Top A(FB) Theory

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W' exchange mechanism

arXiv:0908.2589, Phys. Lett. B on-line

S. Jung, H. Murayama, A. Pierce, J. Wells 0907.4112

Paul H. Frampton, Jing Shu, Kai Wang, 0911.2955

J. Shu, T. Tait, K. Wang, 0911.3237

Measurements of $A_{t\,FB}$

$$A_{fb} \equiv \frac{N_t(\cos\theta > 0) - N_t(\cos\theta < 0)}{N_t(\cos\theta > 0) + N_t(\cos\theta < 0)}$$

$0.20 \pm 0.11_{\text{stat.}} \pm 0.047_{\text{syst.}}$ (0.695/fb CDF Schwarz Thesis)

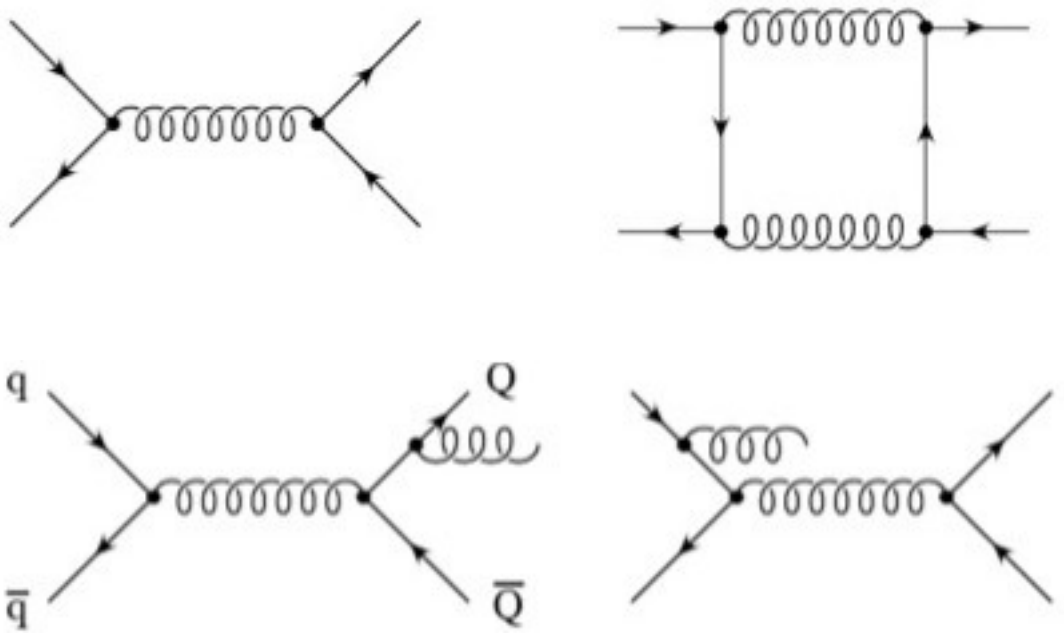
$0.19 \pm 0.09_{\text{stat.}} \pm 0.02_{\text{syst.}}$ (0.9/fb D0 0712.0851)

$0.17 \pm 0.07_{\text{stat.}} \pm 0.04_{\text{syst.}}$ (1.9/fb CDF 0806.2472)

$0.193 \pm 0.065_{\text{stat.}} \pm 0.024_{\text{syst.}}$ (3.2/fb CDF note 9724)

