

## Updates (inputs)

- $m_W$ ,  $\sin^2\theta$ ,  $m_Z$ : OK
- EW fits : Jorge will circulate results asap
- Higgs
  - Cross sections
    - stick to HL-LHC central values; PDF and  $\alpha_S$  uncertainties including LHeC prospects
    - Installed MCFM (last version), some compilation errors and interactions with the authors, now running cross sections
    - Help from Daniel (thanks!). Can your setup produce cross sections separately for the various sub-processes?
  - Couplings
    - Disappointingly small impact, see next slide. So discussions, but effect seems real.
    - What do we do?

## Updates (inputs)

- Higgs couplings

Parameter	Relative signal theory uncertainty		
	HL-LHC YR	w/o PDF+alphaS	w/o PDF+alphaS, QCD scale, and BR
<b>kW</b>	0.01157	0.01101	0.00614
<b>kZ</b>	0.00989	0.00942	0.00370
<b>kt</b>	0.02612	0.02525	0.01361
<b>kb</b>	0.02116	0.02030	0.01106
<b>ktau</b>	0.01533	0.01399	0.00618
<b>kg</b>	0.02180	0.02017	0.00841
<b>kgam</b>	0.01076	0.00972	0.00423
<b>kmu</b>	0.02049	0.01862	0.01410
<b>kZgam</b>	0.06356	0.06169	0.03088

# Updates (inputs)

- Contact interactions
  - Found understanding with ATLAS analyzers and PC
  - Refer to most recent paper 30 fb<sup>-1</sup>, 13 TeV
    - Scale statistics to 3 ab<sup>-1</sup>
    - Systematics unchanged
    - Mass-dependent reduction of PDF uncertainties
  - PC agrees with this procedure
  - Timescale ~two weeks. Can prepare text in advance, and include the table when it comes.
  - Physics question (Klaus):

With LHeC you get to pretty high  $Q^2$ . Does it make sense to extract the PDFs assuming the SM and then use them for EFT fits? Wouldn't you need to do a common fit to both datasets fitting EFTs and PDFs simultaneously?

Old stuff

mW

$\sqrt{s}$ [TeV]	7	14	14	14	14
$\mathcal{L}$ [fb $^{-1}$ ]	5	1	1	1	1
PDF set	CT10	CT14	HL-LHC	LHeC	LHeC
Acceptance	$ \eta  < 2.4$	$ \eta  < 2.4$	$ \eta  < 2.4$	$ \eta  < 2.4$	$ \eta  < 4$
Statistical	$\pm 7$	$\pm 5$	$\pm 4.5$	$\pm 4.5$	$\pm 3.7$
PDFs	$\pm 9$	$\pm 12$	$\pm 5.8$	$\pm 2.2$	$\pm 1.6$
Other Syst.	$\pm 13$	-	-	-	
Total	$\pm 19$	13	7.3	5.0	4.1

**Table 1.2:** Measurement uncertainty for different lepton acceptance regions, centre-of-mass energies and PDF sets, combined fits to the  $p_T^\ell$  and  $m_T$  distributions, and for 200  $pb^{-1}$  collected at each energy. The numbers quoted for  $0 < |\eta| < 2.4$  correspond to the combination of the four pseudorapidity bins in this range. In each case, the first number corresponds to the sum of statistical and PDF uncertainties, and the numbers between parentheses are the statistical and PDF components, respectively.

