

Global uncertainty estimate (QCD, EWK, PDFs) with correlations b/w channels

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Theory uncertainties

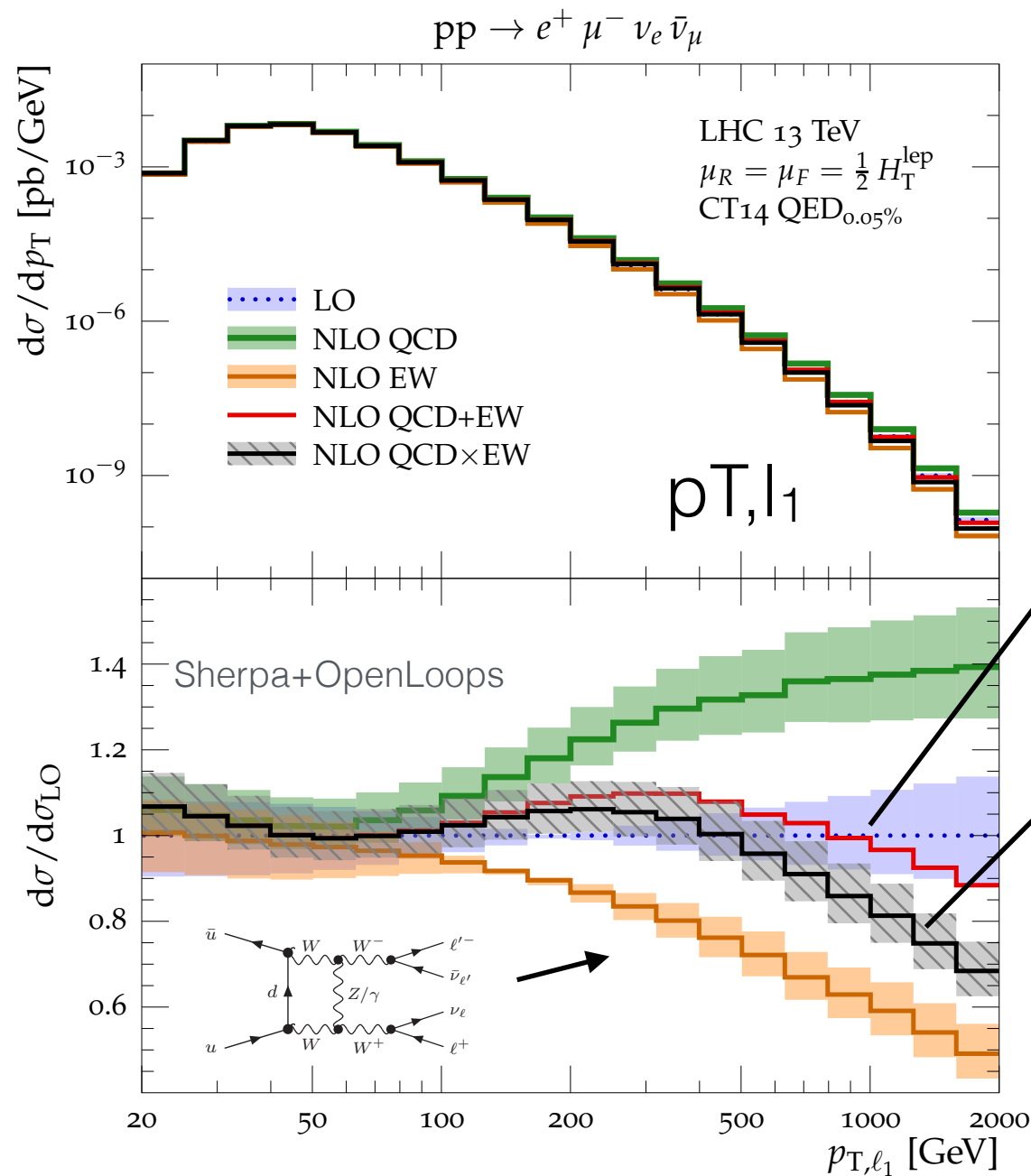
- higher-order QCD (normalization and shapes)
- higher-order EW (shapes, enhanced in tails)
- QCD-EW combination
- PDFs
- Monte Carlo: matching, shower, hadronisation

Questions: do we have to go beyond what is currently done?

