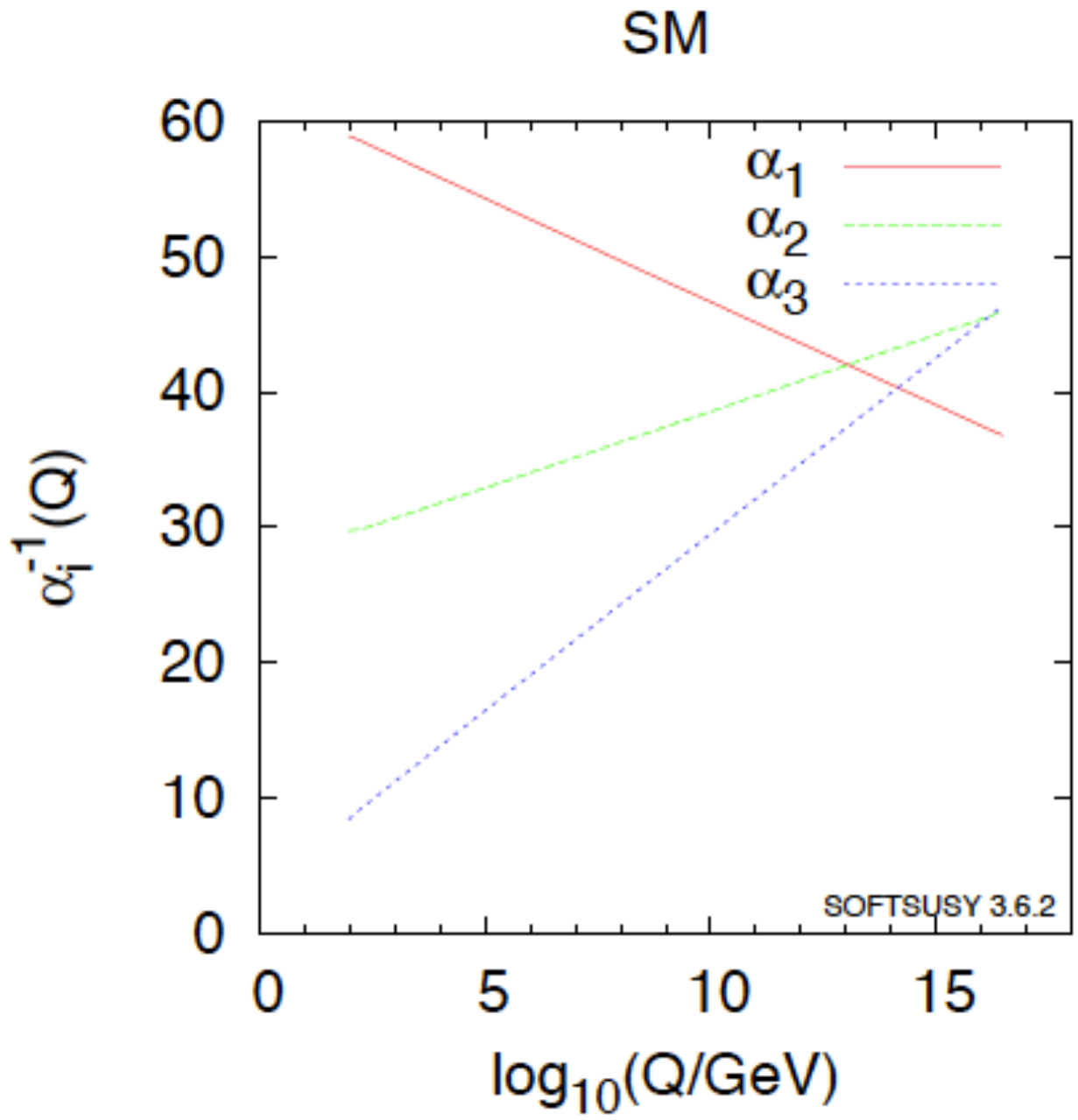
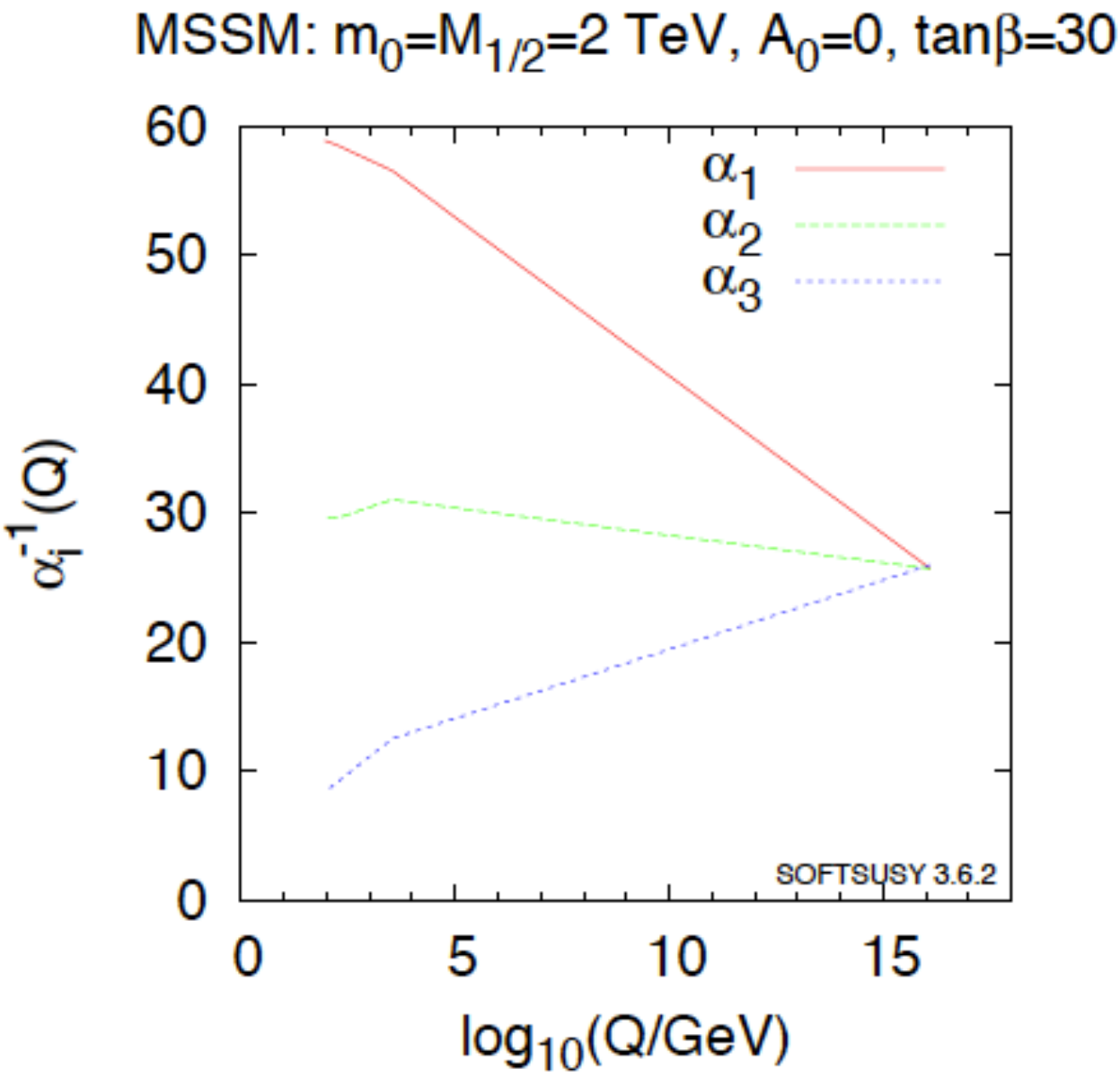

SM
60
50
40
30
20
10
0
0
5
10
15
$\alpha_i^{-1}(Q)$
$\log_{10}(Q/\mathrm{GeV})$
α_1
α_2
α_3
SOFTSUSY 3.6.2


MSSM: m0=M1/2=2 TeV, A0=0, tanβ=30
α1
α2
α3
SOFTSUSY 3.6.2
αi-1(Q)
log10(Q/GeV)
0
10
20
30
40
50
60
0
5
10
15

