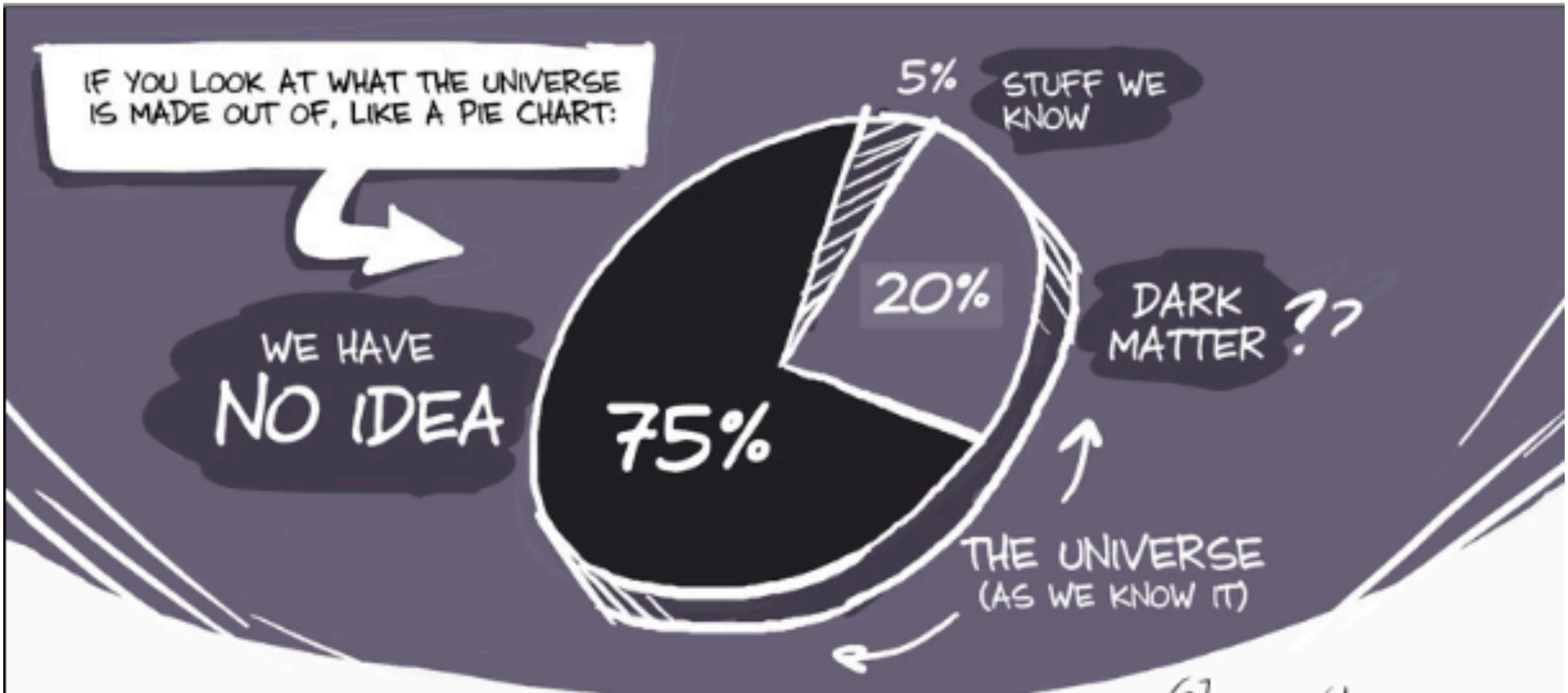
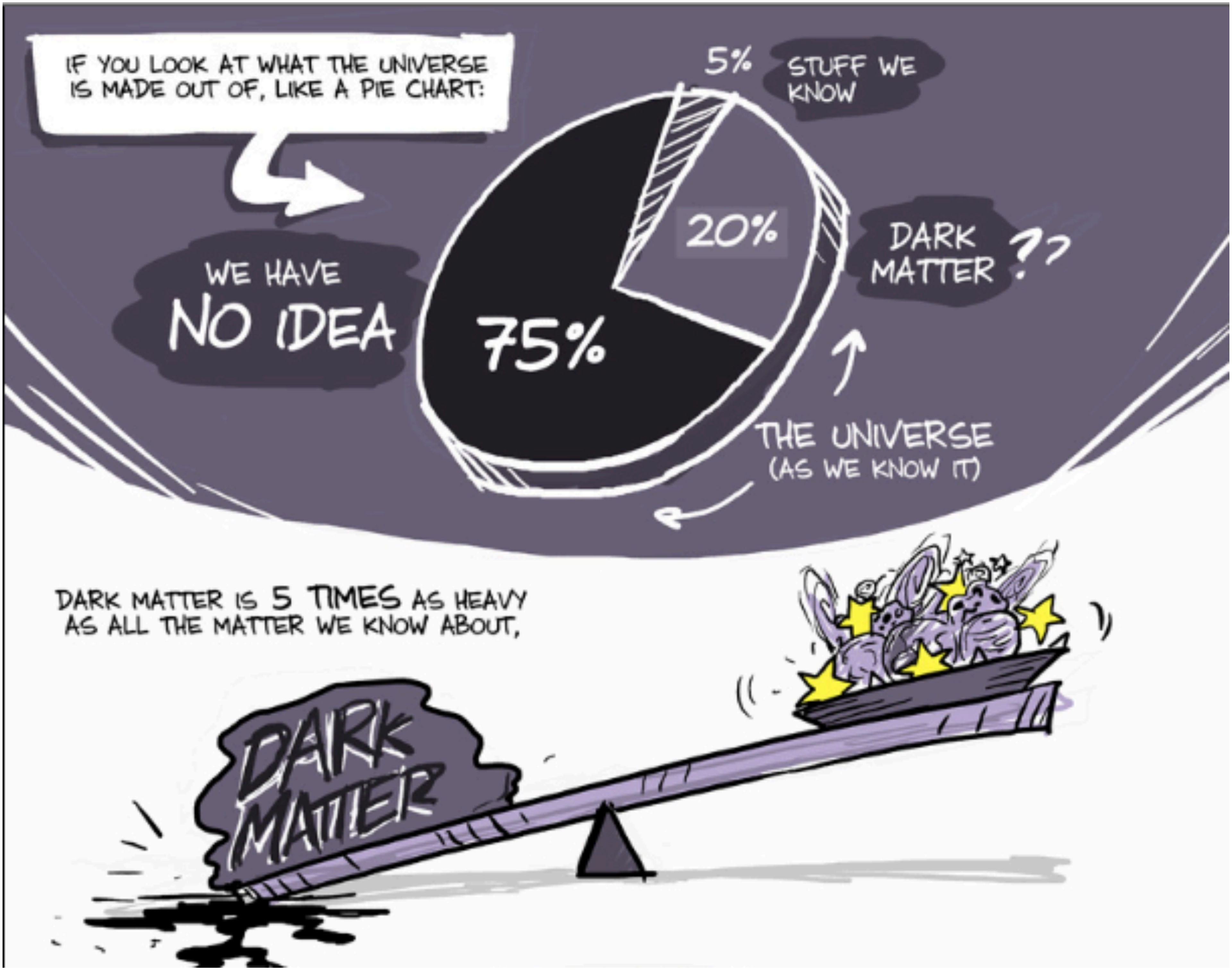
Exploring the Unknown Universe

Daniel Whiteson, UC Irvine


IF YOU LOOK AT WHAT THE UNIVERSE IS MADE OUT OF, LIKE A PIE CHART:
5%
STUFF WE KNOW
20%
DARK MATTER ??
WE HAVE
NO IDEA
75%
THE UNIVERSE
(AS WE KNOW IT)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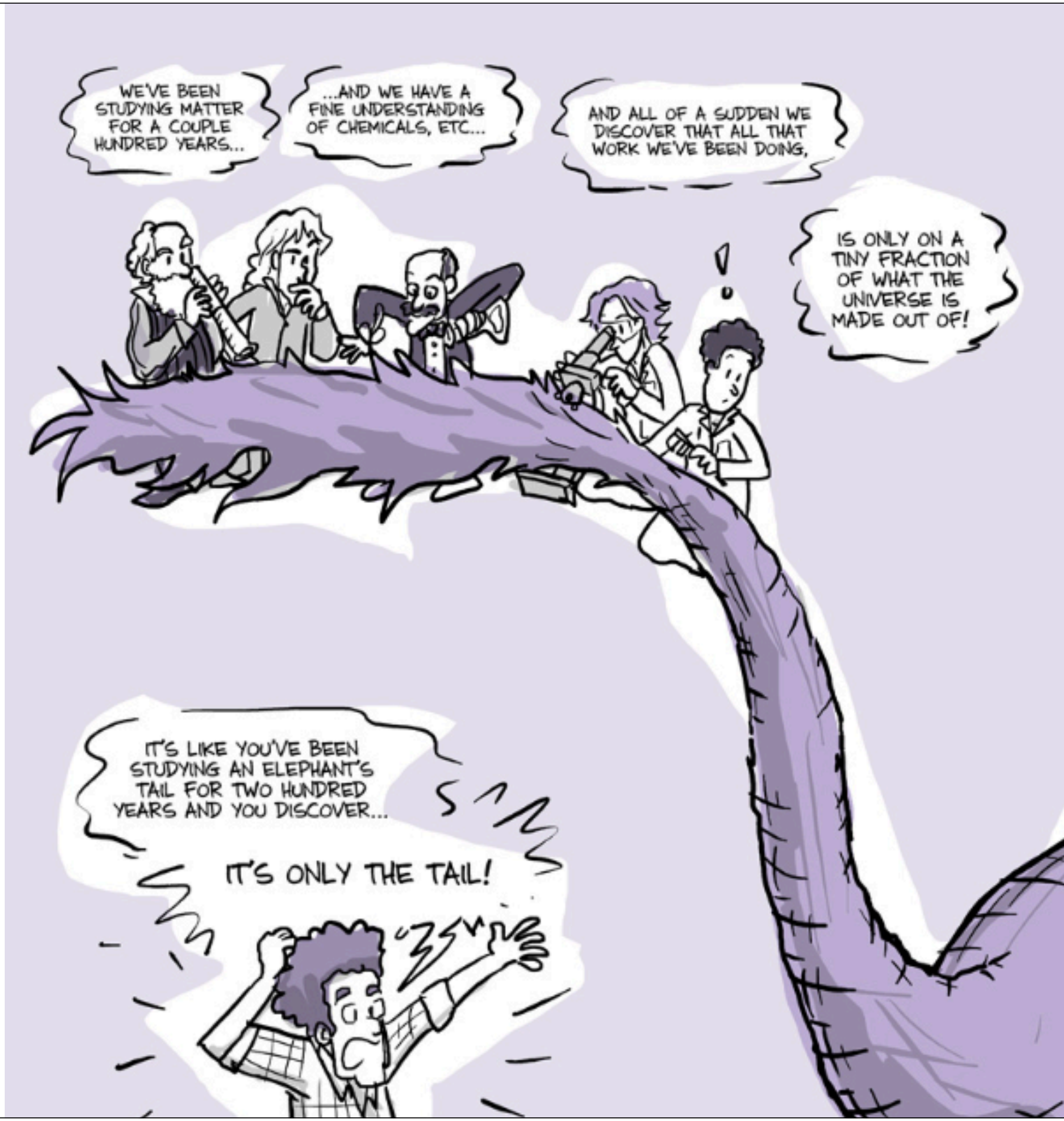
5%
STUFF WE KNOW
20%
DARK MATTER ??
WE HAVE NO IDEA
75%
THE UNIVERSE (AS WE KNOW IT)
DARK MATTER IS 5 TIMES AS HEAVY AS ALL THE MATTER WE KNOW ABOUT,
DARK MATTER


WE'VE BEEN STUDYING MATTER FOR A COUPLE HUNDRED YEARS...
...AND WE HAVE A FINE UNDERSTANDING OF CHEMICALS, ETC...
AND ALL OF A SUDDEN WE DISCOVER THAT ALL THAT WORK WE'VE BEEN DOING,
IS ONLY ON A TINY FRACTION OF WHAT THE UNIVERSE IS MADE OUT OF!
!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!
IT'S LIKE YOU'VE BEEN STUDYING AN ELEPHANT'S TAIL FOR TWO HUNDRED YEARS AND YOU DISCOVER...
IT'S ONLY THE TAIL!

Motivation

The Standard Model

$$
\begin{gathered}
-\frac{1}{2}\partial_\nu g^a_\mu \partial_\nu g^a_\mu - g_s f^{abc}\partial_\mu g^a_\nu g^b_\mu g^c_\nu - \frac{1}{4}g_s^2 f^{abc}f^{ade} g^b_\mu g^c_\nu g^d_\mu g^e_\nu + \\
\frac{1}{2}ig_s^2(\bar{q}^\sigma_i \gamma^\mu q^\sigma_j)g^a_\mu + \bar{G}^a\partial^2 G^a + g_s f^{abc}\partial_\mu \bar{G}^a G^b g^c_\mu - \partial_\nu W^+_\mu \partial_\nu W^-_\mu - \\
M^2 W^+_\mu W^-_\mu - \frac{1}{2}\partial_\nu Z^0_\mu \partial_\nu Z^0_\mu - \frac{1}{2c_w^2}M^2 Z^0_\mu Z^0_\mu - \frac{1}{2}\partial_\mu A_\nu \partial_\mu A_\nu - \frac{1}{2}\partial_\mu H \partial_\mu H - \\
\frac{1}{2}m_h^2 H^2 - \partial_\mu \phi^+ \partial_\mu \phi^- - M^2\phi^+\phi^- - \frac{1}{2}\partial_\mu\phi^0\partial_\mu\phi^0 - \frac{1}{2c_w^2}M\phi^0\phi^0 - \beta_h[\frac{2M^2}{g^2} + \\
\frac{2M}{g}H + \frac{1}{2}(H^2 + \phi^0\phi^0 + 2\phi^+\phi^-)] + \frac{2M^4}{g^2}\alpha_h - igc_w[\partial_\nu Z^0_\mu(W^+_\mu W^-_\nu - \\
W^+_\nu W^-_\mu) - Z^0_\nu(W^+_\mu\partial_\nu W^-_\mu - W^-_\mu\partial_\nu W^+_\mu) + Z^0_\mu(W^+_\nu\partial_\nu W^-_\mu - \\
W^-_\nu\partial_\nu W^+_\mu)] - igs_w[\partial_\nu A_\mu(W^+_\mu W^-_\nu - W^+_\nu W^-_\mu) - A_\nu(W^+_\mu\partial_\nu W^-_\mu - \\
W^-_\mu\partial_\nu W^+_\mu) + A_\mu(W^+_\nu\partial_\nu W^-_\mu - W^-_\nu\partial_\nu W^+_\mu)] - \frac{1}{2}g^2 W^+_\mu W^-_\mu W^+_\nu W^-_\nu + \\
\frac{1}{2}g^2 W^+_\mu W^-_\nu W^+_\mu W^-_\nu + g^2 c_w^2(Z^0_\mu W^+_\mu Z^0_\nu W^-_\nu - Z^0_\mu Z^0_\mu W^+_\nu W^-_\nu) + \\
g^2 s_w^2(A_\mu W^+_\mu A_\nu W^-_\nu - A_\mu A_\mu W^+_\nu W^-_\nu) + g^2 s_w c_w[A_\mu Z^0_\nu(W^+_\mu W^-_\nu - \\
W^+_\nu W^-_\mu) - 2A_\mu Z^0_\mu W^+_\nu W^-_\nu] - g\alpha[H^3 + H\phi^0\phi^0 + 2H\phi^+\phi^-] - \\
\frac{1}{8}g^2\alpha_h[H^4 + (\phi^0)^4 + 4(\phi^+\phi^-)^2 + 4(\phi^0)^2\phi^+\phi^- + 4H^2\phi^+\phi^- + 2(\phi^0)^2H^2] - \\
gMW^+_\mu W^-_\mu H - \frac{1}{2}g\frac{M}{c_w^2}Z^0_\mu Z^0_\mu H - \frac{1}{2}ig[W^+_\mu(\phi^0\partial_\mu\phi^- - \phi^-\partial_\mu\phi^0) - \\
W^-_\mu(\phi^0\partial_\mu\phi^+ - \phi^+\partial_\mu\phi^0)] + \frac{1}{2}g[W^+_\mu(H\partial_\mu\phi^- - \phi^-\partial_\mu H) - W^-_\mu(H\partial_\mu\phi^+ - \\
\phi^+\partial_\mu H)] + \frac{1}{2}g\frac{1}{c_w}(Z^0_\mu(H\partial_\mu\phi^0 - \phi^0\partial_\mu H) - ig\frac{s_w^2}{c_w}MZ^0_\mu(W^+_\mu\phi^- - W^-_\mu\phi^+) + \\
igs_w MA_\mu(W^+_\mu\phi^- - W^-_\mu\phi^+) - ig\frac{1-2c_w^2}{2c_w}Z^0_\mu(\phi^+\partial_\mu\phi^- - \phi^-\partial_\mu\phi^+) + \\
igs_w A_\mu(\phi^+\partial_\mu\phi^- - \phi^-\partial_\mu\phi^+) - \frac{1}{4}g^2 W^+_\mu W^-_\mu[H^2 + (\phi^0)^2 + 2\phi^+\phi^-] - \\
\frac{1}{4}g^2\frac{1}{c_w^2}Z^0_\mu Z^0_\mu[H^2 + (\phi^0)^2 + 2(2s_w^2 - 1)^2\phi^+\phi^-] - \frac{1}{2}g^2\frac{s_w^2}{c_w}Z^0_\mu\phi^0(W^+_\mu\phi^- + \\
W^-_\mu\phi^+) - \frac{1}{2}ig^2\frac{s_w^2}{c_w}Z^0_\mu H(W^+_\mu\phi^- - W^-_\mu\phi^+) + \frac{1}{2}g^2 s_w A_\mu\phi^0(W^+_\mu\phi^- + \\
W^-_\mu\phi^+) + \frac{1}{2}ig^2 s_w A_\mu H(W^+_\mu\phi^- - W^-_\mu\phi^+) - g^2\frac{s_w}{c_w}(2c_w^2 - 1)Z^0_\mu A_\mu\phi^+\phi^- - \\
g^1 s_w^2 A_\mu A_\mu\phi^+\phi^- - \bar{e}^\lambda(\gamma\partial + m_e^\lambda)e^\lambda - \bar{\nu}^\lambda\gamma\partial\nu^\lambda - \bar{u}^\lambda_j(\gamma\partial + m_u^\lambda)u^\lambda_j - \\
\bar{d}^\lambda_j(\gamma\partial + m_d^\lambda)d^\lambda_j + igs_w A_\mu[-(\bar{e}^\lambda\gamma^\mu e^\lambda) + \frac{2}{3}(\bar{u}^\lambda_j\gamma^\mu u^\lambda_j) - \frac{1}{3}(\bar{d}^\lambda_j\gamma^\mu d^\lambda_j)] + \\
\frac{ig}{4c_w}Z^0_\mu[(\bar{\nu}^\lambda\gamma^\mu(1+\gamma^5)\nu^\lambda) + (\bar{e}^\lambda\gamma^\mu(4s_w^2 - 1 - \gamma^5)e^\lambda) + (\bar{u}^\lambda_j\gamma^\mu(\frac{4}{3}s_w^2 - \\
1 - \gamma^5)u^\lambda_j) + (\bar{d}^\lambda_j\gamma^\mu(1 - \frac{8}{3}s_w^2 - \gamma^5)d^\lambda_j)] + \frac{ig}{2\sqrt{2}}W^+_\mu[(\bar{\nu}^\lambda\gamma^\mu(1+\gamma^5)e^\lambda) + \\
(\bar{u}^\lambda_j\gamma^\mu(1+\gamma^5)C_{\lambda\kappa}d^\kappa_j)] + \frac{ig}{2\sqrt{2}}W^-_\mu[(\bar{e}^\lambda\gamma^\mu(1+\gamma^5)\nu^\lambda) + (\bar{d}^\kappa_j C^\dagger_{\lambda\kappa}\gamma^\mu(1 + \\
\gamma^5)u^\lambda_j)] + \frac{ig}{2\sqrt{2}}\frac{m_e^\lambda}{M}[-\phi^+(\bar{\nu}^\lambda(1-\gamma^5)e^\lambda) + \phi^-(\bar{e}^\lambda(1+\gamma^5)\nu^\lambda)] - \\
\frac{g}{2}\frac{m_e^\lambda}{M}[H(\bar{e}^\lambda e^\lambda) + i\phi^0(\bar{e}^\lambda\gamma^5 e^\lambda)] + \frac{ig}{2M\sqrt{2}}\phi^+[-m_d^\kappa(\bar{u}^\lambda_j C_{\lambda\kappa}(1-\gamma^5)d^\kappa_j) + \\
m_u^\lambda(\bar{u}^\lambda_j C_{\lambda\kappa}(1+\gamma^5)d^\kappa_j] + \frac{ig}{2M\sqrt{2}}\phi^-[m_d^\lambda(\bar{d}^\lambda_j C^\dagger_{\lambda\kappa}(1+\gamma^5)u^\kappa_j) - m_u^\kappa(\bar{d}^\lambda_j C^\dagger_{\lambda\kappa}(1 - \\
\gamma^5)u^\kappa_j] - \frac{g}{2}\frac{m_u^\lambda}{M}H(\bar{u}^\lambda_j u^\lambda_j) - \frac{g}{2}\frac{m_d^\lambda}{M}H(\bar{d}^\lambda_j d^\lambda_j) + \frac{ig}{2}\frac{m_u^\lambda}{M}\phi^0(\bar{u}^\lambda_j\gamma^5 u^\lambda_j) - \\
\frac{ig}{2}\frac{m_d^\lambda}{M}\phi^0(\bar{d}^\lambda_j\gamma^5 d^\lambda_j) + \bar{X}^+(\partial^2 - M^2)X^+ + \bar{X}^-(\partial^2 - M^2)X^- + \bar{X}^0(\partial^2 - \\
\frac{M^2}{c_w^2})X^0 + \bar{Y}\partial^2 Y + igc_w W^+_\mu(\partial_\mu\bar{X}^0 X^- - \partial_\mu\bar{X}^+ X^0) + igs_w W^+_\mu(\partial_\mu\bar{Y}X^- - \\
\partial_\mu\bar{X}^+ Y) + igc_w W^-_\mu(\partial_\mu\bar{X}^- X^0 - \partial_\mu\bar{X}^0 X^+) + igs_w W^-_\mu(\partial_\mu\bar{X}^- Y - \\
\partial_\mu\bar{Y}X^+) + igc_w Z^0_\mu(\partial_\mu\bar{X}^+ X^+ - \partial_\mu\bar{X}^- X^-) + igs_w A_\mu(\partial_\mu\bar{X}^+ X^+ - \\
\partial_\mu\bar{X}^- X^-) - \frac{1}{2}gM[\bar{X}^+ X^+ H + \bar{X}^- X^- H + \frac{1}{c_w^2}\bar{X}^0 X^0 H] + \\
\frac{1-2c_w^2}{2c_w}igM[\bar{X}^+ X^0\phi^+ - \bar{X}^- X^0\phi^-] + \frac{1}{2c_w}igM[\bar{X}^0 X^-\phi^+ - \bar{X}^0 X^+\phi^-] + \\
igMs_w[\bar{X}^0 X^-\phi^+ - \bar{X}^0 X^+\phi^-] + \frac{1}{2}igM[\bar{X}^+ X^+\phi^0 - \bar{X}^- X^-\phi^0]
\end{gathered}
$$

Can this be right?

