Perturbativity constraints on $U(1)_{B-L}$ and Left-Right Models

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In collaboration with
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Outline

- Introduction
- Theoretical Constraints
- Bounds in $U(1)_{B-L}$ model
- Bounds in Minimal LRSM
- Conclusions

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- From experimental point of view, interesting to look at prospects of new physics at TeV scale.
- Many TeV scale extensions introduce extended gauge groups like extra $U(1)$ or $SU(2) \times U(1)$.
- We'll look at pertubativity constraints in 2 extensions where extra gauge groups contribute to the electric charge namely $U(1)_{B-L}$ and minimal LRSM.

Theoretical Constraints

- Consider an SM extension: $SU(2)_L \times U(1)_X \times U(1)_Z$ such that:

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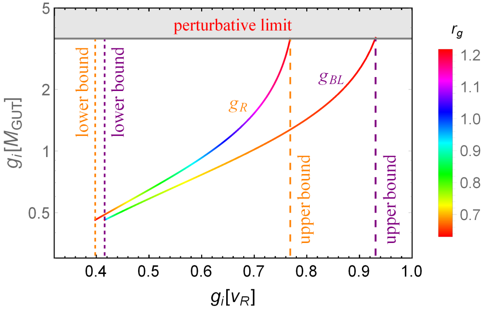
- Then requiring that coupling g_Z is perturbative at breaking scale,

$$\Rightarrow \quad \boxed{r_g \equiv \frac{g_X}{g_L} > \tan\theta_W \left(1 - \frac{4\pi}{g_Z^2}\frac{\alpha_{EM}}{\cos^2\theta_W}\right)^{-1/2}}$$

$SU(2)_L \times U(1)_{I3R} \times U(1)_{B-L}$ (Gauge Couplings)



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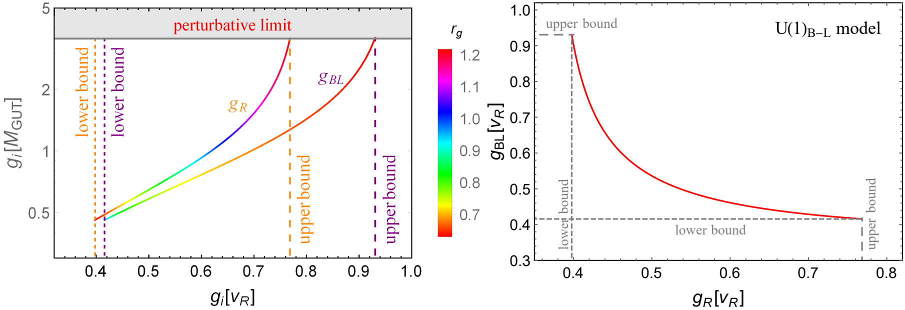

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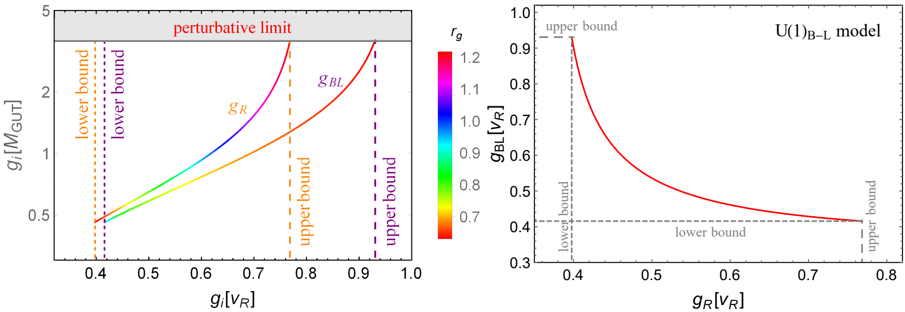
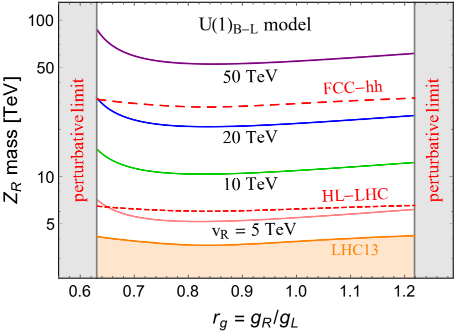


$$0.398 < g_R < 0.768; \quad 0.416 < g_{BL} < 0.931, \text{ with } 0.631 < r_g < 1.218$$

at $v_R = 5$ TeV

$SU(2)_L \times U(1)_{I3R} \times U(1)_{B-L}$ (Z_R searches)



(ATLAS-CONF-2016-045)
(CMS-PAS-EXO-16-031)

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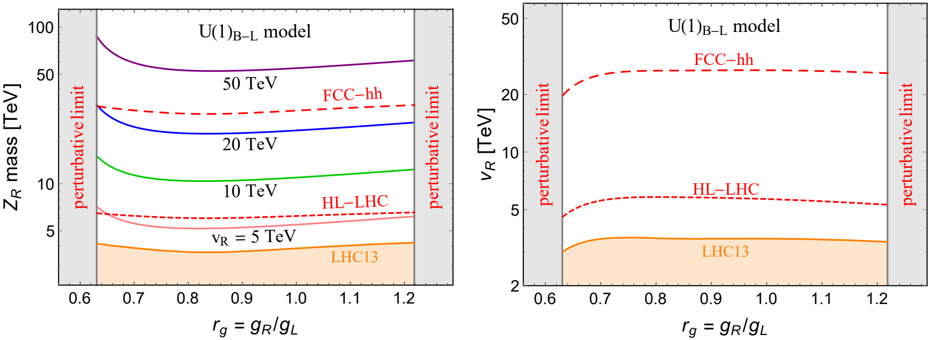

