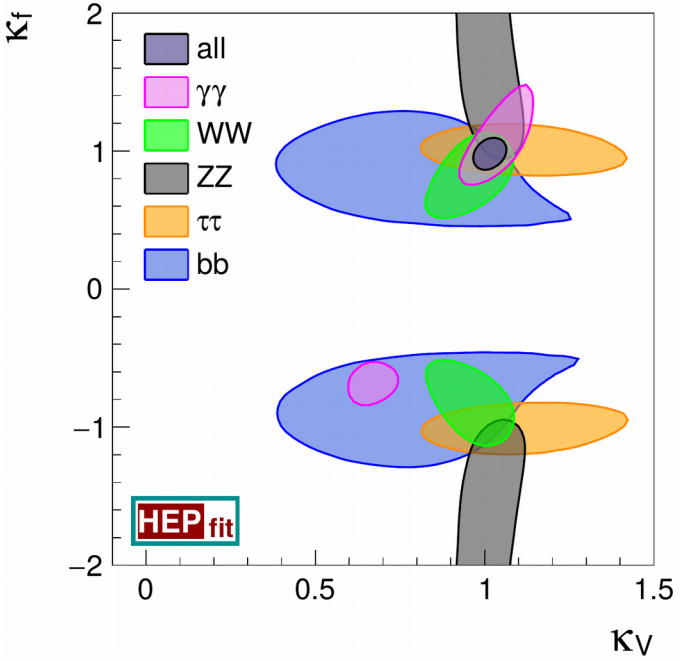
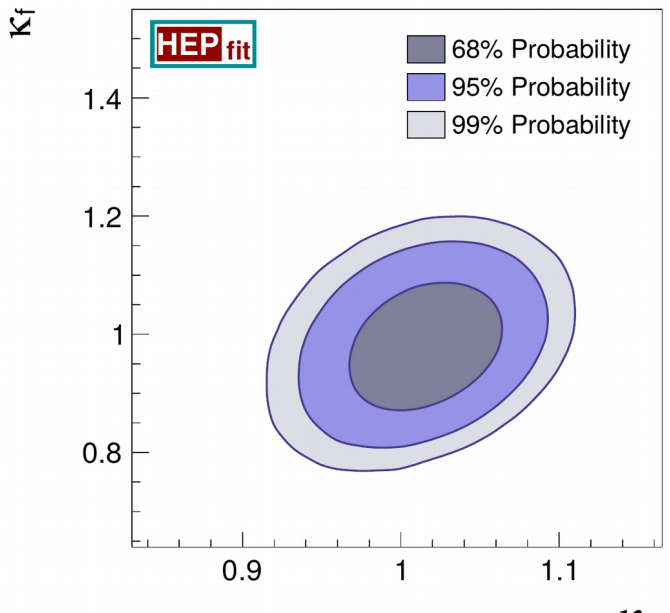
κ_V and κ_f



