

## Motivation

- Drell-Yan transverse momentum spectrum
- Study contributions from npQCD and perturbative multi-gluon resummation
- Rapidity interval between DY and leading jet
- Multi-jet emissions are sensitive probe of multi-gluon emissions
- Study quark induced process especially in mass range above the Z mass

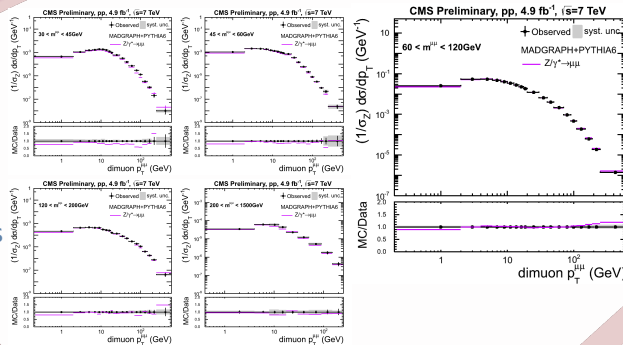
## Event Selection

- Drell-Yan decaying into two muons with  $|\eta^\mu| < 2.1$
- Transverse momentum  $p_{T, \text{leading}}^\mu > 20 \text{ GeV}$  and  $p_{T, \text{subl}}^\mu > 10 \text{ GeV}$
- Anti- $k_T$  particle-flow jets with  $R = 0.5$
- Kinematic cuts on the jets  $p_T^{\text{jet}} > 30 \text{ GeV}$  and  $|\eta^{\text{jet}}| < 4.5$
- To reduce background from top pair events  $E_T^{\text{miss}} > 80 \text{ GeV}$
- Differentially in the Drell-Yan mass within  $30 < m^{\text{DY}} < 1500 \text{ GeV}$

## Cross Section Measurement

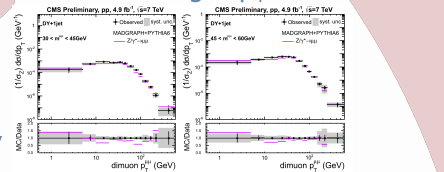
- Drell-Yan and associated jets as a function of  $m^{\text{DY}}$
- Cross Section as a function of  $p_{T, \text{DY}}$
- Cross Section as a function of  $|\Delta y(\text{DY}, j^{\text{lead}})|$
- Detector and Efficiency Correction
- Normalized to the Z Peak region (60 - 120 GeV)

## Inclusive DY

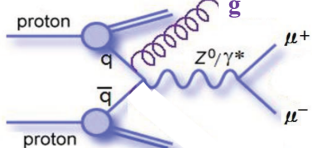


Dimuon  $p_T$  in different invariant mass bins

DY + 1 jet  
 $p_T$  is shifted towards larger  $p_T$



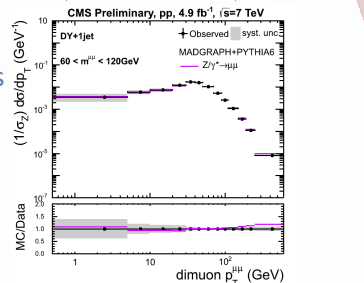
Three different event topologies



Inclusive DY, DY + 1 jet, DY + 2 jets

Resummation effects at small  $p_T$

Study multiple gluon emissions

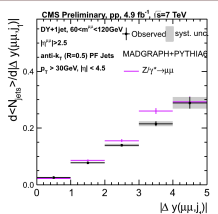


## Measurement of double differential Drell-Yan and associated jet cross sections at low and high invariant masses in pp collisions at $\sqrt{s} = 7 \text{ TeV}$



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on behalf of the CMS Collaboration

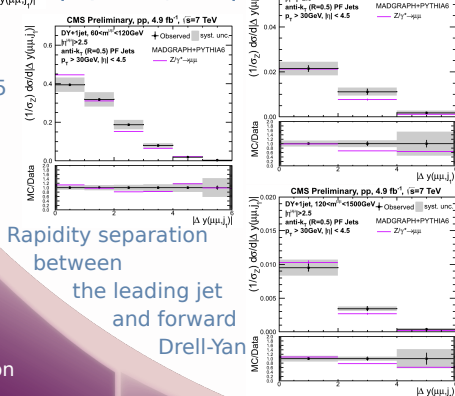
05<sup>th</sup> March 2014  
LHCC Poster Session  
CERN, Switzerland



Average Number of jets between the Drell-Yan and leading jet

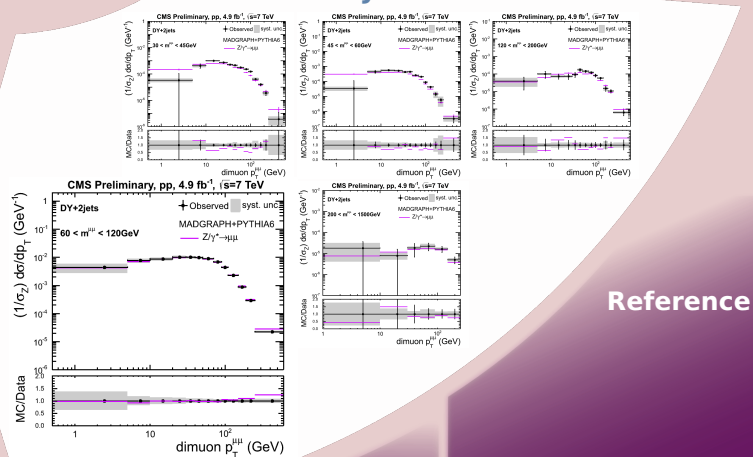
DY + 1 jet  
 $|\Delta y(\text{DY}, j^{\text{lead}})|$

$|\eta^{\text{DY}}| > 2.5$



Rapidity separation between the leading jet and forward Drell-Yan

DY + 2 jets



Reference

## Background Estimation

- Top Pair: scaled to describe the side region  $E_T^{\text{miss}} > 80 \text{ GeV}$
- Data driven QCD background: Same sign dimuon events with inverse isolation cut
- Diboson production scaled to NLO cross section; Single W normalized to inclusive cross section measured by CMS
- Z to  $\tau\tau$  shape estimated from simulation normalized to Z+jets cross section

## Conclusion

- First measurement of DY and associated jets cross section as a function of  $m^{\text{DY}}$
- Measured  $p_T$  spectrum of DY lepton pair is well produced by MadGraph simulation  
Rise at small  $p_T$  in inclusive DY is a measure for soft gluon resummation  
For DY+jets the behavior at  $p_T < 30 \text{ GeV}$  is a signal for perturbative jet resummation, which is well produced by parton showers
- Rapidity difference between DY lepton pair and leading jet  
Not reproduced by MadGraph simulation  
MadGraph predicts the jets to be closer to the DY lepton pair
- MadGraph shows reasonable description of number of jets as a function of  $|\Delta y|$

[1] P. Ciproano et al., "Higgs boson as a gluon trigger", Phys. Rev. D 88 (Nov,2013) 097501

[2] CMS-PAS-FSQ-13-003