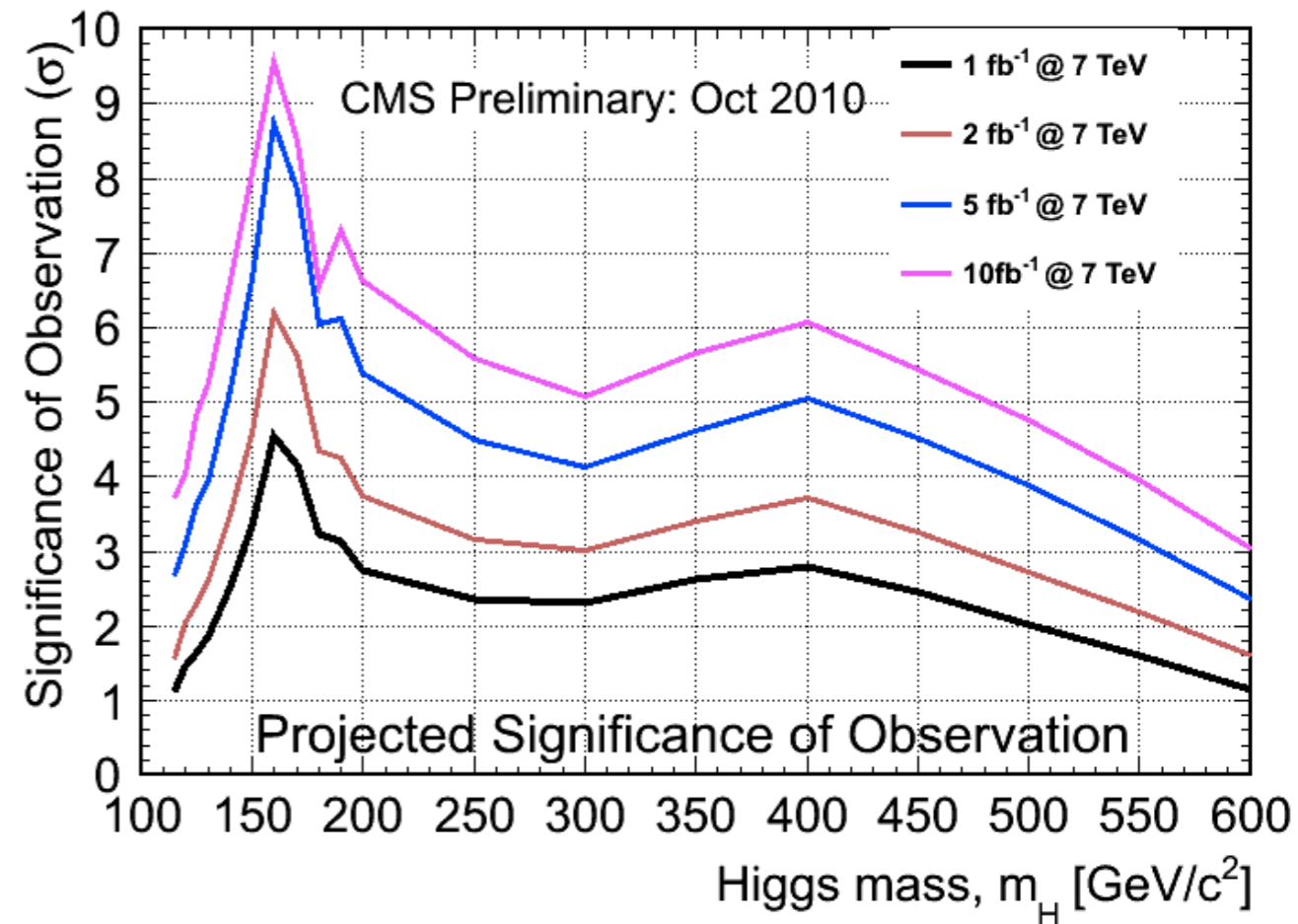
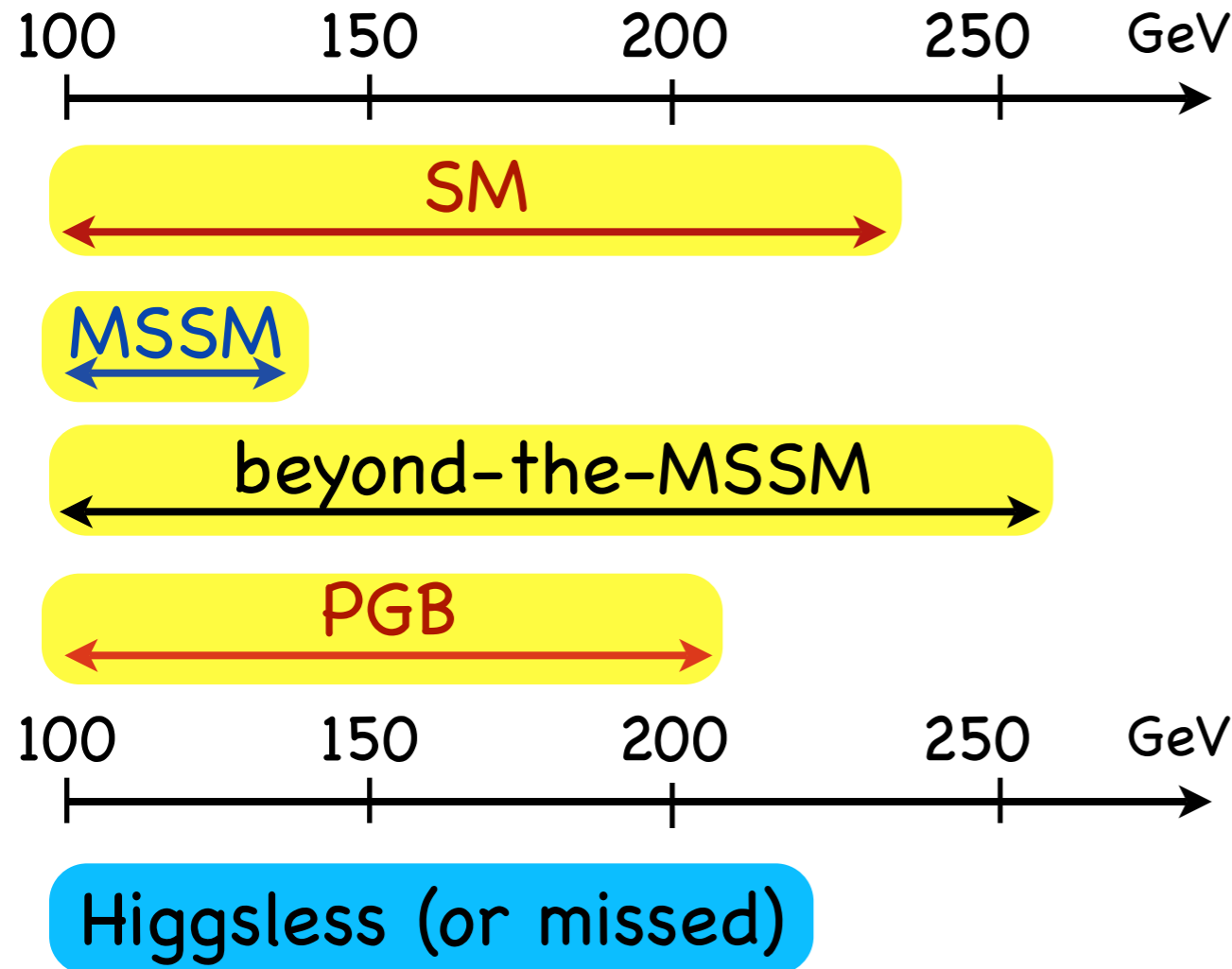


