JOHANNES GUTENBERG UNIVERSITÄT MAINZ

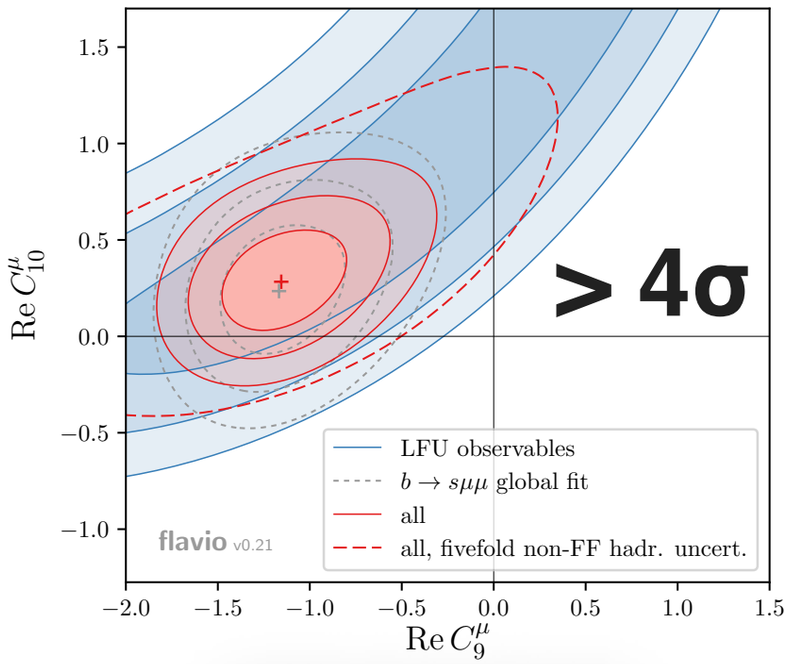
B-anomalies: A Model Builder's Guide

Admir Greljo

Based on
… , 1802.04274, 1801.07641,
1708.08450, 1706.07808, 1704.09015,
1609.07138, 1603.04993,
1506.01705

