Trilepton Analysis
Post CSC Status

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SUSY/Exotics UK meeting
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Outline of Post CSC Activity

- RHUL Trilepton Note Ready:

  "Trilepton SUSY Signatures at ATLAS"

  [CERN-ATL-COM-PHYS-2008-xxx]

- New Significance Definition/Results

  [Glen Cowan and Eilam Gross (ATLAS Statistics Forum), private communication.]

- Data Driven Background Estimates

  under way

Preliminary

Significance Approximations

S +/- ΔS
B +/- ΔB

1. $\frac{S}{\sqrt{S+B}}$

2. $\frac{S}{\sqrt{B}}$

3. $\sqrt{2((S+B)ln(1+\frac{S}{B})-S)}$

4. =3. + including stat errors on B

4. "what the expected significance would be if the statistical error on B would be the same as its (current) MC stat error."

[Glen Cowan and Eilam Gross (ATLAS Statistics Forum), private communication.]

Only for already established signals (S exists and is precisely known).

Holds if S << B and B is sufficiently large

Discovery significance if B is known precisely ≈ expression 2, in the limit S << B

Discovery significance that takes into account inflation of MC sample yields used to estimate Equiv-Lumi S and B (including +/-ve weights)

Significance Results

Inclusive Trilepton Search
1 fb^{-1}

Exclusive Trilepton Search
(direct gaugino prod)
10 fb^{-1}

Sample	# After Inc selection		# After Excl selection		Luminosity [fb^{-1}]
	In Sample	For 1 fb^{-1}	In Sample	For 10 fb^{-1}	
SU2 Signal	-	-	56	80.9	
SU2 Bckgnd	-	-	0	0.0	6.92
SU2 Inc	90	13.0	-	-	
SU3 Inc	1617	94.3	-	-	17.14
SU4 Inc	151	311.7	-	-	0.48
$t\bar{t}$	+15-5	10.6	+21-4	179.7	0.95
Zb	0	0.0	0	0.0	0.75
ZW	4	1.3	61	204.4	2.98
ZZ	0	0.0	14	11.0	12.67
WW	0	0.0	0	0.0	1.22
$Z\gamma$	0	0.0	1	3.4	2.98

S

B = $\sum_i b_i$

1. $\frac{S}{\sqrt{S+B}}$
2. $\frac{S}{\sqrt{B}}$
3. $\sqrt{2((S+B)ln(1+\frac{S}{B})-S)}$
4. =3. + including stat errors on B

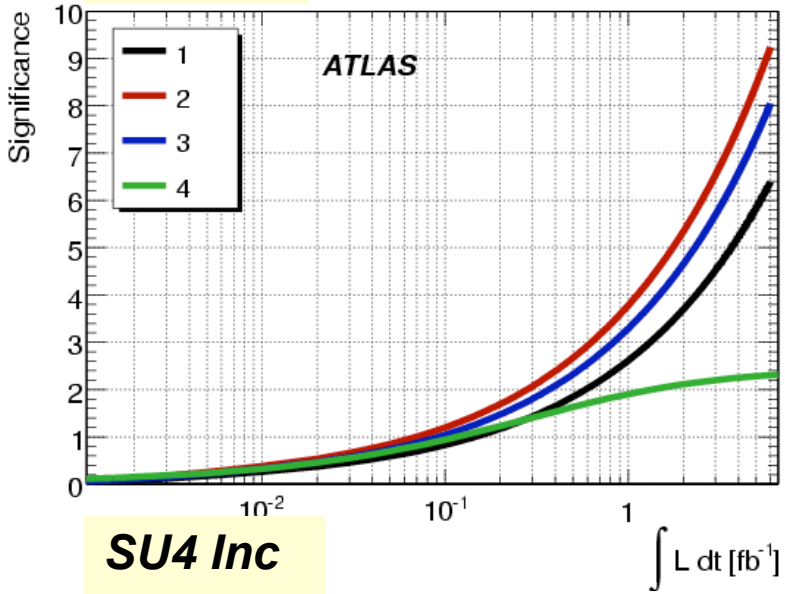
Significance	SU2 Inc	SU3 Inc	SU4 Inc	SU2 Excl
1	2.6	9.1	17.3	3.7
2	3.8	27.3	90.3	4.1
3	3.3	16.6	38.9	3.9
4	1.9	8.7	17.9	1.2

