

Fiducial Cross Sections: WGI activities

Robert Harlander

3rd LHXSWG meeting on fiducial cross sections

Dec 2, 2015

<https://indico.cern.ch/event/461692/>

Structure of WGI

Higgs XS&BR	<u>Mail</u>	<u>Bruce Mellado (Witwatersrand)</u>	<u>Pasquale Musella (Zurich)</u>	<u>Massimiliano Grazzini (Zürich)</u>	<u>Robert Harlander (Wuppertal)</u>
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BR		<u>Mail</u>	<u>Daniela Rebuzzi (Pavia)</u>		<u>Ivica Puljak (Split)</u>		<u>Ansgar Denner (Würzburg)</u>	<u>Sven Heinemeyer (IFCA)</u>	<u>Alexander Mück (Aachen)</u>
ggF		<u>Mail</u>	<u>Dag Gillberg (CERN)</u>	<u>Chris Hays (Oxford)</u>	<u>Giovanni Petrucciani (CERN)</u>	<u>Andrea Massironi (Northeastern U)</u>	<u>Stefano Forte (Milano)</u>	<u>Achilleas Lazopoulos (ETH Zürich)</u>	<u>Giulia Zanderighi (Oxford)</u>
VBF/VH	<u>Mailing List</u>	<u>Mail</u>	<u>Jason Nielsen (UCSC)</u>	<u>Elisabetta Pianori (Warwick)</u>	<u>Pietro Govoni (Milano-Bicocca)</u>	<u>Andrea Rizzi (Pisa)</u>	<u>Stefan Dittmaier (Freiburg)</u>	<u>Barbara Jäger (Tübingen)</u>	<u>Francesco Tramontano (Naples)</u>
ttH/tH	<u>Mailing List</u>	<u>Mail</u>	<u>Stefan Guindon (SUNY)</u>		<u>Christopher Neu (Virginia)</u>		<u>Stefano Pozzorini (Zürich)</u>	<u>Laura Reina (Florida)</u>	
Offshell		<u>Mail</u>	<u>Yanyan Gao (Edinburgh)</u>		<u>Jian Wang (Florida)</u>	<u>Livia Soffi (Cornell)</u>	<u>Fabrizio Caola (CERN)</u>	<u>Nikolas Kauer (Royal Holloway)</u>	

Activities

see contributions to July 2015 workshop:

<http://indico.cern.ch/event/350628/>

... related to fiducial cross sections:
“not much”...

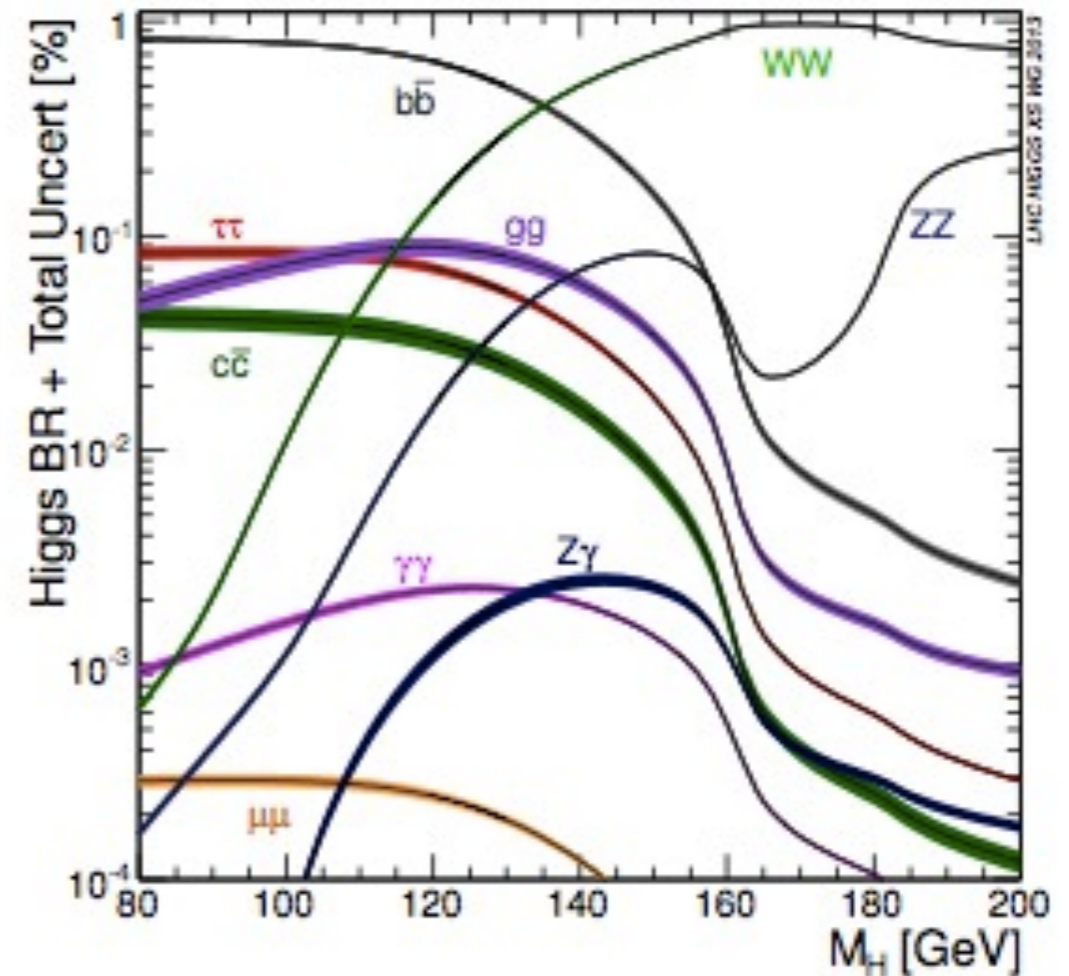
Primary target:

Best currently available theory predictions
for SM Higgs cross sections, distributions, BRs

Focus: inclusive xsecs and dist's
H+n-jet
process specific generic cuts
dominant BGs

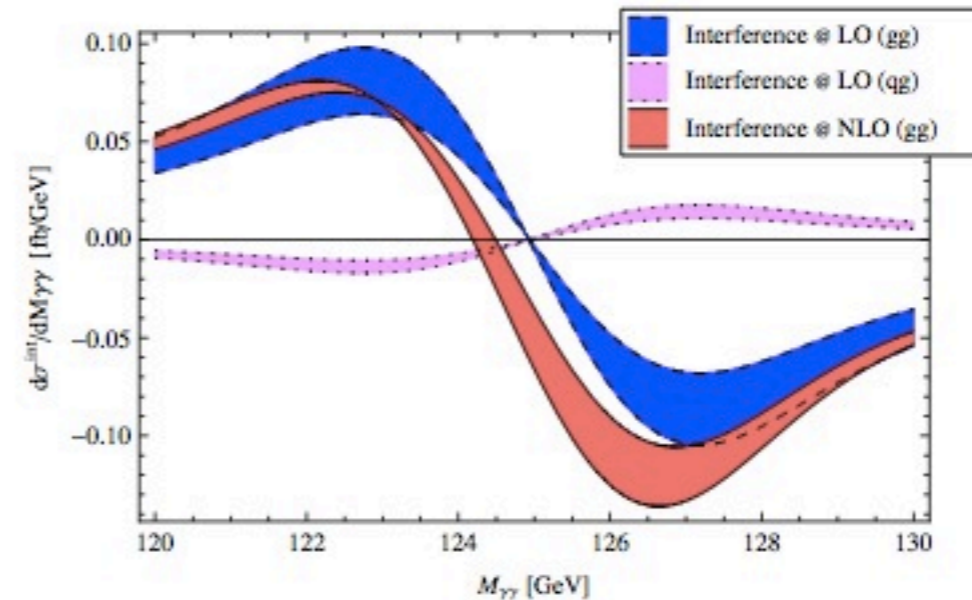
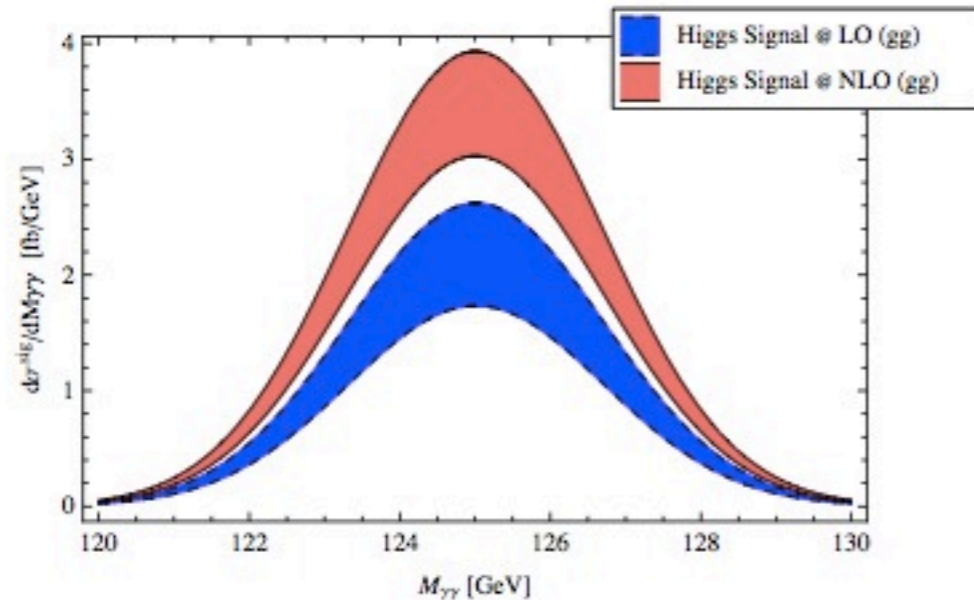
BRs/partial widths for
SM and MSSM decays

