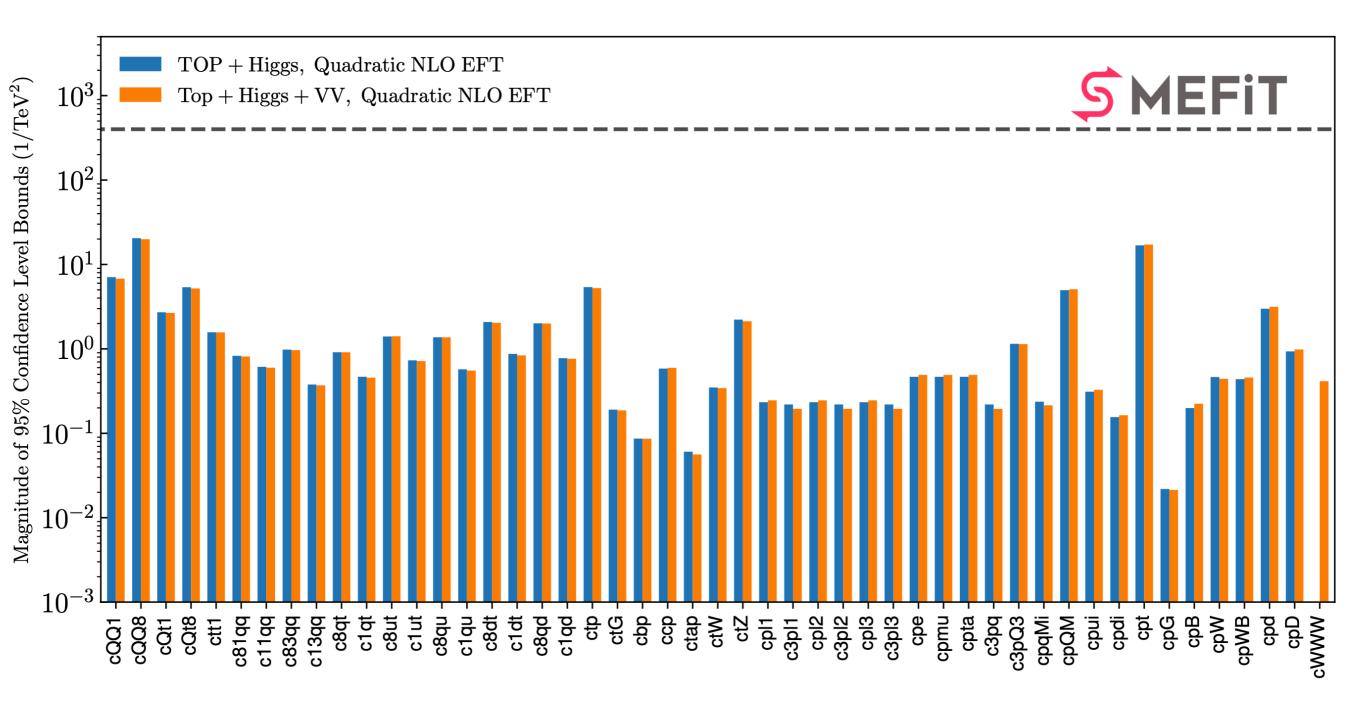
a complementary method to assess the information on the EFT parameter space provided by different processes/observables is carrying out the fit with and without them and comparing results



impact of Higgs & diboson data when added to the top-quark dataset

#### Global fits

a complementary method to assess the information on the EFT parameter space provided by different processes/observables is **carrying out the fit with and without them** and comparing results



impact of diboson data when added to the top-quark & Higgs dataset

#### Summary and outlook

- Establishing a clean map between processes/operators and EFT parameters is non-trivial
- Several statistical estimators and tools available, their combination is necessary to determine the complete picture
- These estimators can be evaluated at different levels, from processes to datasets or even to individual bins, depending on the information we are searching for
- Should be careful and evaluate only quantities which are model-independent (in particular, on the overall normalisation of the EFT operators)
- From The more global the dataset and the more general the EFT basis, the more interesting information one can obtain from such analysis!