

Z -> ee Cross Section

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WZ Group

- Formed Feb 15, to measure W and Z c.s. as quickly as possible
- Standardize c.s. analyses as much as possible
 - use standard packages, define common datasets, share efficiency calculations, etc.
- W/Z to muons led by Kristian Harder
- W/Z to electrons led by Jonathan Hays

Goals

- Cross-check of luminosity
 - Absolute normalisation
 - Time dependence/stability
- Physics
 - W/Z production cross section
 - Indirect measurement of W width
- Tool development
 - Improved tools for other analyses
 - Drive tuning of GEANT Monte Carlo

$Z \rightarrow ee$ Tasks

- Sample selection
 - Divide up and prepare datasets
- Preselection
 - Measure with em_cert
- Offline electron selection efficiency (JS)
 - Measure with em_cert
- Trigger efficiencies
 - Measure with em_cert
- Electron backgrounds
 - Estimate with GEANT Monte Carlo
- QCD backgrounds
 - Estimate from data (cross checks with MC where possible)
- Recoil modeling
 - Needed for Missing ET and efficiency corrections
- Acceptance corrections
 - Estimate from tuned GEANT Monte Carlo

Run Ranges

runmin	runmax	name	comment on start of run range
160582	167015	v08	
167019	170246	v09	
170247	174802	v10	
174845	178721	v11	
178069	180956	v12a	
184951	190370	v12b	October 2003 shutdown
191266	194567	v12c	March 2004 shutdown
194567	196584	v13a	
201485	201936	v13b	August 2004 shutdown, solenoid changes
202152	204805	v13c	Luminosity electronics change
204807	206161	v13d	Second Lum electronics change
206162	208144	v13e	VME electronics available in Lum
207217	211213	v14a	
211214	212107	v14b	VME electronics primary source
212804	215670	v14c	Nov 2005 shutdown

Z → ee Data Sample

- V13a sample in SAM dataset, created by Heidi
- Data taken just before magnet current changed
- SAM definition:
`testit-v13a-Csskim-2EMhighpt-PASS3-p17.09.03`
- Run ranges: 194567-196584
- Data quality definition: `wzcross_dq`
 - written by Heidi, specifies good and bad run lists, bad lbnns list, and run range for the v13a sample
- 393 good runs

em_cert package

- Designed to standardize and simplify efficiency calculations
- Fills a large number of histograms
- Divides histograms, calculates efficiencies

Use dq_defs

dq cvs packages

- dq_defs - general definitions
- dq_util - code to use definitions
- wzcross_dq - our definitions
- wzcross_dq/doc - documentation for all of these packages

TMB

- edm_dq - interface tmbs to dq
- wzcross_sample - code to filter events

Offline Electron Selection

EM objects passing:

- $pT > 25 \text{ GeV}$
- Spatial track match
- ID = 10 or 11, $\text{emf} > 0.9$, $\text{iso} < 0.15$
- $80 < \text{inv. Mass} < 100 \text{ GeV}$
- In fiducial region:
 $|\eta_{\text{det}}| < 1.1 \text{ for CC, } 1.5 < |\eta_{\text{det}}| < 3.2 \text{ for EC}$

Backup slides

wzcross_dq/dqdefs/v13a-v2006-03-17.dqdef

```
//H. Schellman 3-17-06, update for version 1.3 of the common dq
//special stuff for WZ cross section
“good runs file” = “wzcross_dq/runlists/runlist_triggerlist_v13”
“run range” = 194567 : 196584
“bad lbn file” = “wzcross_dq/badlbn/recording_v13a_E2_SHT22_194567-196584.badlbn”
“bad lbn file” = “wzcross_dq/badlbn/blindlbn”
// common bad runs from the dq grout
// require version 1.3 or greater
“version” = 1.3
// load bad runs from textfiles
“bad runs file” = “dq_defs/common/2002-04-19.2005-11-21/2006-03-17.CALO.badrns”
“bad runs file” = “dq_defs/common/2002-04-19.2005-11-21/2006-03-17.CFT.badrns”
“bad runs file” = “dq_defs/common/2002-04-19.2005-11-21/2006-03-17.MUONS.badrns”
“bad runs file” = “dq_defs/common/2002-04-19.2005-11-21/2006-03-17.SMT.badrns”
// load bad LBNs from textfiles
“bad lbn file” = “dq_defs/common/2002-04-19.2005-11-21/2006-03-17.CALO.badlbn”
// must be good and !bad run
“run list mode” = 0
// can't be a bad lbn
“lbn list mode” = -1
// Event flags checked
“check cal_empty_crate” = 1
“check cal_ring_of_fire” = 1
“check cal_noon_noise” = 1
“check cal_coherent_noise” = 1
// not Monte Carlo
“monte-carlo mode” = 0
```