# Some remarks on new physics with jets

R. Barbieri  
Pisa, April 18, 2011

# Everything around the Higgs boson



Fortunately (hopefully) not

# Motivated new particles in jets (only)

(with significant BRs)

$$H \rightarrow q\bar{q} \quad (m_H < 2m_W)$$

$$H \rightarrow aa \rightarrow q\bar{q} q\bar{q} \quad (\text{not limited by } m_H < 2m_W)$$

$$q\bar{q} \equiv \begin{cases} b\bar{b} & (\tau\bar{\tau}) \\ c\bar{c} \end{cases}$$

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$$\begin{array}{lll} \tilde{g} \rightarrow q\bar{q}\chi & \tilde{q} \rightarrow q\chi & \tilde{l} \rightarrow q\bar{q} \\ \tilde{g} \rightarrow g\chi & \tilde{q} \rightarrow qq & \end{array} \quad \begin{array}{l} q = u, d, s, c \\ q = t, b \end{array}$$

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$$Z' \rightarrow q\bar{q} \quad (\text{a "lepto-phobic" gauge boson})$$

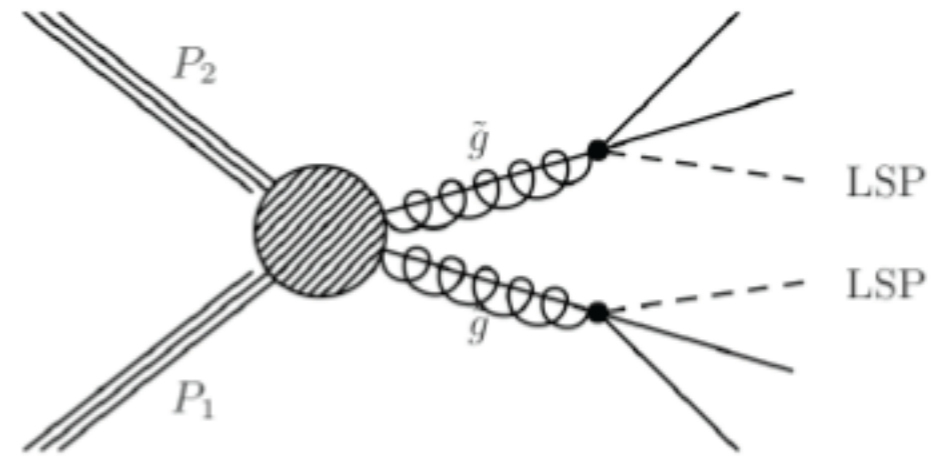
$$V \rightarrow q\bar{q} \quad (\text{a "composite" vector})$$

