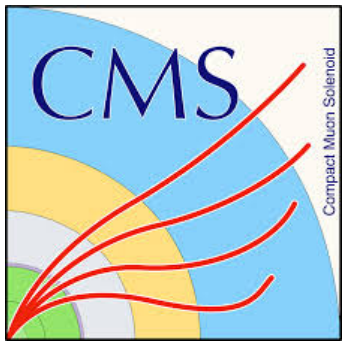


LHC EFT WG Area 2 *and what we can contribute*

Celine Degrande, Abideh Jafari, Pierre Savard

LHC EFT WG Area2 meeting
31 Jan 2022

HELMHOLTZ
SPITZENFORSCHUNG FÜR
GROSSE HERAUSFORDERUNGEN

Recap: what is Area 2?

- What you see in the twiki

Predictions and Tools

Topics covered by the activity area

This activity area addresses all issues of how to simulate EFT and generate events; understanding of the limitations of the models and agreements on the way to proceed in the EFT publications and calculations. Identification and estimation of all relevant theory systematics, and calculation in a form which is usable in likelihood fits by the experimental community; investigation of matters related to the computational limitations in the events production for experimental analyses.

- Guidance
  - Availability (analytic & numeric), usage, assumptions, uncertainties, interplay of tools
  - Reweighting techniques to reduce the full detector simulation sample size (and validation of those techniques)
  - Higher-order corrections in SM couplings
- Deliverables
  - Cross-validation at tree and loop levels
  - Common MC generation and/or settings across experiments
  - Observable calculations (including e.g. fiducial cross-sections, see Area 3.) and analytical parameterizations (also to NLO), comparisons between tools, uncertainties
  - Tools to relate parameters, measured quantities, etc
- Specific theory developments
  - Recommendations for the treatment of unstable particles (combining EFT dependence in production, total width, and decay; treatment in MC tools) (**)
- EFT in PDFs, alpha_s, shower and hadronization

Recap: what is Area 2?

- The current focus is on *Deliverables*

- Deliverables
  - Cross-validation at tree and loop levels
  - Common MC generation and/or settings across experiments
  - Observable calculations (including e.g. fiducial cross-sections, see Area 3.) and analytical parameterizations (also to NLO), comparisons between tools, uncertainties
  - Tools to relate parameters, measured quantities, etc

  - Mainly an effort towards a global combination in future

- One dedicated meeting on the status of theory (Dec 2020)
  - Status updates in 2nd and 3rd general meetings

Area 2 and experiments

In the 3rd general meeting two reports on advancements and studies from the experimental side

- Comparisons of **SM**EFTsim and **SMEFTatNLO**.
- More recently: comparisons of **SM**EFTsim **2.5** and **SM**EFTsim **3.0** + additional tests of **new SM**EFTsim **3.0 features**:
  - ❖ linearised SMEFT corrections to the propagators of unstable particle.
  - ❖ coupling restrictions used to generate interference-only and/or new-physics-only samples.
  - ❖ test one-loop SM interactions with up to 4 gluons (description of Higgs-gluon vertices has been improved).
- Tests of reweighting vs full simulation.

ATLAS

link

SMEFTsim

SMEFT@NLO

MADGRAPH5 aMC@NLO

Area 2 and experiments

In the 3rd general meeting two reports on advancements and studies from the experimental side

Comparison of EFT MC models of Higgs couplings (HVV)

link

CMS

Summary of Conventions

We observe great agreement across all tools for many Higgs Processes

HOWEVER

Agreement requires precise understanding of underlying structure of tools

(1) $ggH, \gamma\gamma H, \gamma ZH$ opposite sign (CP-odd) vs $t\bar{t}H$ in **MadGraph**

(2) $\epsilon_{0123} = +1$ in **MadGraph**, **JHUGen**, and **Analytical**

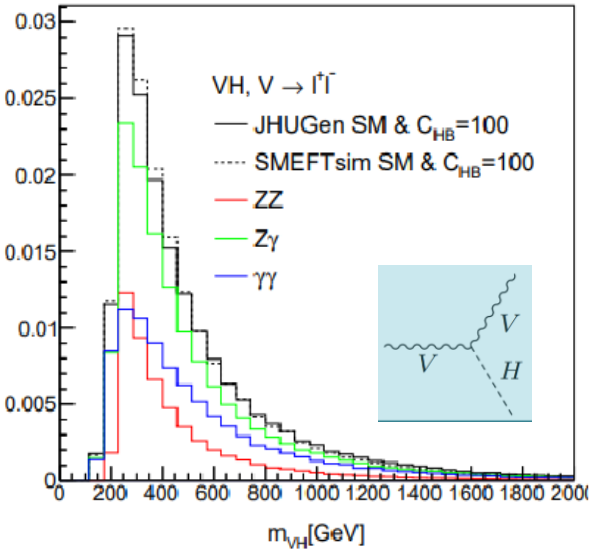
$\epsilon^{0123} = +1 \Rightarrow \epsilon_{0123} = -1$ in **HAWK** (sign switch in v3.0.1)

(3) $D_\mu = \partial_\mu - \mathrm{i}\frac{e}{2s_w}\sigma^i W_\mu^i - \mathrm{i}\frac{e}{2c_w}B_\mu$ in **MadGraph** and **Analytical**