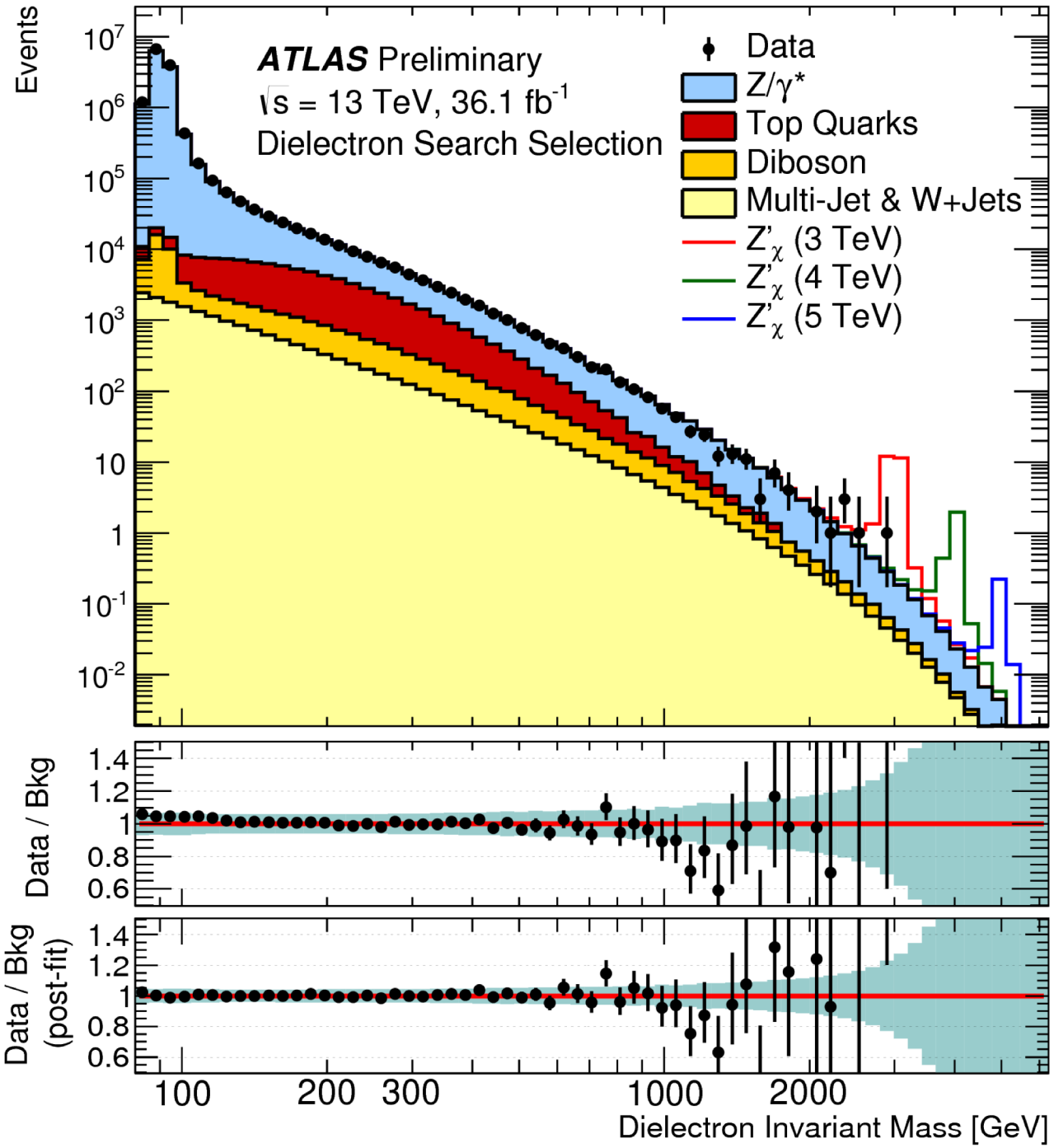
state	Y	Color	Weak	$SU(5)$	$SO(10)$
ν^c	0	$---$	$--$	**1**	
e^c	2	$---$	$++$		
u_r	1/3	$+--$	$-+$		
d_r	1/3	$+--$	$+-$		
u_b	1/3	$-+-$	$-+$		
d_b	1/3	$-+-$	$+-$	**10**	
u_y	1/3	$--+$	$-+$		
u_y	1/3	$--+$	$+-$		**16**
u_r^c	$-4/3$	$-++$	$--$		
u_b^c	$-4/3$	$+-+$	$--$		
u_y^c	$-4/3$	$++-$	$--$		
d_r^c	2/3	$-++$	$++$		
d_b^c	2/3	$+-+$	$++$		
d_y^c	2/3	$++-$	$++$	$\bar{\mathbf{5}}$	
ν	-1	$+++$	$-+$		
e	-1	$+++$	$+-$		

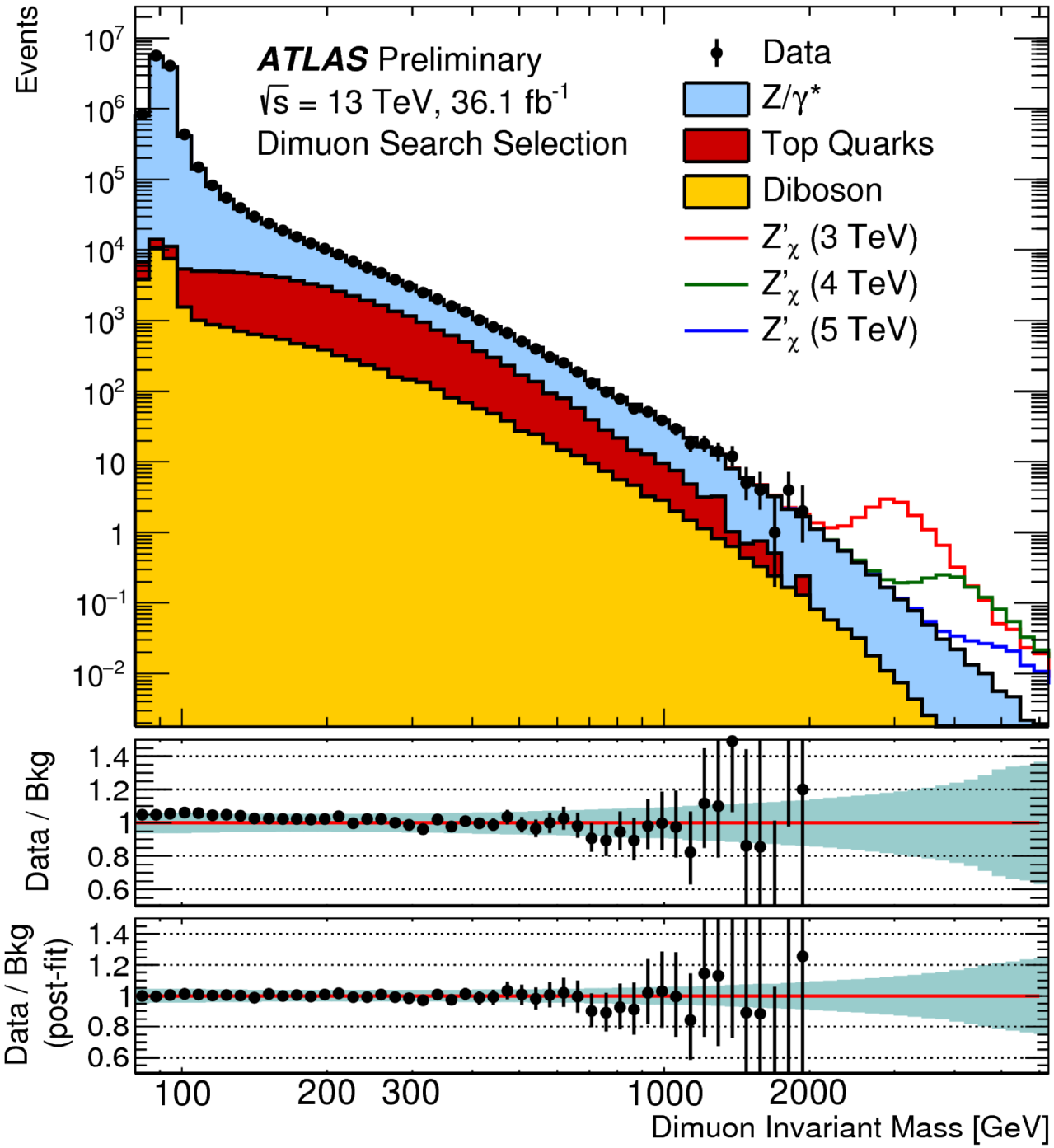
ATLAS/CMS searches for Z’ and W’

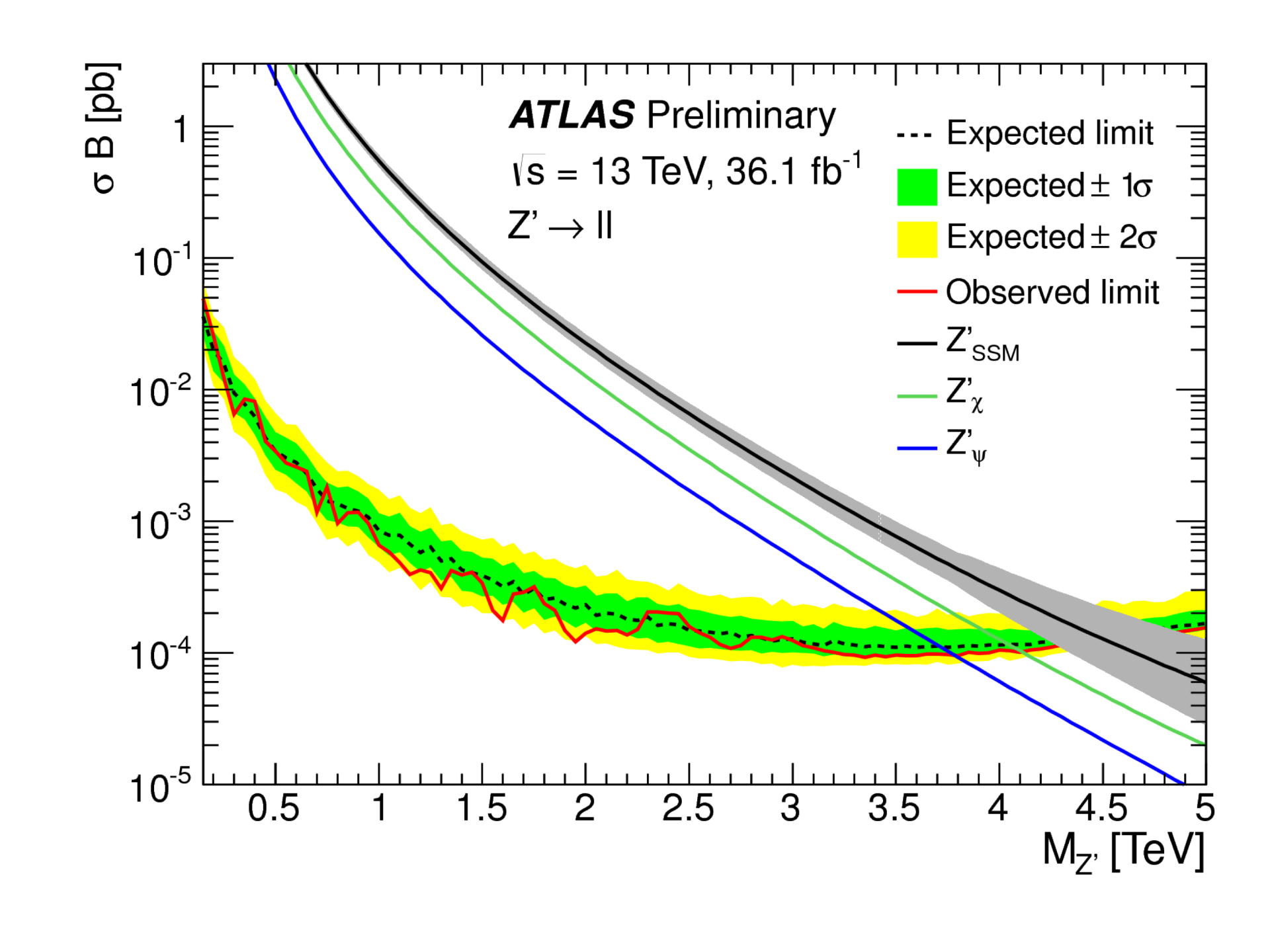
Under the assumption that Z’ and W’ do not have flavour-changing couplings (and when combining e and μ: that couplings are identical)