Preliminary

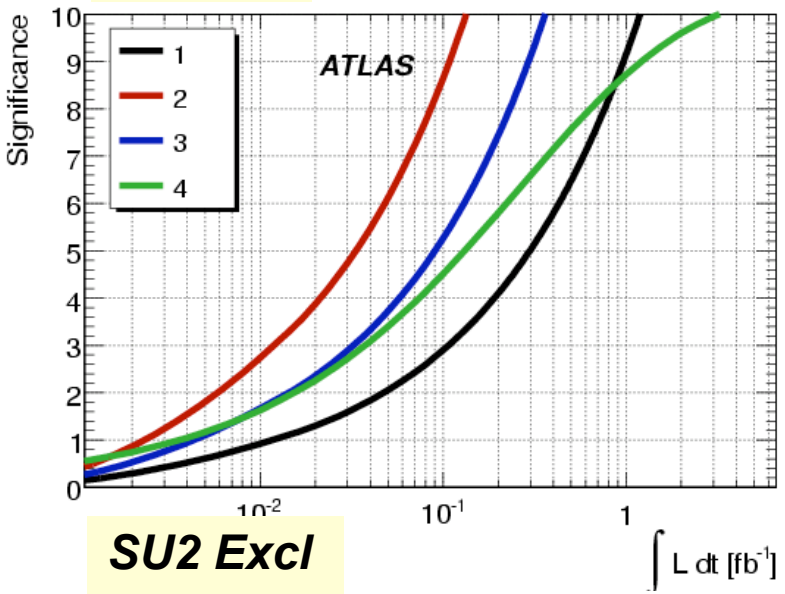
Significance Results

1. $\frac{S}{\sqrt{S+B}}$
2. $\frac{S}{\sqrt{B}}$
3. $\sqrt{2((S+B)ln(1+\frac{S}{B})-S)}$
4. =3. + including stat errors on B

