Search for color sextet s
in early LHC experime

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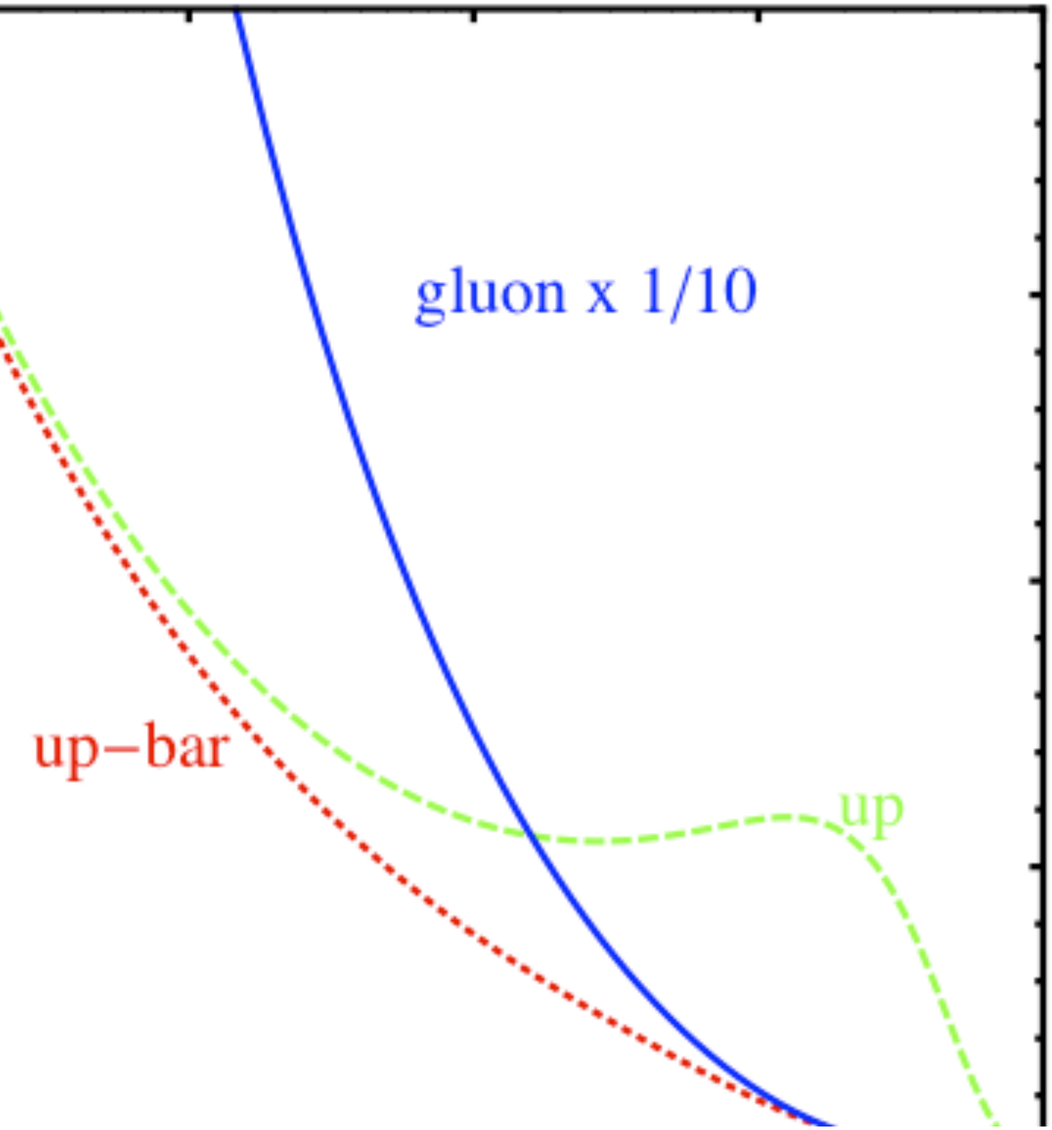
laboration with:

ing-Hong Cao, Chuan-Ren Chen, Gabe Shaughne years of the LHC decade will probe a new frontier of ph



DM, SU

★ Focus here on Ne

Production probe

where valence-qu

★ For early discover

(7 TeV and 1fb^{-1}

helps if the NP is

✷ ***Colored*** - large

✷ ***Novel, easily d***

signature

-quark initial states can produce
 and anti-triplet resonances

$$3 \times 3 = 6 + \bar{3}$$

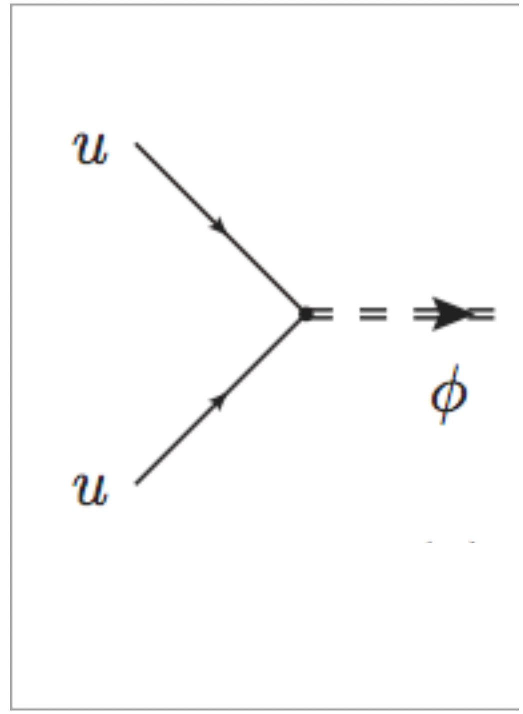
$$3 \times \bar{3} = 1 + 8$$

rvation of sextet scalar (ϕ) would
changes in RGE unification equations

ings (λ_R^{ab}) are not proportional to
 mass; bounds from Tevatron data

$$\phi_j^* K_{ab}^j q_a^T C^\dagger \lambda_R^{ab} P_R q_b + h.c.$$

★ Same-sign top pa



✳ large cross se

✳ Signature: san
pair, b-jets, ar

✳ top quark pol

R. N. Mohapatra, Nobuchika Okada, Hai-Bo Yu,

Chuan-Ren Chen, William Klemm, Vikram Rentala and Kai Wan

Jonathan M. Arnold, Maxim Pospelov, Michael Trott, Mark B. Wi

Ilia Gogoladze, Yukihiro Mimura, Nobuchika Okada, Qaisar Shafi

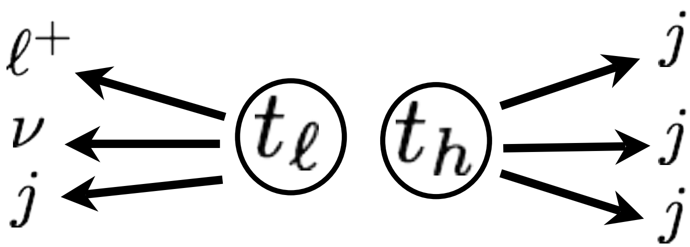
ctroweak quantum numbers

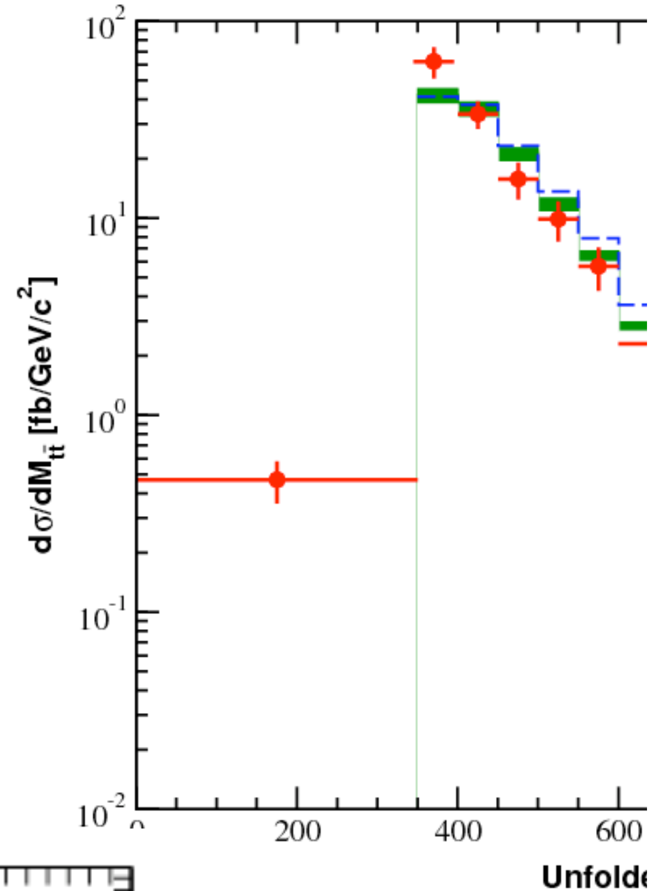
$SU(2)_L$	$U(1)_Y$	$\lvert Q \rvert = \lvert T_3 + Y \rvert$	coupli
1	1/3	1/3	QQ,
3	1/3	1/3, 2/3, 4/3	Q
1	2/3	2/3	D

