Drell-Yan Differential Cross Section Measurement in Dimuon Channel at 13TeV with the CMS Detector

Kyeongpil Lee *on behalf of the CMS collaboration*

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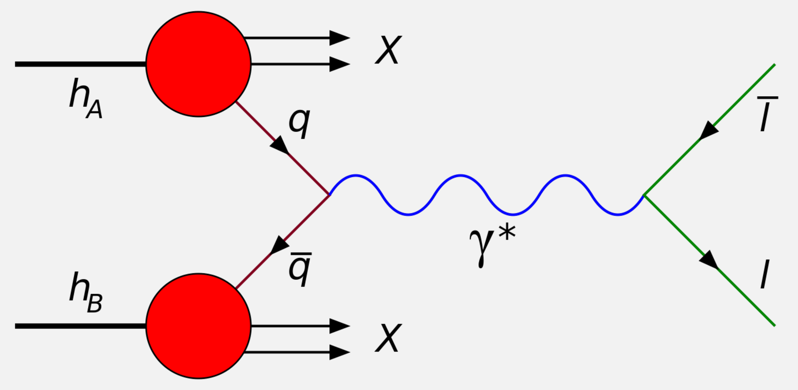
Introduction

Drell-Yan process

- lepton pairs are produced via γ^*/Z exchange



Motivation

- PDF constraints
- Important as background for BSM

DY differential cross section is continuously measured in CMS

- Three papers are already published using 7-8TeV data[*], and

This is the first measurement using 13TeV data!

[*] JHEP10(2011)007, JHEP12(2013)030 and Eur. Phys. J. C (2015) 75:147)

Analysis Overview

Goal

- **Measure the differential cross section $d\sigma/dm$ of Drell-Yan process**
  - **2.8** fb^{-1} data
  - Dimuon channel
  - $15 < M < 3000$ GeV, 43 bins

Cross section in i-th mass bin

$$\sigma_i = \frac{N_i^u}{A_i \ \varepsilon_i \ L}$$

Acceptance — *Efficiency* — *Integrated Luminosity*

Observed yield with
- momentum scale correction
- background subtraction
- unfolding correction

