EFT systematic impacts

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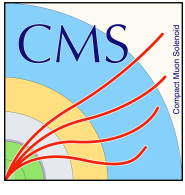


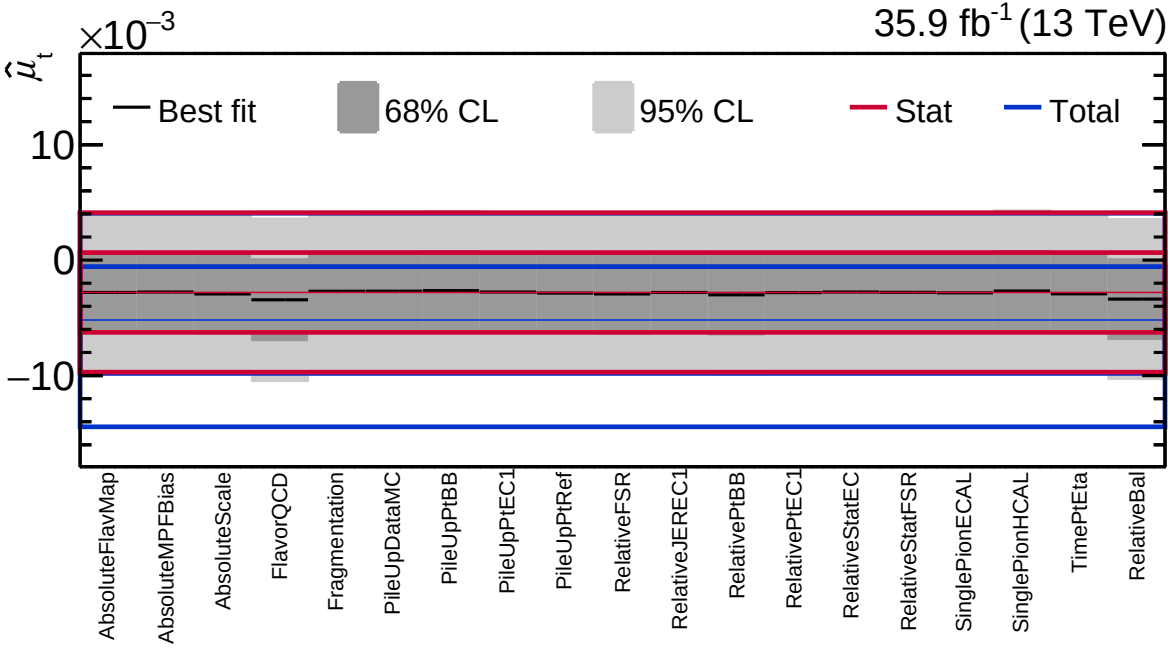
Introduction

- It's known that different systematics affect the spin coefficients differently
- One can forward physics arguments for this:
  - JECs affect b_k^a and c_{kk} the most among the three axes is due to them changing the scattering plane position
  - i.e. a change in p_T/p_z ratio amounts a plane rotation
- That said, we still can't use this idea to constrain systematics effectively
- Try to understand more by evaluating systematic impacts on EFT operators

Setup

- Perform 1D fits using the same distributions as full fit
  - Same setup as TOP-18-006, distribution list etc
  - Fit is done on data
- However, instead of considering the full matrix, use only stat + one source matrix
  - Stat matrix needed because some sources are very small
  - Sources considered are arbitrarily chosen among the larger ones at a glance