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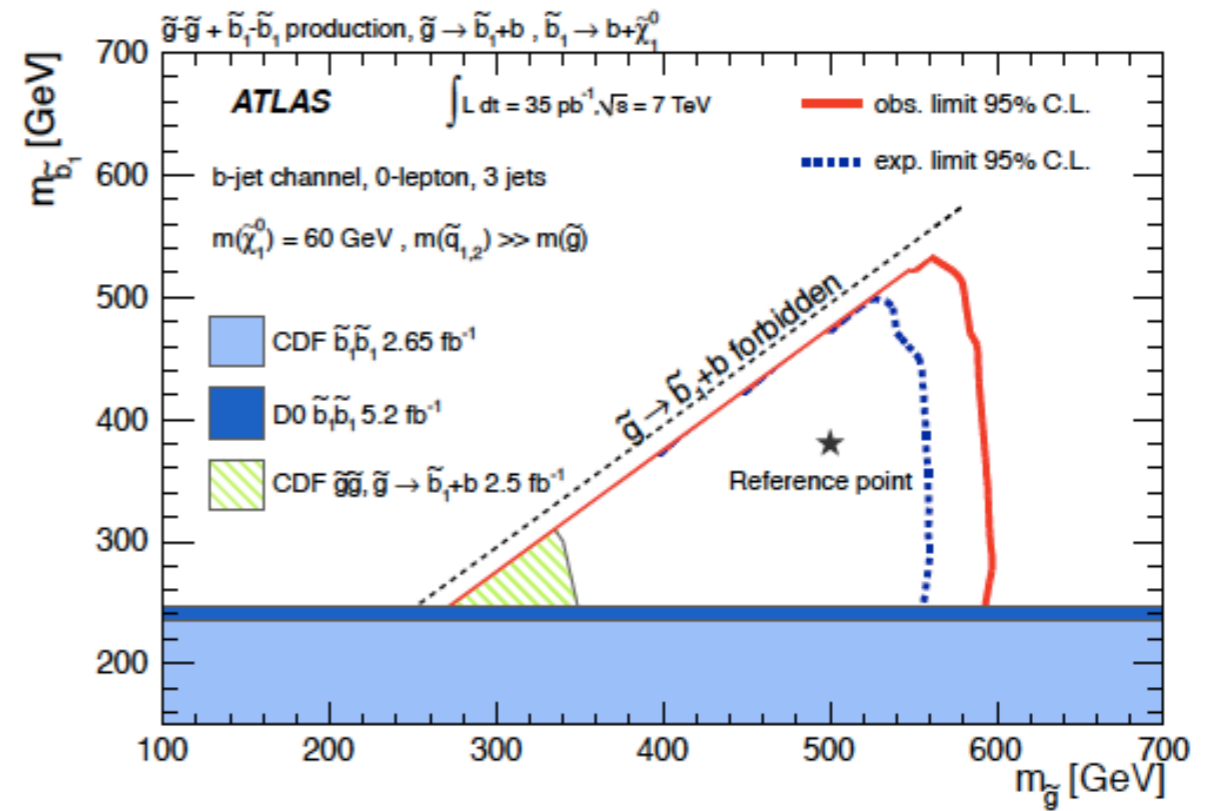
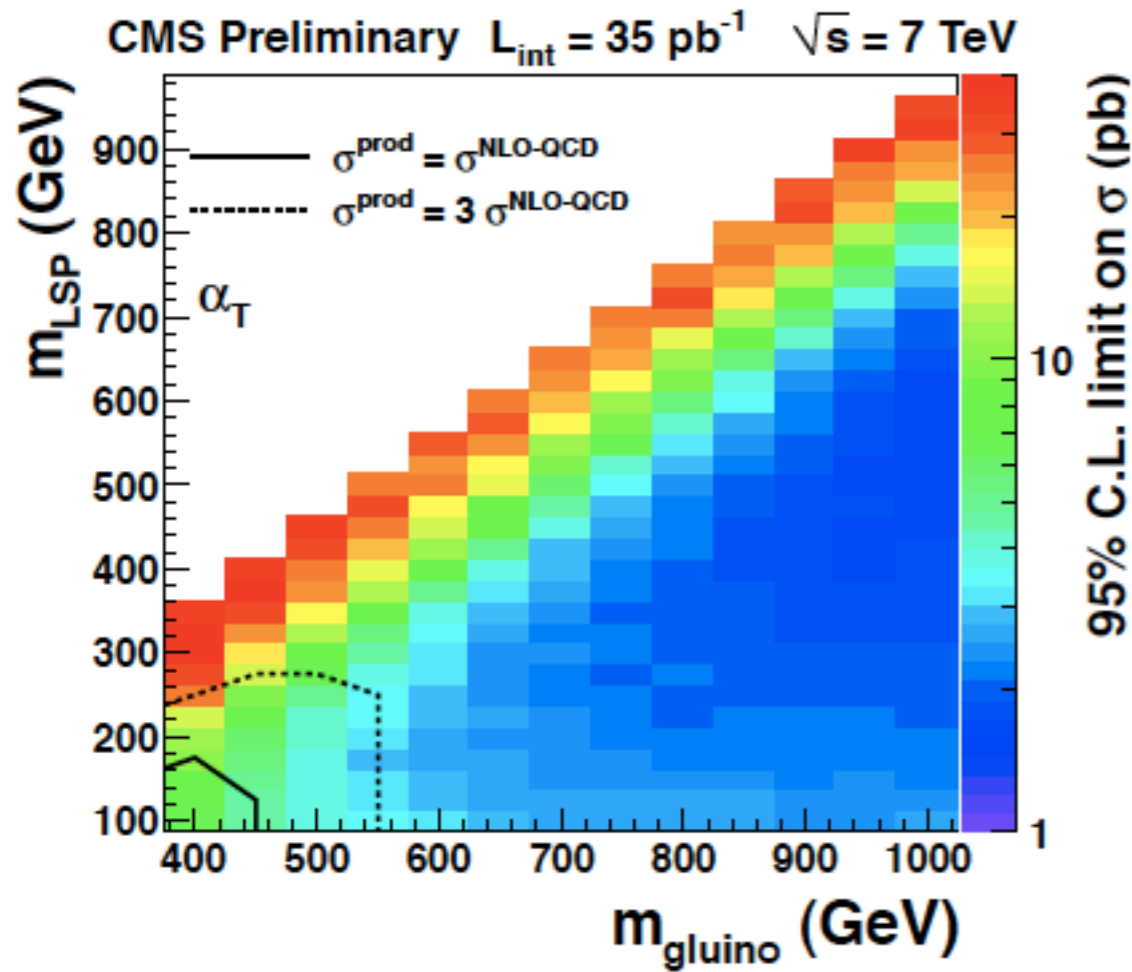

$$Q \rightarrow gq$$

(Can one distinguish a W/Z in a totally hadronic event?)