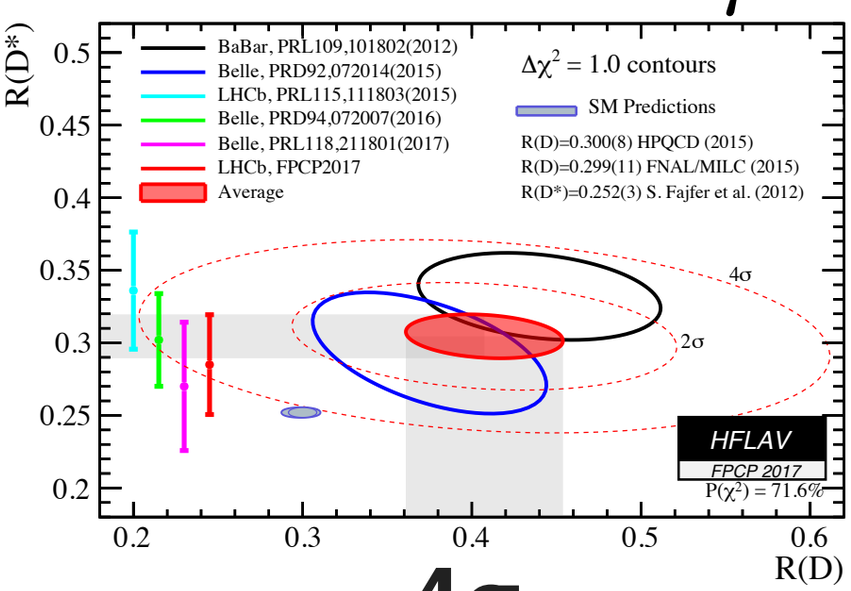
53rd Rencontres de Moriond - EW 2018

$b \to s\mu\bar{\mu}$

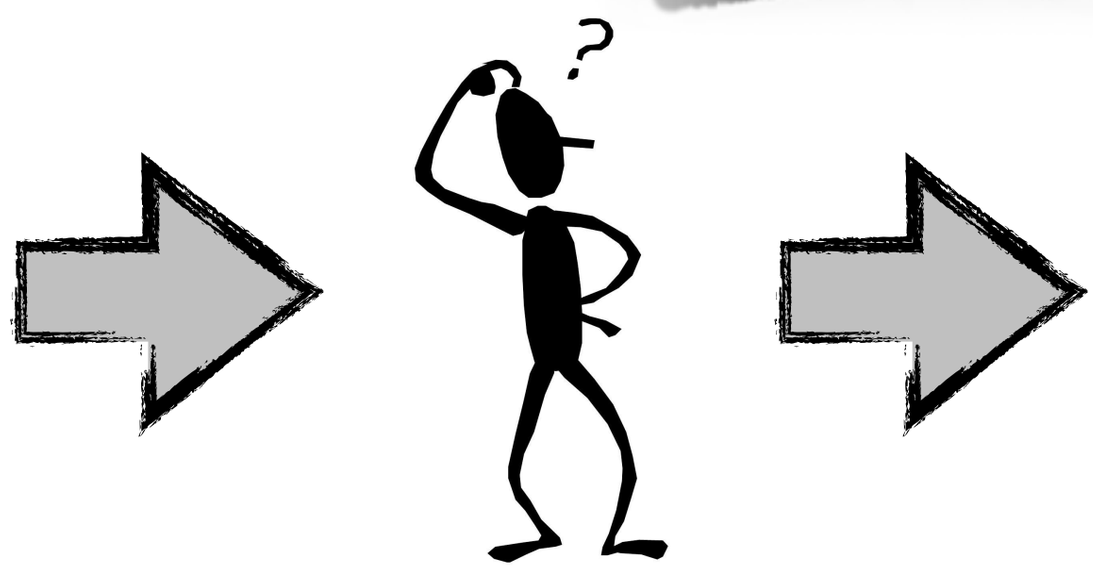


Puzzles

$b \to c\tau\bar{\nu}_{\tau}$



~ 4σ



BSM theorist

Predictions

ATLAS EXPERIMENT

CMS Compact Muon Solenoid

LHCb

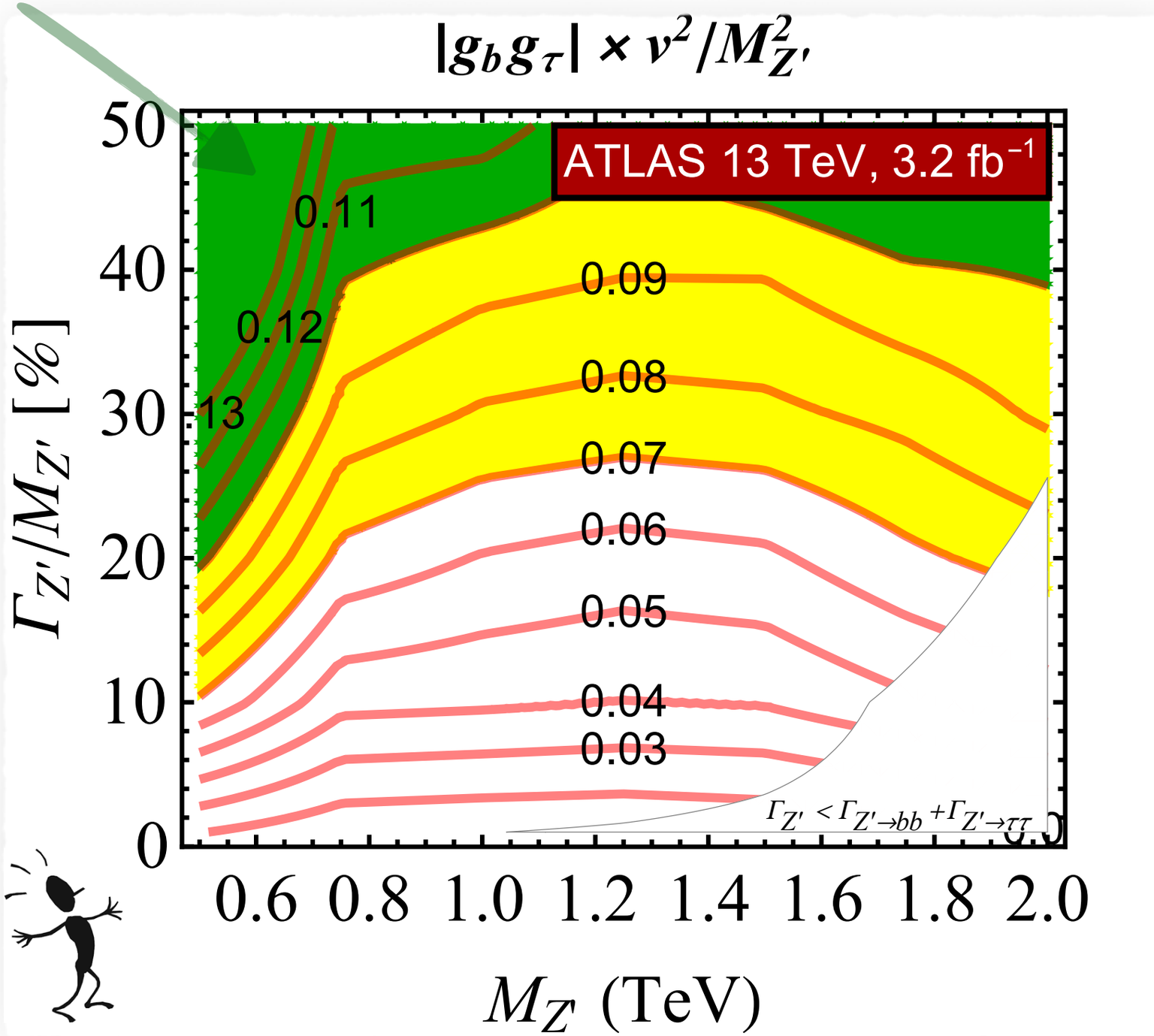
Belle II

etc.

W' model for b → c τ ν

R(D(*))

