

Z' mumu 2013 data

A.M.

Summary from reports of Lanev,
Rodogna Lepton etc



Lanev

- MC and Data Comparison
- Trigger and Events Checks

Rodogna Presentation

- p_T studies and Checks
- Dimuon Spectra with MC

Marcellini Bologna :

- Trigger MC and Data checks

Federica Primavera and Neumeister
Student

- MC and Data Dimuon spectra

I report /summary mainly from Lanev as example

- Introduction
- Run2015B with the tracker-only p_T used for the endcaps.
- First look on data from Run2015C
- Event Displays
- Conclusions



Runs and LHC Fills for Run2015B (Week 2)

Run	Fill	Time, UTC		Lumi, pb ⁻¹			JSONs	Comment
		Start	End	WBM	Delivered	Recorded		
251636	3992	13 07:33	13 07:34	1.07			D	no DCSONly, but $Z \rightarrow \mu^+ \mu^-$ signal exists.
251638		13 07:38	13 08:17	2.62	3.263	2.501	D M	
251642		13 08:42	13 08:46	1.02	0.570269	0.138300		
251643		13 08:50	13 12:50	14.93	14.937	14.325	D M G	
251717	3996	14 07:09	14 07:16	1.86			D	Stage1Test, Problem with pixels
251718		14 07:39	14 09:31	9.48			D	Stage1Test, Problem with pixels
251721		14 09:38	14 11:19	2.48	2.478	2.435	D M G	FSQ/HIN low PU at the end of the run (aft
251781	4001	15 01:40	15 02:15	0.10	0.069917	0.032374		
251883	4008	16 01:30	16 04:27	7.09	0.600418	0.520740	D M G	
252116	4019	20 01:35	20 02:32	1.91				$B = 0$ T
252126	4020	20 04:24	20 05:30	3.24				$B = 0$ T
Grand Total:		08 00:03	16 04:27	67.00	58.732	50.129		(without usage of JSON files!)

Integrated luminosities were calculated using the official tool [lcr2.py](#)

Integrated luminosity using JSON files:

FEVT+ MuonPhys = 46.184 pb⁻¹ (currently)

AOD + DCSONly = 52.795 pb⁻¹

AOD + MuonPhys = 46.068 pb⁻¹ (today; 46.248 pb⁻¹ yesterday)

AOD + Golden = 40.003 pb⁻¹

“DCSONly” = `json_DCSONLY_Run2015B.txt` + `json_DCSONLY_Run2015B_2.8T.txt`



- **MadGraph samples require using weights:**

DY: $\sigma = 6025.2 \text{ pb}$ /DYJetsToLL_M-50_TuneCUETP8M1_13TeV-amcatnloFXFX-pythia8/RunIISpring15DR74-Asympt50ns_MCRUN2_74_V9A-

WJets $\rightarrow \nu\nu$: $\sigma = 6.15e4 \text{ pb}$ /WJetsToLNu_TuneCUETP8M1_13TeV-amcatnloFXFX-pythia8/RunIISpring15DR74-Asympt50ns_MCRUN2_74_V9A-

according to discussions at hypernews:

<https://hypernews.cern.ch/HyperNews/CMS/get/generators/2679/1/1/1/1/2.html>

- **POWHEG and Pythia samples have no weights:**

t \bar{t} : $\sigma = 815.96 \text{ pb}$ /TT_TuneCUETP8M1_13TeV-powheg-pythia8/RunIISpring15DR74-Asympt50ns_MCRUN2_74_V9A-v4

ZZ: $\sigma = 15.4 \text{ pb}$ /ZZ_TuneCUETP8M1_13TeV-pythia8/RunIISpring15DR74-Asympt50ns_MCRUN2_74_V9A-v2

WW: $\sigma = 118.7 \text{ pb}$ /WW_TuneCUETP8M1_13TeV-pythia8/RunIISpring15DR74-Asympt50ns_MCRUN2_74_V9A-v1

WZ: $\sigma = 66.1 \text{ pb}$ /WZ_TuneCUETP8M1_13TeV-pythia8/RunIISpring15DR74-Asympt50ns_MCRUN2_74_V9A-v2

tW: $\sigma = 35.6 \text{ pb}$ /ST_tW_top_5f_inclusiveDecays_13TeV-powheg-pythia8_TuneCUETP8M1/RunIISpring15DR74-Asympt50ns_MCRUN2_74_V9A-v1

t \bar{t} W: $\sigma = 35.6 \text{ pb}$ /ST_tW_antitop_5f_inclusiveDecays_13TeV-powheg-pythia8_TuneCUETP8M1/RunIISpring15DR74-Asympt50ns_MCRUN2_74_V9A-