# gluino pair production



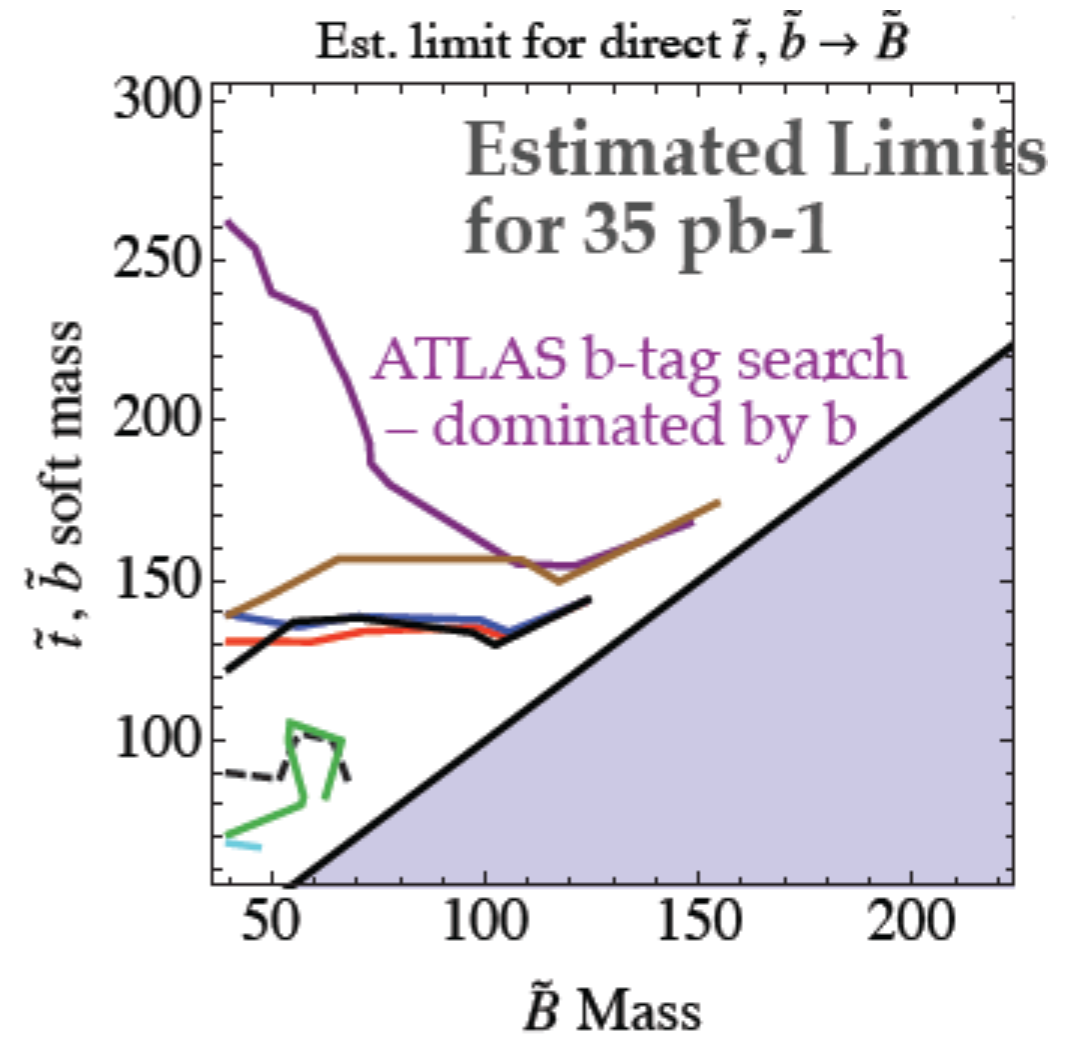
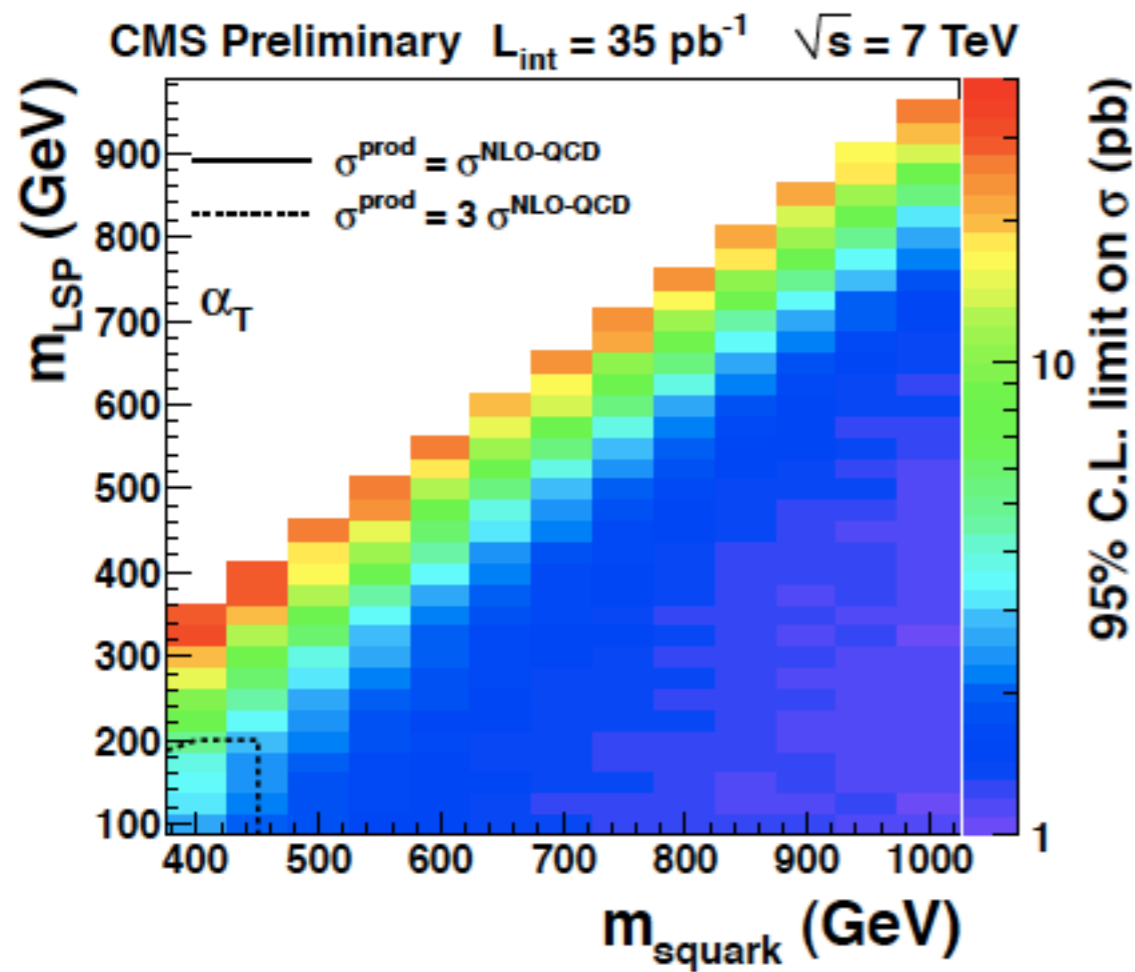
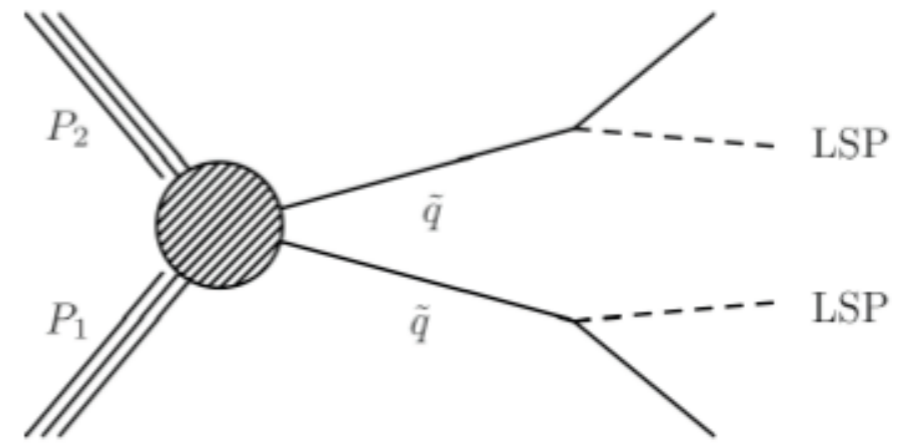
$$\tilde{g} \rightarrow b\bar{b} + \chi$$