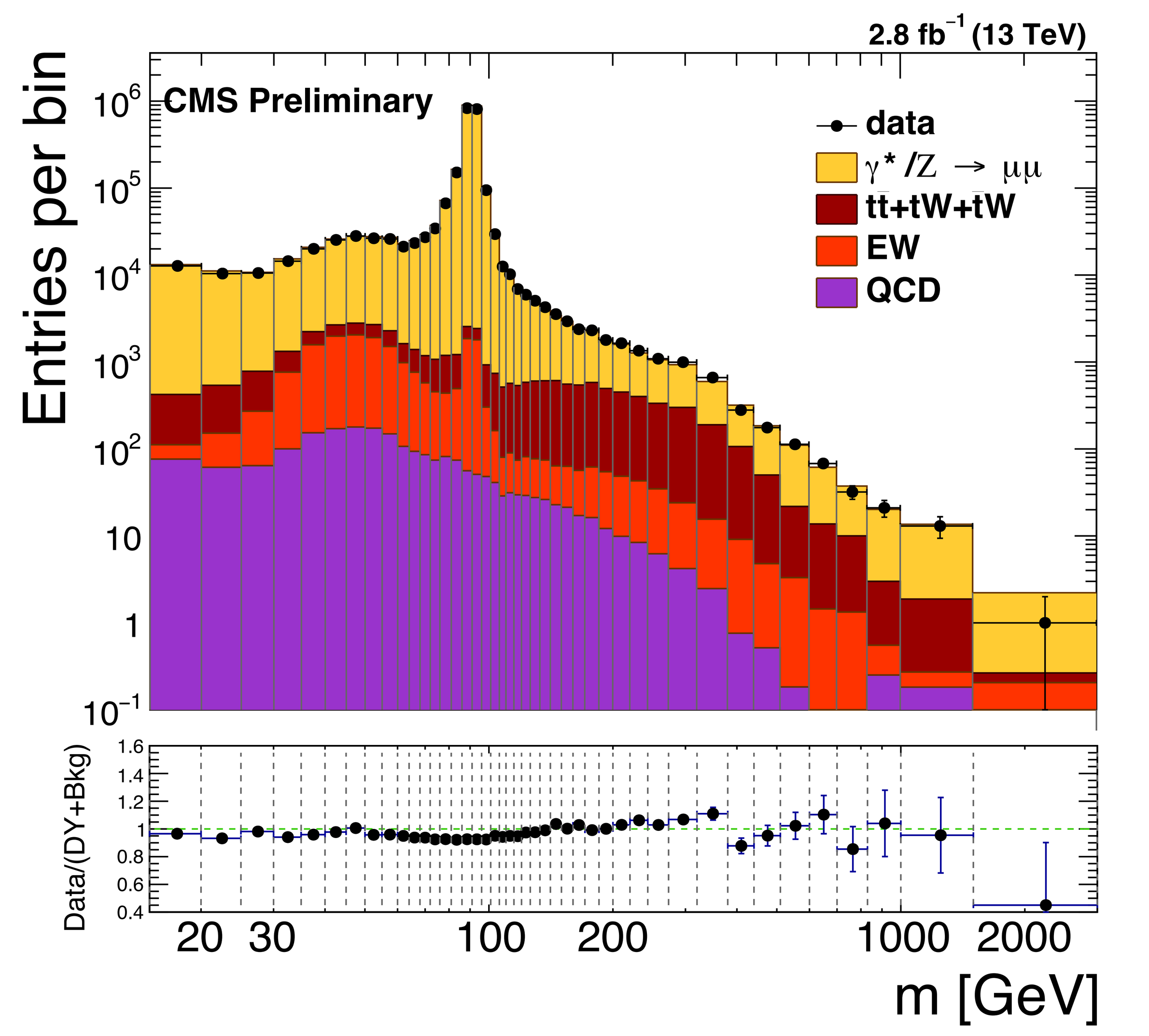
Event Selection & Background Estimation

Event selection

- Isolated single μ trigger ($P_T > 20$ GeV)
- $P_T^{lead\ (sub)} > 22\ (10)$ GeV, $|\eta| < 2.4$
- CMS standard μ selection