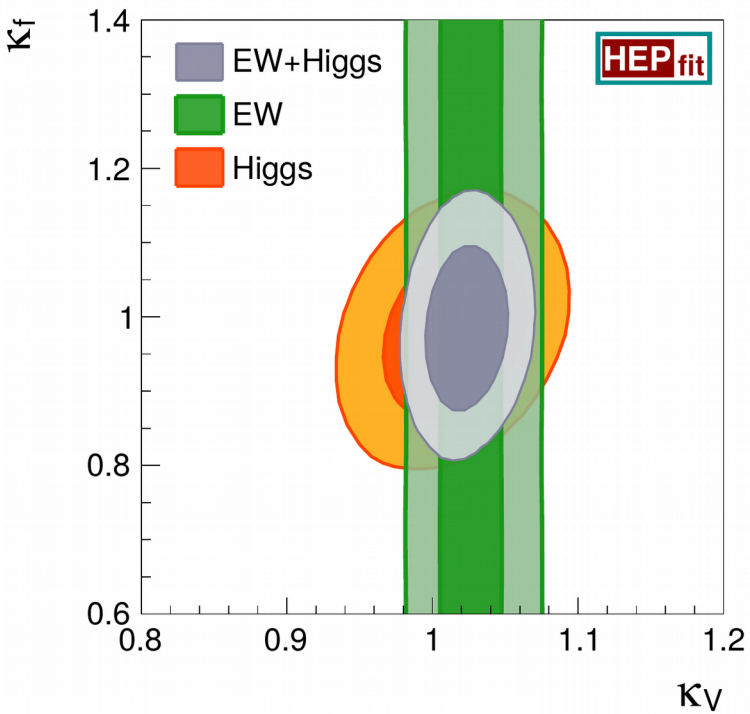


Higgs data only

	Result	95% Prob.	Correlation	
κ_V	1.01 ± 0.03	$[0.95, 1.07]$	1.00	
κ_f	0.98 ± 0.07	$[0.86, 1.12]$	0.29	1.00

Higgs + EWPO

	Result	95% Prob.	Correlation	
κ_V	1.02 ± 0.02	$[0.99, 1.06]$	1.00	
κ_f	0.99 ± 0.07	$[0.86, 1.12]$	0.17	1.00



SMEFT BASICS II

- Effects of $\mathscr{L}_6$ in SM processes suppressed by $\frac{(v,p)^2}{\Lambda^2}$ at linear order
- Truncation of the expansion at D=6 implies $(v,p) \ll \Lambda$ (to be checked a posteriori)
- Higher energy can compensate for lower precision (e.g. LEPII vs LEP); requires detailed knowledge of process kinematics - beware of overflow bins!

Contino et al.

RELEVANT SMEFT OP'S...

$$\mathcal{O}_{\phi G} = (\phi^\dagger\phi)\, G^A_{\mu\nu} G^{A\mu\nu} \ ,$$
$$\mathcal{O}_{\phi W} = (\phi^\dagger\phi)\, W^I_{\mu\nu} W^{I\mu\nu} \ ,$$
$$\mathcal{O}_{\phi B} = (\phi^\dagger\phi)\, B_{\mu\nu} B^{\mu\nu} \ ,$$
$$\mathcal{O}_{\phi WB} = (\phi^\dagger\sigma_I\phi)\, W^I_{\mu\nu} B^{\mu\nu} \ ,$$
$$\mathcal{O}_{\phi D} = (\phi^\dagger D^\mu\phi)^* (\phi^\dagger D_\mu\phi) \ ,$$
$$\mathcal{O}_{\phi\Box} = (\phi^\dagger\phi)\Box(\phi^\dagger\phi)$$

$$\mathcal{O}_{e\phi} = (\phi^\dagger\phi)(\bar{L}\, e_R\phi)$$
$$\mathcal{O}_{u\phi} = (\phi^\dagger\phi)(\bar{Q}\, u_R\widetilde{\phi})$$
$$\mathcal{O}_{d\phi} = (\phi^\dagger\phi)(\bar{Q}\, d_R\phi)$$

$$\mathcal{O}^{(1)}_{\phi L} = (\phi^\dagger i\overleftrightarrow{D}_\mu\phi)(\overline{L}\gamma^\mu L) \ ,$$
$$\mathcal{O}^{(3)}_{\phi L} = (\phi^\dagger i\overleftrightarrow{D}^I_\mu\phi)(\overline{L}\,\sigma_I\gamma^\mu L) \ ,$$
$$\mathcal{O}_{\phi e} = (\phi^\dagger i\overleftrightarrow{D}_\mu\phi)(\overline{e}_R\gamma^\mu e_R) \ ,$$
$$\mathcal{O}^{(1)}_{\phi Q} = (\phi^\dagger i\overleftrightarrow{D}_\mu\phi)(\overline{Q}\gamma^\mu Q) \ ,$$
$$\mathcal{O}^{(3)}_{\phi Q} = (\phi^\dagger i\overleftrightarrow{D}^I_\mu\phi)(\overline{Q}\,\sigma_I\gamma^\mu Q) \ ,$$
$$\mathcal{O}_{\phi u} = (\phi^\dagger i\overleftrightarrow{D}_\mu\phi)(\overline{u}_R\gamma^\mu u_R) \ ,$$
$$\mathcal{O}_{\phi d} = (\phi^\dagger i\overleftrightarrow{D}_\mu\phi)(\overline{d}_R\gamma^\mu d_R) \ ,$$

