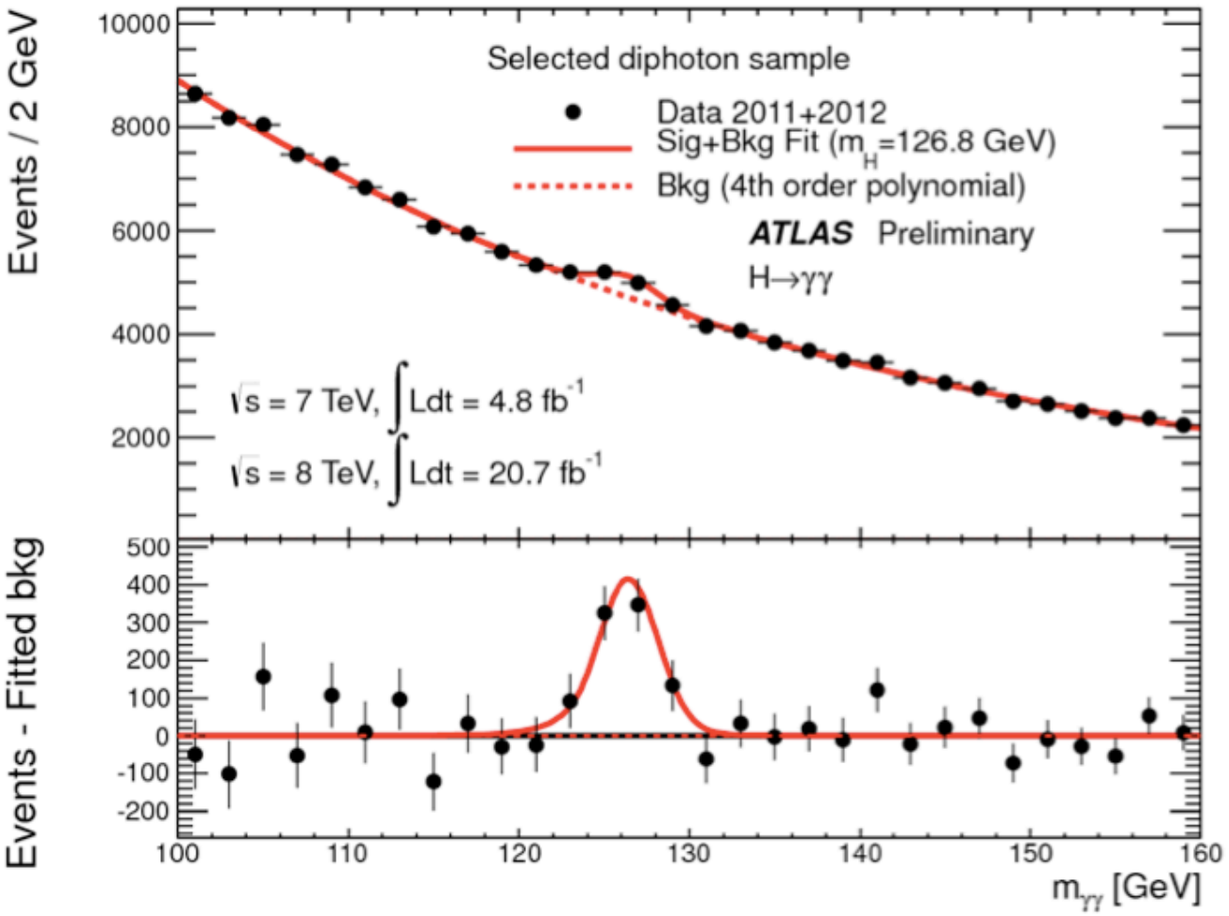
QCD/LHC activities in TH

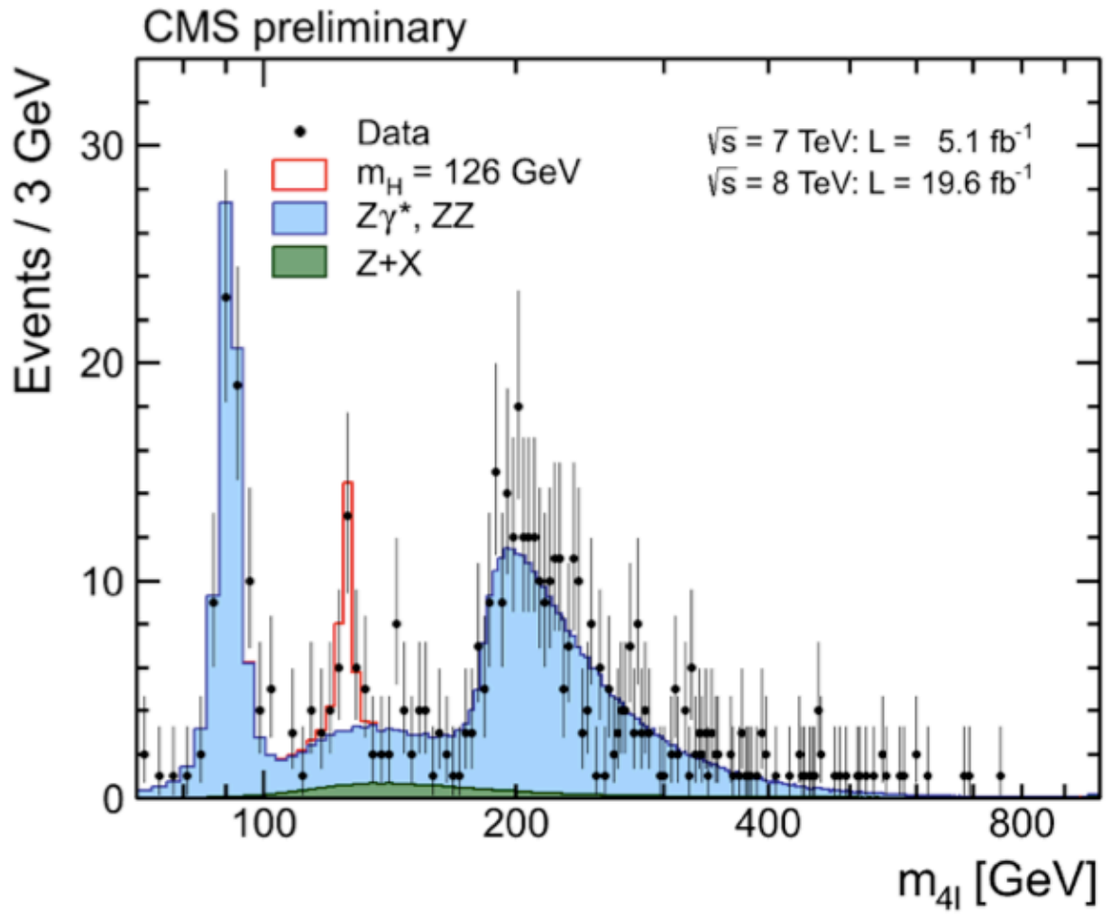
- Key focus: Theoretical work directly related to the **modeling** and the **interpretation** of the data from high-energy collisions (LHC, Tevatron, cosmic rays, ...), including both SM and BSM aspects.
  - calculations for cross sections, with ever increasing accuracy, for processes of ever increasing complexity:
    - development of new "analytical" approaches/tools, as well as "numerical"
    - automatization of calculations
  - modeling of final states, including the transition partons -> particles
  - identification of analysis strategies, to be exploited by the experiments
  - close interaction with the LHC experiments

Key outcomes of 3 yrs at the LHC: I

I: The Higgs signal has been detected through sharp mass peaks in several channels

II: Its production and decay rates are consistent with the SM expectation, at the +/– 20% level .....