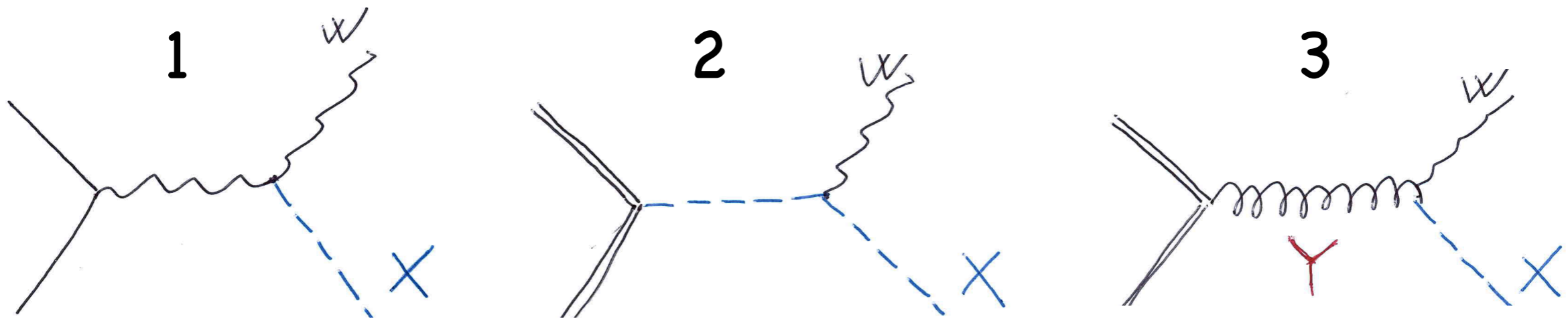
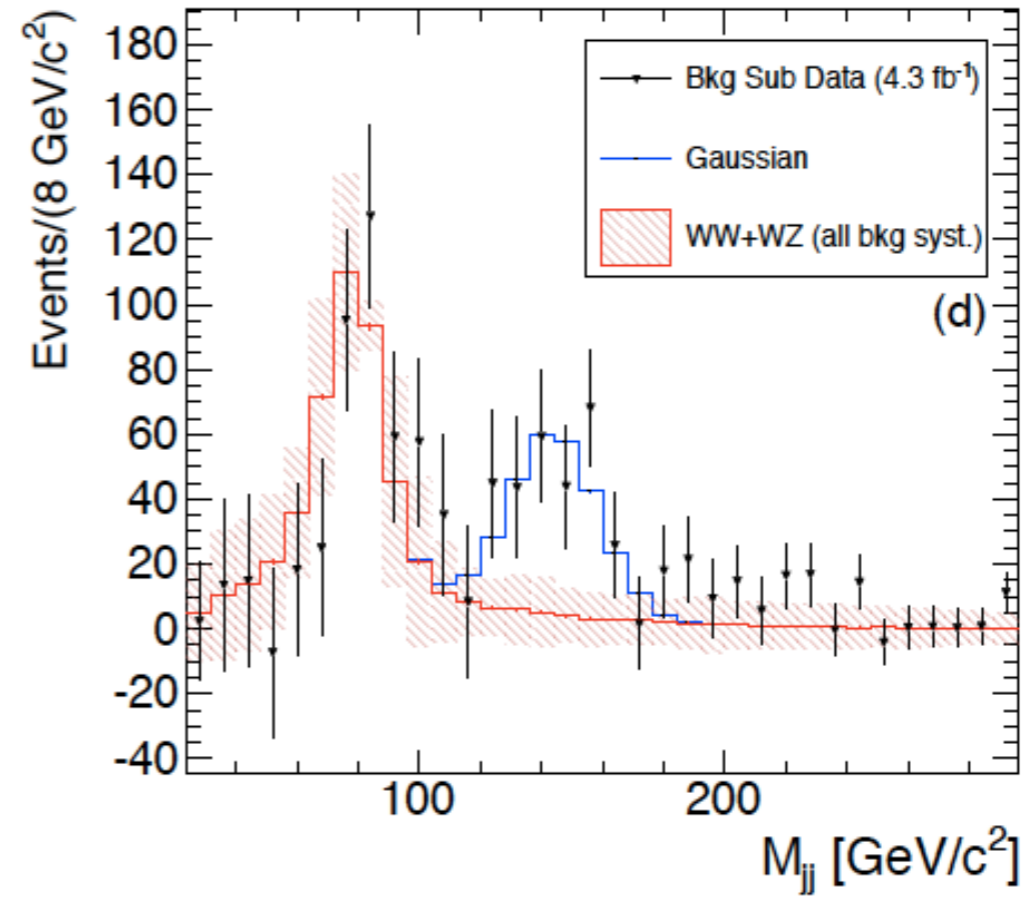
$$\tilde{g} \rightarrow t\bar{t} + \chi$$

