Z + μ studies

Updated results with 28 fb^{-1}

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Z+μ Control Region

1. Comparison with ICHEP results

- Consistent numbers with ICHEP results

2. Check of d_0-significance for Z bosons and additional leptons

- Sizeable effect at high p_T expected for Z leptons, effect smaller for low p_T muons (relevant for muon background)?
- Tracking group: time dependence
  $\rightarrow$ waiting for a list of runs for the comparison

Z+μ Control Region

3. Discussion about definition of light and heavy flavour jet component

- Our definition: MCTruthClassifier
  - Heavy flavour: MCOriginType=25,26,27,29,32,33
    (`https://svnweb.cern.ch/trac/atlasoff/browser/PhysicsAnalysis/MCTruthClassifier/trunk/MCTruthClassifier/MCTruthClassifierDefs.h`)
  - Light flavour: rest
- Definition from background group:
  - Heavy flavour: Everything which passes the 3- and 4-lepton filtered samples (341103-351106)
  - Light flavour: All that comes from BFilter, CFilterBVeto and CVetoBVeto samples (after overlap removal, 361372-361443)

`https://twiki.cern.ch/twiki/bin/view/AtlasProtected/HZZllllRun2MCSamplesMC15c_25ns`

- Comparison of iso+d_0 cut efficiencies

1. Comparison with ICHEP results

ICHEP (14.78 fb^{-1})

- d_0-sig. cut efficiencies:

  MC: (65.1 $\pm$ 1.2) %
  Data: (63.5 $\pm$ 0.4) %
  $\approx$3% difference

- Isolation efficiencies:

  heavy flavour jets:
  MC: (16.4 $\pm$ 0.3) %
  Data: (17.0 $\pm$ 0.2) %

  light flavour jets:
  MC: (11.6 $\pm$ 0.9) %
  Data: (15.1 $\pm$ 0.3) %

  $\approx$4% difference in HF region and $\approx$8% between LF region (data) and HF region (MC)

1. Comparison with ICHEP results

Updated with 28 fb^{-1}

- d_0-sig. cut efficiencies:

  MC: (65.2 $\pm$ 0.9) %
  Data: (62.9 $\pm$ 0.2) %
  $\approx$2.5% difference

- Isolation efficiencies:

  heavy flavour jets:
  MC: (16.4 $\pm$ 0.3) %
  Data: (16.7 $\pm$ 0.2) %

  light flavour jets:
  MC: (11.6 $\pm$ 0.9) %
  Data: (14.9 $\pm$ 0.2) %

  $\approx$2% difference in HF region and $\approx$9% between LF region (data) and HF region (MC)

3. Discussion about definition of light and heavy flavour jet component

- No difference in the efficiencies
  (use sum of expected events to compare to data)
- MC efficiencies for inclusive selection:

Separation with samples			Separation with McTruthClassifier		
LF:	$0.925 \cdot 0.104$	≈ 0.0946	LF:	$0.900 \cdot 0.106$	≈ 0.0936
HF:	$0.555 \cdot 0.191$	≈ 0.1116	HF:	$0.550 \cdot 0.194$	≈ 0.1129

Small effect about 1-3%

ADDITIONAL - pT > 5GeV - 28 fb^{-1}										
	Z-Cand		All muons		d0sig		track+ topo		AllCuts	
Data	236108.00 ±	485.91	232604.00 ±	482.29	147953.00 ±	384.65	44963.00 ±	212.04	30598.00 ±	174.92
Z+light jets	65161.00 ±	1295.20	63875.84 ±	1285.92	59064.63 ±	1248.57	6625.02 ±	390.62	6043.91 ±	382.29
Z+heavy jets	149662.48 ±	463.47	149506.35 ±	463.26	82988.44 ±	347.27	28599.67 ±	212.44	16684.16 ±	161.95
Top Quark	11775.75 ±	46.73	11748.63 ±	46.66	4806.12 ±	30.11	845.90 ±	12.58	517.05 ±	9.82
WZ	4108.70 ±	31.20	4107.35 ±	31.20	3949.65 ±	30.58	3892.65 ±	30.38	3762.12 ±	29.86
ZZ	821.16 ±	3.54	820.51 ±	3.54	758.30 ±	3.41	738.75 ±	3.37	686.66 ±	3.25
Signal	±		±		±		±		±	
Total MC	231529.09 ±	1840.14	230058.68 ±	1830.58	151567.14 ±	1659.94	40701.99 ±	649.39	27693.90 ±	587.17
Cut Eff MC					65.23 ±	0.91	16.02 ±	0.32	10.33 ±	0.27
Cut Eff Data					62.92 ±	0.22	17.71 ±	0.10	11.49 ±	0.11
Z+light jets contibution			27.77 %							
							Isolation Eff MC		15.83 ±	0.45
							Isolation Eff Data		18.25 ±	0.14

