LHC final states, potential experimental and theoretical accuracies

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A comprehensive(?) "review on potential LHC reactions and their accuracies"

Goals:

1) collect "known" cross sections with todays uncertainties

2) estimate how accurate these reactions can be calculated

3) estimate how accurate these reactions can be measured

4) identify cross section ratios to minimize errors

→ clarify the remaining "problems"

theoretical limitations for LHC precision reactions:

- PDF uncertainties (now) and tomorrow
- status: inclusive analytical calculations
- status: (double) differential (p_t and η) cross section calculations
- availability of accurate Monte Carlos?

Experimental limitations for LHC precision reactions:

- counting statistics $\pm 1\%$ $\rightarrow$ with 10^4 events ($\Delta N/N = 1/\sqrt{N}$)
- backgrounds: the cleaner $\rightarrow$ the better!
  (reduced/controlled by cuts)
- uncertainties from efficiency and geometrical acceptance?

a list of well defined final states

- Drell–Yan type lepton pair final states. (This includes on– and off–shell W and Z decays) talks: G. Dissertori (Monte Carlos for Z and W production) and T. Schorner (W^+, W^- to investigate pdfs)

- γ–jet(s), W–jet(s) and Z–Jet(s) final states.
  talk H. Stenzel (PDF-related systematic uncertainties for W+jet production)

- Diboson events of the type WW, WZ, ZZ, $W\gamma \rightarrow$ leptons (SM Higgs production might perhaps be included here).

- Events with top quarks (identified with at least one isolated lepton).

- Hadronic final states with up to n(=2,3 ..) Jets and different p_t and mass.
  talk H. Stenzel (α_s from jet production)

uncertainties from different HO QCD calculations:

ELECTROWEAK GAUGE BOSON RAPIDITY DISTRIBUTIONS AT NNLO

C. Anastasiou, L. Dixon, K. Melnikov and F. Petriello Dec 2003, hep-ph/0312266

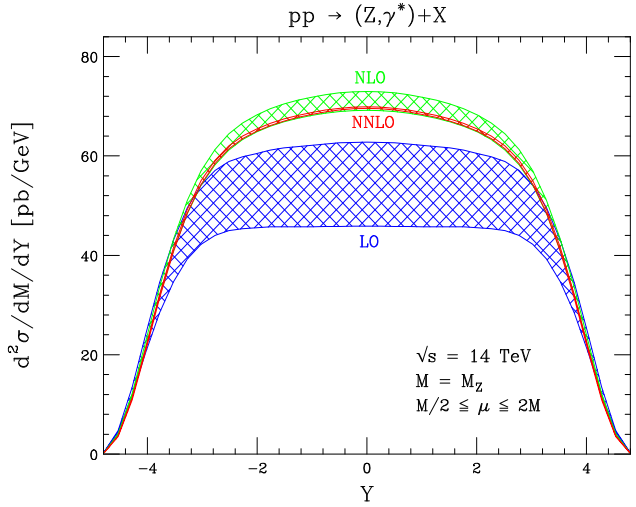


Figure 3: The CMS rapidity distribution of an on-shell Z boson at the LHC. The LO, NLO, and NNLO results have been included. The bands indicate the variation of the renormalization and factorization scales in the range $M_Z/2 \leq \mu \leq 2M_Z$.