B-anomalies



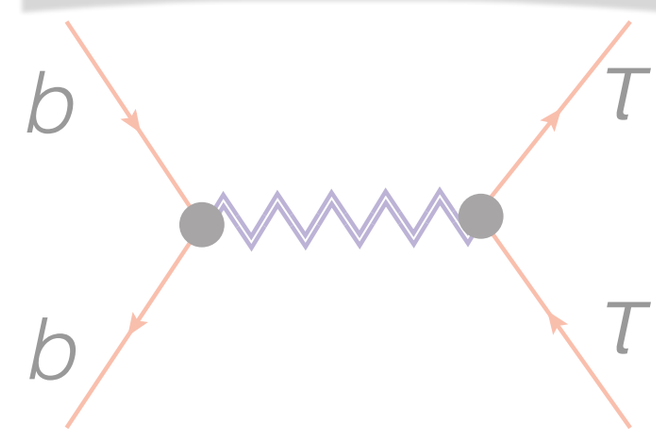
$W' = (\mathbf{1}, \mathbf{3}, 0)$

$B_s \leftrightarrow \bar{B}_s$

tree-level

[AG, Isidori, Marzocca]
JHEP 1507 (2015) 142

$pp \to \tau^+\tau^-$

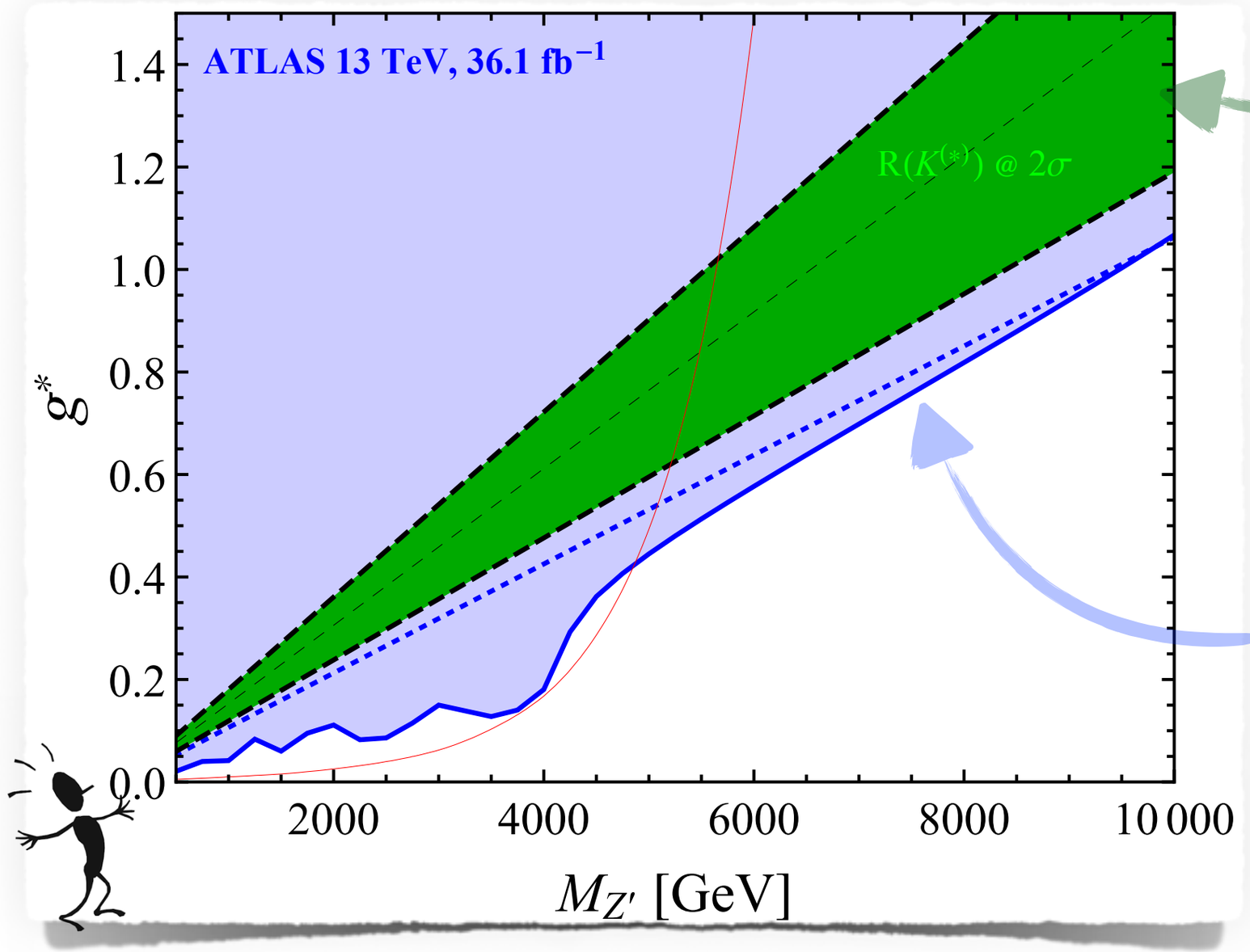


Lesson 1

[Faroughy, AG, F. Kamenik]
Phys.Lett. B764 (2017) 126-134

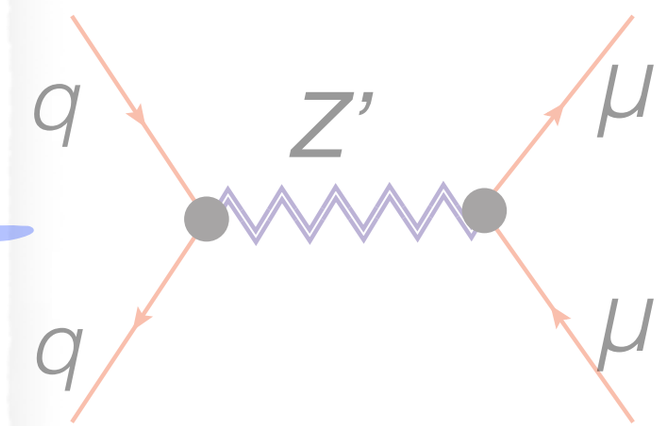
MFV Z' model for b → s μ μ

R(K(*))



B-anomalies

$$pp \to \mu^+\mu^-$$



