Discussions on Future Activities
- Questionnaire -

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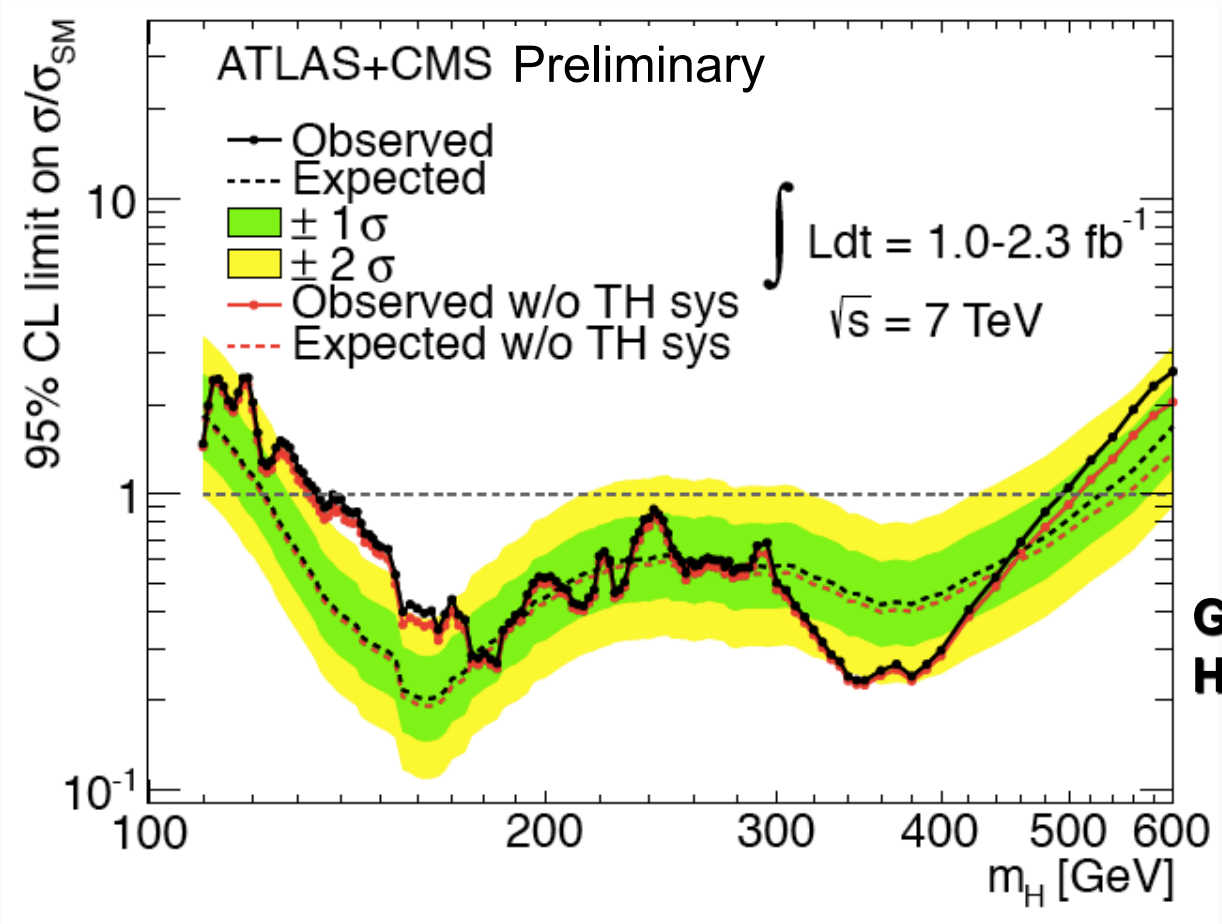
The 5th LHC Higgs Cross Section Workshop
November 21-22, 2011 @ LAL-Orsay

Theoretical systematic uncertainties



Expected exclusion changes by 1 GeV at low mass and 20 GeV at High mass

Gigi Rolandi (CERN, Pisa)
HCP2011@Paris

Thanks to the advances in theory and to LHC Higgs cross section group !

The predictable future: LHC Time-line

2009 — Start of LHC

Run 1: 7 TeV centre of mass energy, luminosity ramping up to few 10^{33} cm^{-2} s^{-1}, few fb^{-1} delivered

2013/14 — LHC shut-down to prepare machine for design energy and nominal luminosity

Run 2: Ramp up luminosity to nominal (10^{34} cm^{-2} s^{-1}), ~50 to 100 fb^{-1}

2017 or 18 — Injector and LHC Phase-I upgrades to go to ultimate luminosity

Run 3: Ramp up luminosity to 2.2 x nominal, reaching ~100 fb^{-1} / year accumulate few hundred fb^{-1}

~2021/22 — Phase-II: High-luminosity LHC. New focussing magnets and CRAB cavities for very high luminosity with levelling

Run 4: Collect data until > 3000 fb^{-1}

2030 — ILC, High energy LHC, ... ?

