$W\gamma$, $Z\gamma$ - Motivation

- What Physics?
- Previous results (LEP,DELPHI)
- What has CDF to offer?
- Run I results
- Event Selection

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Why Investigate $W\gamma, Z\gamma$ events?

- Beyond SM events?
- anamolous couplings
- probe $WW\gamma$ vertex
- anamolous magnetic moment of W as a non-gauge-theory contribution

Previous Results (LEP,DELPHI)

- $W\gamma, Z\gamma$ and radiative W decays, $W \rightarrow f\bar{f}'\gamma$ are interesting because these can probe the $WW\gamma$ vertex and the anomalous magnetic moment of W as a non-gauge-theory contribution.
- The four LEP experiments independently measured the Trilinear Gauge Couplings (TGC) of the $WWV(v = Z/\gamma)$ vertex at the centre of mass energy of 183GeV.

	Λ	$\Delta\kappa$
LEP	-0.020 ± 0.024	0.057 ± 0.055
D0	0.0 ± 0.1	-0.08 ± 0.34
Combined LEP and D0	-0.03 ± 0.07	0.13 ± 0.14

Table 1: Fqcd values used for central result

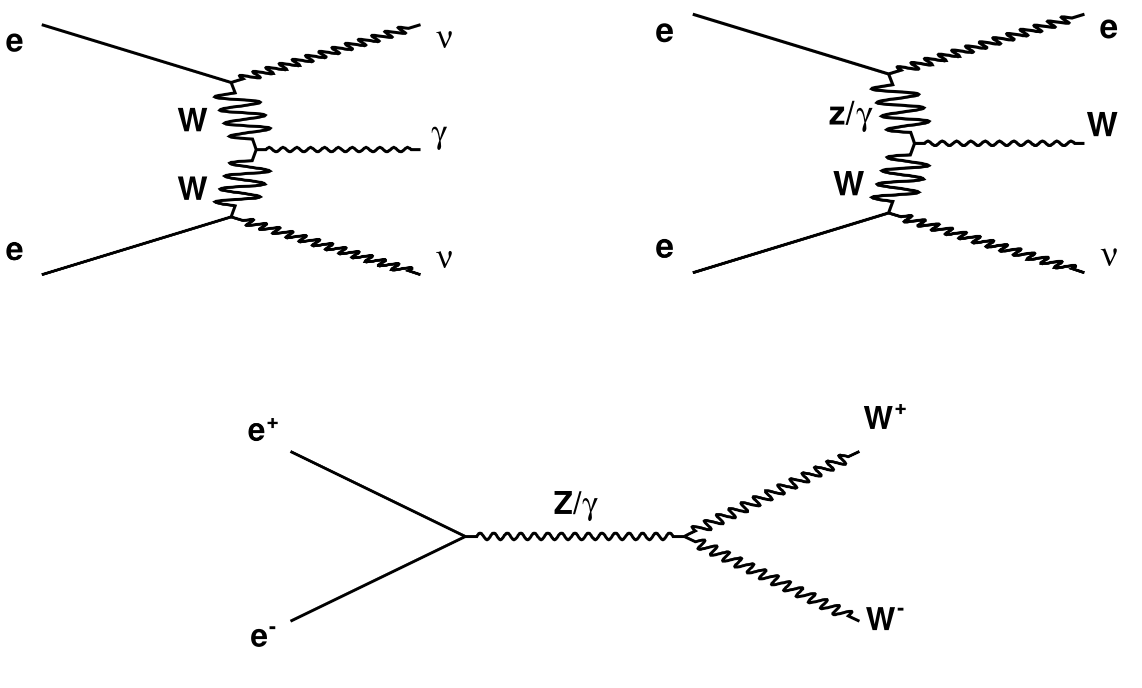


Figure 1: Feynman Diagrams for studying TGCs at LEP2

What does CDF have to offer?