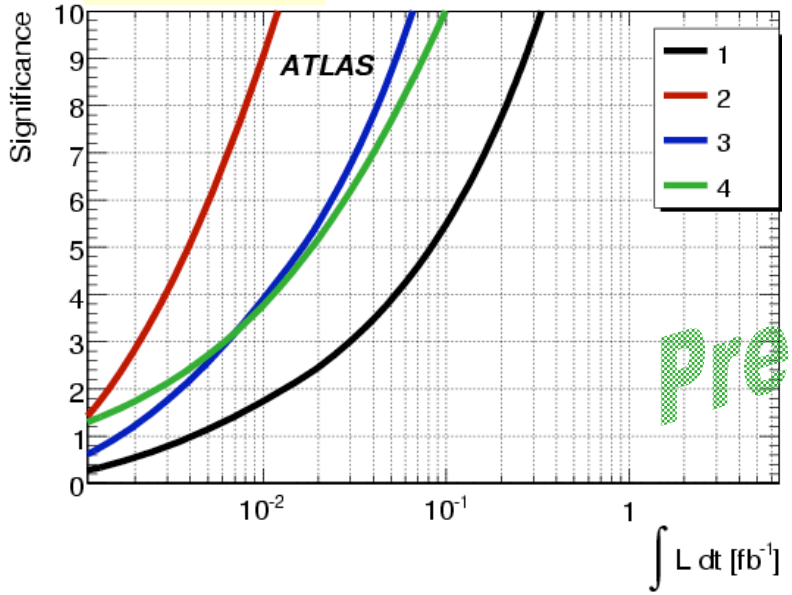
SU2 Inc



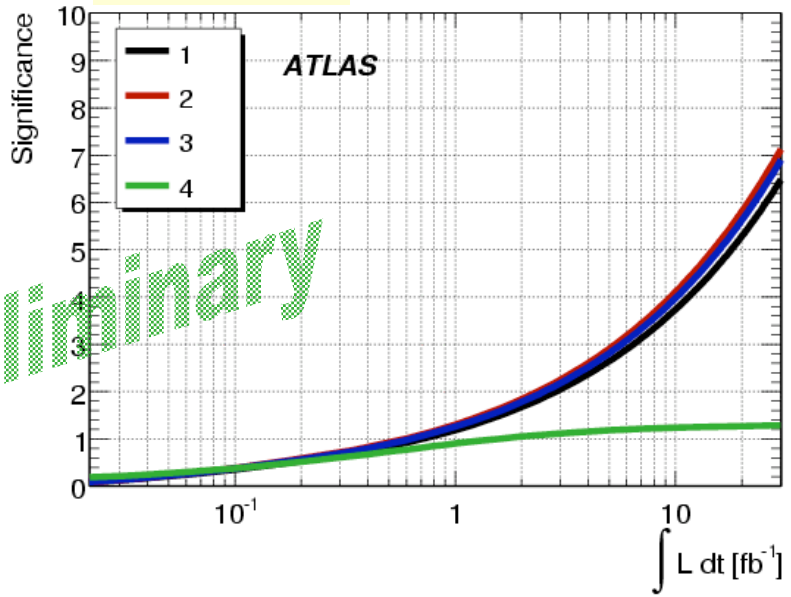
SU3 Inc



SU4 Inc



SU2 Excl



Preliminary

Data Driven Bckg Estimation Ttbar → 3 leps

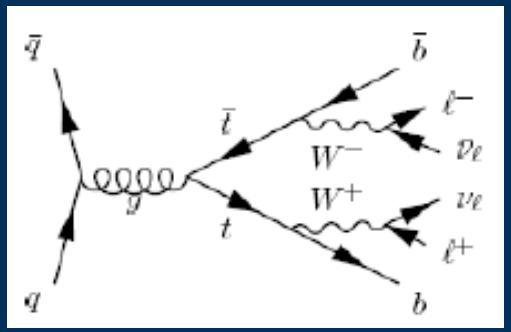
Idea Giacomo Polesello *-> count combinations of lepton flavour and sign in 3-lepton events*

1)	$e^- e^- \mu^+$	*No SFOS*
2)	$\mu^- \mu^- e^+$	
3)	$e^+ e^+ \mu^-$	
4)	$\mu^+ \mu^+ e^-$	
5)	$e^+ e^- \mu^-$	*SFOS*
6)	$e^+ e^- \mu^+$	
7)	$\mu^+ \mu^- e^-$	
8)	$\mu^+ \mu^- e^+$	
9)	$e^+ e^- e^-$	*SFOS*
10)	$e^+ e^- e^+$	
11)	$\mu^+ \mu^- \mu^-$	
12)	$\mu^+ \mu^- \mu^+$	
13)	$e^+ e^+ e^+$	*No OS*
14)	$e^- e^- e^-$	
15)	$\mu^+ \mu^+ \mu^+$	
16)	$\mu^- \mu^- \mu^-$	
17)	$e^+ e^+ \mu^+$	
18)	$e^- e^- \mu^-$	
19)	$\mu^+ \mu^+ e^+$	
20)	$\mu^- \mu^- e^-$	

From ttbar expect

l^+ from W^+ from t decay
l^- from W^- from tbar decay
+ $l^{+/-}$ from a b decay

Require at least an OS pair

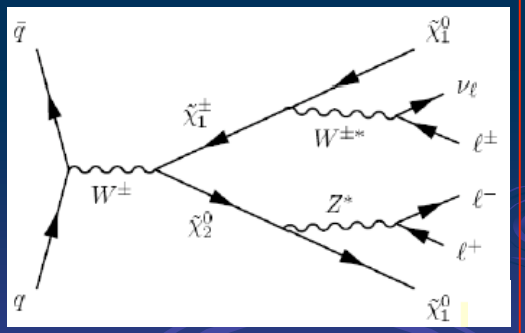


1=2=3=4 = 9=10=11=12 = 0.5(5=6=7=8)
since 5,6,7,8 have twice as many OS combination pairs than the others.

