top-BESS model extended by 125 GeV scalar

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The scene

ESB mechanism ... ???

BSM physics ... ???

The scene

125 GeV boson

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125 GeV boson

- SM compatible
- BSM compatible

weak cplng (SUSY)

strong cplng (TC)

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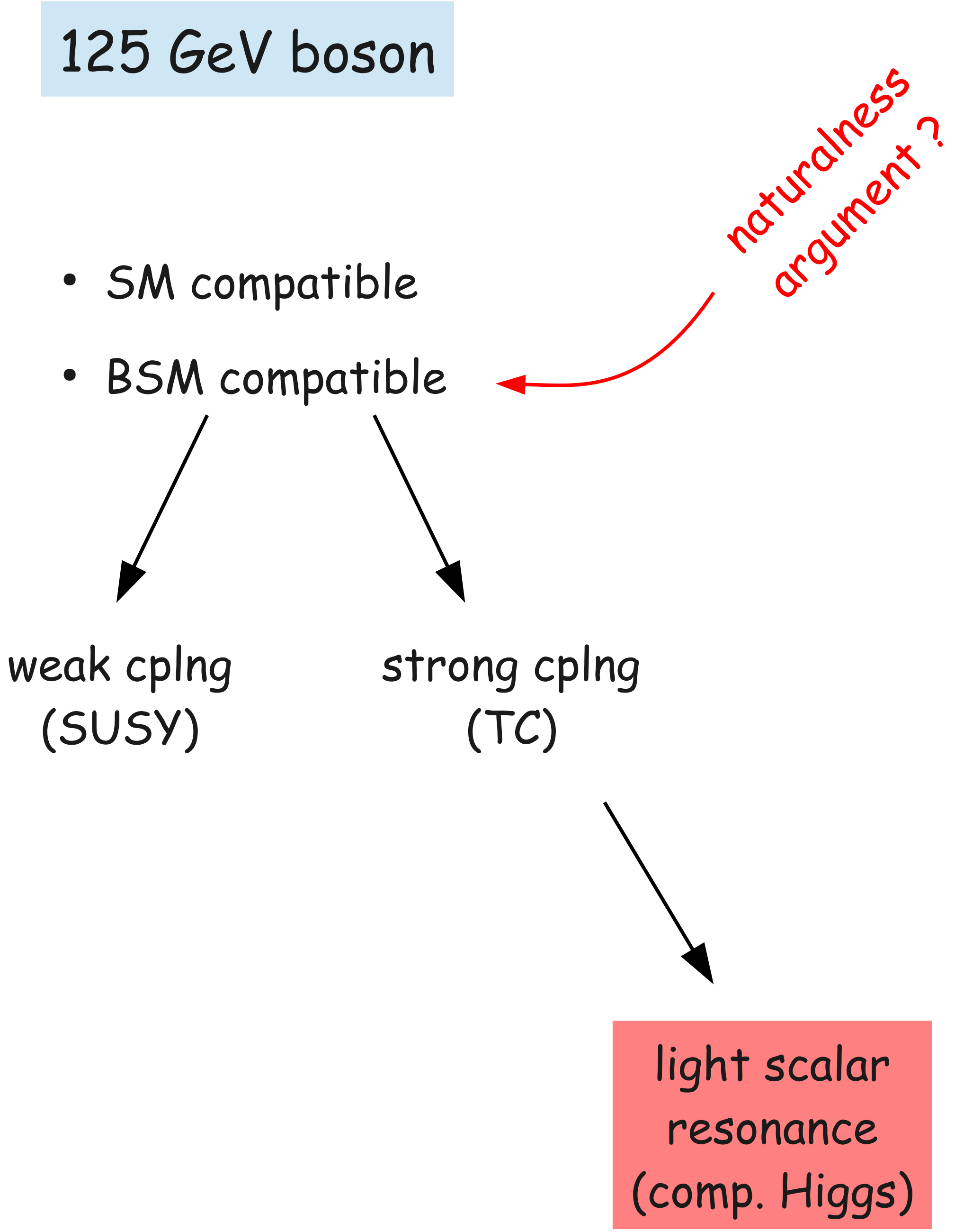

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BSM physics ... ???