Outline

I. Motivation
II. Strategy
III. Results

Searching for new physics

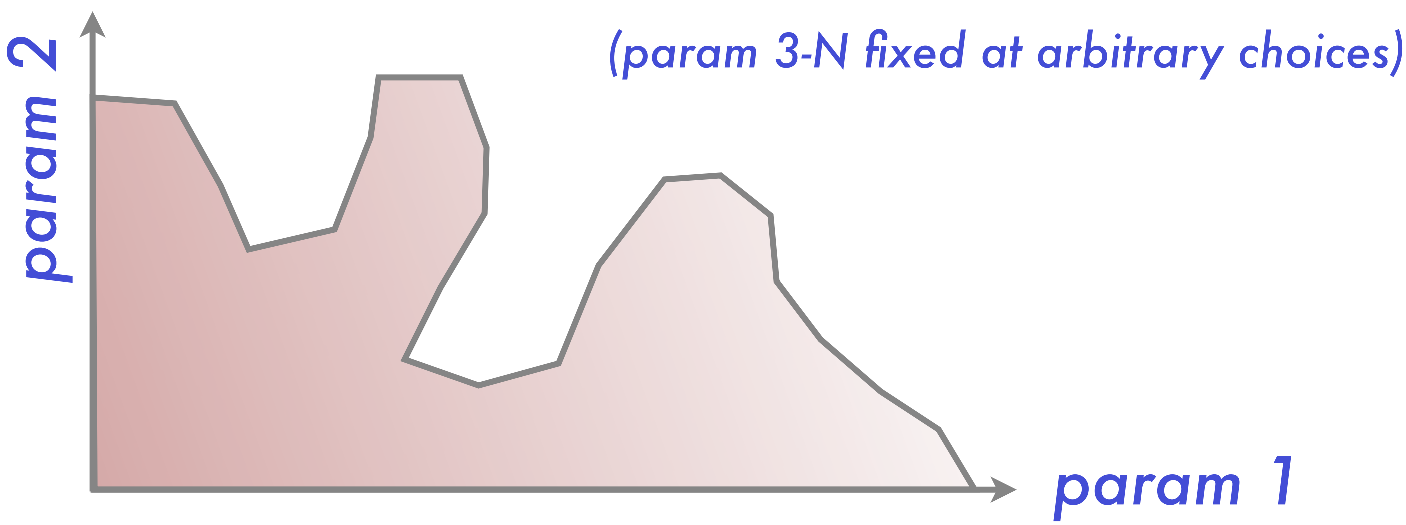
Our goals:

- Maximize possibility for discovery
- Learn something no matter what we see

Traditional approach

Bet on a specific full theory

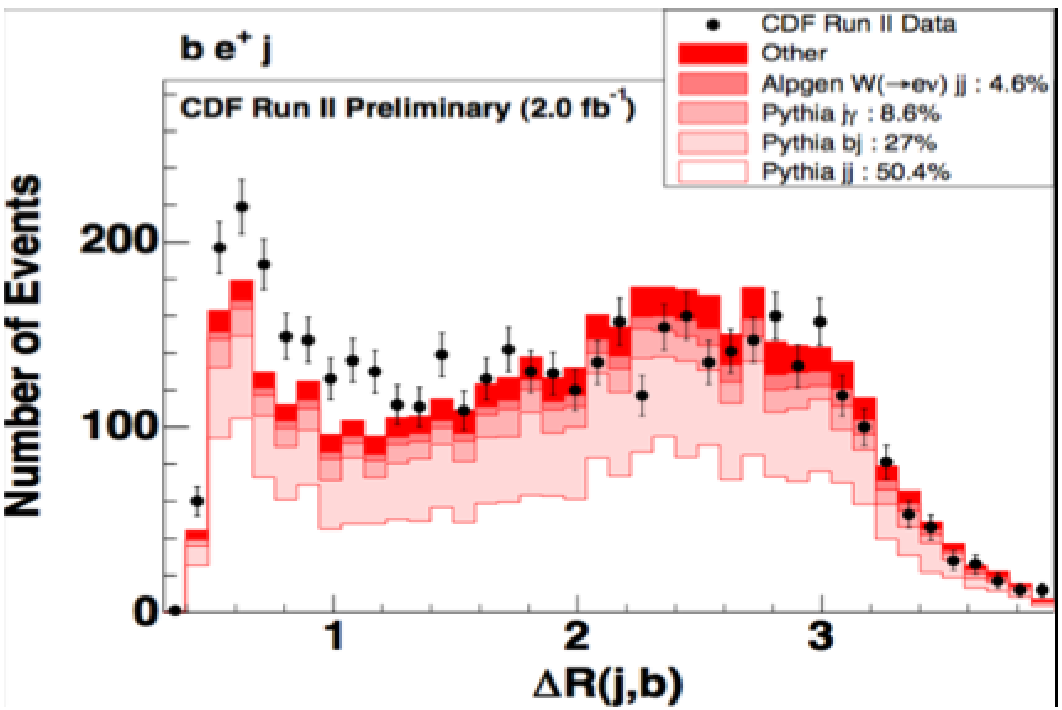
Optimize analysis to squeeze out maximal sensitivity to new physics.



Model independent search

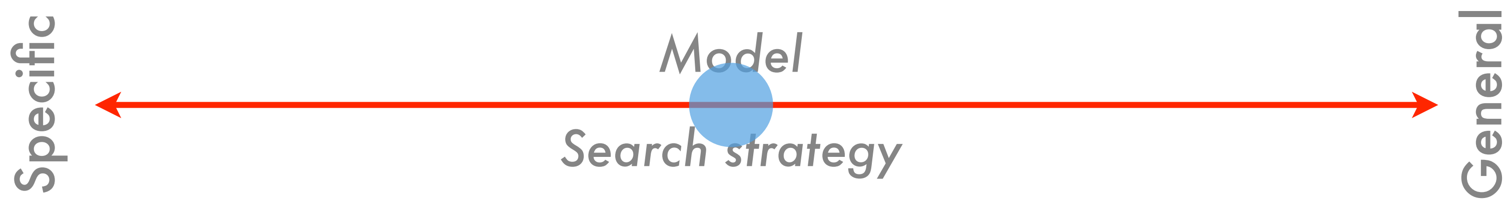
<u>Discard the model</u>

compare data to standard model



"Never listen to theorists.
Just go look for it"
–Aaron Pierce, Theorist

Compromise



Admit the need for a model

New signal requires a coherent physical explanation,
even trivial or effective

Generalize your model

Focus on the general experimental sensitivity

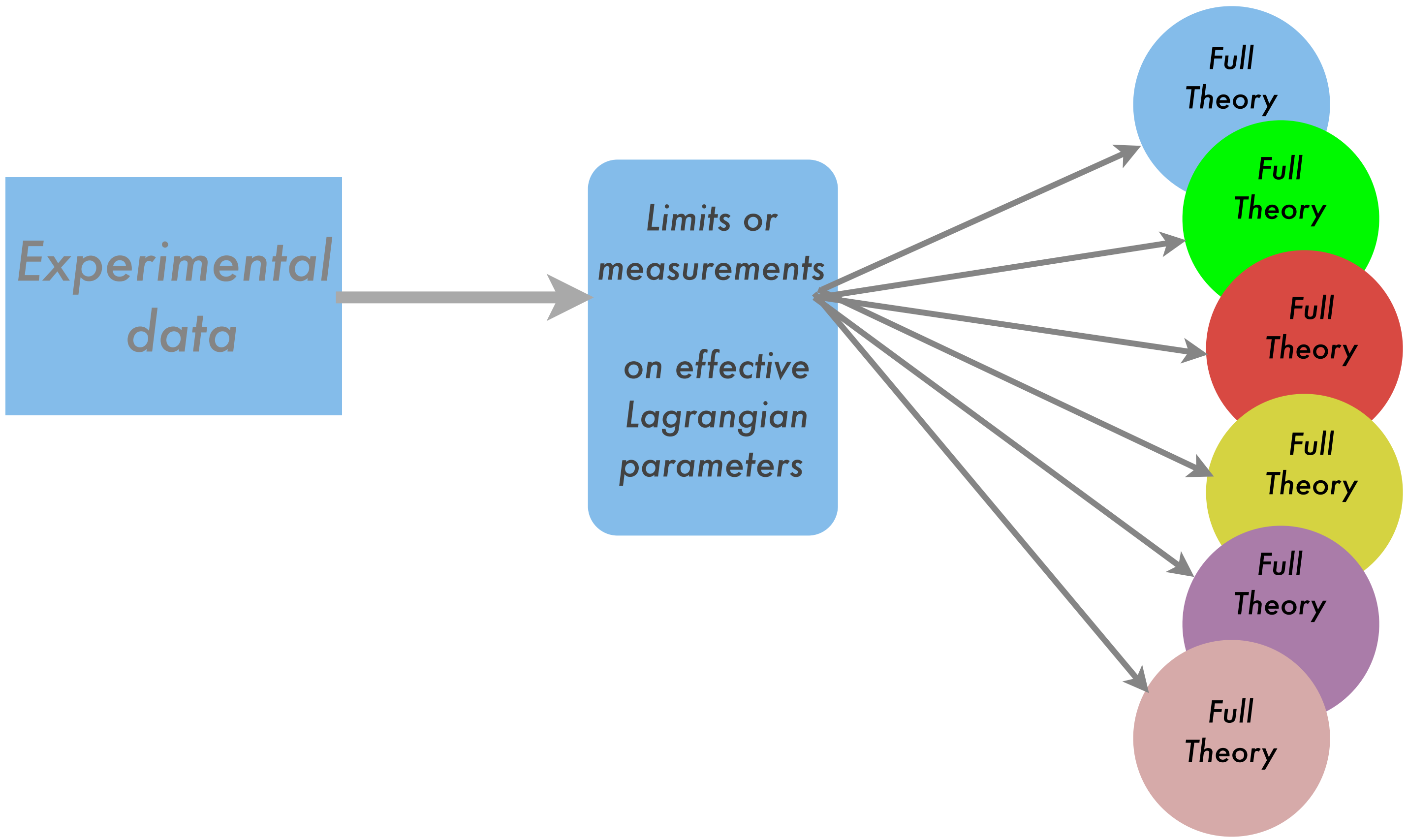
Construct simple models that describe classes of new physics

Examples

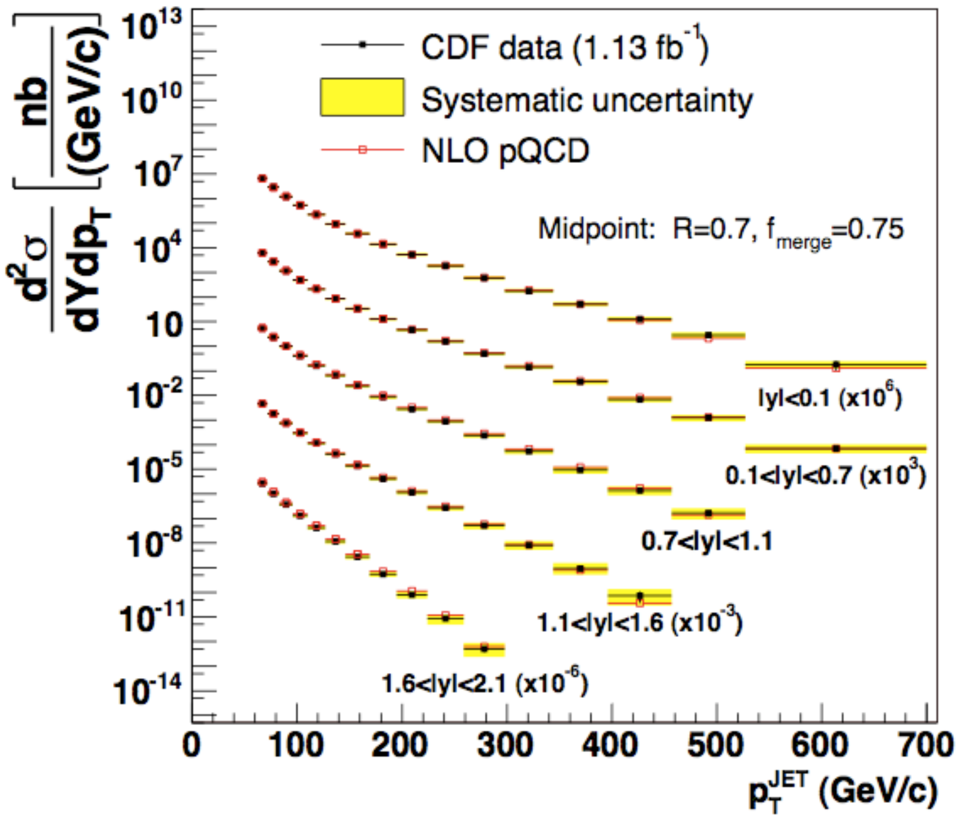
Simple SM extensions: fourth generation, Z′, resonances (X->tt) etc

Effective Lagrangian

A natural, compact language for communication between theory and experiment.



A Theorist's dream?



Unfolded cross-sections

Deconvolution to remove detector effects

Publish measured differential cross-sections

Theorists don't need to know/have detector description

This is hard!

Outline

I. Motivation
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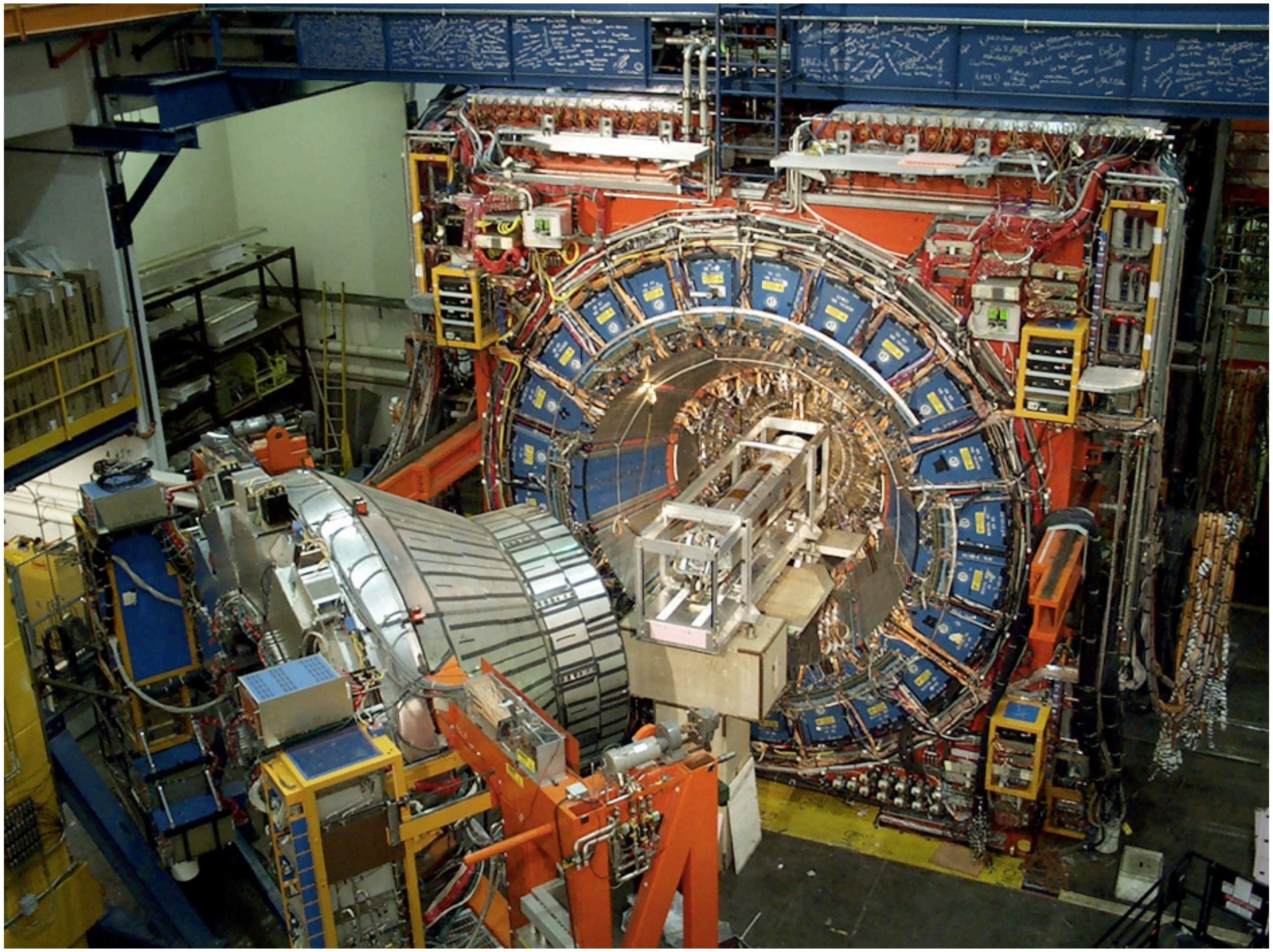
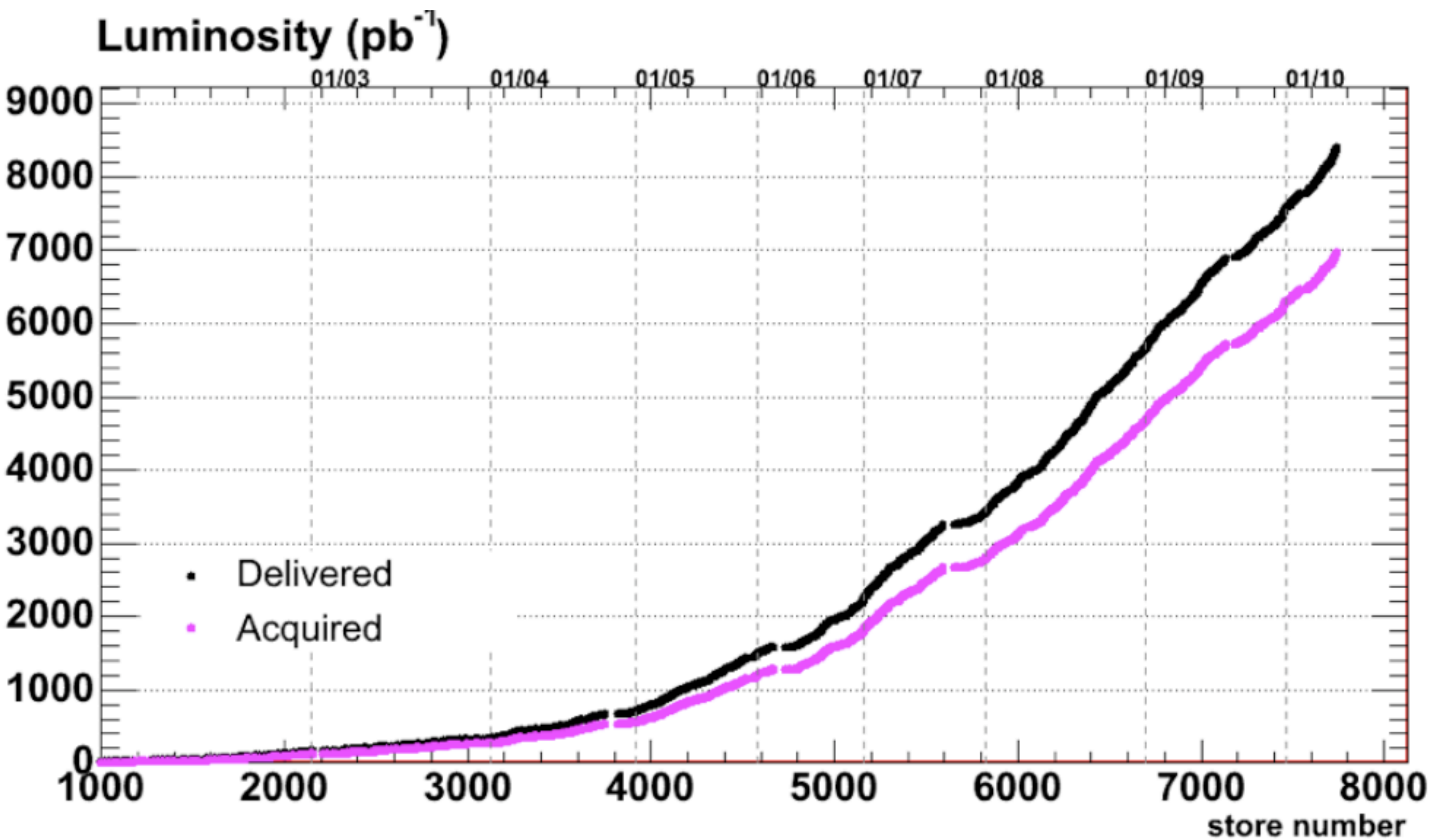
   a. *Heavy resonances (Z′)*
   b. *Heavy quarks (b′, t′)*
   c. *Simplified SUSY*

CDF



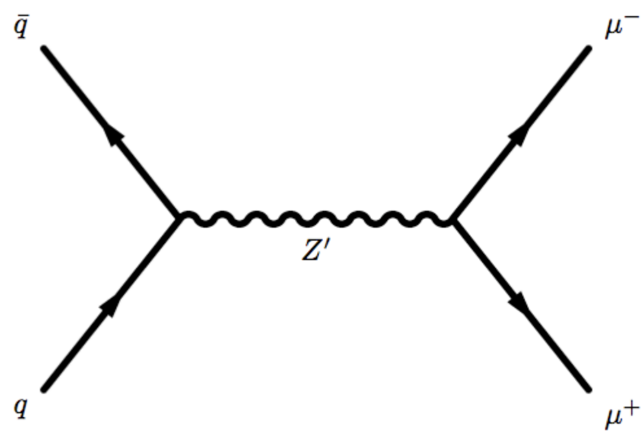
Dataset


Luminosity (pb^{-1})
01/03
01/04
01/05
01/06
01/07
01/08
01/09
01/10
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Delivered
Acquired
1000
2000
3000
4000
5000
6000
7000
8000
store number