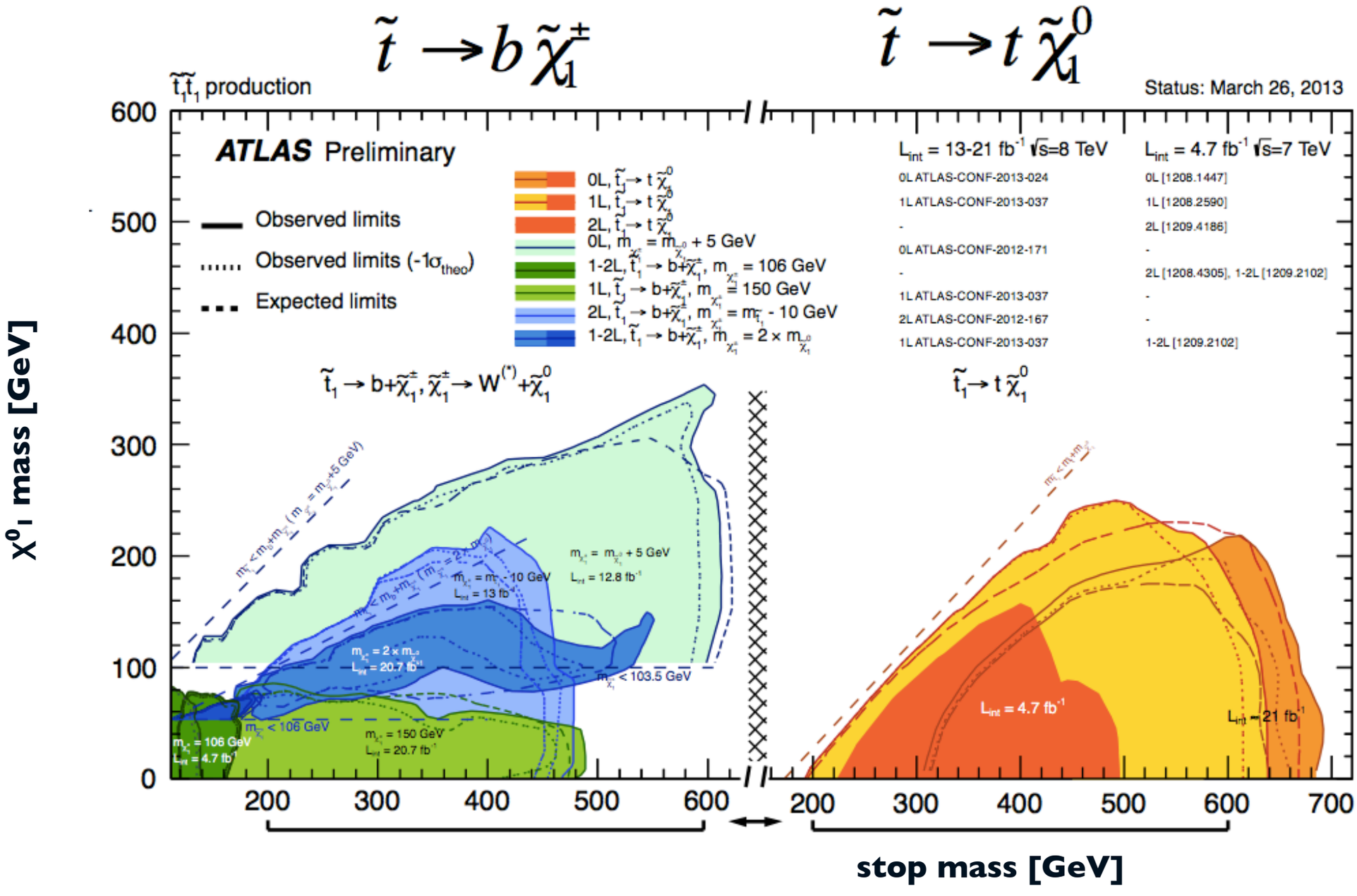




.... how far can we push the accuracy of these tests, and probe the mechanism of EWSB ?