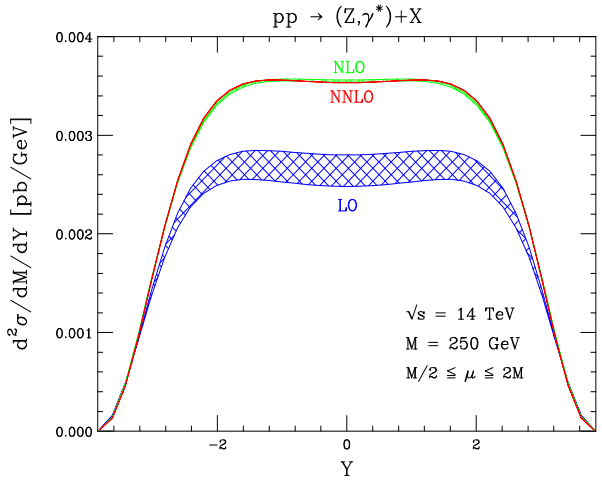
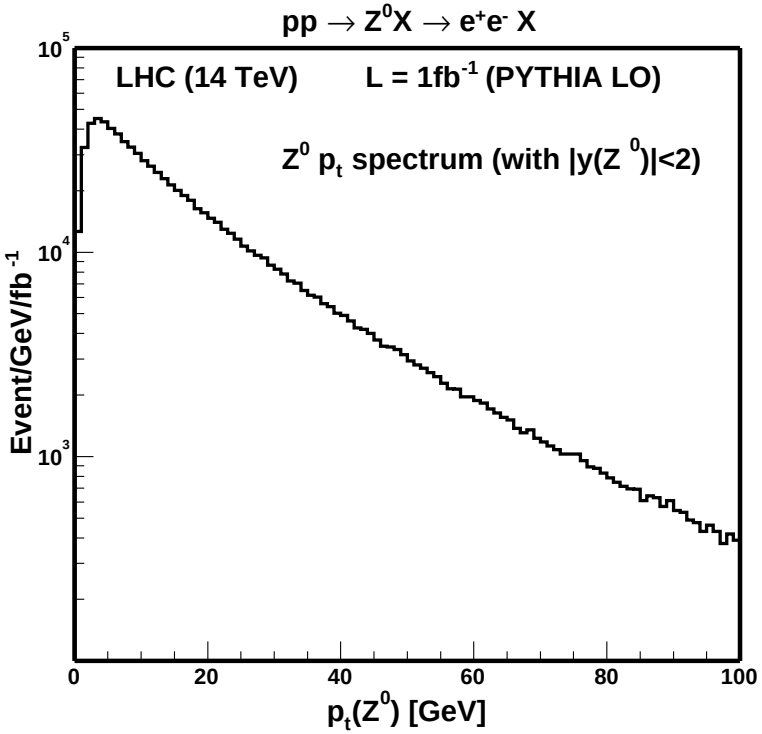


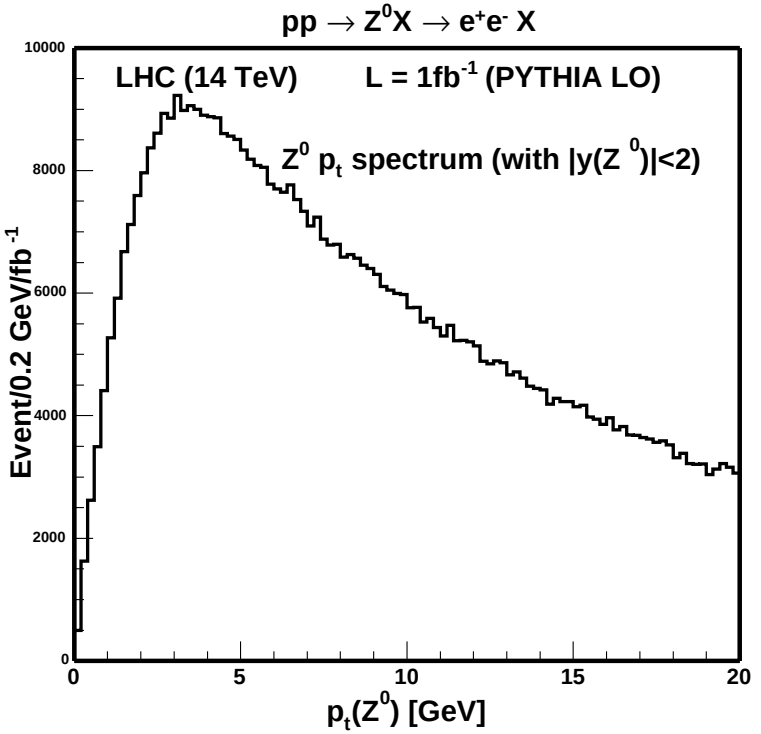
Figure 14: The rapidity distribution for (Z, γ^*) production at the LHC for an invariant mass $M = 250$ GeV. The LO, NLO, and NNLO results have been included. The bands indicate the residual scale dependences.

high(est) precision QCD test at the LHC? the p_t spectrum of the Z boson!

Huge cross section, "no" background and precision measurement

$pp \to ZX \to e^+e^-X$





who will predict p_t spectrum in all its beauty?

including (multi)jet activity and rapidity distribution!

use result to invent (iterative?) a method to predict p_t spectrum of other final states!

perspectives? more volunteers welcome!

W and Z production (on and off shell) including additional jet production lots of volunteers (γ-jet volunteers needed!)

diboson (WW, WZ, ZZ and W γ) "more coverage needed"

top production "no volunteers so far"

jet final states "more coverage needed"