$$\mathcal{O}_{LL} = (\bar{L}\gamma^\mu L)(\bar{L}\gamma^\mu L)$$

BOUNDS ON SMEFT COEFF'S

- Working in GIMR basis, obtain bounds from
  - EWPO only
  - Higgs only
  - EWPO + Higgs combined
- working at linear order, fit one operator at a time or all relevant op's simultaneously
- take C_i at EW scale, no running included

[See also Corbett et al, Ellis et al, Falkowski & Riva, ...]

Bounds from EWPO

Operator	95% prob. range $\frac{C_i}{\Lambda^2}$ [TeV^{-2}]	95% prob. lower bound on Λ [TeV] ($\lvert C_i\rvert = 1$)
$C_{\phi WB}$	$[-0.0095, 0.0038]$	10
$C_{\phi D}$	$[-0.028, 0.0036]$	6.0
$C_{\phi l}^{(1)}$	$[-0.0058, 0.011]$	9.6
$C_{\phi l}^{(3)}$	$[-0.012, 0.0051]$	9.1
$C_{\phi e}^{(1)}$	$[-0.017, 0.005]$	7.7
$C_{\phi Q}^{(1)}$	$[-0.026, 0.044]$	4.8
$C_{\phi Q}^{(3)}$	$[-0.011, 0.015]$	8.2
$C_{\phi u}$	$[-0.066, 0.087]$	3.4
$C_{\phi d}$	$[-0.15, 0.054]$	2.5
C_{LL}	$[-0.0093, 0.021]$	6.8

PRELIMINARY

BOUNDS FROM HIGGS

Operator	95% prob. range $\frac{C_i}{\Lambda^2}$ [TeV^{-2}]	95% prob. lower bound on Λ [TeV] ($\lvert C_i\rvert = 1$)
$C_{\phi G}$	$[-0.00078, 0.0062]$	13
$C_{\phi W}$	$[-0.018, 0.0083]$	7.5
$C_{\phi B}$	$[-0.0053, 0.0026]$	14
$C_{\phi WB}$	$[-0.0047, 0.0097]$	10
$C_{\phi D}$	$[-1.5, 0.31]$	0.83
$C_{\phi\Box}$	$[-0.12, 1.6]$	0.80
$C_{\phi l}^{(3)}$	$[-0.62, 0.10]$	1.3
$C_{\phi Q}^{(1)}$	$[-3.1, 1.2]$	0.57
$C_{\phi Q}^{(3)}$	$[-0.14, 0.22]$	2.1
$C_{\phi u}$	$[-1.2, 1.4]$	0.86
$C_{\phi d}$	$[-3.7, 3.5]$	0.52
$C_{e\phi}$	$[-0.036, 0.020]$	5.2
$C_{u\phi}$	$[-2.1, 0.17]$	0.69
$C_{d\phi}$	$[-0.00065, 0.066]$	3.9
C_{LL}	$[-0.21, 1.2]$	0.90

- In progress: evaluation of uncertainty of SMEFT expansion (linear vs quadratic)

