

LHC Higgs Working Group Plans



20th Workshop of the LHC Higgs WG
November 13-15, 2023

LHC Higgs WG Steering Committee



Recognition for work within the LHC Higgs WG

- ▶ Being active in a working group, in particular being convener, involves a considerable time investment, therefore it is important that these efforts are rewarded
- ▶ For theorists, the “reward” is publications and citations, however the outcome of HWG work does not always meet the criteria of a journal publication (e.g. code comparisons, recommendations, etc, rather than “new results”)



Recognition for work within the LHC Higgs WG

News: SciPost (J-S Caux, thanks!) offered to create a new branch

“Physics Community Reports”

<https://scipost.org/SciPostPhysCommunityRep/about>

Refereeing criteria are adapted to the purpose, at least one of the following should be fulfilled (in addition to the general acceptance criteria)

- Provide a novel and synergetic link between different research areas.
- Present a step forward on a previously identified research stumbling block.
- Fill in a gap concerning reference results or benchmarks in a particular research direction, with clear potential for multi-pronged follow-up work.

Expect most LHC Higgs WG reports to be submitted to Physics Community Reports in the future.



Other ways of recognition

- ▶ Theorists becoming associate members of experimental collaborations:
 - **ATLAS**: Formal schemes for association exist. Depending on scheme and contributions, co-authorship of papers/PUB notes.
 - **CMS**: Decision on a case-by-case basis.
- ▶ Theorists being acknowledged in experimental papers (considered to be of low impact).
- ▶ Recommendation letters from TAC/SC/WG conveners: already common practice.
- ▶ Invitations to speak at collaboration meetings.



Yellow Report 5

- ▶ Four Yellow Reports produced by the LHC Higgs WG over its lifetime:
 - *"Inclusive Observables"* [[CERN-2011-002](#)]
 - *"Differential Distributions"* [[CERN-2012-002](#)]
 - *"Higgs Properties"* [[CERN-2013-004](#)]
 - *"Deciphering the Nature of the Higgs Sector"* [[CERN-2017-002](#)]

- ▶ HL-LHC data-taking will start in 2029. Aim to collect 1000 fb^{-1} data during Run 4 (2029–2032).
 - What can we achieve with this dataset?
 - What recommendations are needed for analyses?
 - **Plan to collect this information in a new Yellow Report 5.**



Towards Yellow Report 5

- ▶ YR5 preferably not monolithic, rather many separate reports; could be published in a dedicated *SciPost Physics Community Reports* Volume
- ▶ Time scale ~2025, focus on Run 4 of HL-LHC (1000 fb^{-1}) and include Run 3 results as far as available
- ▶ Predictions should be reproducible (ideally provide runcards)
- ▶ Initial brainstorming for experimental wishlist with ATLAS and CMS Higgs/HDBS convenors in July 2023



More details about plans for YR5

- Section on PDF uncertainties.
- Recommendations for parton showers, hadronization.
- Higgs mass - use final Run 1+2 ATLAS+CMS combination (if available by YR5 time) as input for predictions.
- Important themes:
 - **WG1:**
 - Higher precision (xs+decays), boosted final states, $H \rightarrow c\bar{c}$
 - **WG2:**
 - STXS, EFT interpretations - work out granularity that is needed for Run 4
 - CP studies (binning, precision of $t\bar{t}H$)
 - High precision for EFTs
 - kappa framework -> embed into HEFT
 - Library of models to have a uniform starting point for ATLAS/CMS/theory.



More details about plans for YR5

Important themes, continued:

- **WG3:**
 - Interference SM-BSM
 - Synchronize MSSM/NMSSM & Co benchmarks
 - Links to Dark Matter WG
 - Higgs decays to LLPs
- **WG4:**
 - HEFT/SMEFT HH production modes besides gluon fusion
 - HHH production
 - Reduce uncertainties in gluon fusion HH
- **Cross-topic:**
 - EFTs: combination of high precision SM predictions with lower order BSM tools
 - Benchmarks for BSM models/EFTs



Outlook

- ▷ We should start now to work towards YR5.
- ▷ As it is not monolithic, timescales for contributions do not need to be exactly aligned.
 - Tables with cross sections at 13.6 TeV are needed much sooner and therefore planned to be separate from YR5.
- ▷ Identification of needs and tasks should start in the working groups and across groups.
- ▷ Nothing is set in stone, we are here to discuss about it!