125 GeV boson

- SM compatible
- BSM compatible

naturalness argument ?

weak cplng (SUSY)

strong cplng (TC)

higher spin resonances

light scalar resonance (comp. Higgs)

The scene

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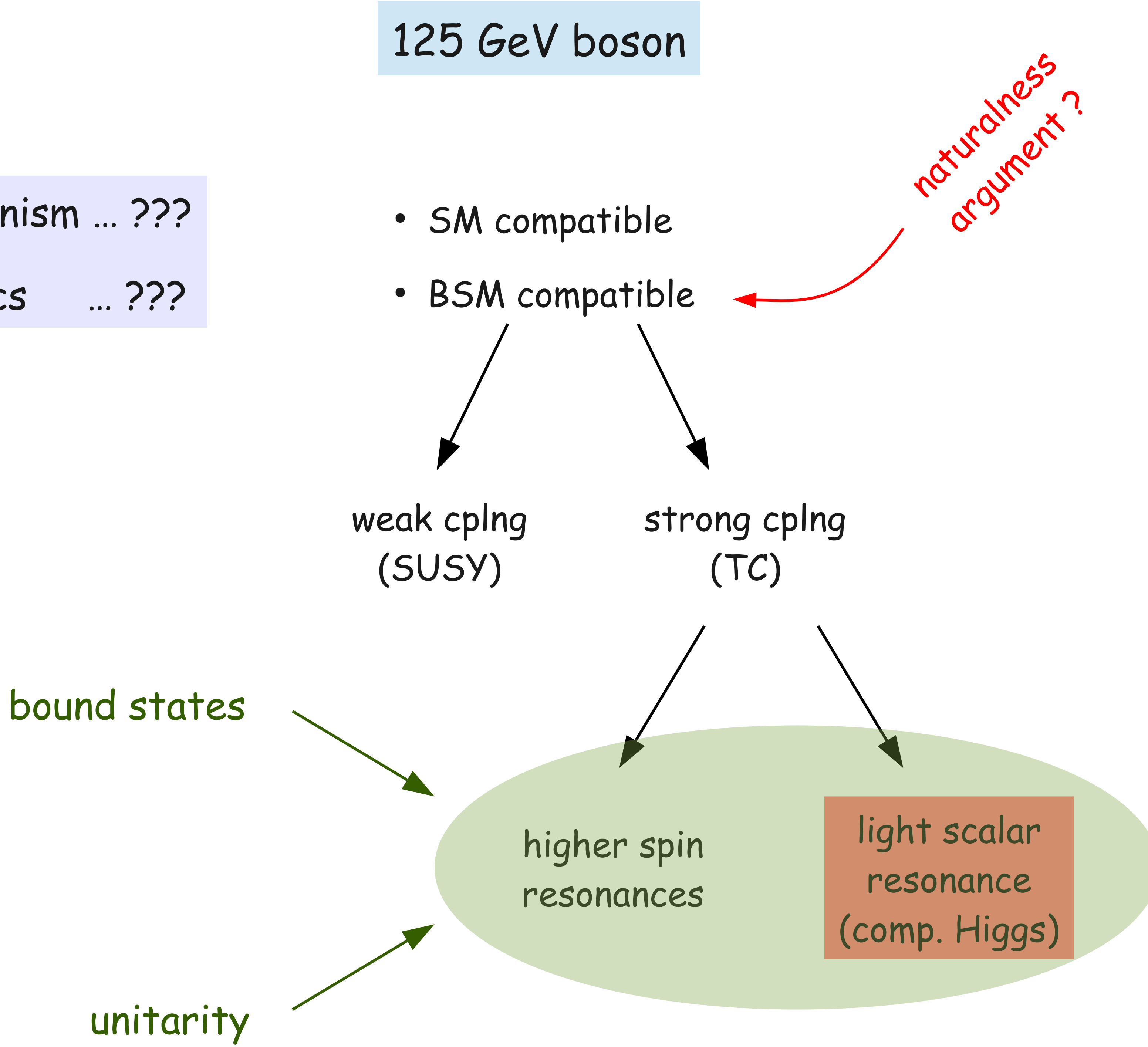

Effective Field Theory

Why?