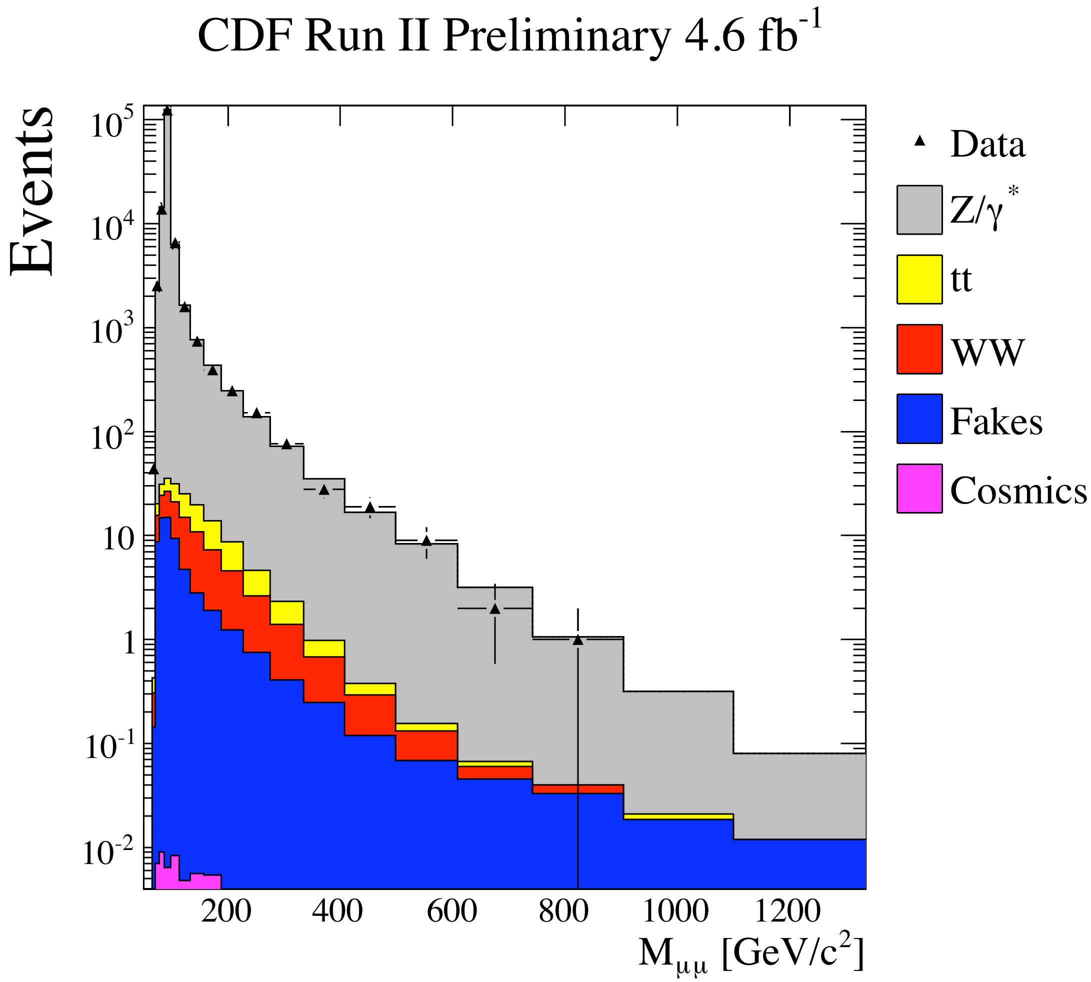
High mass resonances

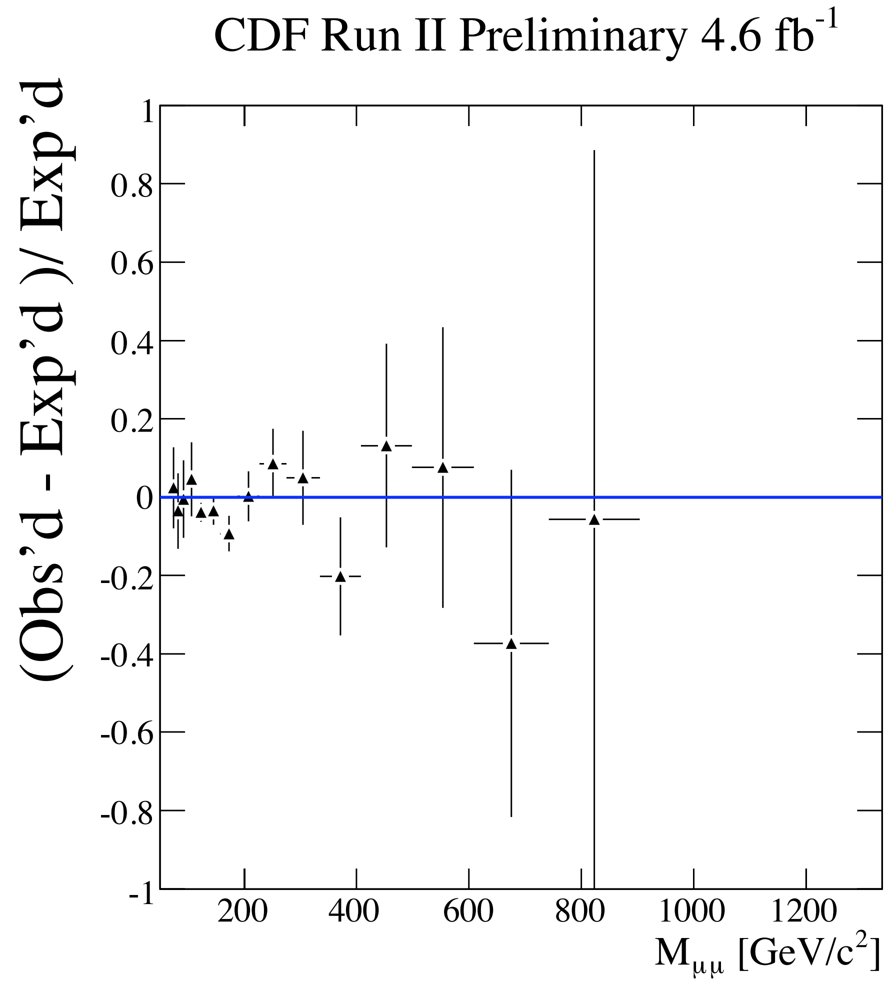
UCI Undergrad
Eddie Quinlan

Z′ to di-muons



High mass dimuon res.



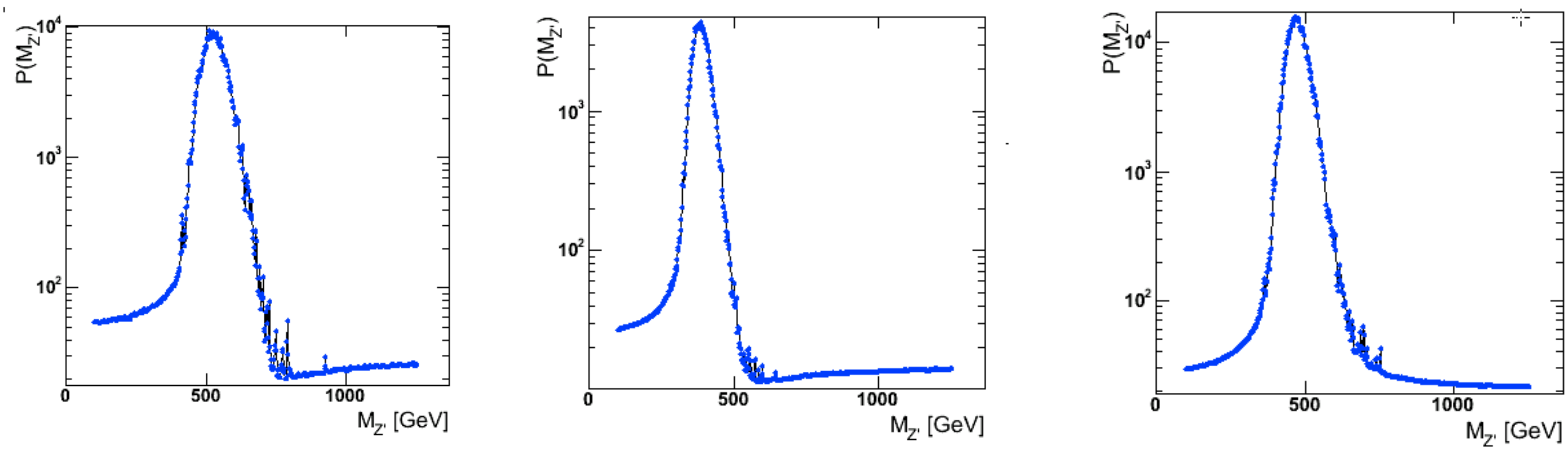


PRL 2011, to appear

Z′ to muons

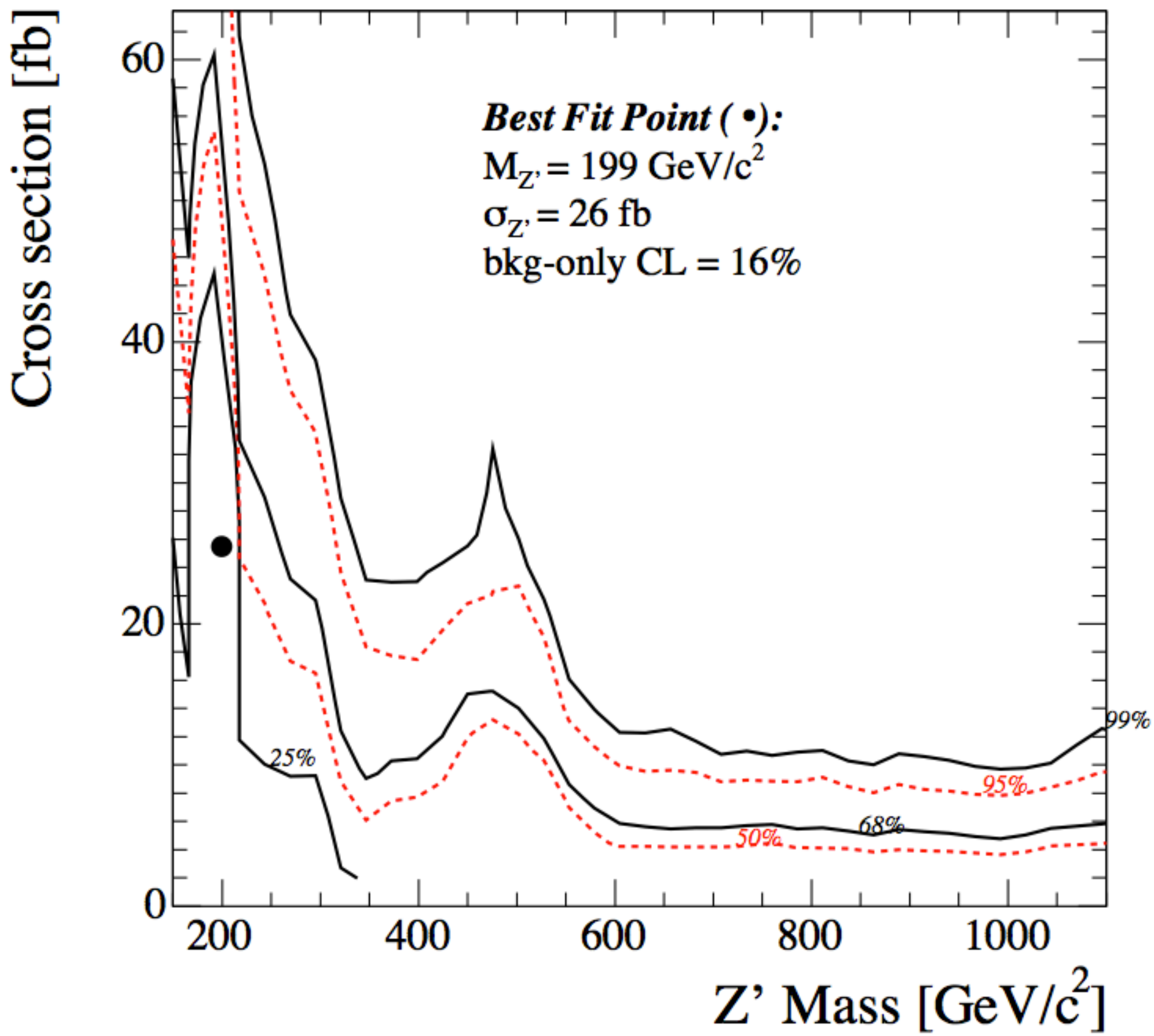
$$P_{Z'}(x_i|M_{Z'}) = \int dq_1 dq_2 |\mathcal{M}_{Z'}(M_{Z'})|^2$$

$$\times f_{PDF}(x_p) f_{PDF}(x_{\bar{p}}) T(p_1, q_1) T(p_2, q_2) P_{PT}(q_1 + q_2, N_{jets})$$



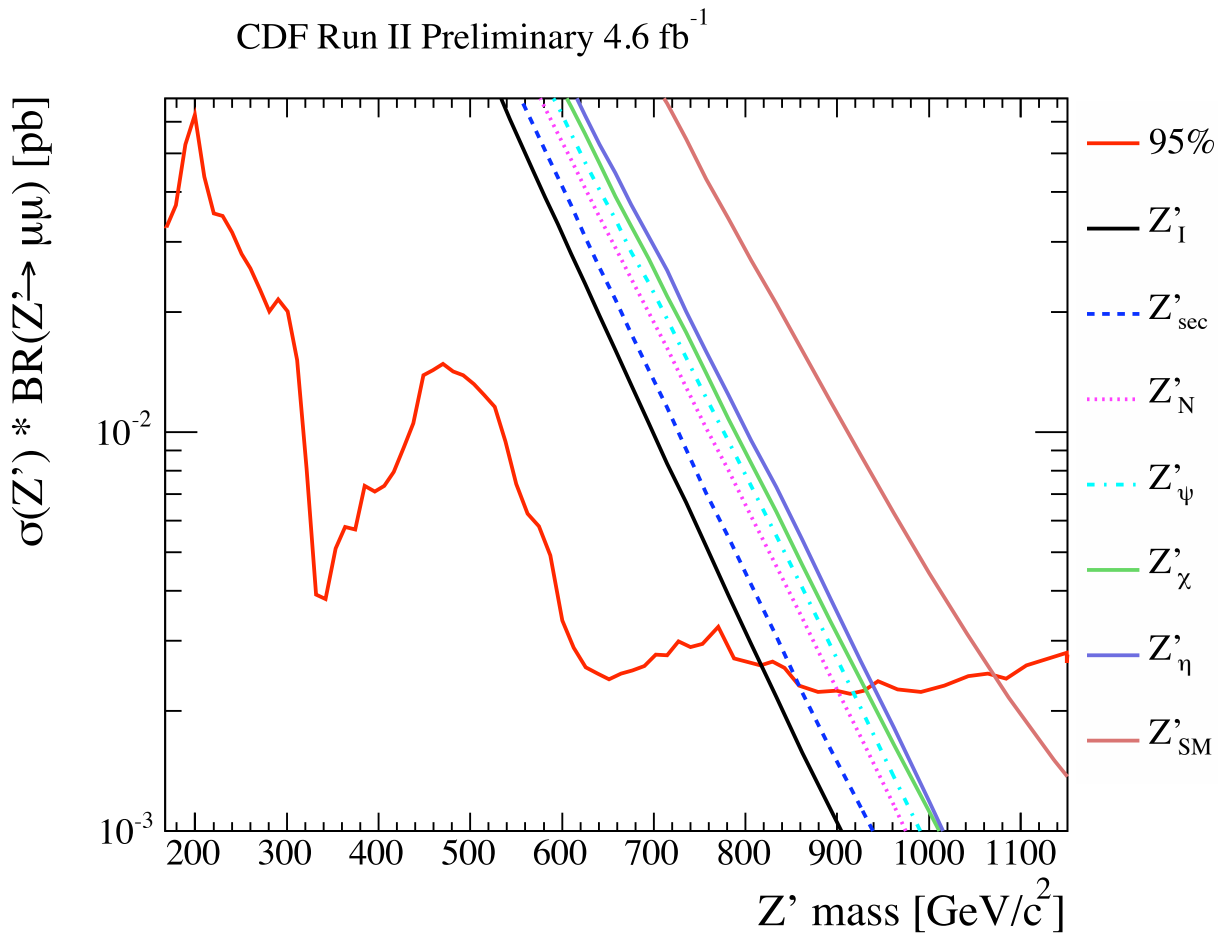
PRL 2011, to appear

Z' to muons



PRL 2011, to appear

Z' to muons

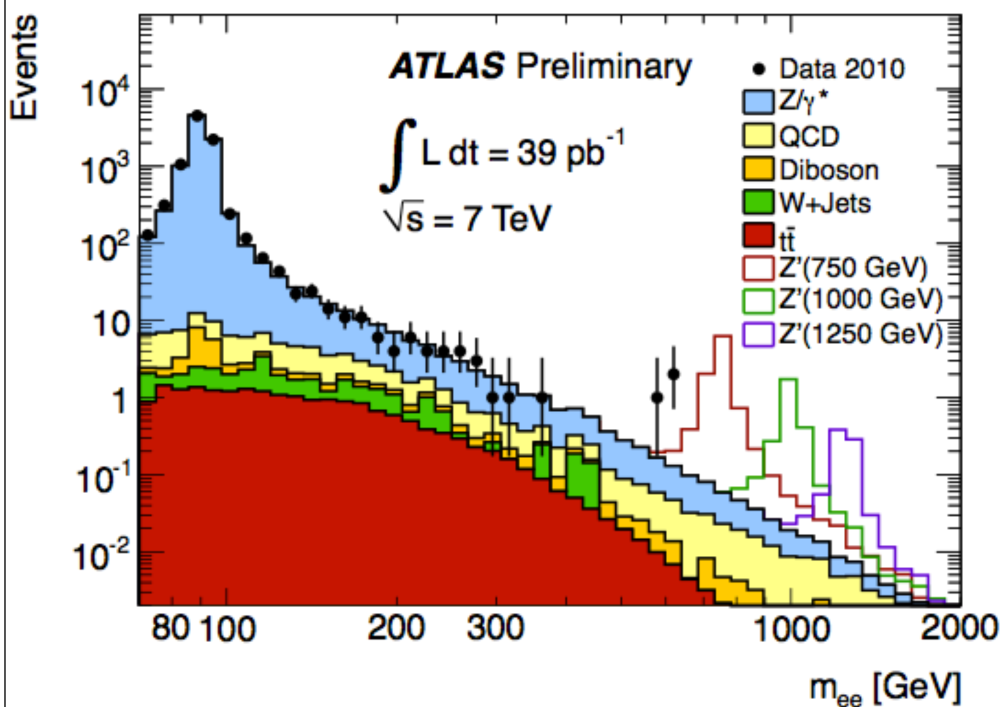


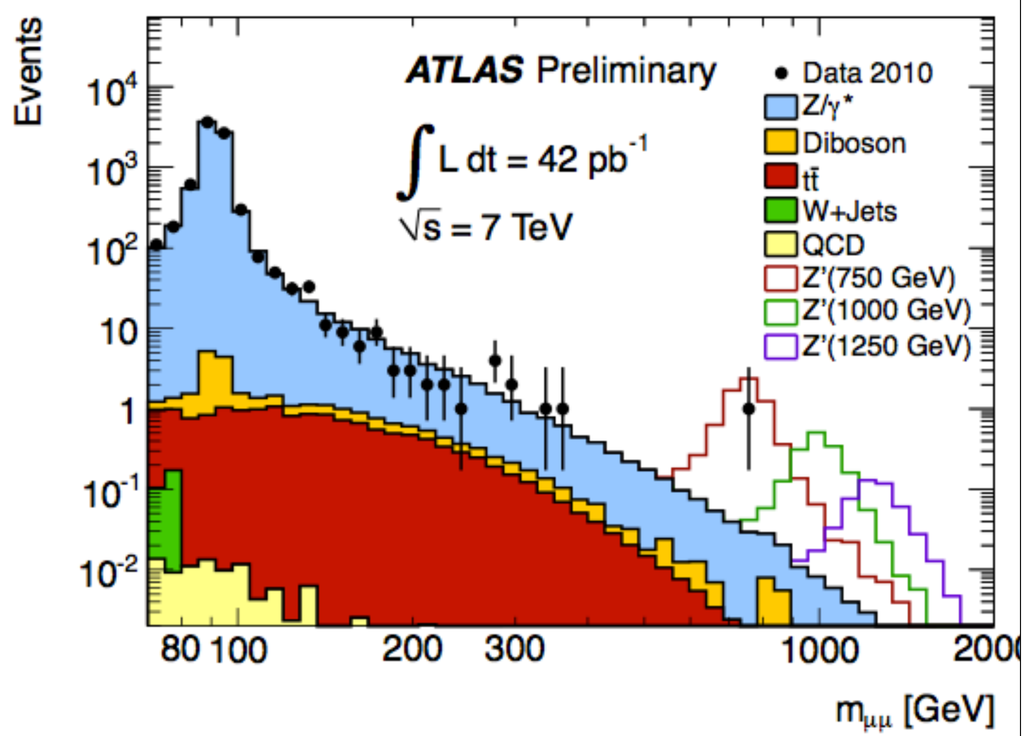
Model	Mass Limit (GeV/c^2)
Z'_I	817
Z'_{sec}	858
Z'_N	900
Z'_ψ	917
Z'_χ	930
Z'_η	938
Z'_{SM}	1071

PRL 2011, to appear

ATLAS Z'

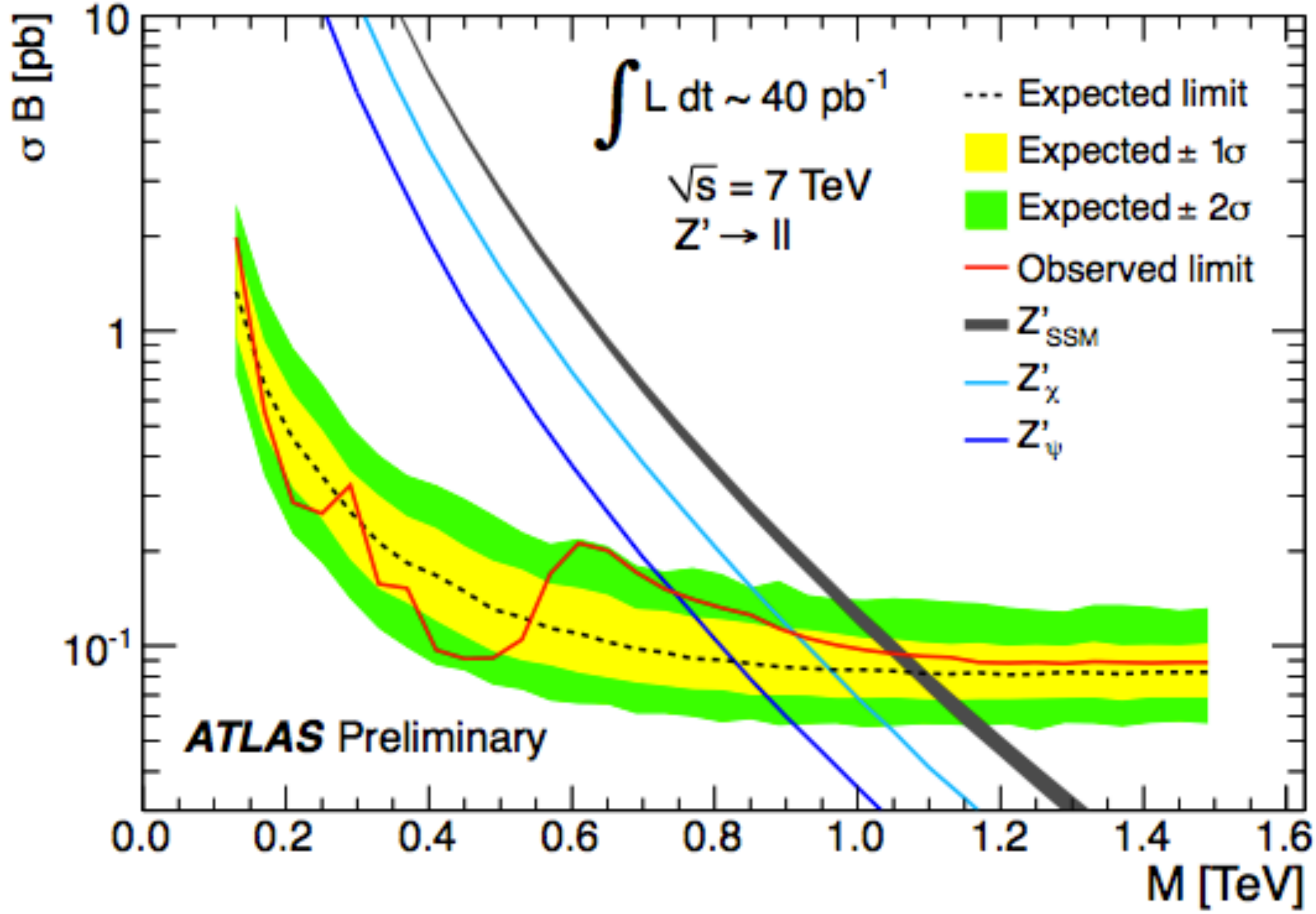
Penn
+other groups





Limits

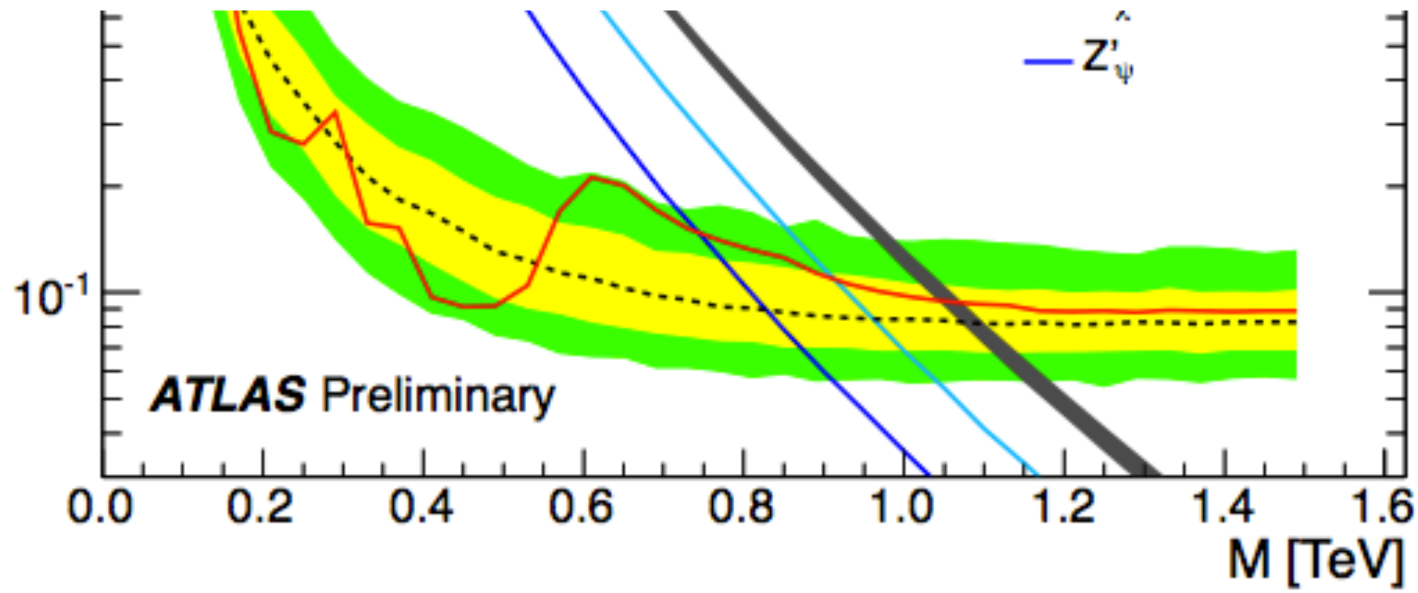
Penn
+other groups



Limits

Penn
+other groups

	Observed limit		Expected limit	
	mass [TeV]	σB [pb]	mass [TeV]	σB [pb]
$Z'_{\mathrm{SSM}} \rightarrow e^+e^-$	0.957	0.155	0.964	0.148
$Z'_{\mathrm{SSM}} \rightarrow \mu^+\mu^-$	0.834	0.297	0.895	0.206
$Z'_{\mathrm{SSM}} \rightarrow \ell^+\ell^-$	1.048	0.094	1.084	0.082