Key outcomes of 3 yrs at the LHC: 2

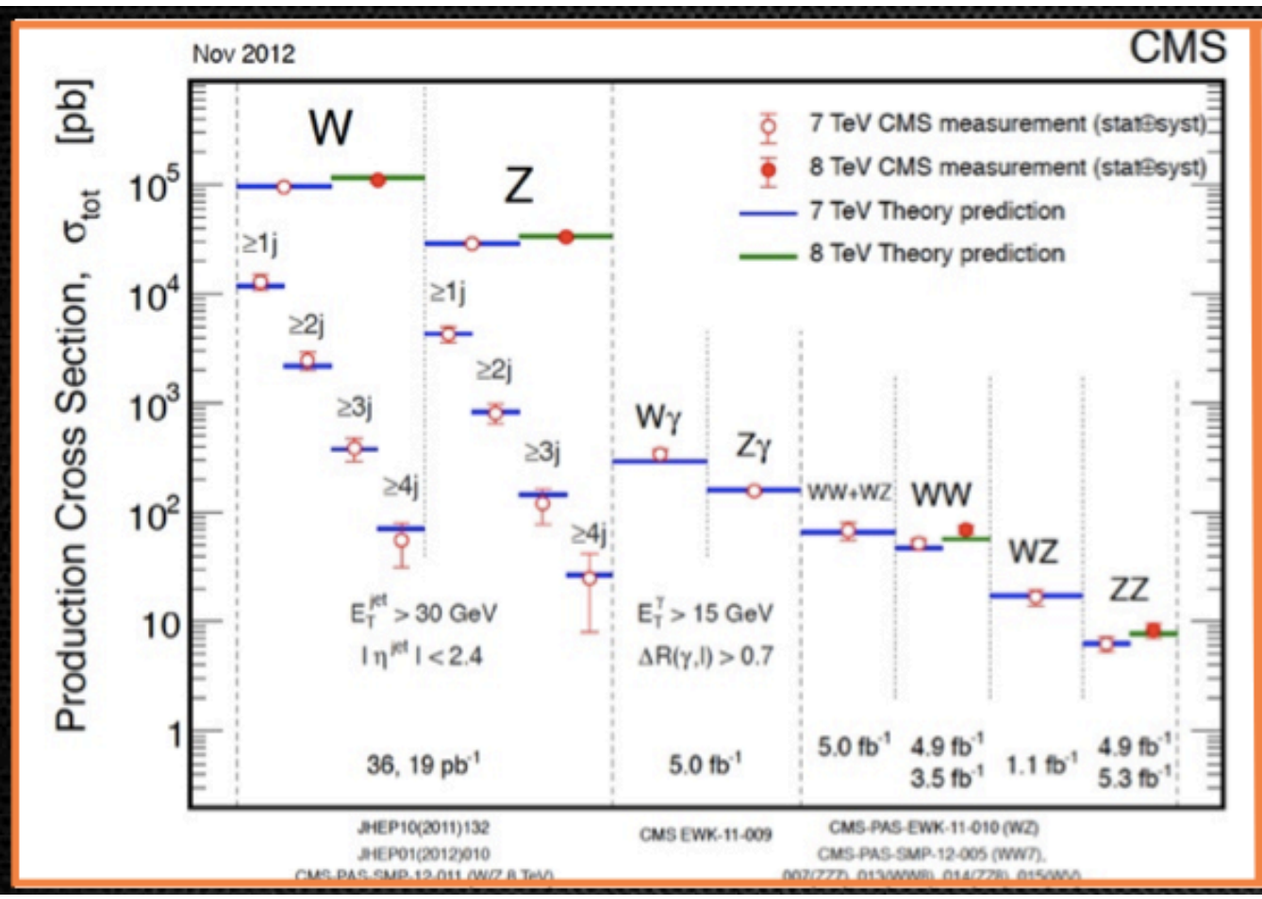
No sign of BSM, in all places the experiments have looked .....