- experiment-theory bridge
- unifying description for the classes of models

How?

- symmetry
- particle contents
- model-dependent assumptions

BESS = Breaking EW Symmetry Strongly

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symmetry: $SU(2)_L \times SU(2)_R \rightarrow SU(2)_{L+R}$

particles: SM fermions

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SM gauge bosons

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$SU(2)_{L+R}$ vector triplet

g'' … gauge cplng

$M_\rho \approx \sqrt{\alpha}\, g''\, v/2$

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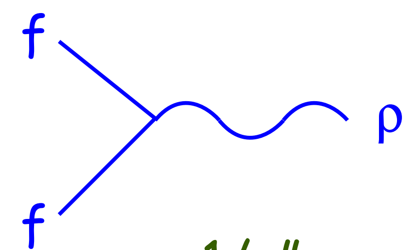
mixing
$V \rightarrow \rho$



$\sim 1/g''$

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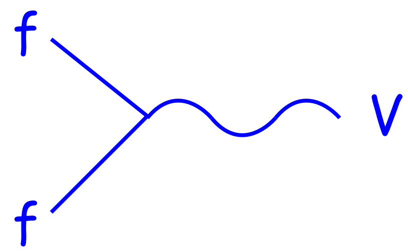
$M_\rho \approx \sqrt{\alpha}\, g''\, v/2$

Direct interactions to fermions

BESS:

- chiral
- universal



$\sim b_L\, g'',\; b_R\, g''$

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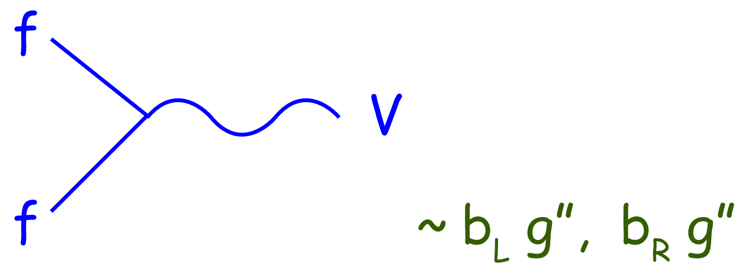
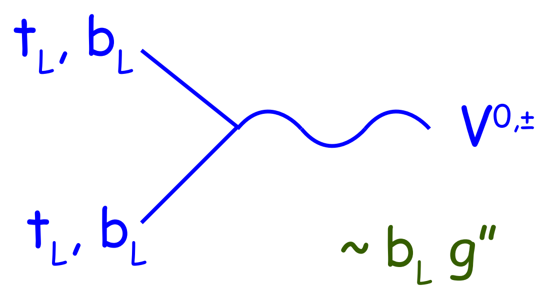
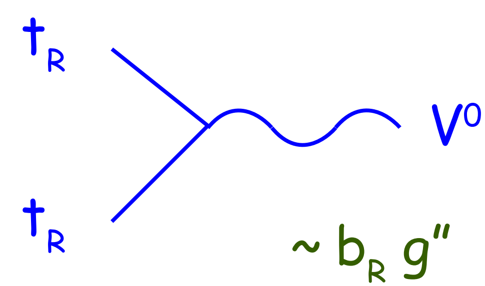
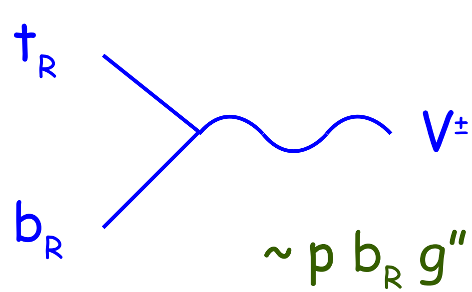


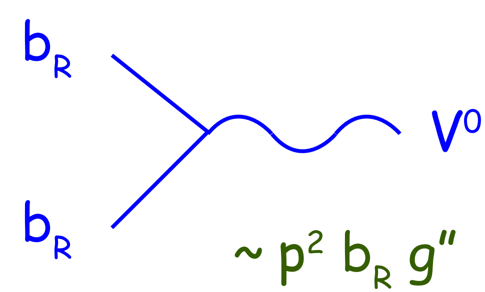
top-BESS:

- chiral
- top, bottom only









Motivation

- restrictions from precision measurements
- special role of top quark (3rd quark generation)
- $Z \to b\bar{b}$
- partial compositeness of fermions

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some p.c. models: $m_f \propto \varepsilon_L \varepsilon_R$

$$\left.\begin{aligned} \varepsilon_L^{b,t} &\propto b_L \\ \varepsilon_R^t &\propto b_R \\ \varepsilon_R^b &\propto p\, b_R \end{aligned}\right\} \qquad \frac{m_b}{m_t} = p \approx 0.03$$

Lambda terms

$$I_b^h(\psi_h) = i\bar{\chi}_h \left[\partial\!\!\!/ + V\!\!\!/ + ig' B\!\!\!/ (B-L)/2\right] \chi_h,$$

$$\begin{aligned} I_\lambda^h(\psi_h) &= i\bar{\chi}_h \bar{\omega\!\!\!/}^\perp \chi_h \\ &= i\bar{\chi}_h \left[\omega\!\!\!/^\perp + (\xi_L^\dagger W\!\!\!\!/\, \xi_L - \xi_R^\dagger B\!\!\!/^{R3} \xi_R)/2\right] \chi_h, \end{aligned}$$

h = L, R

tBESS with the scalar resonance

particles: SM fermions
+
SM gauge bosons
+
$SU(2)_{L+R}$ vector triplet
+
125 GeV scalar

$$\mathcal{L}_{\rm ESB} = \frac{1}{2}\partial_\mu h\,\partial^\mu h - \frac{1}{2}M_h^2 h^2 + \frac{1}{2}\left(M_Z^2 Z_\mu Z^\mu + 2M_W^2 W_\mu^+ W^{-\mu} + M_{V^0}^2 V_\mu^0 V^{0\mu} + 2M_{V^\pm}^2 V_\mu^+ V^{-\mu}\right) \times \left(1 + 2a\frac{h}{v} + a'\frac{h^2}{v^2} + \ldots\right),$$

$$\mathcal{L}_{\rm ferm}^{\rm scalar} = -\frac{1}{v}\sum_i \left(\bar{\psi}_L^i M_f^i \psi_R^i\right)\left(1 + c_i\frac{h}{v} + c_i'\frac{h^2}{v^2} + \ldots\right)$$

SM: $a = c_i = 1$, $a' = c_i' = \ldots = 0$

Unitarity

EW gauge boson scattering:

- SM Higgs $\rightarrow$ unitarity holds for all energies
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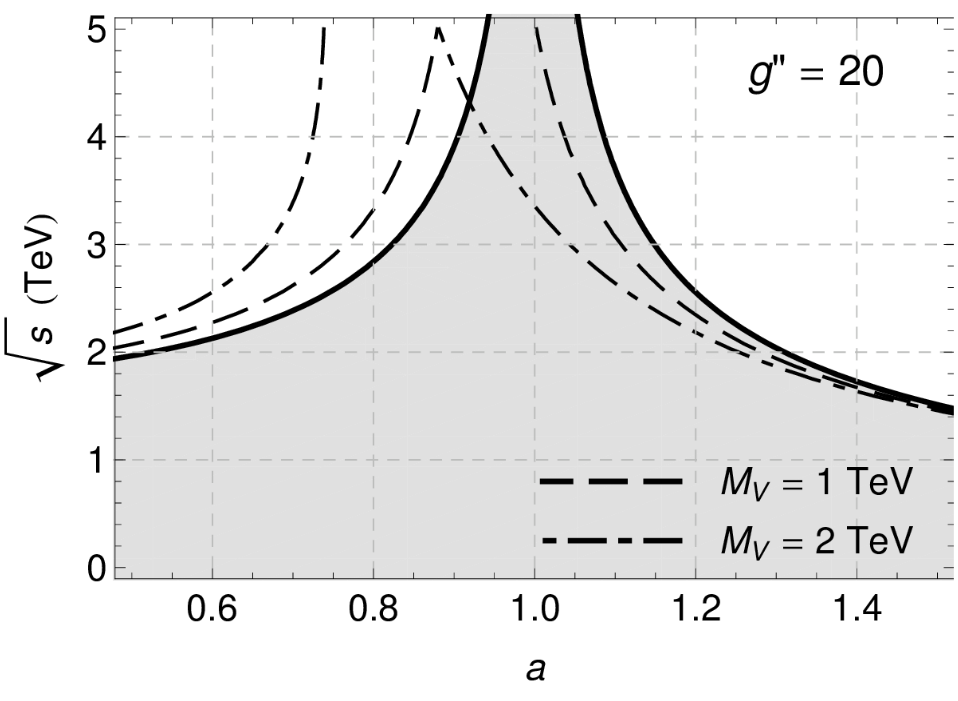