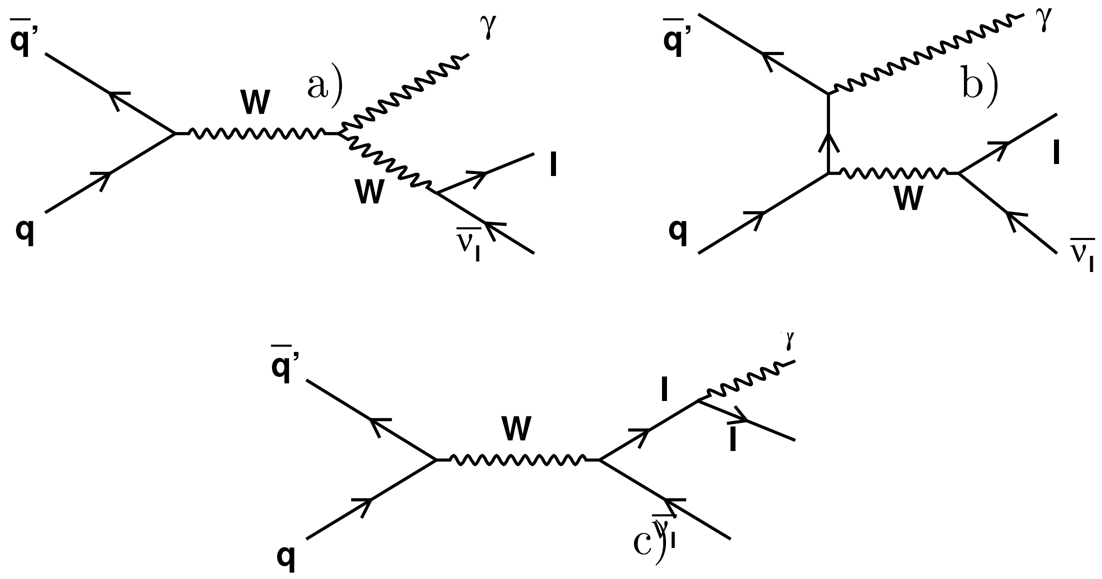


Figure 2: Standard Model Feynman Diagrams for Wγ events at CDF

Run I results

Signal	$l\gamma \not{E}_t$	$ll\gamma$
Mean Rate μ_{SM}	7.64 ± 0.71	5.77 ± 0.61
CDF Data N_0	16	5
$P(N \geq N_0 \mid \mu_{SM})$	0.0072	
$P(N \leq N_0 \mid \mu_{SM})$		0.61

Table 2: Fqcd values used for central result

Q. Are thes excesses found in Run II?

Event Selection

- $W \to l\not{E}_t$ above 25GeV
- $Z \to ll$ above 25GeV

cut
$7 < E_T < 40$ GeV
$9 < \|ZCes\| < 230$ cm
$\|XCes\| < 21$ cm
Not in chimney.
Had/Em $< 0.055 + 0.00045 \cdot E_t$
$Iso4/E_t < 0.1$ for $E_t < 20$GeV
$Iso4 < 2GeV$ for $E_t > 20$GeV
$N3d < 1$ or $N3d = 1$ and $p_t < 1$ GeV
Lshr < 0.5
$\chi^2 < 20(5)$
2nd cluster cut