From signal expect

l^+l^- from Z
$l^{+/-}$ from $W^{+/-}$

Require at least a SFOS pair

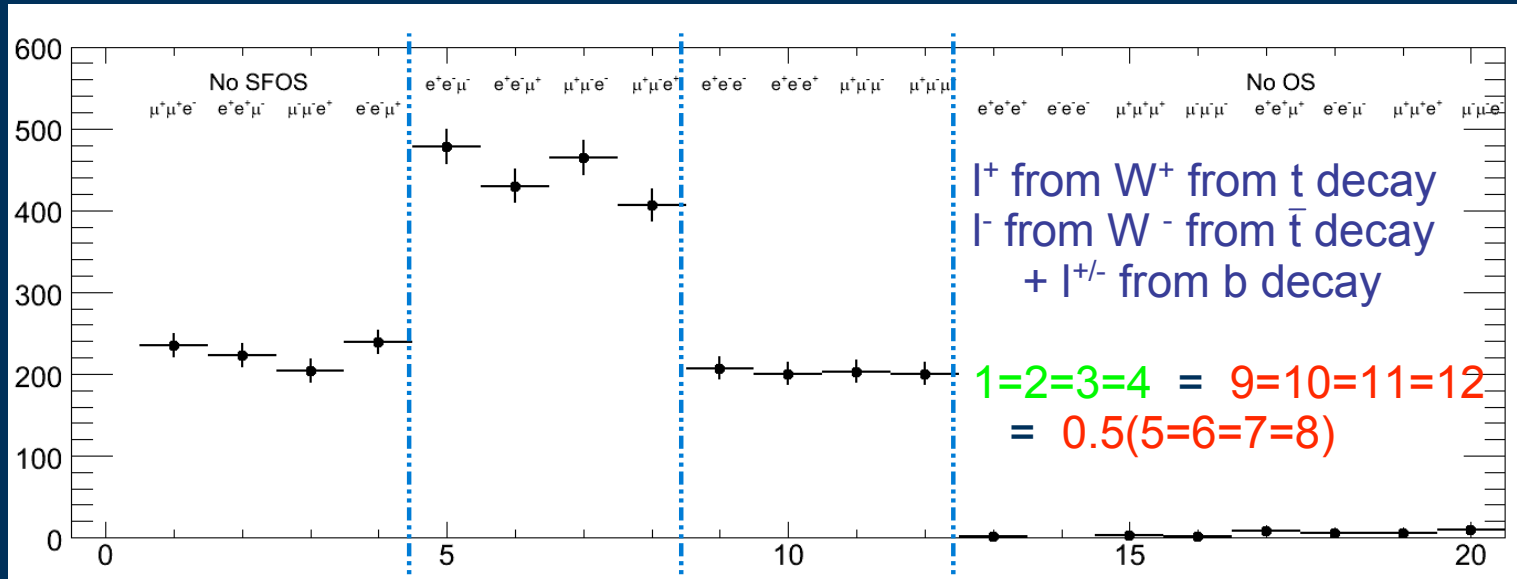


1=2=3=4 = 0
5=7=9=11 < 6=8=10=12
since $\sigma(pp \to ZW^-) < \sigma(pp \to ZW^+)$

