

CERN Theory Group Retreat

Les Houches – Nov 6 2013

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In broad terms, I am interested in collider phenomenology and improving theory predictions. My focus is on

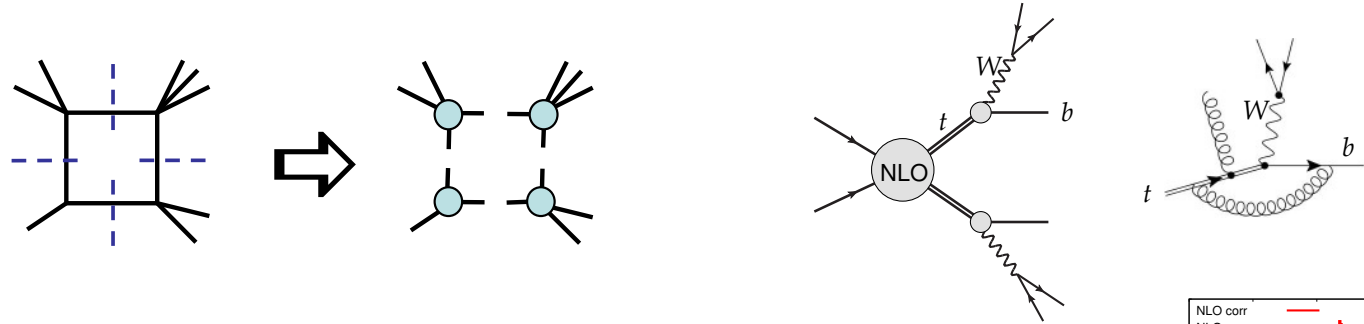
- Higher order corrections
(QCD, electroweak sector)
- Realistic modelling of particle reactions
(decay chains, spin correlations at NLO,...)
- Proper field-theoretical description of experimental procedures
(top mass definition, jet binning in H production,...)

Applied to phenomenology of:

- Electroweak gauge bosons + jet
- Top quark pairs, $t\bar{t}$ + jets, gauge bosons, missing energy
- Higgs production, H +jet
- Z production, T and stop quark pair production

Top quark physics

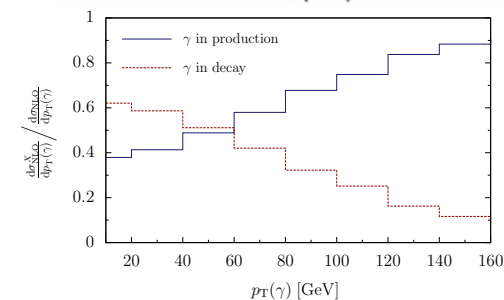
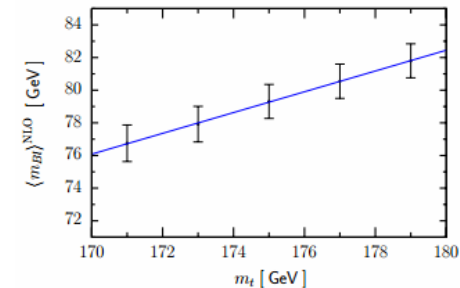
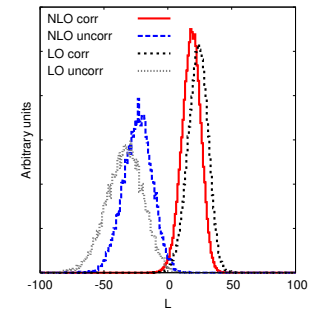
Technical aspects:



Physics:

- Top quark spin correlations
- Top mass determination from kinematic distributions
- $t\bar{t}$ +jet, $t\bar{t}$ +photon (A_{FB} , Q_{top} , ...)
- Determination of electroweak couplings in $t\bar{t}$ + Z, H
- $Z' \rightarrow t\bar{t}$ production including interference with QCD
- Fermionic top quark partner: $pp \rightarrow T'T'\bar{t}$ with $T' \rightarrow t + A_0$
- Stop quarks: $pp \rightarrow \tilde{t}\tilde{t}^*$ with $\tilde{t} \rightarrow t + \chi_0$

$$\mathcal{R}(\Phi_{\text{obs}}) = \frac{P_c(\Phi_{\text{obs}})}{P_c(\Phi_{\text{obs}}) + P_u(\Phi_{\text{obs}})}$$



Higgs physics

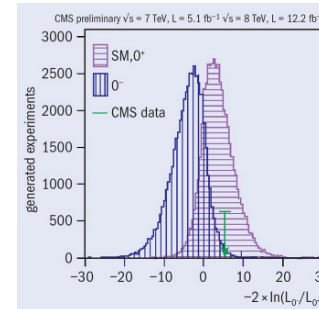
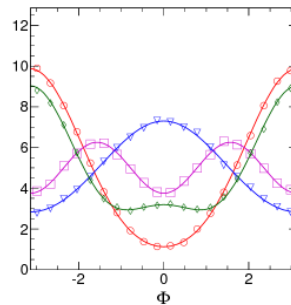
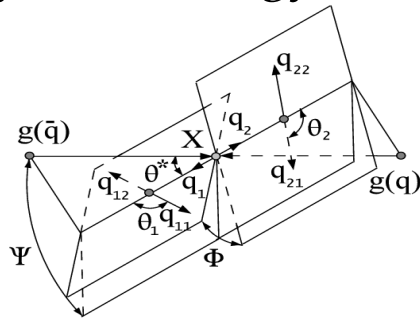
- **Spin and CP-measurements** of the 126 GeV resonance

Joint theoretical-experimental effort: MELA technique, JHU Generator

Consider most general couplings for

$$pp \rightarrow \text{spin-0,1,2} \rightarrow VV \rightarrow 4f, \quad pp \rightarrow \text{VBF,QCD} \rightarrow H+jj, \quad pp/e^+e^- \rightarrow HV$$

Analysis of energy-related + angular distributions in multivariate LL analysis



- **Development of NNLO QCD framework for H+jet**

Important SM process. Experimental cross sections binned in #jets.

NLO QCD + resummation still carry large uncertainties (~20-30%).

Calculation was practically impossible until very recently.

Basic idea: Sector decomposition + FKS.

H+jet: robust test of the framework.

Very algorithmic procedure suggests automation.