- QCD scale variations
- MC systematics from cross comparison
-

Example: WW-DF

[Kallweit, JML, Pozzorini, Schönherr; '17]



Given **QCD** and **EW** corrections are sizeable, also mixed **QCD-EW** uncertainties of relative have to be considered.

Additive combination

$$\sigma_{\text{QCD+EW}}^{\text{NLO}} = \sigma^{\text{LO}} + \delta\sigma_{\text{QCD}}^{\text{NLO}} + \delta\sigma_{\text{EW}}^{\text{NLO}}$$

Multiplicative combination

$$\sigma_{\text{QCD} \times \text{EW}}^{\text{NLO}} = \sigma_{\text{QCD}}^{\text{NLO}} \left(1 + \frac{\delta\sigma_{\text{EW}}^{\text{NLO}}}{\sigma^{\text{LO}}} \right)$$

(try to capture some $\mathcal{O}(\alpha\alpha_s)$ contributions, e.g. EW Sudakov logs × soft QCD)

Difference between these two approaches indicates size of missing mixed **EW-QCD** corrections. Here: 10-20% in the tail.

Can be significantly larger for other channels.

p_{T, l_1} of hardest lepton

- ▶ +40 % **QCD** corrections in the tail (Note: slight jet veto applied)
- ▶ LARGE negative **EW** corrections due to **Sudakov behaviour**: -40% @ 1 TeV