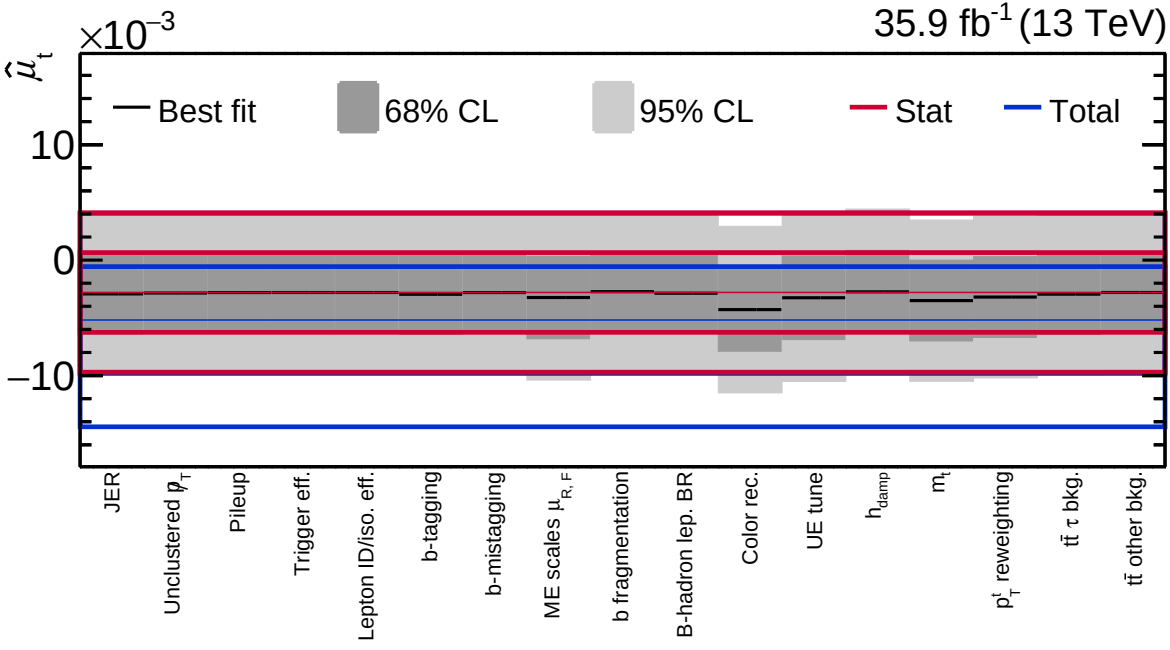
$\hat{\mu}_t$: JEC



Directly affects: c_{jj}, $c_{rk} + c_{kr}$, c_{hel}

Fitted distributions: c_{kk}, c_{nn}, $c_{rk} + c_{kr}$, c_{hel}

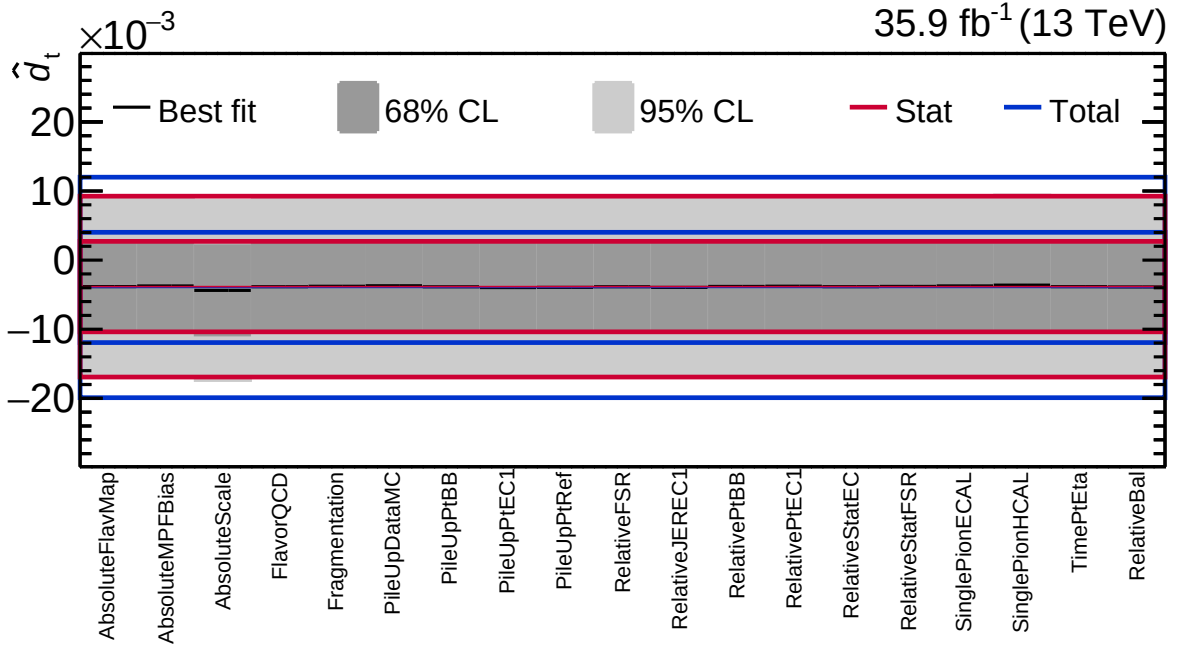
$\hat{\mu}_t$: others



Directly affects: c_{ij}, $c_{rk} + c_{kr}$, c_{hel}

Fitted distributions: c_{kk}, c_{nn}, $c_{rk} + c_{kr}$, c_{hel}

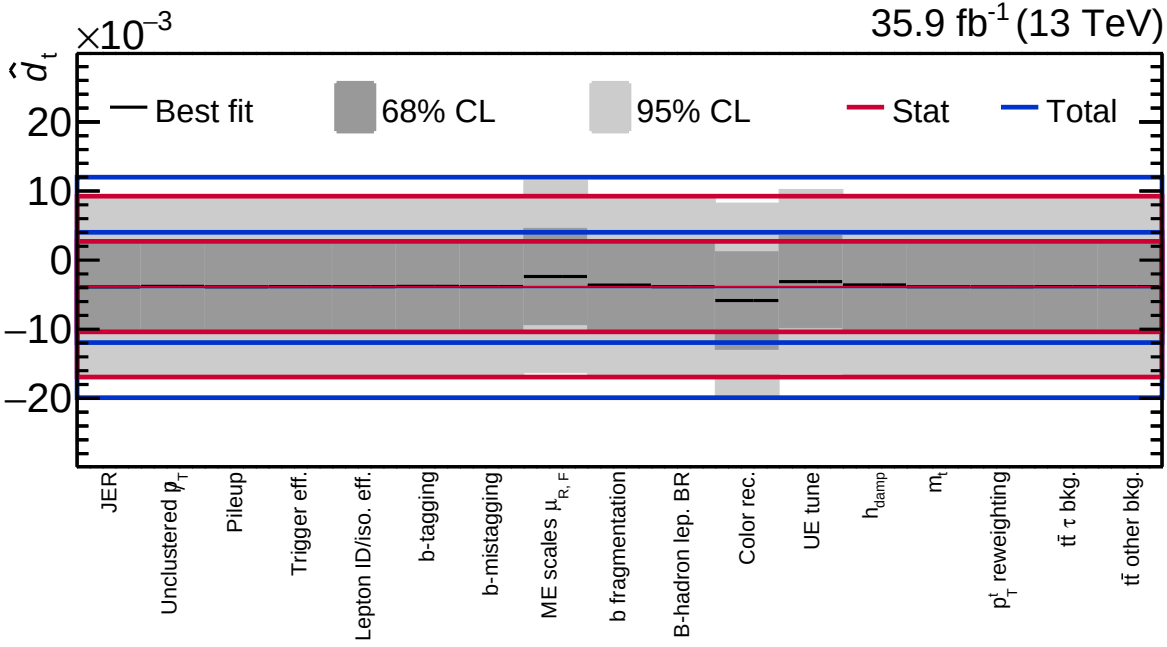
$\hat{d}_t$: JEC



Directly affects: $c_{nr} - c_{rn}$, $c_{nk} - c_{kn}$

Fitted distributions: b_r^2, b_n^1, $c_{nr} - c_{rn}$, $c_{nk} - c_{kn}$

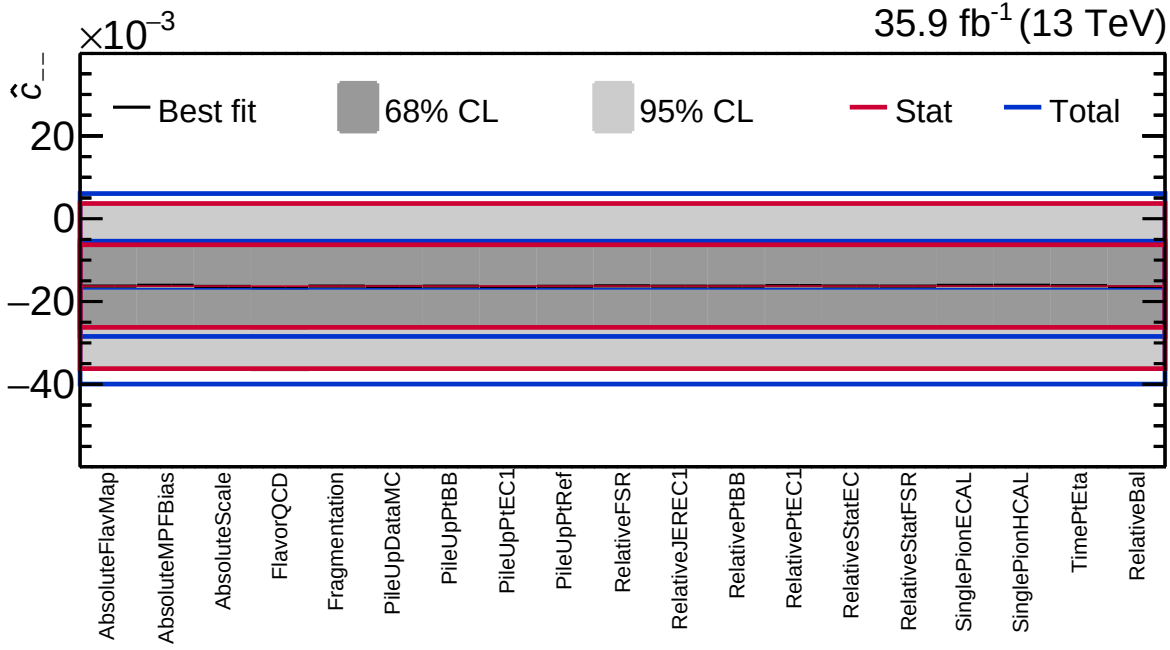