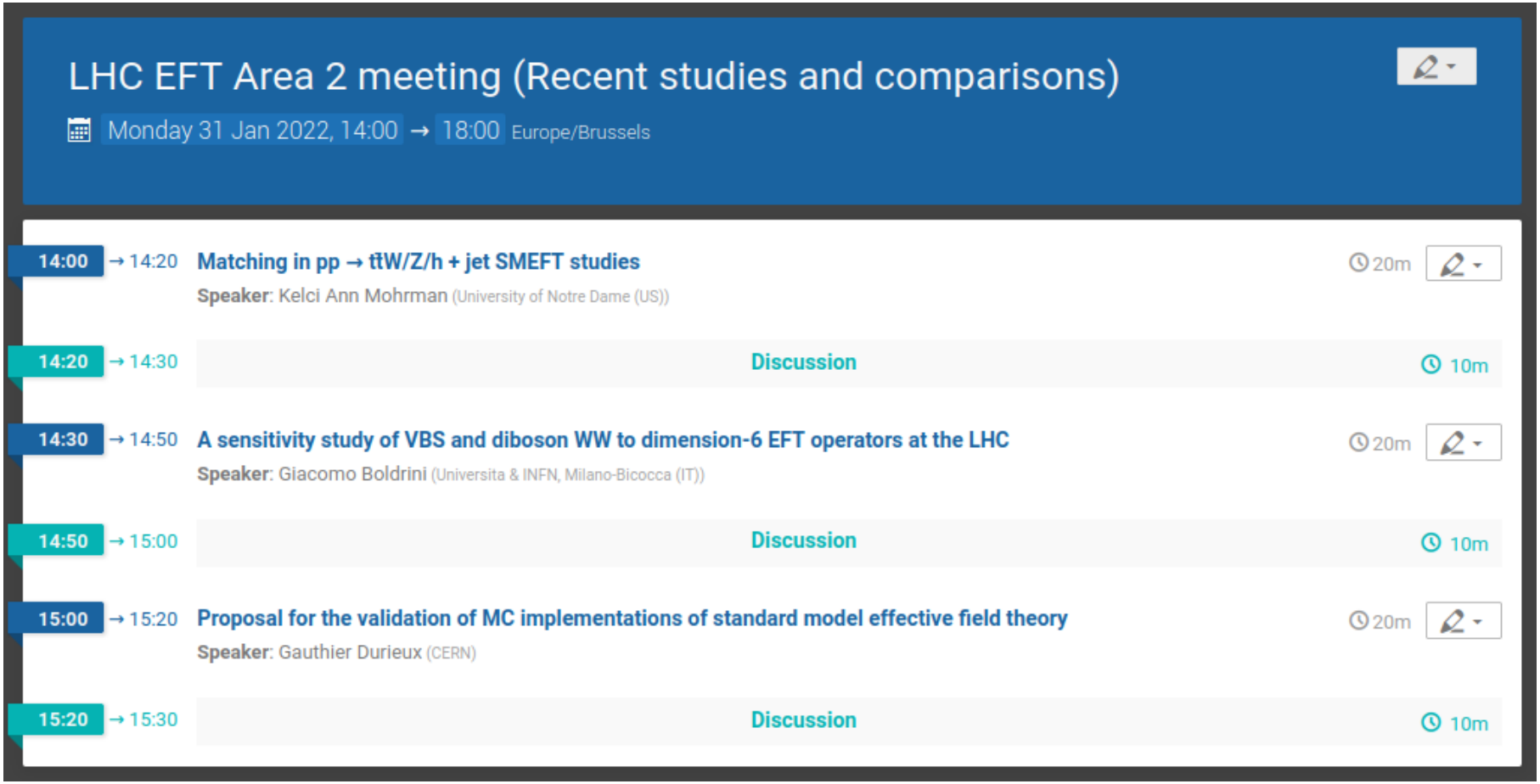
$D_\mu = \partial_\mu - \mathrm{i}\frac{e}{2s_w}\sigma^i W_\mu^i + \mathrm{i}\frac{e}{2c_w}B_\mu$ in **HAWK** and **JHUGen**

(4) Using point-like couplings to approximate EWNLO effects

(5) Analytical calculation of point like couplings



Agenda of today



LHC EFT Area 2 meeting (Recent studies and comparisons)

Monday 31 Jan 2022, 14:00 → 18:00 Europe/Brussels

14:00 → 14:20	**Matching in pp → tt̄W/Z/h + jet SMEFT studies** **Speaker**: Kelci Ann Mohrman (University of Notre Dame (US))	20m
14:20 → 14:30	**Discussion**	10m
14:30 → 14:50	**A sensitivity study of VBS and diboson WW to dimension-6 EFT operators at the LHC** **Speaker**: Giacomo Boldrini (Universita & INFN, Milano-Bicocca (IT))	20m
14:50 → 15:00	**Discussion**	10m
15:00 → 15:20	**Proposal for the validation of MC implementations of standard model effective field theory** **Speaker**: Gauthier Durieux (CERN)	20m
15:20 → 15:30	**Discussion**	10m