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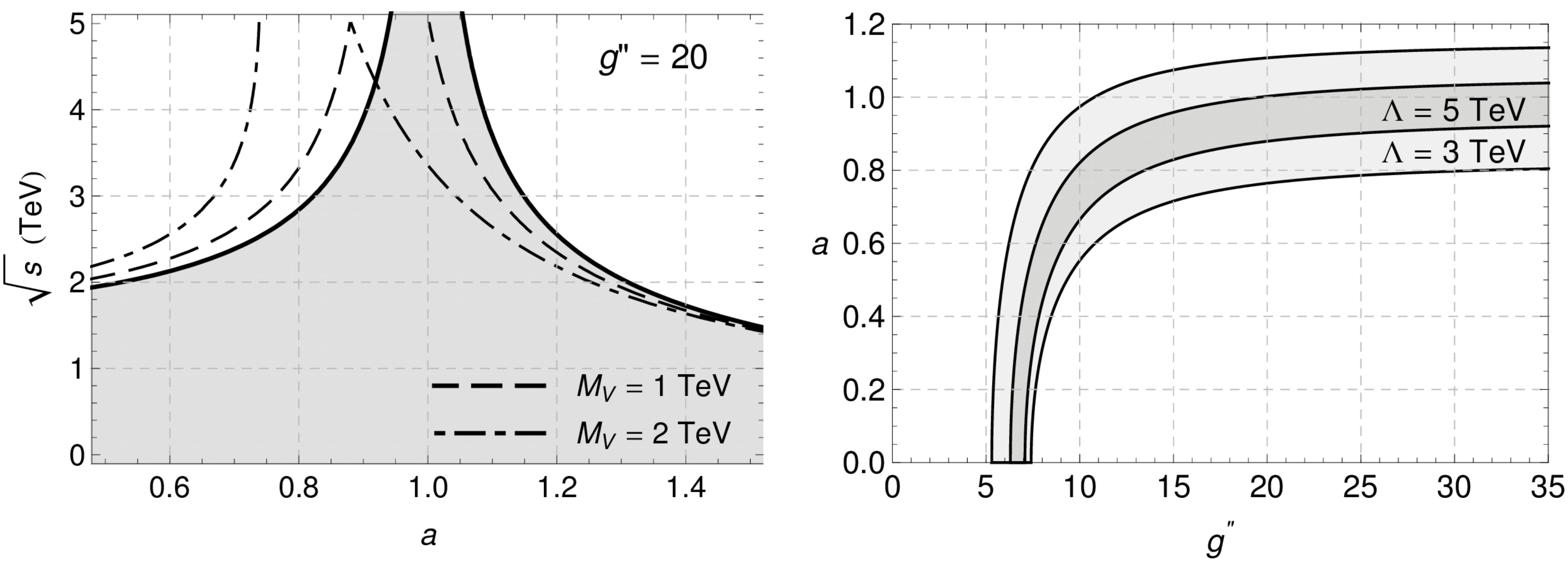

The low-energy data analysis

- LE Lagrangian: $M_\rho \to \infty$, g'' fixed
- free params: a, $x=g/g''$, p, $\Delta L=b_L-2\lambda_L$, $\Delta R=b_R+2\lambda_R$
- observables: ε_1, ε_2, ε_3, $\Gamma_b(Z\to b\bar{b})$, $BR(B\to X_s\gamma)$