$\hat{d}_t$: others



Directly affects: $c_{nr} - c_{rn}$, $c_{nk} - c_{kn}$

Fitted distributions: b_r^2, b_n^1, $c_{nr} - c_{rn}$, $c_{nk} - c_{kn}$

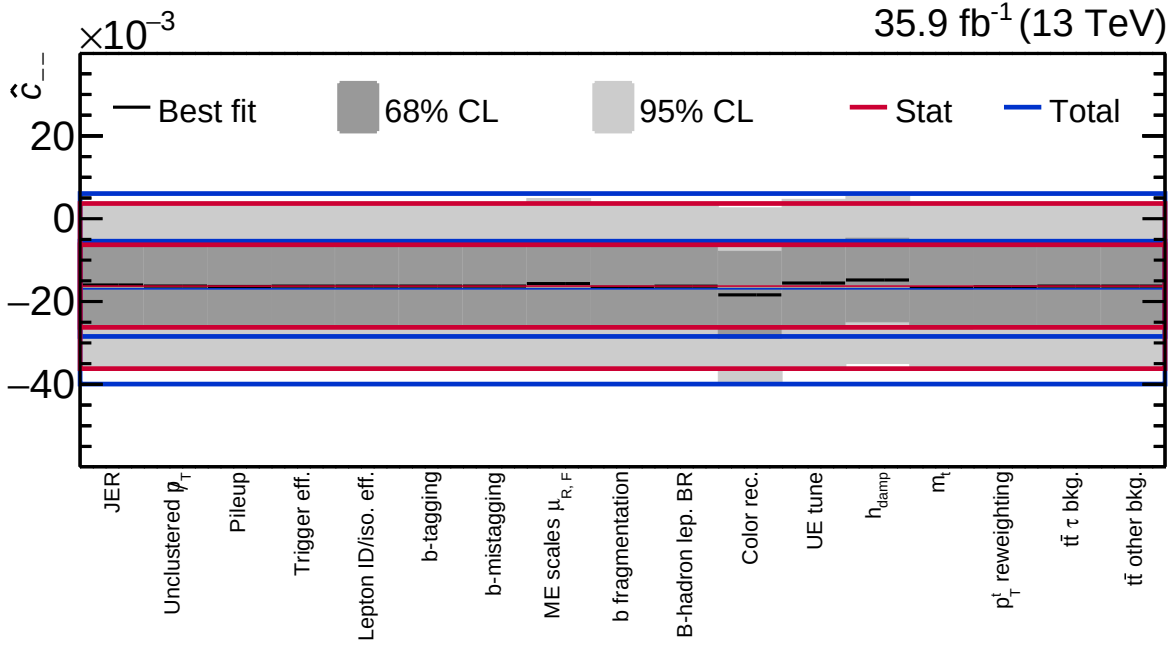
$\hat{c}_{--}$: JEC



Directly affects: $c_{nr} - c_{rn}$, $c_{nk} - c_{kn}$

Fitted distributions: b_r^2, b_n^1, $c_{nr} - c_{rn}$, $c_{nk} - c_{kn}$

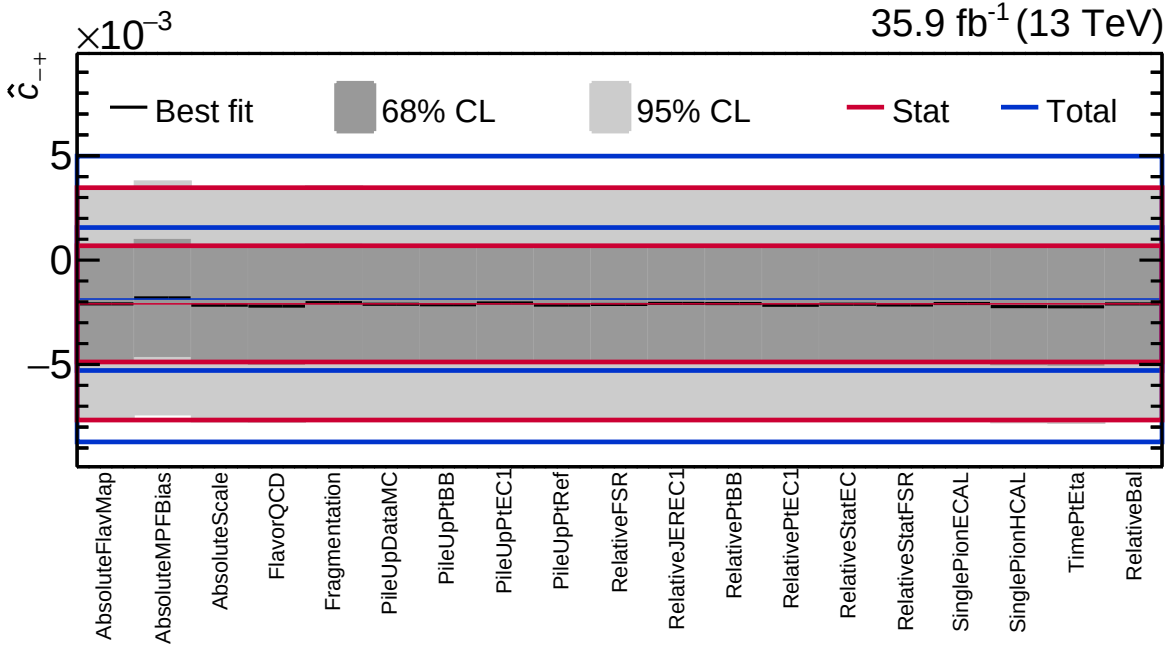
$\hat{c}_{--}$: others



Directly affects: $c_{nr} - c_{rn}$, $c_{nk} - c_{kn}$

Fitted distributions: b_r^2, b_n^1, $c_{nr} - c_{rn}$, $c_{nk} - c_{kn}$

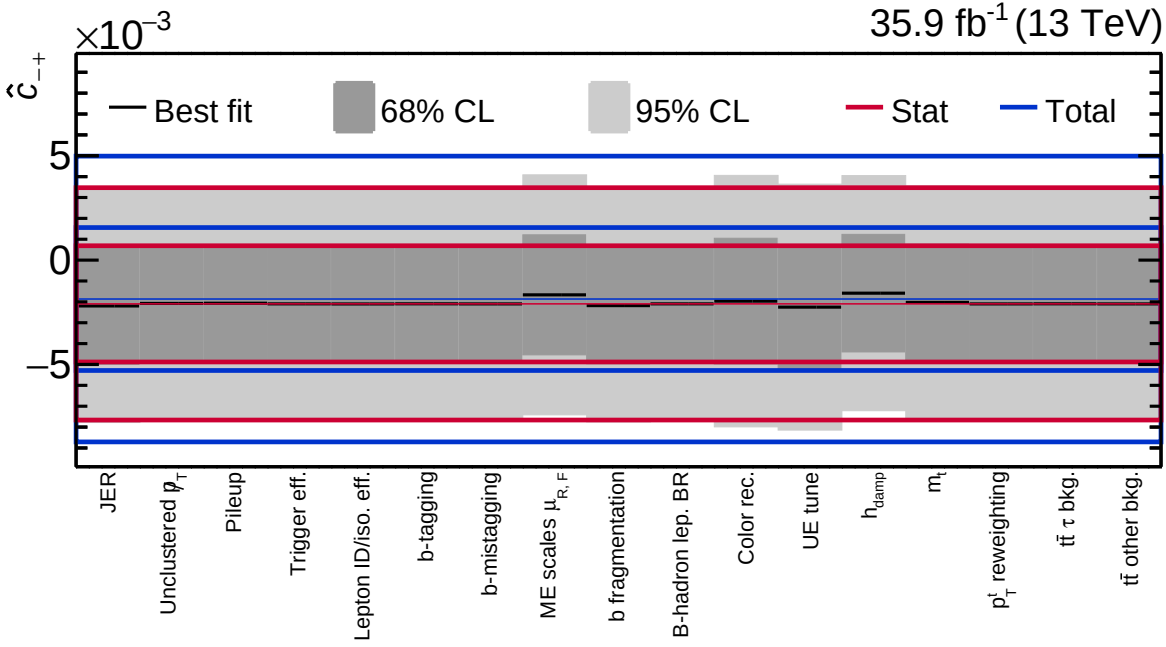