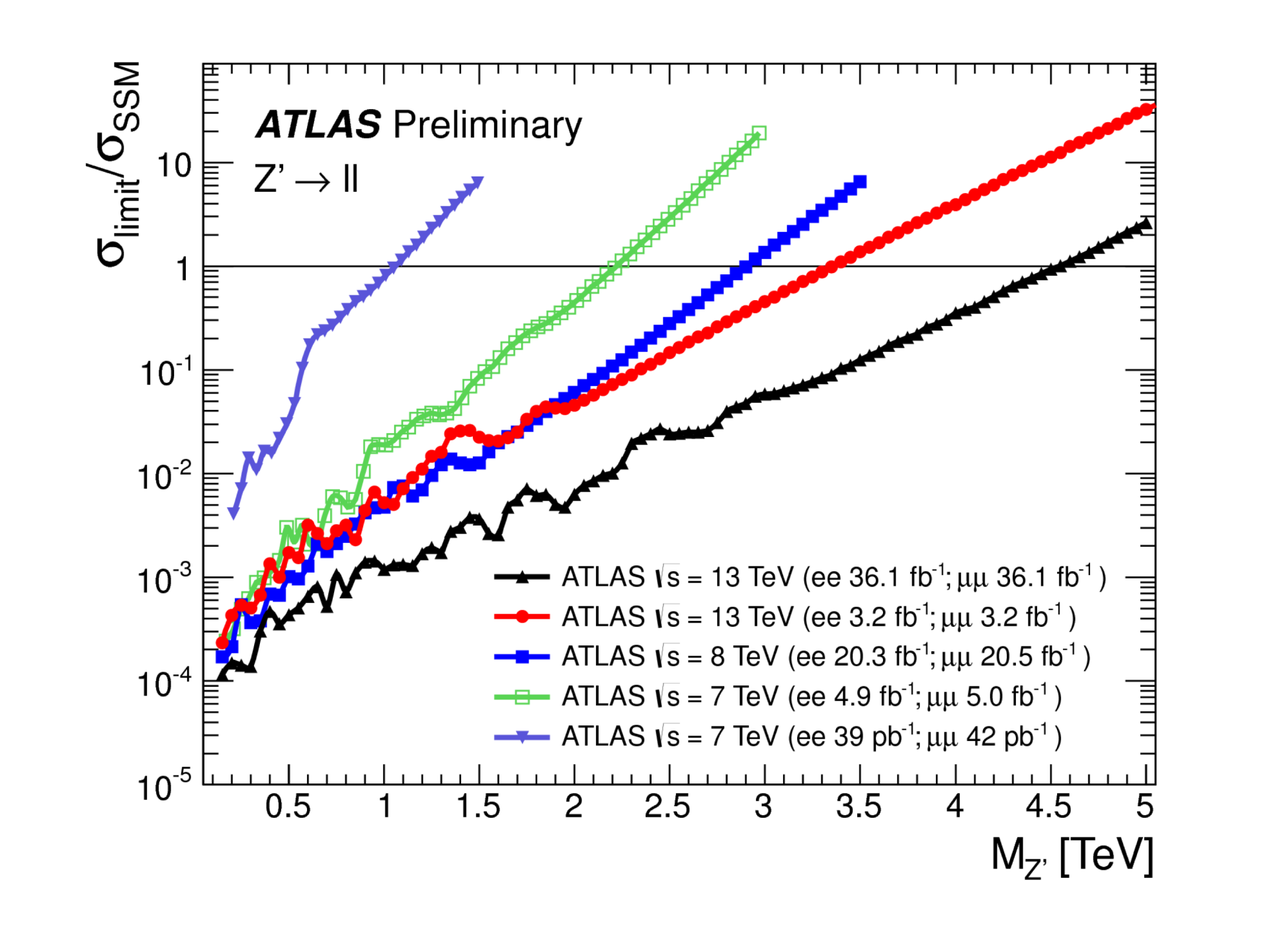
SSM = Sequential Standard Model

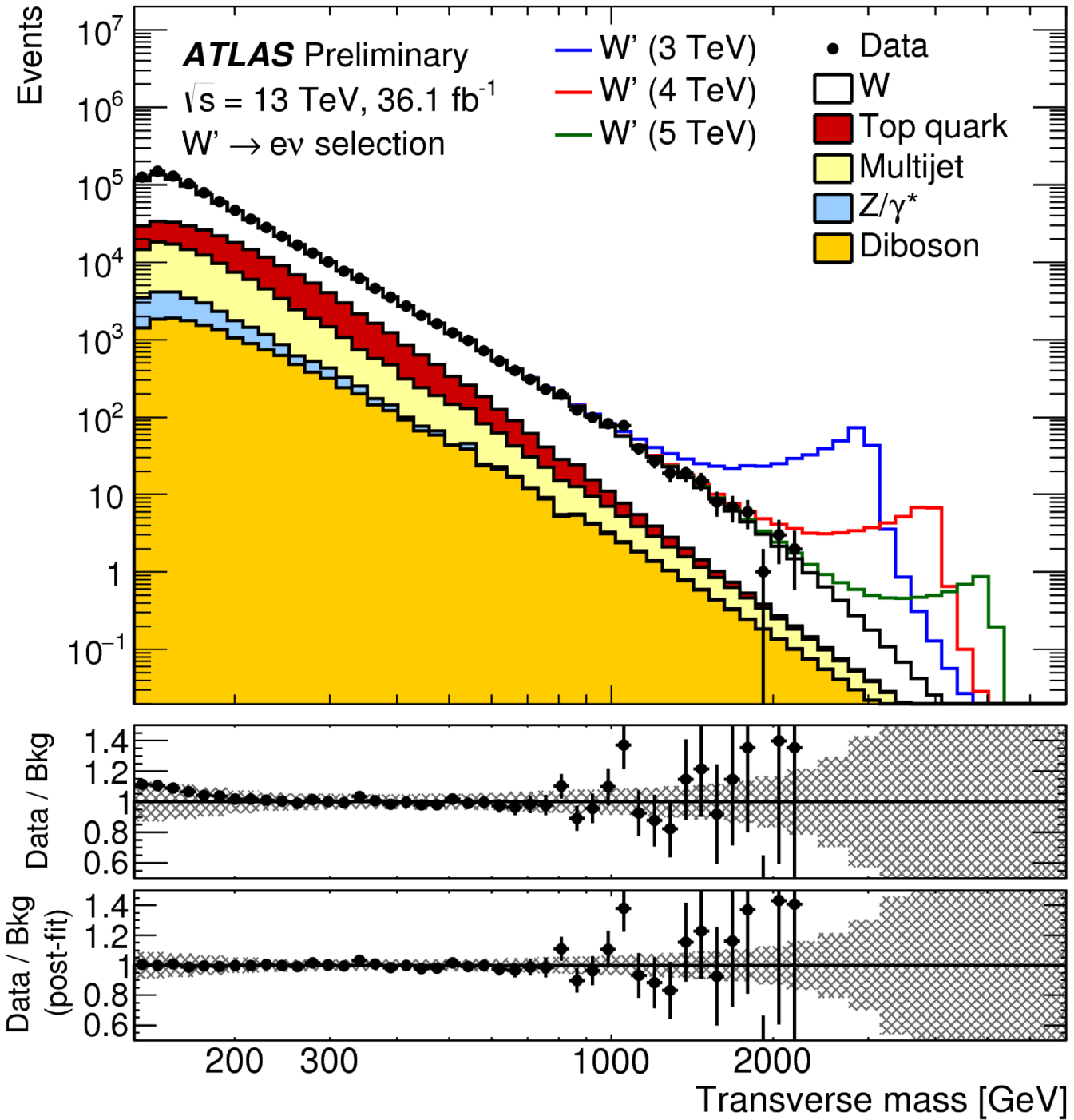
$$SO(10) \rightarrow SU(5) \times U(1)_X$$


ATLAS Preliminary
√s = 13 TeV, 36.1 fb-1
Dielectron Search Selection
Data
Z/γ*
Top Quarks
Diboson
Multi-Jet & W+Jets
Z'χ (3 TeV)
Z'χ (4 TeV)
Z'χ (5 TeV)
Events
Data / Bkg
Data / Bkg (post-fit)
Dielectron Invariant Mass [GeV]