$$\tilde{g} \rightarrow t\bar{b} + \chi$$

# stop pair production



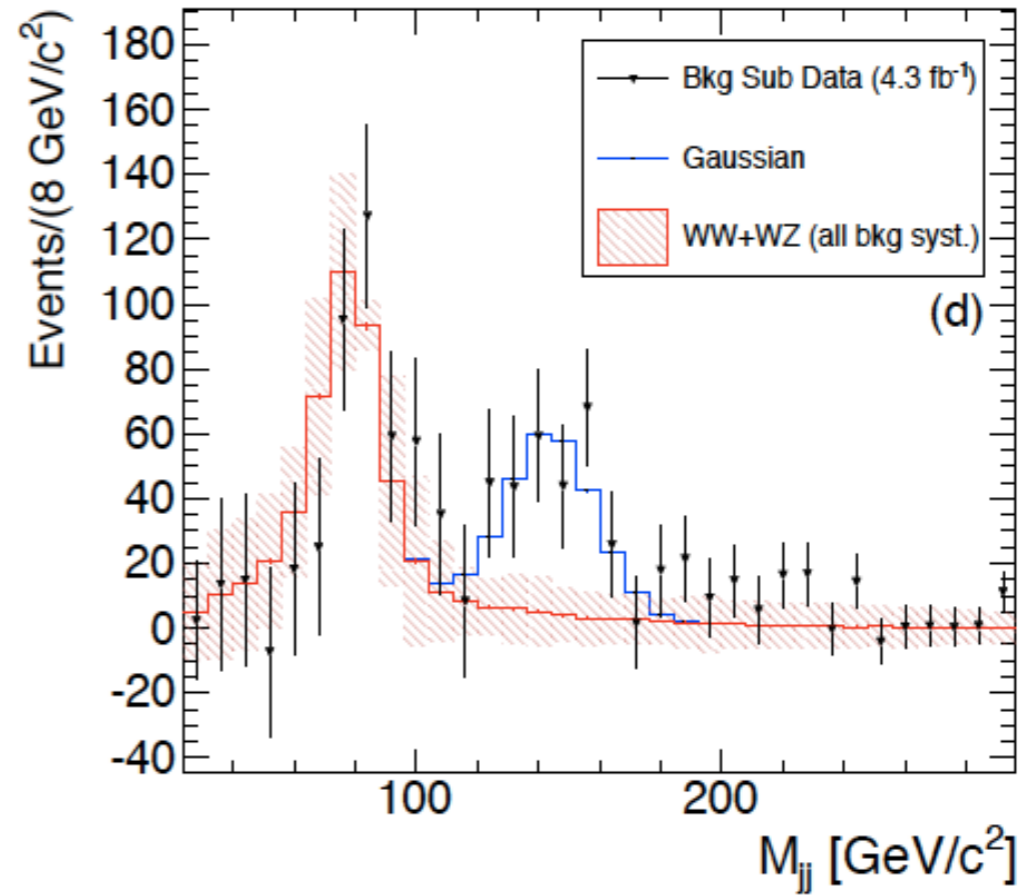
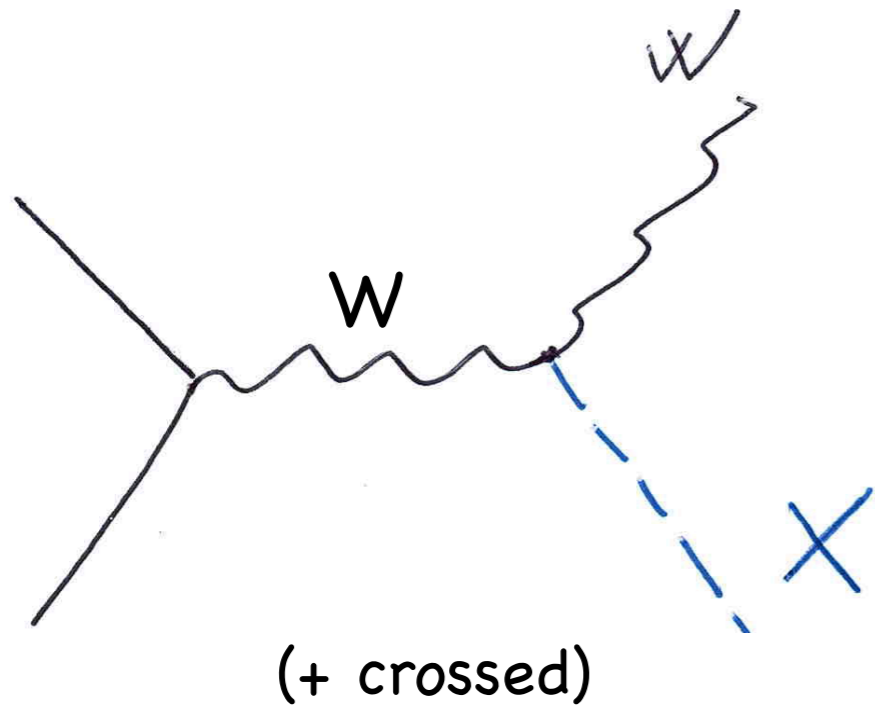
# An exercise (highly incomplete)



all with  $X \rightarrow jj$

4. pair production

1



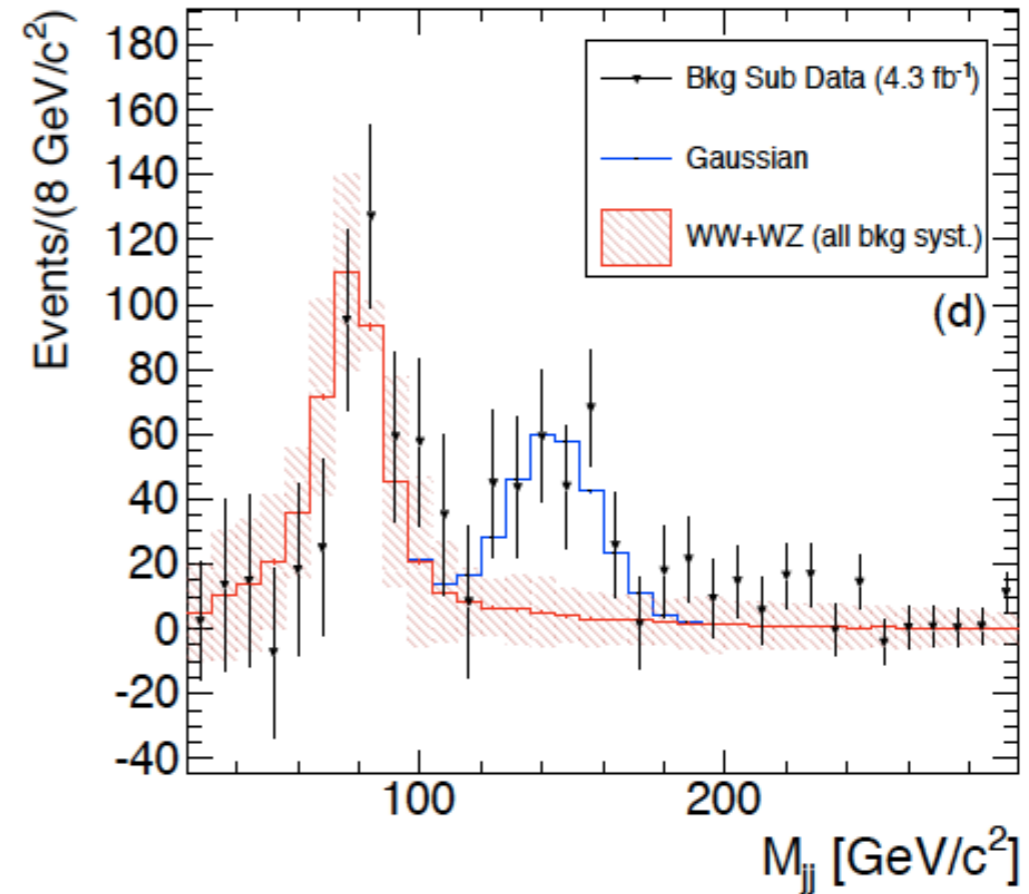
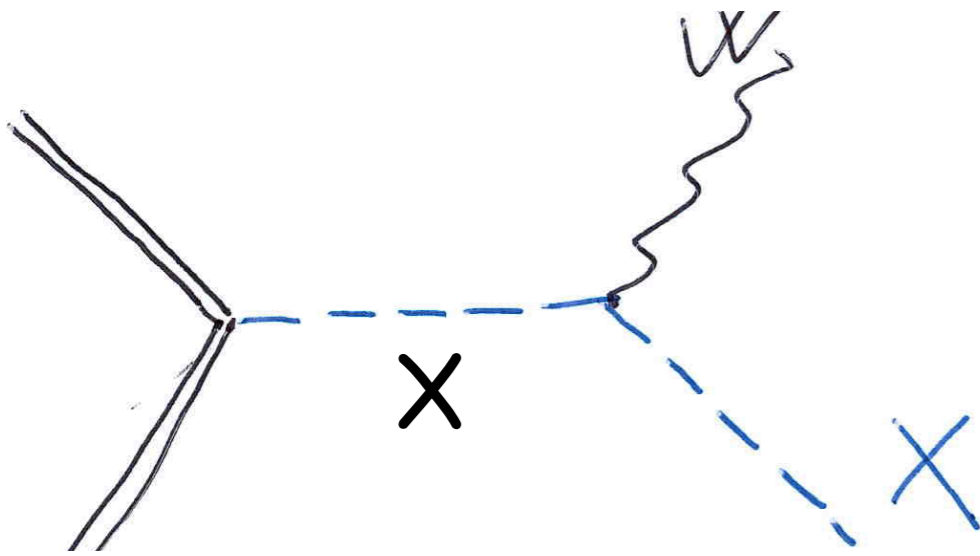
$X = H$  We know

