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WG2 Higgs Properties: Outlook and Plans

J. Jovićević, on behalf of the WG2

The 22nd Workshop of the LHC Higgs Working Group
CERN, December 5, 2025

WG2 organisation

WG2 Higgs properties:

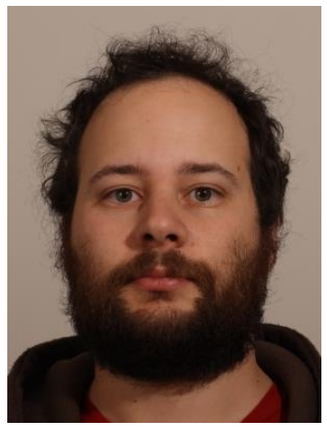
Daniele Barbucci (TH)

Pier Paolo Giardino (TH)

Jelena Jovicevic (ATLAS)

Giacomo Ortona → Jonathon Mark Langford (CMS)

Thanks Giacomo!



Welcome Jonathon!

Thanks to Sarah Heim and Hongtao Yang who finished their terms during this year!

WG2 organisation

WG2 Higgs properties

Fiducial, Differential and Template XS:

Frank Tackmann (TH)

Matteo Bonanomi (CMS)

Haide Abidi (ATLAS)

Higgs CPV:

Henning Bahl (TH)

Jose Miguel No (TH)

Daniel Winterbottom (CMS)

Lorenzo Rossini (ATLAS)

LHC EFT working group

Both subgroups have overlap with LHC EFT group.
we will try to strengthen this link through common efforts.

Ongoing efforts - workshop reflection

WG2 parallel session:

- EFT Theory Uncertainties at the LHC - Francesco Montagno;
- Bridging theory and experiment in the search for CP violating Higgs interactions: Parametrizations and dictionary - Marta Fuentes Zamoro;
- Could electron-top interactions spoil the measurement of the Higgs trilinear? A quantitative estimate at future lepton colliders - Lucine Tabatt;
- VHbb CP analysis - Ricardo Barrué;
- Search for anomalous HVV coupling in the gamma gamma final state - Federica De Rigg;
- Higgs-top coupling measurements from ATLAS and CMS - Valnetina Vecchio;
- Higgs to charm coupling - Ming-Yan Lee.

Many thanks to all speakers!

WG2 plenary session:

- CP violation in the Higgs sector: Run 3 and beyon - Henning Bah;
- Higgs decays in the SMEFT at NLO - Matthew Forslund;
- SMEFT, Anomalous Couplings and CPV from CMS and ATLAS - Daniel Winterbottom;
- Summary from the Higgs coupling measurements (Run 2 summary and available results from Run 3) from ATLAS and CMS - Serhat Ordek.

Ongoing efforts - workshop reflection

Joint session with LHC EFT group:

- POPxf: An Exchange Format for Polynomial Observable Predictions - Ken Mimasu;;
- Probing H Coupling and CP properties at FCC-ee - ofia Giappichini;
- ATLAS+CMS Outlook talk - Brendon Bullard;

Cross-topic plenary:

- Path for deriving uncertainties for STXS 1.3 - Sarah Heim;

Lightning session for LHCHWG Report 5:

- CPV benchmarks - Rui Santos;

And many other relevant talks...

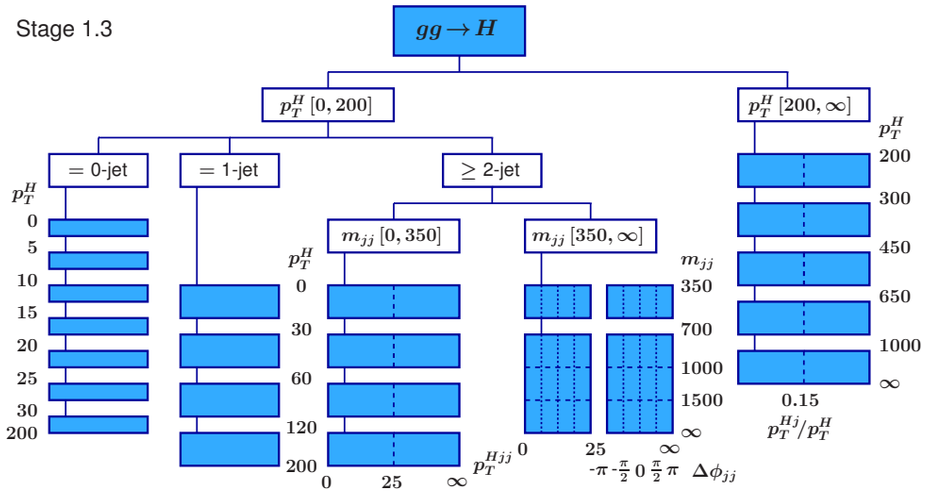
Many thanks to all speakers!

