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LHC Higgs Cross Section Working Group 2 - Higgs Properties

Organization:

- **Group meetings**: WG2: Higgs Properties
- **Mailing list**: lhc-higgs-properties@cernNOSPAMPLEASE.ch
- **git area**: https://gitlab.cern.ch/LHCHIGGSXS/LHCHXSWG2
- **Conveners**: Nicolas Berger (Annecy LAPP), Mauro Donega (ETH Zurich), Ken Mimasu (King’s College London), Giuliano Panico (Firenze)
- **Previous conveners**: Jorge de Blas (Granada), Predrag Milenovic (Belgrade), Marco Delmastro (Annecy), Francesco Riva (CERN), David Marzocca (Trieste), Mingshui Chen (Beijing)

Topics:

- **STXS & fiducial/differential XS**
  - Recommendations for the fiducial and differential (Fid/DiffXS twiki) and simplified template cross sections (STXS) measurement and uncertainties computation.
  - Dedicated Fid./Diff./STXS twiki (with more details and contact emails).

- **PO**
  - Overview of effective POs and tools for extraction from measurements
  - Reweighting code to apply to existing MC
  - HiggsPO model available in Madgraph with NLO QCD corrections for VH/VBF production

- **EFT**
  - Tools: Implementation of Warsaw basis in FeynRules (available) with NLO QCD corrections in Madgraph (in development)
  - Validity (for discussion): defining the region of ci vs Lambda; square term gives an estimate of the uncertainty from higher powers of 1/Lambda
  - STXS->EFT mapping (available for HEL with SILH basis, in development for SMEFT with Warsaw)
  - Standard procedure for combined fit to Higgs+EW+Top data (for discussion, in coordination with other LHC Physics groups)
  - Initiative on establishing the EFT interpretation workflow guidelines/recommendations.
  

Roadmap

<table>
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<tr>
<th>Topic</th>
<th>ShortDescription</th>
<th>Deliverables</th>
<th>Timescale</th>
<th>Notes</th>
<th>Status</th>
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<tr>
<td><strong>STXS &amp; differential XS</strong></td>
<td>STXS stage 1.2 and TH uncertainties treatment recommendation</td>
<td>Note/journal (+ Rivet code?)</td>
<td>2020</td>
<td>To be ready in 2021</td>
<td>In Progress</td>
</tr>
<tr>
<td><strong>STXS &amp; differential XS</strong></td>
<td>STXS stage 1.2 binning recommendation</td>
<td>Note/arXiv/(journal) + Rivet code</td>
<td>Concluded</td>
<td>arXiv, to be updated with Stage 1.2</td>
<td>Definitions and Rivet routine done, documentation TBD</td>
</tr>
<tr>
<td><strong>STXS &amp; differential XS</strong></td>
<td>STXS decay-side binning definition</td>
<td>Note + Rivet code</td>
<td>2022</td>
<td>Draft note</td>
<td>Ongoing</td>
</tr>
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A non-exhaustive list of aspects for discussion/clarification can be found here, together with google doc where anyone interested can sign-up for particular topics.
**EFT Interpretation Workflow Summary:**
Processes, Operators and BSM Interpretations

| XS | BSM Benchmarks and mapping to EFT. Determine benchmarks sensitive to differential and coupling measurements, define relevant EFT parameters | Note/arXiv | Early 2019 | Ready
|---|---|---|---|---|

| EFT | Interpretation Workflow Summary: Processes, Operators and BSM Interpretations | Note | 2020-2021 | Addendum to BSM Benchmarks note

| EFT | Fit to STXS using a standardized mapping of STXS stage 1.2 | Note/(arXiv) | Summer 2019 | LHCHXSWG-2019-004

| EFT | Global Fit in EFT Framework; inclusion of top and Electroweak measurements | Note | During 2021 | In plan

| EFT | High-Energy Higgs Probes: Longitudinal multiboson processes as tests of Higgs physics | Note | During 2021 | Not started yet

[∗] PO presentation by D. Marzocca

**Recent meetings:**

Link to the dedicated indico category: WG2: Higgs Properties

- WG2 fid/diff/STXS meeting: ggH stage 1.2 uncertainties 04/11/2020
- Higgs measurements and their EFT interpretations 01/7/2020
- [STXS] Meeting on Updates to Uncertainties for Stage 1.2 25/06/2020
- EXP+TH LO/NLO EFT scheme discussion: 09/04/2020
- WG2-related plenary & discussion sessions in Oct 2019 general meeting 16/10/19
- STXS gg->H & ttH closure + diffXS variables discussion 16/9/19
- STXS discussion on ttH & ggH binning (for stage 1.2) 24/7/19
- STXS discussion at Les Houches 2019 12/6/19
- ttH STXS binning discussion 6/6/19
- Joint VBF & fid/dif/STXS meeting: STXS qq Hqq binning 17/1/19
- WG2 session in Dec 2018 general meeting 10/12/18
- WG2 fid/dif/STXS meeting: Presentation of results and STXS updates November 23
- CP and dimension-8 EFT November 13
Validation and benchmarking of EFT tools June 14
STXS meeting May 17
WG2 session in March 2018 general meeting March 27
Benchmark scenarios February 23 (2018)
Winter meeting December 11 (2017)
WG2 session in July 2017 general meeting July 14
Joint EW+WG2 meeting July 10
STXS meeting July 6
Kickoff meeting May 8

Tools:

EFT Interpretation Workflow Twiki page

STXS & Differential XS
  - The STXS Rivet code
  - Classification: Rivet routines that assign STXS bin labels to a given MC event.

PO
  - FeynRules implementation

EFT
  - Mapping of the STXS to HEL parameters
  - FeynRules implementation of the Warsaw basis (SMEFTsim)

- coupling modifiers
  - Latest updates from Yellow Report 4

Past projects

EFT approach to LHC Higgs searches
Extension of the kappa formalism

Tools

STXS.tgz: Revision 8941 of the STXS classification code