$$\mathscr{L} \supset Z'_\mu J_\mu$$

$$J_\mu = g_Q^{(1),ij}(\bar{Q}_i\gamma_\mu Q_j) + g_L^{(1),kl}(\bar{L}_k\gamma^\mu L_l)$$

$$g_Q^{(1),ii} = g_L^{(1),22} = g_* \qquad \boxed{g_Q^{(1),23} = V_{ts}g_*}$$

Lesson 2

[AG, Marzocca]
Eur.Phys.J. C77 (2017) no.8, 548

Coherent picture of B-anomalies

$b \to c\tau\bar{\nu}_\tau$

V-A operator

Hint I

$b \to s\mu\bar{\mu}$

V-A operator

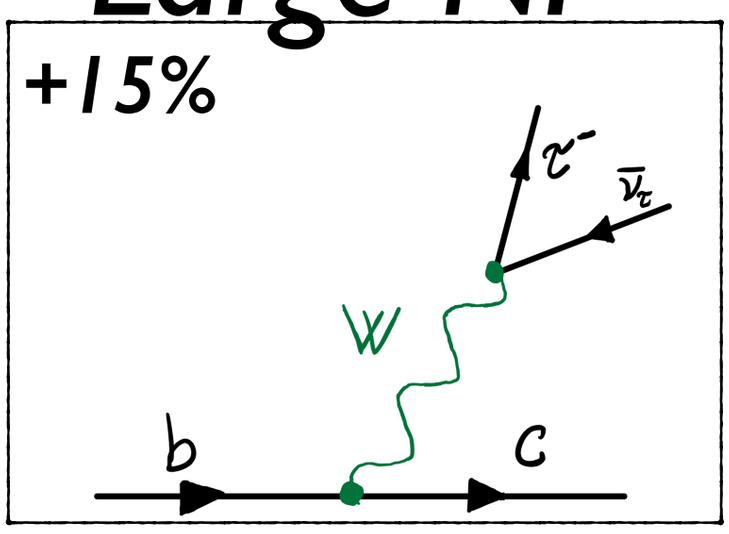
Common origin?