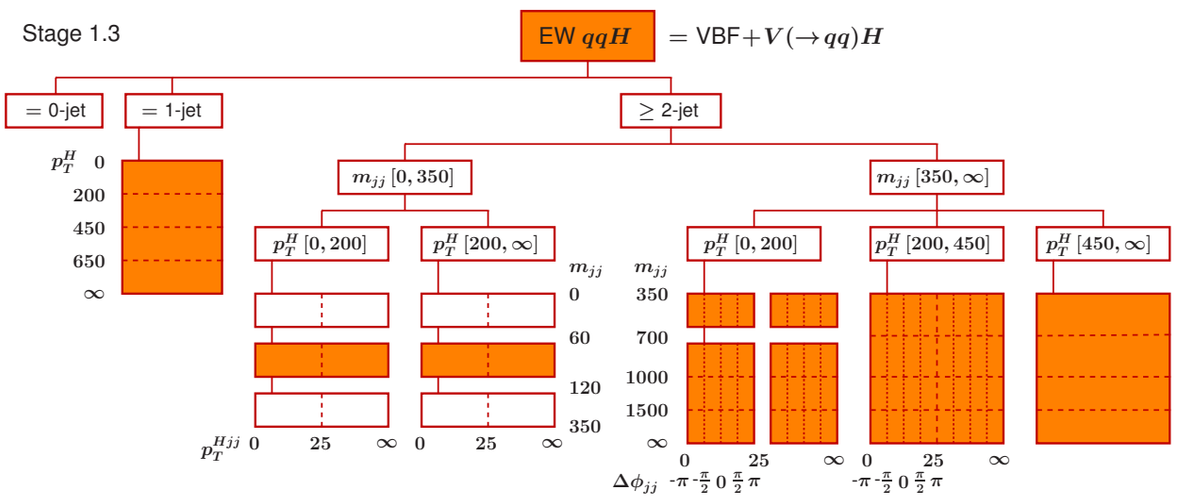
STXS matters

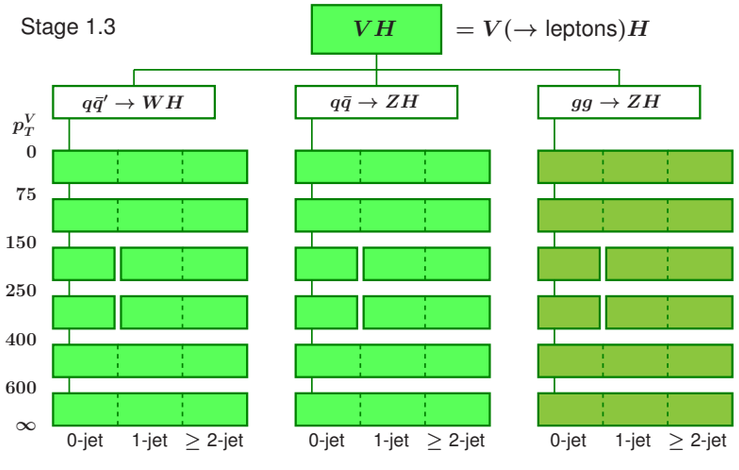
STXS 1.3: Bins defined, main difference w.r.t 1.2:

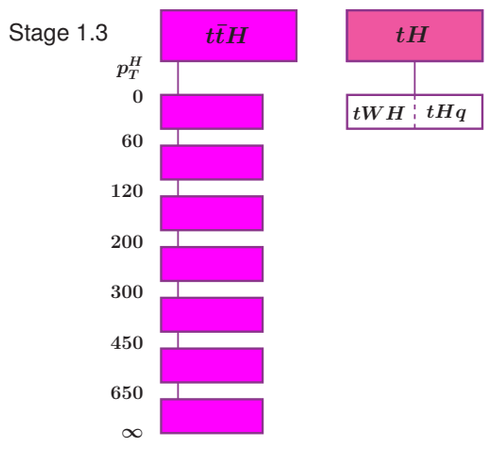
- ggF H: more granular pT(H) spectrum, new CP-sensitive binning ($\Delta\Phi_{jj}$);
- VBF/V(qq)H: V(qq)H boosted bins, high high p_T(H) bin and $\Delta\Phi_{jj}$ splits.
- V(lep)H: Increase p_T(V) granularity, few dashed became solid lines;
- ttH/tH: Additional high p_T(H) bin. tHjb/tWH dashed split.

- New bin schematics made by Frank and available on STXS subgroup Twiki .









STXS matters

STXS 1.3:

- Plan to work with WG1 on STXS **predictions** and **uncertainties calculations** - uncertainties belong to specific predictions, should be evaluated coherently,
- **Predictions**: Would be good to provide STXS predictions to the collaboration. E.g. the new VBF calculation (https://arxiv.org/pdf/2507.22574v1), or from the recommended generators if dedicated STXS calculations not available;
- **Uncertainties calculations - should be evaluated for predictions;**
  - WG1+WG2 meeting - towards STXS 1.3 uncertainties past July;
  - Path for deriving talk by Sarah today:

Documentations

- STXS 1.1. and 1.2. binning accepted yesterday by SciPost!
- Ongoing work on STXS 1.3 binning note - aim to be part of Report 5.
- STXS 1.2 uncertainty note obsolete, plan to publish STXS 1.3 as soon as available.
  - Potentially could quite STXS 1.2 numbers in STXS 1.3 note, however we already have two PUB notes from ATLAS:
    VH: ATL-PHYS-PUB-2018-035/ ggH+ttH: ATL-PHYS-PUB-2023-031

STXS matters

Need to **update Rivet** routine to include STXS 1.3

STXS - EFT parametrisation, ideally should be done within WG2 commonly done by experiments and theorists (interplay with LHC EFT group).

- Would simplify posterior validation of the individual parametrisation.
- Could benefit from new updates, e.g. Higgs decays in the SMEFT at NLO (Matthew's talk);
- Can release parametrisation in new popxf format (Ken's talk):
- Let's try to do the best together!

Anything on fiducial / differential?

CPV group matters

Recently established group attracting lots of interest. Main goals:

Common parametrisation:

- Provided dictionary between different parameterisations of CPV Higgs interactions, https://arxiv.org/abs/2511.07905 (Higgs basis, κ's and angles, CP fractions and EFTs - SMEFT & HEFT);
- Experiments are welcome to validate the dictionary;

Cross-topic with STXS subgroup: STXS bins for CPV:

- CPV sensitive bins defined for ggF and VBF. Higher granularity and new bins for VH and ttH planned for the STXS Stage 2.0,

CPV benchmarks - common with WG3:

- Idea is to define a set of benchmark points/planes for models where LHC will have sensitivity so we can e.g compare sensitivity of different observables. Some models under consideration, proposals welcome.
- Original plan was to have a note on report 5 timeline.

Plan to have an open meeting after Christmas.

Information on the MC generators and settings that can be used to simulate CPV for the various processes will be put in CPV group twiki.

Conclusions

- Many new developments relevant to WG2 goals were presented during the workshop.
- WG2 and its subgroups have numerous activities planned for the upcoming period.
- Several of these activities are shared with other groups - WG1, WG3, and the LHC EFT Working Group - making close collaboration essential.
- To produce the best recommendations, we should work together, avoid duplication of effort, and ensure consistent cross-validation.
- Recommendations should be clear and coherent with the current state of knowledge in the field.
- Publications planned, still few aiming Report 5.
- New efforts are always welcome!

Thank you for your attention!