Large at both CDF and D0

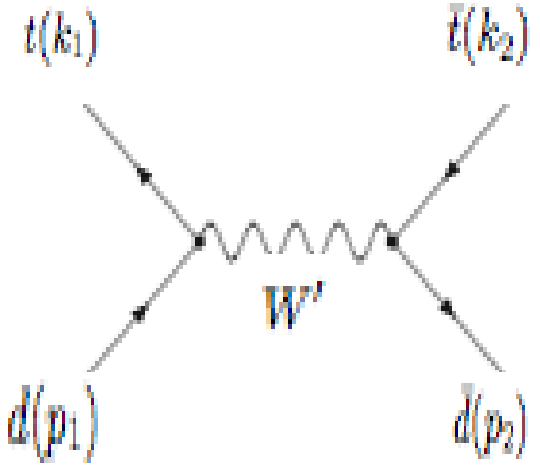
QCD gives ~ 0.05 only



Next order QCD which interfere with the tree gives

$A_{FB}^{(SM)}=0.051\pm0.015$

J. Kuhn and G. Rodrigo, PRD 59, 054017 (1999); PRL 81, 49 (1998)



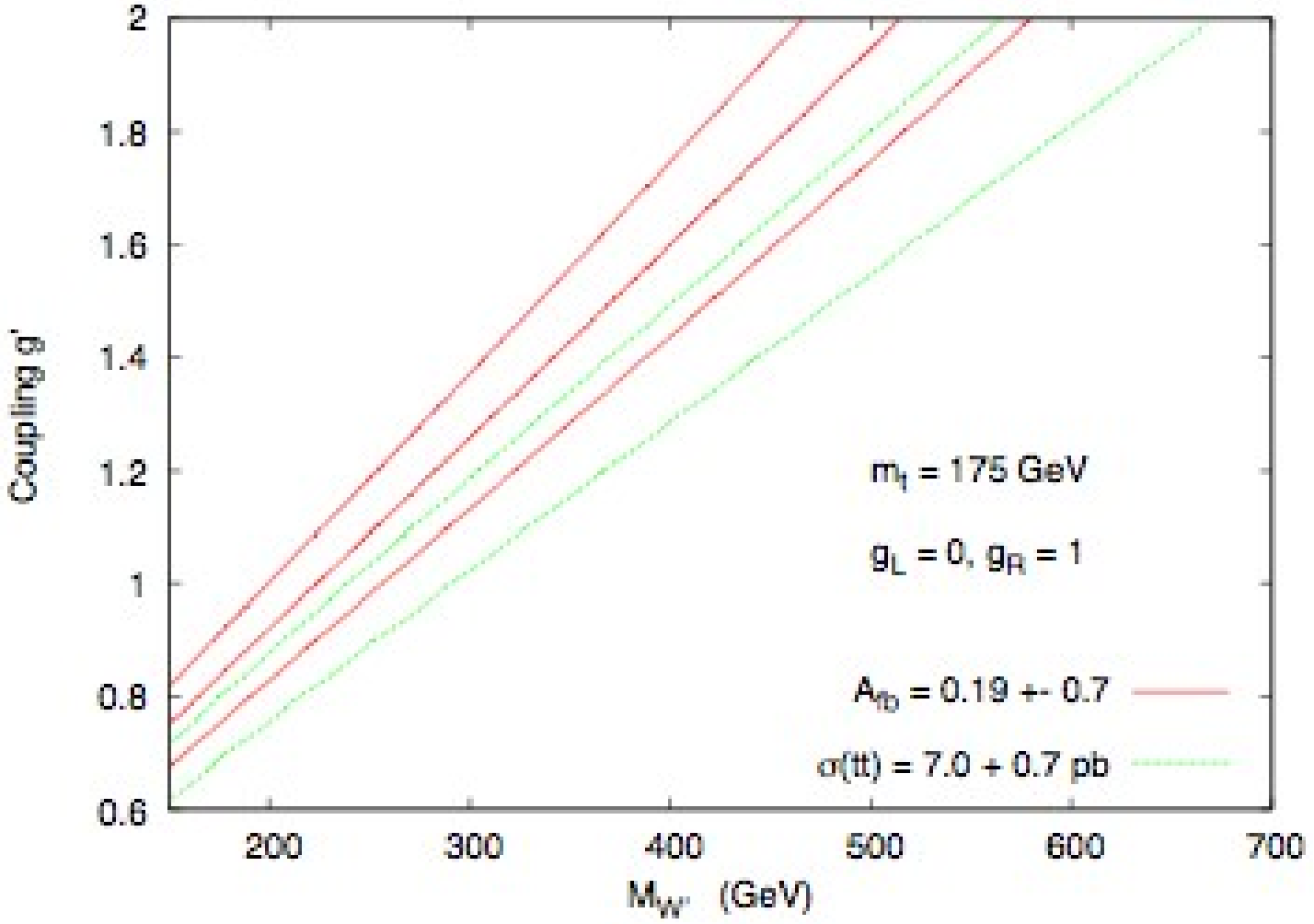
$$-g' W'^{+}_{\mu} \bar{t}\gamma^{\mu}(g_L P_L + g_R P_R) d$$