ADDITIONAL MUON - LIGHT JETS - PT BALANCE CUT AT 0.1									
		All muons		d0sig		track+topo		AllCuts	
Data		51526.00 ±	226.99	41488.00 ±	203.69	8037.00 ±	89.65	6522.00 ±	80.76
Z+light jets		33292.10 ±	940.52	31626.68 ±	924.26	3155.56 ±	263.81	3068.02 ±	261.94
Z+heavy jets		14025.62 ±	141.92	8269.13 ±	109.04	2633.95 ±	65.12	1594.57 ±	50.04
Top Quark		1336.03 ±	16.27	654.93 ±	11.59	77.97 ±	3.98	49.57 ±	3.13
WZ		373.14 ±	9.31	359.91 ±	9.16	336.67 ±	8.86	328.13 ±	8.76
ZZ		75.81 ±	1.07	70.47 ±	1.04	65.18 ±	1.00	61.02 ±	0.97
Signal		±		±		±		±	
Total MC		49102.70 ±	1109.09	40981.12 ±	1055.09	6269.33 ±	342.77	5101.31 ±	324.84
Cut Eff MC				83.35 ±	2.88	12.06 ±	0.76	9.69 ±	0.70
Cut Eff Data				80.38 ±	0.54	14.95 ±	0.19	12.01 ±	0.17
Z+light jets contibution		67.80 %							
						Isolation Eff MC		11.62 ±	0.86
						Isolation Eff Data		14.94 ±	0.21

ADDITIONAL MUON - pT> 5GeV - HEAVY JETS				
	|d0sig|>3.0		track+topo	
Data	84651.00 ±	290.95	14338.00 ±	119.74
Z+light jets	4811.21 ±	307.67	581.11 ±	80.23
Z+heavy jets	66517.91 ±	306.60	11915.50 ±	137.49
Top Quark	6942.51 ±	35.65	328.85 ±	7.86
WZ	157.70 ±	6.17	130.53 ±	5.61
ZZ	62.21 ±	0.95	52.09 ±	0.88
Signal	±		±	
Total MC	78491.54 ±	657.04	13008.08 ±	232.07
Cut Eff MC			16.39 ±	0.33
Cut Eff Data			16.77 ±	0.15

ADDITIONAL - pT > 5GeV - McTruthClassiflier - 28 fb^{-1}										
	Z-Cand		All muons		d0sig		track+ topo		AllCuts	
Data	236108.00 ±	485.91	232604.00 ±	482.29	147953.00 ±	384.65	44963.00 ±	212.04	30598.00 ±	174.92
Z+light jets	71741.43 ±	1298.13	70418.70 ±	1289.11	63382.63 ±	1250.67	7435.06 ±	392.13	6590.55 ±	383.37
Z+heavy jets	143082.05 ±	455.17	142963.50 ±	454.31	78670.44 ±	339.63	27789.62 ±	209.64	16137.53 ±	159.37
Top Quark	11775.75 ±	46.73	11748.63 ±	46.66	4806.12 ±	30.11	845.90 ±	12.58	517.05 ±	9.82
WZ	4108.70 ±	31.20	4107.35 ±	31.20	3949.65 ±	30.58	3892.65 ±	30.38	3762.12 ±	29.86
ZZ	821.16 ±	3.54	820.51 ±	3.54	758.30 ±	3.41	738.75 ±	3.37	686.66 ±	3.25
Signal	±		±		±		±		±	
Total MC	231529.09 ±	1834.77	230058.69 ±	1824.82	151567.14 ±	1654.40	40701.98 ±	648.10	27693.91 ±	585.67
Cut Eff MC					65.23 ±	0.91	16.02 ±	0.32	10.33 ±	0.27
Cut Eff Data					62.92 ±	0.22	17.71 ±	0.10	11.49 ±	0.11
Z+light jets contibution			30.61 %							
							Isolation Eff MC		15.83 ±	0.45
							Isolation Eff Data		18.25 ±	0.14

ADDITIONAL MUON - LIGHT JETS - PT BALANCE CUT AT 0.1										
			All muons		d0sig		track+topo		AllCuts	
Data			51526.00 ±	226.99	41488.00 ±	203.69	8037.00 ±	89.65	6522.00 ±	80.76
Z+light jets			34900.16 ±	941.44	32849.42 ±	925.12	3272.63 ±	264.15	3156.42 ±	262.19
Z+heavy jets			12417.56 ±	134.91	7046.39 ±	101.45	2516.88 ±	63.74	1506.17 ±	48.73
Top Quark			1336.03 ±	16.27	654.93 ±	11.59	77.97 ±	3.98	49.57 ±	3.13
WZ			373.14 ±	9.31	359.91 ±	9.16	336.67 ±	8.86	328.13 ±	8.76
ZZ			75.81 ±	1.07	70.47 ±	1.04	65.18 ±	1.00	61.02 ±	0.97
Signal			±		±		±		±	
Total MC			49102.70 ±	1103.00	40981.12 ±	1048.36	6269.33 ±	341.73	5101.31 ±	323.78
Cut Eff MC					83.35 ±	2.87	12.06 ±	0.75	9.69 ±	0.70
Cut Eff Data					80.38 ±	0.54	14.95 ±	0.19	12.01 ±	0.17
Z+light jets contibution			71.08 %							
							Isolation Eff MC		11.62 ±	0.85
							Isolation Eff Data		14.94 ±	0.21

ADDITIONAL MUON - pT> 5GeV - HEAVY JETS - McTruthClassifi				
	|d0sig|>3.0		track+topo	
Data	84651.00 ±	290.95	14338.00 ±	119.74
Z+light jets	7036.06 ±	312.42	844.52 ±	82.44
Z+heavy jets	64293.06 ±	301.75	11652.10 ±	136.19
Top Quark	6942.51 ±	35.65	328.85 ±	7.86
WZ	157.70 ±	6.17	130.53 ±	5.61
ZZ	62.21 ±	0.95	52.09 ±	0.88
Signal	±		±	
Total MC	78491.54 ±	656.94	13008.09 ±	232.98
Cut Eff MC			16.39 ±	0.33
Cut Eff Data			16.77 ±	0.15

BACKUP