Table 3: The list of cuts to select photons

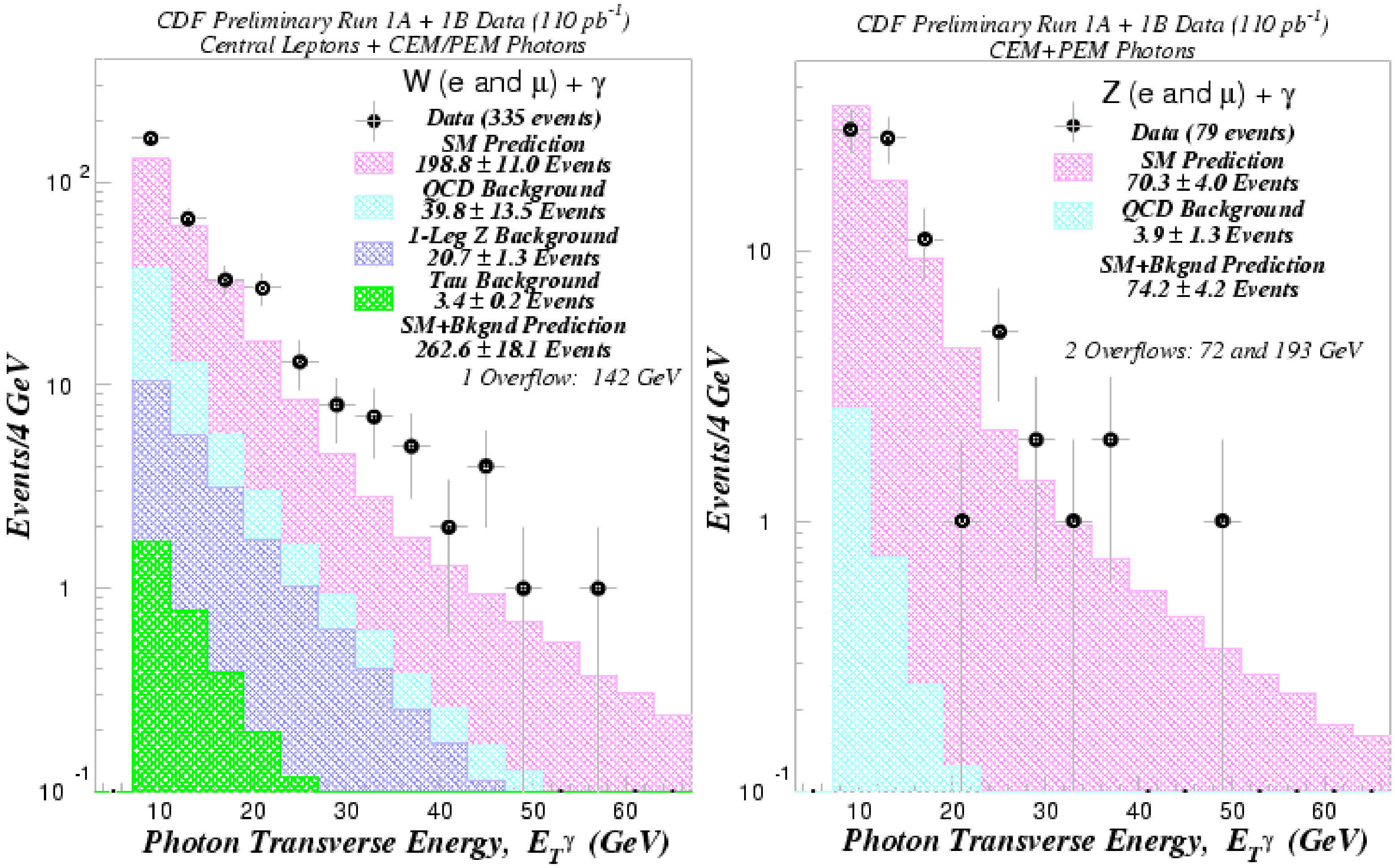


Figure 3: Photon Et for Wγ events(left) and Zγ events(right) at CDF

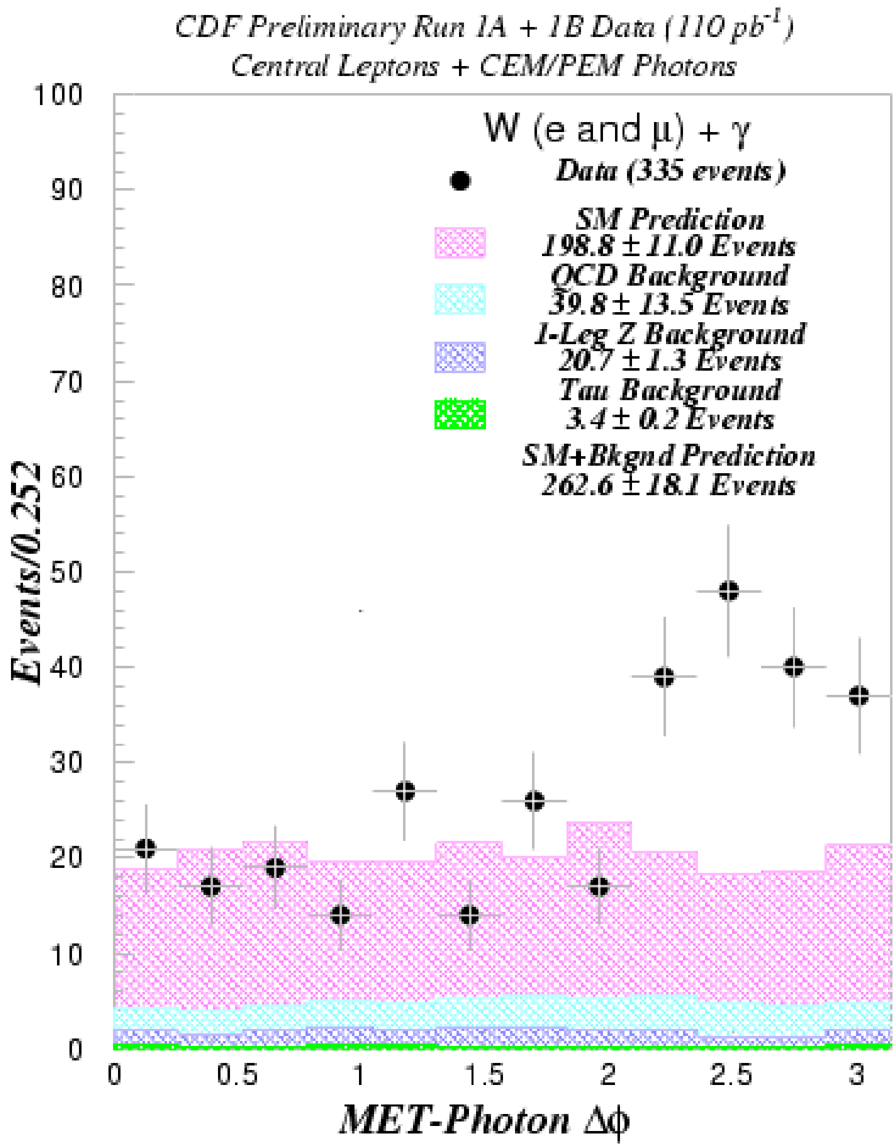


Figure 4: The $W+\gamma \not{E}_t-$ photonϕ angular seperation, $\Delta\phi(\not{E}_t-\gamma)$, overlaid on the Standard Model prediction plus background expectation.

Conclusions and Further Studies

- $W\gamma$ and $Z\gamma$ channels are interesting to understand beyond the Standard Model physics
- CDF is well placed to contribute in this area
- CDF has provided some interesting results already
- Run II aims to build on Run I results.