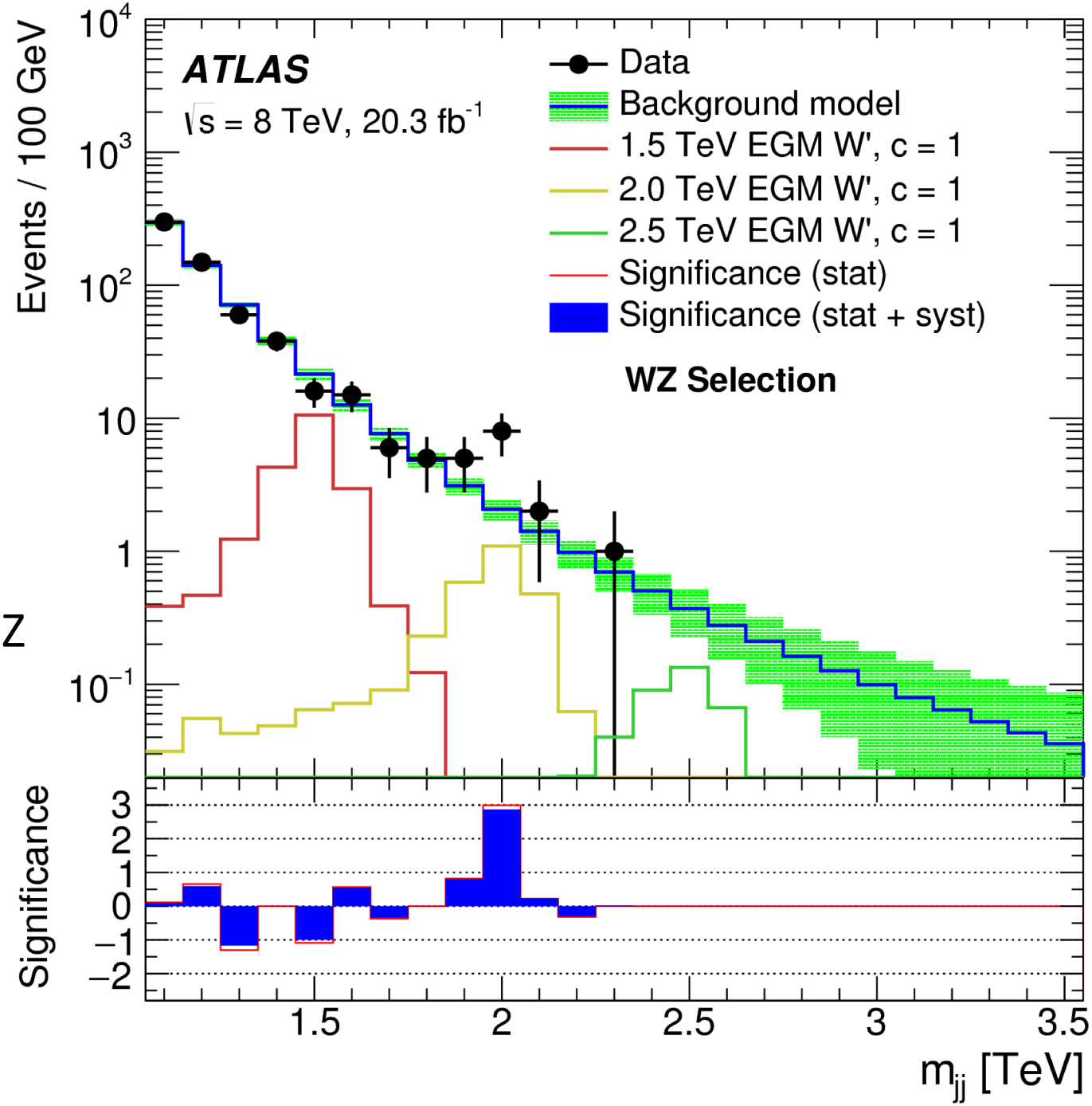

ATLAS Preliminary
√s = 13 TeV, 36.1 fb-1
Dimuon Search Selection
Data
Z/γ*
Top Quarks
Diboson
Z'χ (3 TeV)
Z'χ (4 TeV)
Z'χ (5 TeV)
Events
Data / Bkg
Data / Bkg (post-fit)
Dimuon Invariant Mass [GeV]


ATLAS Preliminary
√s = 13 TeV, 36.1 fb-1
Z' → ll
Expected limit
Expected ± 1σ
Expected ± 2σ
Observed limit
Z'SSM
Z'χ
Z'ψ
σ B [pb]
MZ' [TeV]
1
10-1
10-2
10-3
10-4
10-5
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

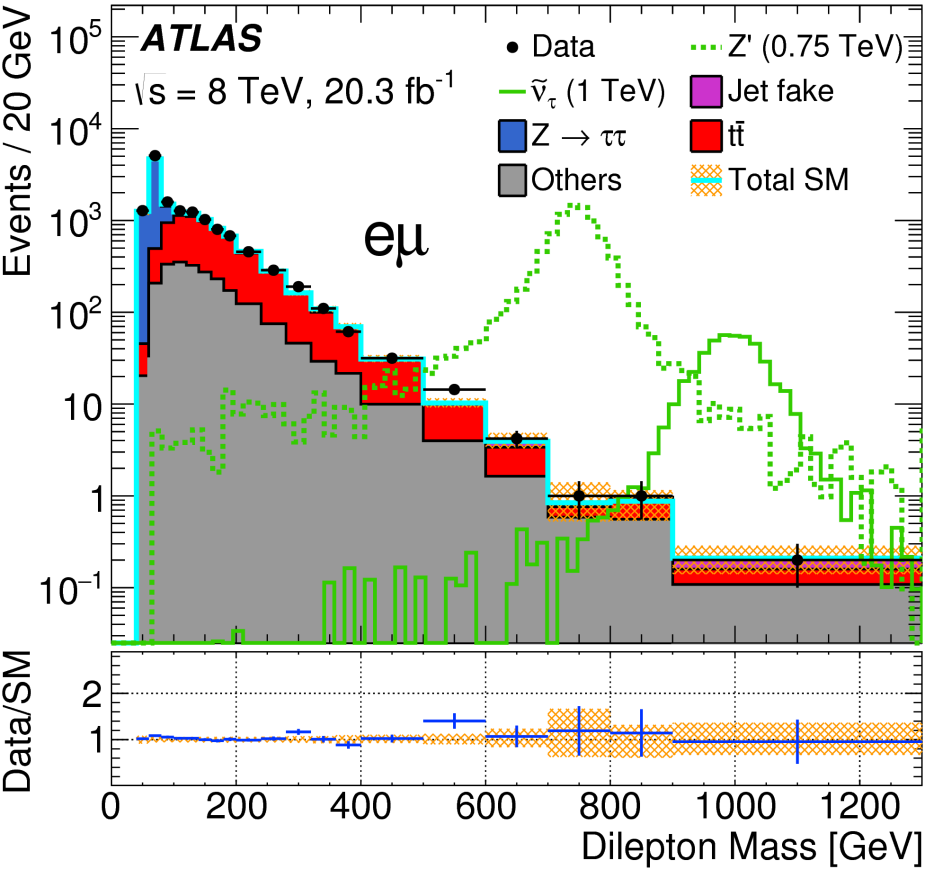

ATLAS Preliminary
Z' → ll
σlimit/σSSM
MZ' [TeV]
ATLAS √s = 13 TeV (ee 36.1 fb-1; μμ 36.1 fb-1)
ATLAS √s = 13 TeV (ee 3.2 fb-1; μμ 3.2 fb-1)
ATLAS √s = 8 TeV (ee 20.3 fb-1; μμ 20.5 fb-1)
ATLAS √s = 7 TeV (ee 4.9 fb-1; μμ 5.0 fb-1)
ATLAS √s = 7 TeV (ee 39 pb-1; μμ 42 pb-1)

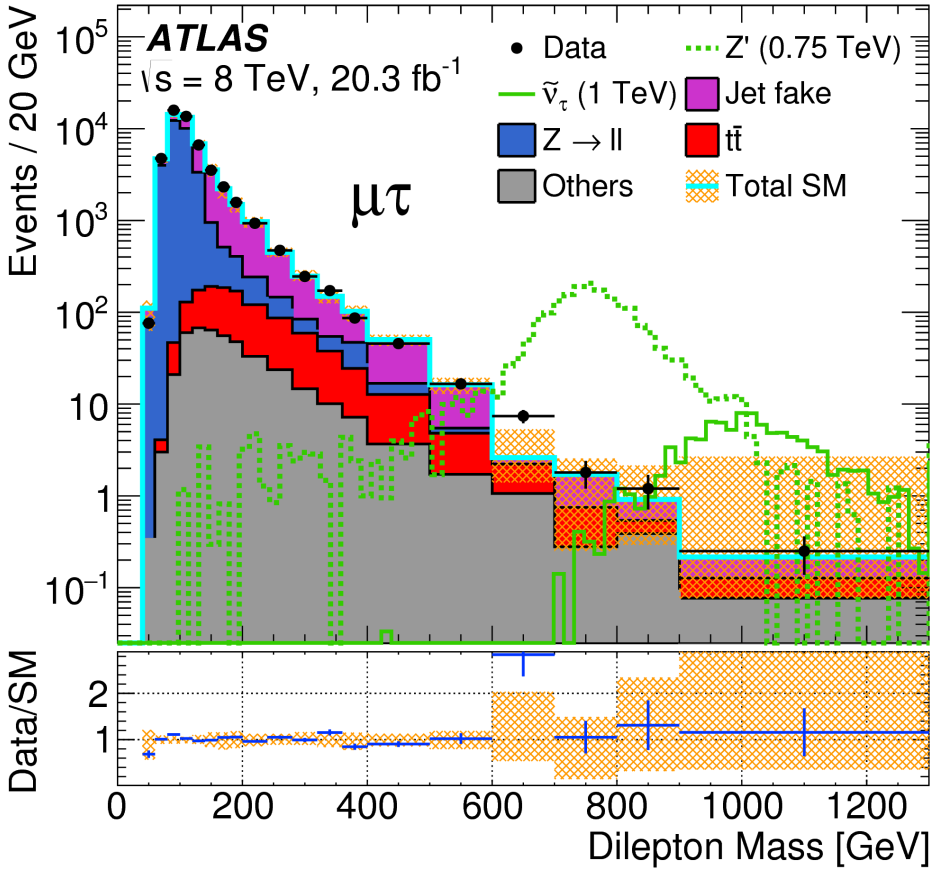

ATLAS Preliminary
√s = 13 TeV, 36.1 fb-1
W' → eν selection
W' (3 TeV)
W' (4 TeV)
W' (5 TeV)
Data
W
Top quark
Multijet
Z/γ*
Diboson
Events
Data / Bkg
Data / Bkg (post-fit)
Transverse mass [GeV]