$$(\bar{Q}_L^i \gamma_\mu \sigma^a Q_L^j)(\bar{L}_L^\alpha \gamma^\mu \sigma^a L_L^\beta)$$

R(K(*))

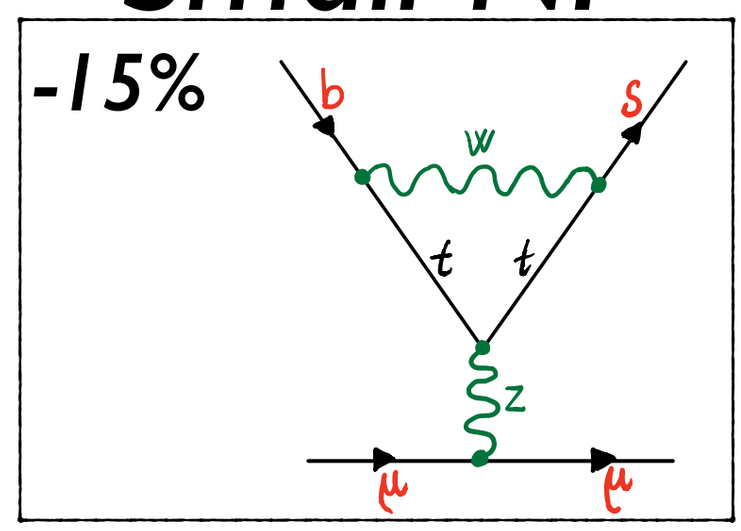
R(D(*))

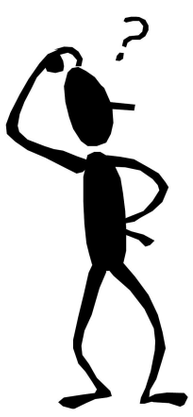
Large NP



Hint II

Small NP





Flavour puzzle?