# sin2theta

$\sqrt{s}$ [TeV]	8	14	14	14
$\mathcal{L}$ [fb <sup>-1</sup> ]	20	3000	3000	3000
PDF set	MMHT2014	CT14	PDF4LHC15 <sub>HL-LHC</sub>	LHeC
Experimental	$\pm 23$	$\pm 9$	$\pm 7$	$\pm 7$
PDFs	$\pm 24$	$\pm 16$	$\pm 13$	$\pm 3$
Other Syst.	$\pm 13$	-	-	-
Total	$\pm 36$	$\pm 18$	$\pm 15$	$\pm 8$

**Table 1.1:** The breakdown of uncertainties from the ATLAS preliminary results at  $\sqrt{s} = 8$  TeV with 20 fb<sup>-1</sup> [?] is compared to the projected measurements with 3000 fb<sup>-1</sup> of data at  $\sqrt{s} = 14$  TeV for two PDF sets considered in this note. All the numbers values are given in units of 10<sup>-5</sup>. Note that other sources of systematic uncertainties, such as the impact of the MC statistical uncertainty, evaluated in Ref. [?] are not considered in this prospect analysis. For the HL-LHC prospect PDFs the "ultimate" scenario is chosen.

# sigmaH

Process	$\sigma_H$ pb	$\Delta_{\text{scale}}$	$\Delta_{\text{PDF}+\alpha_S}$ (current)	$\Delta_{\text{PDF}+\alpha_S}$ (HL-LHC)	$\Delta_{\text{PDF}+\alpha_S}$ (LHeC)
Gluon-fusion					
Vector-boson-fusion					
$pp \rightarrow WH$					
$pp \rightarrow ZH$					
$pp \rightarrow t\bar{t}H$					

Table 1.3: Higgs cross sections

## HLLHC report table :

Table 2: Gluon fusion Higgs boson production cross sections and uncertainties as a function of the  $pp$  collider energy.

$\sqrt{s}$	$\sigma$	$\delta(\text{theory})$	$\delta(\text{PDF})$	$\delta(\alpha_s)$
13 TeV	48.61 pb	$\begin{matrix} +2.08\text{pb} \\ -3.15\text{pb} \end{matrix} \begin{pmatrix} +4.27\% \\ -6.49\% \end{pmatrix}$	$\pm 0.89 \text{ pb } (\pm 1.85\%)$	$\begin{matrix} +1.24\text{pb} \\ -1.26\text{pb} \end{matrix} \begin{pmatrix} +2.59\% \\ -2.62\% \end{pmatrix}$
14 TeV	54.72 pb	$\begin{matrix} +2.35\text{pb} \\ -3.54\text{pb} \end{matrix} \begin{pmatrix} +4.28\% \\ -6.46\% \end{pmatrix}$	$\pm 1.00 \text{ pb } (\pm 1.85\%)$	$\begin{matrix} +1.40\text{pb} \\ -1.41\text{pb} \end{matrix} \begin{pmatrix} +2.60\% \\ -2.62\% \end{pmatrix}$
27 TeV	146.65 pb	$\begin{matrix} +6.65\text{pb} \\ -9.44\text{pb} \end{matrix} \begin{pmatrix} +4.53\% \\ -6.43\% \end{pmatrix}$	$\pm 2.81 \text{ pb } (\pm 1.95\%)$	$\begin{matrix} +3.88\text{pb} \\ -3.82\text{pb} \end{matrix} \begin{pmatrix} +2.69\% \\ -2.64\% \end{pmatrix}$

# contents

- mW, sin2theta: OK
- mZ : propose to include it, and refer to CDF measurement
  - $\delta m_Z \sim 15$  MeV with 55k events
- Higgs / Marumi
  - $\alpha_s$  : used  $\Delta\alpha_s = 0.0015 \rightarrow$  factor 10
  - PDFs : PDF4LHC\_HLLHC  $\rightarrow$  LHeC
    - Requested calculation of PDF uncertainty factor at lower perturbative order; waiting for news
    - Otherwise estimate from PDF plots ( $\delta g$  at  $x \sim 0.01$ , etc)
- Contact interactions
  - Dan Hayden, Noam Hod (ATLAS)
  - Proposal : scale 13 TeV result according to statistics ( $30 \text{ fb}^{-1} \rightarrow 3 \text{ ab}^{-1}$ ), with and without PDF uncertainty
  - Timescales
    - Analysis : few weeks
    - Publication : contacted PC; waiting. Worthwhile?
- SUSY : received refs from Monica
- EW fit : Jorge to circulate plots