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Minimal Z' models:
present bounds &
early LHC reach

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Work in progress with:

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100-200 pb^{-1} @ 7-10 TeV in 2010?

Minimal Z' models

- $G = \text{SU}(3)_C \times \text{SU}(2)_L \times \text{U}(1)_L \times \text{U}(1)'$
- Only SM fermions + RH neutrinos
- Flavour-blind couplings, no anomalies

Not restrictive to write (can.kin.terms, mass basis):

$$\mathcal{L}_{\text{NC}} = e A J_{\text{em}} + g_Z (Z J_Z + Z' J_{Z'})$$

where J_Z and $J_{Z'}$ are obtained by rotating

$$J_Z^0 = \text{SM current coupled to SM } Z^0$$

$$J_{Z'}^0 = (g_Y/g_Z) J_Y + (g_{\text{BL}}/g_Z) J_{\text{B-L}}$$

[see, e.g., Appelquist-Dobrescu-Hopper, hep-ph/021207]

mass & kinetic mixing effects automatically included

3 indep. parameters: $M_{Z'}$ g_Y g_{BL}

Constraints from GUTs

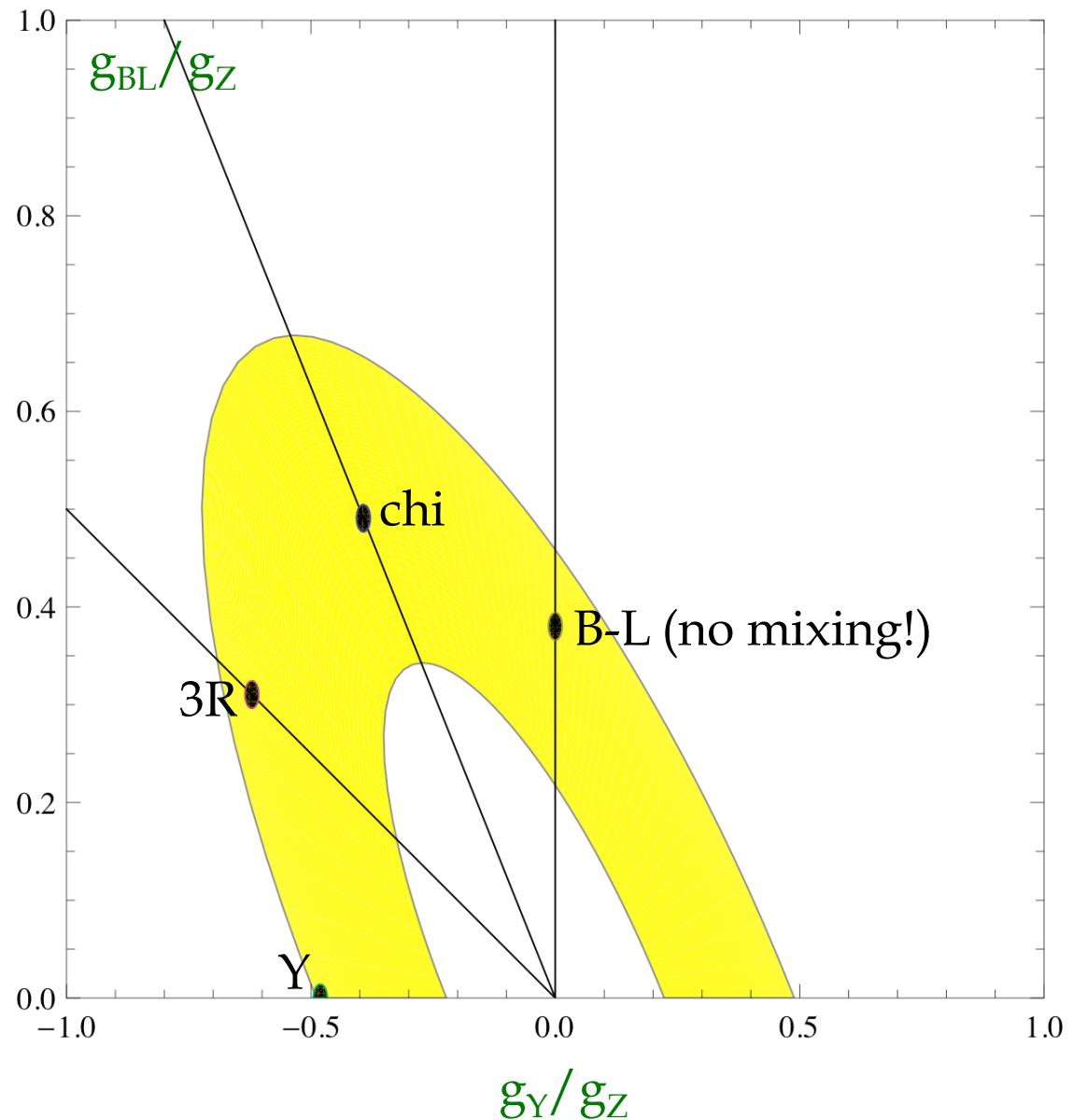
Plausible range of
boundary conditions
@ $M_U \sim 10^{16}$ GeV