Coherent picture: EFT & Simplified models

Vector LQ triplet $(\mathbf{3},\mathbf{3},2/3)$

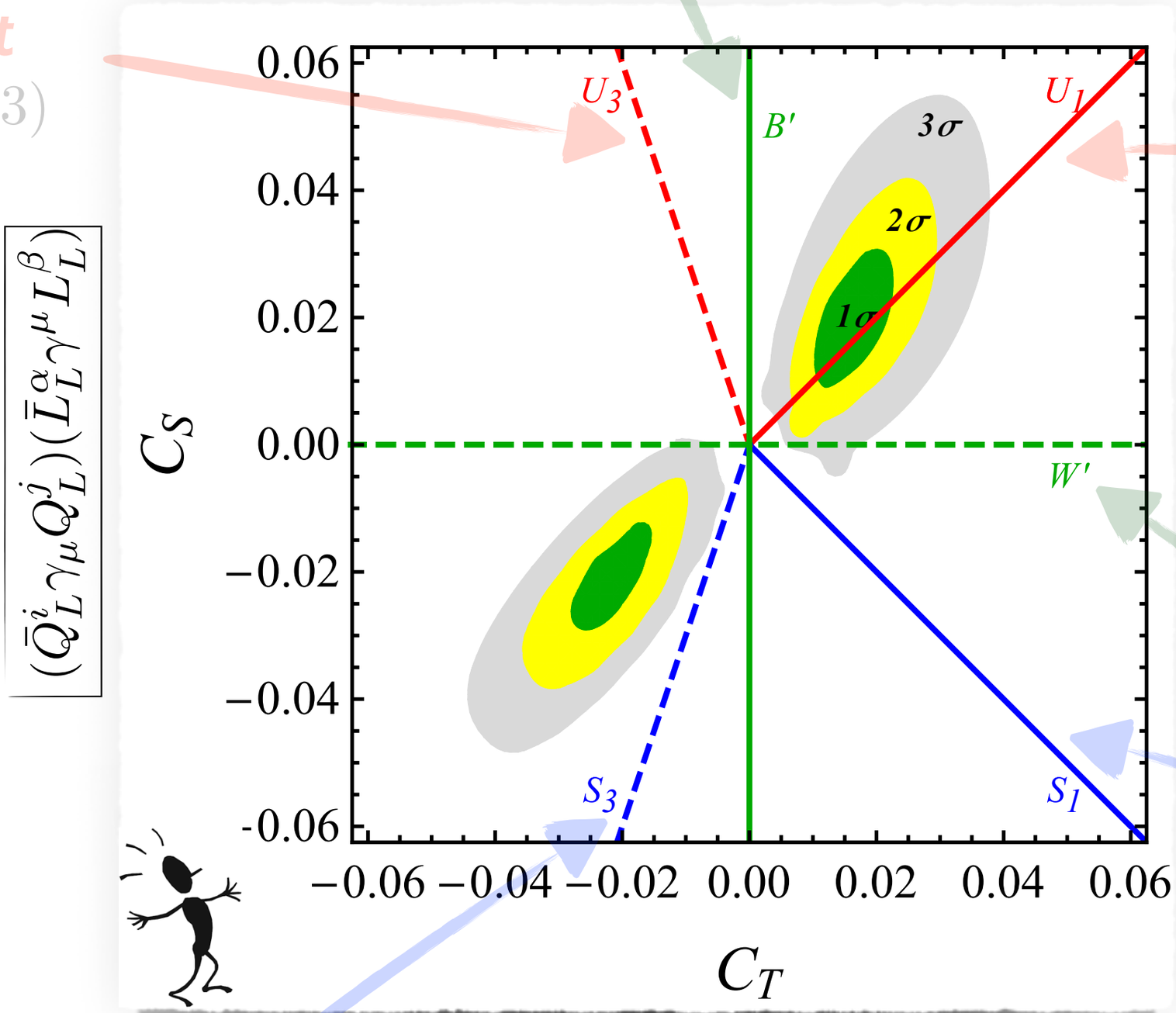
Z' $(\mathbf{1},\mathbf{1},0)$

R(K(*))

R(D(*))

Fit to

- Semileptonic B-decays
- LFU and LFV in tau decays
- Z-pole precision



Vector LQ singlet $(\mathbf{3},\mathbf{1},2/3)$

W' $(\mathbf{1},\mathbf{3},0)$