$\hat{c}_{-+}$: JEC



Directly affects: b_n^a

Fitted distributions: b_n^1, b_n^2, $b_{r^*}^1$, $c_{nk} + c_{kn}$

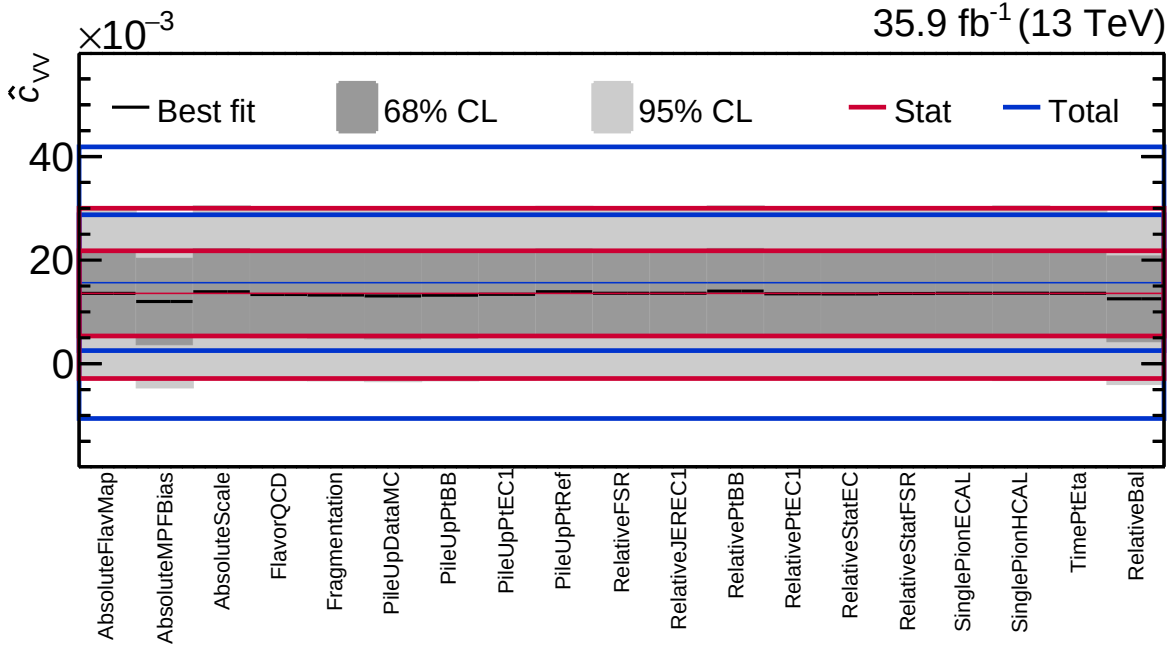
$\hat{c}_{-+}$: others



Directly affects: b_n^a

Fitted distributions: b_n^1, b_n^2, $b_{r^*}^1$, $c_{nk} + c_{kn}$

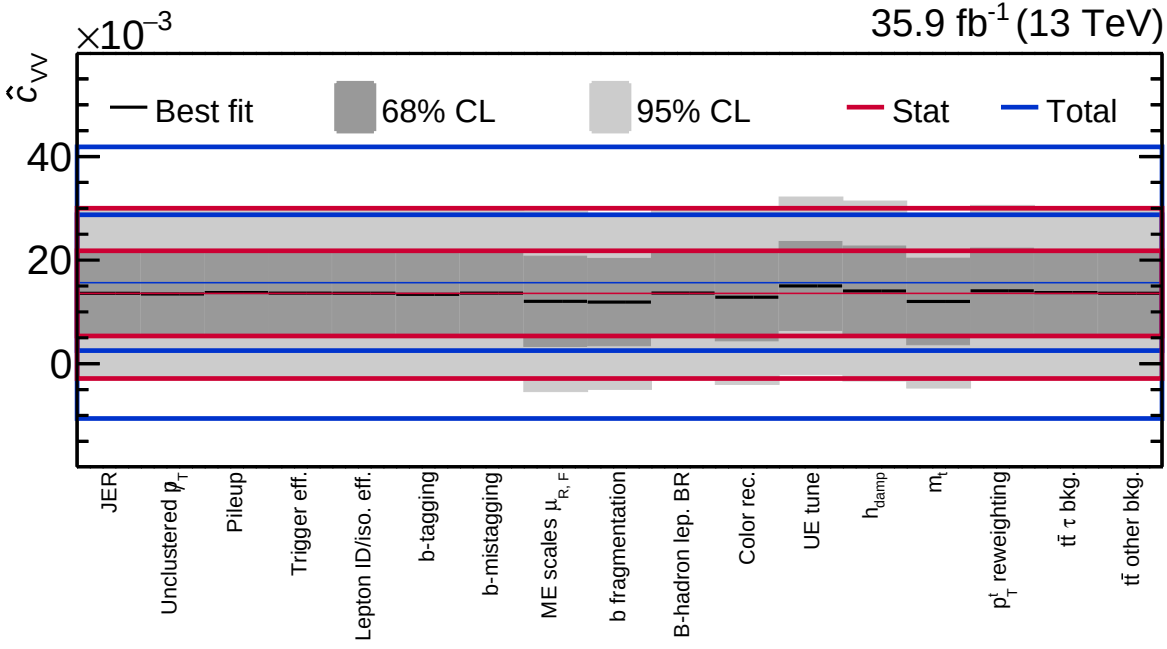
$\hat{c}_{VV}$: JEC



Directly affects: c_{jj}, $c_{rk} + c_{kr}$, c_{hel}

Fitted distributions: c_{kk}, c_{nn}, $c_{rk} + c_{kr}$, c_{hel}

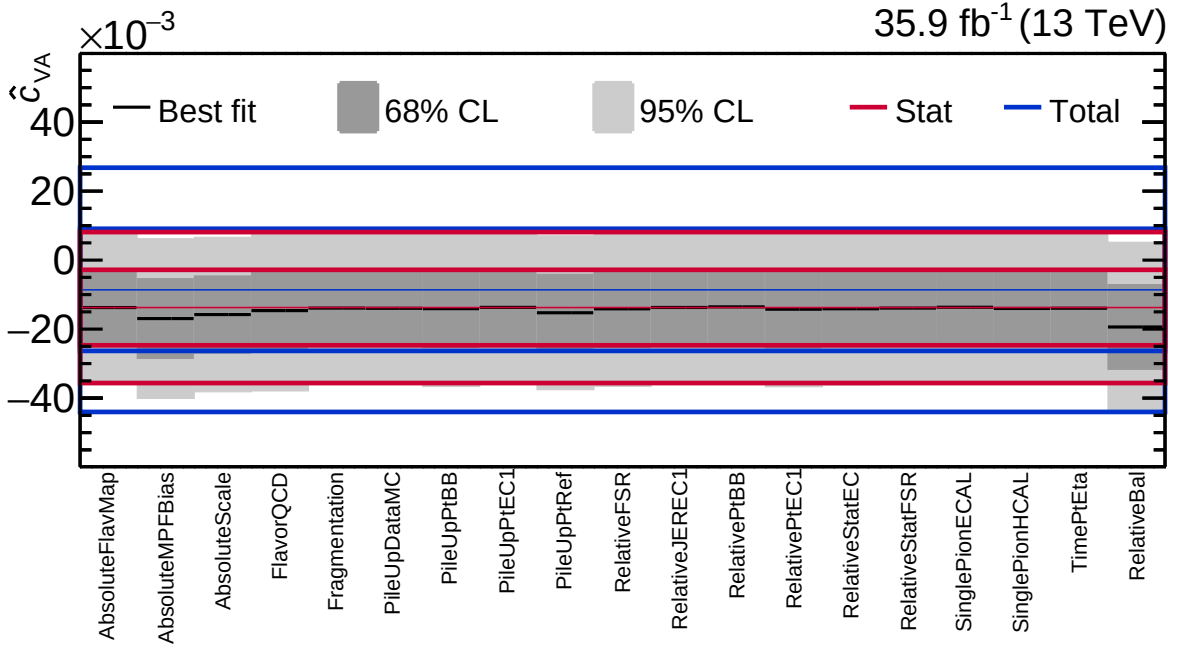
$\hat{c}_{VV}$: others



Directly affects: c_{ij}, $c_{rk} + c_{kr}$, c_{hel}