Outline

I. Motivation

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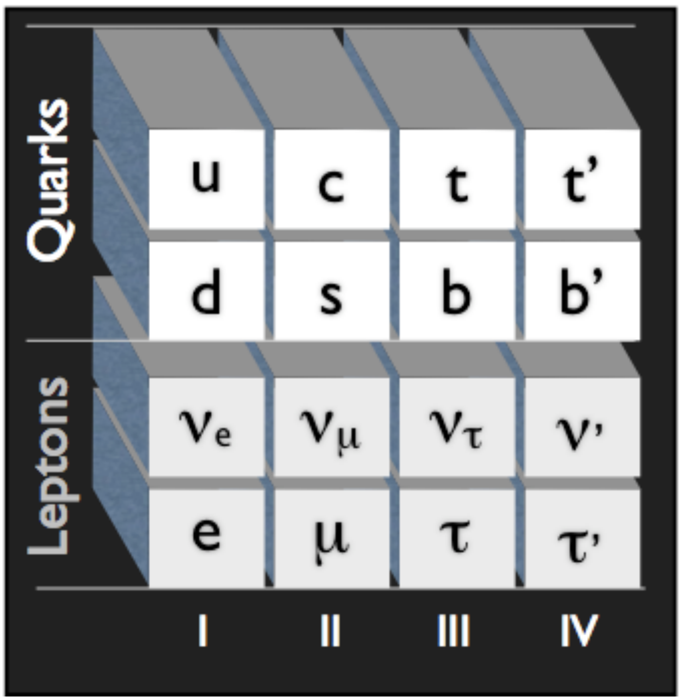
a. Heavy resonances (Z′)

b. Heavy quarks (b′, t′)

c. Simplified SUSY

4th generation

PDG says it's
ruled out to 6σ....



4th generation

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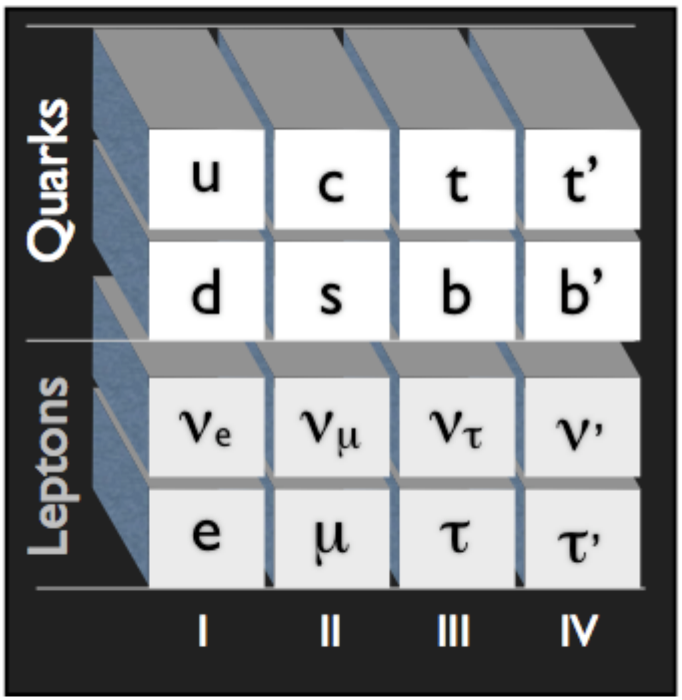
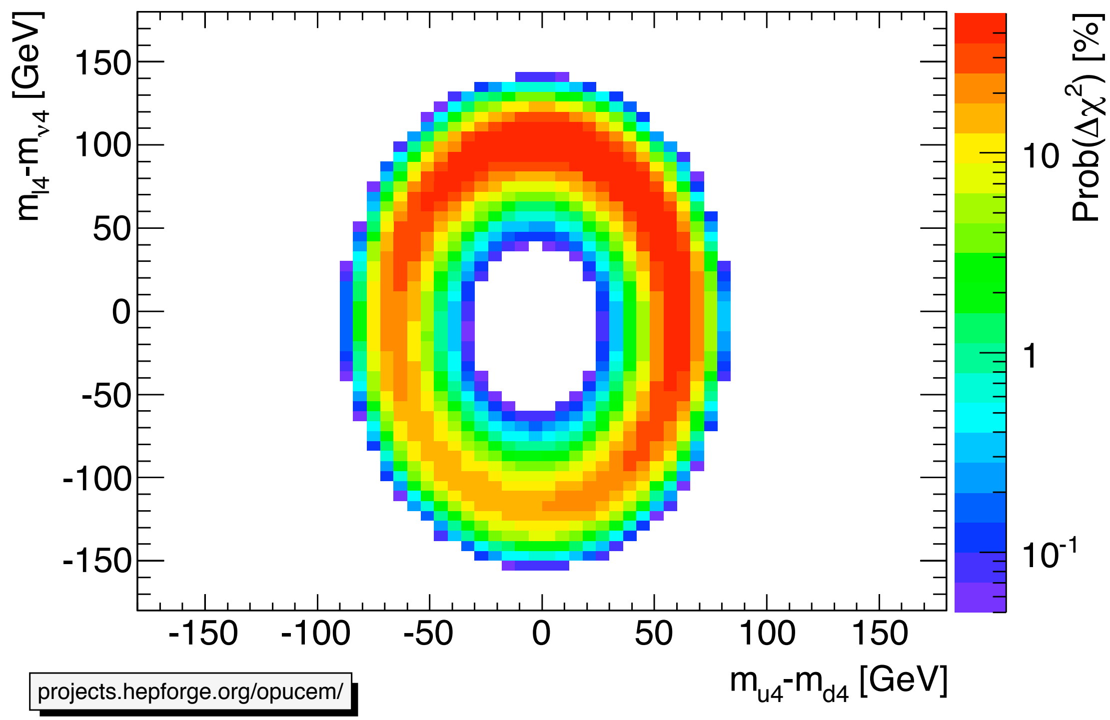


..that's true if the
masses are degenerate



t′

UC Davis

Selection

1 lepton

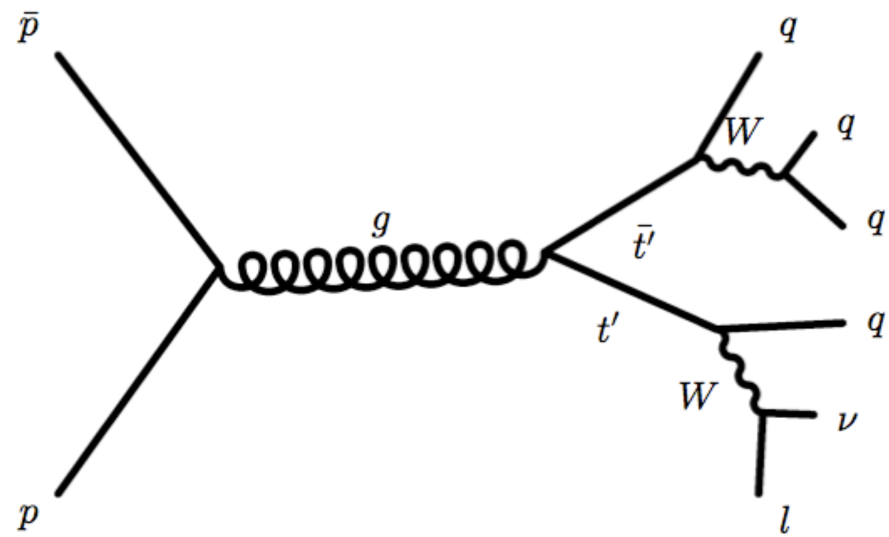
pt>20 GeV

4 jets

pt>20 GeV

Missing transverse energy

>20 GeV



Sample

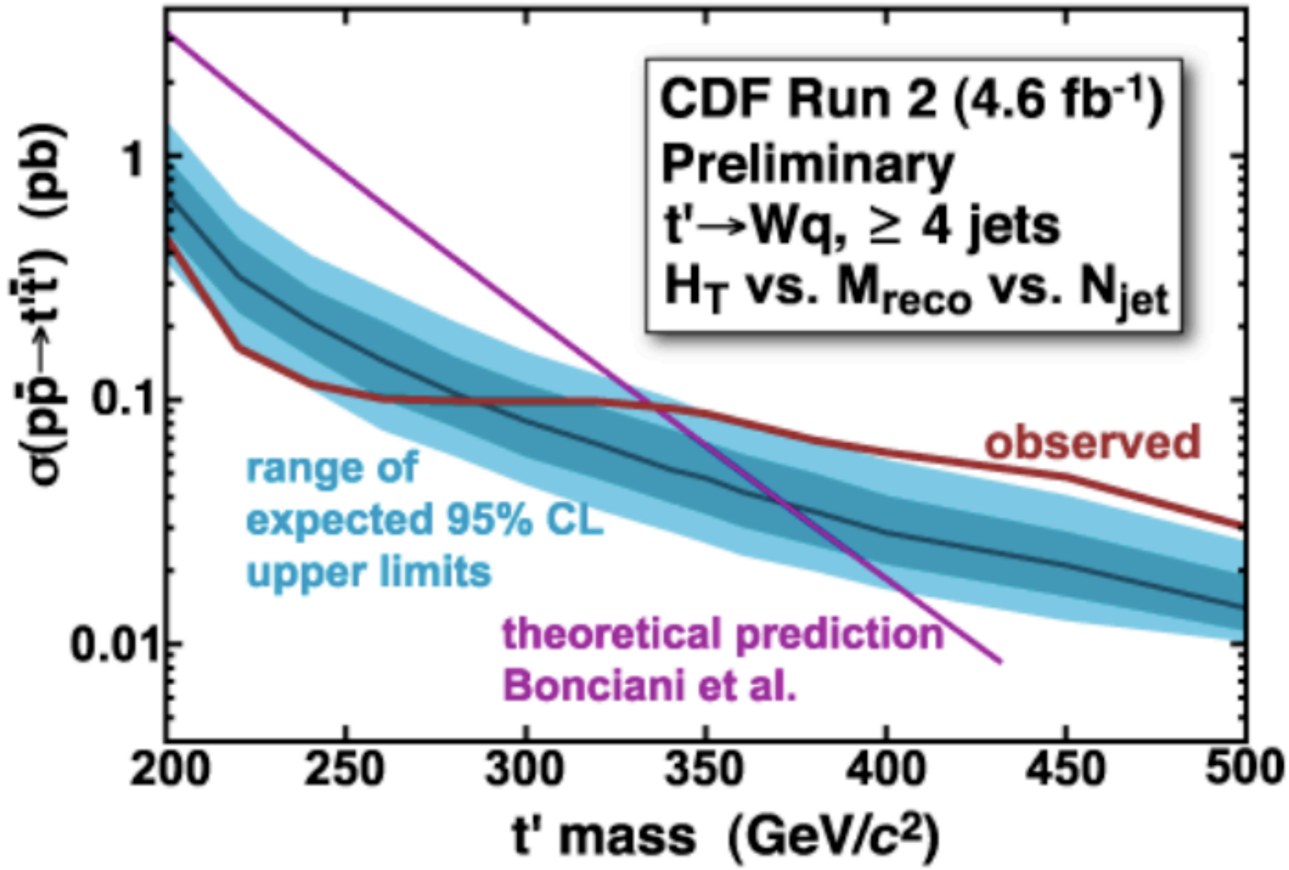
4.6/fb

t′

UC Davis

Limit

$m_{t'} > 335$ GeV



b′

UCI Undergrad
Matt Hickman

Selection

2 like-signed leptons

pt>20 GeV

at least one isolated

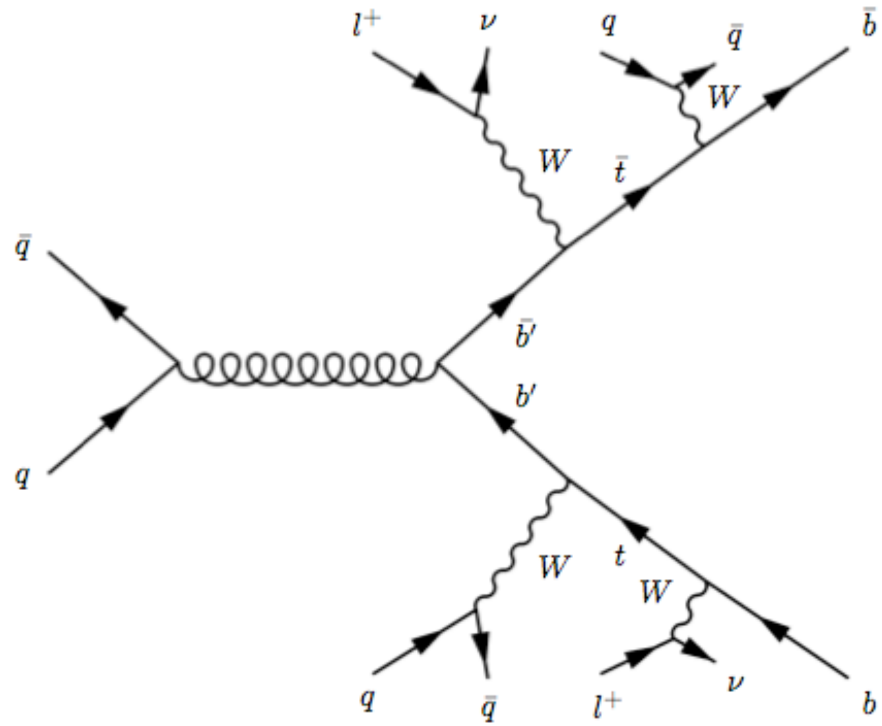
2 jets

pt>20 GeV

>=1 btags

Missing transverse energy

>20 GeV



Sample

2.7/fb

PRL 104 091801 (2010)

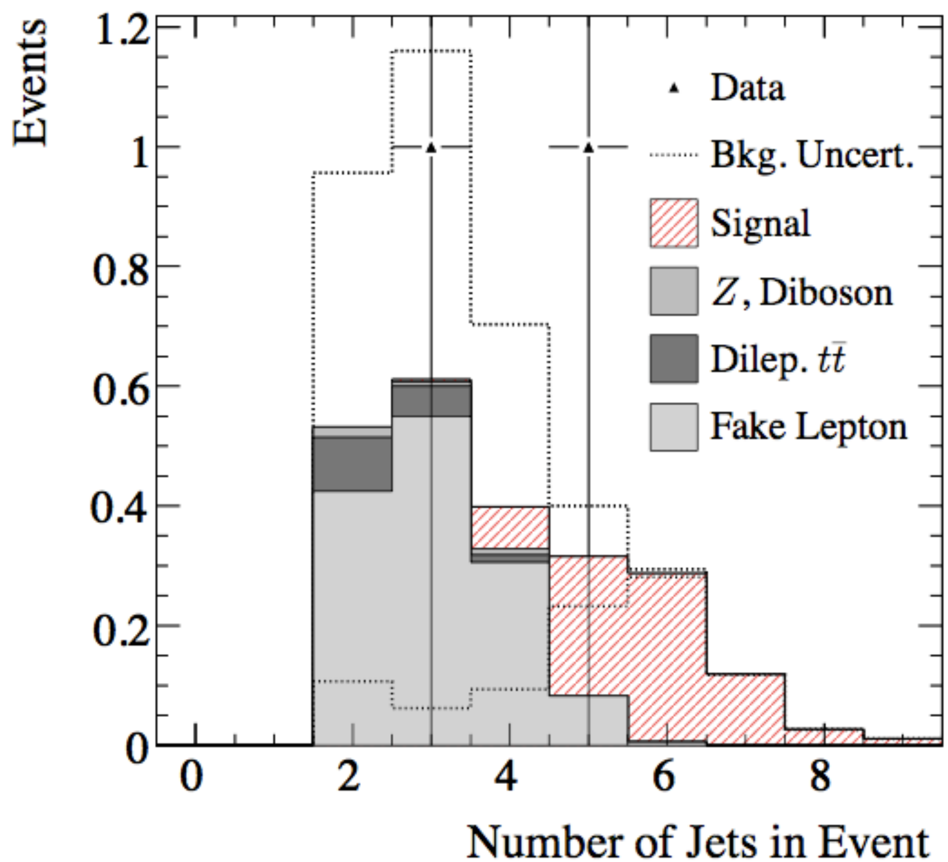
b′

Final selection

2 like-signed leptons

2 jets *>=1 btags*

Missing transverse energy



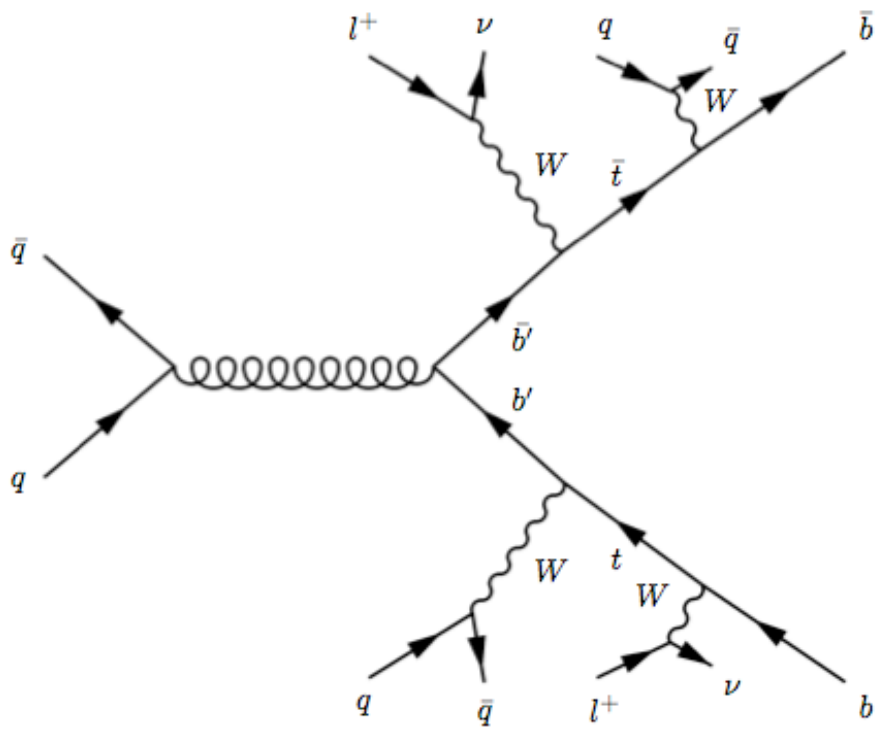
$m_{b'} > 338$ GeV

PRL 104 091801 (2010)

b′ decays

UCI undergrad
Reza AmirArjomand

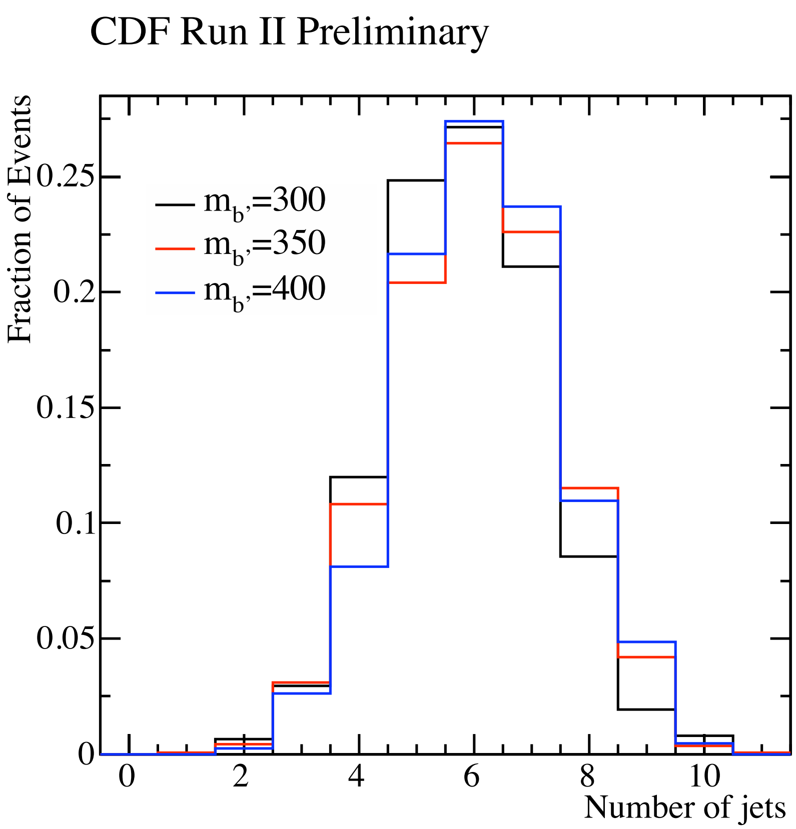
If b′ -> Wt

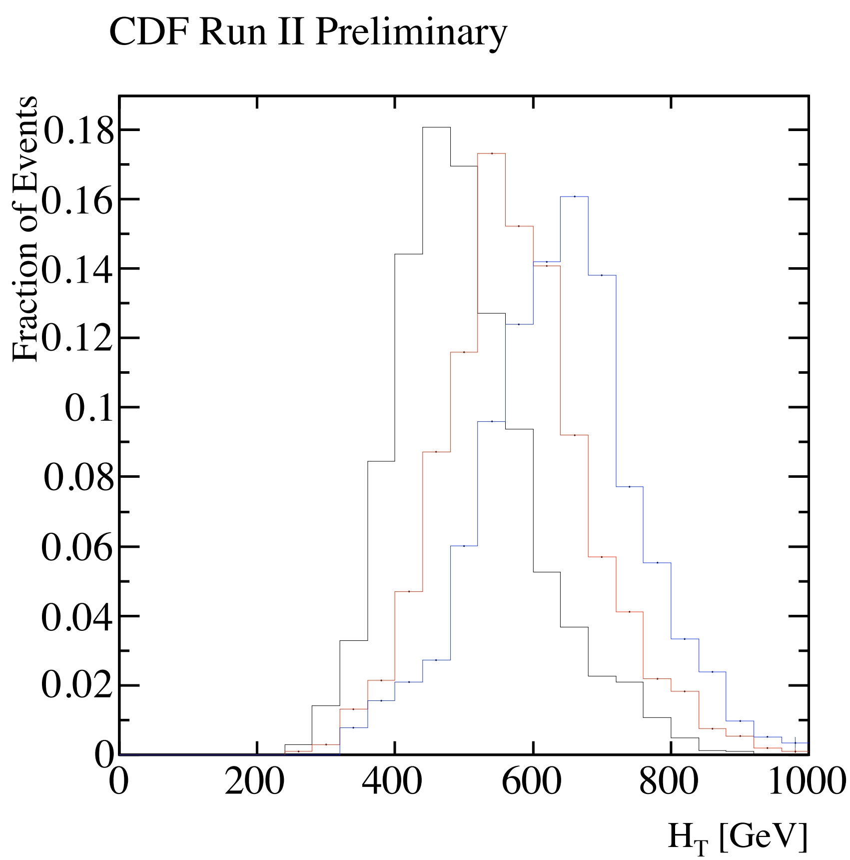


same-sign lepton selection: ~2%

consider single-lepton mode

Signal (madgraph)