Background estimation

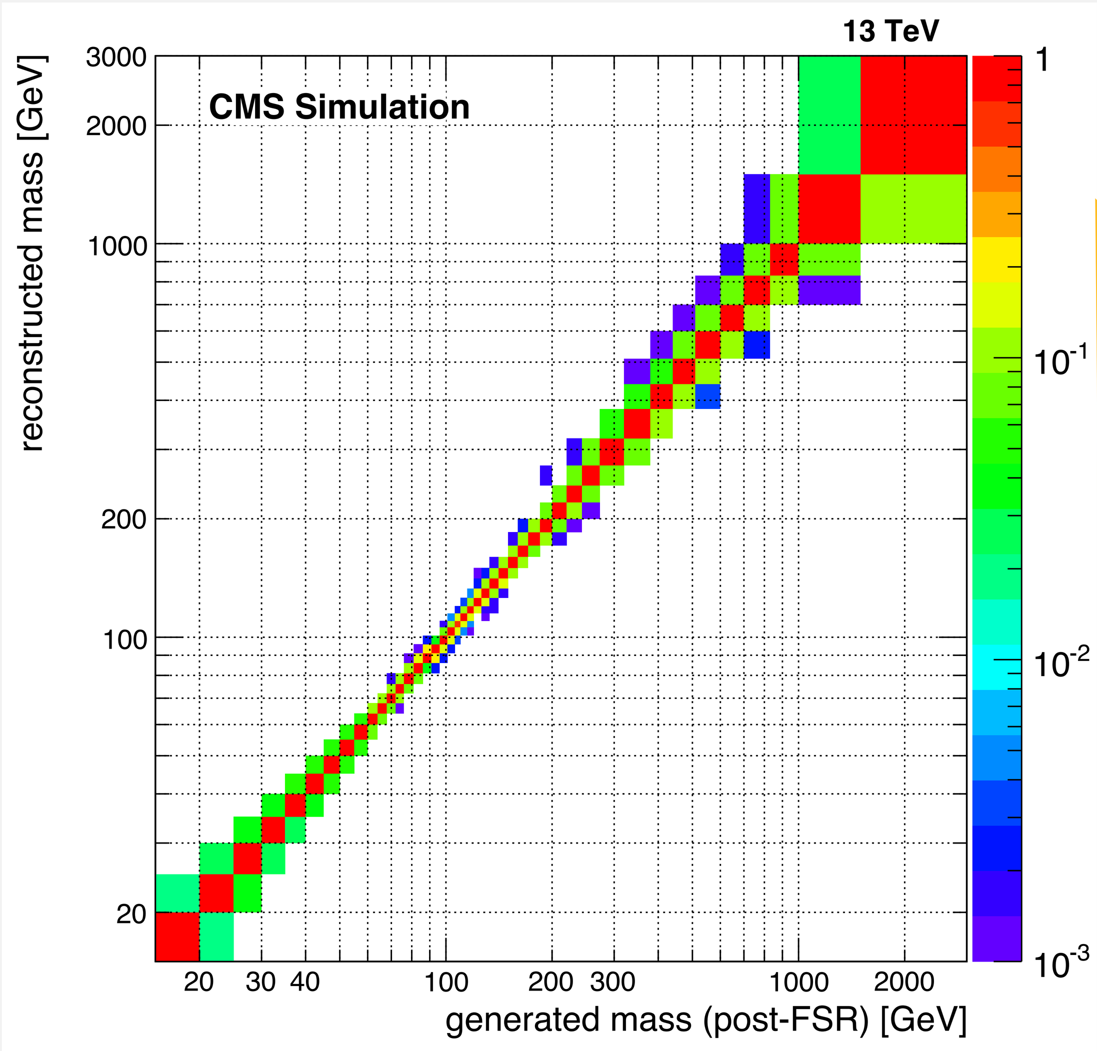
- **Data-driven:**
  - Fake rate method: QCD, W+Jets
  - $e\mu$ method: WW, DY→$\tau\tau$, $t\bar{t}$, tW+$\bar{t}$W
- **MC-based**: WZ, ZZ



Corrections

[1] *Unfolding for the detector resolution*

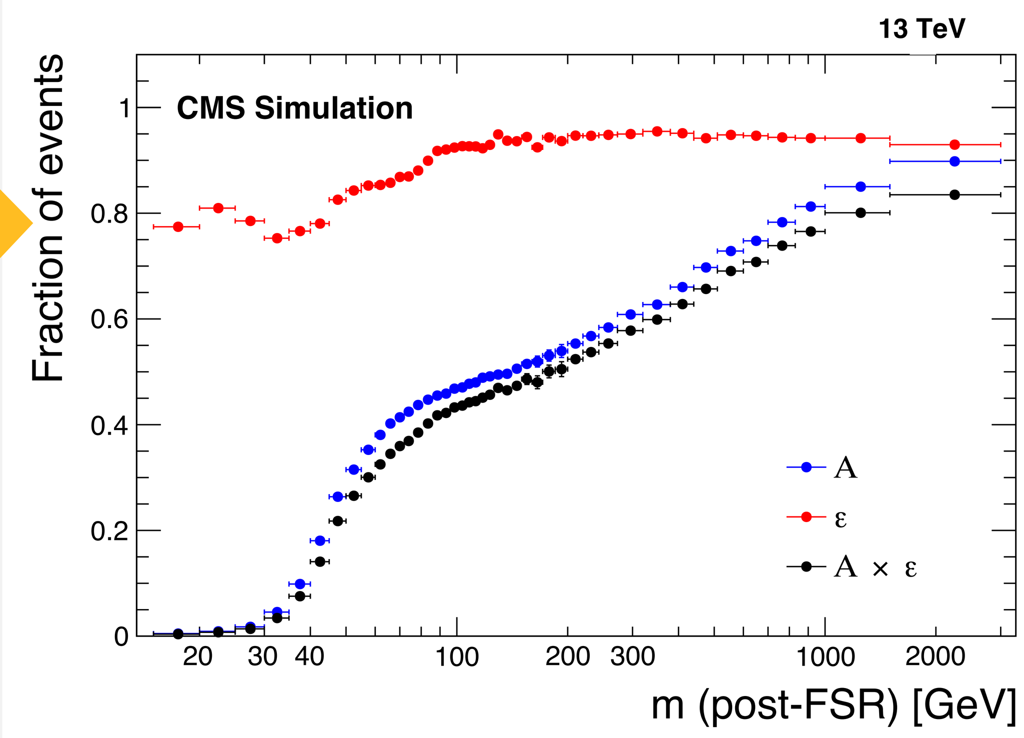
- Correct the bin migration effect
- Response matrix: from aMC@NLO