W’ → WZ


ATLAS
√s = 8 TeV, 20.3 fb-1
Data
Background model
1.5 TeV EGM W', c = 1
2.0 TeV EGM W', c = 1
2.5 TeV EGM W', c = 1
Significance (stat)
Significance (stat + syst)
WZ Selection
Events / 100 GeV
Significance
mjj [TeV]

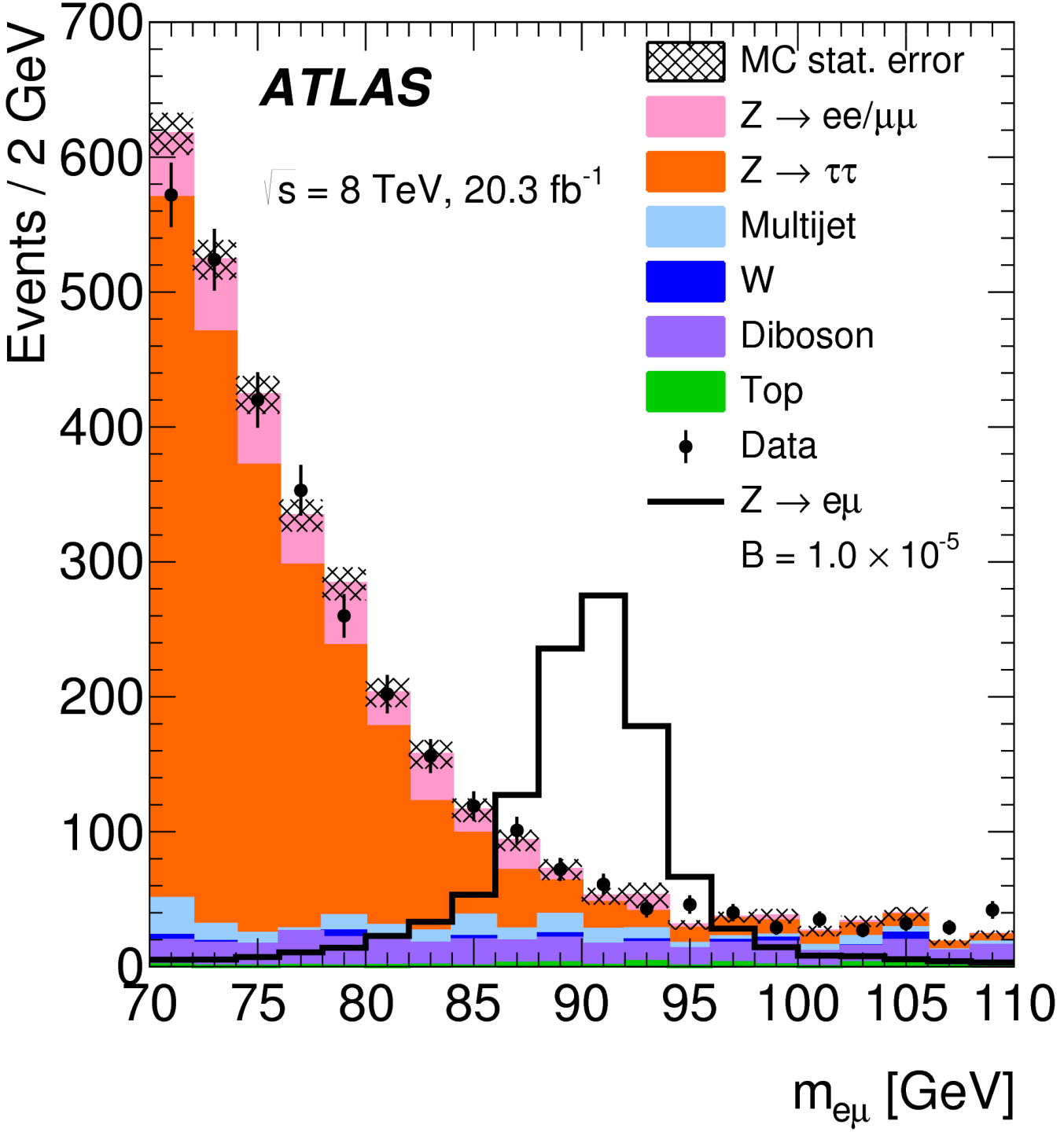
Z’ search with flavour-changing couplings



