Fits and related systematics

Florencia Canelli, Nuno Castro
on behalf of the LHC EFT WG conveners

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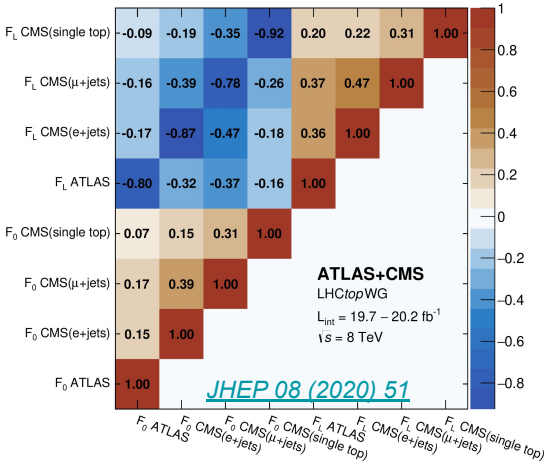
Experimental EFT fits

- There is a considerable experience in ATLAS+CMS in the combination of measurements, including in context of EFT
  - But so far done with limited scope (e.g. particular WGs)

- How to go beyond this and move to global fits?
  - Combinations to be done within the LHC EFT WG (ATLAS+CMS with guidance from the LHC EFT WG)
  - How to profit from the current experience?
    - Experiments
    - Theory (many global fits already available)

- Goals for the fits?



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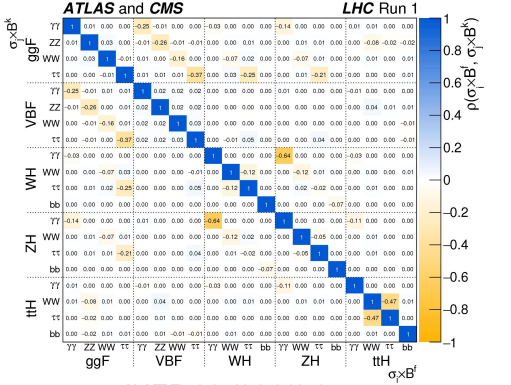

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Inputs and outputs, fitting procedures and tools (1)

- How to obtain results in a reasonable timescale?
  - Practical considerations of limited time and experimental input: pragmatic approach

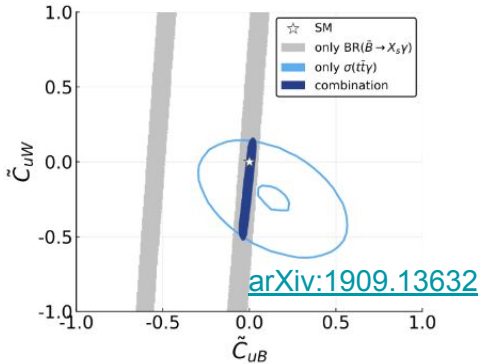
- Fitting benchmarks for synchronisation
  - Which would be the relevant benchmarks, i.e. set of inputs to test the technical framework?
  - Could these be used already to obtain relevant results?
    - Would it be useful to start with a not-so-global fit using a few input measurements from Higgs, Top and SM?

Inputs and outputs, fitting procedures and tools (2)

- Use of ML tools to identify the best observables to provide better constraints in a multidimensional space?
- Comparisons of input information between experimental results
  - Which formats? Likelihood-based or observable-based fits?
- Compare fits: experimental/theory, among different groups
  - Can we use the available “theory” fits as a guide to learn which technical aspects are important? And vice-versa?
- Consideration of common WG fits
  - Which frameworks? Best approaches?

Comparison to, and inclusion of non-LHC constraints

- LEP, Tevatron, flavor, g-2, EDM, etc. results
  - How to properly treat them in the fit?
    - For experiments which are no longer active, do we have enough information? (e.g. systematics, correlations)
      - How to deal with the unavailable information?
    - Inclusion in the fit vs. comparison of constraints



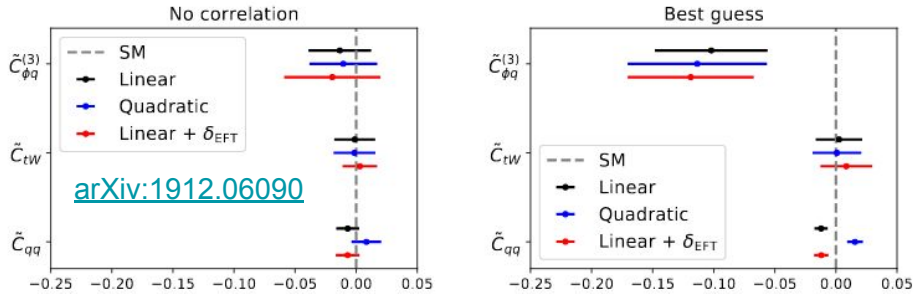
arXiv:1909.13632

Theoretical systematics

- EFT: inferring BSM effects from precision measurements
  - Signal and background modelling is critical
    - Higher order effects can be of the same order as the BSM effects
    - How to deal with this?
      - Specific regions of the phase space?
      - Better modelling?
- Missing higher orders in the EFT
- Unknown SMEFT corrections to extraction of α_s, PDFs, hadronization, etc
- Correlations between theory uncertainties

Experimental systematics

- EFT operators affect both signal and backgrounds across the different measurements
  - How to properly treat this in a global fit?
  - Correlations in systematics (for different measurements, namely between experiments)
  - Experimental detector acceptance effects and their propagation to global fits
  - Correlations with the theory uncertainties (modelling)? Background modeling?
  - Can we build upon the previous experience in inter-experiments combinations?
  - Scalability of the procedure with increasing number of inputs (and systematics)?



Presentation of EFT Fits

- How to allow / stimulate (re-)interpretations of the obtained results?
  - E.g. re-interpretation of global EFT fits would involve using the constraints on higher-dim operators to set constraints on a specific, concrete, BSM model
  - Which information would be useful to publish?
    - Covariance matrices
    - Multidimensional likelihoods
    - …
- Do we need standards fors this?
- Technical difficulties?

Projections of EFT fit constraining power

- Smaller priority than the previous items, but also very important
- Can also provide useful input to the present/medium term fits
- What can be learn from the work done / being done for the update of the European Strategy and Snowmass?
- How to organize this effort for the future?