[2] *Acceptance & Efficiency*

$$A \times \varepsilon = \frac{N_{acc}}{N_{gen}} \times \frac{N_{sel}}{N_{acc}} = \frac{N_{sel}}{N_{gen}}$$

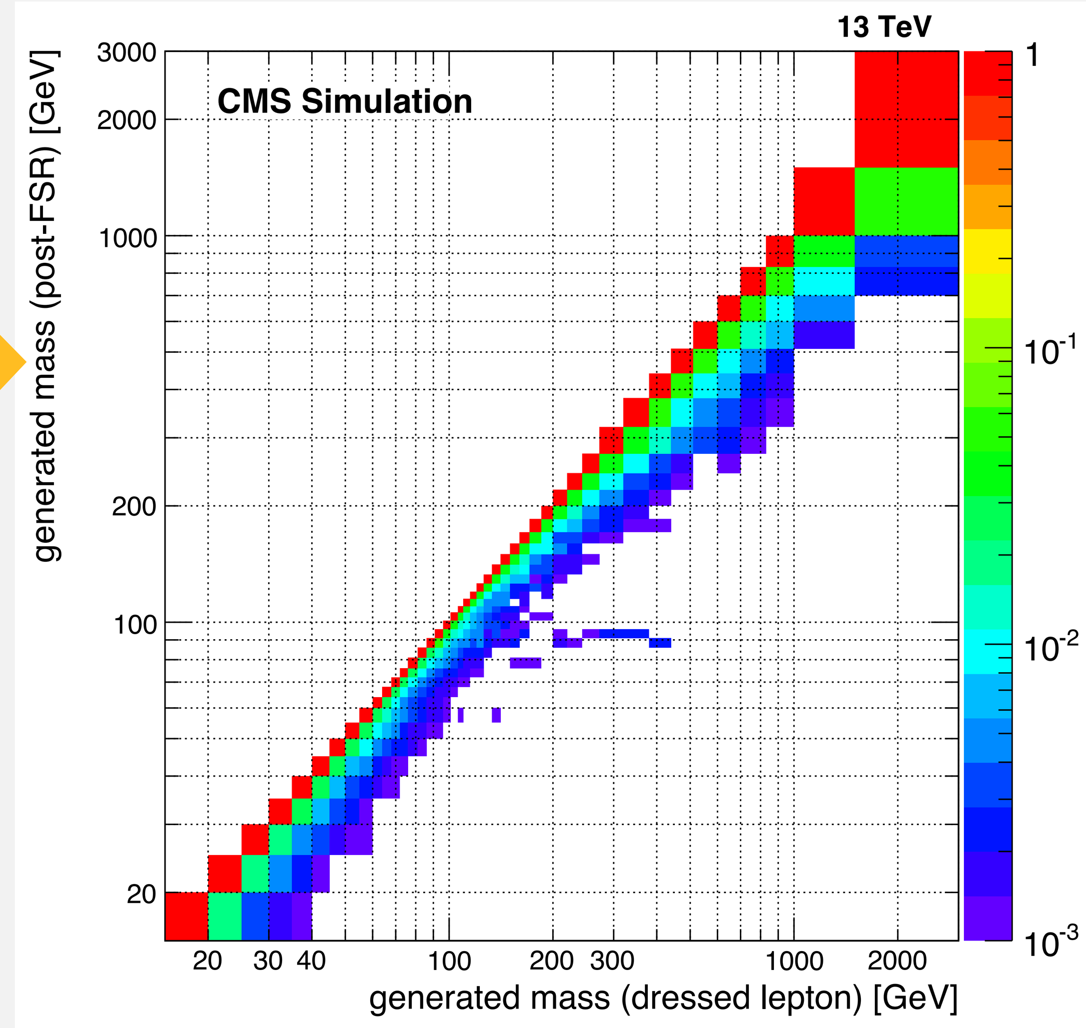
events passing acceptance cut; # events passing event selection; # total events