Triggers

- v8 -> v11
 - EM_HI_SH
 - EM_HI
 - EM_MX_SH
 - EM_MX
- v12
 - E1_SHT_20
 - E1_SH_30
 - E2_SH_20
 - E2_SHT_30
- v13
 - E1_SHT20
 - E1_SH30
 - E2_SHT22
 - E3_SHT22
- v14
 - E1_SHT25
 - E1_SH35
 - E4_SHT25
 - E4_SH35
 - 2CEM6_E15_SHT22
 - 2CEM6_E15_SH30

Preselection Efficiency

Tag and probe method:

Tag: tight electron (with track match), single EM trigger fired

Probe: track satisfying:

- $pT > 12 \text{ GeV}$, $dca < 1.0$, $\text{chi}^2 < 8.0$
- $|\eta_{\text{det}}| < 1.1$ for CC, $1.5 < |\eta_{\text{det}}| < 3.2$ for EC
- $0.1 < \text{phimod} < 0.9$
- Track pT sum around $R=0.4$ less than 3 GeV
- $\text{deltaZ(EM, track)} < 2\text{cm}$
- $\text{deltaPhi(EM, track)} > 2$
- $65 < \text{Mass(EM, track)} < 115 \text{ GeV}$

Check if the EM object matched to the probe track passes:

$$|\text{ID}| = 10 \text{ or } 11, \text{emf} > 0.9, \text{and } \text{iso} < 0.15$$

Hmatrix Efficiency

- $Z \rightarrow ee$ selection: CCCC only
- $70 < \text{inv. Mass} < 110 \text{ GeV}$
- Tag is a tight electron passing:
 - Fires single EM trigger
 - $pT > 25 \text{ GeV}$
 - $|\text{ID}| = 10 \text{ or } 11, \text{emf} > 0.9, \text{iso} < 0.2$
 - In fiducial region
 - $|\eta_{\text{det}}| < 0.9$ for CC, $\text{Hmx7} < 12$ for CC, $\text{Lhood8} > 0.85$
 - Spatial track match ($\text{chi2prob} > 0.01$)
- Probe is an EM object passing:
 - In fiducial region
 - Isolation < 0.2
 - EMFraction > 0.9
 - $pT > 3 \text{ GeV}$
 - Spatial track match ($\text{chi2prob} > 0.01$)

Spatial Track Matching Efficiency

- Probe passing:
 - In fiducial region
 - Isolation < 0.2
 - EMFrac > 0.9
 - $pT > 3 \text{ GeV}$
 - $\text{HMx} < 12$
 - $70 < \text{inv. mass} < 110 \text{ GeV}$

Likelihood Efficiency

- Probe passes:
 - In fiducial region
 - Isolation < 0.2
 - EMFrac > 0.9
 - $pT > 3 \text{ GeV}$
 - Loose track matching ($\text{chi2prob} > 0$)
 - $\text{HMx} < 50$
 - $70 < \text{inv. Mass} < 110 \text{ GeV}$
- Check whether $\text{Lhood8} > 0.85$

Z → ee Cross Section

Sys errors uncertainty	Relative Uncertainty	
	σ_Z (177 pb ⁻¹)	σ_Z (1000 pb ⁻¹)
Drell-Yan Correction	0.30	0.30
QCD Bkgd subtract	0.58	< 0.58
PMCS Parameters	0.88	0.88
Preselection Effic.	1.22	< 1.22 (< 0.6?)
Trigger Effic	0.07	< 0.07
Track-match Effic	0.24	0.24
Likelihood Effic	0.34	< 0.34
Total	1.69	

Z -> ee Cross Section

Previous measurement, at 177 pb⁻¹ :

$$\sigma_z \times \text{BR}(Z \rightarrow ee) =$$

$$267.7 \pm 3.0 \text{ (stat)} \pm 1.6 \text{ (sys stat)} \pm 4.5 \text{ (sys)} {}^{+4.0}_{-3.3} \text{ (pdf)} \pm 17.4 \text{ (lumi)} \text{ pb}$$
$$= 267.7 \pm 3.4 {}^{+4.0}_{-3.3} \text{ } {}^{+/- 17.4}_{-/- 4.5} \text{ pb}$$

Next measurement, at 1 fb⁻¹ :

$$\sigma_z \times \text{BR}(Z \rightarrow ee) =$$

$$267.7 \pm 1.3 \text{ (stat)} \pm 0.7 \text{ (sys stat)} \pm 4.5 \text{ (sys)} {}^{+4.0}_{-3.3} \text{ (pdf)} \pm 17.4 \text{ (lumi)} \text{ pb}$$
$$= 267.7 \pm 1.5 {}^{+4.0}_{-3.3} \text{ } {}^{+/- 17.4}_{-/- < 4.5} \text{ pb}$$