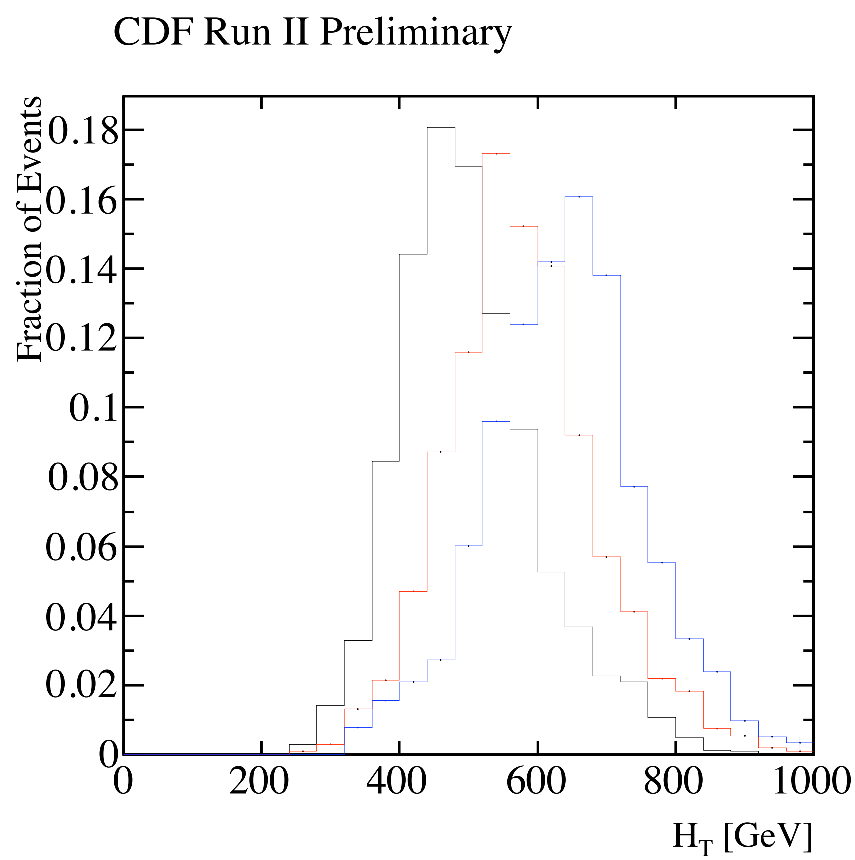


Eight hard partons, ~6 jets

Signal (madgraph)

HT

- Scalar sum of transverse energy in the event
- Includes jets, lepton and missing transverse energy
- Captures soft recoil and unclustered jets



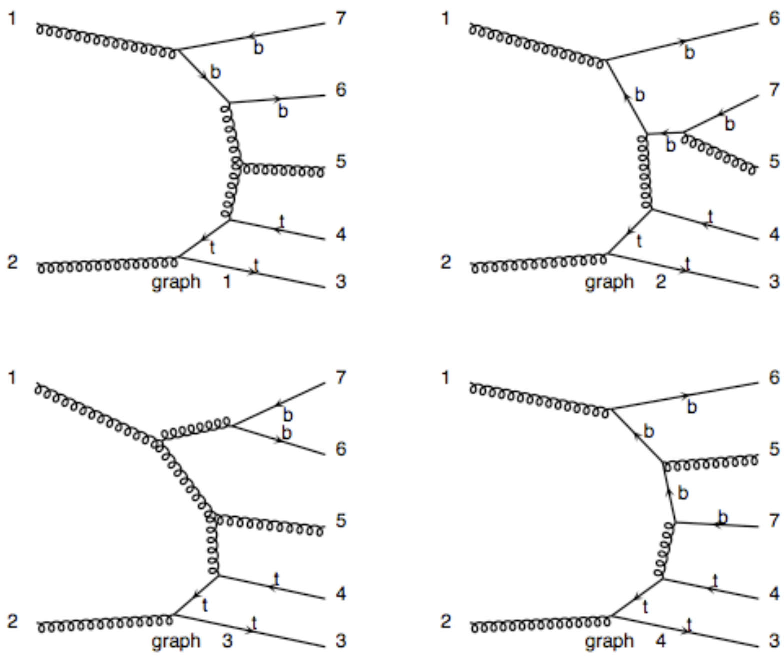
top quark pair background

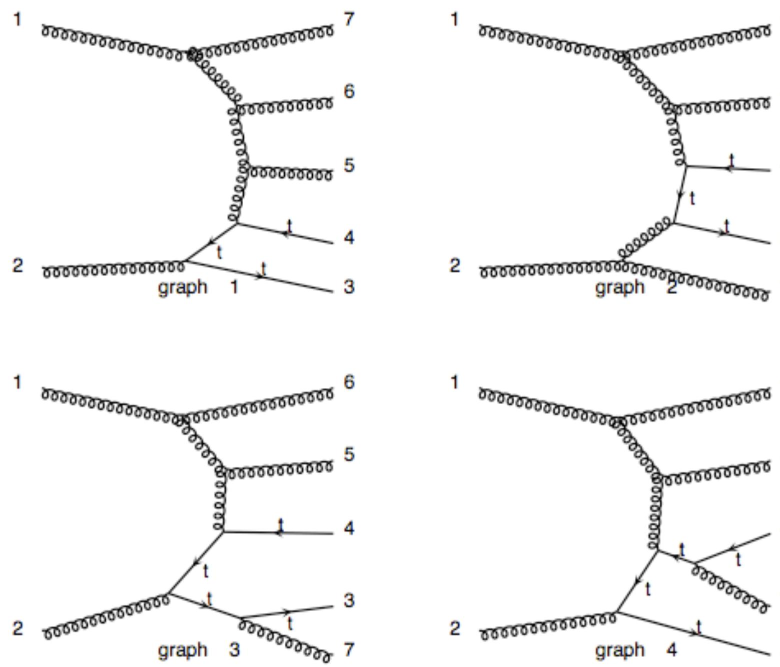
<u>tt + 0,1,2,3p</u>

p = udscb

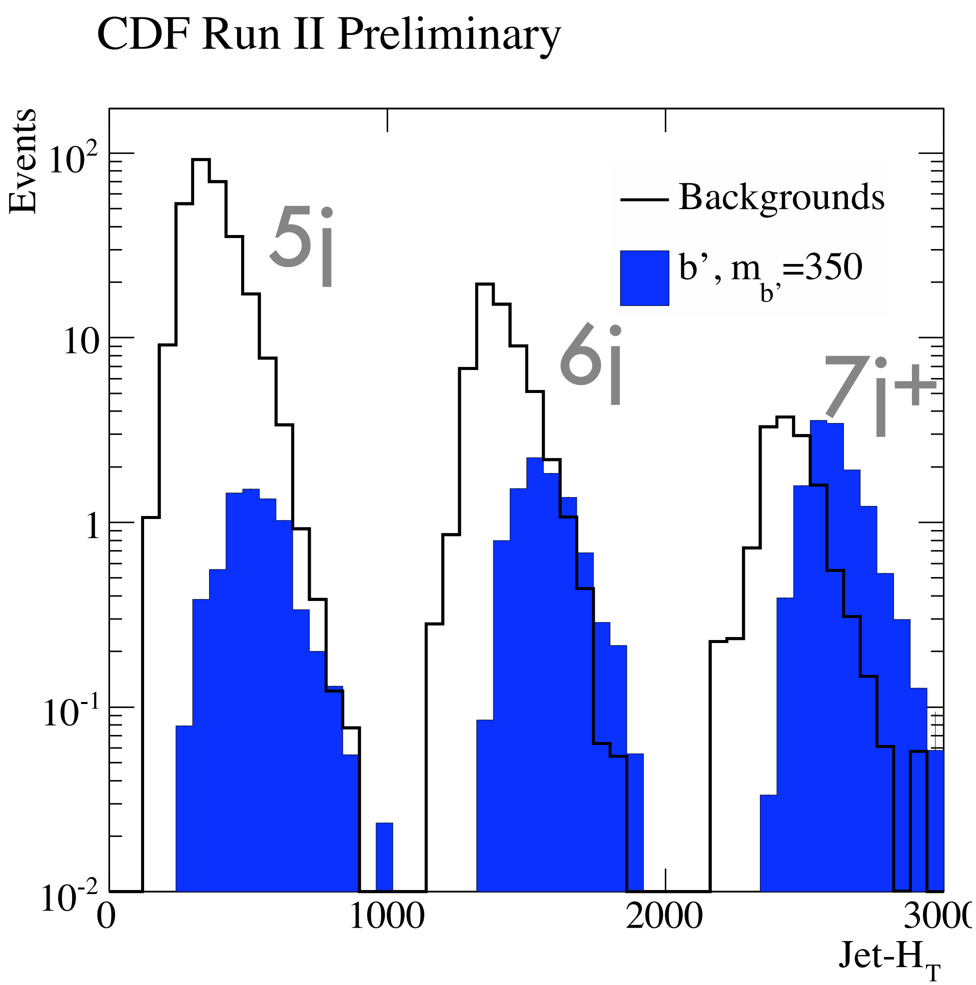
Madgraph+Pythia

MLM matching





Analysis technique



normalized to 5/fb

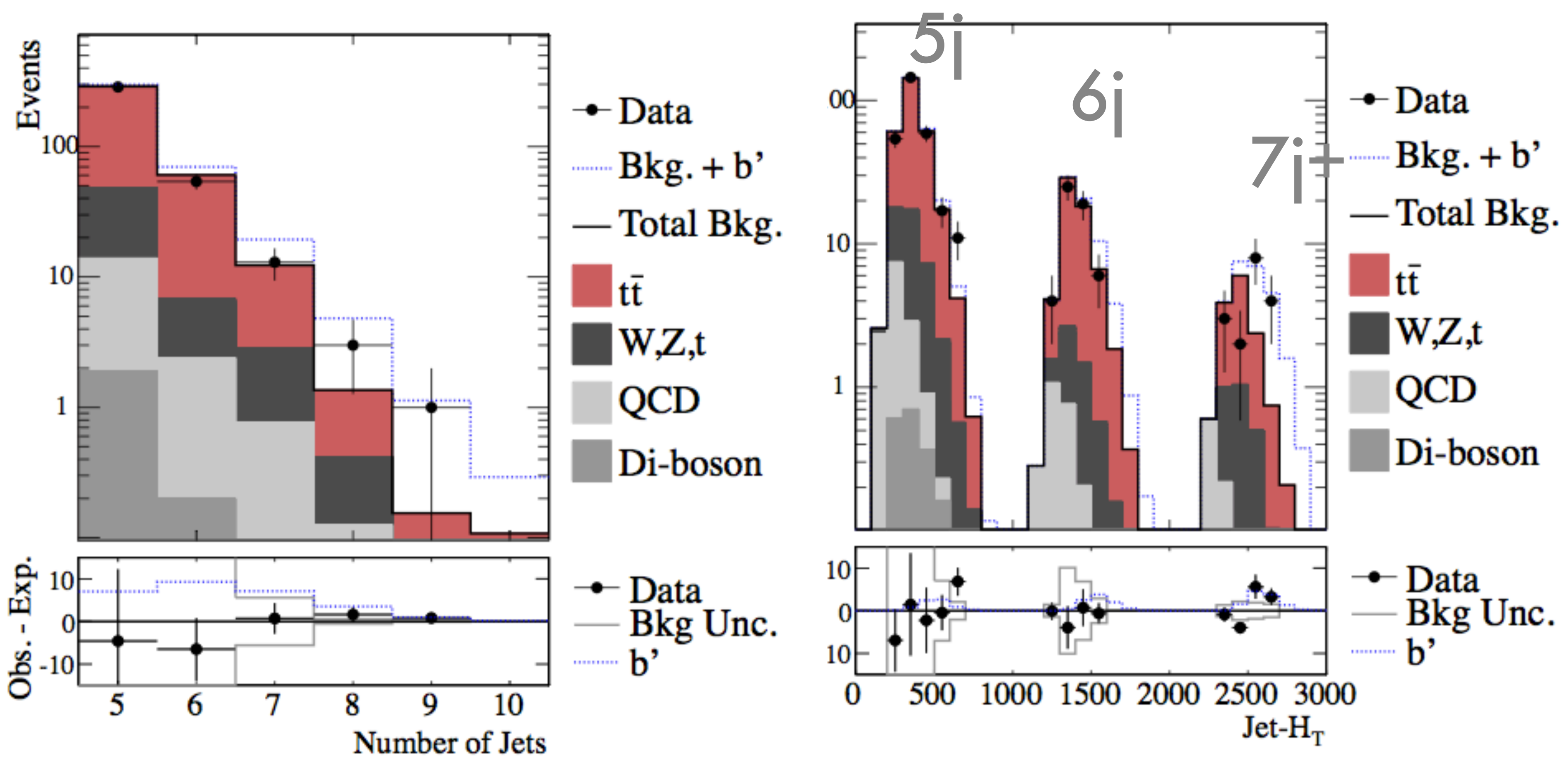
Events

heavy *and* jetty

Analysis variable

- if $N_{jets} == 5$, Jet-$H_T = H_T$.
- if $N_{jets} == 6$, Jet-$H_T = H_T + 1000$ GeV.
- if $N_{jets} >= 7$, Jet-$H_T = H_T + 2000$ GeV.

Data, >=1 b-tag

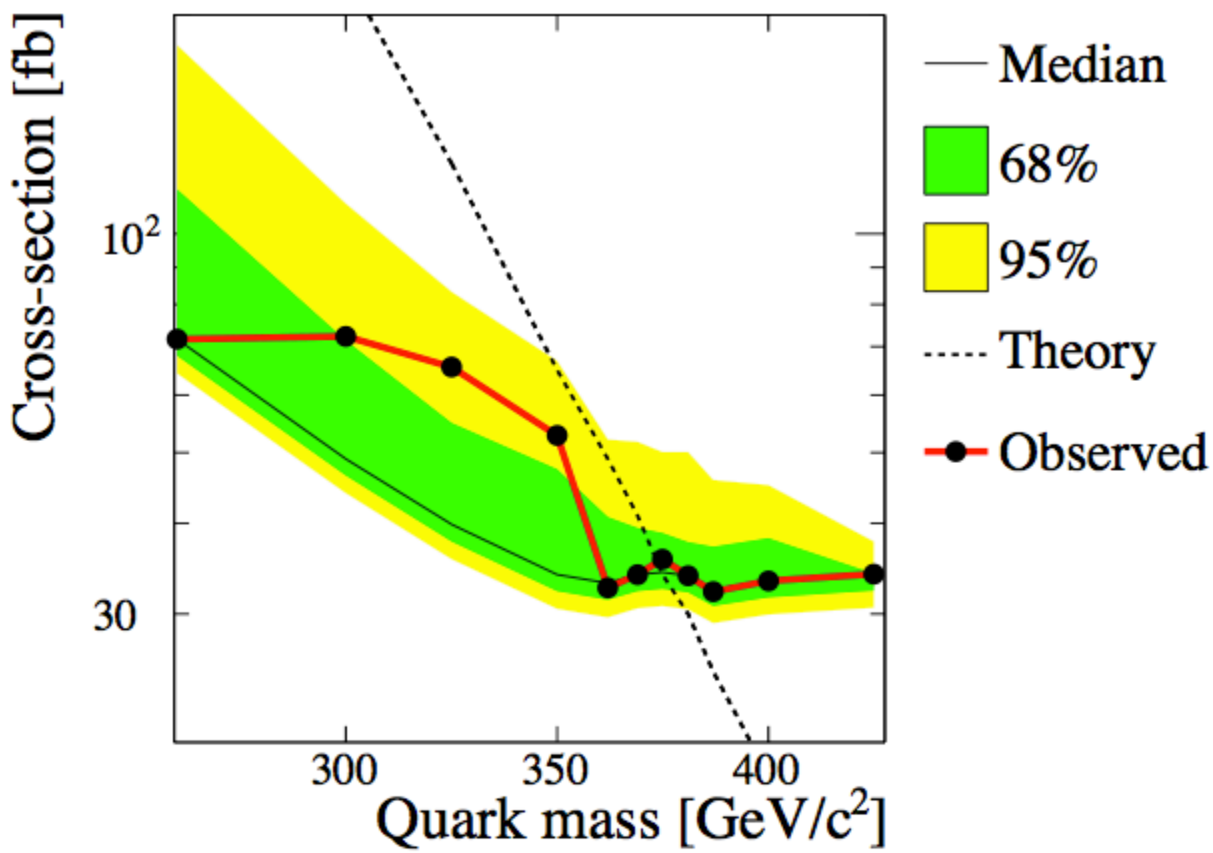


Events
100
10
1
Data
Bkg. + b'
Total Bkg.
$t\bar{t}$
W,Z,t
QCD
Di-boson
Obs. - Exp.
10
0
-10
Data
Bkg Unc.
b'
5
6
7
8
9
10
Number of Jets
5j
6j
7j+
00
10
1
Data
Bkg. + b'
Total Bkg.
$t\bar{t}$
W,Z,t
QCD
Di-boson
10
0
10
Data
Bkg Unc.
b'
0
500
1000
1500
2000
2500
3000
Jet-H_T

The numbers

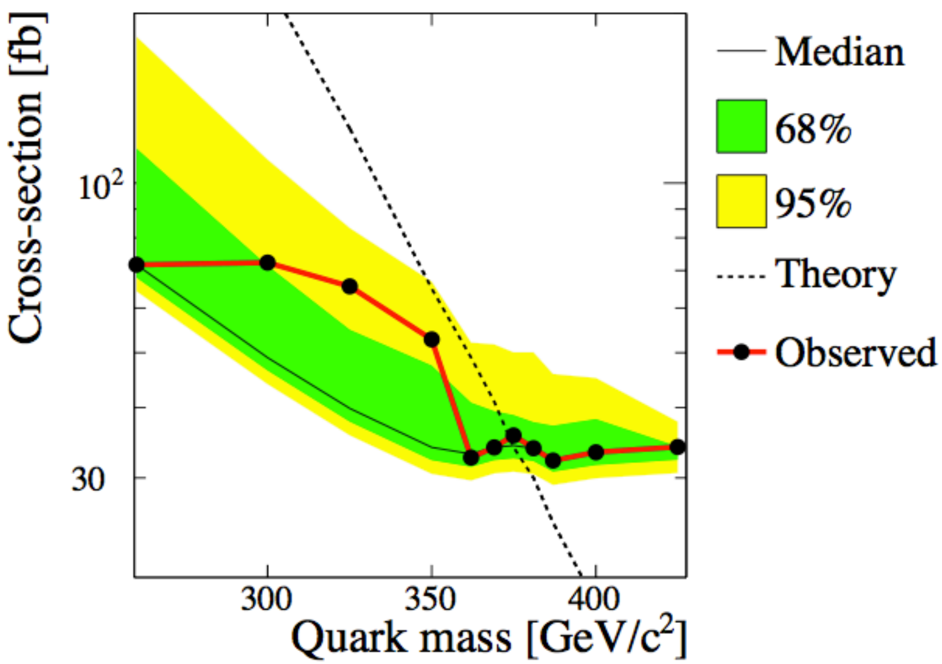
	Control Region		Signal Region		Sum	
Jets	Exp.	Obs.	Exp.	Obs.	Exp.	Obs.
5	207 ± 125	199	84 ± 65	87	291 ± 190	286
6	43 ± 31	40	18 ± 12	14	61 ± 43	54
≥ 7	11 ± 3.9	5	3.4 ± 3.4	12	14 ± 7.1	17

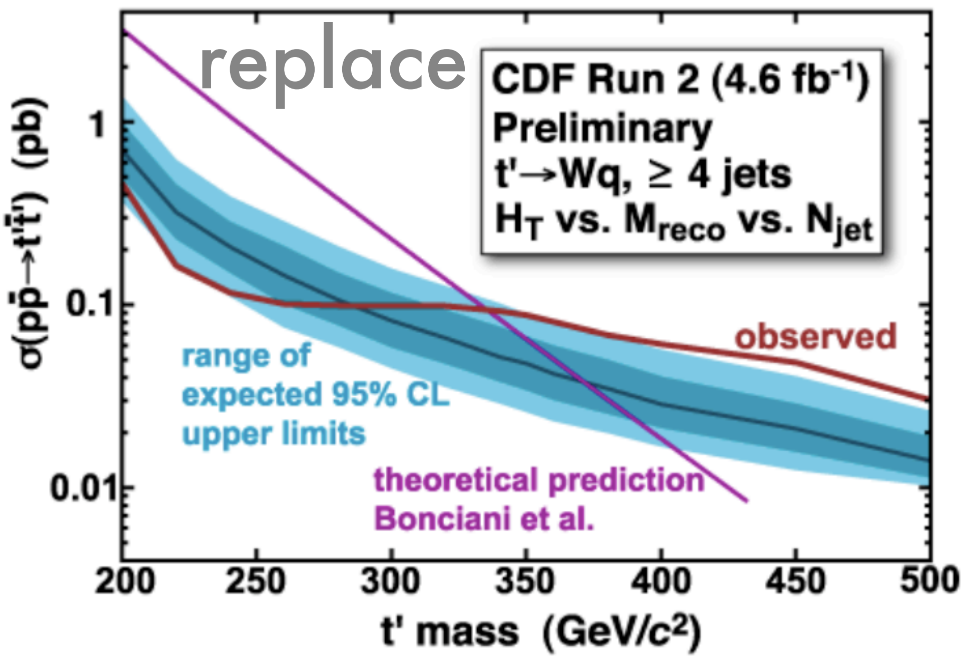
The limits



Cross-section [fb]
10^2
30
300
350
400
Quark mass [GeV/c^2]
Median
68%
95%
Theory
Observed