PRELIMINARY

BOUNDS FROM EWPO + HIGGS

Operator	95% prob. range $\frac{C_i}{\Lambda^2}$ [TeV^{-2}]	95% prob. lower bound on Λ [TeV] ($\lvert C_i\rvert = 1$)
$C_{\phi G}$	$[-0.00076, 0.0063]$	13
$C_{\phi W}$	$[-0.018, 0.0084]$	7.5
$C_{\phi B}$	$[-0.0053, 0.0025]$	14
$C_{\phi WB}$	$[-0.0052, 0.0045]$	14
$C_{\phi D}$	$[-0.028, 0.0035]$	6.0
$C_{\phi\Box}$	$[-0.12, 1.6]$	0.80
$C_{\phi l}^{(1)}$	$[-0.0058, 0.011]$	9.6
$C_{\phi l}^{(3)}$	$[-0.012, 0.0052]$	9.1
$C_{\phi e}^{(1)}$	$[-0.017, 0.0051]$	7.7
$C_{\phi Q}^{(1)}$	$[-0.026, 0.044]$	4.8
$C_{\phi Q}^{(3)}$	$[-0.010, 0.015]$	8.1
$C_{\phi u}$	$[-0.066, 0.087]$	3.4
$C_{\phi d}$	$[-0.15, 0.055]$	2.5
$C_{e\phi}$	$[-0.037, 0.020]$	5.2
$C_{u\phi}$	$[-2.1, 0.16]$	0.69
$C_{d\phi}$	$[-0.0006, 0.066]$	3.9
C_{LL}	$[-0.0093, 0.021]$	6.9

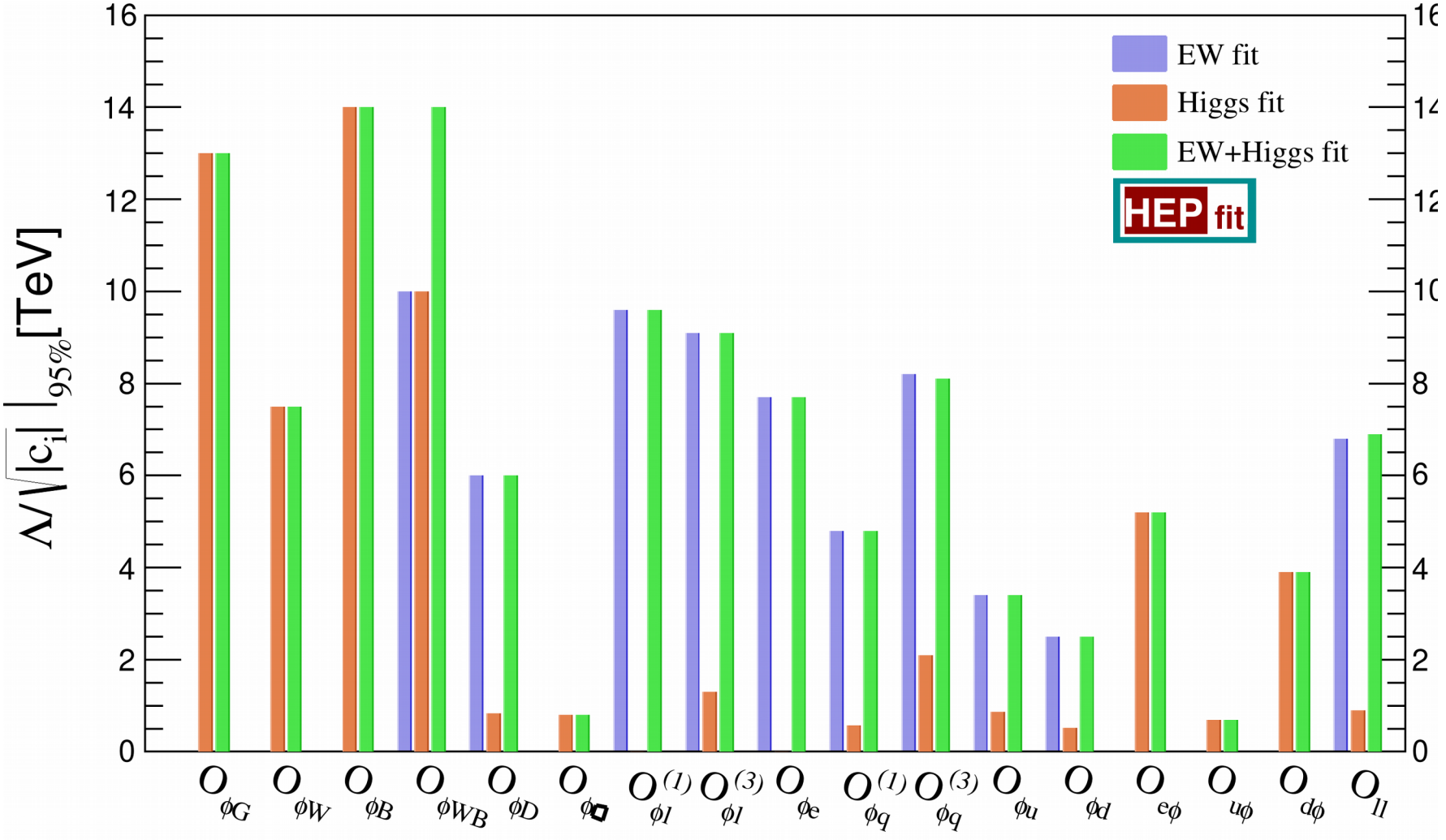
Wilson Coefficient	Λ [TeV] Indv.	Λ [TeV] Marg.
C_{dH}	0.65	0.31
C_{eH}	0.57	0.48
C_G	0.61	0.54
C_{HB}	17.7	2.2
$C_{H\Box}$	0.84	0.24
C_{Hd}	2.7	0.93
C_{HD}	6.8	1.4
C_{He}	8.2	2.0
C_{HG}	12.5	8.3
$C_{H\ell}^{(1)}$	8.9	2.6
$C_{H\ell}^{(3)}$	9.9	1.3
$C_{Hq}^{(1)}$	4.9	2.7
$C_{Hq}^{(3)}$	8.4	1.2
C_{Hu}	3.6	1.7
C_{HW}	9.8	1.4
C_{HWB}	14.1	1.7
$C_{\ell\ell}$	7.4	1.7
C_{uG}	1.2	0.20
C_{uH}	0.46	0.09
C_W	0.80	0.61