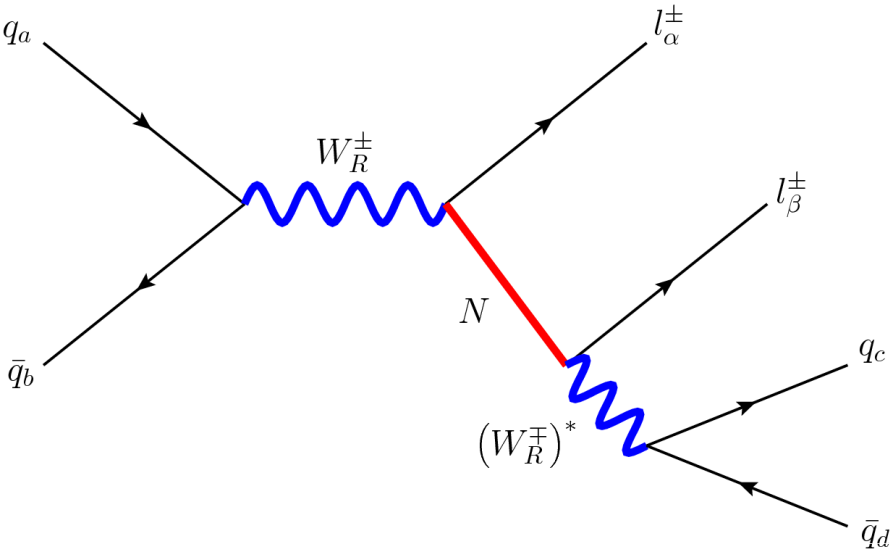


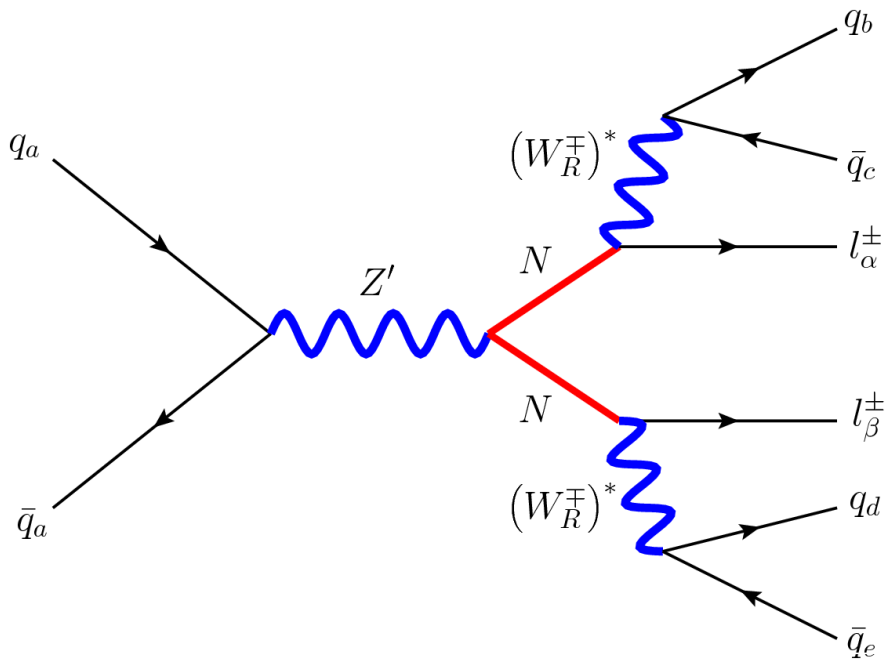
Z → eμ search

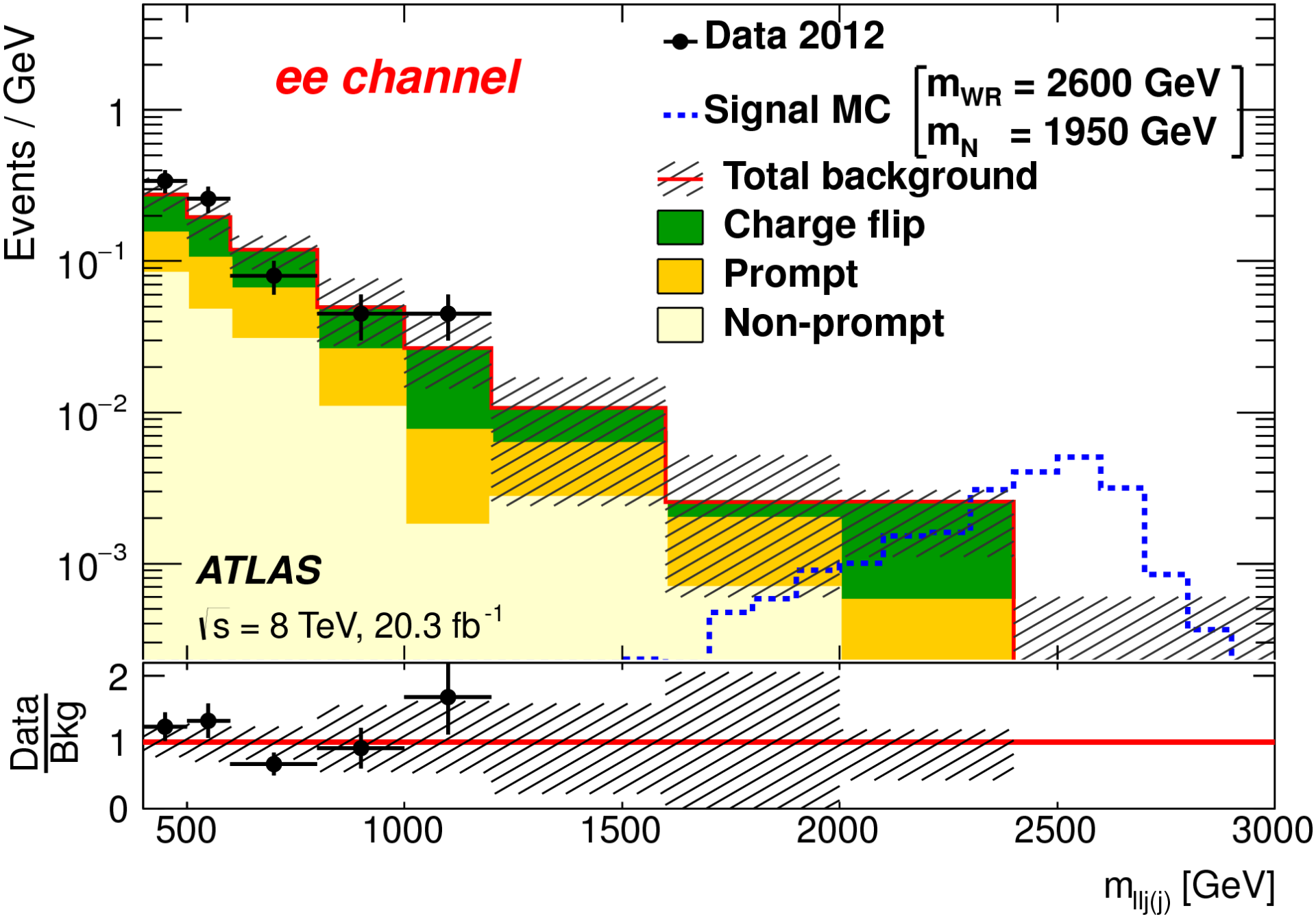
Br < 7.5 x 10^{-7}

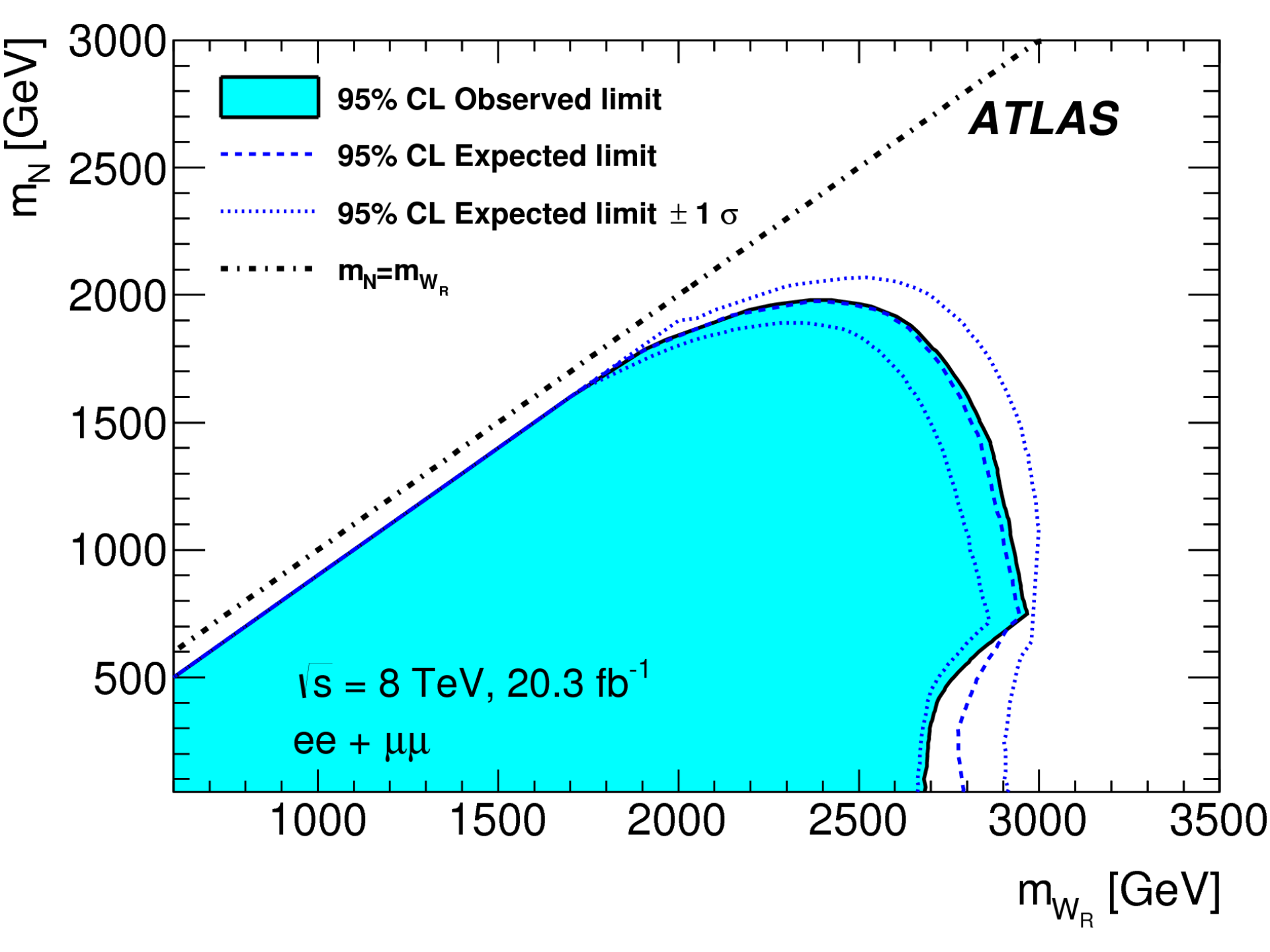


W_R coupling to lepton + right-handed N

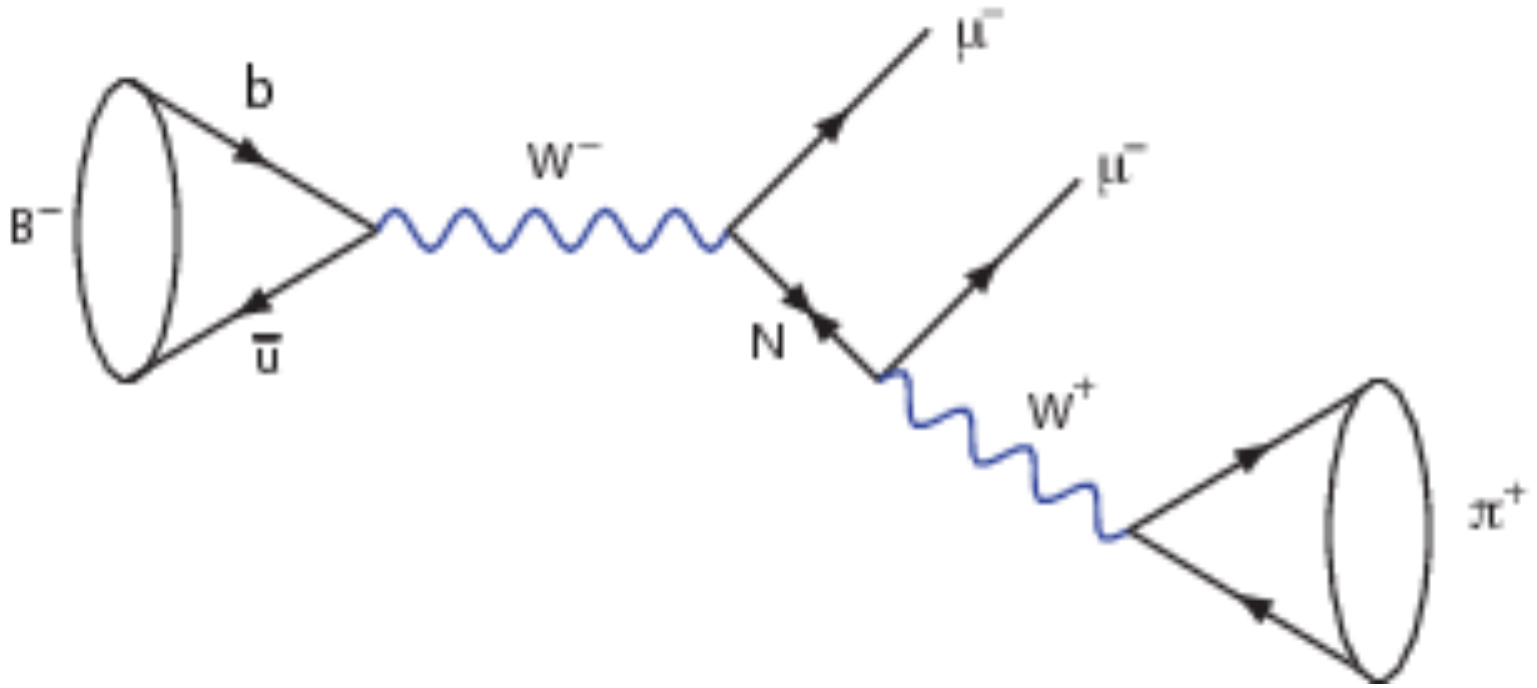




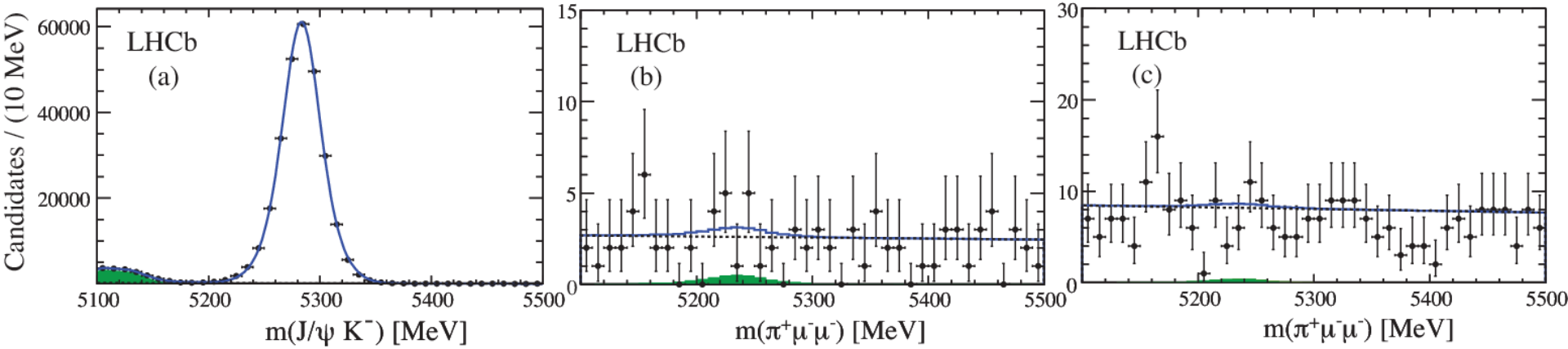

ee channel
Data 2012
Signal MC
m_{WR} = 2600 GeV
m_N = 1950 GeV
Total background
Charge flip
Prompt