RGE running
from M_U to M_Z
(SM or MSSM)



favoured range in
(g_Y, g_{BL}) plane

Specific models
= special points



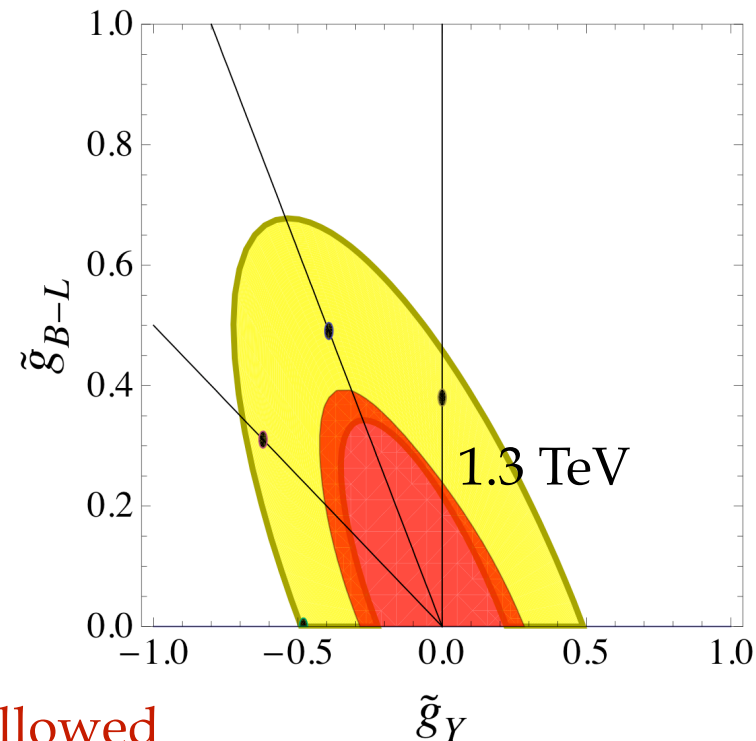
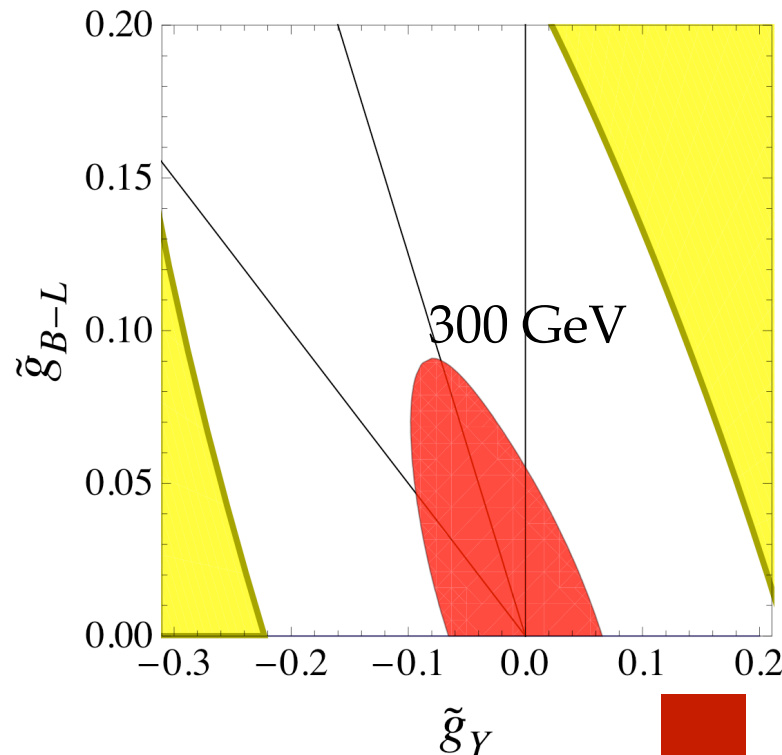
Constraints from EWPT