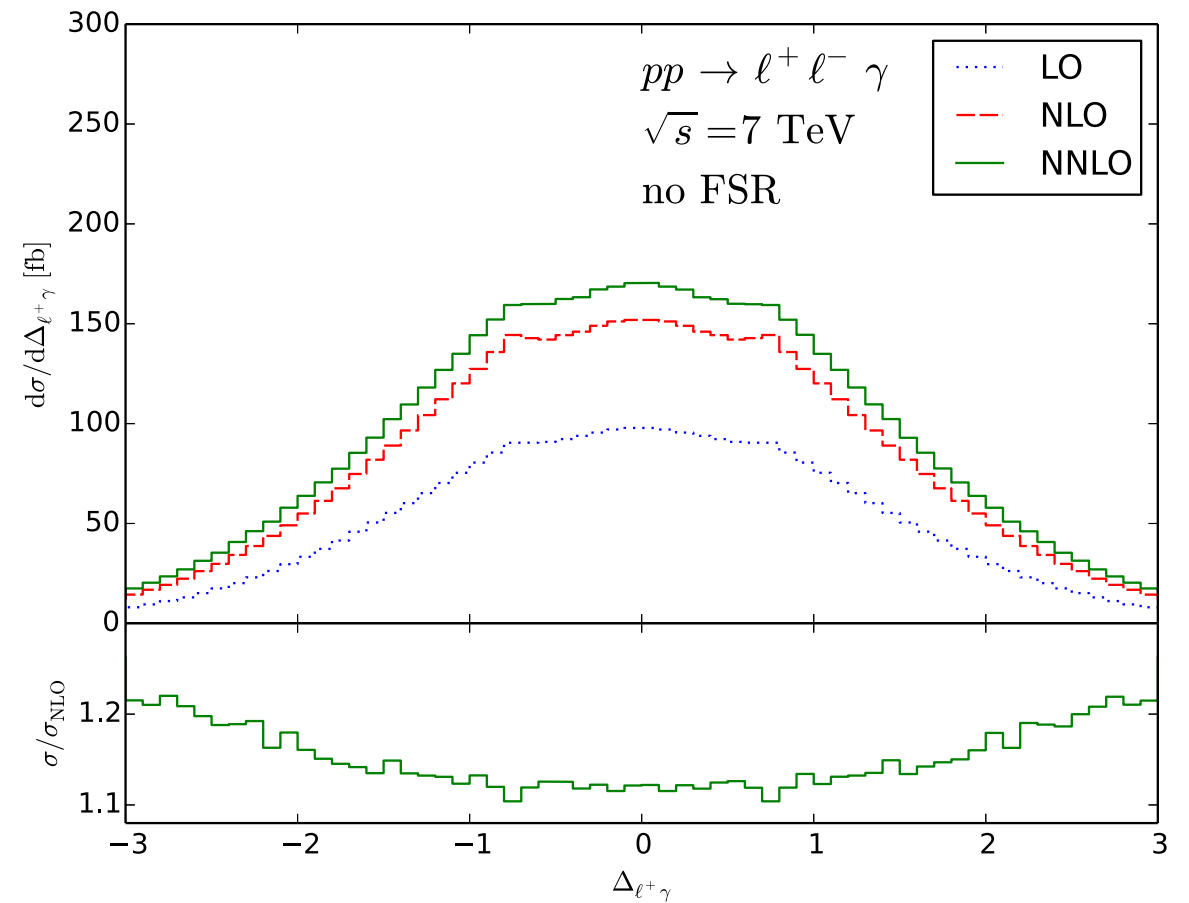
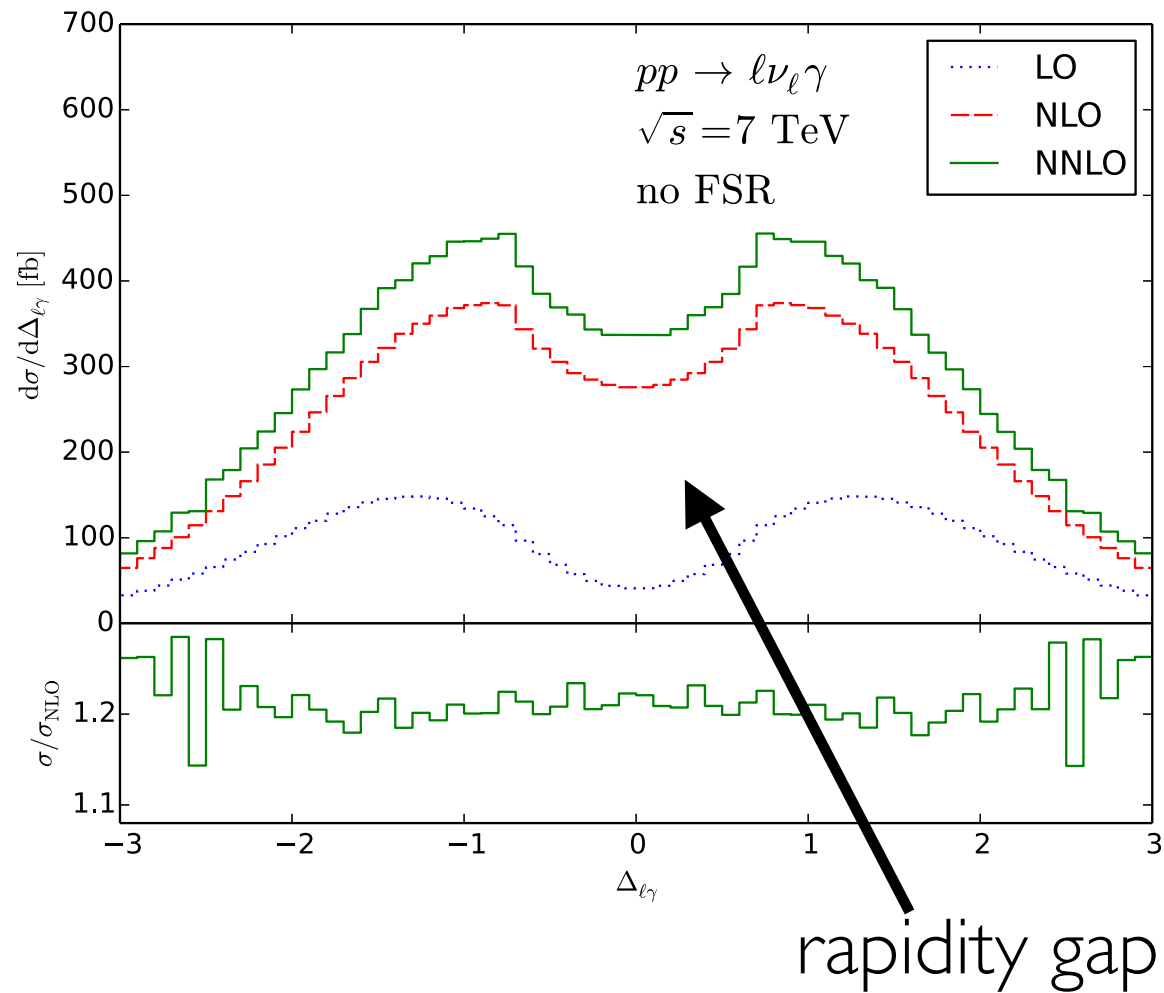
Questions:

do we need a systematic treatment of theory systematics between different channels? What do we gain?