Sergio Bertolucci (CERN)
HCP2011@Paris

LHC 2012 run

Machine parameters:

- Which energy ? (3.5 TeV, 4 TeV) ,
  Which bunch spacing ? (50ns, 25ns), Which beta* in IP1/5 ?

Physics goals and conditions:

- What will be the priorities ? What required integrated luminosity ?
- Pile-up, Background limitations ?

Preparing 2012:

- First discussion on LMC on November 26
- to be followed by an LHC meeting in Evian December 12-14
- and finalized in Chamonix in February 2012

1. Physics Program

After light Higgs discovery or exclusion in 2012 ?

- Light Higgs discovery
  - Should we concentrate on Higgs property ?
  - J^{PC}, BR, Yukawa, Higgs self-coupling, rare decay, etc.
- No light Higgs
  - Work on BSM Higgs physics ?
    - Weak EWSB: SUSY(MSSM, NMSSM, xMSSM), THDM, etc.
    - Strong EWSB: Composite Higgs, Little Higgs, Higgs less, etc.
  - Heavy Higgs and $V_L V_L$ scattering study ?

What is the direction of our physics program?

Electroweak Symmetry Breaking (EWSB)

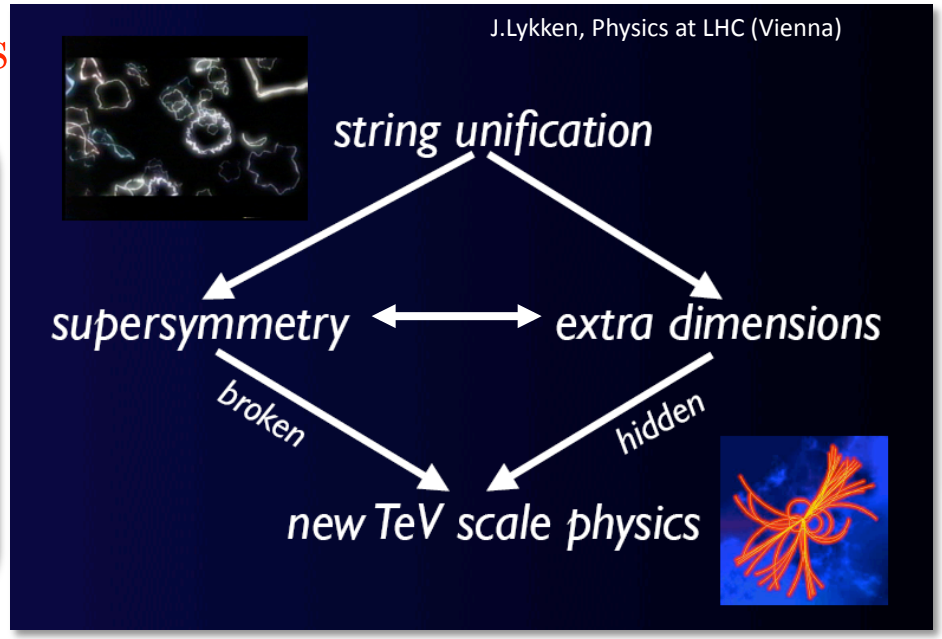
LHC early discovery?

Extended Gauge Symmetry
Higgsless
Left-Right Symmetric Model, Gauge-Higgs Unification

W', Z'

$\tilde{g}/\tilde{q}$, xMSSM Higgs

SUSY
(m)SUGRA
GMSB
AMSB
Mirage
Split SUSY
RPV, …



Graviton, BH

Extra-Dimension
LED(ADD)
Randall-Sundrum
Universal ED(KK)
…

Resonances

Dynamical Symmetry Breaking
Strong EWSB, Chiral Lagrangian, Technicolor
Top-quark Condensation
Composite Higgs, Little Higgs

Precision EW data

Poor experimentalist's compilation of models. Perhaps "Not even wrong"!

2. Group Organization

How we can improve the group organization ?

- Current structure
  1. Higgs production - ggF, VBF, WH/ZH, ttH, MSSM(h/H/A, $H^{\pm}$)
  2. Common issues - PDF, BR, NLO MC, PO
  3. Higgs decay - $H \rightarrow \gamma\gamma$, ZZ, WW, $\tau\tau$, bb, $H^{\pm}$
- 2(3) contacts from EXP, and 2 contacts from TH.