Convenient to adapt results and methods of
Cacciapaglia-Csaki-Marandella-Strumia hep-ph/0604111

Fit 9 effective EW parameters: $S, T, U, W, Y, V, X, de_q, dC_q$

LEP-1 Z-pole data mostly constrain Z_0 - Z_0' mixing $|\theta| < \mathcal{O}(10^{-3})$

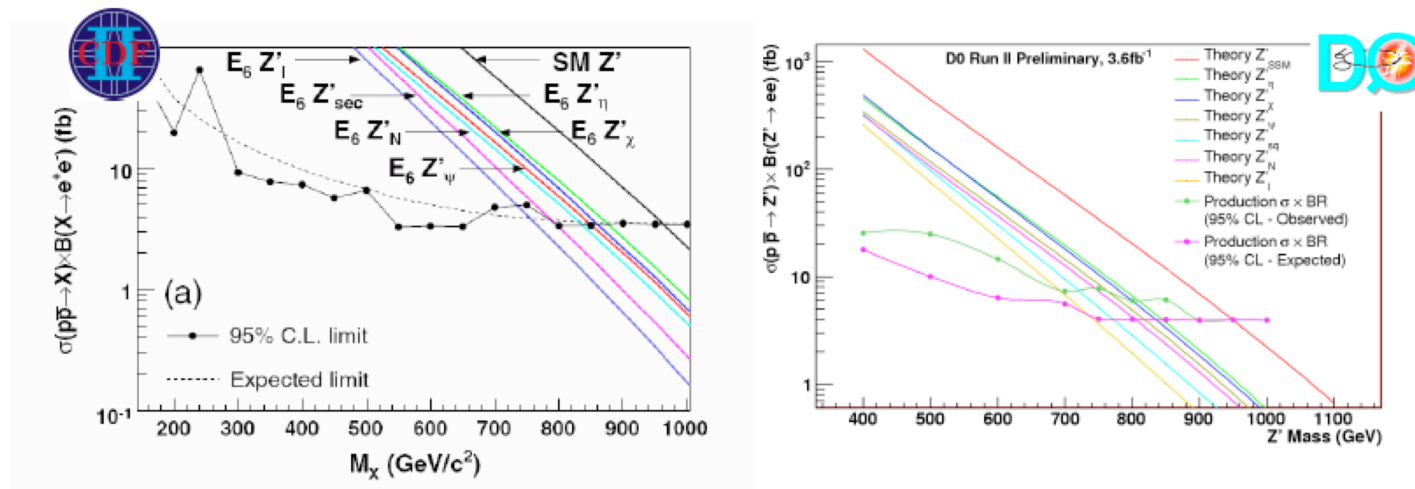
LEP-2 (off-pole) data & APV constrain 4-fermion effective operators



Tevatron direct searches: experiment

[CDF, 0810.2059 (e) & 0811.0053 (mu); D0, 5923-CONF July 2009 (e)]

