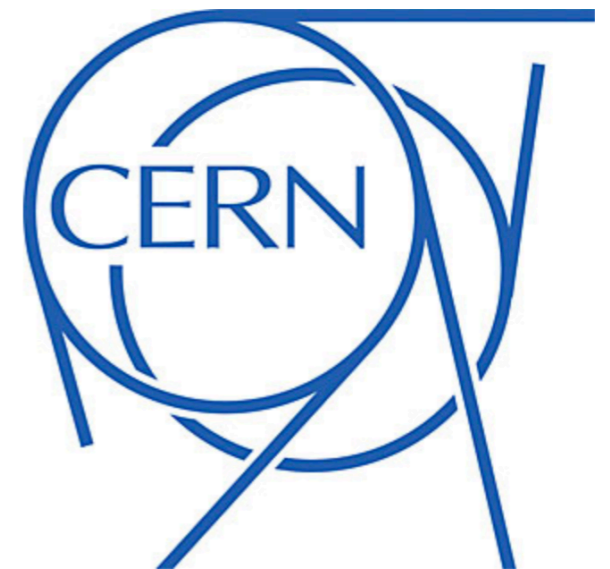# Fitting exercise: ATLAS vision

Ana Cueto (CERN)

ATLAS plans

▷ ATLAS experience and plans already presented in <u>this talk</u>.

▷ Aim for a Higgs + EW + top + non-LHC constraints

HIGGS

STXS measurements

Likelihood reparametrisation

EW

**WW, WZ, 4l and VBF Z
(one distribution from each)**

Gaussian model with NP

TOP

**At least one of: ttV, tt
differential cross section, tt
charge asymmetries, 4top**

non-LHC

**Z-pole and diboson data
from LEP**

Helps lifting flat directions
Multivariate Gaussian term in the LH

Previous step: HWW+WW

▷ Combination of H->WW* production mode signal strengths in the VBF and ggH channel with differential WW cross sections

▷ Measured in **orthogonal regions** (use WW SR as CR for H->WW) and uncertainties correlated appropriately

See Jack's talk

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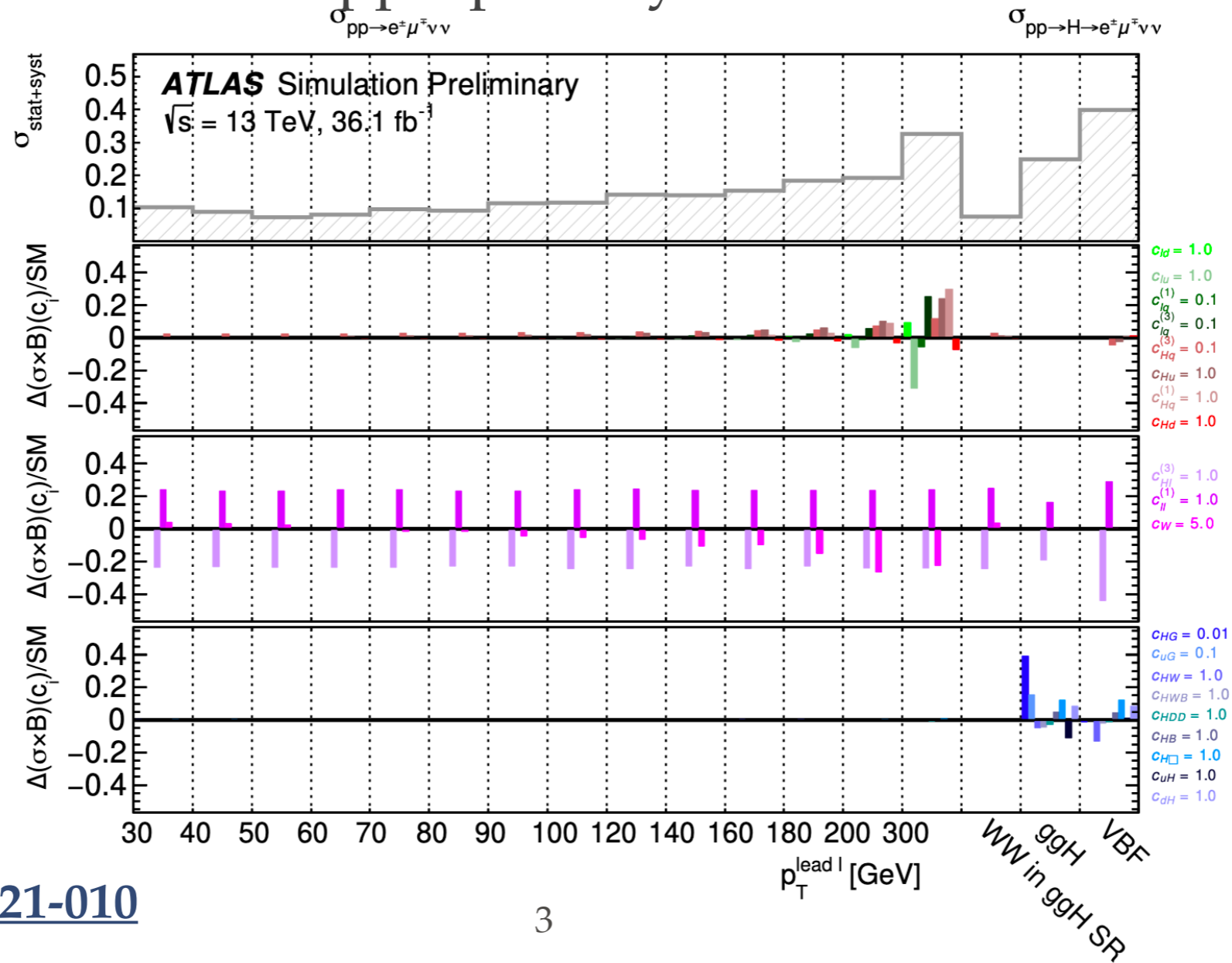
Global fit: Some agreements