Table 10: 95% probability on the lower bound on Λ [TeV] for the cases of fitting coefficient at a time (left), and fitting all coefficients simultaneously (right).

PRELIMINARY

Ellis, Murphy, Sanz, You

Bounds from EWPO + Higgs

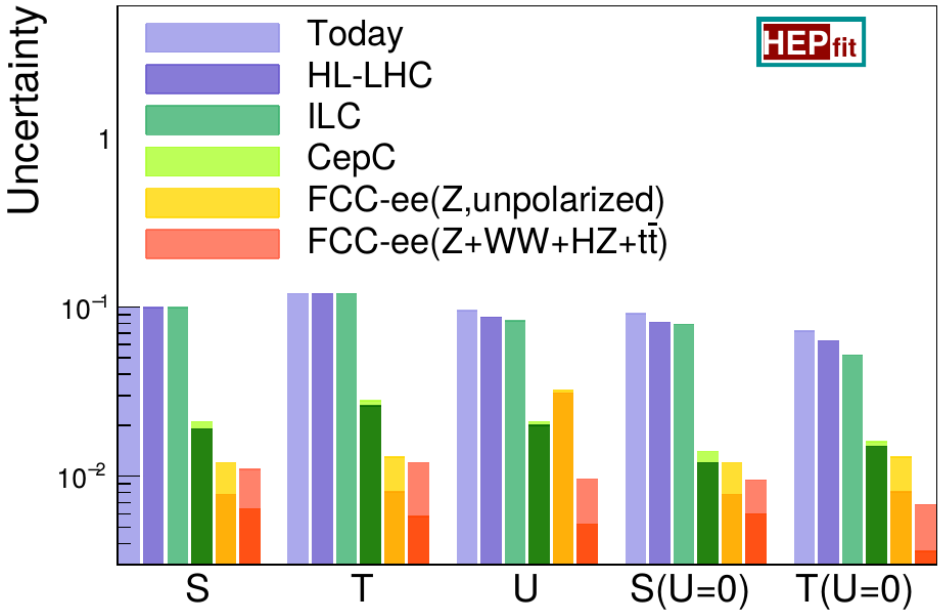


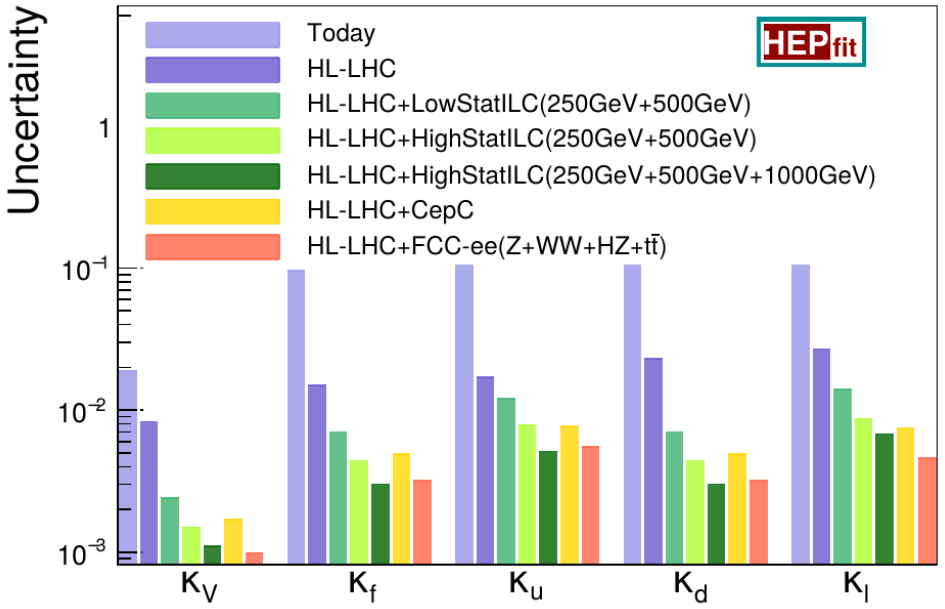
PRELIMINARY

Coefficient	Z-pole + m_W	WW at LEP2	Higgs Run1	Higgs Run2	LHC WW high-p_T
$\bar{C}_{dH}$	×	×	36	64	×
$\bar{C}_{eH}$	×	×	49.6	50.4	×
$\bar{C}_{G}$	×	×	2.3	97.7	×
$\bar{C}_{HB}$	×	×	19	81	×
$\bar{C}_{H\Box}$	×	×	19.7	80.3	0.01
$\bar{C}_{Hd}$	99.88	×	0.04	0.07	×
$\bar{C}_{HD}$	99.92	0.06	×	×	×
$\bar{C}_{He}$	99.99	0.01	×	×	×
$\bar{C}_{HG}$	×	×	34	66	0.02
$\bar{C}^{(1)}_{H\ell}$	99.97	0.03	×	×	×
$\bar{C}^{(3)}_{H\ell}$	99.56	0.41	×	×	0.01
$\bar{C}^{(1)}_{Hq}$	99.98	×	0.01	0.01	×
$\bar{C}^{(3)}_{Hq}$	98.6	0.96	0.19	0.23	0.07
$\bar{C}_{Hu}$	99.5	×	0.2	0.3	0.04
$\bar{C}_{HW}$	×	×	18	82	×
$\bar{C}_{HWB}$	57.9	0.02	8.2	33.9	×
$\bar{C}_{\ell\ell}$	99.66	0.32	×	0.01	0.01
$\bar{C}_{uG}$	×	×	7.8	92.2	×
$\bar{C}_{uH}$	×	×	9.5	90.5	×
$\bar{C}_{W}$	×	96.2	×	×	3.8