What about Correlations?

Zgamma vs. Wgamma

[Grazzini, Kallweit, Rathlev; '15]



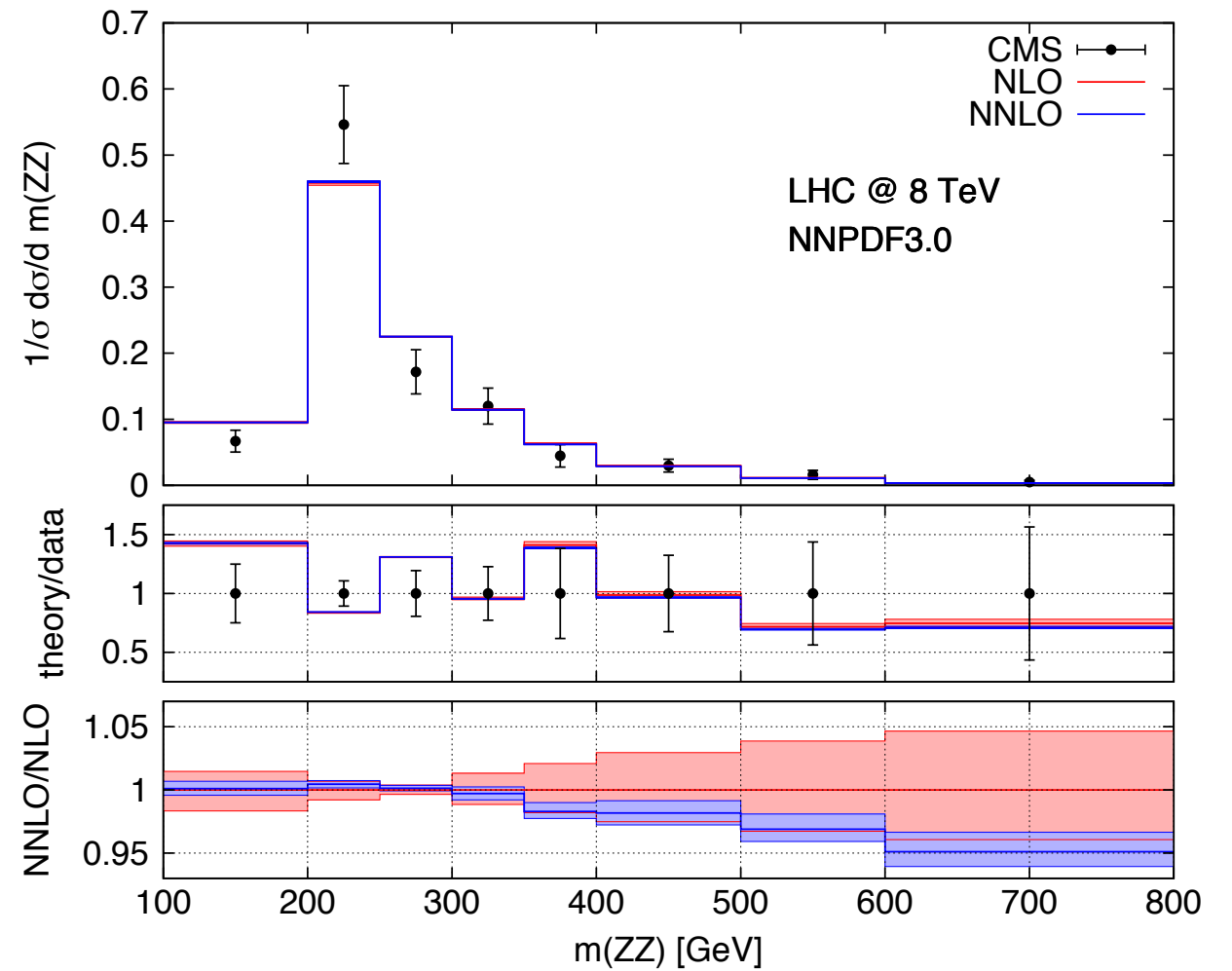
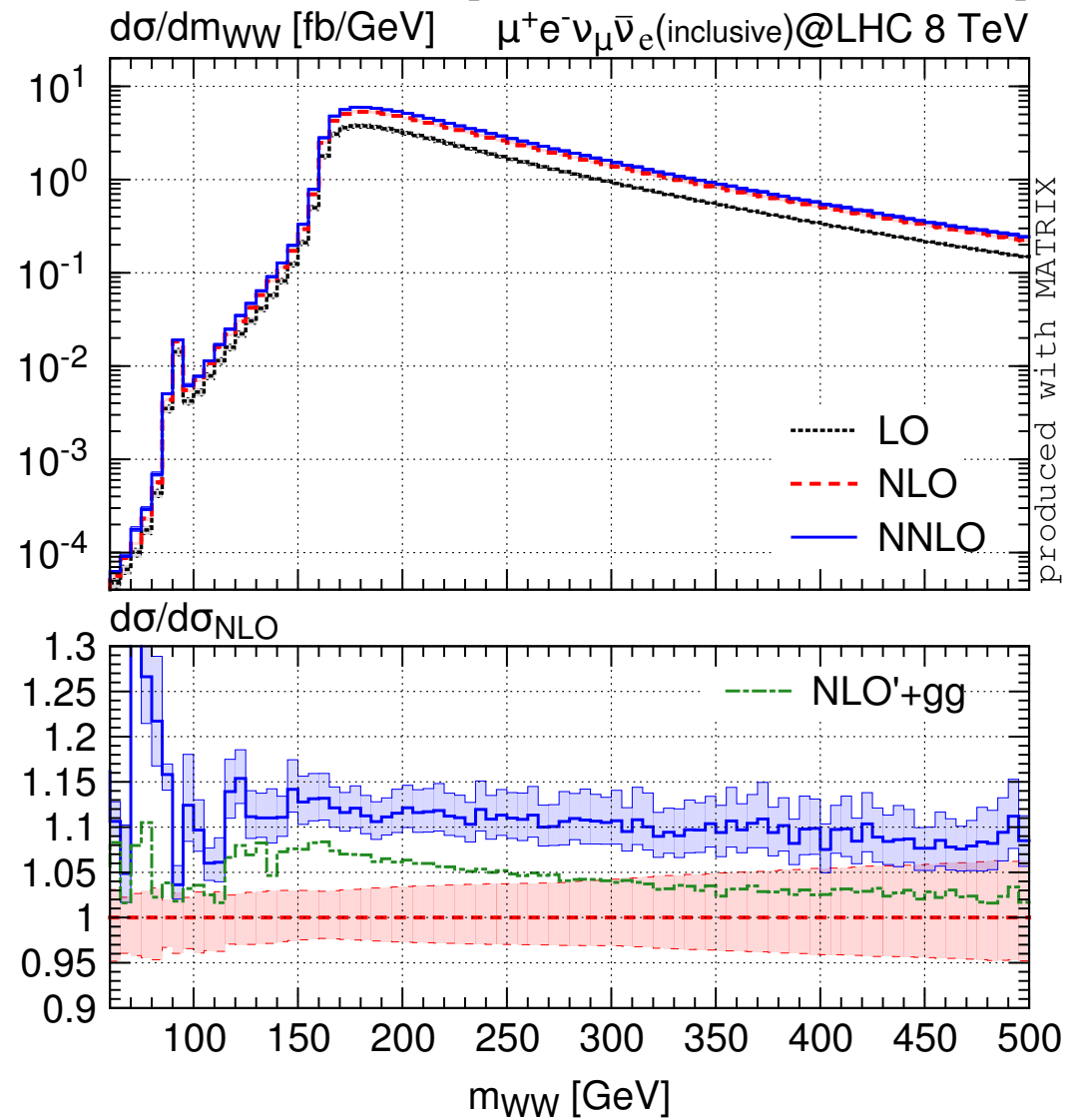
NNLO QCD corrections can be quite different!

WW

ZZ

[Grazzini, Kallweit, Rathlev; '15]

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NNLO QCD corrections can be quite different!

Still, there should be some level of correlation of the QCD uncertainties.
How to quantify this?

What about correlations between VV and VBS ?