$X = Z' \rightarrow q\bar{q}$  and  $m_{Z'} \approx 140 \text{ GeV}$

Can such a  $Z'$  have escaped detection in  $q\bar{q} \rightarrow Z' \rightarrow q\bar{q}$  ?

(What's the lowest possible coupling of  $Z'$  to  $q\bar{q}$  ?)

2



Initial state can be  $q\bar{q}$ ,  $qq$ ,  $qg$  (but not  $gg$ )

$$X \rightarrow jj \quad \text{and} \quad m_X \approx 140 \text{ GeV}$$

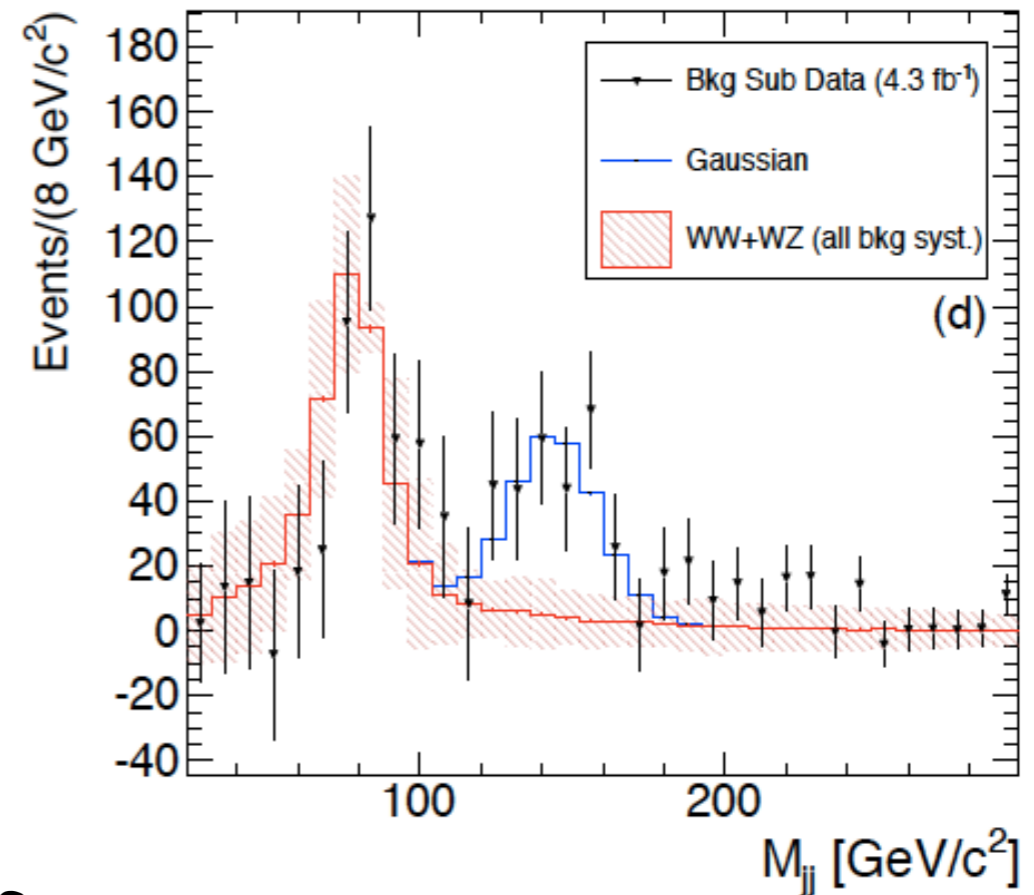
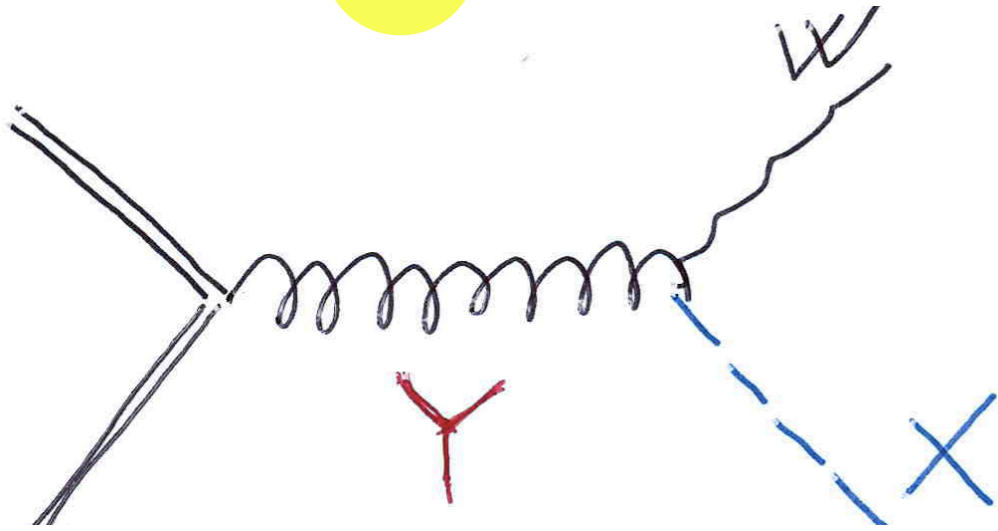
$$jj = q\bar{q} \text{ or } qq \text{ or } gq$$

Can such an  $X$  have escaped detection in  $jj \rightarrow X \rightarrow jj$ ?  
(now the  $X \rightarrow jj$  coupling is directly fixed by the signal)

No signal in  $Z jj$ ?