Direct searches

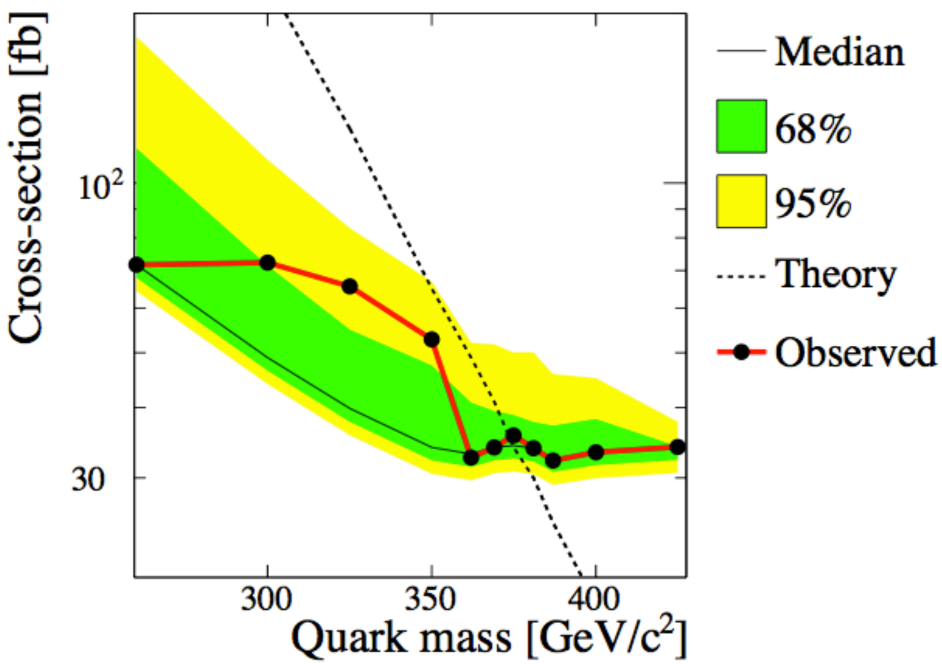


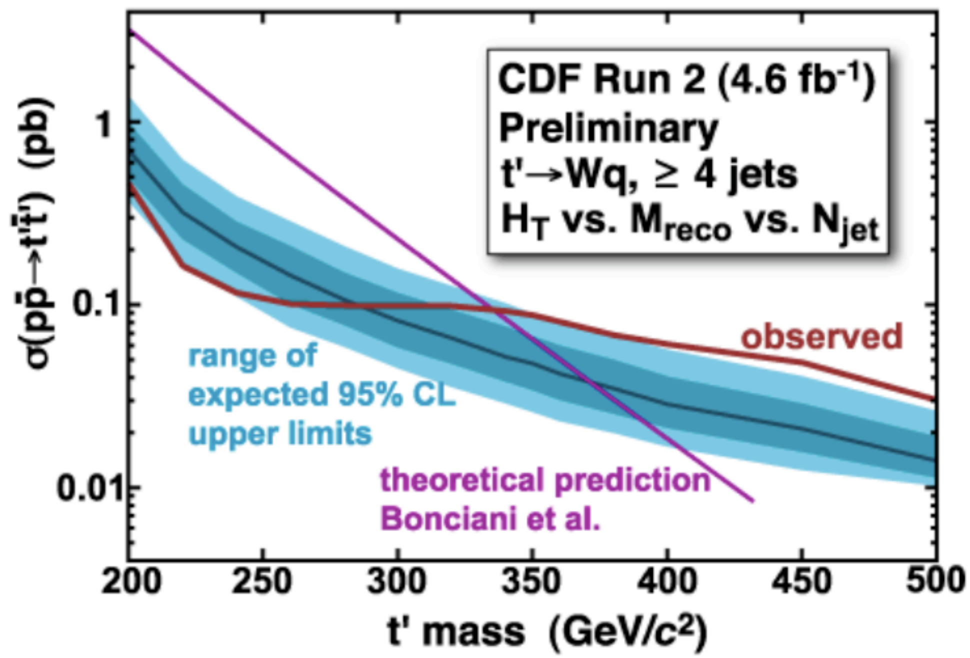


$m_{b'} > 372$ GeV

$m_{t'} > 335$ GeV

Direct searches





$m_{b'} > 372$ GeV

If BR(b' → Wt)=100%

$m_{t'} > 335$ GeV

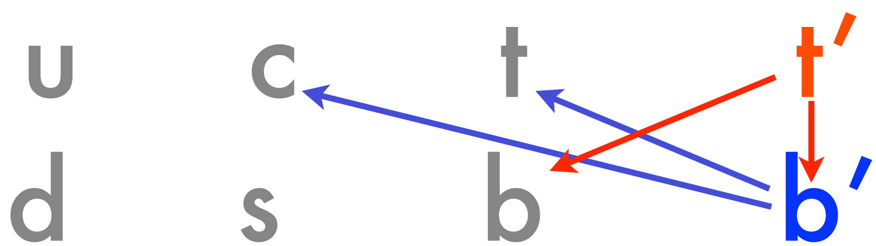
If BR(t' → Wq)=100%

b′ and t′

UCI postdoc
Christian Flacco

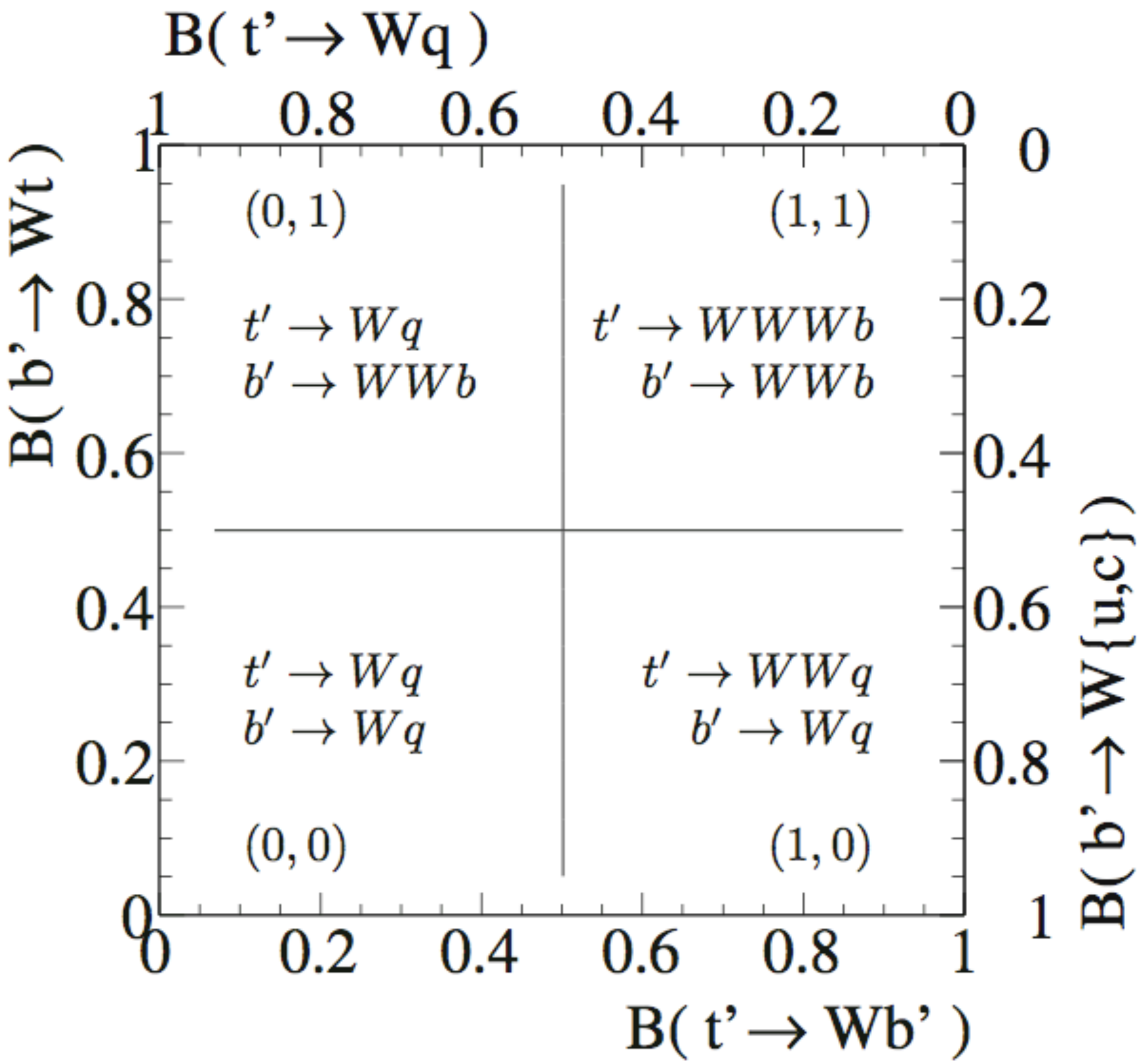
UCI undergrad
Matt Kelly

If $m_{t'} > m_{b'}$



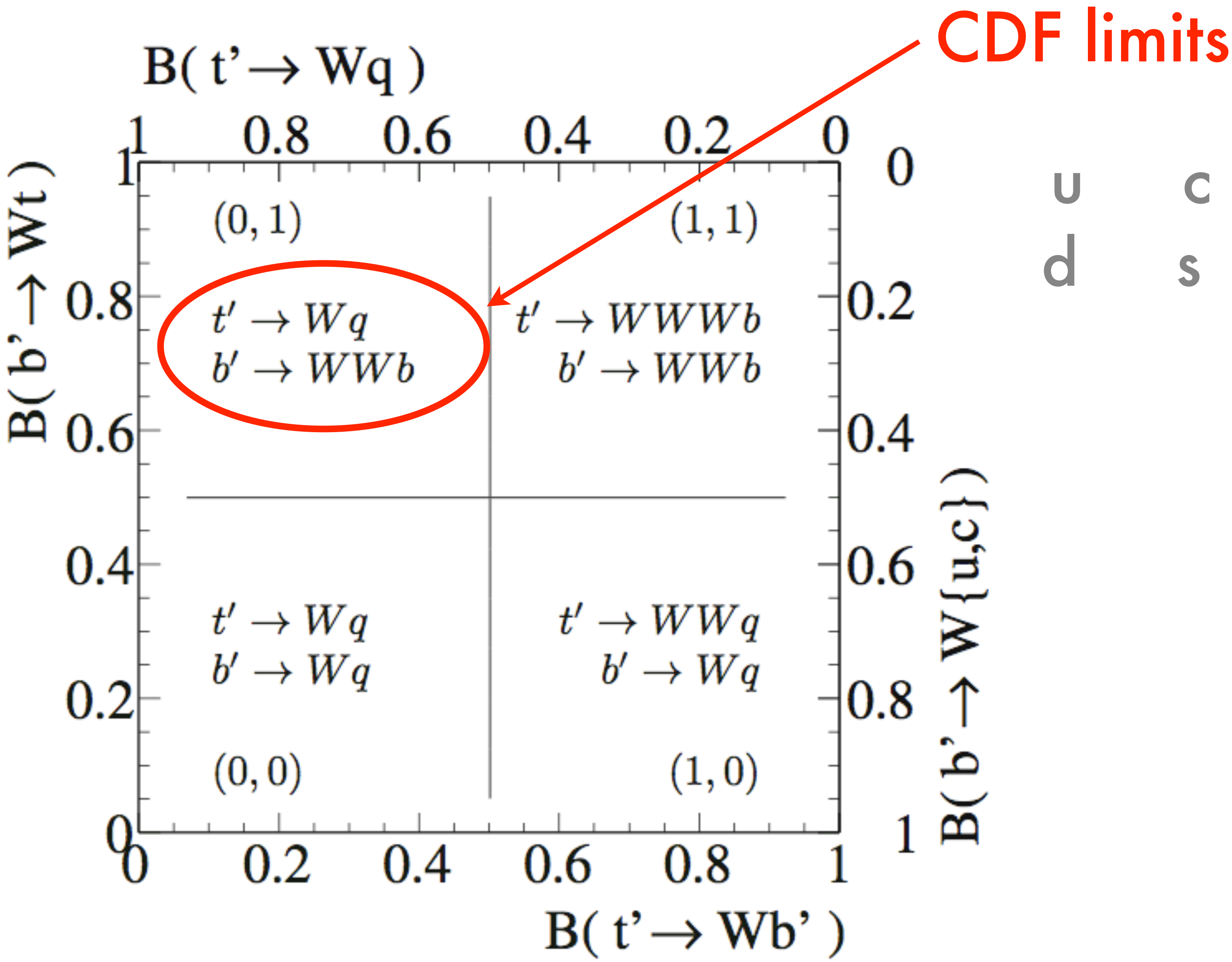
PRL 2010, PRD 2011

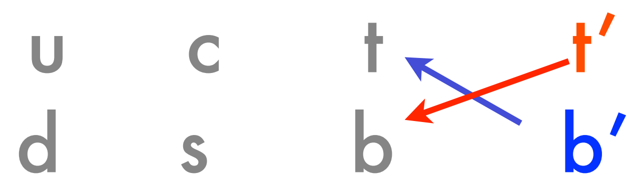
b′ and t′



PRL 2010, PRD 2011

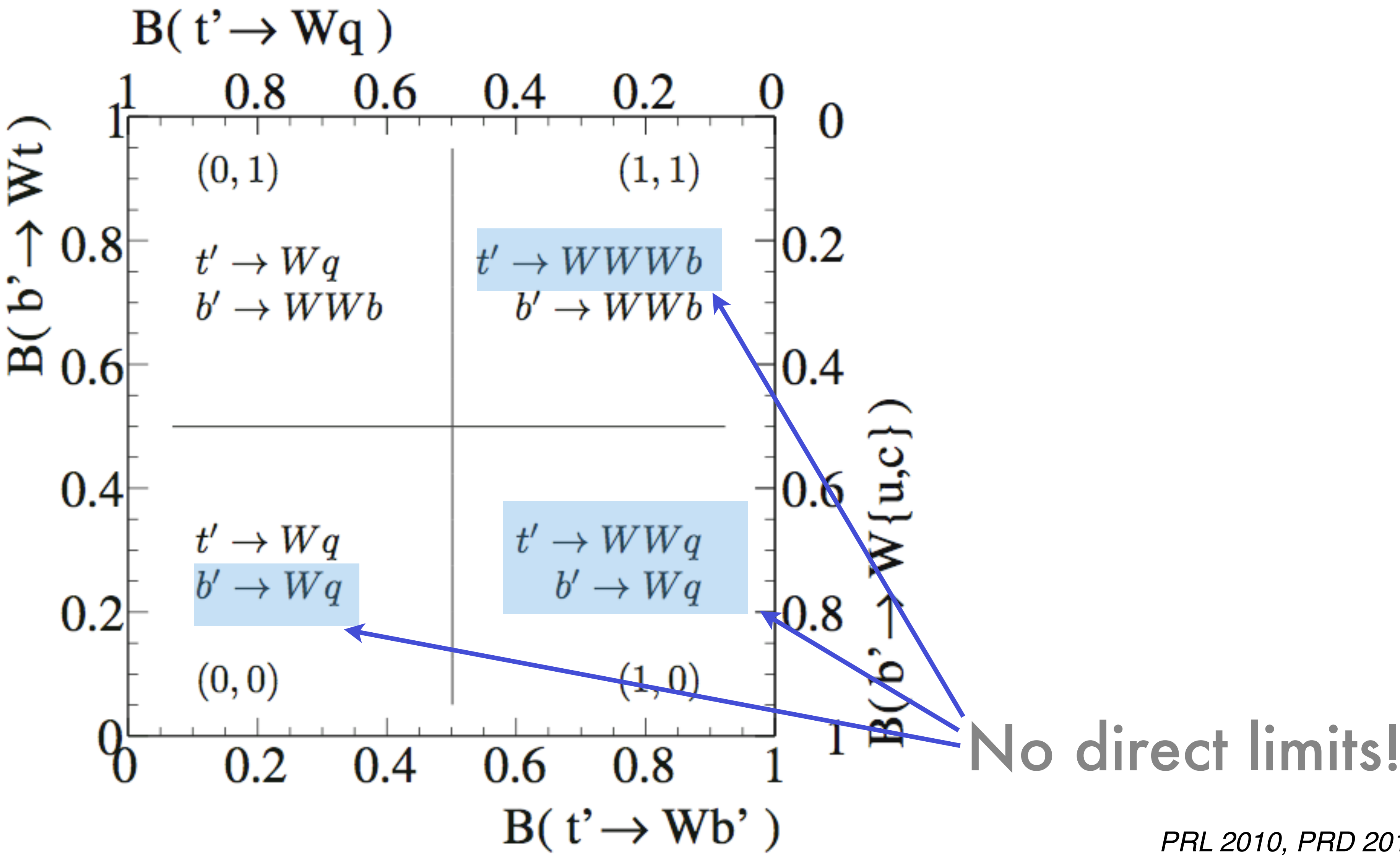
b′ and t′





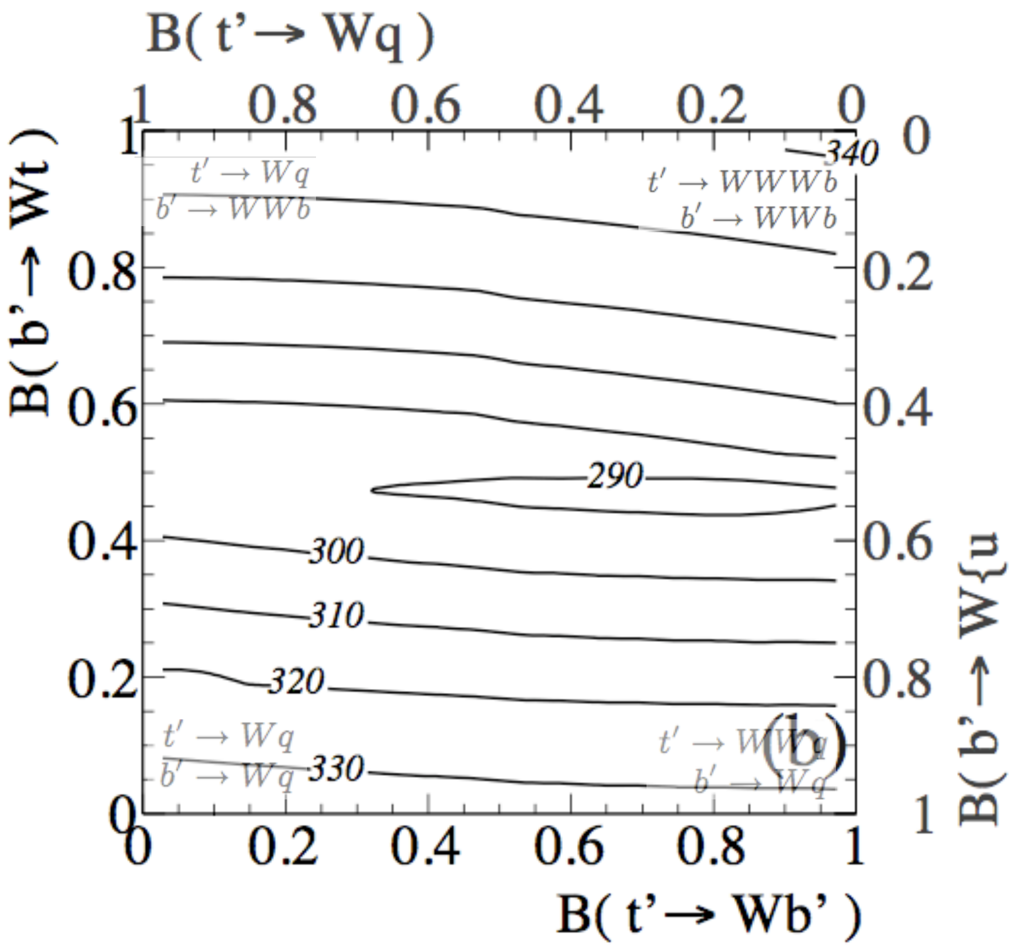
PRL 2010, PRD 2011

b′ and t′

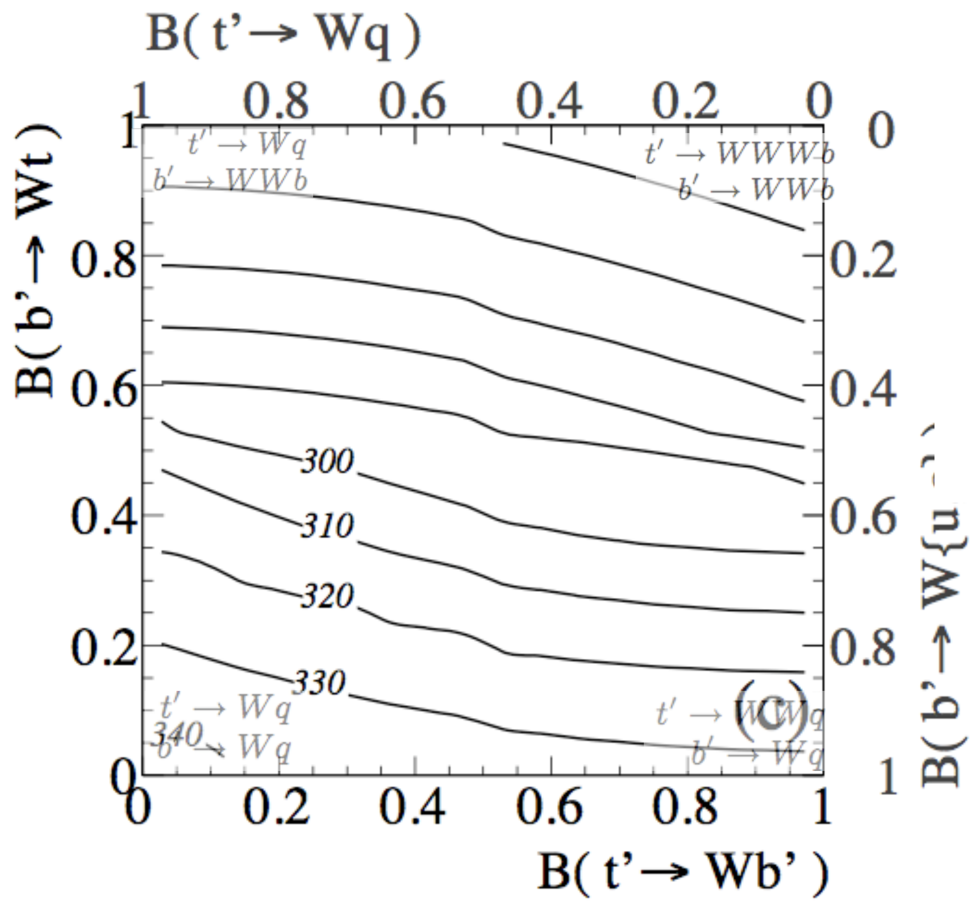


PRL 2010, PRD 2011

t′ and b′



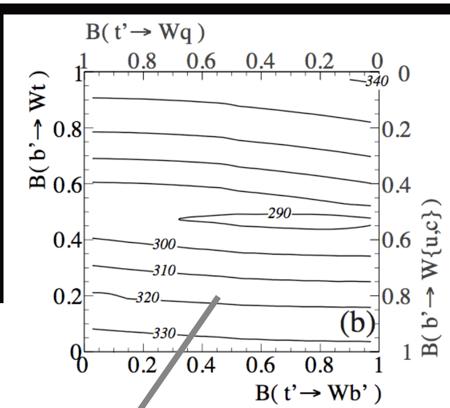
$m_{t'} = m_{b'} + 100$



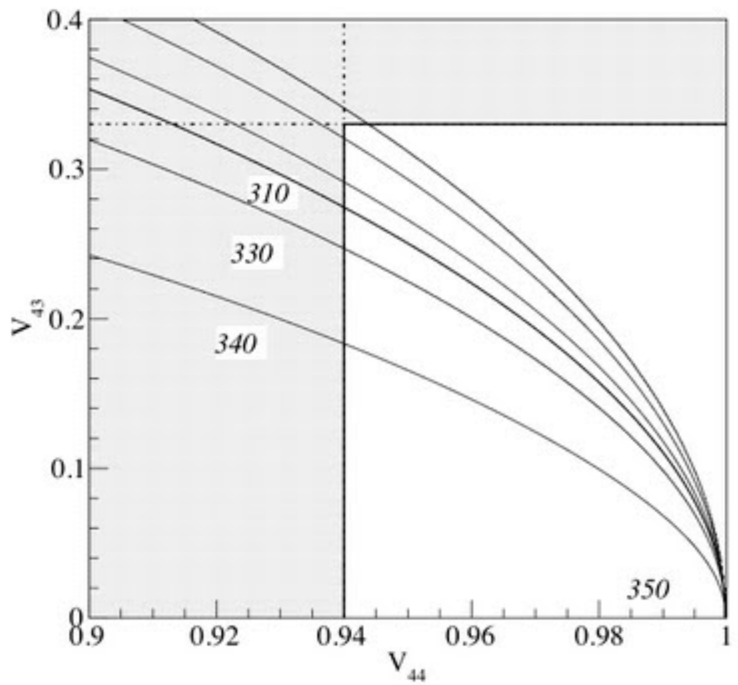
$m_{t'} = m_{b'} + 50$

PRL 2010, PRD 2011

Limits



$$V_{CKM4} = \begin{pmatrix} V_{ud} & V_{us} & V_{ub} & V_{ub'} \\ V_{cd} & V_{cs} & V_{cb} & V_{cb'} \\ V_{td} & V_{ts} & V_{tb} & V_{tb'} \\ V_{t'd} & V_{t's} & V_{t'b} & V_{t'b'} \end{pmatrix}$$