Fitted distributions: c_{kk}, c_{nn}, $c_{rk} + c_{kr}$, c_{hel}

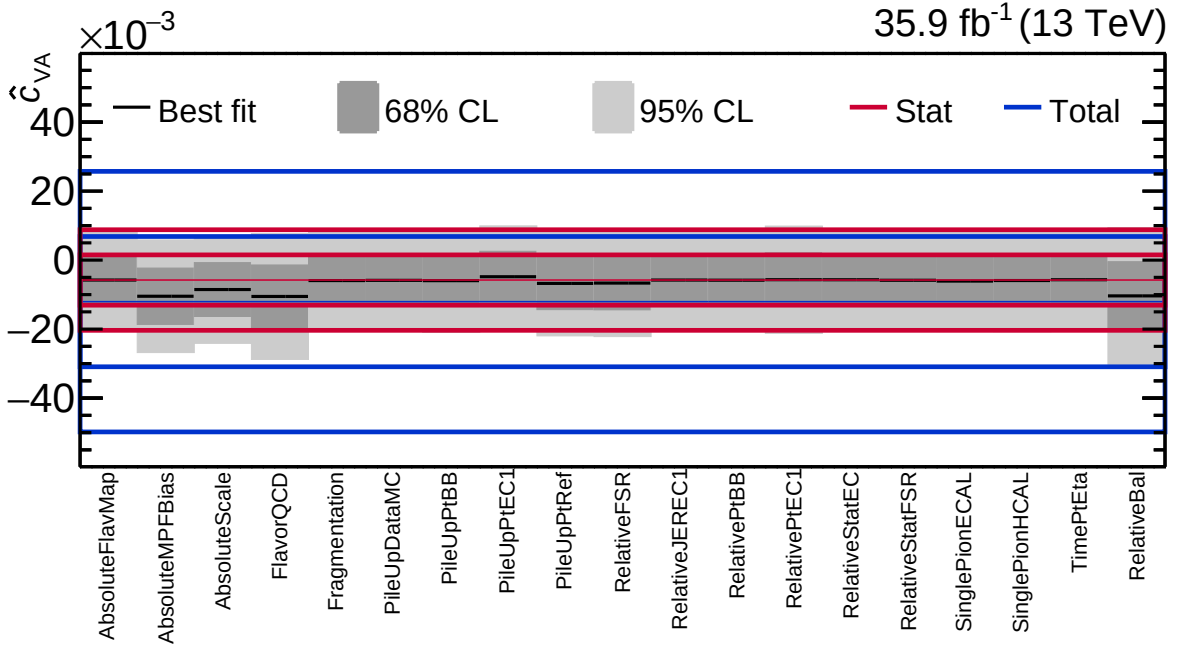
$\hat{c}_{VA}$: JEC



Directly affects: b_k^a, b_r^a

Fitted distributions: b_k^2, b_r^2, c_{kk}, $c_{nr} + c_{rn}$

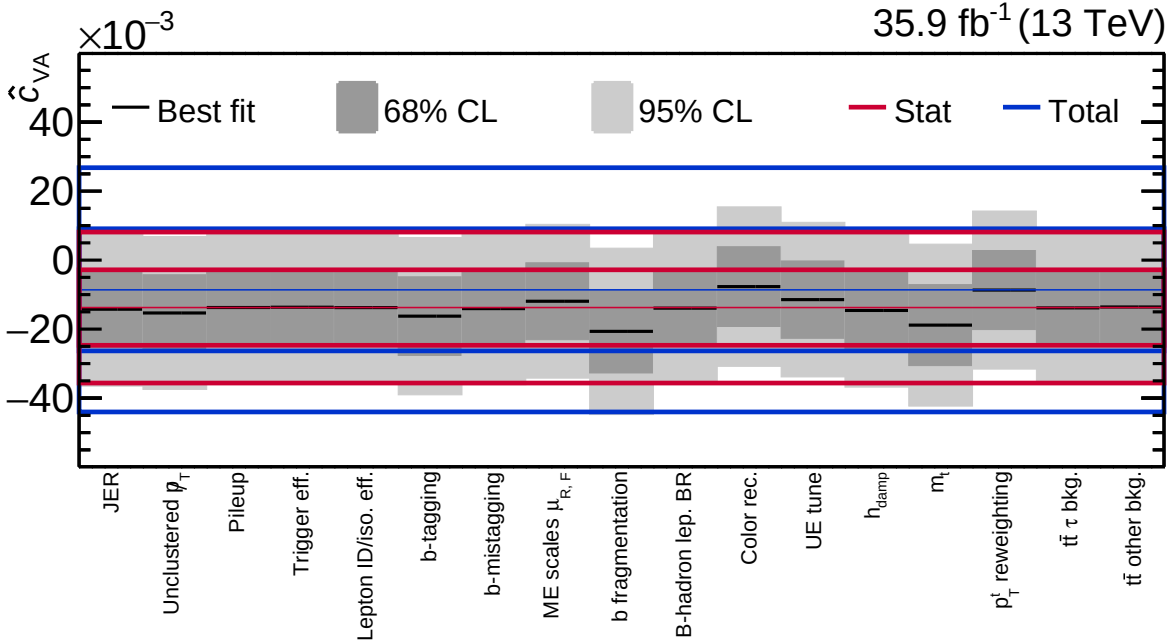
$\hat{c}_{VA}$: JEC follow up



Directly affects: b_k^a, b_r^a

Fitted distributions: b_k^a, b_r^a

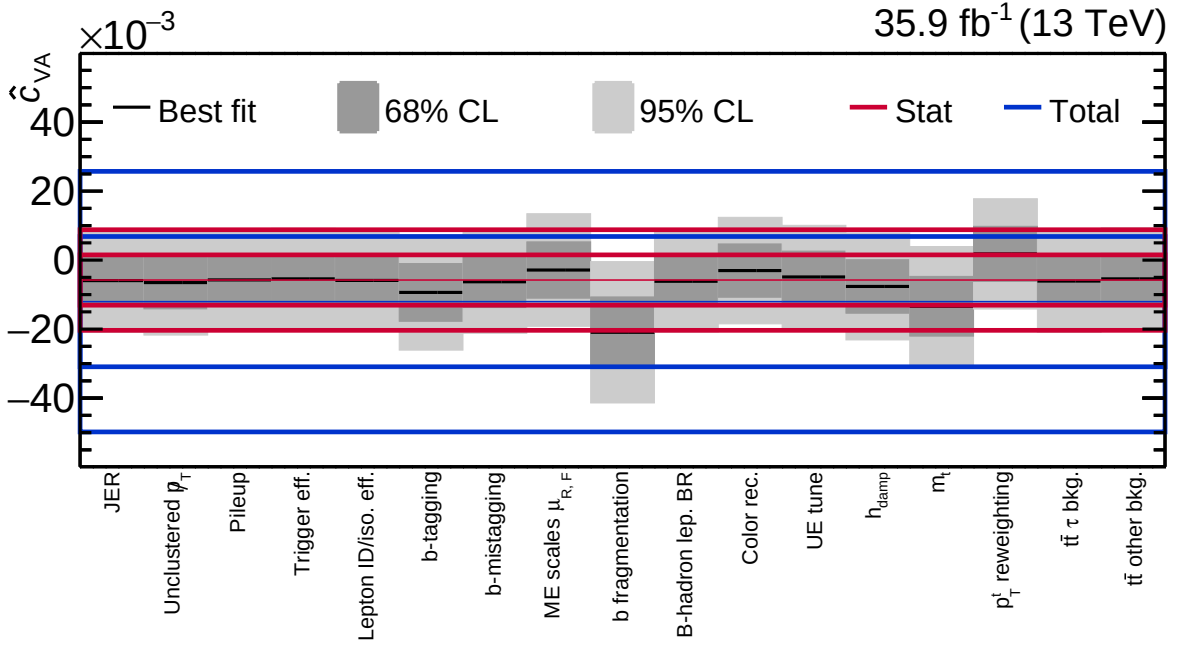
$\hat{c}_{VA}$: others



Directly affects: b_k^a, b_r^a

Fitted distributions: b_k^2, b_r^2, c_{kk}, $c_{nr} + c_{rn}$

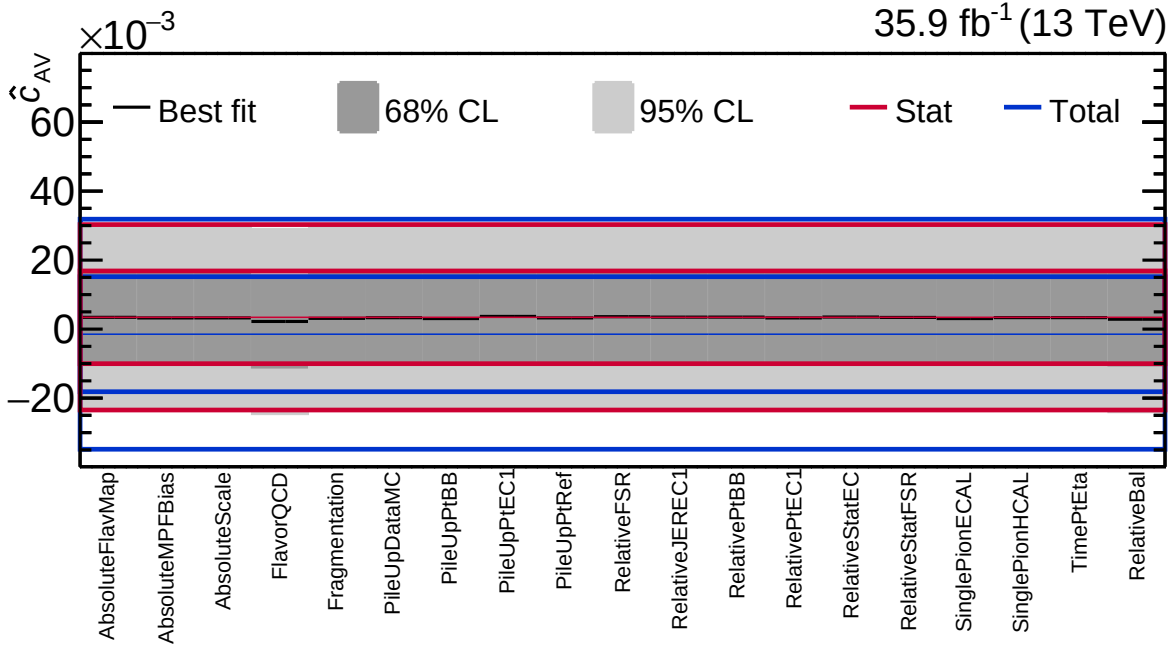