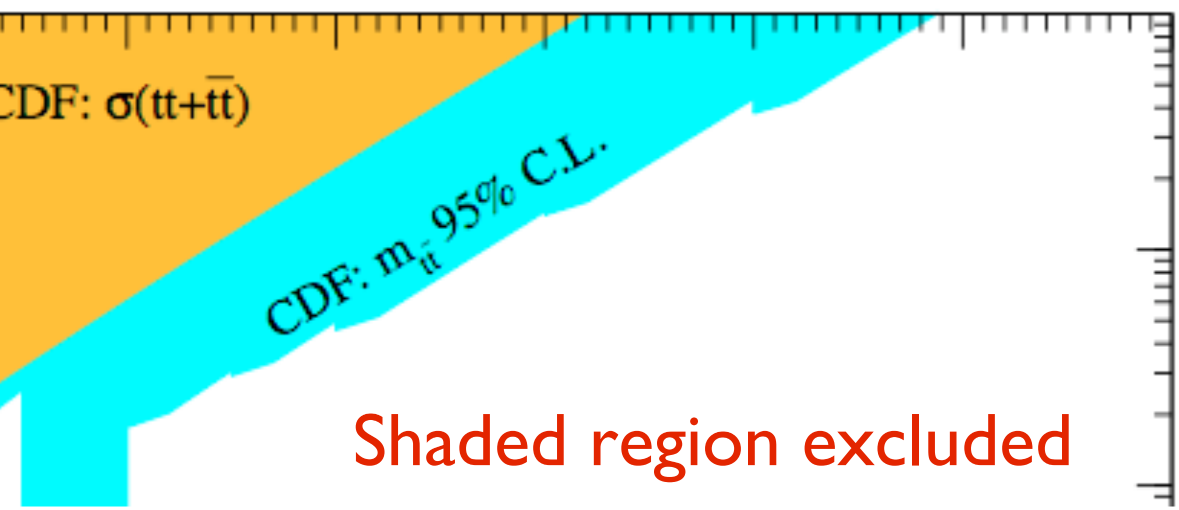
pair cross section constrained
DF measurement of
me-sign top pair search

$$\sigma_{tt+\overline{tt}} < 0.7 \text{ pb}$$

stribution in $M_{t_\ell t_h}$





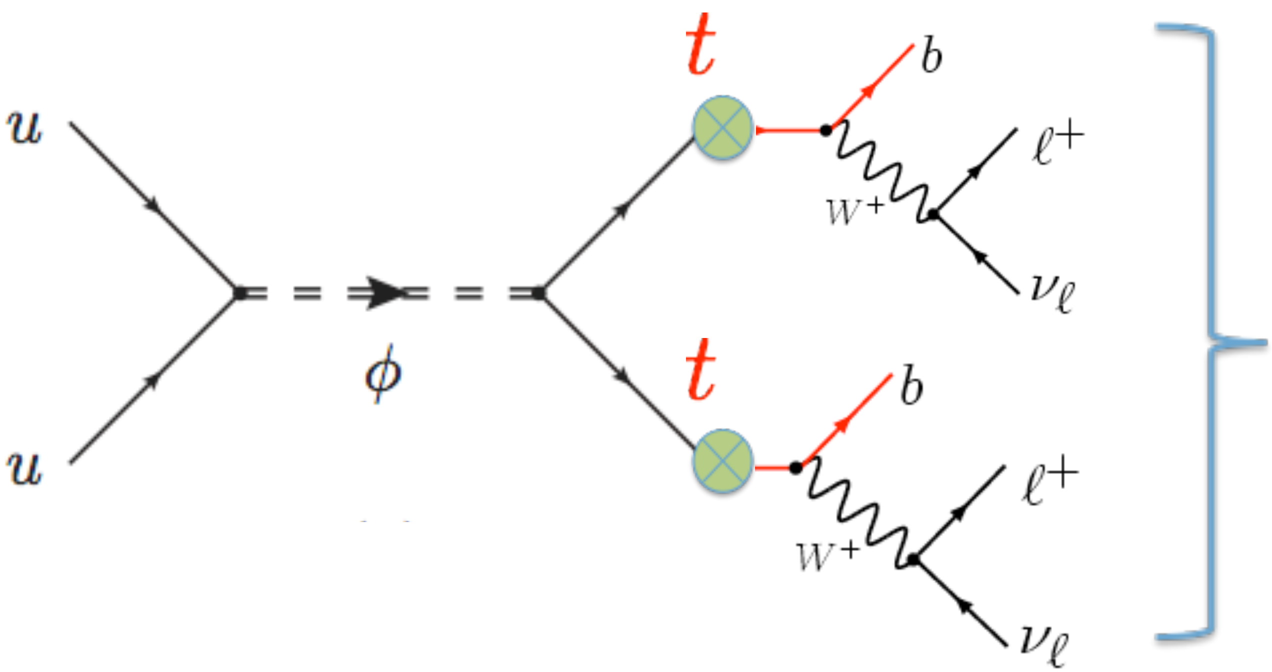


$\sigma(uu \rightarrow$

$\propto \quad \sigma(uu \rightarrow$

$\propto \quad [\sigma(uu -$

l topology



same sign c
2 b-jets an

better r
than fo

nent backgrounds (ALPGEN)