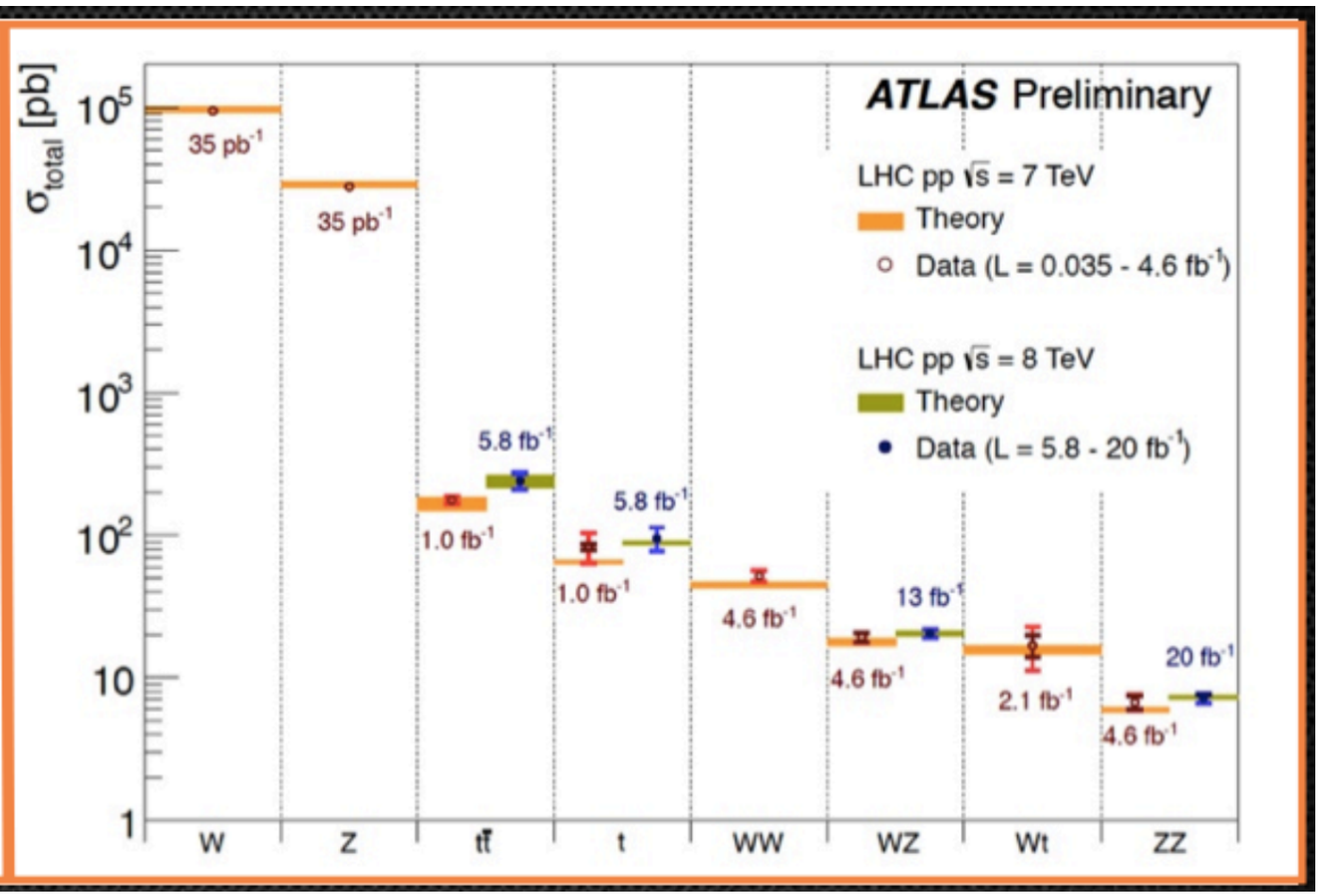


.... how to access regions of parameters of BSM models where the sensitivity is low?

Key outcomes of 3 yrs at the LHC: 3

The theoretical description of high-Q^2 processes at the LHC is very good ....





.... but must and can be improved

Current challenges for the field: precision

CMS submission to Strategy Group,
https://indico.cern.ch/contributionDisplay.py?contribId=177&confId=175067

Coupling	Uncertainty (%)			
	300 fb^{-1}		3000 fb^{-1}	
	Scenario 1	Scenario 2	Scenario 1	Scenario 2
κ_γ	6.5	5.1	5.4	1.5
κ_V	5.7	2.7	4.5	1.0
κ_g	11	5.7	7.5	2.7
κ_b	15	6.9	11	2.7
κ_t	14	8.7	8.0	3.9
κ_τ	8.5	5.1	5.4	2.0

Plus Hμμ coupling to better than 5% at 3000fb^{-1}

Scenario 1: same systematics as 2012 (TH and EXP)
Scenario 2: half the TH syst, and scale with 1/sqrt(L) the EXP syst

Note: assume no invisible Higgs decay contributing to the Higgs width

Note: results of scenario 2 @ 3000/fb are overall as powerful as LC@500GeV !!

Current challenges for the field: precision

Theoretical uncertainties on production rates (Higgs XS WG, arXiv:1101.0593)