- Difference between ε_{MC} and ε_{DATA}: corrected by scale factor from Tag&Probe method

[3] *FSR correction*

- To obtain dressed lepton's distribution
  - Dressed lepton: $\vec{P}^{\mu}_{dressed} = \vec{P}^{\mu}_{post\text{-}FSR} + \sum_{\Delta R(\mu,\gamma)<0.1} \vec{P}^{\gamma}$

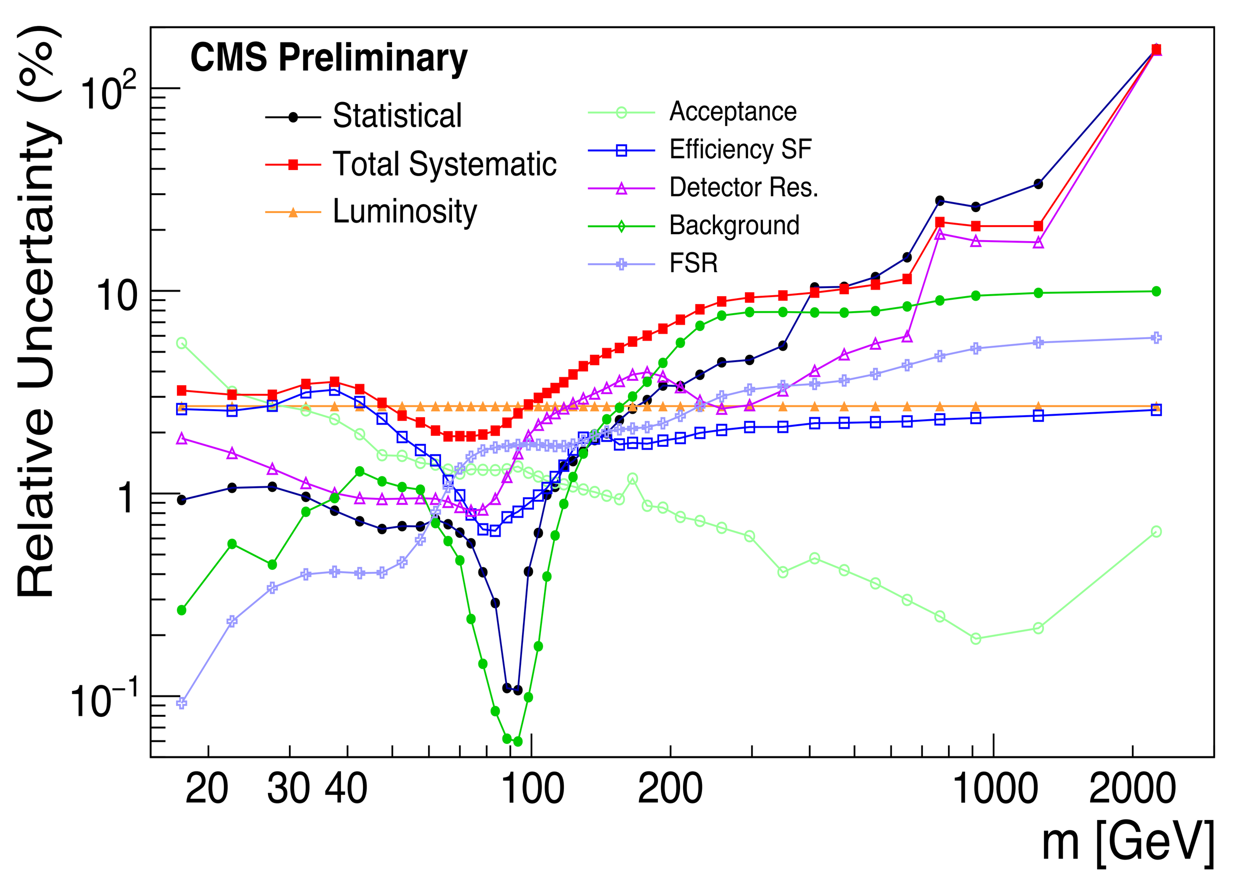


Systematic Uncertainties