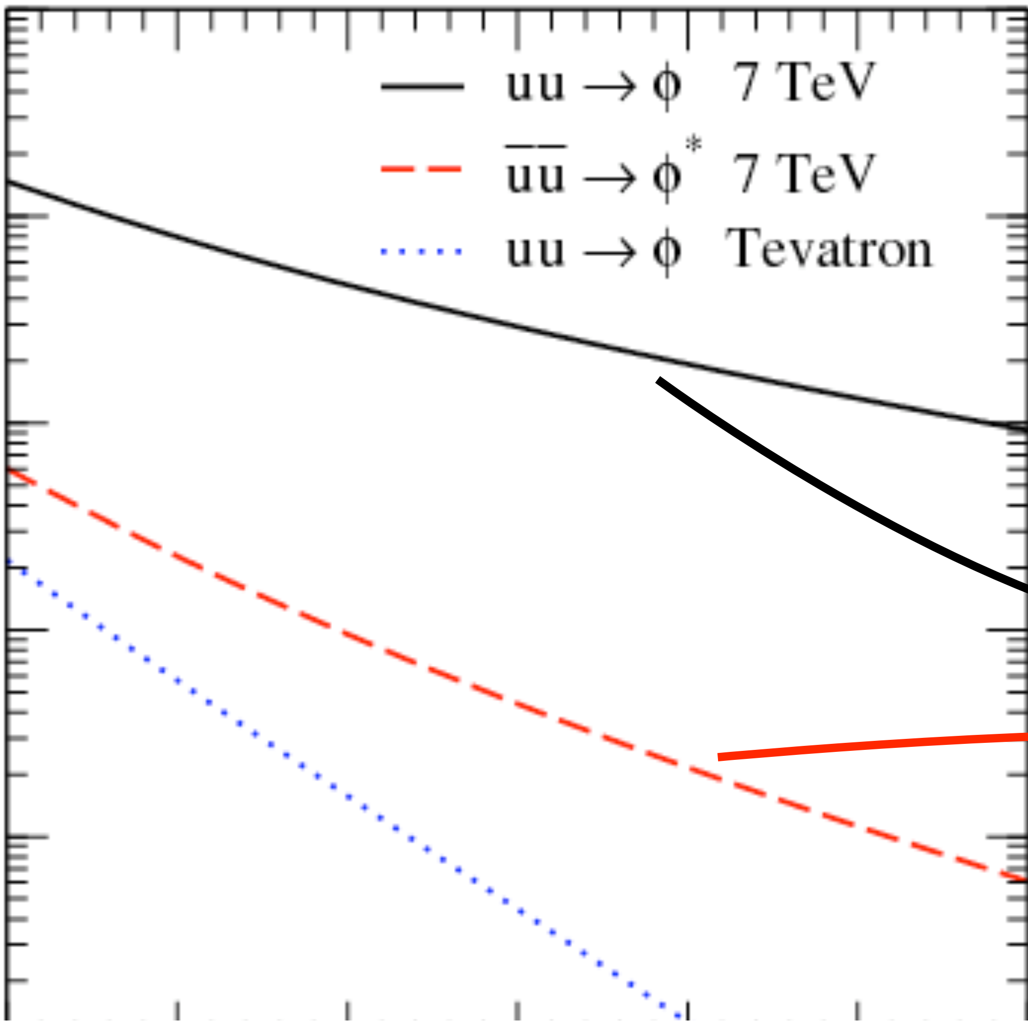
$$\rightarrow t\bar{t} \rightarrow b\bar{b}W^+W^-,\ W^+ \rightarrow \ell^+\nu,\ W^- \rightarrow jj,\ \bar{b} \rightarrow \ell^+$$

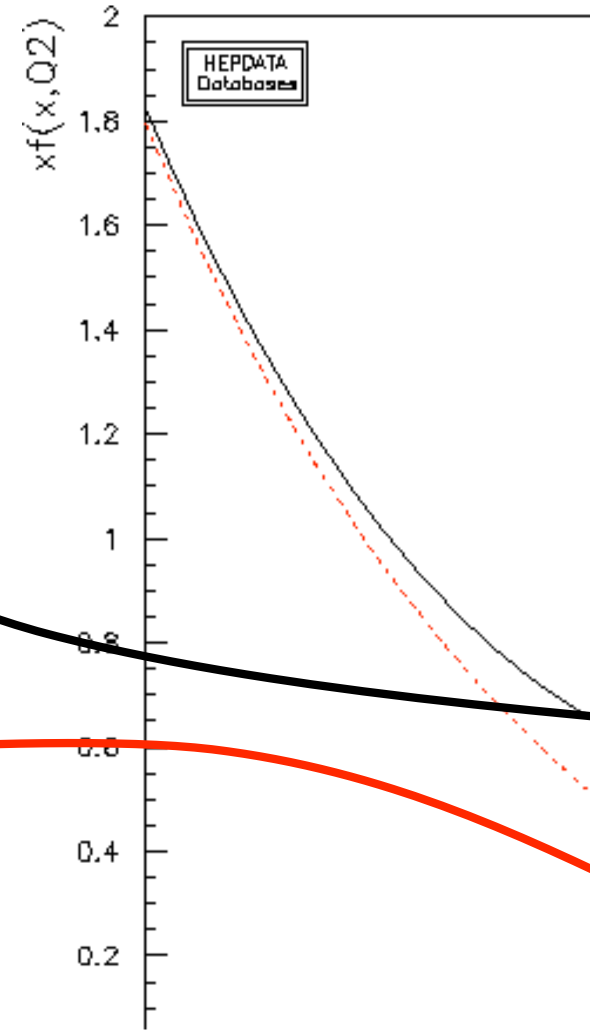
$$\rightarrow W_1^+W_2^+jj,\ W^+ \rightarrow \ell^+\nu$$

re positive di-muons

ame-sign top pairs contribute an asymmetry in charge m

trong dependence on sextet scalar mass owing to PDF c





ptance cuts

ptons $p_{T,\ell} \geq 20 \text{ GeV} \qquad |\eta_\ell| < 2.0$

ts: $p_{T,j} \geq 50 \text{ GeV} \qquad |\eta_j| < 2.5$

eparation: $\Delta R_{\ell\ell,\ell j,jj} > 0.4$

gy smearing

$$\frac{\delta E}{E} = \frac{a}{\sqrt{E/\text{GeV}}} \oplus b$$

ptons: $a = 10\%, \qquad b = 0.7\%$

s: $a = 50\%, \qquad b = 3\%$

ng rates / Mistag rates

e cuts to extract signal:

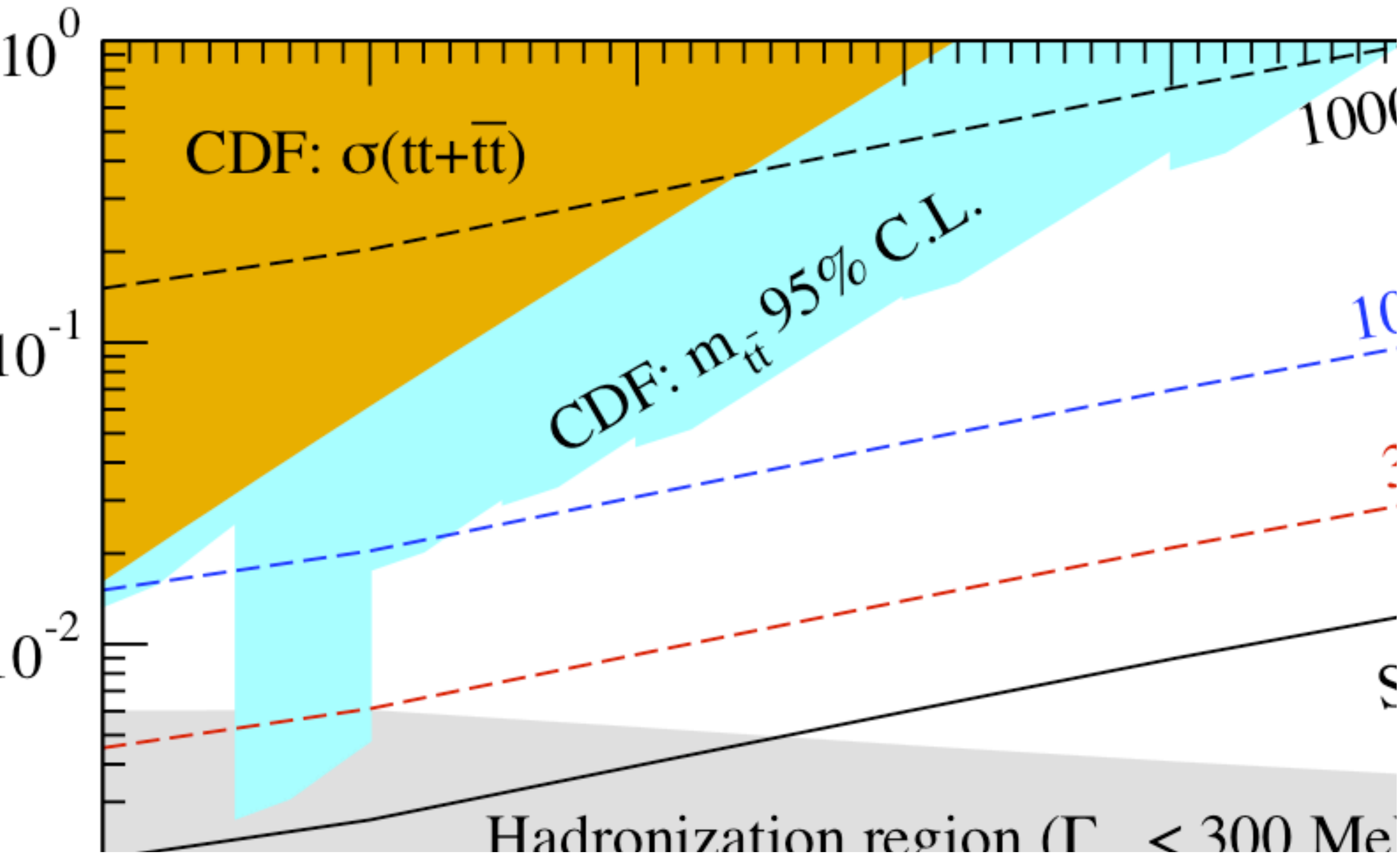
me sign di-muons

vo jets with pT>50GeV

✳ Shown are numbe

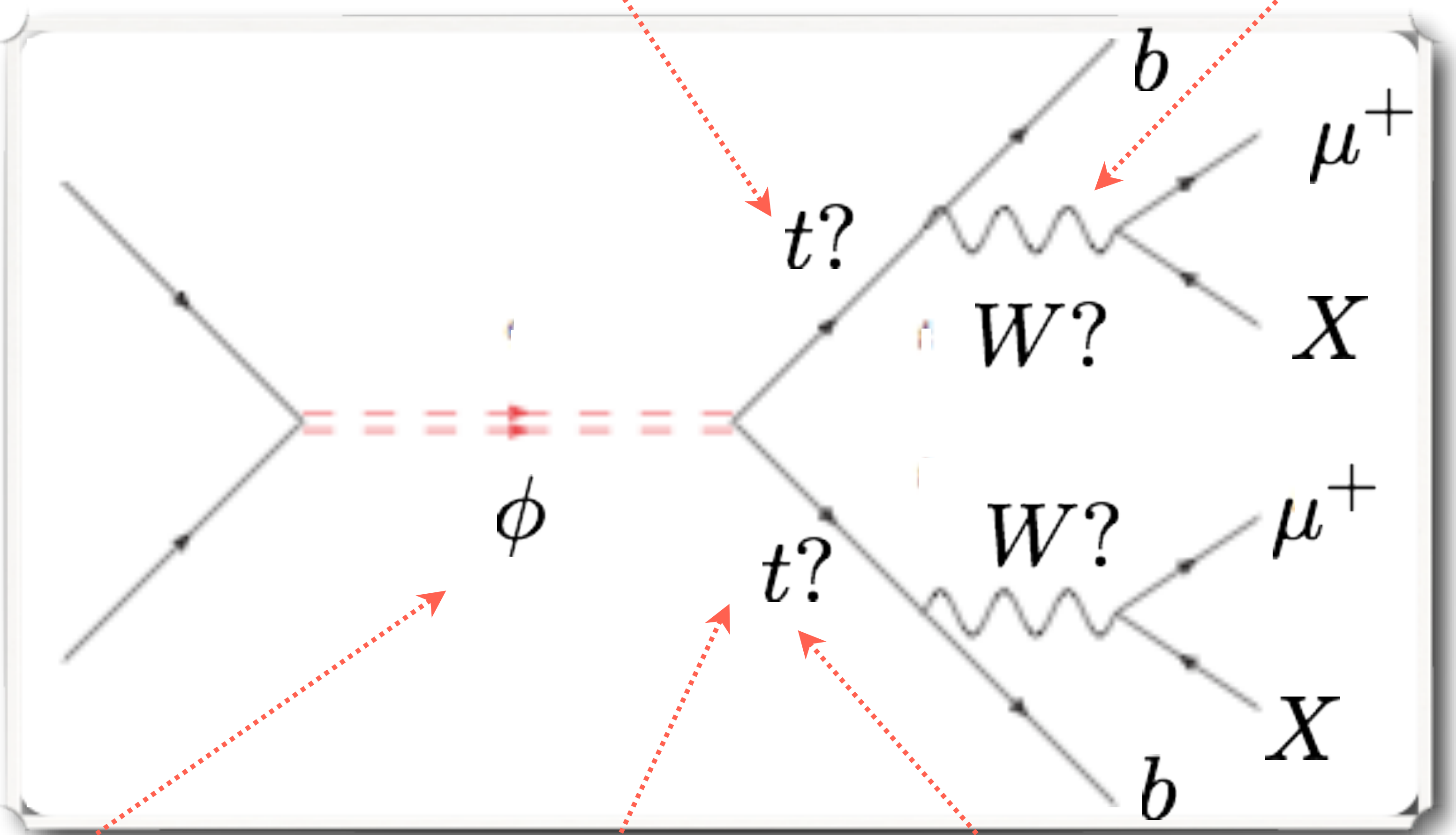
✳ about 4.6 backgro

7 TeV $\mathcal{L} =$



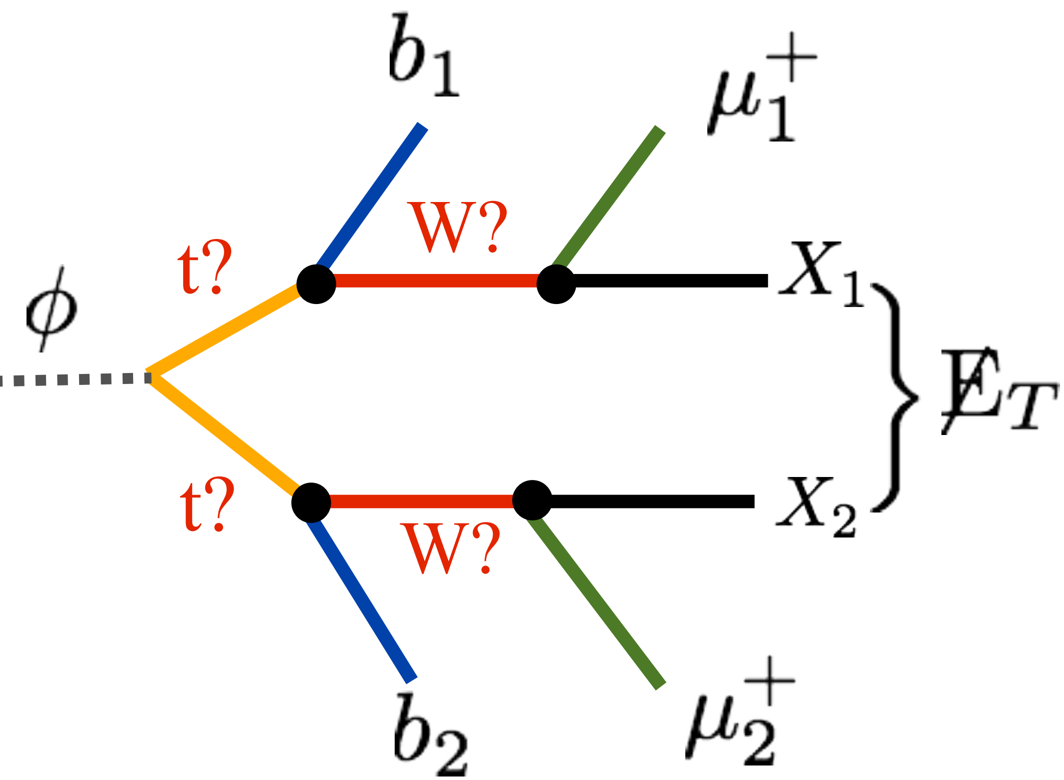
) Does each jet + lepton pair
reconstruct a top quark?