- Used Prompt Reco SingleMuon AOD dataset:

/SingleMuon/Run2015B-PromptReco-v1/AOD

- PromptReco JSONs has been used: $\int \mathcal{L} dt = 1.04 \times 46.011 = 47.9 \text{ pb}^{-1}$

- HLT trigger used: **HLT_Mu45_eta2p1_v1**

Offline cut $p_T > 48 \text{ GeV}$



MC

Used MC datasets **RunIISpring15DR74-Asympt50ns_MCRUN2_74_V9A** to perform first Data / MC comparison.

Cross section were taken from CMS twiki page:

<https://twiki.cern.ch/twiki/bin/viewauth/CMS/StandardModelCrossSectionsat13TeV>
DY, $t\bar{t}$ — NNLO calculation; dibosons — NLO calculations.

DY: $\sigma = 6025.2$ pb /DYJetsToLL_M-50_TuneCUETP8M1_13TeV-amcatnloFXFX-pythia8/RunIISpring15DR74-Asympt50ns_MCRUN2_74_V9A-v2

$t\bar{t}$: $\sigma = 815.96$ pb /TT_TuneCUETP8M1_13TeV-powheg-pythia8/RunIISpring15DR74-Asympt50ns_MCRUN2_74_V9A-v4

ZZ: $\sigma = 15.4$ pb /ZZ_TuneCUETP8M1_13TeV-pythia8/RunIISpring15DR74-Asympt50ns_MCRUN2_74_V9A-v2

WW: $\sigma = 118.7$ pb /WW_TuneCUETP8M1_13TeV-pythia8/RunIISpring15DR74-Asympt50ns_MCRUN2_74_V9A-v1

WZ: $\sigma = 66.1$ pb /WZ_TuneCUETP8M1_13TeV-pythia8/RunIISpring15DR74-Asympt50ns_MCRUN2_74_V9A-v2

WJets $\rightarrow l\nu$: $\sigma = 6.15e4$ pb /WJetsToLNu_TuneCUETP8M1_13TeV-amcatnloFXFX-pythia8/RunIISpring15DR74-Asympt50ns_MCRUN2_74_V9A-v1

tW : $\sigma = 35.6$ pb /ST_tW_top_5f_inclusiveDecays_13TeV-powheg-pythia8_TuneCUETP8M1/RunIISpring15DR74-Asympt50ns_MCRUN2_74_V9A-v1

$t\bar{t}W$: $\sigma = 35.6$ pb /ST_tW_antitop_5f_inclusiveDecays_13TeV-powheg-pythia8_TuneCUETP8M1/RunIISpring15DR74-Asympt50ns_MCRUN2_74_V9A-v2



List of Unprescaled Muon Triggers

These triggers have been unprescaled in Run2015B:

Single Muon triggers:

HLT_Mu45_eta2p1

HLT_Mu50

HLT_Mu50_eta2p1

HLT_Mu55

HLT_Mu300

HLT_Mu350

Double Muon triggers:

HLT_Mu17_TrkIsoVVL_Mu8_TrkIsoVVL_DZ

HLT_Mu17_TrkIsoVVL_TkMu8_TrkIsoVVL_DZ

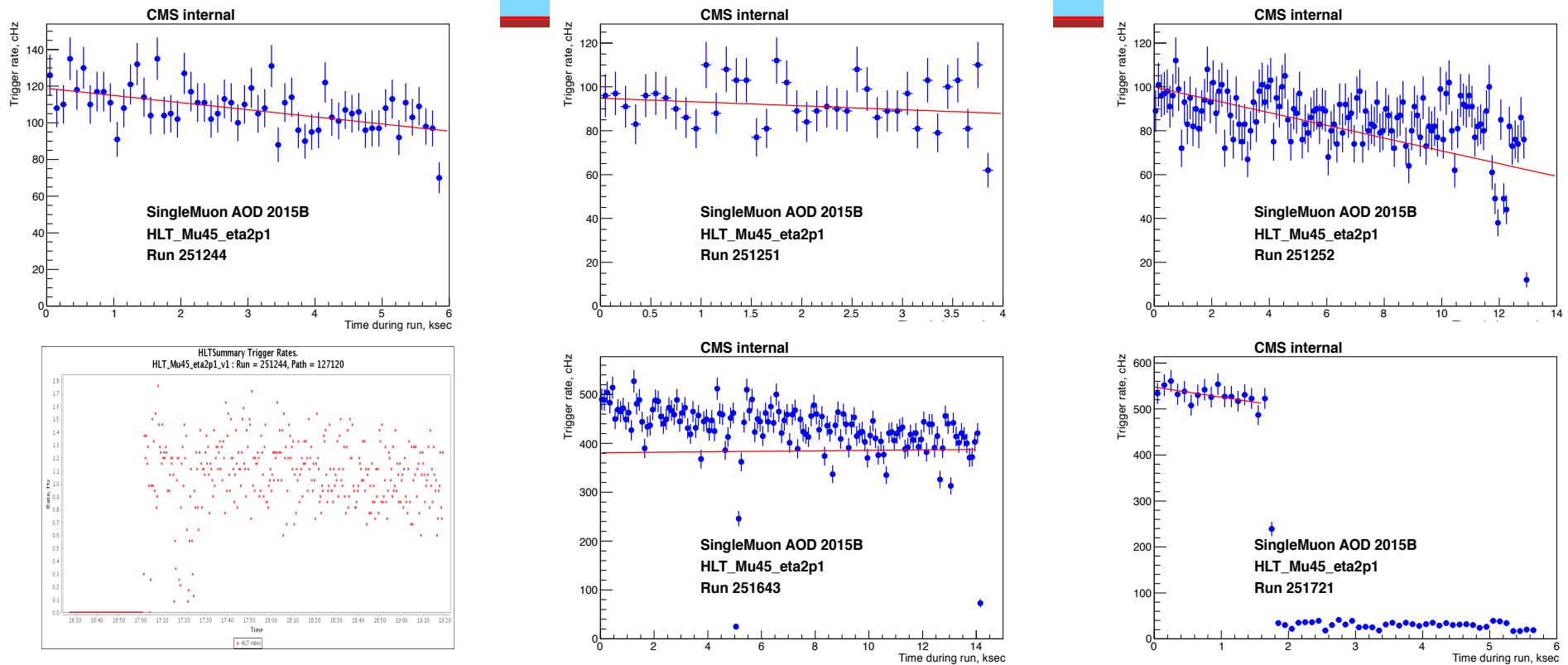
HLT_Mu27_TkMu8

HLT_Mu30_TkMu11

HLT_Mu40_TkMu11



Trigger rates for several runs

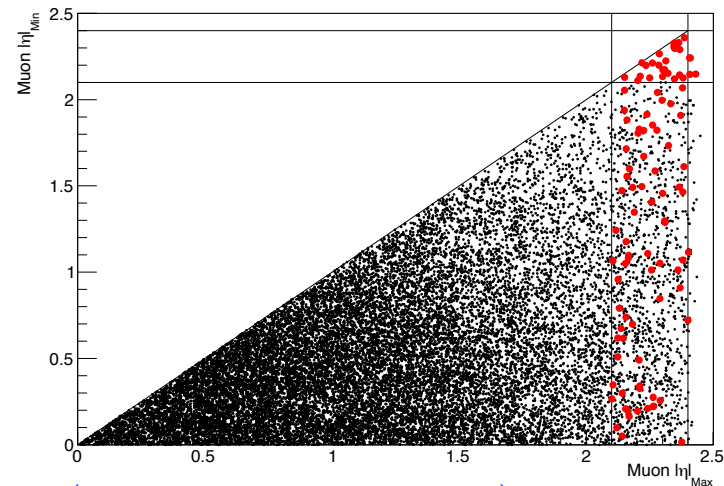
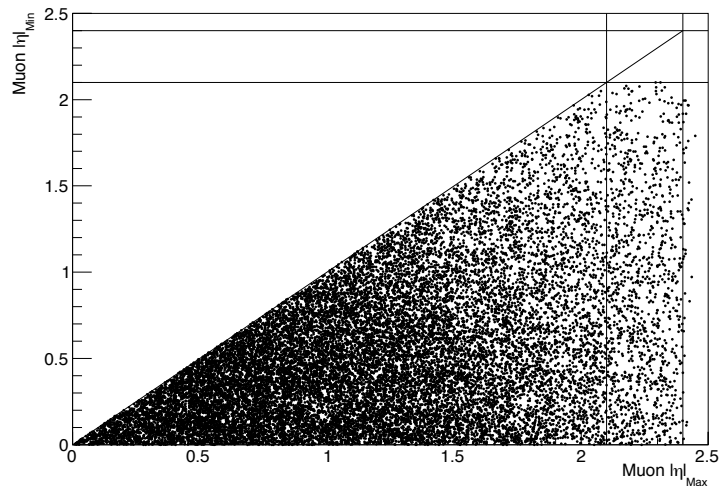