$$\hat{s} = (p_1 + p_2)^2,\ t = (p_1 - k_1)^2,\ u = (p_1 - k_2)^2$$

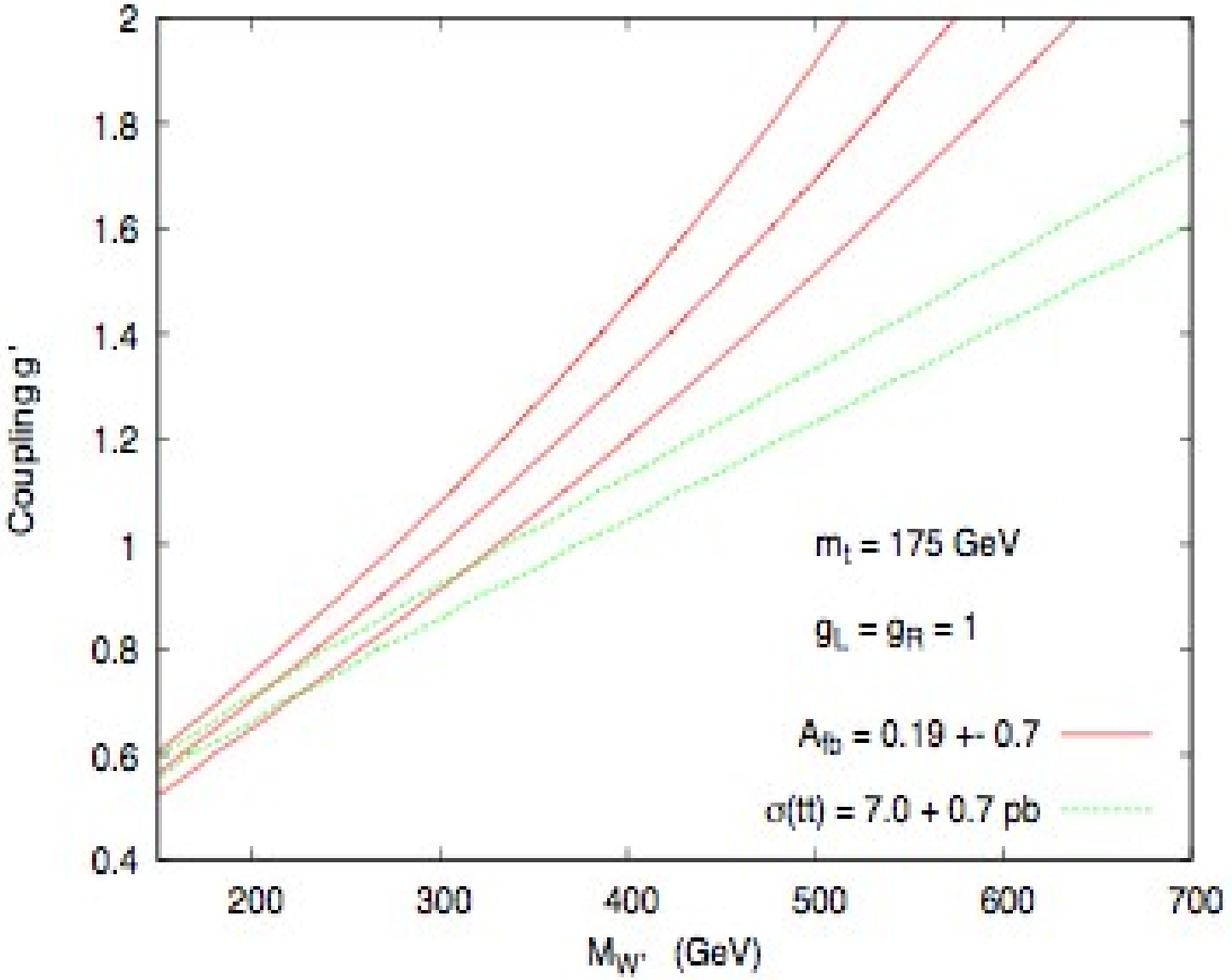
$$u_t = u - m_t^2 = -\tfrac{1}{2}\hat{s}(1 + \beta\cos\theta)$$
$$t_t = t - m_t^2 = -\tfrac{1}{2}\hat{s}(1 - \beta\cos\theta)$$
$$t_{W'} = t - m_{W'}^2$$