Do we need to restructure the organization in 2012 ?

LHC Higgs Cross Section Working Group

ATLAS ⊕ CMS ⊕ LHCb ⊗ Theory

MC Group
MC4LHC

PDF4LHC

Creation announced in January 2010.
Kickoff meeting on February 3, 2010.
Workshops in Torino (Nov. 2009), Freiburg (April 2010),
CERN (July 2010), Bari (Nov. 2010), BNL (May 2011), Paris (Nov. 2011)

Task: **SM and MSSM Higgs Cross Section and BRs**

- Compute and agree on cross sections and Brs
- Use the same Standard Model input parameters
- Uncertainty estimation (scale, α_s, PDF, etc.)
- Monte Carlo at NLO for signal and bkg.
- Define pseudo-observables
- **Cross sections of background SM processes**

SM Cross
Section
Task
Force

Working Groups:
ggF, VBF, WH/ZH, ttH, MSSM
H→γγ/WW/ZZ/ττ/bb, H±
PDF, BR, NLO MC, Pseudo-Observables

Statistics
Forum

3. Group Activity

How we can improve the group activity ?

- Workshops – twice per year ?
  - In the past, Nov. 2009, Apr./Jul./Nov. 2010, May/Nov. 2011
  - At CERN or outside ?
- Publications in CERN Report or in refereed journal ?
  - CERN Report: Handbook
    1. Inclusive Observables
    2. Differential Distributions
    3. Higgs properties ?
- Relation with other activities ?
  - LHC Higgs combination WG,
  - LPCC, LHC2TSP, PDF4LHC, other Higgs workshops, etc.

4. Group Communications

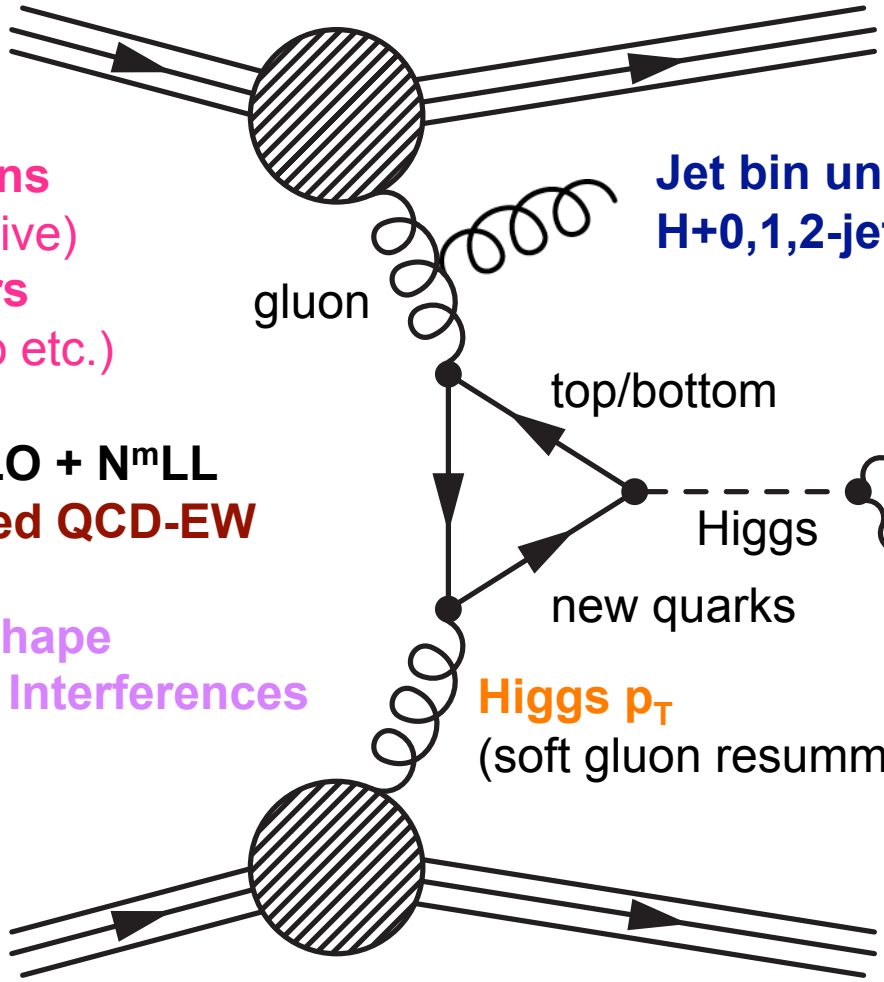
How we can improve communications between us ?

