TOP-BESS MODEL

AND

ITS PHENOMENOLOGY

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STANDARD MODEL — GAUGE PRINCIPLE — EW SYMMETRY

$SU(2)_L \times U(1)_Y \quad \Rightarrow \quad$ EW interactions

ELECTROWEAK SYMMETRY BREAKING PUZZLE

Spontaneous Symmetry Breaking + Higgs mechanism

ESB SCENARIOS

ESB alternatives

Benchmark hypothesis $\rightarrow$ SM Higgs

- Weakly interacting
- Strongly interacting

BESS Model

Breaking Electroweak Symmetry Strongly

R. Casalbuoni, S. De Curtis, D. Dominici, R. Gatto

PL**B155**, 95 (1985), NP**B282**, 235 (1987)

BESS Model

Breaking Electroweak Symmetry Strongly

- effective Lagrangian
- $\not{H}$SM + new vector resonances
- Local symmetry

$$SU(2)_L \times U(1)_Y \times SU(2)_{HLS} \xrightarrow{SSB} U(1)_{em}$$

$$g \qquad\qquad g' \qquad\qquad g'' \qquad\qquad\qquad e$$

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$$ g \quad\quad g' \quad\quad g'' \quad\quad\quad e$$

- *Gauge sector:* GB-mixing
- *Fermion sector:*
  - ◇ <u>direct</u> coupling: universal chiral   ... bg'', $b'g''$
  - ◇ <u>indirect</u> coupling: GB-mixing induced   ... $1/g''$

- *gauge sector:* identical to BESS
- *fermion sector:* modified

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◇ *bottom$_R$* disentangled from *top$_R$*   ... p

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- $\diamond$ new fermion Lagrangian terms   ... λ_L, λ_R

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- ◇ *consequences:* weakened low-energy limits on b's (... and λ's)

DECAY WIDTHS

- $V \rightarrow (W, Z) + (t, b) + \ldots$

- $\Gamma \sim 10$ GeV

WW, *tt*, *bb*

Phenomenology
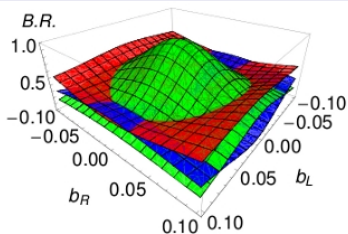
Unitarity constraints

- $W_L^+ W_L^-$, $Z_L Z_L$, $W_L^\pm Z_L$, $W_L^\pm W_L^\pm$

- tree level

- Equivalence Theorem
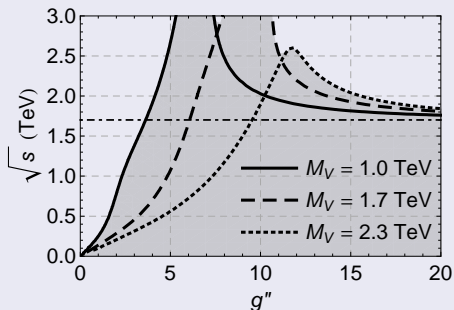
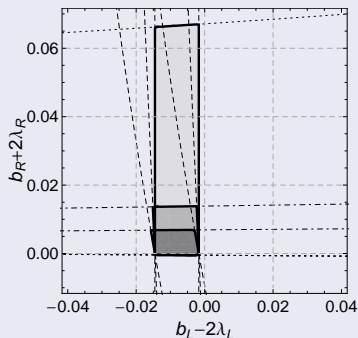# LOW-ENERGY LIMITS

MEASURED OBSERVABLES (LEP + SLC + TEVATRON)

EWPD ϵ-analysis: ϵ_1, ϵ_2, ϵ_3, ϵ_b, $\Gamma(Z \to b\bar{b})$, $B \to X_s\gamma$, $p\bar{p} \to WZX$

Low-energy limits

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ϵ_1, $\Gamma(Z \to b\bar{b})$, $B \to X_s\gamma$ RESTRICTION

Intersections of 90% C.L. allowed regions.

$M_V = 1$ TeV
$g'' = 10$

HIDING THE PEAK

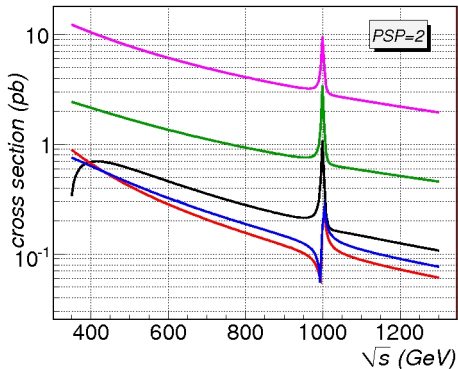$M_V = 1$ TeV, $g'' = 20$, $p = 0$, $\lambda_R = 0$
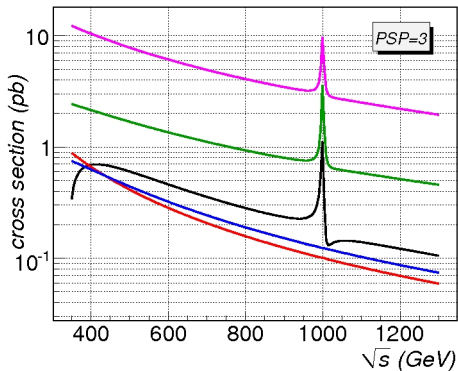

- **no direct cplng**
  $b_L = 0$
  $b_R = 0$
  $\lambda_L = 0$

- **outside the DV**
  $b_L = -0.010$
  $b_R = +0.030$
  $\lambda_L = 0$

- **$t\bar{t}$ & $b\bar{b}$ in the DV**
  $b_L = +0.009$
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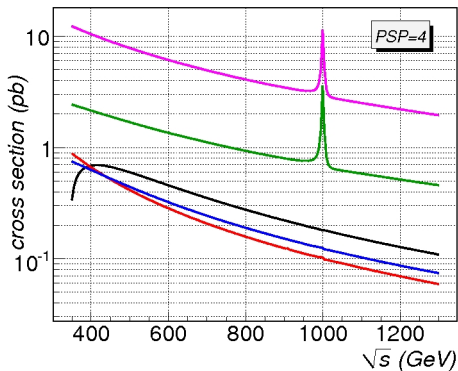$M_V = 1$ TeV, $g'' = 20$, $p = 0$, $\lambda_R = 0$

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CONCLUSIONS

- the actual mechanism of ESB still remains a puzzle

- **top-BESS model** — the effective description of strong ESB

- modification of BESS model; special role of top quark
  - ⋆ *new SU(2) vector triplet*
  - ⋄ *direct coupling to top and bottom only*
  - ⋄ *disentangled interaction of the right-handed top-bottom doublet*
  - ⋄ *new λ terms*

- low-energy limits on the fermion parameters are relaxed