Low mass: *efficiency scale factor (~3%)*

Z peak: *FSR (< 2%)*

High mass: *background (< 10%)*

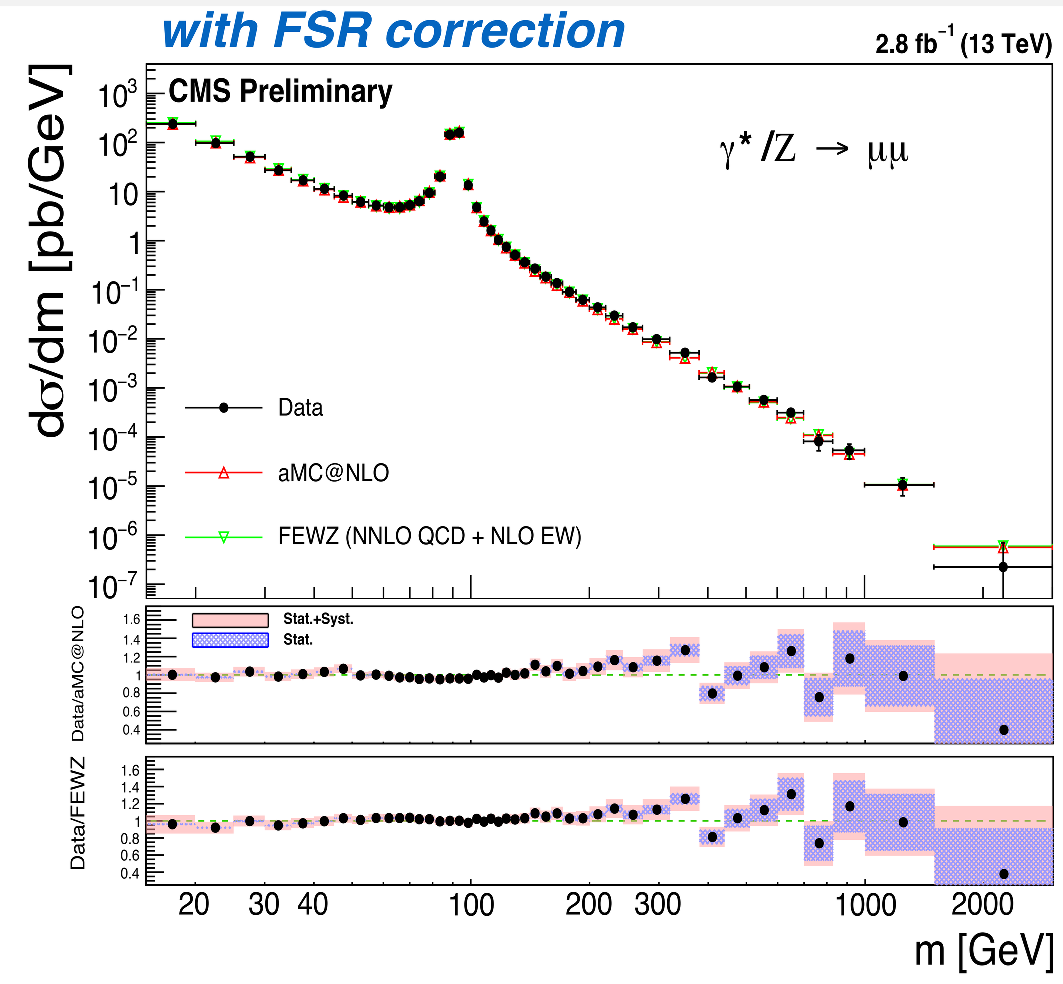


Results & Conclusion

Compared with FEWZ (NNLO, NNPDF3.0) and aMC@NLO

→Experimental result generally shows good agreement with the prediction

Full phase space diff. x-section with FSR correction



Fiducial diff. x-section without FSR correction