Scalar LQ singlet $(\bar{\mathbf{3}},\mathbf{1},1/3)$

Scalar LQ triplet $(\bar{\mathbf{3}},\mathbf{3},1/3)$

$(\bar{Q}^i_L\gamma_\mu\sigma^a Q^j_L)(\bar{L}^\alpha_L\gamma^\mu\sigma^a L^\beta_L)$

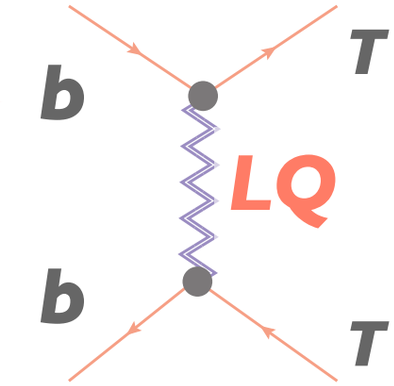
Lesson 3

[Buttazzo, AG, Isidori, Marzocca]
JHEP 1711 (2017) 044

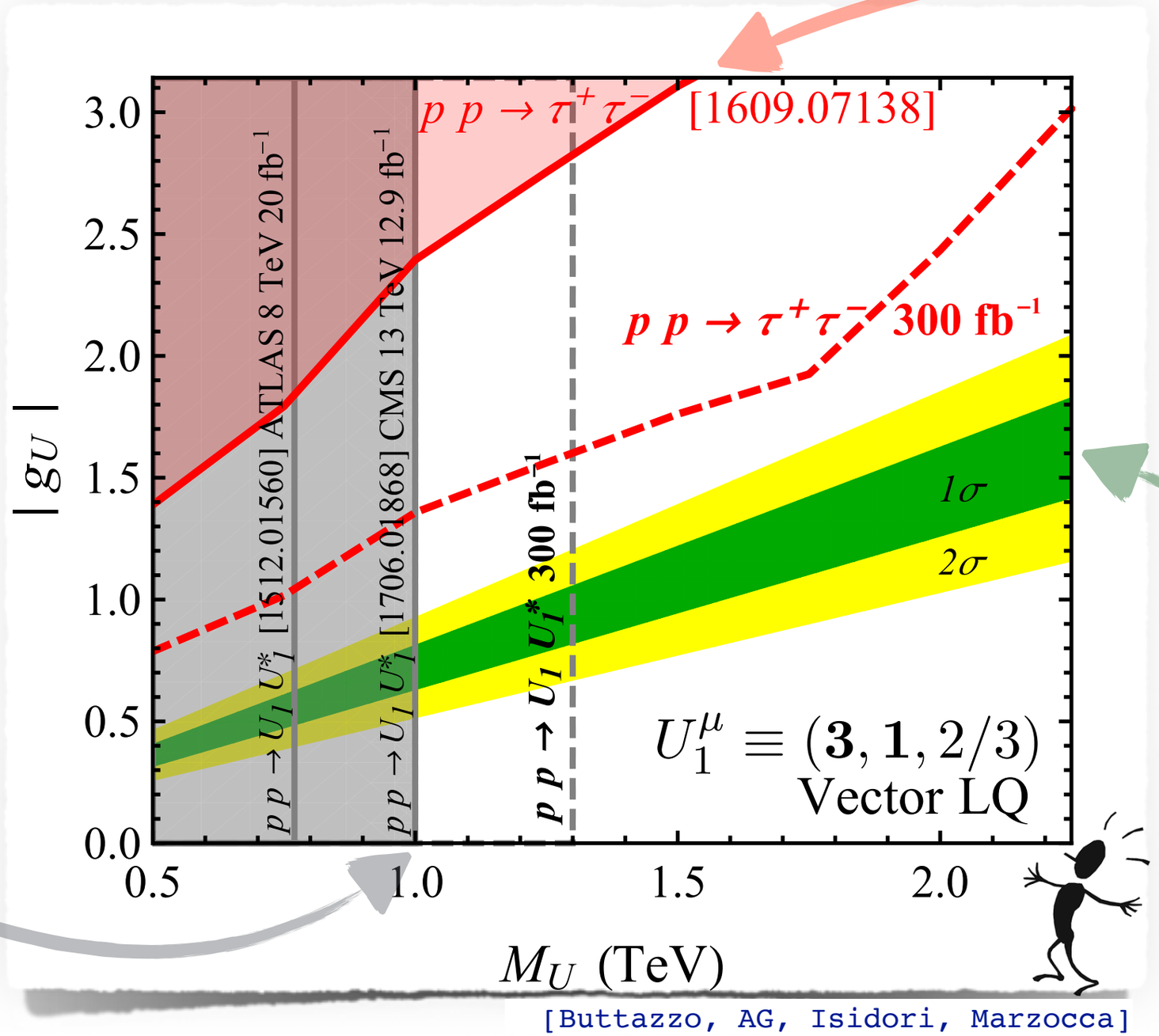
R(K(*))