▷ **Basis**: Dimension-6 Warsaw basis

▷ **Flavour structure**: "topU3l" $U(2)^3_{q,u,d}U(3)^2_{l,e}$ when combining with top. $U(3)^5$ without top.

▷ **Input scheme**: (mW, mZ, GF) scheme alpha-scheme as alternative

▷ **SMEFTsim** (for tree-level) and **SMEFT@NLO** (for loop-induced) to simulate the EFT impact

▷ Single insertions of SMEFT operators for each process

▷ Rescale predictions to best SM computation $\quad \sigma(c) = \sigma^{\text{SM}} \dfrac{\sigma^{\text{EFT}}(c)}{\sigma^{\text{EFT}}(c=0)}$

▷ Include acceptance effects as multiplicative factor in the reparametrisation when suitable

   ✳ Mostly used in Higgs analyses

Global fit: Some agreements

▷ Combined likelihood: product of per analysis LH

   ✳ Using common NPs for experimental and theory uncertainties

▷ Simultaneous fit when possible. PCA to find sensitive directions

   ✳ More common among Higgs analyses
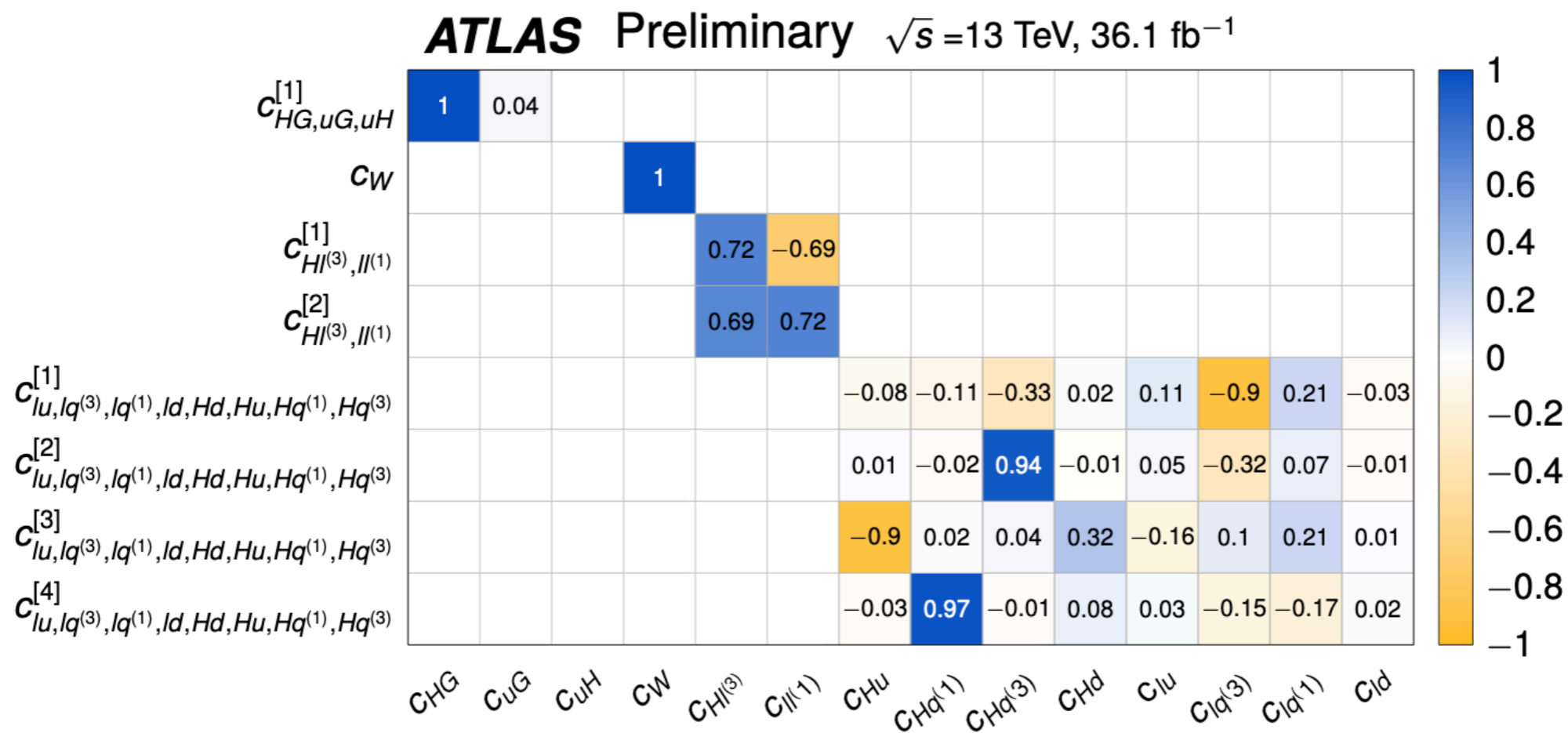
But also several open questions

Linear | Linear+quadratic | just report both ?

Issues with EFT validity in tails of distributions?

Quadratic is incomplete

Interference effects can be suppressed

Linear make yields/cross sections go negative for some values of c_i

Truncation? Clipping (derive limits for various clipping energies)?

Uncertainties in the EFT predictions? Which ones?

Missing orders in the EFT expansion

Interplay with QCD uncertainties?

▷ Overlap with the goals of the EFT WG

* Pragmatic solutions to be taken in the short-, mid-term

Combination with CMS

▷ Two main areas of discussion is needed:
   ✳ Combination of measurements itself
   ✳ EFT strategy

▷ Experience combining <u>Higgs analysis</u> and some top measurements
   (some event with interpretations: <u>W helicity</u>)
   ✳ How many measurements will we be combining?
   ✳ Size of the workspaces and technical limitations: thousands of NPs,