Non-prompt
ATLAS
$\sqrt{s}$ = 8 TeV, 20.3 fb^{-1}
Events / GeV
Data / Bkg
m_{lljj} [GeV]


95% CL Observed limit
95% CL Expected limit
95% CL Expected limit ± 1 σ
m_N=m_W_R
ATLAS
√s = 8 TeV, 20.3 fb^-1
ee + μμ
m_N [GeV]
m_W_R [GeV]
3000
2500
2000
1500
1000
500
1000
1500
2000
2500
3000
3500

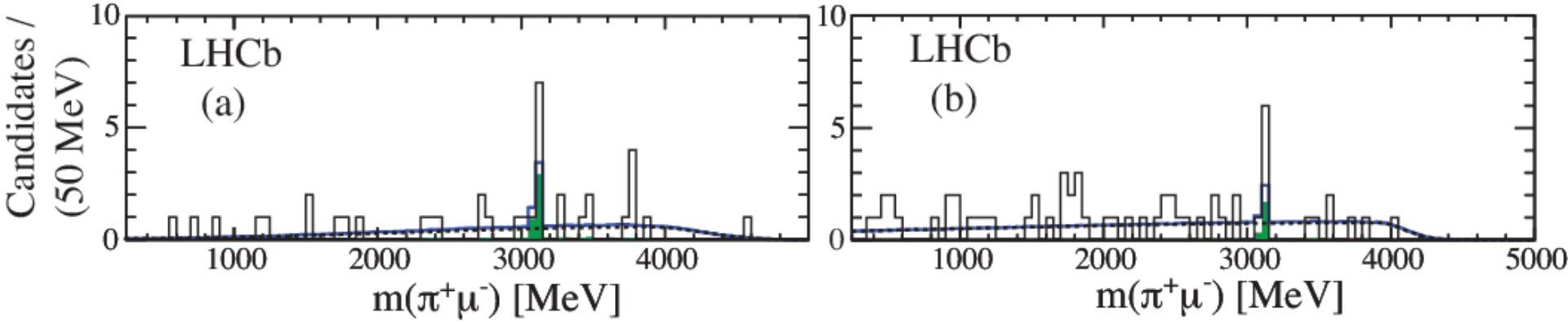
Different phase space: B decays



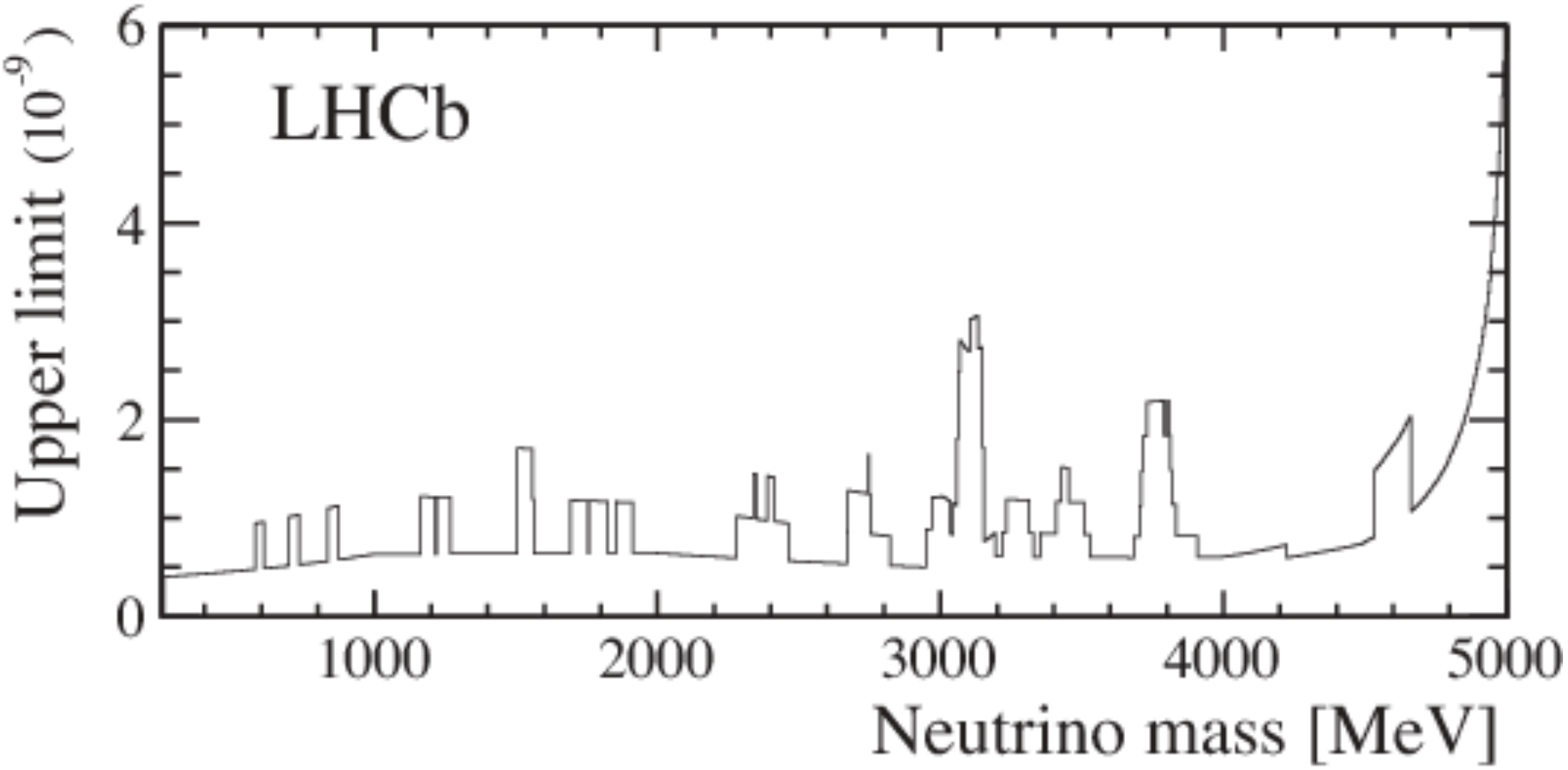
pi-mu-mu mass (should be B)