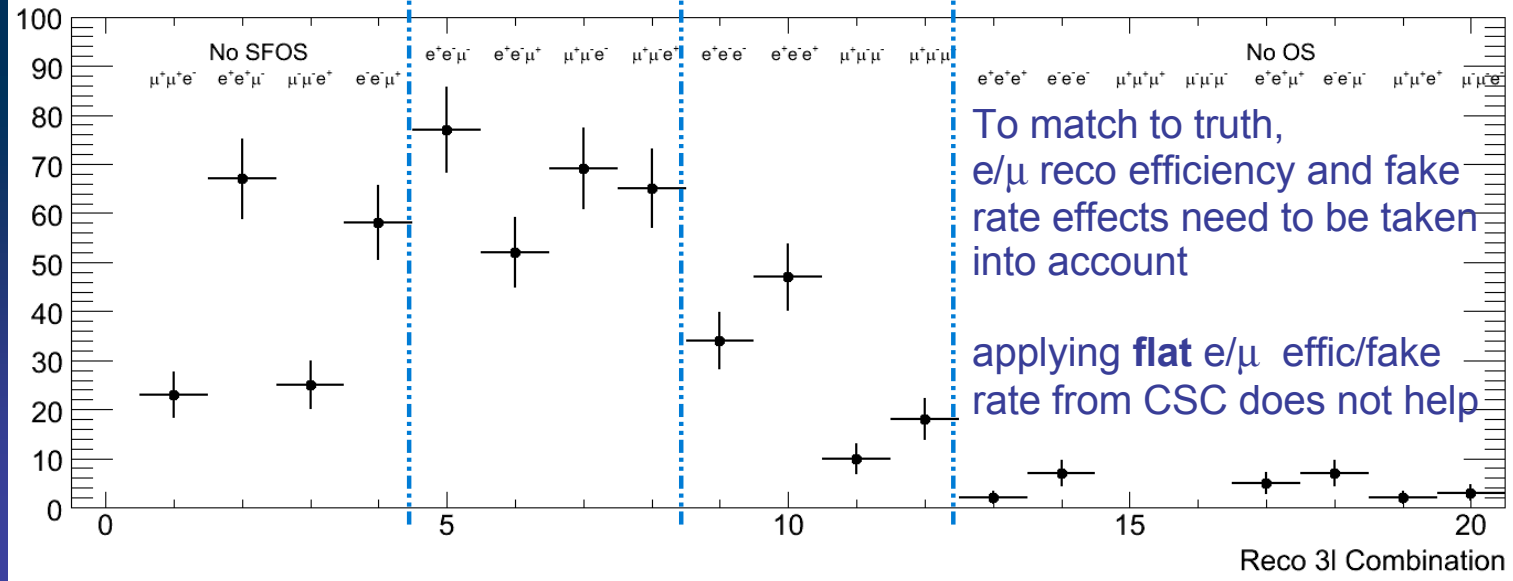
Can we use 1-4 to predict 5-12 ?