Ellis, Murphy, Sanz, You

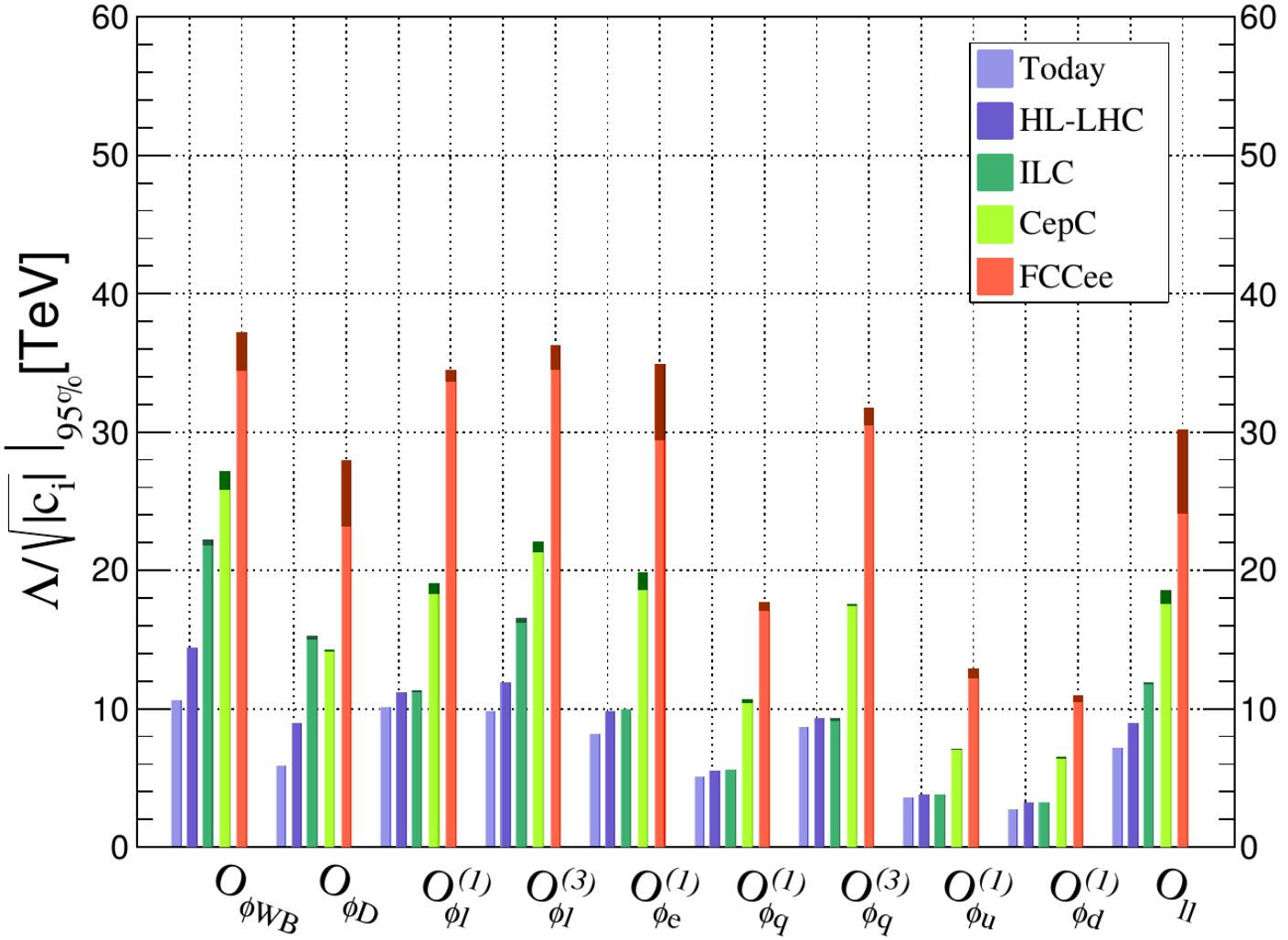
Future Prospects: NP analyses



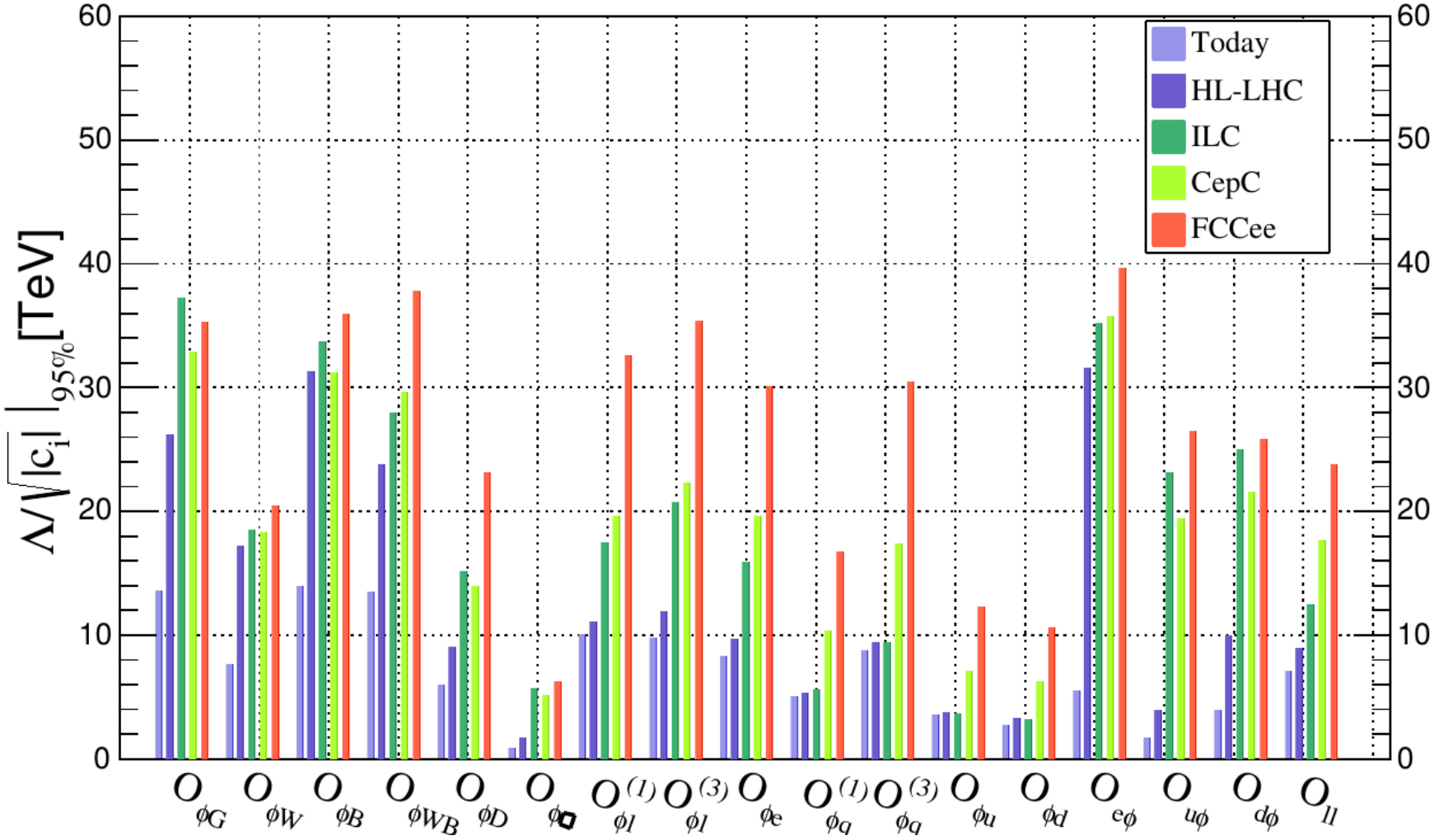


Lighter: incl. th. error;
darker: no theory error

Future Prospects: Λ from EWPO



Future Prospects: Λ from EWPO, μ_i



INPUTS FOR THE YR

- Updated projection of uncertainties on μ_i for all production modes and decays
- Additional inputs?
  - p_T distributions
  - ratios of BR's
  - ...