theoretical and parametric
uncertainties



using HDECAY, Prophecy4F, Hto4l

no cuts or distributions



Higgs width constraints, mass shifts

Off-peak vs. on-peak SM xsecs (ggF, VBF)

$H \rightarrow ZZ$ $H \rightarrow WW$ $H \rightarrow \gamma\gamma$

signal, signal-BG, BG only

M_{VV} and M_T distributions

applying ATLAS+CMS off-shell search cuts

ttH, tH signal (NLO+PS, NLO+EW)

WWbbH (ttH+off-shell top decays)

lvjjbbbb (irreducible BG to ttH)

ttV, ttVV

signal modeling (NLO+PS comparisons, scale choices)

common event categorization: tt+jets, ttb, ttbb, ttc, ...

inclusive cuts

- Report results of tool comparison (see $t\bar{t} + b$ -jet discussion) for

- ▷ $t\bar{t} + b$ jets
- ▷ $t\bar{t} +$ jets
- ▷ $t\bar{t} + H/Z/W$
- ▷ $t\bar{t} + \gamma(s)$

coordinating with experimental benchmark validation.

Emphasis will be put on coherent definition of theoretical uncertainties.

↔ Some of these studies will be coordinated with MC studies within the Les Houches 2015 Workshop.

- Review of theoretical results with focus on more recent ones, such as:

- ▷ NLO QCD predictions for $pp \rightarrow tH + j$ at 13 TeV
[Demartin et al. → MadGraph5_aMC@NLO]
- ▷ Off-shell $t\bar{t}H(b\bar{b})$ production and decay: interference effects between signal and background (LO) [Denner et al.]
- ▷ Off-shell $t\bar{t}H$ production with top leptonic decays at NLO in QCD [Denner et al.]
- ▷ NLO QCD+EW corrections to $t\bar{t} + H/Z/W$ production
[Frixione et al. → MadGraph5_aMC@NLO]

inclusive xsec

N3LO, residual uncertainties

H+n-jet (n=0,1,2,3)

fixed order, NLO+PS, quark mass effects, ...

H+2-jet in VBF fiducial regions

Higgs p_T

resummation, quark mass effects, ...

in H+n-jet bins

Benchmark observables

Defined a comprehensive list of benchmarks to study, only very few of which will be shown today:

- Inclusive Higgs p_T , rapidity
- Jet binned cross sections: exclusive =0j, =1j, =2j; inclusive $\geq 0j$, $\geq 1j$, $\geq 2j$, $\geq 3j$
- Higgs p_T separately for =0, =1, =2, ≥ 3 jets
- Jet kinematics: p_T , y for the three leading jets
- Variables in di-jet events: $m(jj)$, $\Delta y(jj)$, $\Delta\phi(jj)$
- Events in two VBF fiducial regions:
 - $m(jj) > 400$ GeV, $\Delta y(jj) > 2.8$, with and without a 3rd jet veto
 - $m(jj) > 600$ GeV, $\Delta y(jj) > 4.0$, with and without a 3rd jet veto

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fully differential VBF at NNLO

VBF Hjj and Hjjj at NLO+PS

fully differential VH at NNLO

comparison of and to NLO+PS

$gg \rightarrow ZH$

VBF cuts

Conclusions

Focus on generic theory predictions

Little activity towards specific fiducial xsec analyses

But: comparisons/validation of tools and methods
will be valuable for future activities