Rates of HLT_Mu45_eta2p1 in runs 251244, 251251, 251252, 251643 are compatible with WBM values: 0.86, 0.93, 0.81, 4.26 Hz.

Difference arises since WBM averages trigger rates for all lumisections even without Physics declared.

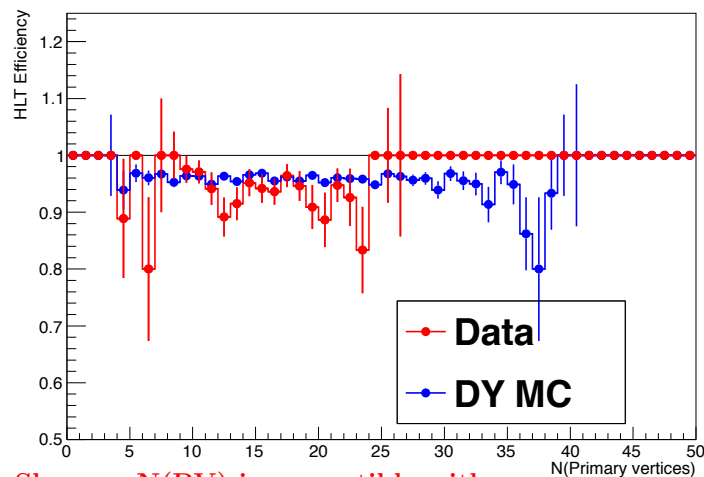


Statistics of triggers: Summary



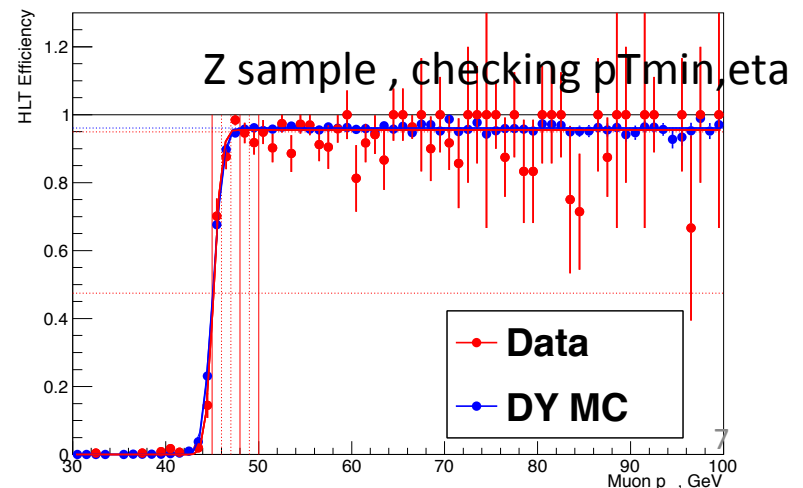
- Used Drell-Yan MC sample with $M \in [2, 3]$ TeV (our region of interest) and HLT_Mu45_eta2p1 as baseline trigger.
- Adding HLT_Mu50 increases statistics by $\sim 0.5\%$ — Not a large amount.

HLT Efficiency vs Number of Primary Vertices



Slope vs N(PV) is compatible with zero within statistical uncertainty.