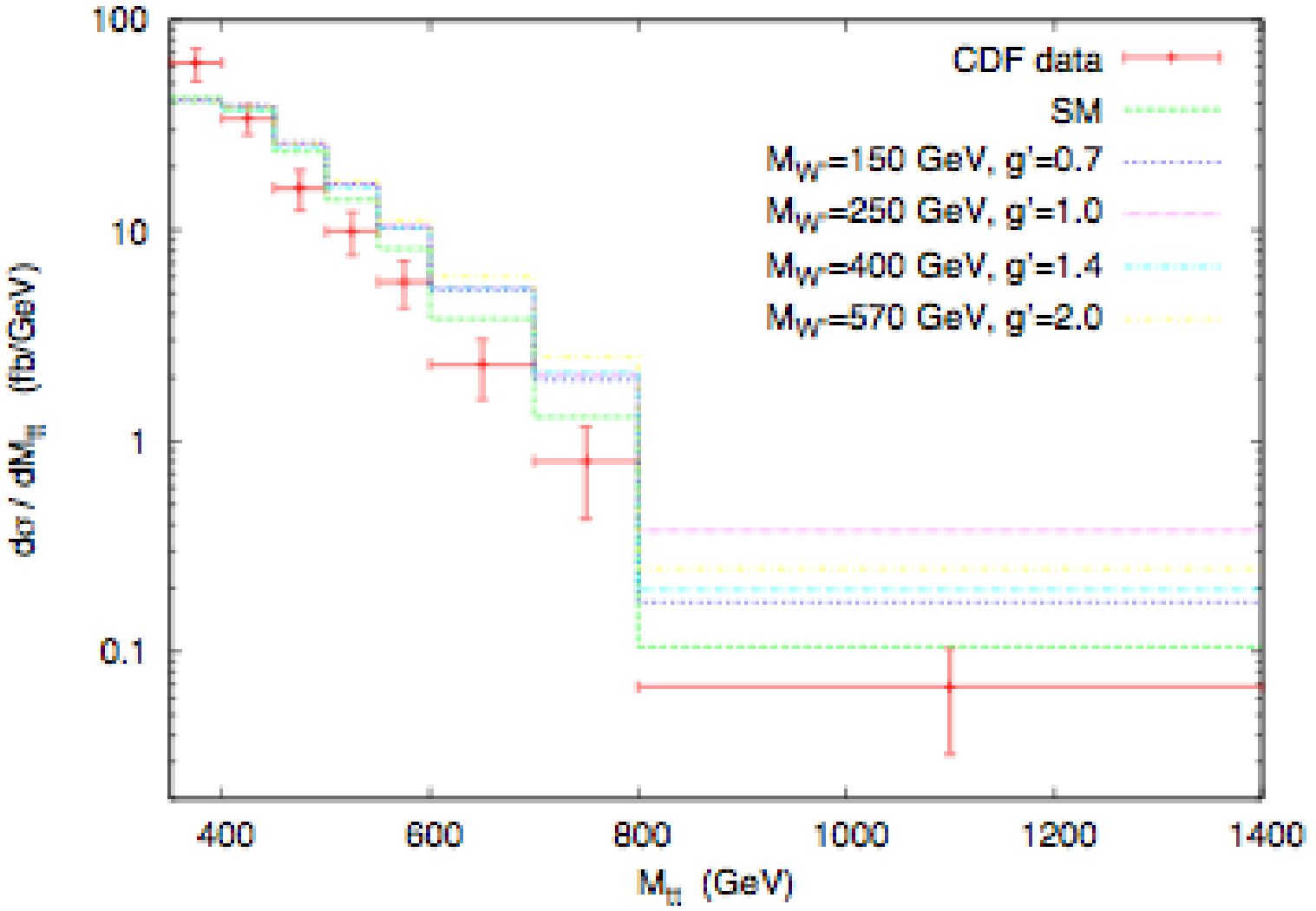
$$\sum |\mathcal{M}|^2 = \frac{16 g_s^4}{\hat{s}^2}\left(u_t^2 + t_t^2 + 2\hat{s}m_t^2\right) + \frac{16 g'^2 g_s^2}{\hat{s}\, t_{W'}}(g_L^2 + g_R^2)\left[2u_t^2 + 2\hat{s}m_t^2 + \frac{m_t^2}{m_{W'}^2}(t_t^2 + \hat{s}m_t^2)\right]$$