(1) Are the mu
from W-bo

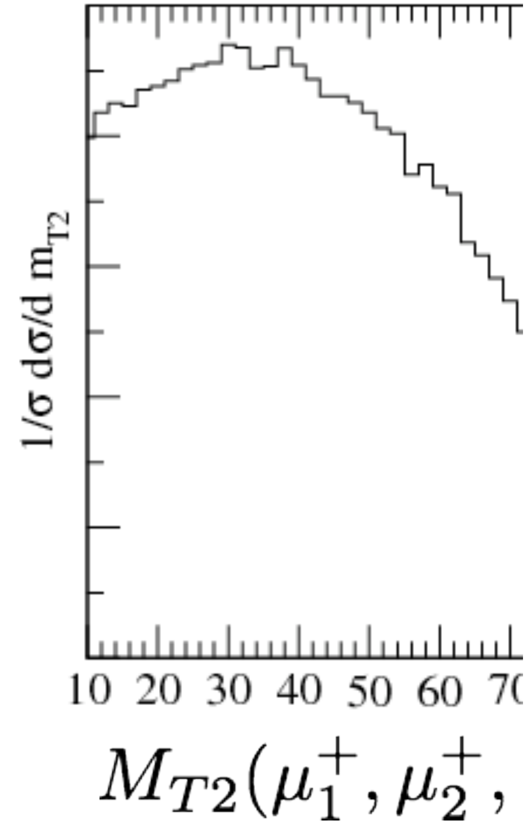


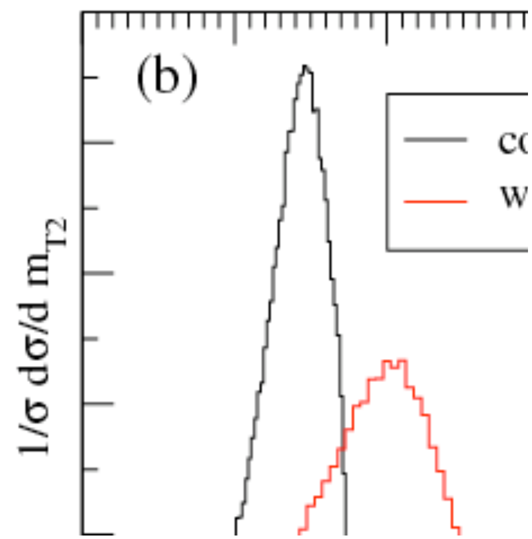
t is the mass

is similar to transverse mass of
oson, but works for the case of
missing particles in the final state