Trigger Turn-on Curve



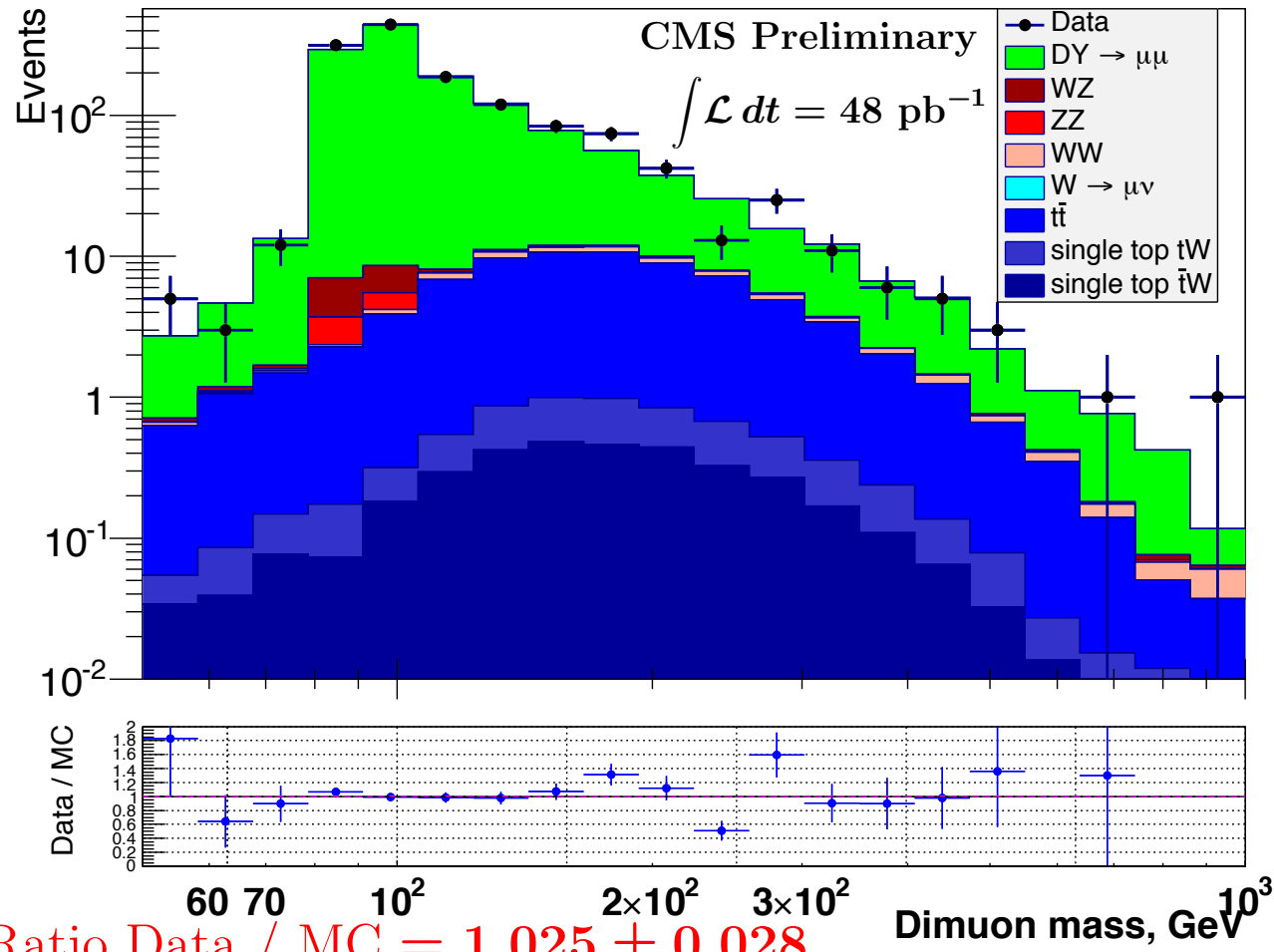
We can take offline cut around $p_T \geq 48$ GeV or 47 GeV

- HLT trigger used: `HLT_Mu45_eta2p1_v1`
Offline cut $p_T > 48$ GeV
- It is known that endcap alignment is not the best in Prompt reconstruction at Run2015B
<https://indico.cern.ch/event/438183/contribution/1>
- For endcap muons ($|\eta| > 1.2$) momentum resolution is better for tracker-only muons than for Tune-P muons.
<https://indico.cern.ch/event/437532/contribution/2>
- Therefore there was a proposal to do mass plots for LHCP using tracker-only p_T for the endcaps
- Also with tracker-only p_T used everywhere, both in barrel and in endcaps
- Our heaviest dimuon has muons with $\eta = 1.464$ and 0.584 :
 $M = 835.783 \pm 32.930$ GeV for Tune-P
 $M = 921.042 \pm 51.685$ GeV for tracker muon in endcap
 $M = 953.783 \pm 72.078$ GeV for both tracker muons



tracker-only muon for endcaps ($|\eta| > 1.2$)