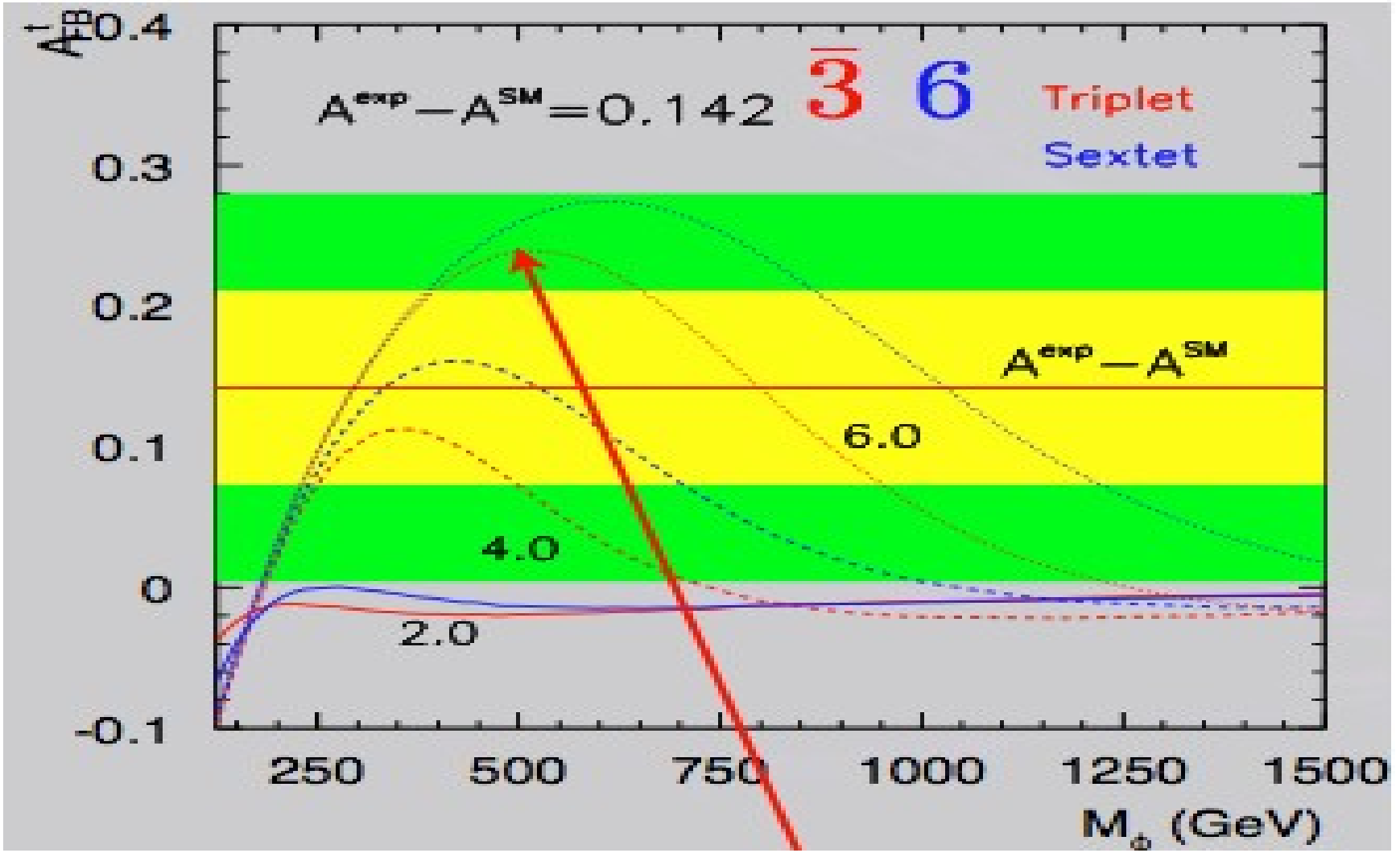
$$+ \frac{9 g'^4}{t_{W'}^2}\left[4\left((g_L^4 + g_R^4)u_t^2 + 2g_L^2 g_R^2 \hat{s}(\hat{s} - 2m_t^2)\right) + \frac{m_t^4}{m_{W'}^4}(g_L^2 + g_R^2)^2(t_t^2 + 4m_{W'}^2\hat{s})\right]$$



The contour of the asymmetry in $t\bar{t}$ production in the plane of $(M_{W'}, g')$.