Background Estimation: Preliminary Ttbar

Truth
3l comb
truth lepton:
from W,Z,τ,b



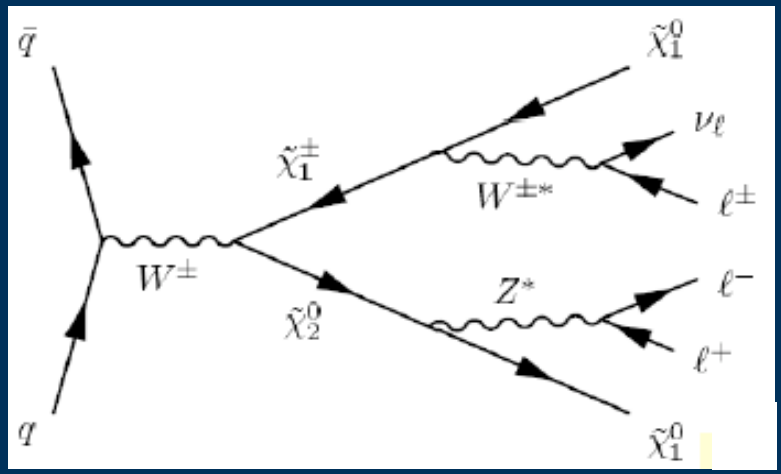
Reco
3l comb

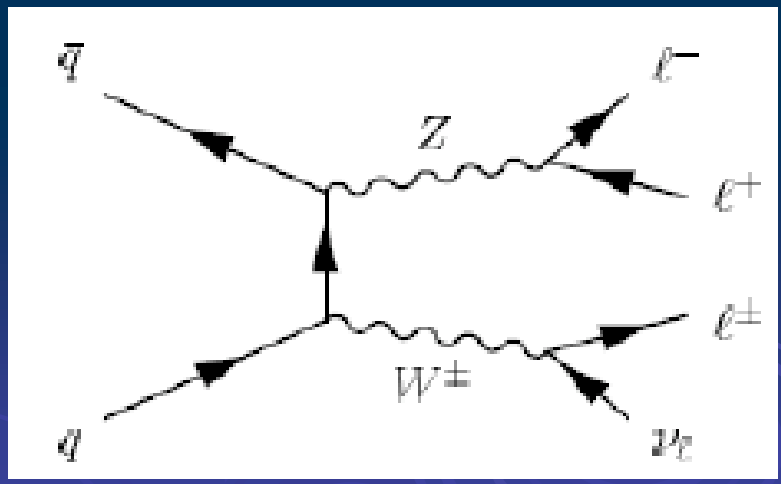


Comment

- At first we will use a ZW sample, which is cleaner, should mimic our signal well, and has much better statistics

