Higgs Round Table

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Higgs XS WG

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In the following you will find several issues which we want to discuss during this closing (discussion) session, with the goal of reaching an agreement.

We need to come to the agreement on a common recipe of PDF errors:

- α_s value
- PDF + α_s error definition
- XS central value, envelope method or other methods ?

  If no envelope, instead why not:
  - computing σ with different PDF sets,
    then take the average and correctly compute the error
    (correlated and non-correlated component)

- correlation between different Higgs production channels
  due to common PDF set

AlphaS

Proposal to form a group of expert to give to the LHC
community a "world average value of alphaS"
Experts from

- lattice
- LEP EW fit
- LEP event shape
- tau leptons
- DIS
- HERA: jets
- Tevatron: jets at high Q2
- Charmonio

While we are finishing with the inclusive ones, we should move to the cross section within acceptance cuts:

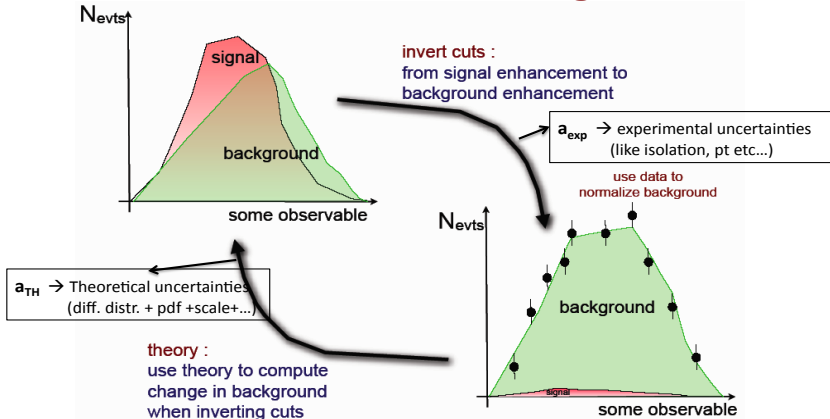- How to define the cuts in the programs, to match the experimental resolution ?

This area will become important as our next step for exclusive calculations:

1. differential distribution for Higgs signal,
   for example Higgs p_T
2. comparison between LO PS MC and NLO MC,
   how to normalize to NNLO ?
3. Can this be studied within the existing working framework ?
   Study $\gamma\gamma$, *WW*, *ZZ* in ggF group, or re-organize the group?

SM background processes I

- Important:
  study theoretically the SM backgrounds for Higgs search, such as W/Z+jets, WW^*/ZZ^*, Wbb/Zbb, tt, $ttbb$ etc.
- Background estimation via "data-driven methods":
  rely on theory to relate XS in different kinematic regions
  $\Rightarrow$ reliability of result needs theoretical input
- Proposal:
  study theoretical errors of SM backgrounds to Higgs search with common ATLAS and CMS cuts.
- Related issue:
  interference between Higgs signal and backgrounds

The control of the background

$$N^B_{(signal\ region)} = a_{exp} * a_{TH} * N^B_{control\ region}$$

a_{exp} - uncorr between exp
a_{TH} - 100% correlated [1]

SM background processes II

Examples:

1. $WW^{(*)} \to l\nu l\nu$:   background $qq/gg \to WW$ from data ?
2. $ZZ^{(*)} \to 4\,l$:   background $qq/gg \to ZZ$ from data ?
3. VBF: central jet-veto, effect of UE, QCD background

Questions:

- Shall we study theoretically these SM background processes? How accurate should they be predicted?
- Shall we study the theoretical error for background estimation via "data-driven method"?
- Shall we study $\gamma\gamma$, $WW^{(*)}$, and $ZZ^{(*)}$ with priority?
- Interferences between Higgs signal and backgrounds?

TH and Exp errors

To discuss

- list of
  - theoretical systematic errors
  - central values
  - and their uncertainties

- correlation between the experiments

TH errors

- For signal XS:
  - parametric errors and their propagation
  - EW corr, renormalization scheme
  - QCD $\otimes/\oplus$ EW corr (factorized or added) ?
  - QCD scales (ren: μ_R, fact: μ_F)
    define central value and range and scan strategy
- PDF uncertainties
- Background treatment:
  LO $\times$ K factor or NLO, interference with signal, etc. ?
- Possible approximations ?

Note: TH errors are 100% correlated between the two exp.
      (if using the same programs!)

Some example on TH errors and correlations

Source	Cent. value and var.	% on Signal	% on Bkgrd	int. corr. %	inter-exp corr. %
Luminosity	$XX \pm 10\%$	10	10	100	100
$\sigma(gg \rightarrow H)$	$XX \pm YY$	a%	0	100	100
$\sigma(qq \rightarrow Hqq)$	$XX \pm YY$	a%	0	100	100
etc. etc. etc.					
$\sigma(WW)$	$XX \pm YY$	0	a%	100	a_{TH} %
$W \rightarrow e\nu$ fake rate	$XX \pm YY$	a%	b%	100	a_{TH}%

But more in detail, e.g.:

Source	variation	$H \rightarrow 4\mu$	$H \rightarrow 2\mu 2e$	$H \rightarrow 4e$	$ZZ \rightarrow 4l$	$Zbb \rightarrow 4l$	inter-exp corr.
Luminosity	10%	10%	10%	10%	10%	10%	b%
PDF	$\pm Y$	a%	a%	a%	b%	b%	100%
QCD scale	$\pm Y$	a%	a%	a%	b%	b%	100%
$\sigma(Zbb)$	$X \pm Y$	$a_{exp} \times a_{TH}\%$	$a_{exp} \times a_{TH}\%$	$a_{exp} \times a_{TH}\%$	0	$a_{TH}\%$	$a_{TH}\%$
μ reco eff	$X \pm Y$	a%	a/2%	0	a%	a%	0
etc etc etc							

Beyond SM

Strategy:

Up to now, we concentrated on MSSM scenario.

- Shall we go beyond MSSM scenarios?
  E.g. NMSSM, Higgsless, Fermiophobic, etc.

Publish or Perish

Yellow Report

- We agreed in Freiburg to write a CERN Yellow Report.
- Better to start the writing now in order to finalize it at Bari workshop, since the status of inclusive Higgs XS calculations is already well advanced.
  (Then ATLAS and CMS can quote the paper.)
- We should compile all references relevant to the Higgs XS.

Next Workshops

Dates

- When/where shall we have the next workshops ?

- Too frequent with current agenda? Bari in November 2010.

- Postpone BNL before summer 2011, Paris in autumn 2011?