V_{ud}	=	0.97418	±	0.00027	Nuclear Beta decay
V_{us}	=	0.2255	±	0.0019	Semileptonic K-decay
V_{ub}	=	0.00393	±	0.00036	Semileptonic B-decay
V_{cd}	=	0.230	±	0.011	Semileptonic D-decay
V_{cs}	=	1.04	±	0.06	Semi- /Leptonic D-decay
V_{cb}	=	0.0412	±	0.0011	Semileptonic B-decay
V_{tb}	>	0.74			Single Top-production

PRL 2010, PRD 2011

heavy quarks

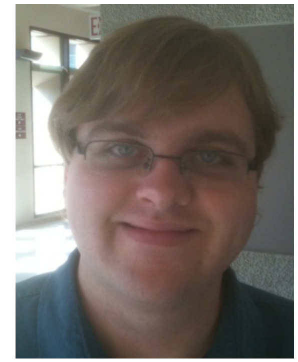
If the lifetime is short enough
so the decay is in the central detector:

$$m_{Q'} > 290 \text{ GeV}$$

PRL 2010, PRD 2011

ATLAS t′

UCI grad student
Michael Werth



Selection

2 OS leptons

pt>20 GeV

2 jets

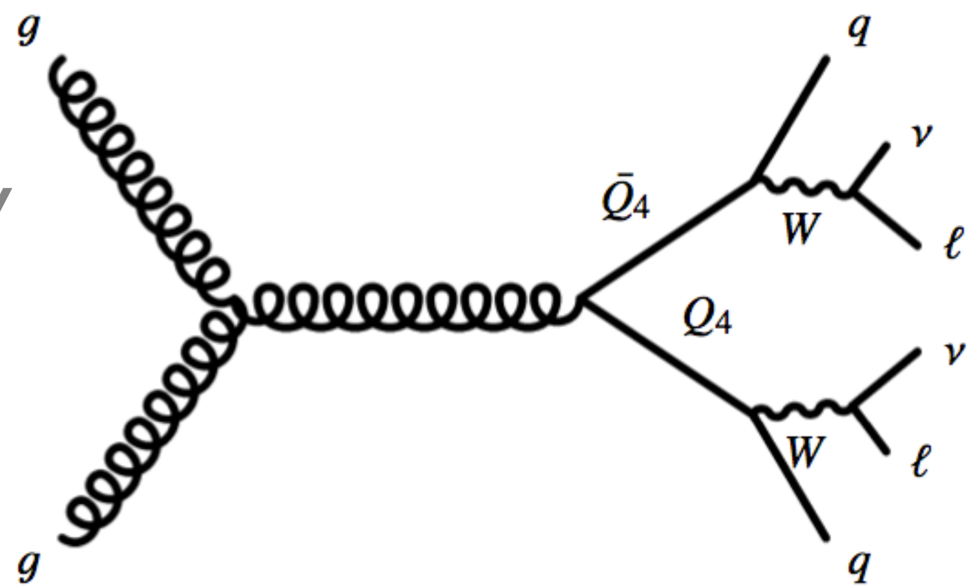
pt>20 GeV

Missing transverse energy

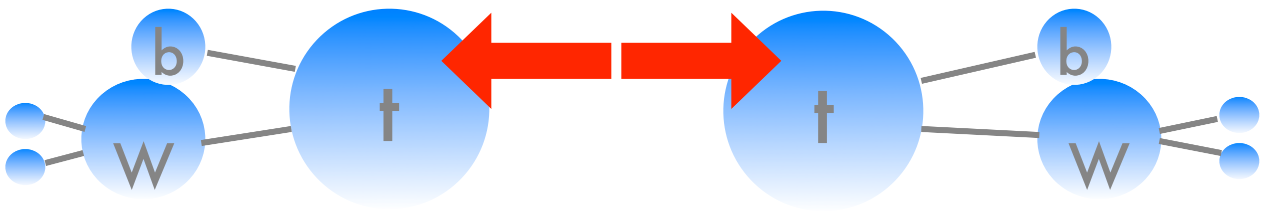
>20 GeV

Sample

35/pb

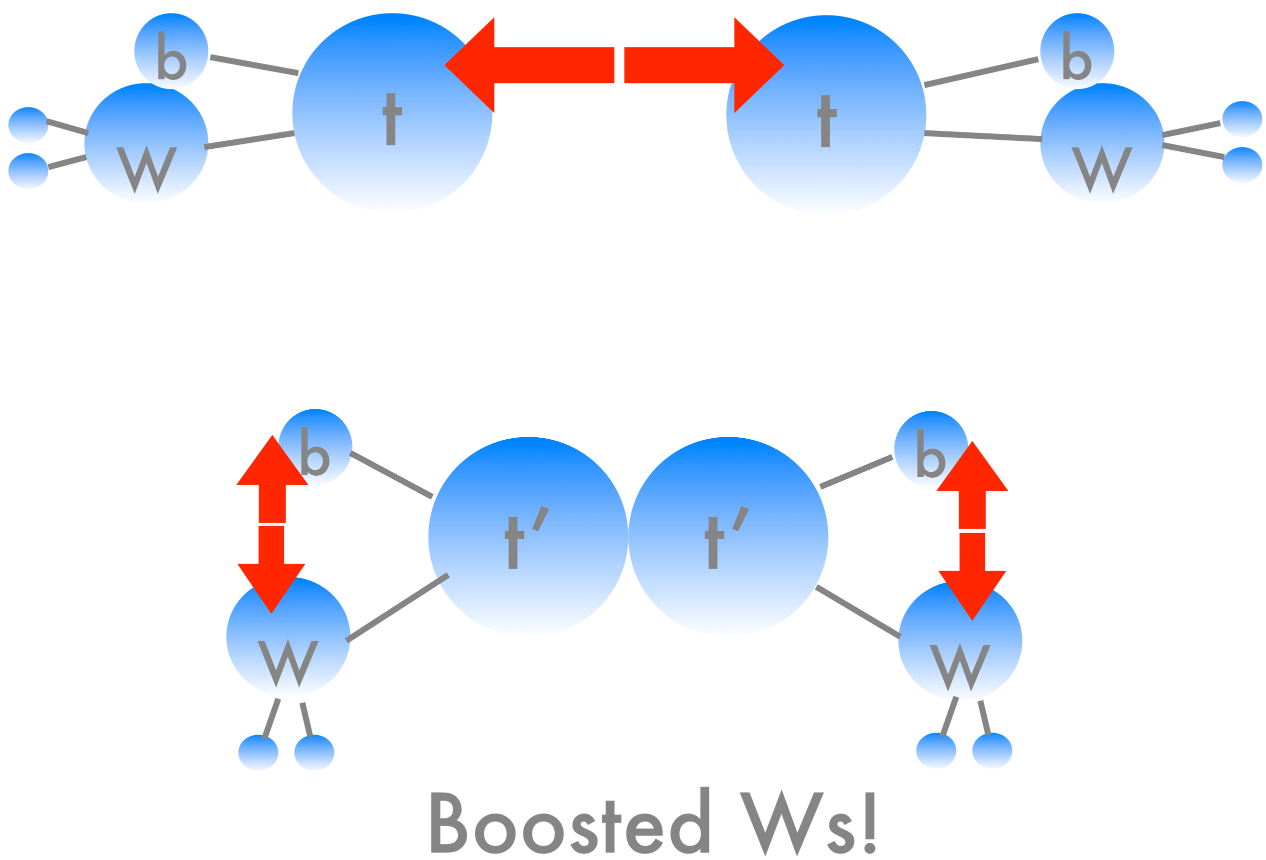


topology

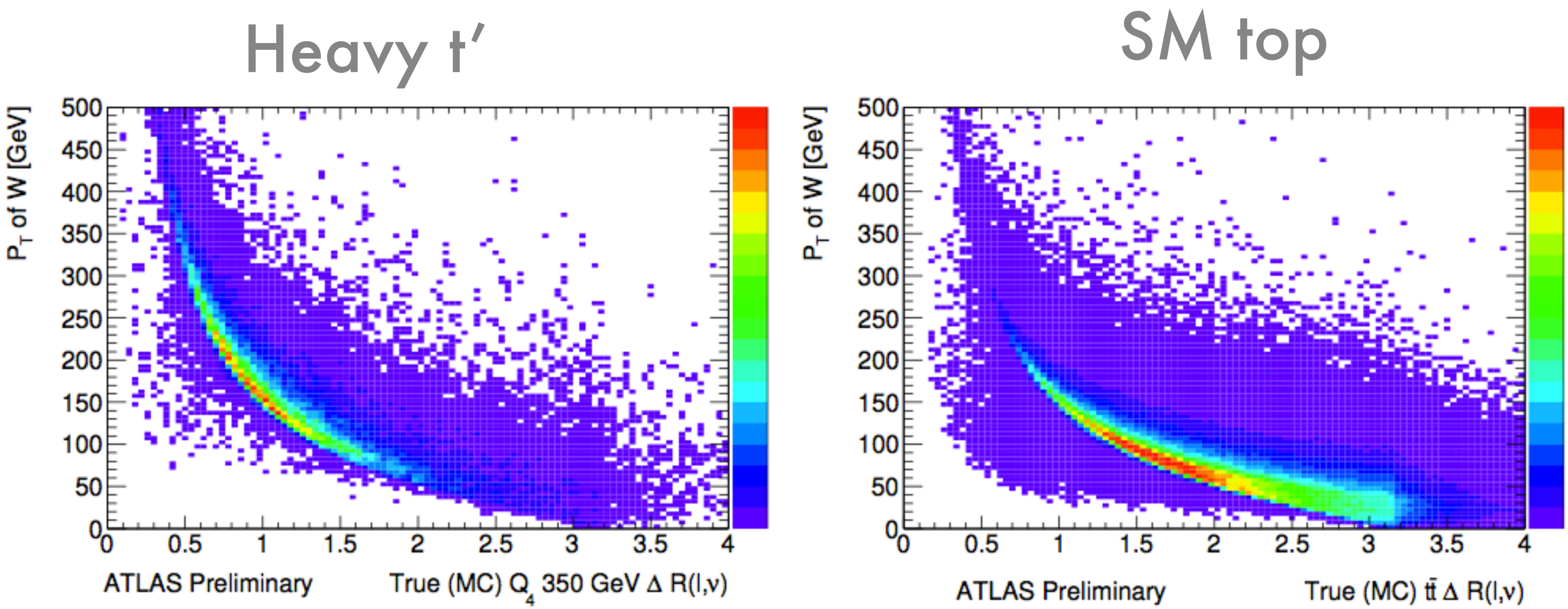


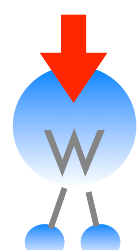
Boosted tops

topology



Lepton-neutrino angles

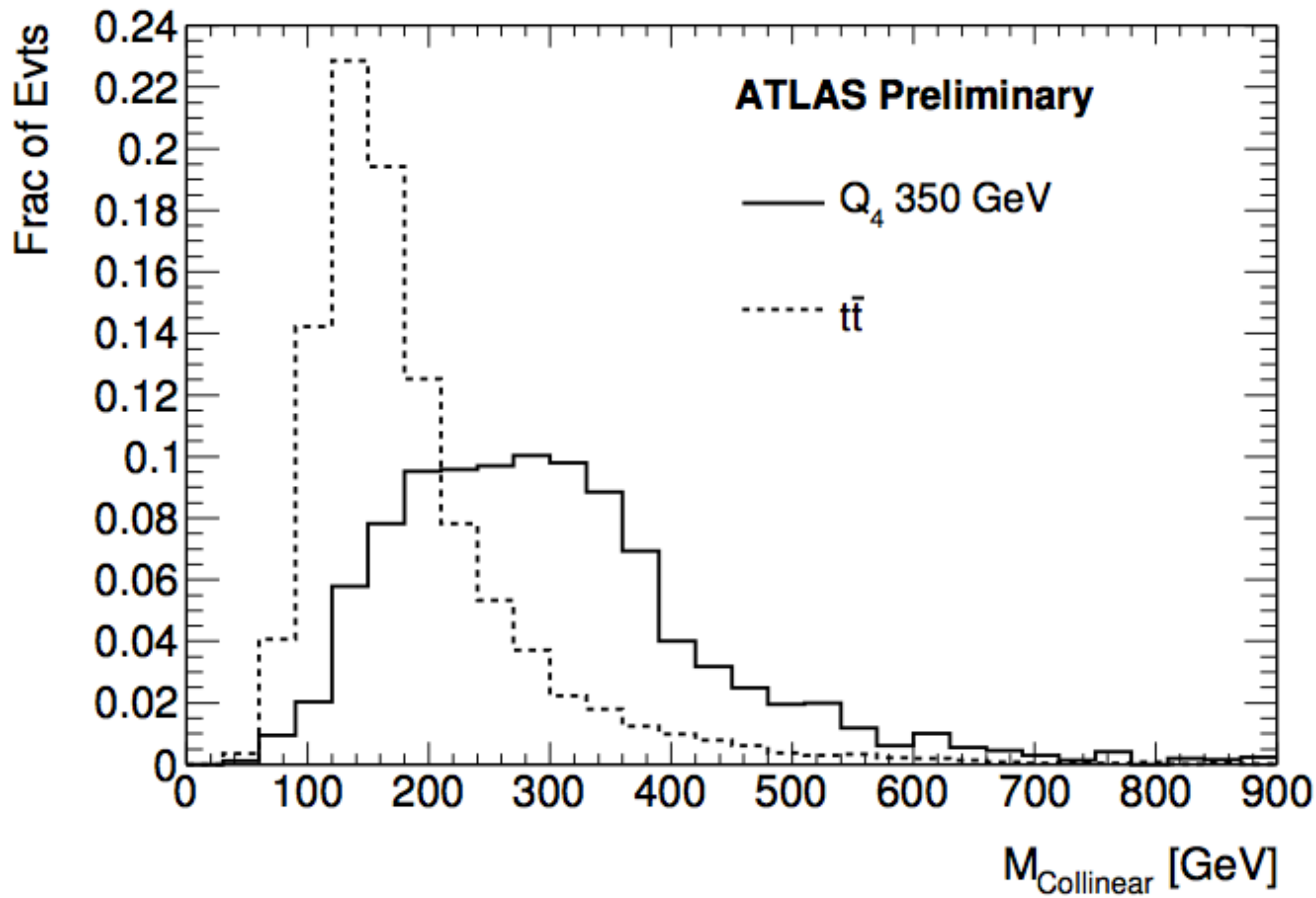




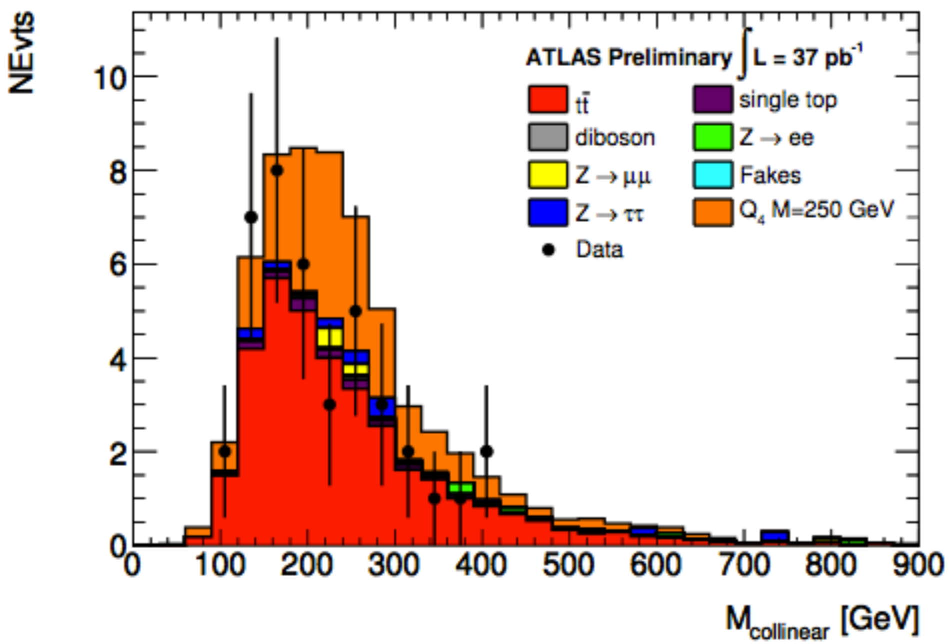
More W p_T means smaller opening angle

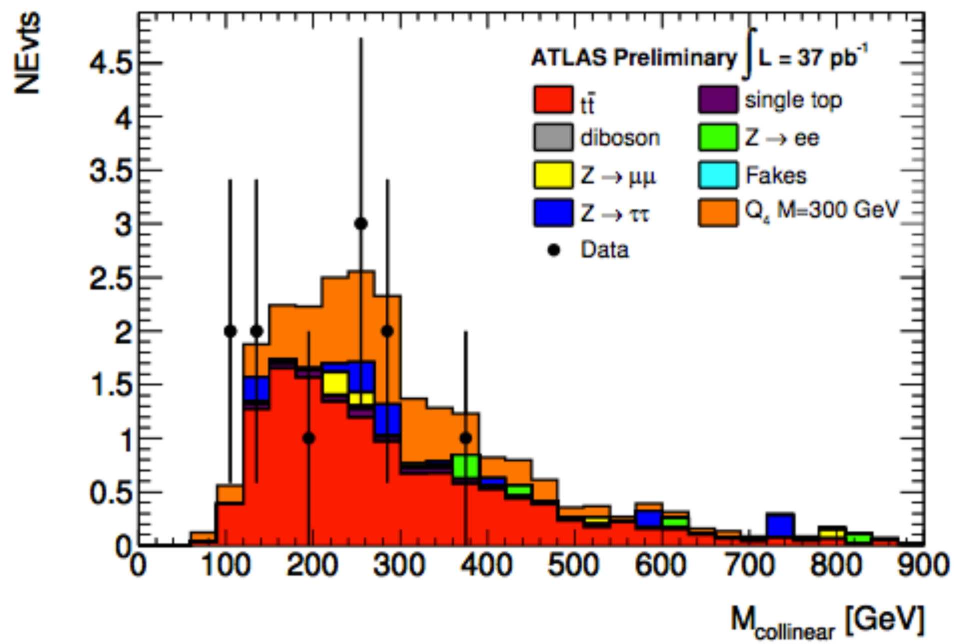
Mass reconstruction

Assume lepton and neutrino are ~collinear



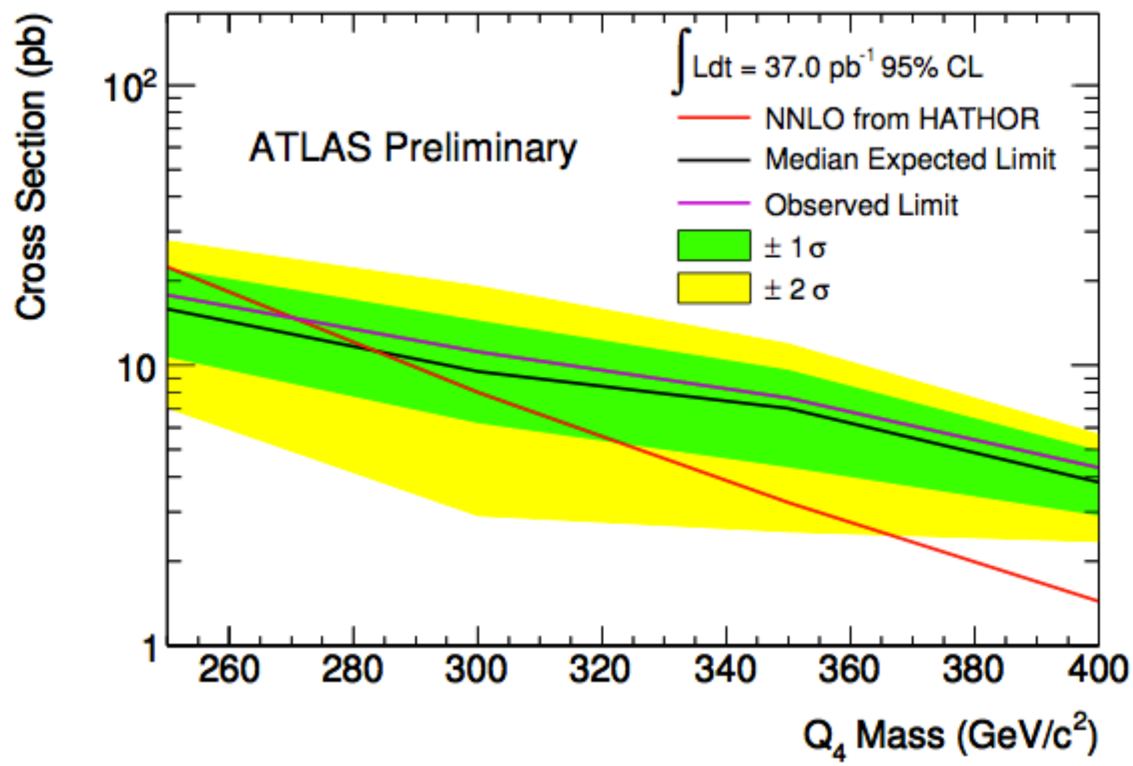
Data





No sign of heavy quarks...