Trilepton ($\chi\chi$) signal

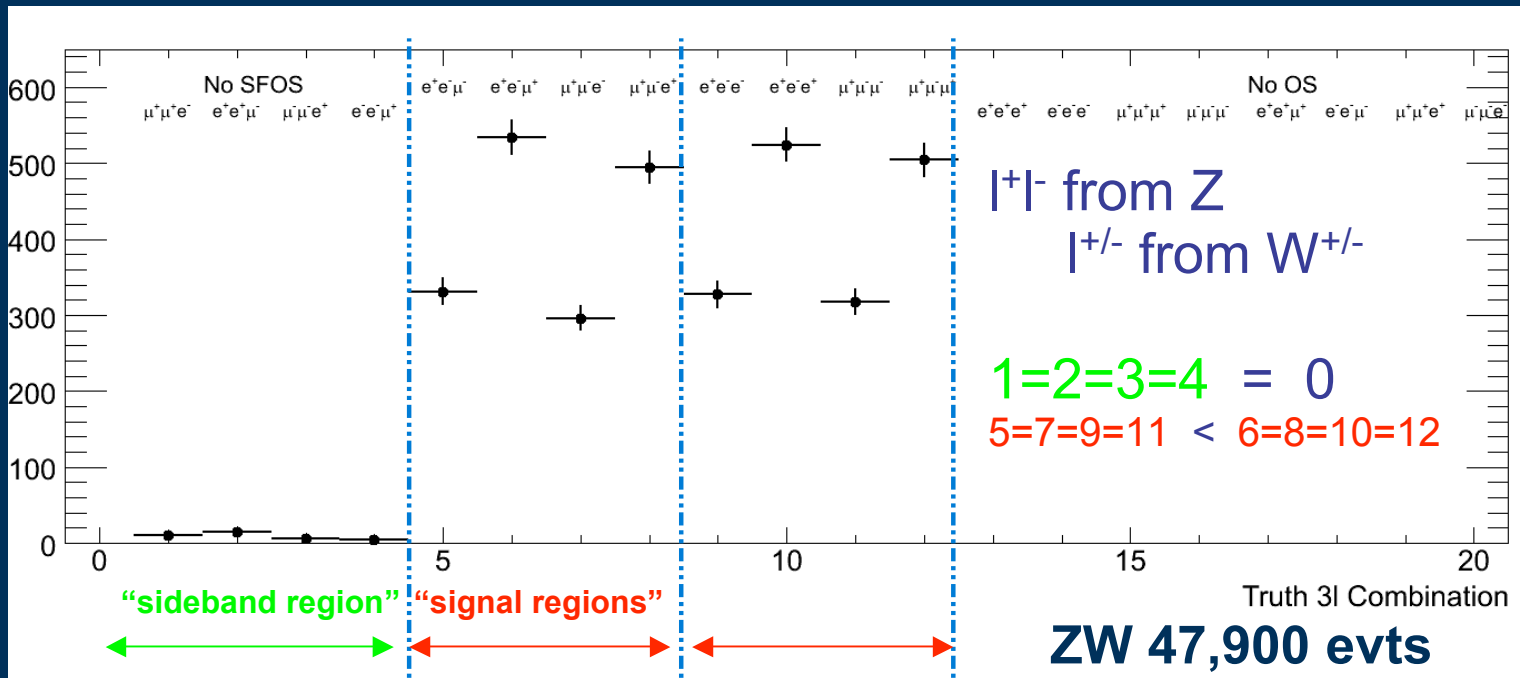




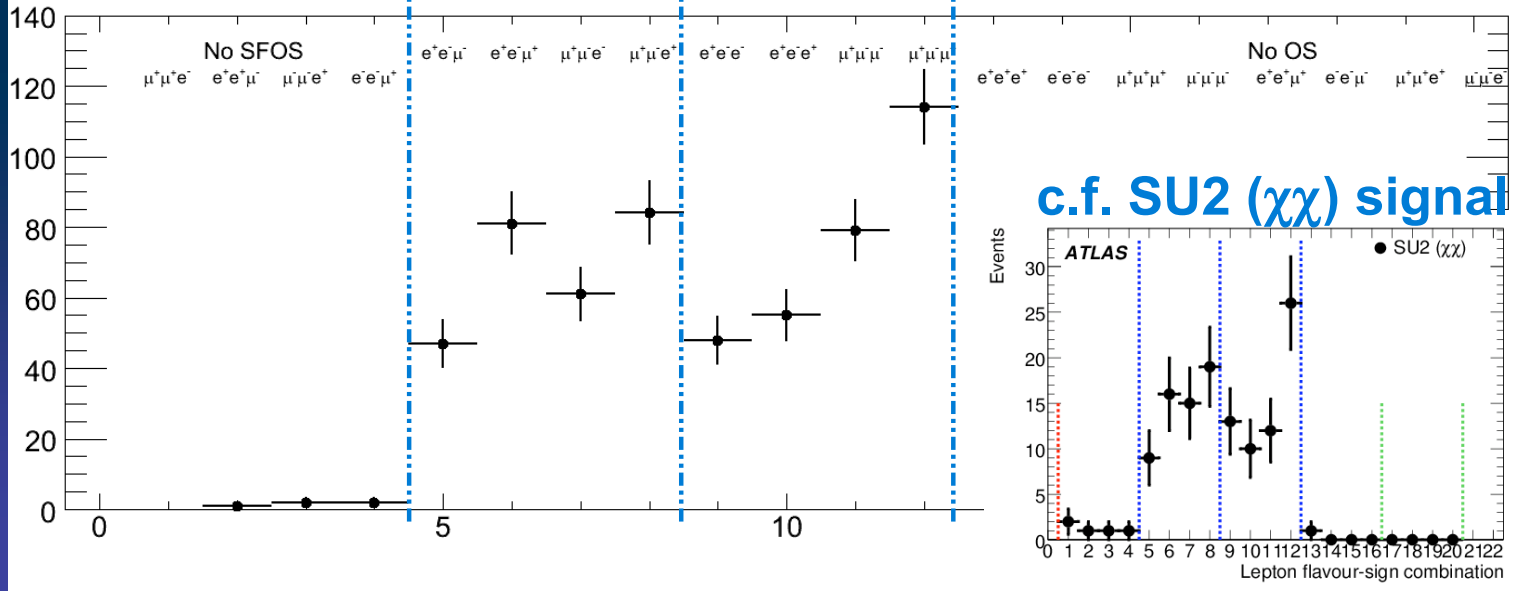
"signal-like" ZW

Background Estimation: Preliminary "signal-like" ZW

Truth
3l comb
truth lepton:
from W,Z,τ



Reco
3l comb



Trilepton Status Summary

- Preliminary results with New Discovery significance calculation [Glen Cowan and Eilam Gross (ATLAS Statistics Forum), private commun.]
  - show that SU2 channel significance is degraded significantly, if the statistical error on B would be the same as its (current) *background* MC stat error
  - Discovery significances for SU3 and SU4 analyses are reduced, but still look promising!!
- Obv. to trust *any* discovery significance, must be able to determine B precisely
  - Achievable with sufficient statistics (eg data driven methods).
- To establish the lepton flavour-sign sideband method, Reco efficiencies and Fake Rates must be well understood within our 3-lep environment
- Work ongoing