$\hat{c}_{VA}$: others follow up



Directly affects: b_k^a, b_r^a

Fitted distributions: b_k^a, b_r^a

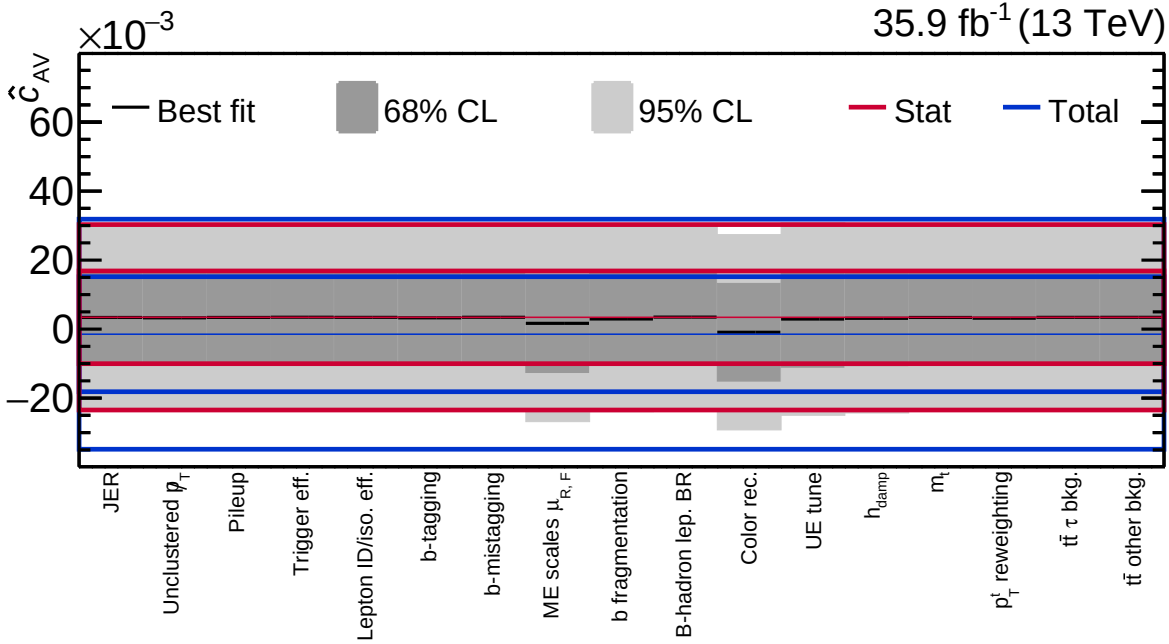
$\hat{c}_{AV}$: JEC



Directly affects: $b^{a}_{k^*}$, $b^{a}_{r^*}$

Fitted distributions: $b^{1}_{k^*}$, $b^{2}_{k^*}$, $b^{1}_{r^*}$, $b^{2}_{r^*}$

$\hat{c}_{AV}$: others



Directly affects: $b^{a}_{k^*}$, $b^{a}_{r^*}$

Fitted distributions: $b^{1}_{k^*}$, $b^{2}_{k^*}$, $b^{1}_{r^*}$, $b^{2}_{r^*}$

Afterword

- JECs show some interesting behavior
  - The sources with largest impact on P, CP even operators consistent with A/H
  - Rather small impact on the CP violating ones
  - Different impact on $\hat{c}_{VA}$ and $\hat{c}_{AV}$ very interesting considering their similar impact on B_i^a
- Other experimental tend to be small except on $\hat{c}_{VA}$
  - Dominated by b-tagging and unclustered $\not{p}_T$, which is related to scattering plane position
- Impact of theoretical sources is worrying
  - Tend to drive central value of fits
  - What do color reconnection, UE tune and h_{damp} have to do with P, CP violation?
  - They are large also for P, CP even ones...
- Apparently the study adds more questions than it answers