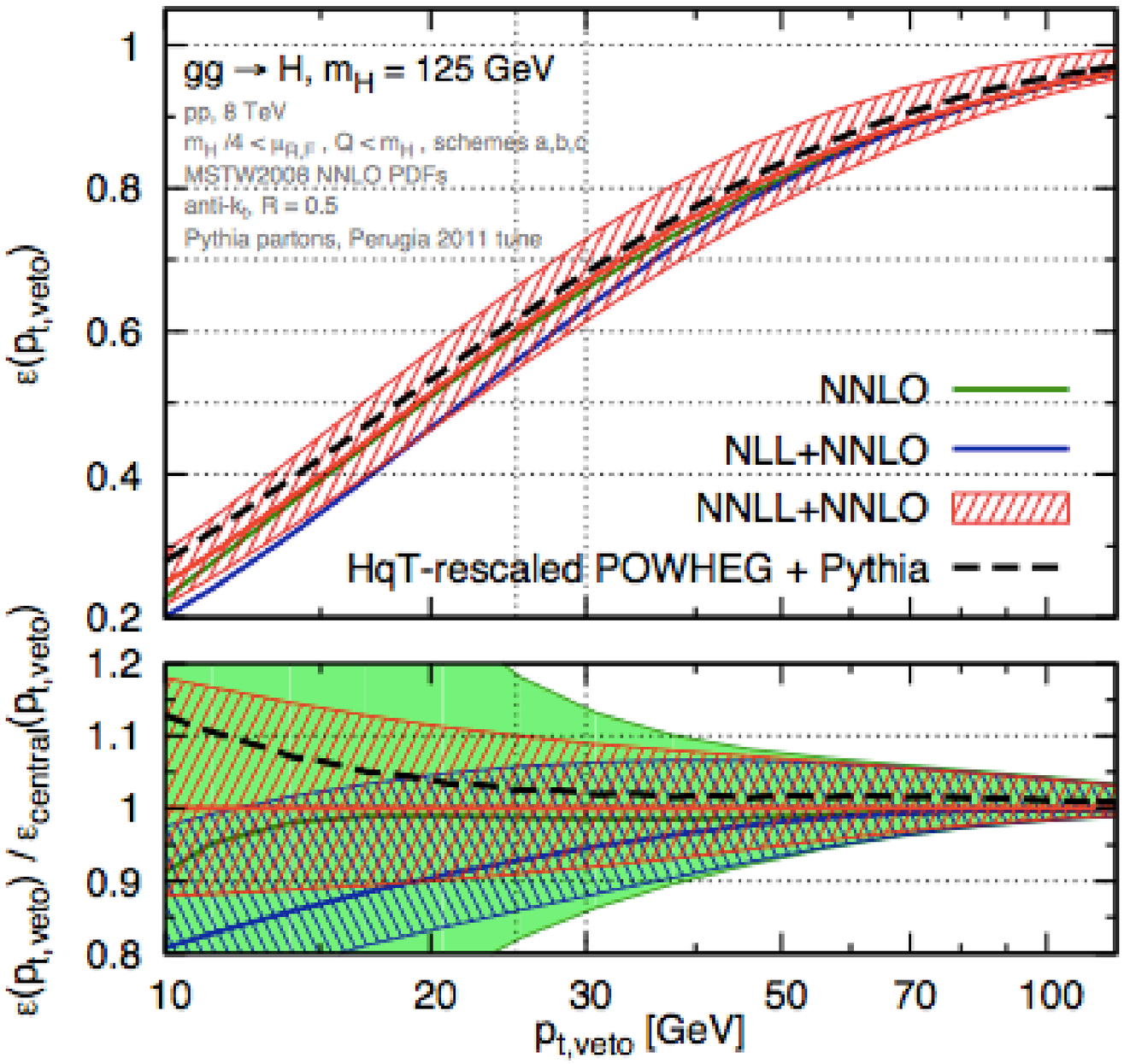
14 TeV	δ(pert. theory)	δ(PDF, α_S)
gg→H	± 10 %	± 7%
VBF (WW→H)	± 1 %	± 2%
qq→WH	± 0.5 %	± 4%
(qq,gg)→ZH	± 2 %	± 4%
(qq,gg)→ttH	± 8 %	± 9%

Improve with higher-loop calculations:
gg->H @ NNNLO
ttH @ NNLO

Improve with dedicated QCD measurements, and appropriate calculations

Current challenges for the field: accurate description of final states

- to properly model experimental selection cuts
- to properly model the separation between signals and background
- to improve the sensitivity to rare and "stealthy" final states in BSM searches



Ex. jet veto efficiency, required to reduce bg's to H→WW*

Banfi, Monni, Salam, Zanderighi, arXiv:1206.4998

Long-term group members:

- Fellows and staff presenting themselves in this session
  - Korinna Zapp (Fellow 2012-2014, attending a workshop in S.Africa)
  - Giulia Zanderighi (staff, arriving Jan 1)
  - Guido Altarelli (Emeritus Staff)

Common group activities

- Collider Cross Talk (Thursday morning, 11am)
- Friday QCD lunch (meet outside common room at 12:45pm)
- Friday seminar