- HLT trigger used: HLT_Mu45_eta2p1_v1
Offline cut $p_T > 48$ GeV





Runs and LHC Fills for Run2015C

Run	Fill	Time, UTC		Lumi, pb ⁻¹			JSONs	
		Start	End	WBM	Delivered	Recorded		
254227	4201	08.13 03:29	08.13 04:47	0.24			DCS	
254229		08.13 04:53	08.13 04:56	0.02			DCS	
254231		08.13 05:14	08.13 05:39	0.09			DCS	
254232		08.13 05:43	08.13 06:23	0.10			DCS	
Grand Total:		08.13 03:29	08.13 06:23	0.45	0.476	0.372		(withou
Grand Total:		08.13 03:29	08.13 06:23		0.405	0.347		(using I

- HLT trigger used: `HLT_Mu45_eta2p1_v1`
Offline cut $p_T > 48$ GeV

All other runs in Run2015C have been taken with $B = 0$ T so far

Integrated luminosities were calculated using the official tool `brilcalc`

Integrated luminosity using JSON file:

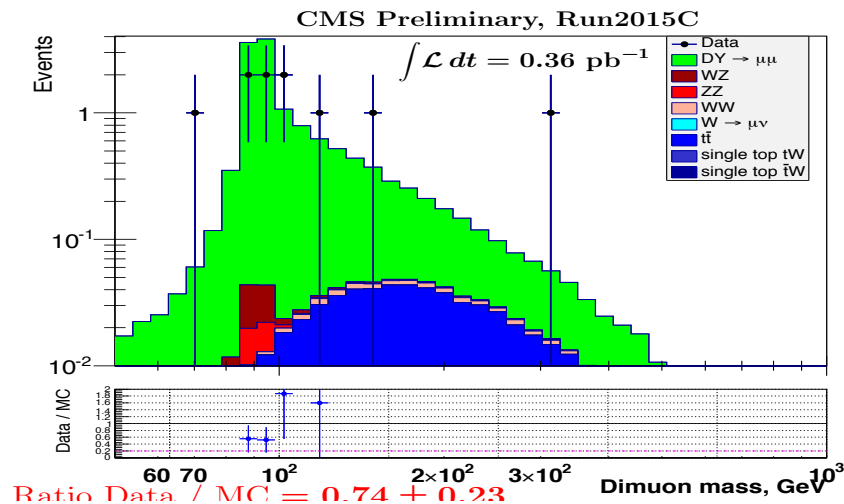
$$\text{FEVT+ DCSONly} = 1.04 \times 0.347 = 0.361 \text{ pb}^{-1}$$

Heaviest dimuon has mass 324 GeV

HLT Menu = Run2015/25ns14e33/v3.3/V2



Dimuon mass spectra for Run2015C



→ Dimuon Mass
Log scale

Event Display



Event with Dimuon $M = 836$ GeV

run : ls : evt = 251562 : 414 : 367325039

Summary View

Delay 3.0s

Run 251562 Lumi 414 Event 367325039 Sun Jul 12 09:18:52 2015 CEST

Filtering is OFF.

Rho Phi

Rho Z

3D Tower

Lego

Table

Collection	Muons
pT	global tracker SA calo tr pt eta phi matches d0 d0 / d0Err charge
1	430.8 true true true false 454.0 0.584 0.075 3 -0.097 -55.091 1
0	325.8 true true true false 414.0 1.464 -3.033 4 0.093 38.845 -1
7	4.4 false false true false -99.0 -0.675 1.045 0 -999.000 -999.000 -1
8	1.5 false true false 1.5 -2.203 0.471 1 -0.036 -2.756 1
8	1.5 false true false 1.5 -1.745 -0.887 1 -0.122 -10.946 -1