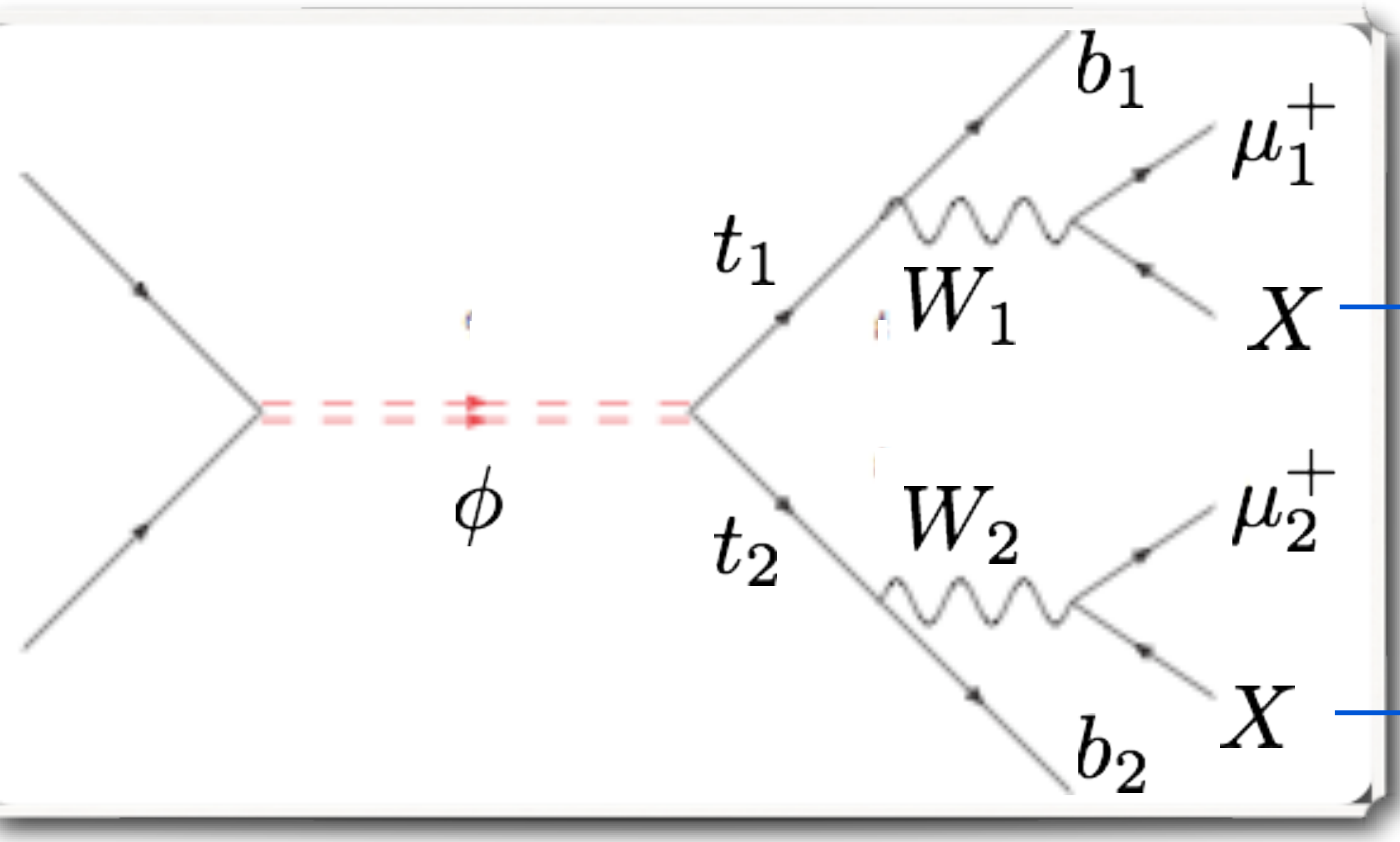


$$(\mu_1^+, \mu_2^+, \not{E}_T) \le m_W^2$$





ur unknowns and four on-shell conditions

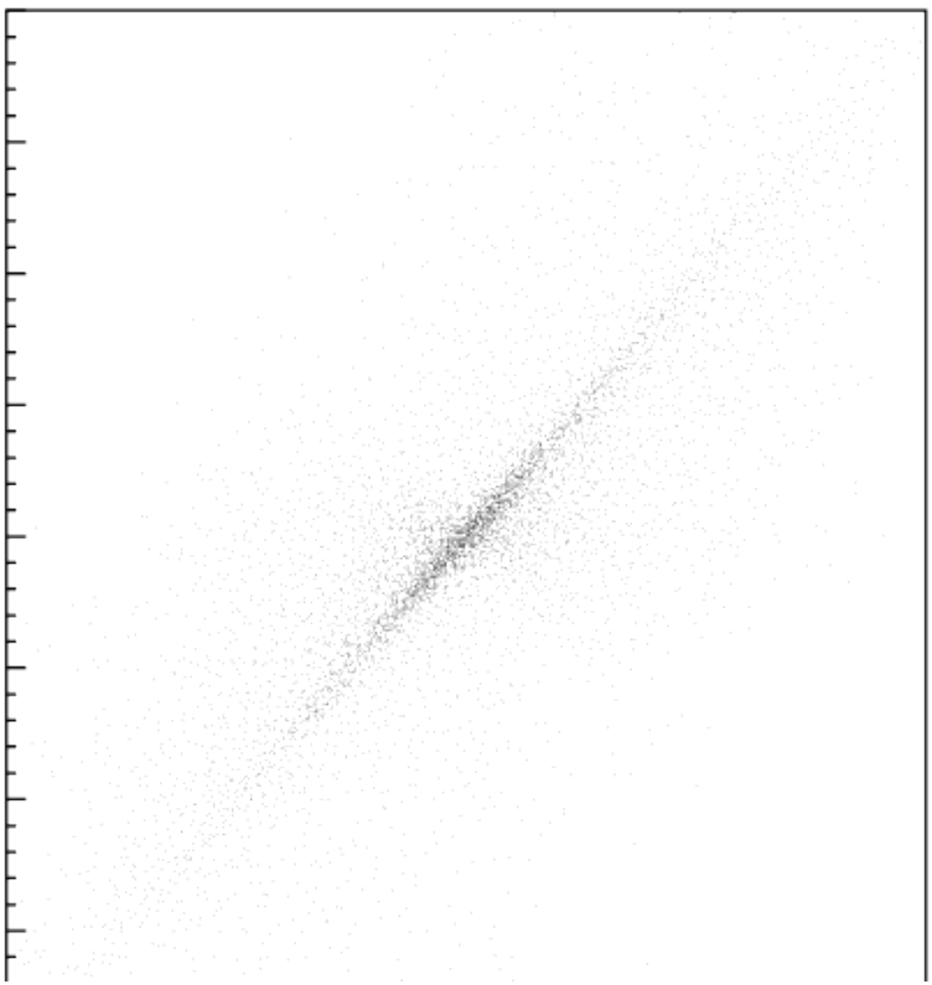


$$= (p_{\mu_1} + p_{\nu_1})^2$$

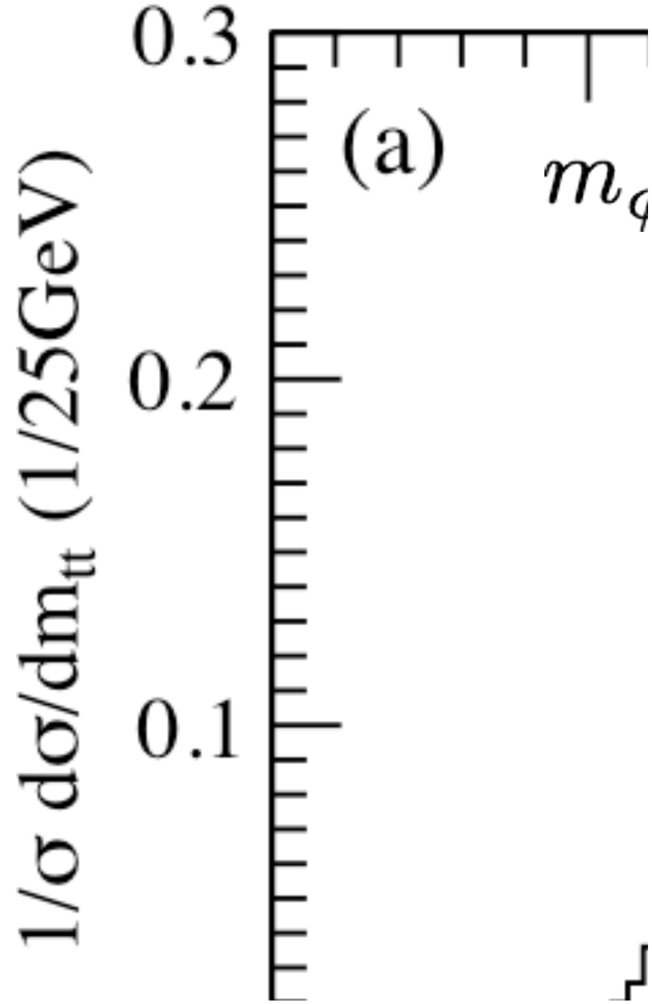
$$= (p_{\mu_2} + p_{\nu_2})^2$$

Quartic equation

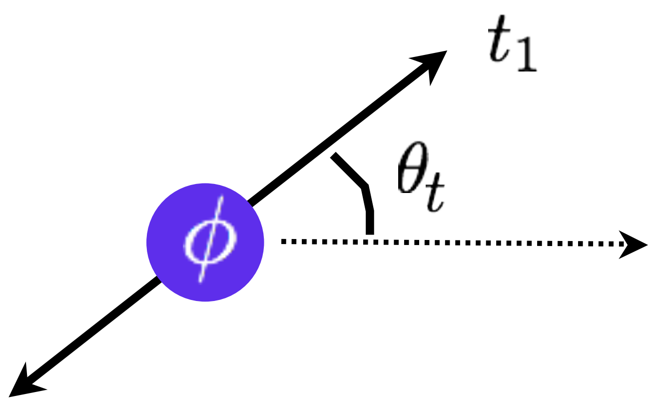
g correlation between the true and reconstructed $p_x^{\nu_1}$



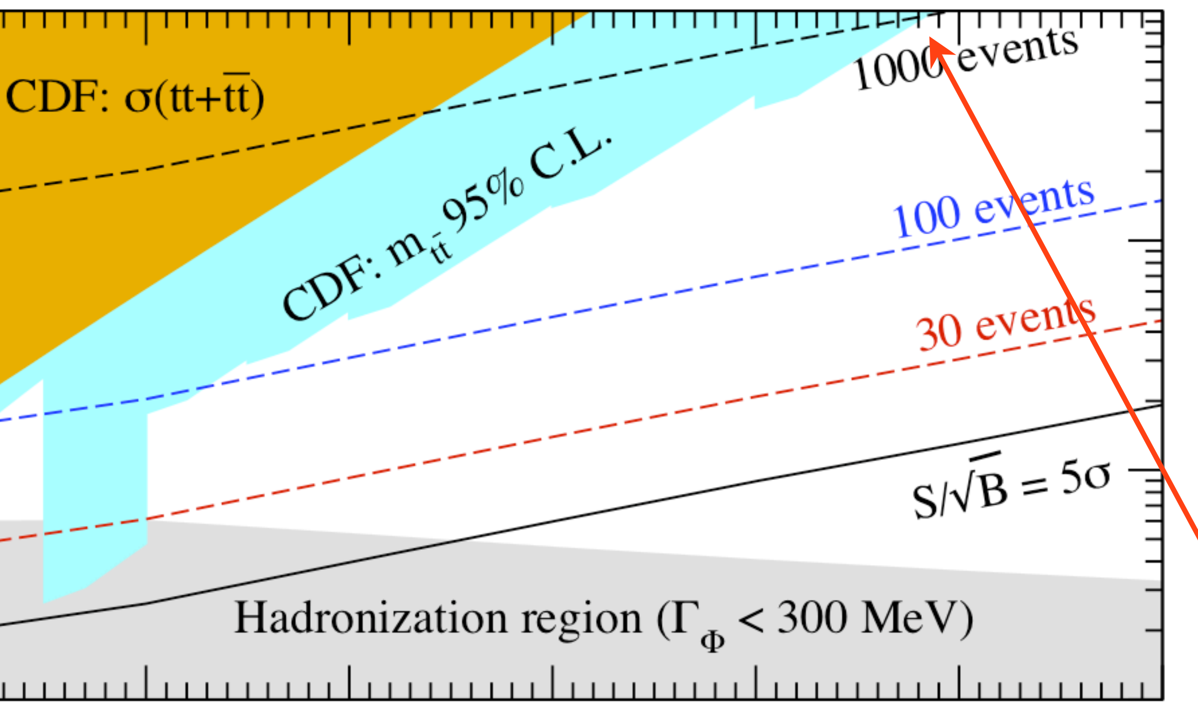
★ The mass of the can be determin

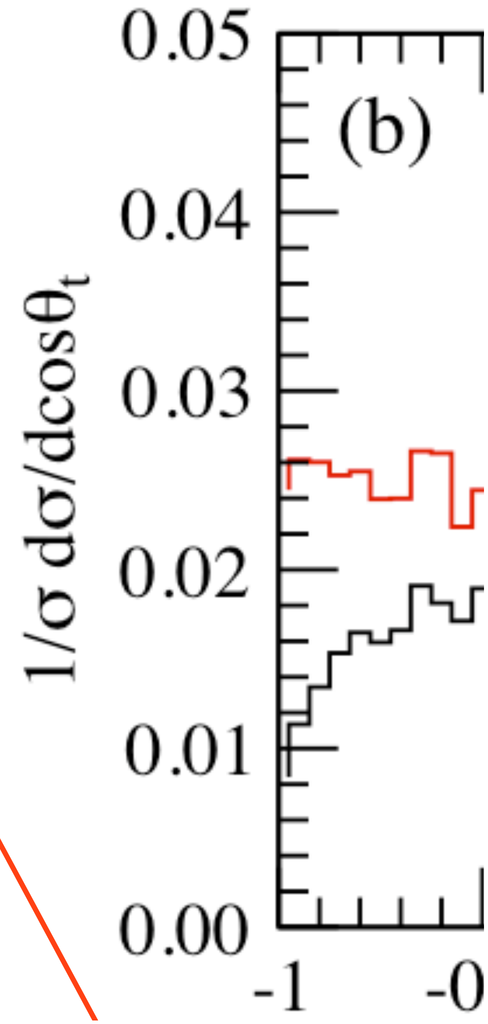


★ Can we determ
heavy resonanc



Not easy !