R(D(*))

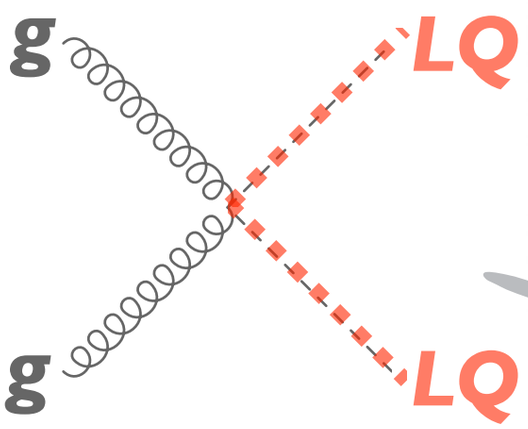
Vector LQ: *High-p_T hunt*



[Faroughy, AG, F. Kamenik]
Phys.Lett. B764 (2017) 126-134



B-anomalies



[Buttazzo, AG, Isidori, Marzocca]
JHEP 1711 (2017) 044

Vector LQ: *Model building*

Gauge boson of an extended "4321" gauge symmetry

[Di Luzio, AG, Nardecchia], Phys.Rev. D96 (2017) 115011

[AG, Ben Stefanek], 1802.04274

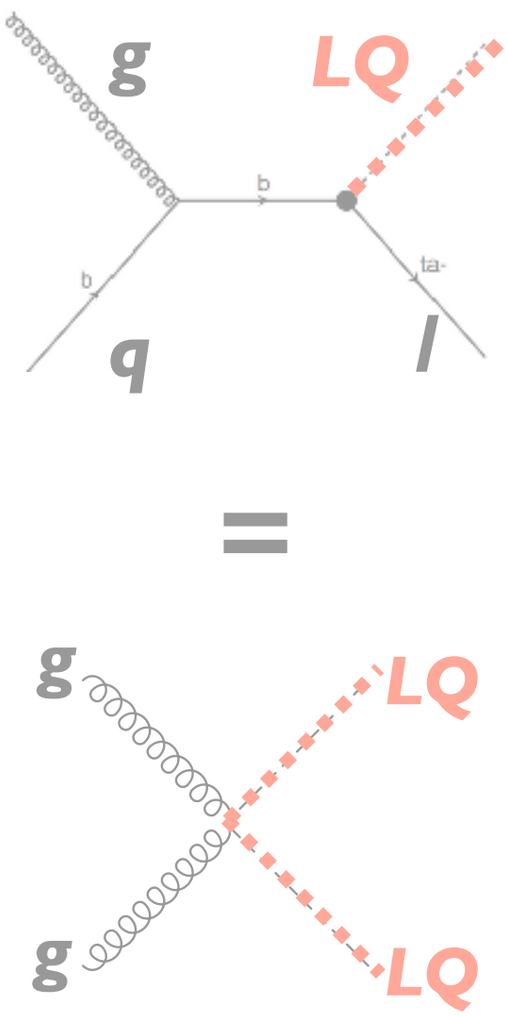
See also

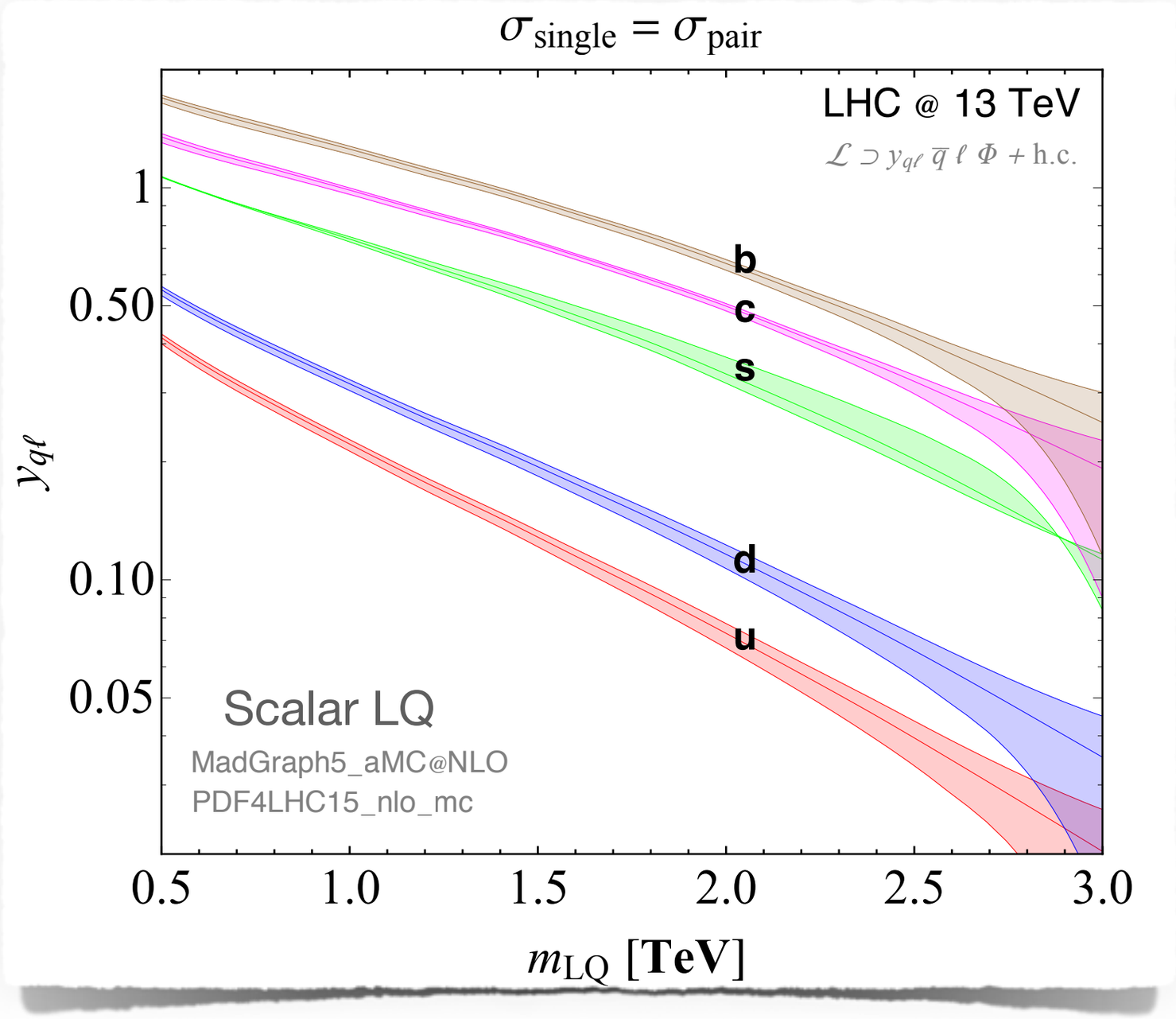
[Bordone, Cornella, Fuentes-Martin, Isidori], 1712.01368

Talk by Javier Fuentes-Martin

LQ physics review:
[Doršner, Fajfer, AG, Košnik, F. Kamenik]
Phys.Rept. 641 (2016) 1-68

LQ at the LHC





LQ MC tool at NLO QCD:
http://lqnlo.hepforge.org

See also talk by Yuta Takahashi

[Doršner, AG]
1801.07641

Thank you