Table

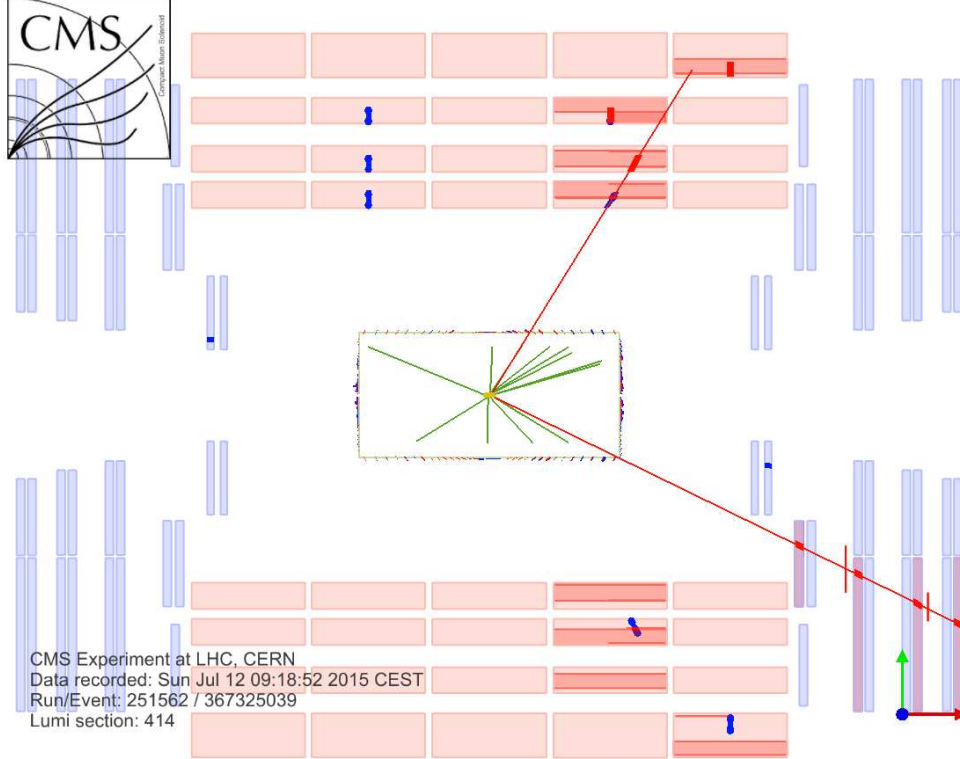
Table

Filter Name

- HLT_DoubleMu33NoFiltersNoVtx_v1
- HLT_DoubleMu38NoFiltersNoVtx_v1
- HLT_IsoMu17_eta2p1_v2
- HLT_IsoMu17_eta2p1_LooseIsoPFTau20_SingleL1_v2
- HLT_DoubleIsoMu17_eta2p1_v2
- HLT_IsoMu24_eta2p1_LooseIsoPFTau20_v2
- HLT_IsoMu20_v2
- HLT_IsoMu20_eta2p1_v2
- HLT_IsoMu24_eta2p1_v2
- HLT_IsoMu27_v2
- HLT_IsoTKMu20_v2
- HLT_IsoTKMu20_eta2p1_v2
- HLT_IsoTKMu24_eta2p1_v2
- HLT_IsoTKMu27_v2
- HLT_L2DoubleMu28_NoVertex_2Cha_Angle2p5_Mass10_v
- HLT_L2DoubleMu38_NoVertex_2Cha_Angle2p5_Mass10_v
- HLT_Mu20_Mu10_v1
- HLT_Mu20_Mu10_DZ_v1
- HLT_Mu17_TkIsoVVL_Mu8_TkIsoVVL_DZ_v2
- HLT_Mu17_TkIsoVVL_TkMu8_TkIsoVVL_DZ_v2
- HLT_Mu27_TkMu8_v2
- HLT_Mu30_TkMu11_v2
- HLT_Mu40_TkMu11_v2
- HLT_Mu50_v1
- HLT_Mu55_v1
- HLT_Mu45_eta2p1_v1
- HLT_Mu50_eta2p1_v1
- DST_Physics_v1
- HLT_Mu300_v1
- HLT_Mu350_v1
- HLTriggerFirstPath
- HLT_AK8PFJet360_TrimMass50_v2
- HLT_AK8PFJet700_TrimR0p1PT0p03Mass50_v2
- HLT_CaloJet500_NonJRD_v2
- HLT_DimMuon15_PsiPrime_v1
- L1_SingleMu16_Eta2p1
- L1_DoubleMu8_EG6
- L1_ETT90
- L1_DoubleMu0_Eta1p6_WdEta18
- L1_SingleMu18er
- L1_DoubleMu0_Eta1p6_WdEta18_OS
- L1_DoubleMu_12_5
- L1_DoubleMu_10_0_WdEta18
- TechTrigger
- TechTrigger



Event with Dimuon $M = 836$ GeV



Event with Dimuon $M = 836$ GeV