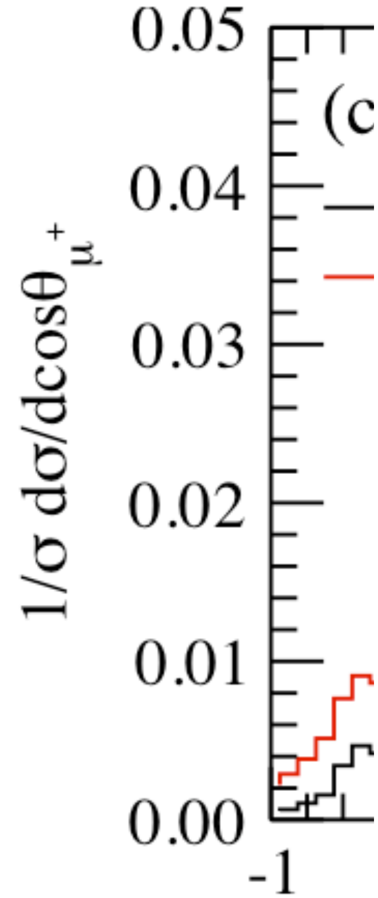


ization correlates with angle between
uark spin and charged lepton momenta

$$\frac{d\Gamma(t \to b\ell\nu)}{d\cos\theta} = \frac{1}{2}\left(1 + \frac{N_+ - N_-}{N_+ + N_-}\cos\theta\right)$$

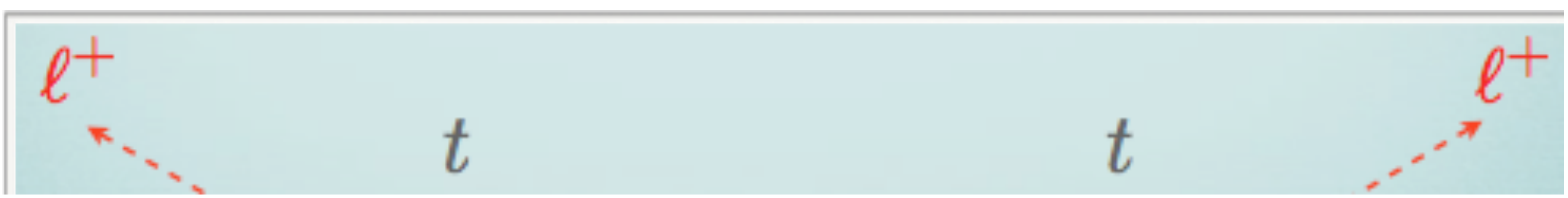
ged lepton typically follows top quark spin

handed top quark $\quad \frac{1}{2}(1+\cos\theta)$



nly 30 events required to distinguish
unpolarized case

larization of the top quarks can be determined to be rig

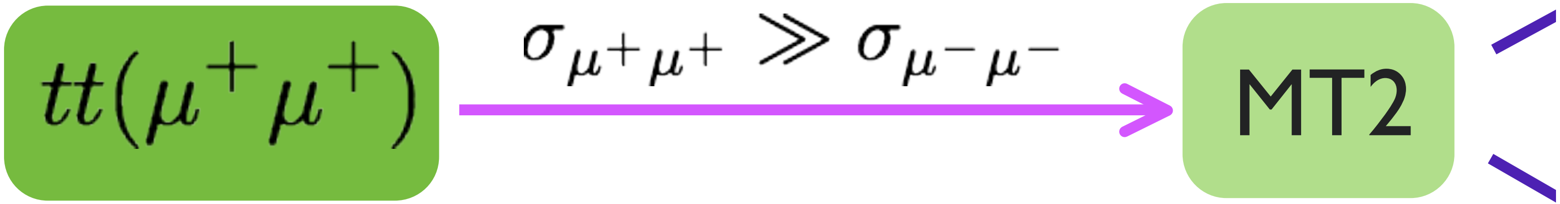


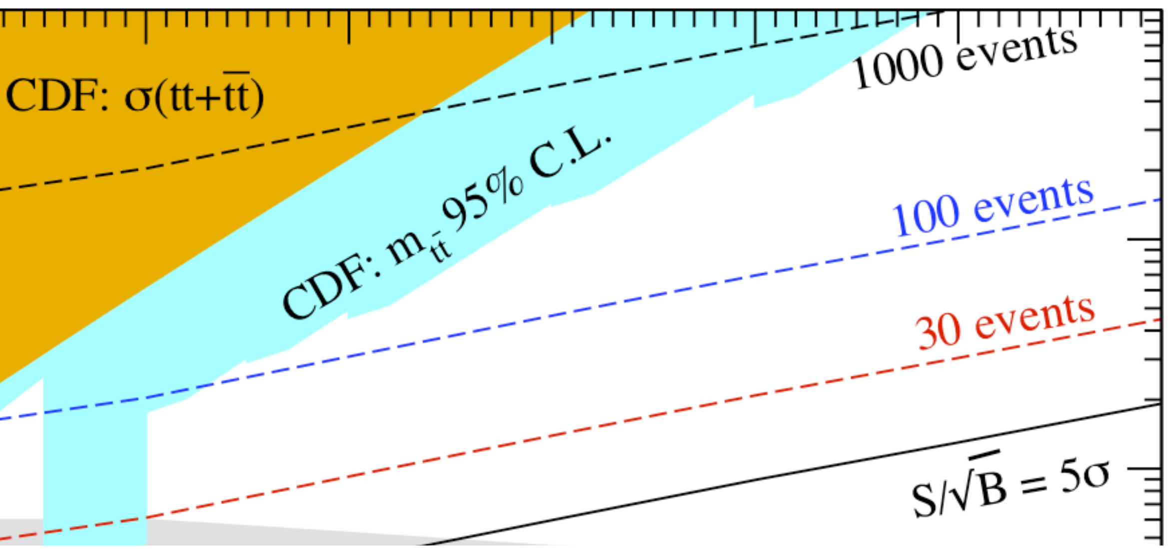
sextet scalar may be a long shot but offers good discove

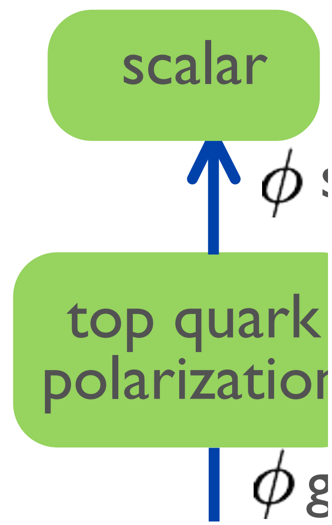
ced cross section relative to EW scale new physics; 30 e