Coupling g'
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
200
300
400
500
600
700
$M_{W'}$ (GeV)
m_t = 175 GeV
$g_L = g_R = 1$
A_{fb} = 0.19 +- 0.7
σ(tt) = 7.0 + 0.7 pb

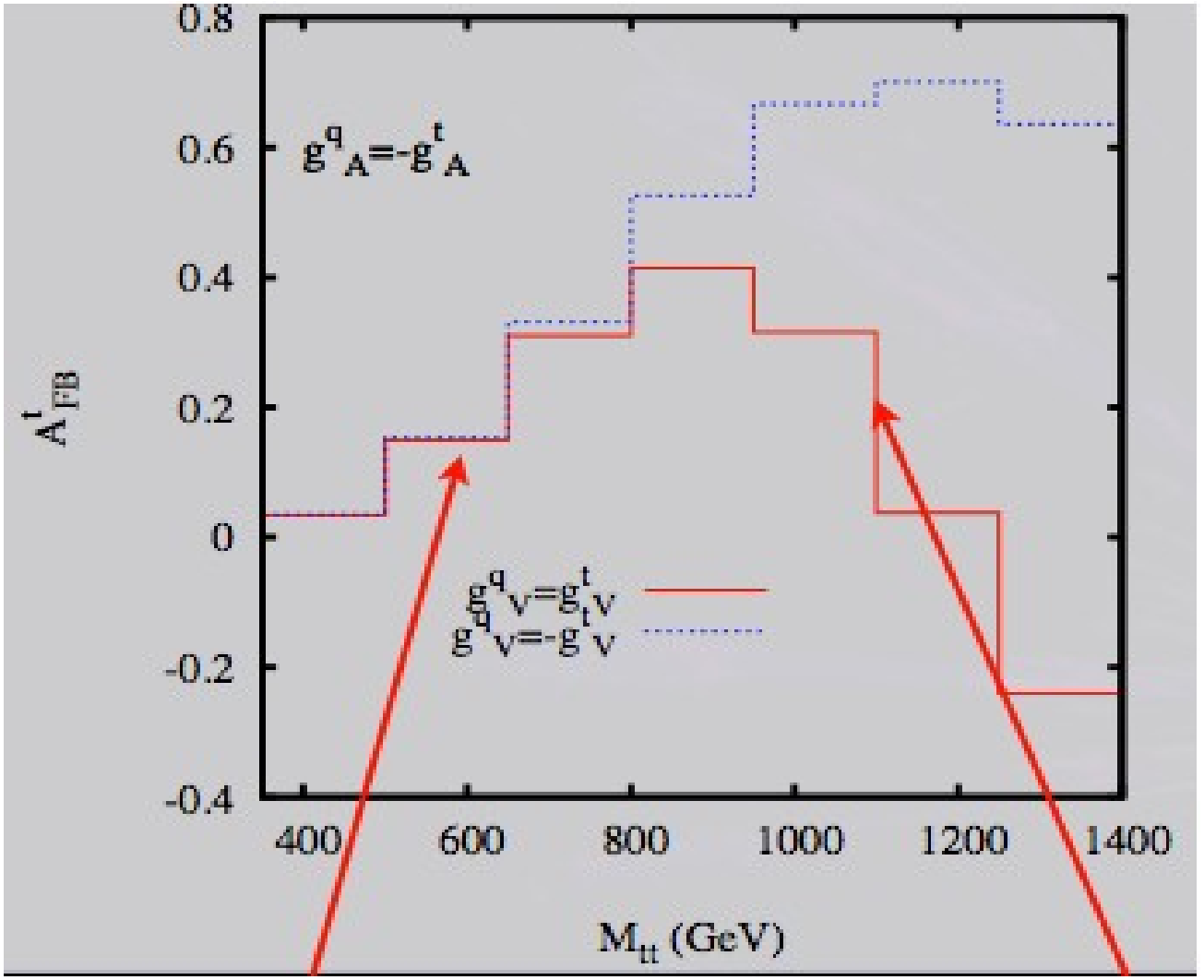

100
10
1
0.1
dσ / dM$_{tt}$ (fb/GeV)
400
600
800
1000
1200
1400
M$_{tt}$ (GeV)
CDF data
SM
M$_{W'}$=150 GeV, g'=0.7
M$_{W'}$=250 GeV, g'=1.0
M$_{W'}$=400 GeV, g'=1.4
M$_{W'}$=570 GeV, g'=2.0



Shu, Tait, Wang et al. On color scalars

Summary

- TEVATRON is unique in the top FB asymmetry
- Exchange W'/Z' or scalars is a viable explanation of the large top FB asymmetry
- New particles, W',Z' ... will be produced in LHC



Axigluon, by Frampton, Shu, Wang