Further opportunities for collaboration

- Various WGs (PDF4LHC, LHC WGs) and Workshop activities are regularly running at CERN

LHC Physics Centre at CERN (LPCC)

- Umbrella for activities of common interest to all LHC experiments:
  - contacts/interactions with the theory community, via Workshops or Working Group activities:
    - discussion/interpretation of data
    - development of theory tools used by the experiments
  - combination of experimental results from different experiments
    - LHC WG's (e.g. Top, EW, etc)
  - definition of common physics programmes (e.g. Forward Physics)
  - discussion and support for the development of tools. Examples: Detector Simulation tools (Geant), B-decay tables and generators (EvtGen), Statistical analysis tools (RooStat, etc)
  - organization of tutorials (e.g. Rivet 2 tutorial scheduled for November 21)
  - organization of seminars by the LHC experiments (Tue at 11am)
  - etc.etc.

Follow all LPCC activities from the web page http://cern.ch/lpcc

LPCC links

- WELCOME
  - About the LPCC
  - Visit the LPCC
  - Subscribe to LPCC News
- LHC WORKING GROUPS
  - MB & UE WG
  - Electroweak WG
  - Rate normalization WG
  - Top WG
  - Forward Physics WG
- EVENTS
  - Forthcoming events
  - Past events
- LHC PUBLICATIONS
- STUDENTS RESOURCES
- MISC

Useful links

CERN
LHC & exps
LHC centres in other Labs
HEP

Latest LHC data publications (full list)

ALICE
Two and Three-Pion Quantum

News

LHC analysis projects for PhD students in the CERN ATLAS group
01/28/2013
The CERN ATLAS group offers opportunities for the supervision of PhD students, to be engaged in projects of LHC data analyses. For more details, see
http://lpcc.web.cern.ch/LPCC/index.php?page=misc
Read More...

MCPLOTS release
02/17/2011
MCPLOTS is a new cern-based website for Monte Carlo comparisons, intended as a simple browsable repository of plots comparing HEP event generators to a wide variety of available experimental data, mainly based on the RIVET analysis tool.
For more details:
Read More...

Forthcoming events

Next 2 weeks

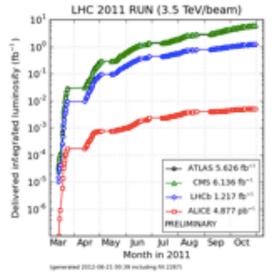
QCD Tools for LHC Physics: From 8 to 14 TeV - What\'s needed and why?
11/14/2013 || 09:00 => 11/15/2013 || 18:00
The meeting is designed to promote an informal, loosely structured, working atmosphere between experimentalists and phenomenologists, who are actively confronting precision predictions and comparisons with LHC data, with a goal to

Status of LHC ops

SHUTDOWN

LHC programme coordination

LHC integrated luminosity from 2011-2012 runs charts



Coming events at CERN

Academic Training Lecture Regular Programme, 05/11, 11h - The Higgs Particle (2/3) by Kado, Marumi

LHC Seminar, 05/11, 11h - CP violation in charmless two-body B decays at LHCb by Perazzini, Stefano

Conferences & Workshops, 06/11, 8h - CERN Theory Group Retreat by Mangano, Michelangelo & Antoniadis, Ignatios

Academic Training Lecture Regular Programme, 06/11, 11h - The Higgs Particle (3/3) by Kado, Marumi

Sign-up for WG mailing list from the respective web pages

Myself

- Scientific interests: all of the above and more.
- In charge of the LPCC
- Co-leading the "hadron collider physics" part of the FCC study, with F.Gianotti (detectors) and A.Ball (detector/machine interface)
  - initially steer the work in these directions:

FHC.1.1 Exploration of EW Symmetry Breaking (EWSB)
FHC.1.2 Exploration of BSM phenomena
FHC.1.3 Continued exploration of SM particles
FHC.1.4 Opportunities other than pp physics
FHC.1.5 Theoretical tools for the study of 100 TeV collisions

  - Kickoff mtg of the FCC Study: Febr 12-14 2014 (will cover all aspects, from civil engineering to magnet development, with little space for physics)
    - pre-meeting focused on physics: Febr 10-11
  - will promote strong collaboration with parallel efforts in China, and in the US

Propose a meeting, tomorrow at 6pm, to have a first discussion on topics, plans, etc