

The LHC Higgs Cross Section Working Group: proposal for a development of the group towards the high energy run

1. Preamble

The LHC Higgs cross-section working group was created in January 2010. The aim of this group was to produce agreements on cross sections, branching ratios and pseudo-observables relevant to SM and MSSM Higgs boson(s). In spring 2012, the group was restructured and new subgroups were added with the goal of discussing Higgs property/measurement and BSM extensions. Three CERN Reports have been completed, "Inclusive Observables" (CERN-2011-002), "Differential Distributions" (CERN-2012-002), and "Higgs Property Measurements" (CERN-2013-004). These achievements facilitated the comparison and combination of Higgs results at LHC since the beginning of the LHC physics programme.

After 4 years of activities, the overall contacts think that it is the right moment to reorganize our group in view of long LHC shutdown 2013-2014 (LS1) and the future run at higher energy.

2. New Structure

There are two pillars in the current and future Higgs physics, 1) Higgs property measurements and 2) BSM Higgs searches. We suggest to put them as the main subjects to be discussed in the working group. It is also very important to maintain full support for Higgs cross sections and branching ratios, not only for Higgs production channels like ggF, VBF, WH/ZH, and ttH, but also for Higgs pair productions, in view of Higgs property measurements. Thus we suggest to have a third sub working group devoted to the subject of precision calculations for SM Higgs production and decay. Each sub working group shall have a structure with appropriate and separate topics.

SWG1: Higgs properties

Discuss theoretical issues related to the experimental determination of Higgs boson properties (mass, couplings and spin/CP), e.g. related to EWK corrections or other theoretical aspects. The development of a model-independent framework for interpreting the coupling measurements in the framework of an effective theory should also be pursued.

SWG2: Higgs XS & BR

Provide theoretical cross sections and branching ratios in all Higgs related processes for pp collisions (ggF, VBF, WH/ZH, ttH, HH, HHH, qqHH, WHH, ZHH + any others that may become relevant) at all relevant centre-of-mass energies (e.g. 13, 14 TeV but also possibly at higher energies if found to be useful). Both inclusive and differential (e.g. in p_T or n-jet) cross sections should be provided as far as possible. The cross sections of background processes and their uncertainties relevant to Higgs physics and its impact on Higgs property measurements may also be discussed in this group in collaboration with the relevant physics groups within the collaborations.

SWG3: BSM Higgs

The SWG3 will not aim to survey all possible BSM-related aspects of Higgs physics, but should concentrate few important topics in BSM Higgs physics, such as the MSSM. Define cross sections and branching ratios for well-known BSM benchmark models as required by experiments for analysis interpretation.

There are common issues across different WG's. These include NLO MC, Jets and PDFs. NLO MC's are important tools for Higgs physics, and should cover new progresses in NLO MC's for SM and BSM Higgs(es). The SM backgrounds related to the Higgs signal are also very important, and may cover NLO MC's for V+jets, VV+jets, Vbb/Vcc, top, etc. with close contact with SM, Top and MC WG's in each collaboration. Jets play a central role in Higgs physics and theoretical issues to reduce the associated uncertainties should be discussed. We also need to follow up the progress in NNLO PDF predictions with LHC data, in close contact to PDF4LHC WG. These common issues will be discussed inside each working group.

3. Working Group Mandate and Organization

The principal role of this WG is to provide the SM and BSM Higgs cross section (inclusive/differential) and branching ratio numbers and associated uncertainties plus common tool developments. This group should discuss Higgs theoretical/phenomenological issues only, and LHC data will be discussed elsewhere in the LHC Higgs Combination WG. The group should be an open forum with wide participations from experimental and theory communities.

The new organization should have a working-group-like structure, to cover current and future needs of Higgs physics. The milestones and deliverables should be realistic, well-defined and clear and available so that everybody can check the outcome. To maintain the momentum, physical meetings shall be organized every two-three months, to review the progresses.

We propose to create the steering committee, which supervises the overall activity. For steering committee members, both ATLAS and CMS Physics Coordinators nominate two experimentalists, with their mandates staggered preferably. In addition four theorists should be identified by the theory community. The steering committee should determine the mandate and selection procedure for the conveners in each SWG1,2,3. The terms of the appointment of the steering committee members is two years.

Each sub working group (SWG1,2,3) should be supervised by one convener from ATLAS, one from CMS and two from Theory. A long write-up of this proposal, which will be submitted to the collaborations, will describe in more detail the milestones and deliverables of the three sub working groups.

P.S. The current structure of LHC Higgs cross section working group can be found at <https://twiki.cern.ch/twiki/bin/view/LHCPhysics/CrossSections>

Notes added (16 Apr 2014):

- The Steering Committee (SC) must clarify the future appointment procedure for the TH members.
- The SC appoints the theory conveners of the subgroups after an open call for nominations to a large community. The experimental conveners are appointed by the experiments. There will be no ex-officio membership in the SC.
- SC members and subgroup conveners should normally not serve for more than one consecutive two-year appointment.
- There should be open LHC Higgs XS WG meetings twice a year where a general discussion on the overall strategy and organisation of the group can be held.