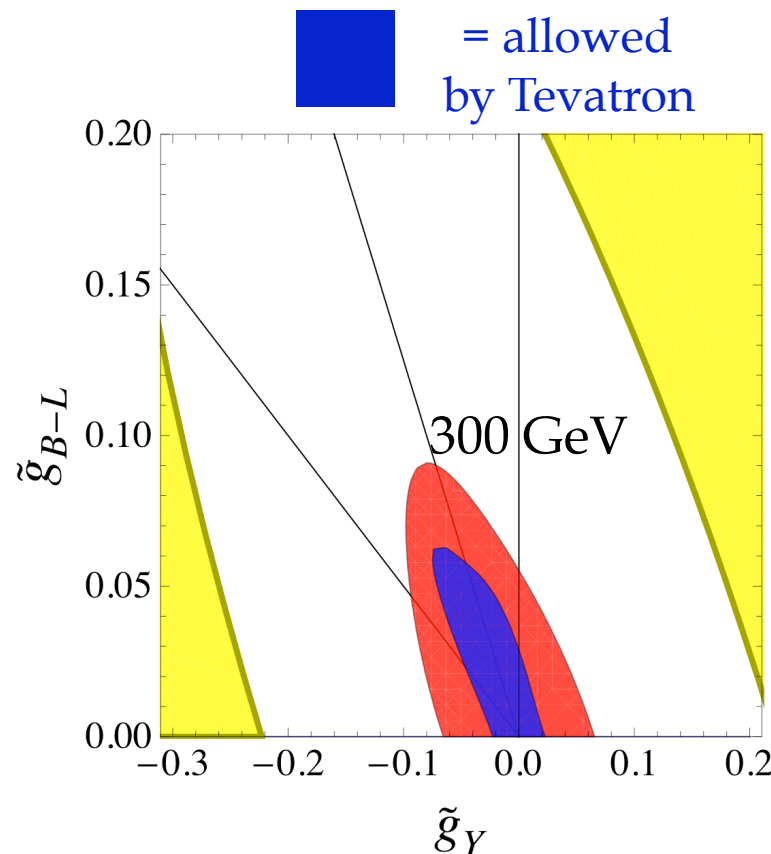
Typical bounds are on $\sigma(Z') \cdot BR(Z' \rightarrow l^+ l^-)$ as a function of $M_{Z'}$, assuming a sufficiently narrow width



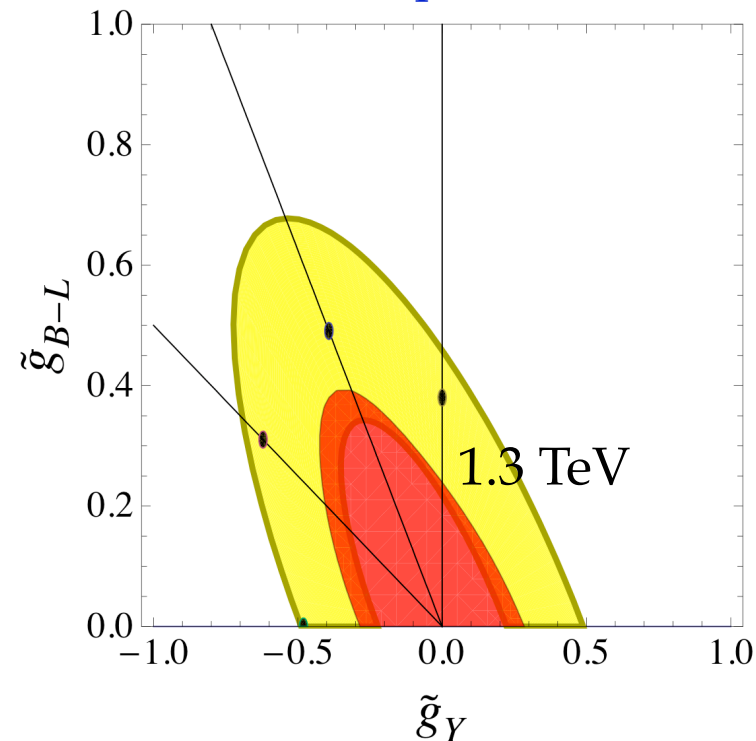
Z' model	Z' _{SM}	Z' _ψ	Z' _χ	Z' _η	Z' _I	Z' _{sec}	Z' _N
Exp. Lim (GeV)	961	846	857	873	755	788	831
Obs. Lim (GeV)	963	851	862	877	735	792	837
Exp. Lim (GeV)	949	817	834	844	732	774	803
Obs. Lim (GeV)	950	763	800	810	692	719	744

Tevatron direct searches: pheno

Easy to extract bounds on minimal Z' models parameters
Using for example most recent CDF/D0 data
(with a NLO calculation and MSTW-08 PDF):



Tevatron not competitive with EWPT



Early LHC prospects



$s = (7 \text{ TeV})^2 \text{ Int.lum.}=100 \text{ pb}^{-1}$



$s = (10 \text{ TeV})^2 \text{ Int.lum.}=400 \text{ pb}^{-1}$

region NOT accessible to LHC
(rough estimate for now,
detailed study in progress)
needs more energy/luminosity