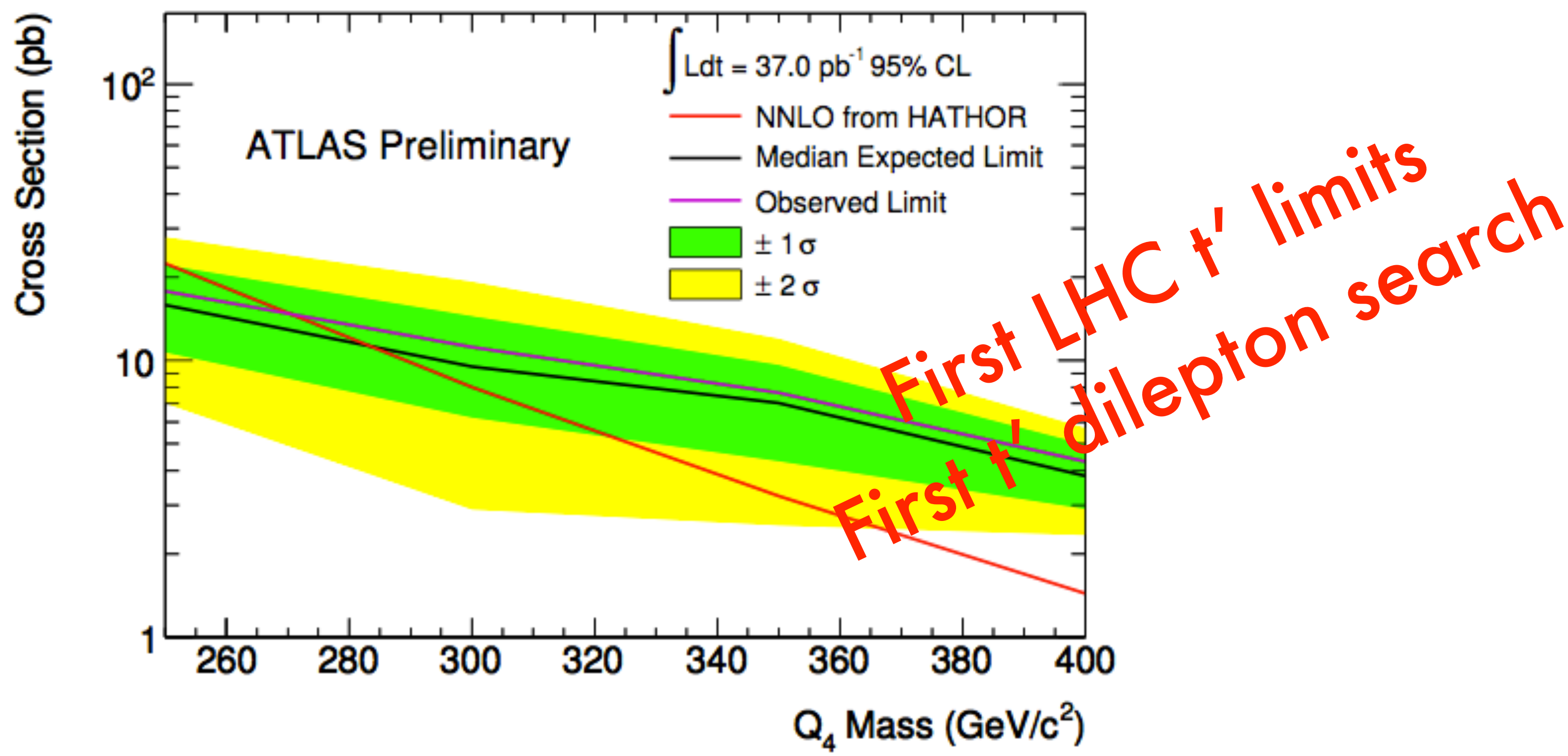
Limit



Limit

$m_{t'} > 275$ GeV

Limit



Limit

$m_{t'} > 275$ GeV

Dark Matter

Need long lived dark matter X

Dark Matter

Need long lived dark matter X

Give it some dark charge that is conserved

(eg R-parity for susy LSP)

SM Particles

SM Charges

Dark Matter X

Dark Charge

Dark Matter

Need long lived dark matter X
Give it some dark charge that is conserved
(eg R-parity for susy LSP)

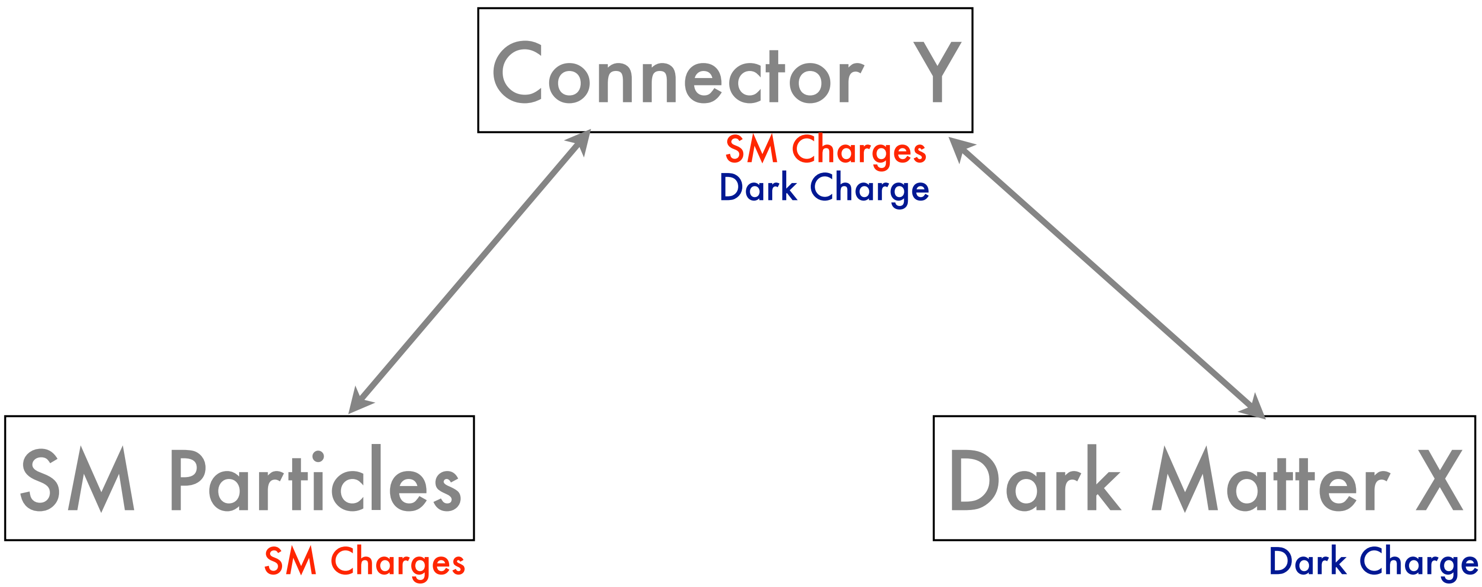
SM Particles
SM Charges

Dark Matter X
Dark Charge

X can't be light ($\lesssim$ 10 GeV) and carry SM charges to be consistent with relic density.

Dark Matter

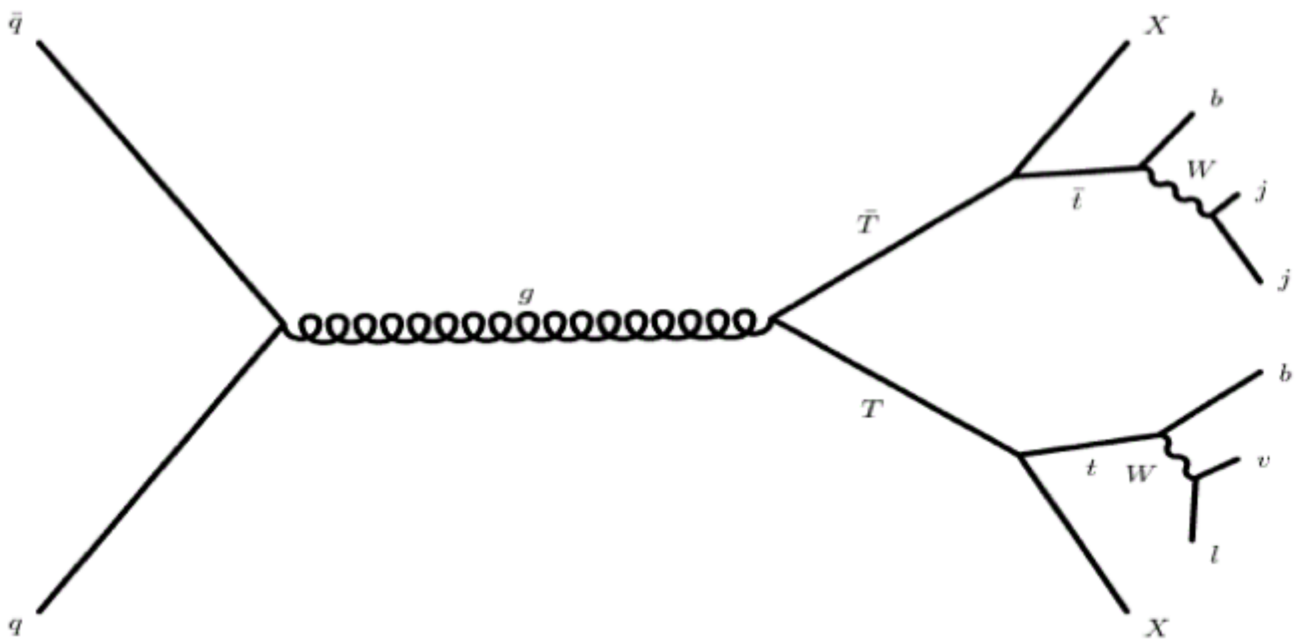
Need long lived dark matter X



Produce Y, decay as Y -> f X

Dark Matter+4th gen

UCI grad student
Kanishka Rao

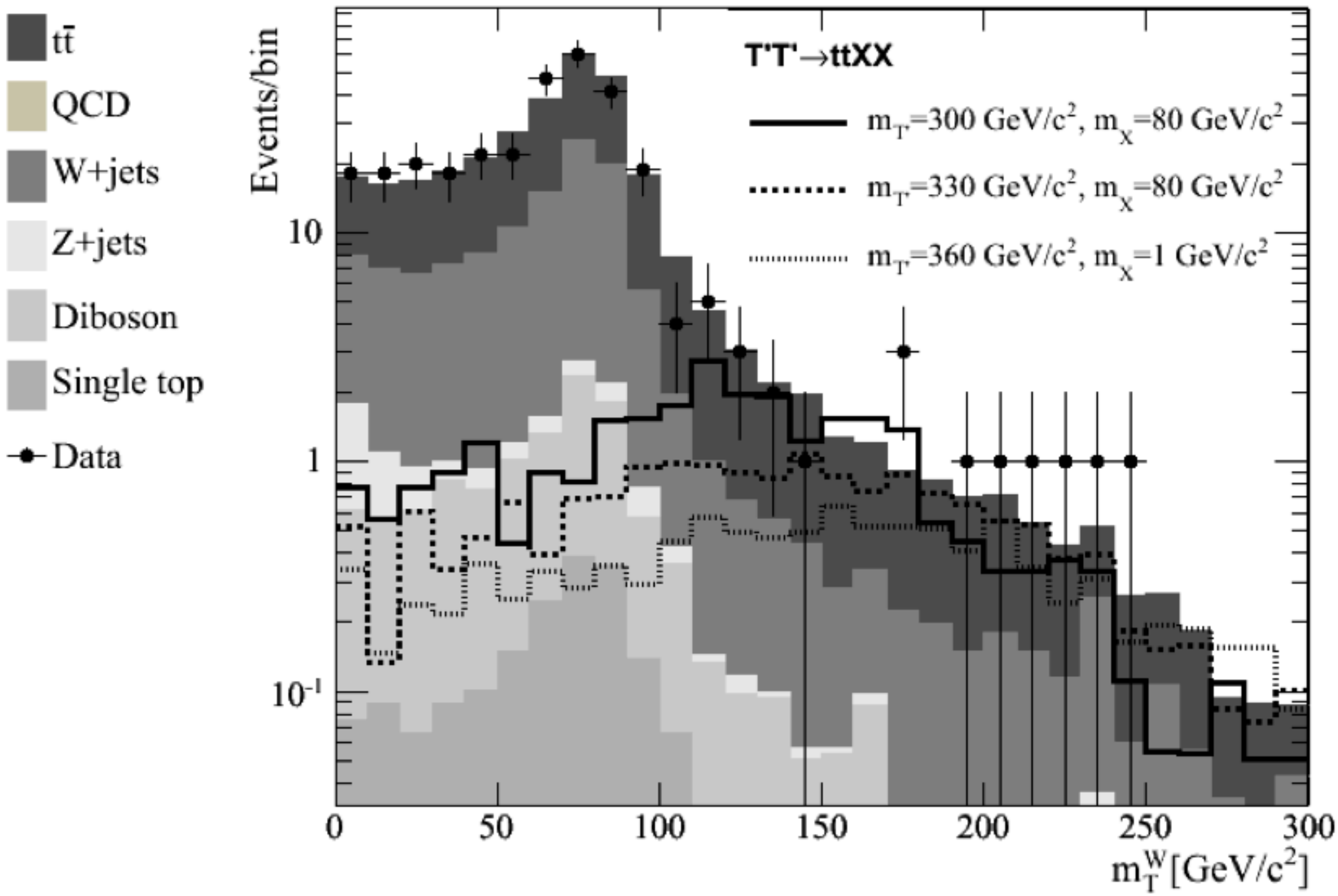


<u>Look for ttbar + invisible X</u>

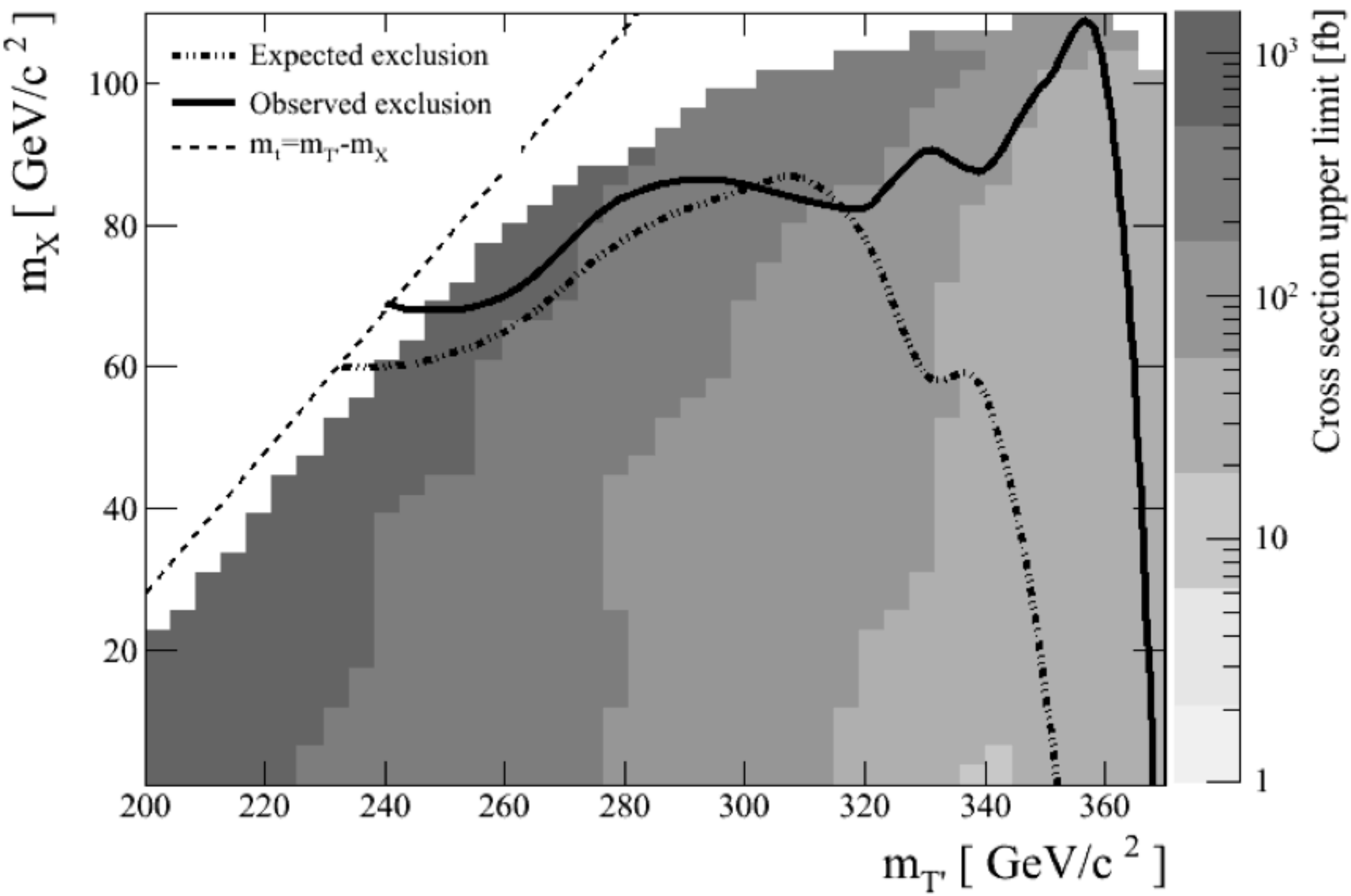
T' -> t+X

stop -> t + LSP

Transverse mass



Limits



Expected exclusion
Observed exclusion
m_t=m_T'-m_X
m_X [GeV/c^2]
m_T' [GeV/c^2]
Cross section upper limit [fb]
200
220
240
260
280
300
320
340
360
20
40
60
80
100
1
10
10^2
10^3

Outline

I. Motivation

II. Strategy

III. Results

a. Heavy resonances (Z′)

b. Heavy quarks (b′, t′)

c. Simplified SUSY

SUSY

<u>Goal</u>

Set limits on SUSY-like processes

in as general a fashion as possible

<u>Approach</u>

Use effective lagrangian, explicitly set particle masses (EW scale):

simple to handle, easy to interpret

Set limits as functions of these masses, not parameters of specific models:

can be easily translated into arbitrary models

How?

<u>How many particles & parameters needed?</u>

Want leptons

needs Ws and Zs, so chargino/neutralinos and sleptons

Want strong production

so squarks and gluinos

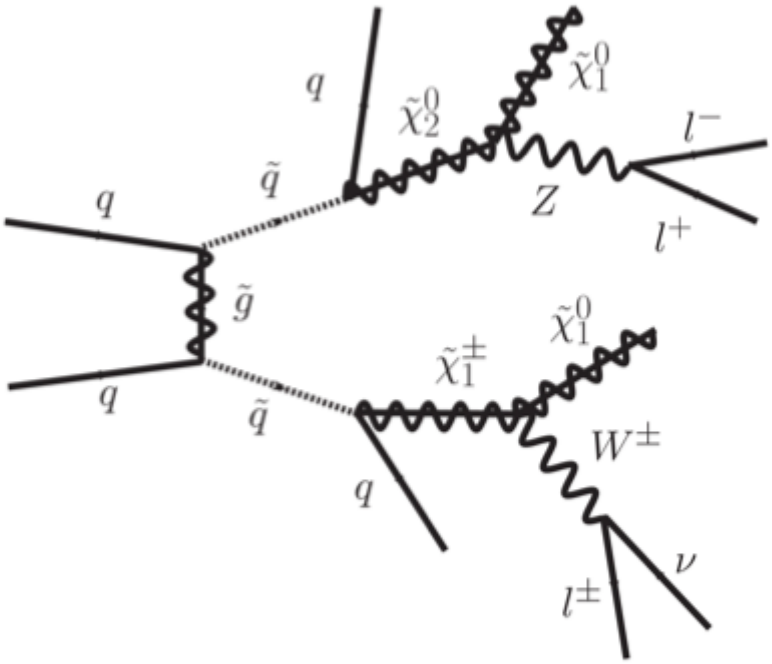
R-Parity conserving

need LSP

Large sections of this space are 3 or 4-dimensional

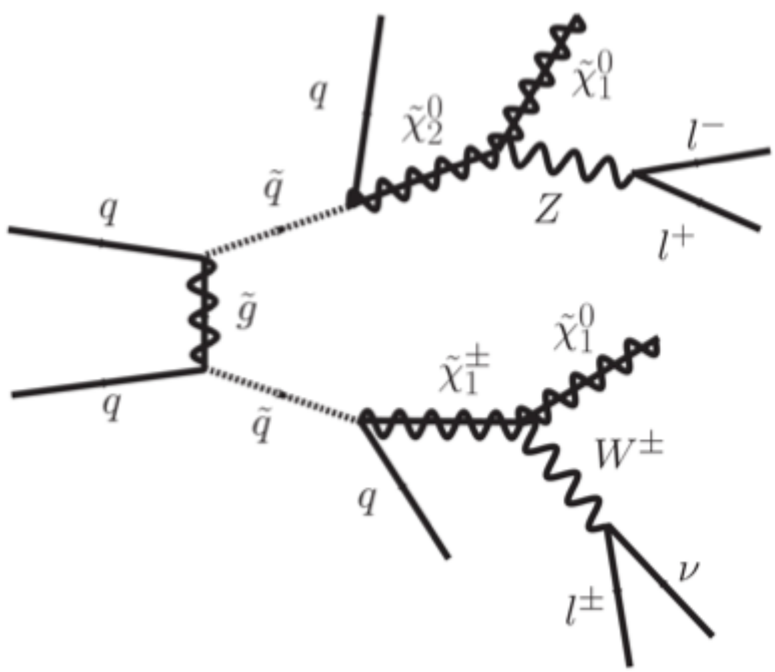
SUSY simplified

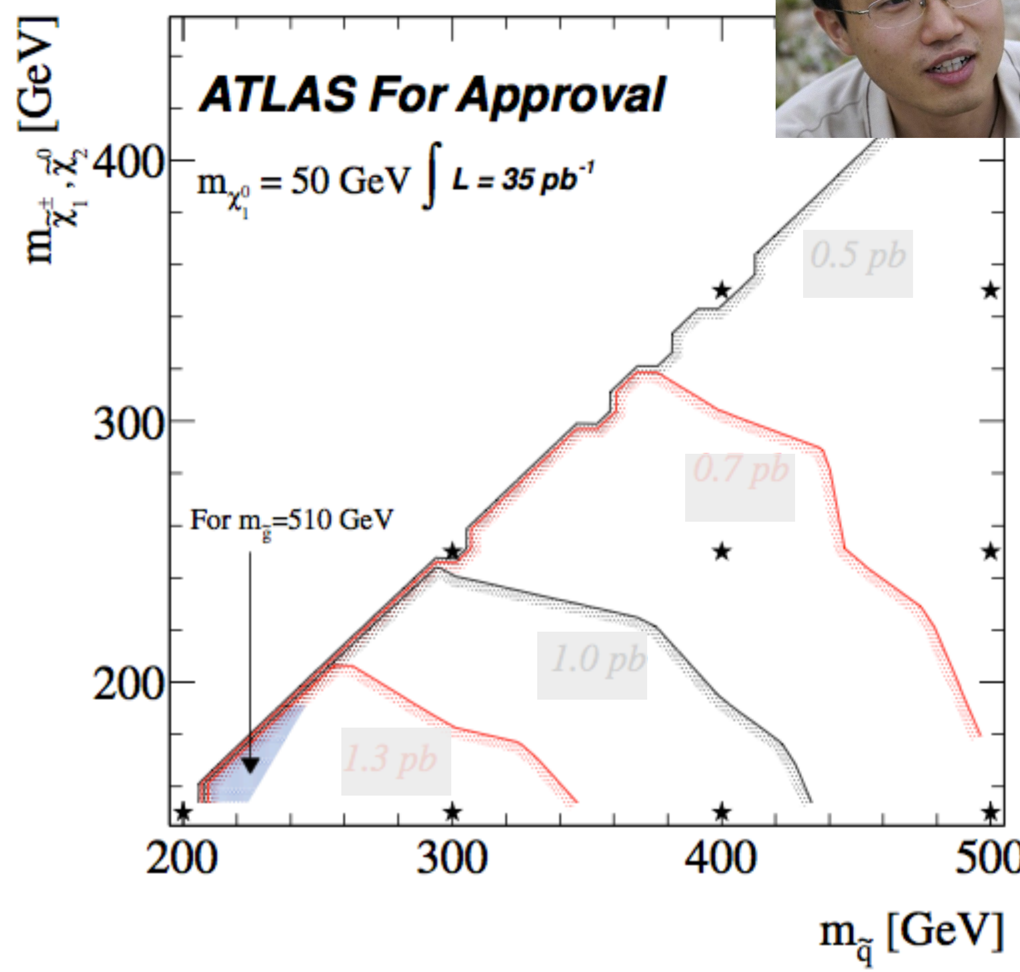
UCI postdoc
Ning Zhou



SS SUSY simplified

UCI postdoc
Ning Zhou





CDF

Still producing world-class physics

ATLAS

Working well, much more to come