Summary Discussion

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of the LHC Higgs Cross Section Working Group
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Thank You!

Thank you very much for perfect organization
and joyful dinner in Freiburg!

Best Wishes,
ALL the participants

Group Tasks

Our prime mandate: for SM and MSSM Higgs analyses

– Compute and agree on cross sections and branching ratios

– Use the same input parameters

– Strategy on uncertainties (α_s, PDF, scale etc.) PDF4LHC

– Monte Carlo at NLO for the signal MC4LHC

– Define pseudo-observables

– Cross sections of background SM processes SM XS TF

– Prepare to compare and combine

Beyond SM and MSSM?

– Other SUSY scenario, Invisible Higgs decay, Higgsless, …

Common setup

- Standard Model Input Parameters
  - https://twiki.cern.ch/twiki/bin/view/LHCPhysics/SMInputParameter
  - Lepton/Quark & Gauge boson masses = PDG values,
  - Mtop=172.5+-2.5GeV, Mbot=4.75GeV, Mcharm=1.40GeV (pole mass)
  - Study differences in pole mass and MSbar mass
  - QCD α_s
- Cross Section Calculation
  - MH=[90,1000]GeV (up to meaningful Higgs mass)
  - Δ=5GeV step for [90,200]GeV, Δ=10-50GeV for [200,1000]GeV?
  - Should be coherent among ggF, VBF etc. and MC for later combination.
- PDF4LHC Recipe?
  - PDG α_s or built in α_s fit
  - 68% & 95% C.L. error definition?

Setup for Higgs cross section calculation

1. LHC centre-of-mass energy, Ecm = 7 TeV (14 TeV as next step?)
2. SM input parameter

   https://twiki.cern.ch/twiki/bin/view/LHCPhysics/SMInputParameter

   definition of charm and bottom quark masses (pole or MSbar)
3. Define Higgs mass range and step for calculation,

   e.g. ggF MH = [90 GeV, 1 TeV].
4. Used PDF sets and α_s CTEQ, MSTW, NNPDF, ABKM etc. Program is interfaced to LHAPDF?
5. List limitations in calculation, full m_{top} and m_{bottom} dependence? (e.g. heavy top-limit in ggF);
6. List missing interferences inside signal predictions and with other SM processes.
7. Higgs width, narrow width approximation?
8. Calculations, up to which order? 4-flavour or 5-flavour scheme? Inclusive and exclusive? Calculation of $d\sigma/dX$ possible? Application of phase-space cuts?

Towards LHC Combination?

Expect L~100pb^{-1} end 2010; L~1fb^{-1} end 2011.

- Prescription for the estimation of ALL the systematic uncertainties (luminosity, detector resolution, physics inputs etc…) with correlations.
- A common policy on what to publish (i.e. the likelihood functions for all the channels…?)

- Towards the statistics exercise with Statistics Forum
  1. Shall we do MC exercise for combination?
     An exercise with published material with RooStat?
  2. First combination for winter or summer 2011 conference?

  We need the agreement by ATLAS/CMS direction on this activity.

Theoretical errors

1. Electroweak radiative corrections, renormalization scheme;
2. QCD and EW corrections, factorized or added?
3. QCD renormalization scale (μ_R) and factorization scale (μ_F) uncertainties;
    1. Define the central values and range of μ_R and μ_F,
       e.g. $\mu_R = \mu_F = [M_H/2, 2M_H]$ for ggF.
    2. Define the scan strategy, diagonal and anti-diagonal scan,
       2D scan (e.g. $1/2 < \mu_R/\mu_F < 2$)..
4. PDF uncertainty; how to define 68% and 95(90)% C.L. PDF + α_s error? To be discussed with PDF4LHC and Statistics Forum.
5. Background treatment. Are backgrounds included by using X for generating an LO which is subsequently reweighted by a Y NLO? Is interference included?
6. Other errors due to theory approximation.

Policies

- **Data Handling Policy**
  - We shall NOT discuss experimental data in this group.
  - ATLAS and CMS can provide MC study public results in table format for histograms.
- **Citation Policy**
  - We should compile ALL the relevant publications.
  - ATLAS and CMS will use it for their papers.
- **Publication Policy**
  - Can publish papers if no ATLAS/CMS software used.
  - Write CERN Yellow Report like report? In journal?
  - Interim report on Higgs XS before end of 7 TeV run?

Tools

- Mailing Lists
  - lhc-higgs@cern.ch, lhc-higgs-contact@cern.ch
- InDico
- Twiki
  - Please update the information!
- Sharepoint
  - Please try to use it!
- Code Repository
  - SVN, GIT, GENSER etc. There are pros and cons.

Future Workshop

- July 5 (Mon.) – 6 (Tue.), 2010 @ CERN (TH)
  - During CERN TH institute.
  - Theorists need user registration at CERN for computing.
    - Many thanks to CERN-TH for help.
  - Avoid major ATLAS and CMS weeks.
  - Well before ICHEP2010 in Paris, July 21-28, 2010.

- Nov. 2010 @ Bari (CMS)
- Decide soon time and place for 2011. Please make proposal.

Any comments or suggestions on organization?

Thank you all for participation and stimulating discussions.

Please send us half-page summary of your subgroup session for minutes before this Friday.

See you in Geneva soon!