     large memory consumption, fits taking days to converge, …
   ✳ Understanding each other inputs are expected to trigger long
     discussions

Combination with CMS

▷ EFT reinterpretation might sound trivial after measurements are combined. But it will **require agreements on**:

* **Settings and tools** for EFT simulation and cross-checks of parametrisation

* How to correct for **acceptance effects** in Higgs analyses or if this correction will be applied. Are there substantial differences in the reconstruction strategy that make them be different between experiments?

* Which EFT **uncertainties** to consider and how to estimate them

* How to treat **flat directions**

* How to deal with measurements that are only sensitive to high values of Wilson coefficients in the tails

* Which results to report?

* Usage of **additional non-LHC constraints**

* Probably many other details

Combination with CMS

▷ It will be useful to make a technical exercise:

✳ Can be done without data (e.g. HL-LHC projection)
✳ Using internal workspaces
✳ Simplify the number of measurements
   ✦ But ideally cover issues affecting Higgs, EW and top measurements
✳ Timeline should not be extremely long
   ✦ Some agreements and discussions can take (are taking) place before people put their hands on
   ✦ Around a year would be optimal (otherwise, will affect personpower)
✳ Results to be cross checked by both experiments
✳ Might help converging to recommendations even if pragmatic solutions have to be taken

Conclusions

▷ ATLAS is working towards a global fit with Higgs+EW+Top data

* Experience with interpretations in Higgs combination and H->WW+WW

▷ Experience combining Higgs and top data with CMS

▷ Will probably need to face some technical limitations

▷ EFT interpretation strategy needs to be agreed

▷ Technical exercise will be extremely useful