Backup

Systematic contributions to B_i^a

	B_k^1	B_k^2	B_r^1	B_r^2	B_n^1	B_n^2	$B_{k^*}^1$	$B_{k^*}^2$	$B_{r^*}^1$	$B_{r^*}^2$
JER	0.001	0.002	0.001	0.001	0.001	0.001	-	0.001	0.001	0.001
JEC	0.011	0.012	0.007	0.009	0.003	0.003	0.009	0.008	0.007	0.007
Unclustered $\not{p}_T$	0.001	0.002	0.001	0.001	-	0.001	0.001	-	0.001	0.002
Pileup	-	-	0.002	0.002	-	0.001	0.001	0.001	-	-
Trigger efficiency	0.001	0.001	0.001	0.001	-	-	0.001	0.001	0.002	0.002
Lepton ID	0.001	-	-	-	-	-	-	-	-	-
Kinematic reconstruction	-	-	-	-	-	-	-	-	-	-
b-tagging	0.003	0.004	0.003	0.003	-	-	0.002	0.002	0.001	0.001
Background normalization	0.008	0.008	0.005	0.008	0.001	0.001	0.004	0.005	0.002	0.002
ME + PS scale	0.005	0.004	0.004	0.009	0.003	0.004	0.003	0.004	0.006	0.005
b quark fragmentation	0.009	0.009	0.004	0.005	-	0.001	0.001	0.001	0.001	0.001
B hadron leptonic BR	0.001	0.001	-	-	-	-	-	-	-	-
Color reconnection	0.005	0.003	0.003	0.004	0.008	0.005	0.006	0.008	0.006	0.008
UE tune	0.001	0.003	0.001	0.003	0.002	0.003	0.003	0.002	0.004	0.004
h_{damp}	0.006	0.006	0.004	0.001	0.003	0.004	0.003	0.003	0.004	0.004
Top quark mass	0.007	0.007	-	0.001	0.001	0.002	0.002	0.001	0.002	0.002
PDF	0.001	0.001	-	-	-	-	0.001	0.001	0.001	0.001
p_T^t reweighting	0.003	0.004	0.001	0.001	-	-	0.001	0.001	-	-
Total systematic	0.021	0.021	0.013	0.017	0.010	0.009	0.013	0.014	0.013	0.013
Data	0.009	0.008	0.009	0.009	0.007	0.008	0.010	0.010	0.010	0.009
Signal simulation	0.003	0.003	0.003	0.003	0.003	0.003	0.004	0.004	0.004	0.003
Background simulation	0.005	0.005	0.005	0.005	0.004	0.004	0.006	0.006	0.005	0.005
Total statistical	0.010	0.010	0.011	0.011	0.009	0.009	0.012	0.012	0.012	0.011
Total	0.023	0.023	0.017	0.020	0.013	0.013	0.018	0.019	0.017	0.017

Systematic contributions to C_{ii}, $C_{ij} \pm C_{ji}$, D, $A^{c_{lab}}$ and $A^{\Delta\phi_{\ell\ell}}$

	C_{kk}	C_{rr}	C_{nn}	$C_{rk}+C_{kr}$	$C_{rk}-C_{kr}$	$C_{nr}+C_{rn}$	$C_{nr}-C_{rn}$	$C_{nk}+C_{kn}$	$C_{nk}-C_{kn}$	D	$A^{c_{lab}}$	$A^{\Delta\phi_{\ell\ell}}$
JER	0.001	0.002	0.001	0.004	0.002	0.001	0.001	0.003	0.001	-	-	-
JEC	0.012	0.009	0.005	0.022	0.011	0.011	0.009	0.012	0.007	0.002	-	0.001
Unclustered $\not{p}_T$	0.001	0.001	0.001	0.004	0.001	0.001	0.002	0.001	0.001	-	-	0.001
Pileup	0.002	-	0.001	0.004	0.001	0.001	0.002	0.001	0.001	0.001	-	0.001
Trigger efficiency	0.001	0.001	-	0.002	-	-	-	-	-	-	0.001	-
Lepton ID	0.001	0.001	-	0.001	-	-	-	-	-	-	-	-
Kinematic reconstruction	-	-	-	-	-	-	-	-	-	-	-	-
b-tagging	0.004	0.001	0.002	0.005	0.001	0.001	0.001	0.001	0.001	0.001	-	-
Background normalization	0.017	0.009	0.008	0.025	0.006	0.004	0.004	0.007	0.003	0.004	0.008	0.002
ME + PS scale	0.012	0.006	0.007	0.026	0.011	0.007	0.014	0.011	0.007	0.003	0.002	0.003
b quark fragmentation	0.014	0.002	0.005	0.017	0.001	0.001	0.001	0.002	0.001	0.003	-	0.001
B hadron leptonic BR	-	0.001	0.001	0.002	-	0.001	-	-	-	0.001	-	-
Color reconnection	0.005	0.013	0.006	0.013	0.011	0.014	0.017	0.009	0.008	0.002	0.001	0.001
UE tune	0.008	0.002	0.002	0.004	0.010	0.007	0.005	0.007	0.002	0.003	0.001	0.001
h_{damp}	0.004	0.003	0.001	0.009	0.016	0.011	0.001	0.012	0.009	0.002	0.002	0.004
Top quark mass	0.001	0.002	0.006	0.006	0.009	0.002	0.002	0.009	0.001	0.002	0.001	-
PDF	0.002	0.002	0.001	0.002	-	-	-	-	-	0.001	0.003	0.001
p_T^t reweighting	0.008	0.011	0.005	0.019	-	0.001	-	0.001	-	0.004	0.003	0.005
Total systematic	0.031	0.023	0.016	0.053	0.029	0.024	0.025	0.026	0.016	0.009	0.010	0.007
Data	0.018	0.019	0.010	0.029	0.029	0.024	0.025	0.025	0.020	0.006	0.003	0.003
Signal simulation	0.007	0.007	0.004	0.011	0.011	0.009	0.009	0.010	0.008	0.002	0.001	0.001
Background simulation	0.010	0.010	0.005	0.018	0.017	0.012	0.010	0.015	0.012	0.003	0.002	0.002
Total statistical	0.022	0.023	0.012	0.035	0.035	0.028	0.028	0.031	0.025	0.007	0.003	0.003
Total	0.038	0.032	0.020	0.064	0.046	0.037	0.038	0.041	0.029	0.011	0.010	0.008