3



$Y$  can be many different things

A motivated case:  $q\bar{q} \rightarrow Y \rightarrow WX$

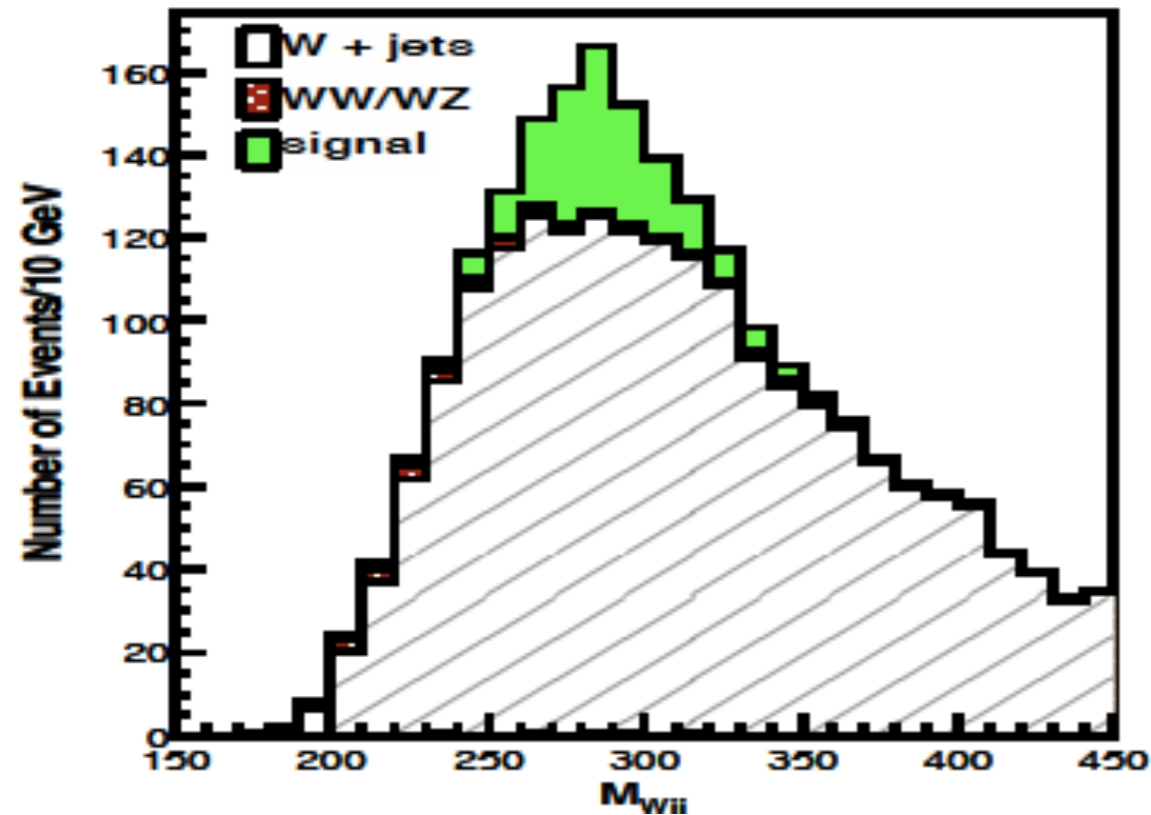
$Y$  a composite spin-1 iso-vector

$X$  a scalar (the Higgs) or a pseudo-scalar with  $X \rightarrow q\bar{q}$

No bump in  $M_{Wjj}$  ?

No signal in  $q\bar{q} \rightarrow Y \rightarrow q\bar{q}$  ? or in  $q\bar{q} \rightarrow Y \rightarrow WZ$  ?

No bump in  $M_{Wjj}$  ?



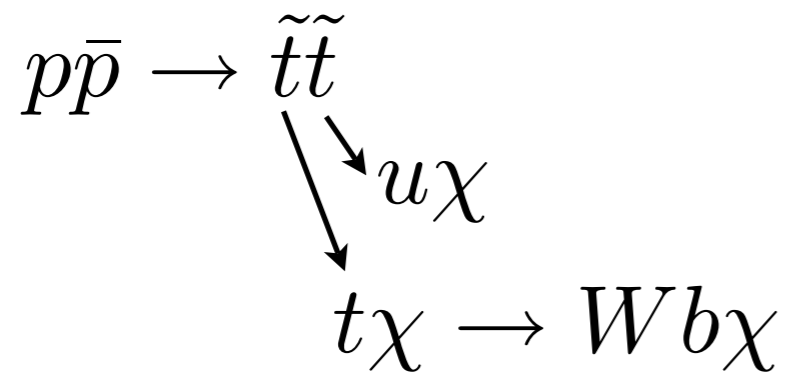
Eichten, Lane, Martin

What about a much broader resonance at higher  $M_{Wjj}$  ?

Need at least to see the distribution in  $M_{Wjj}$

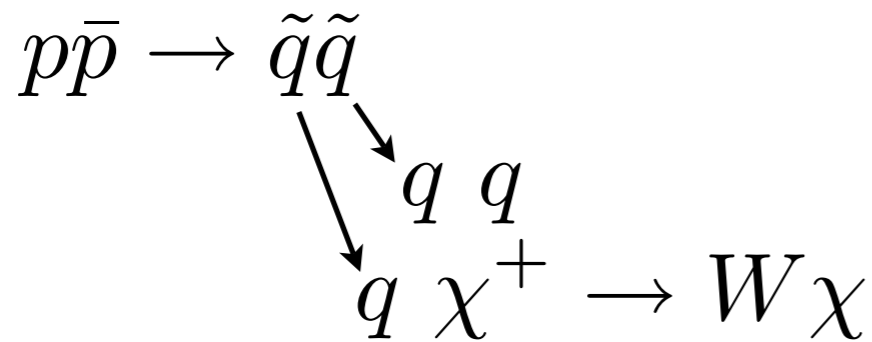
(D'Agnolo)

# 4. pair production



$u\ b = jj$  non-resonant

Isidori, Kamenik



$m_{\tilde{q}} \approx 140\ GeV$

soft and invisible

Can they have escaped detection? (Tevatron and LHC)