- Mailing list
  - Are 2 mailing lists (lhc-higgs, lhc-higgs-contact) sufficient ?
    Needs subgroup mailing lists ?
- InDico, Twiki page, SVN, Sharepoint (Why so unpopular ?)

Any ideas to improve communications ?

Higgs cross section issues

ggF, VBF, WH/ZH, ttH, MSSM Higgs



Higgs Cross Sections
(inclusive/exclusive)
Differential K-factors
(effect of jet-veto etc.)

QCD correction $N^kLO + N^mLL$
EW correction, Mixed QCD-EW

Heavy Higgs Line Shape
SM Backgrounds & Interferences

Jet bin uncertainty
H+0,1,2-jets

Higgs decay
Branching ratios
(QCD/EW corr.)

Higgs p_T
(soft gluon resummation)

PDF+α_s uncertainties
Renormalization/Factorization scale dependence

Tools for Higgs physics

Cross Section ggF, VBF, WH/ZH, ttH, MSSM Higgs

ggF
HIGLU (NLO QCD+EW)
iHixs (NNLO QCD+NLO EW)
HNNLO (NNLO QCD)
ggh@NNLO (NNLO QCD)

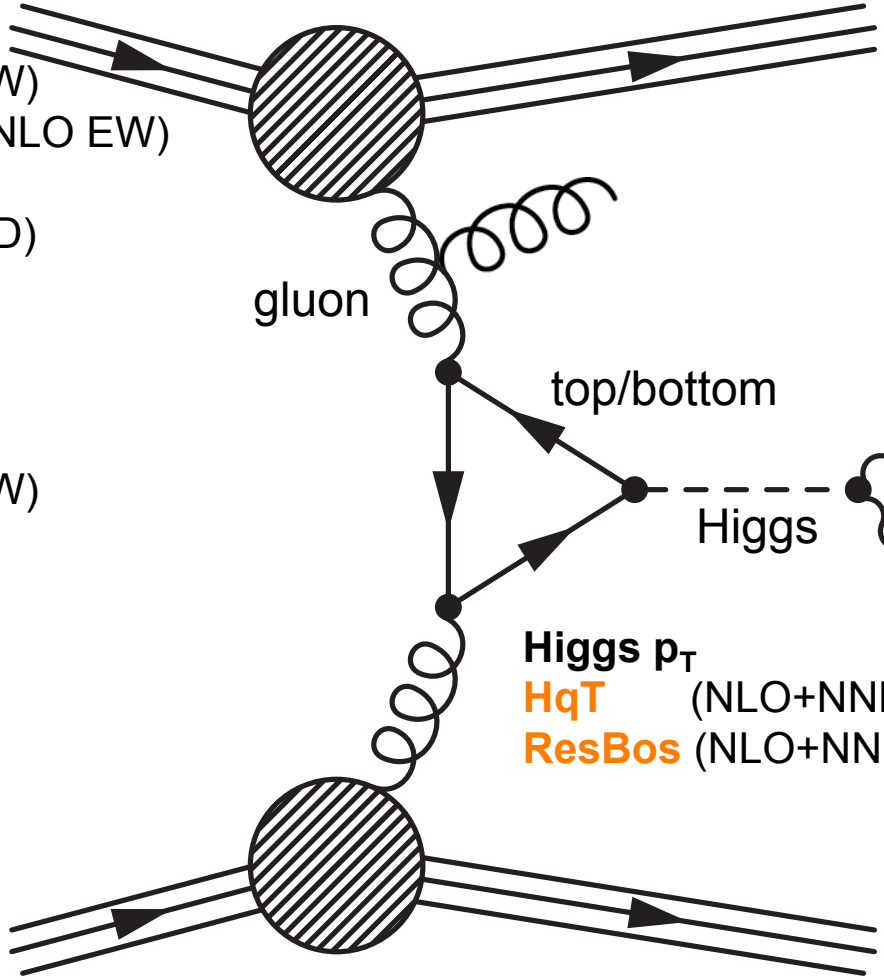
VBF
VV2H (NLO QCD)
VBFNLO (NLO QCD)
HAWK (NLO QCD+EW)

WH/ZH
V2HV (NLO)

ttH
HQQ (QCD LO)

bbH
bbH@NNLO (NNLO)

+ private codes.



Higgs Decay
HDECAY (NLO)
Prophecy4f (NLO)
FeynHiggs, CPSuperH

Higgs p_T
HqT (NLO+NNLL)
ResBos (NLO+NNLL)

NLO MC
aMC@NLO, POWHEG, SHERPA, HERWIG++
MCFM

PDF: MSTW2008, CT10, NNPDF2.1, etc.