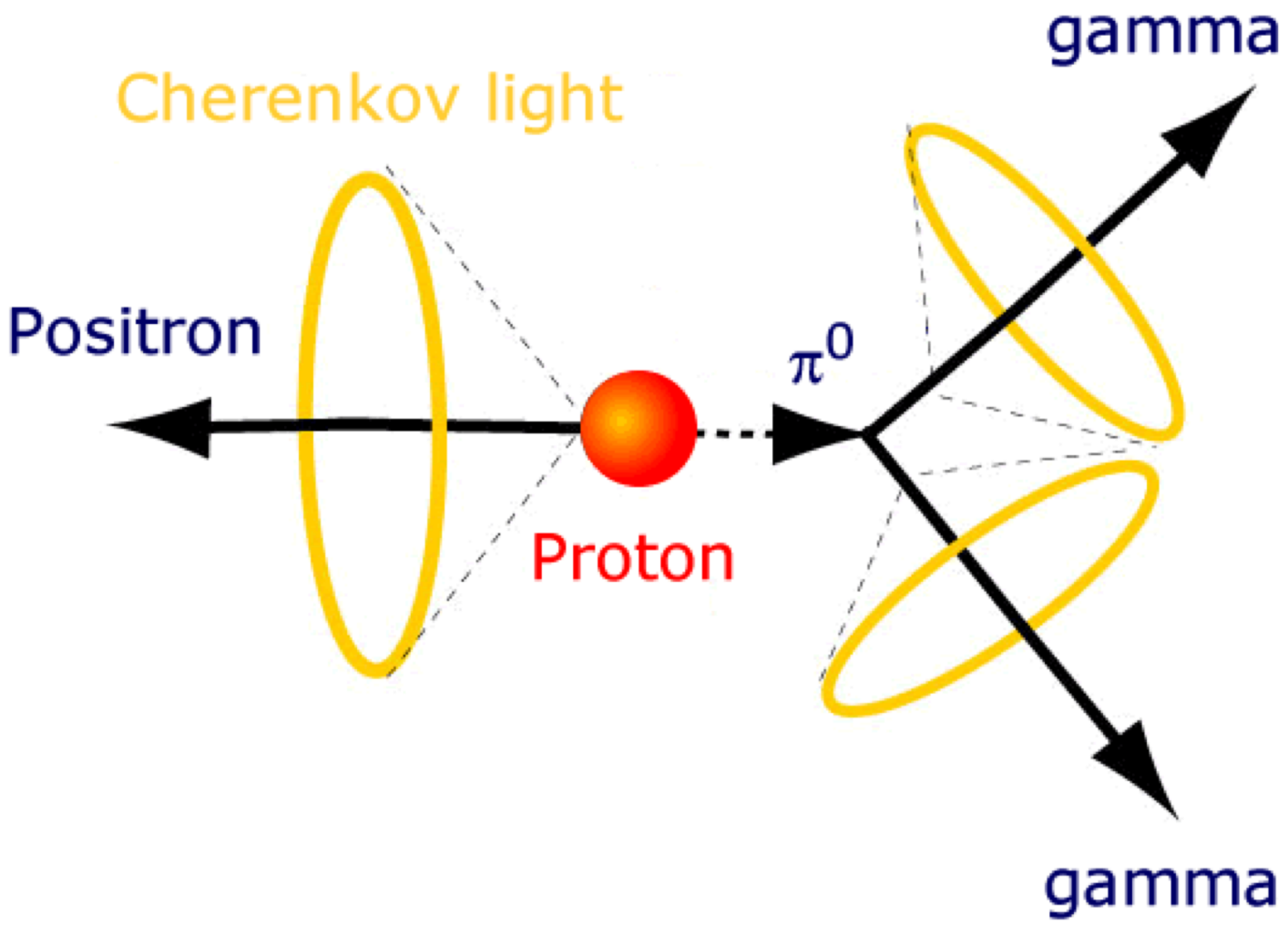
pi-mu mass (measure of N mass)

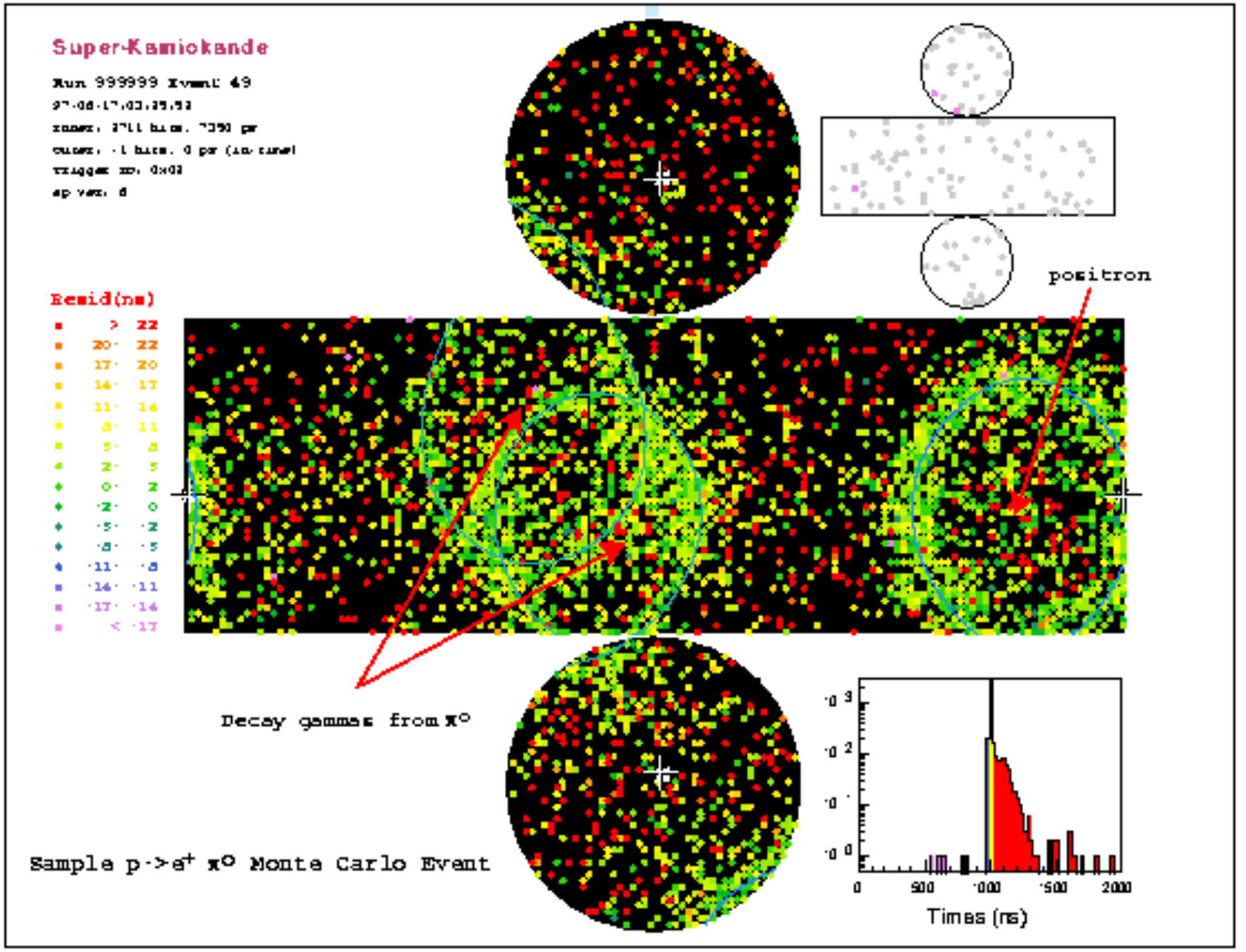


Branching ratio limits

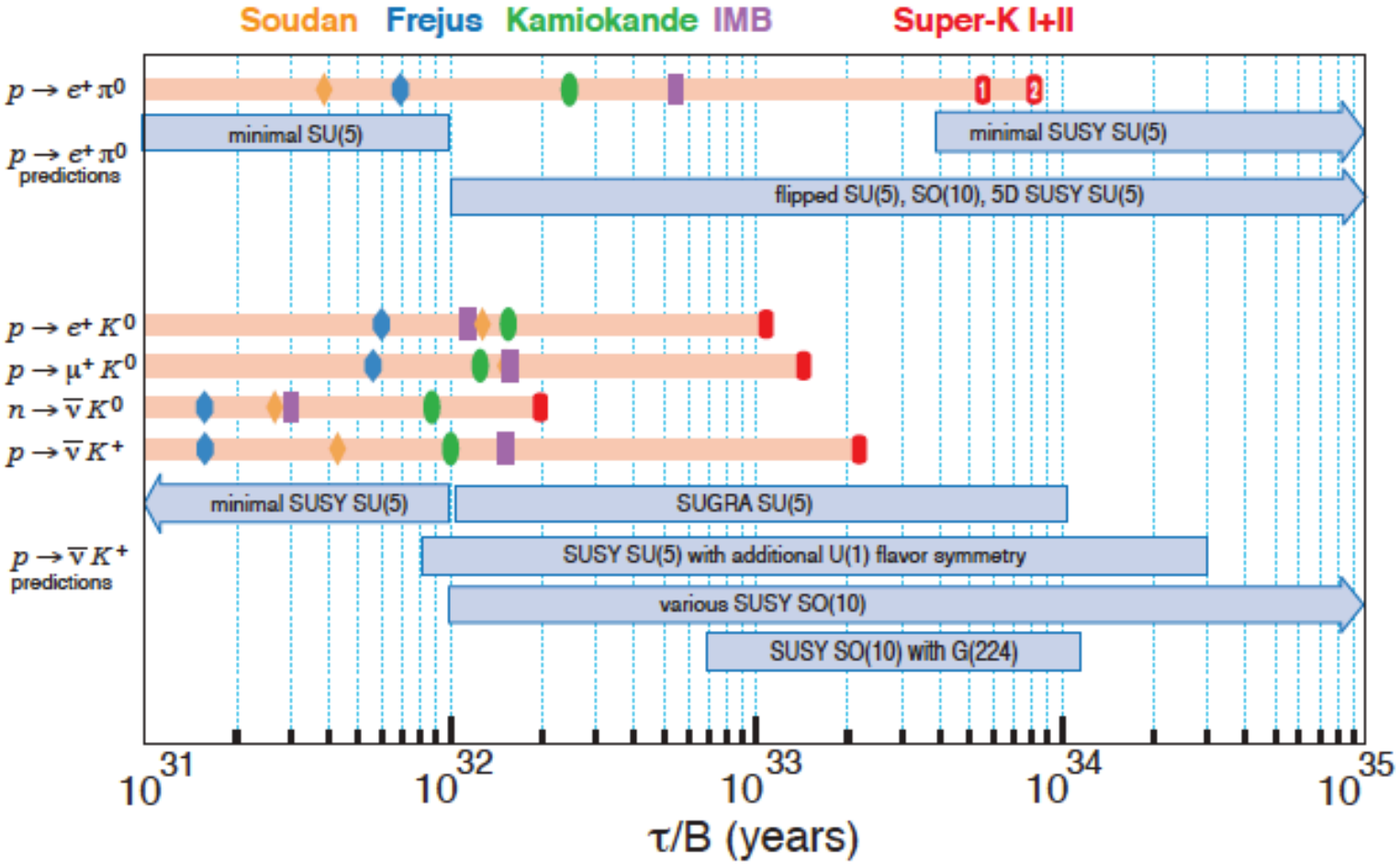


proton decay




Super-Kamiokande
Run 999999 Event: 49
Resid(ns)
positron
Decay gammas from π°
Sample p->e+ π° Monte Carlo Event
Times (ns)

Limits in context with theory



The Next Generation ?