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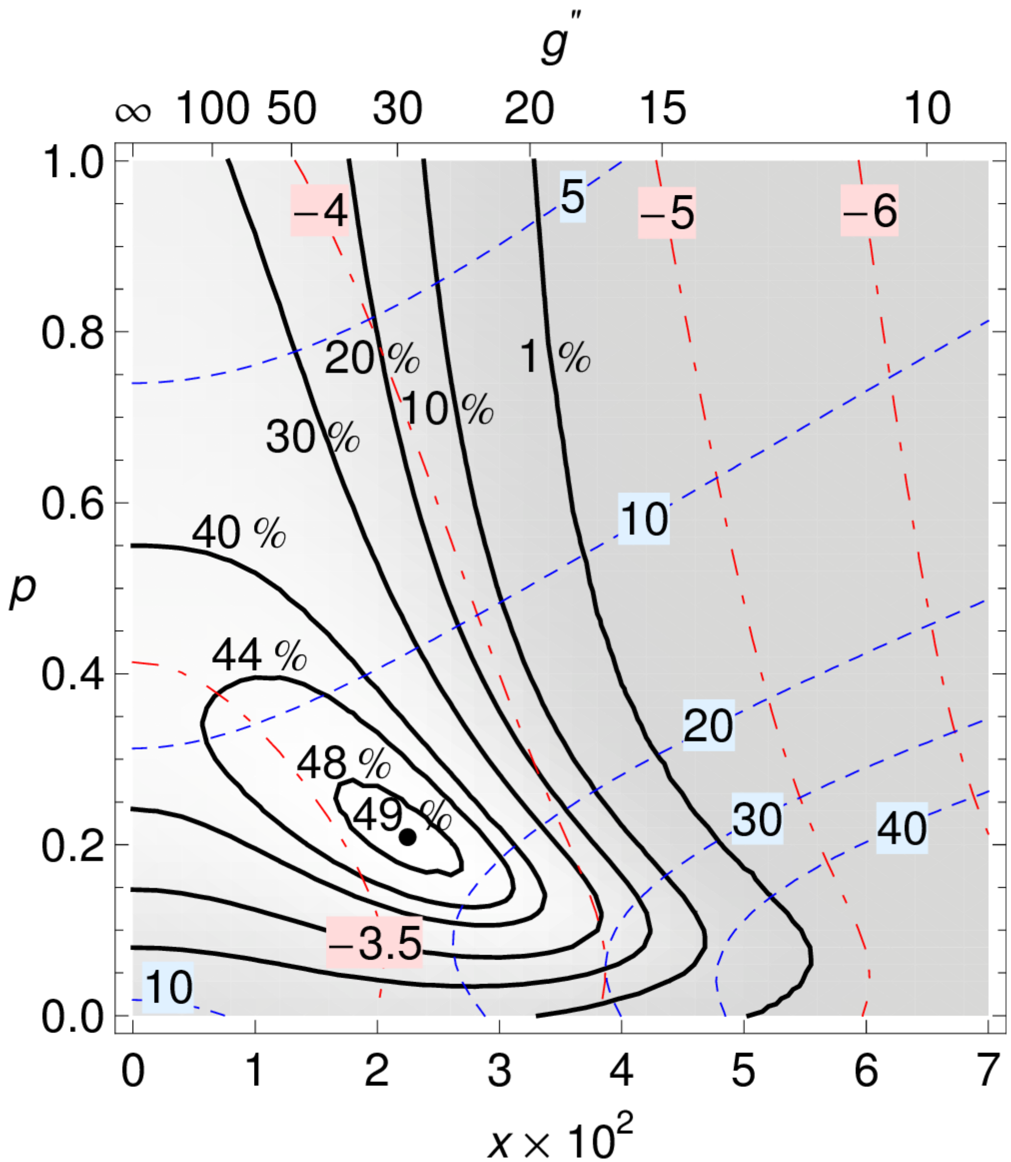
χ^2-fit:

d.o.f. = #obs - #params

#obs = 5

$a = 1 \Rightarrow$ #params = 4

The best fit values



Λ = 1 TeV

g'' = 29

p = 0.209

ΔL = -0.004

ΔR = +0.016

Outlooks

towards experiment

- parameter restrictions
- CompHEP
- signal analysis

towards theory

- model building tool
- observable calc.