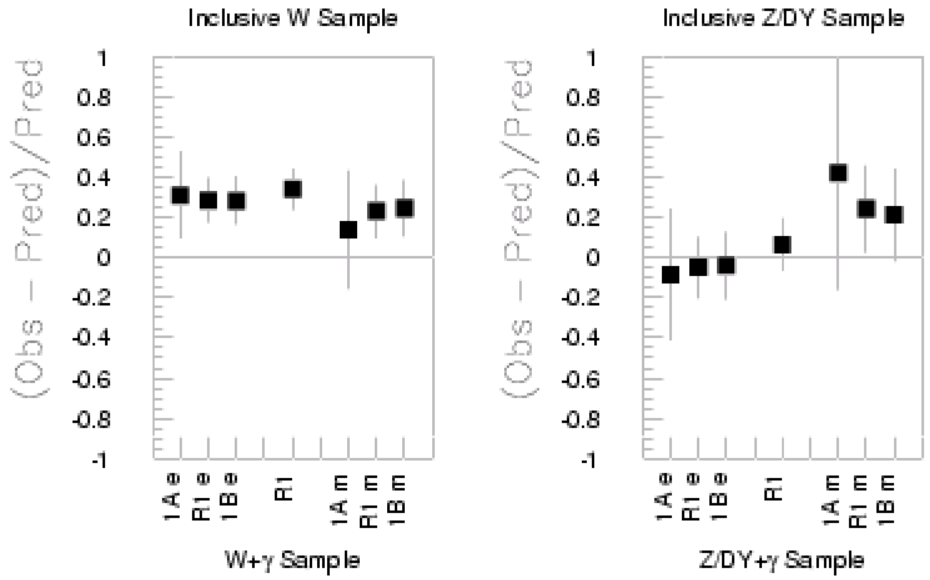
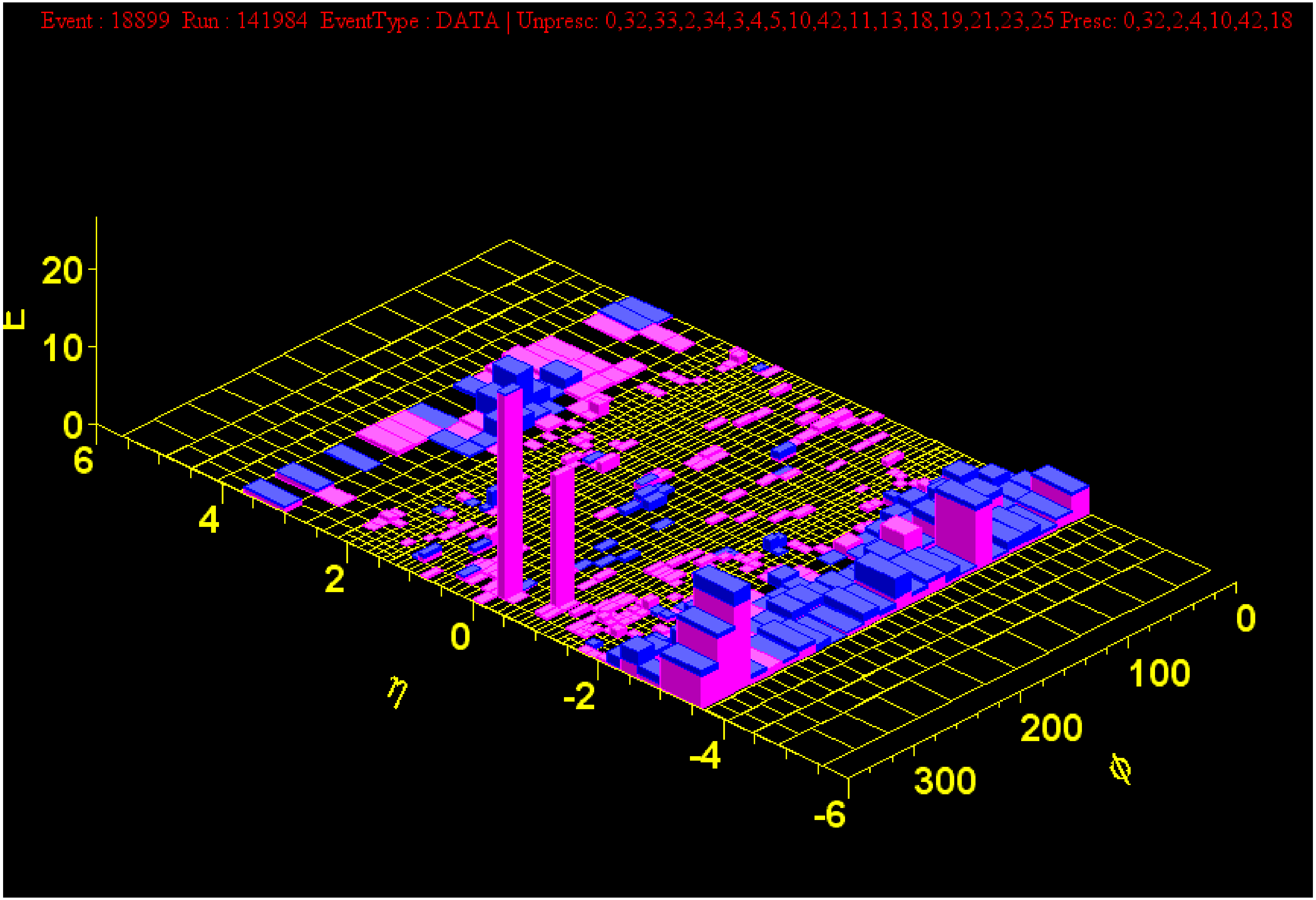


Figure 5: A graphical summary of $W\gamma$ and $Z\gamma$ channels and their deviations from the standard model predictions using the default $V + \gamma$ cuts , from run I.

Process	Run 1B	Run 1A	Total
$W\gamma$	163.29 ± 9.02	35.46 ± 1.93	198.75 ± 10.95
$jet \rightarrow \gamma$	33.52 ± 11.35	6.52 ± 2.13	39.77 ± 13.48
$OLZ + \gamma$	17.69 ± 1.05	2.96 ± 0.18	20.65 ± 1.23
$W \rightarrow \tau + \gamma$	2.82 ± 0.15	0.61 ± 0.04	3.43 ± 0.19
SM Total	218.92 ± 15.27	45.68 ± 3.03	264.60 ± 18.30
Data	278	57	335

Table 4: Comparison of muon plus electron channel $W\gamma$ event yields between the SM plus background expectation nd data using the default $V + \gamma$ cuts from run I.


Event : 18899 Run : 141984 EventType : DATA | Unpresc: 0,32,33,2,34,3,4,5,10,42,11,13,18,19,21,23,25 Presc: 0,32,2,4,10,42,18
E
20
10
0
6
4
2
0
-2
-4
-6
η
0
100
200
300
φ