ally large same-sign dilepton rates allow background reje

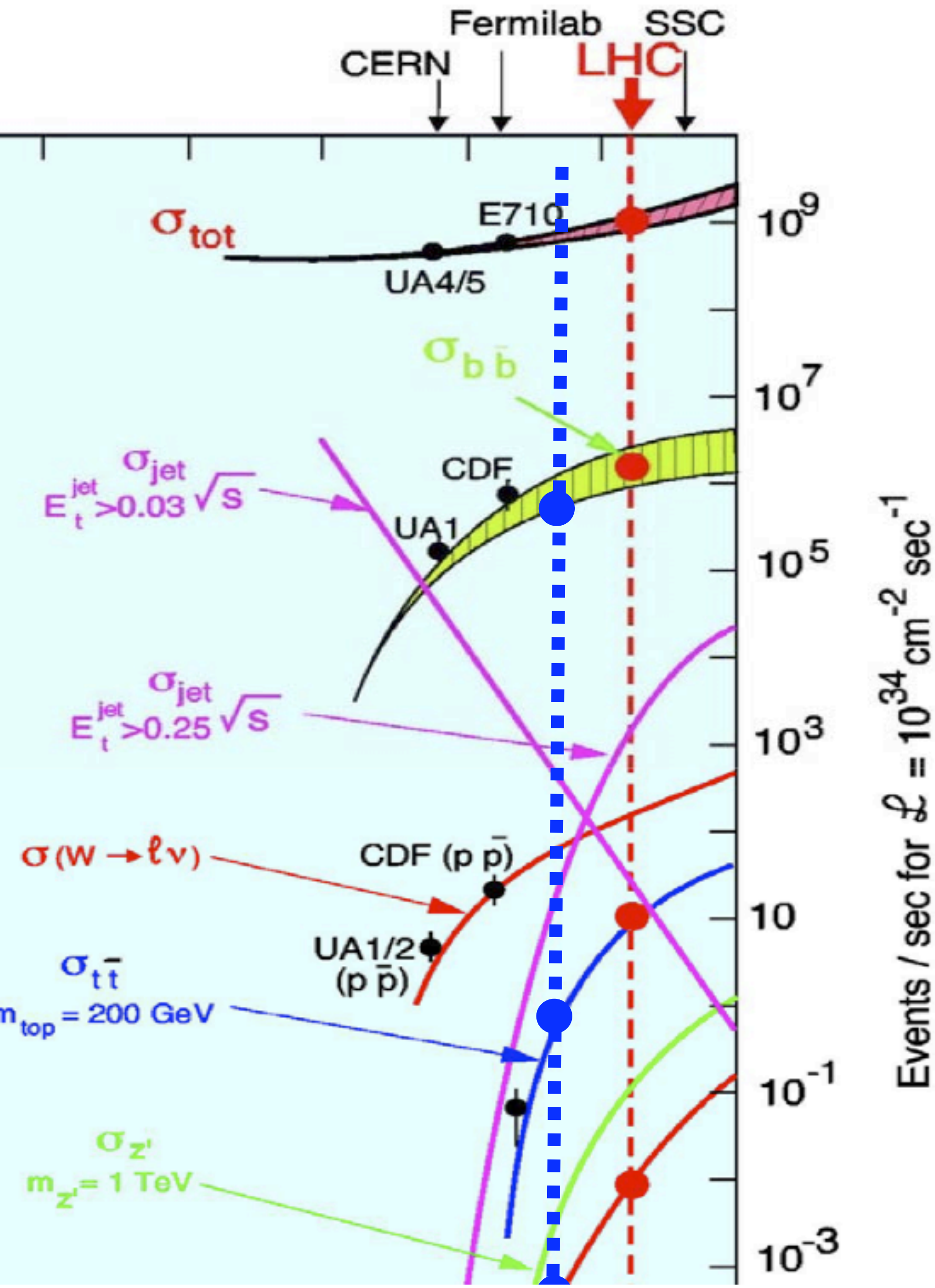
strategy







Backup Slide



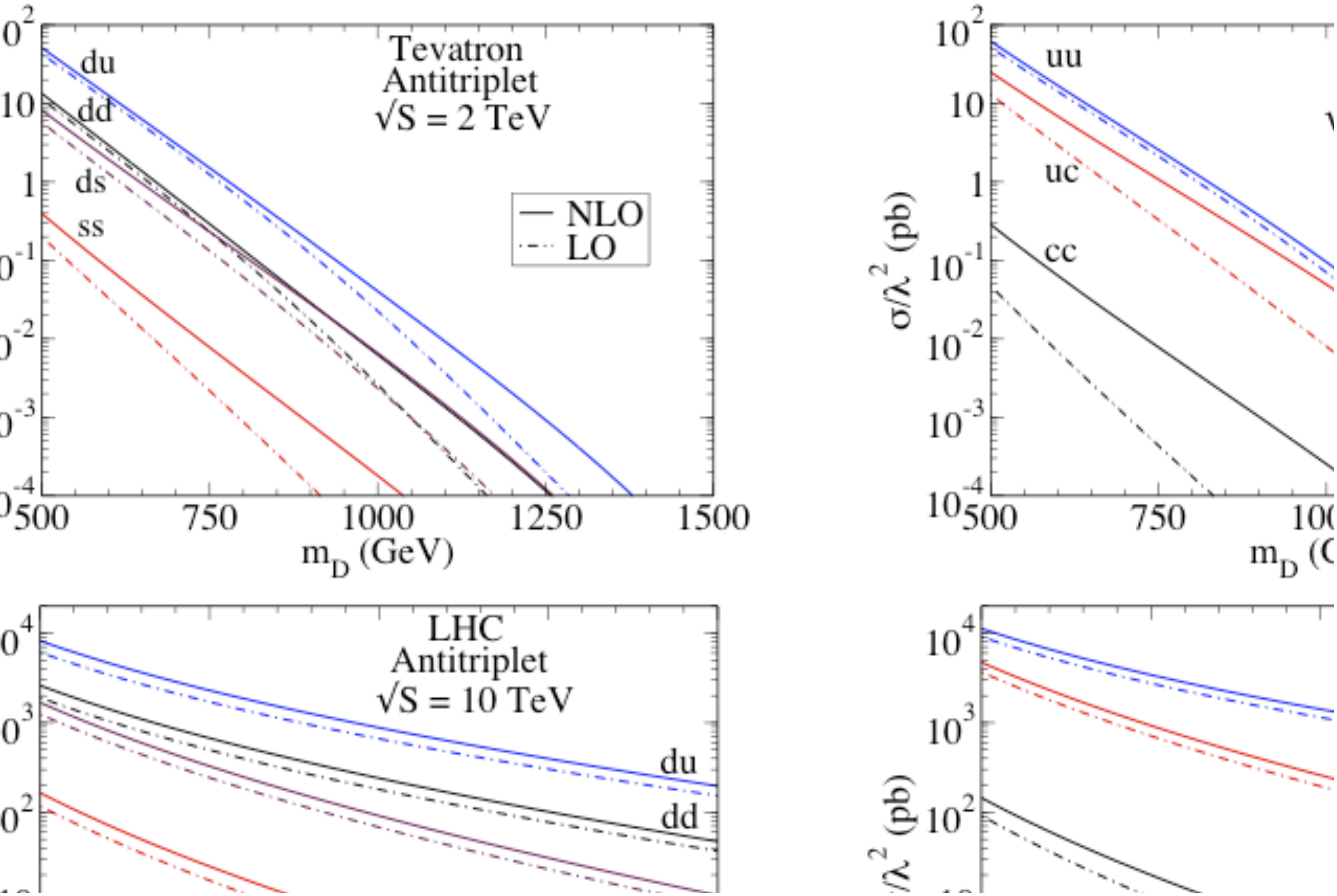
★ Rate for $\mathcal{L} =$

- Inelastic proton-pro
- bottom quark pairs:
- top quark pairs:
- $W \rightarrow \ell\nu$
- $Z \rightarrow \ell\ell$
- Higgs boson (150Ge
- Gluino, Squarks (1T

(1) LHC is a factor

QCD corrections for single color sextet scalar production are a

Han, Lewis, McElmurry



ng the top quark decay products, the charged lepton is
top quark spin.

$$\frac{1}{\Gamma}\frac{d\Gamma(t\to b\ell\nu)}{d\cos\theta}=\frac{1}{2}\left(1+\frac{N_+-N_-}{N_++N_-}\cos\theta\right)$$

the angle, in the top quark rest frame, between the dire
n and the spin of the top quark. In the helicity basis, top
rection of motion.

left-handed top $(1-\cos\theta)$ (b) right-handed top