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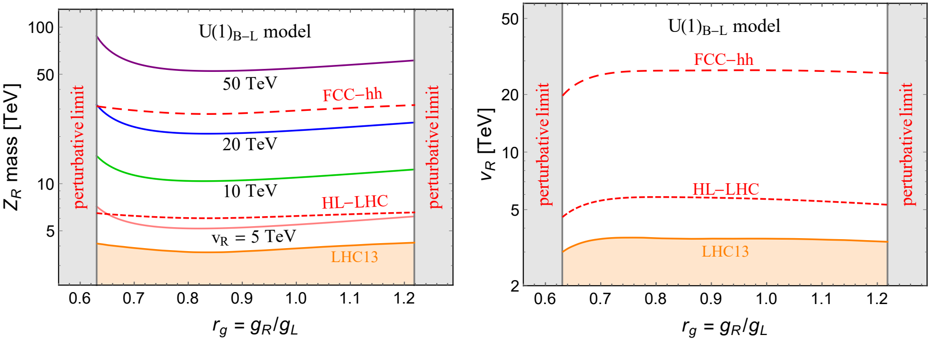
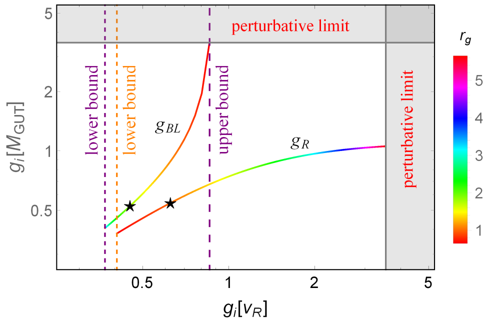


collider	M_{Z_R} [TeV]	v_R [TeV]
LHC13	[3.6, 4.2]	[3.02, 3.57]
HL-LHC	[6.0, 6.6]	[4.60, 5.82]
FCC-hh	[27.9, 31.8]	[19.9, 26.8]

$SU(2)_L \times SU(2)_R \times U(1)_{B-L}$ (Gauge Couplings)



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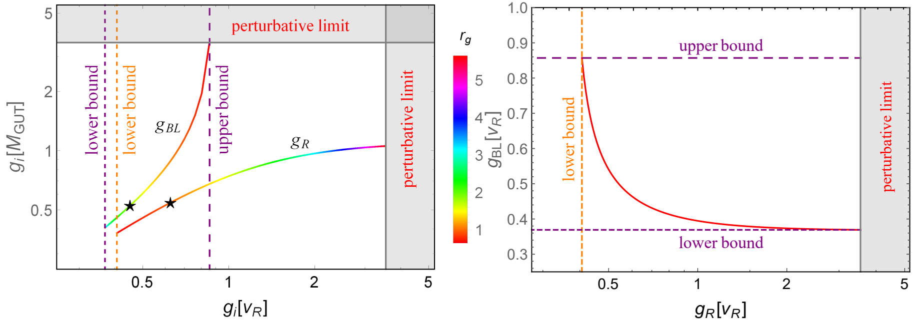

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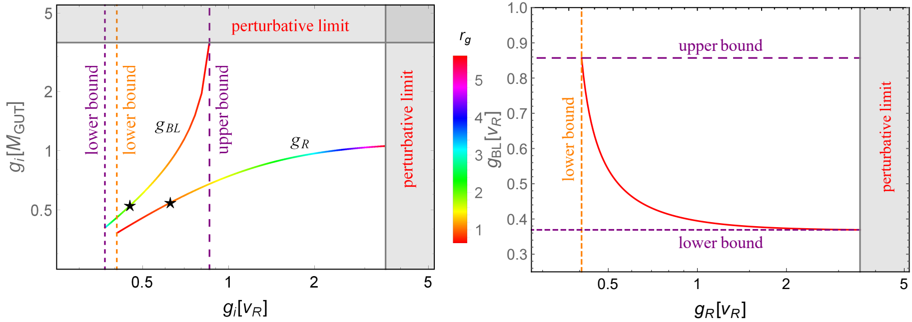
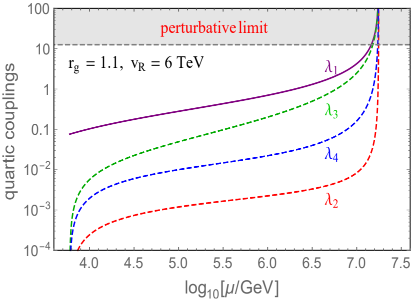
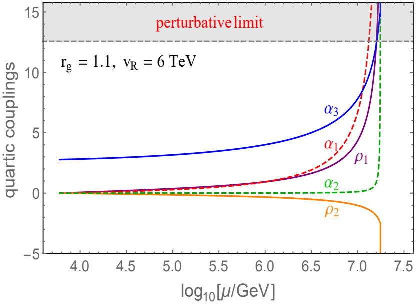


$$0.406 < g_R < \sqrt{4\pi}; \quad 0.369 < g_{BL} < 0.857, \text{ with } 0.648 < r_g < 5.65$$

at $v_R = 10$ TeV

$SU(2)_L \times SU(2)_R \times U(1)_{B-L}$ (Scalar sector)





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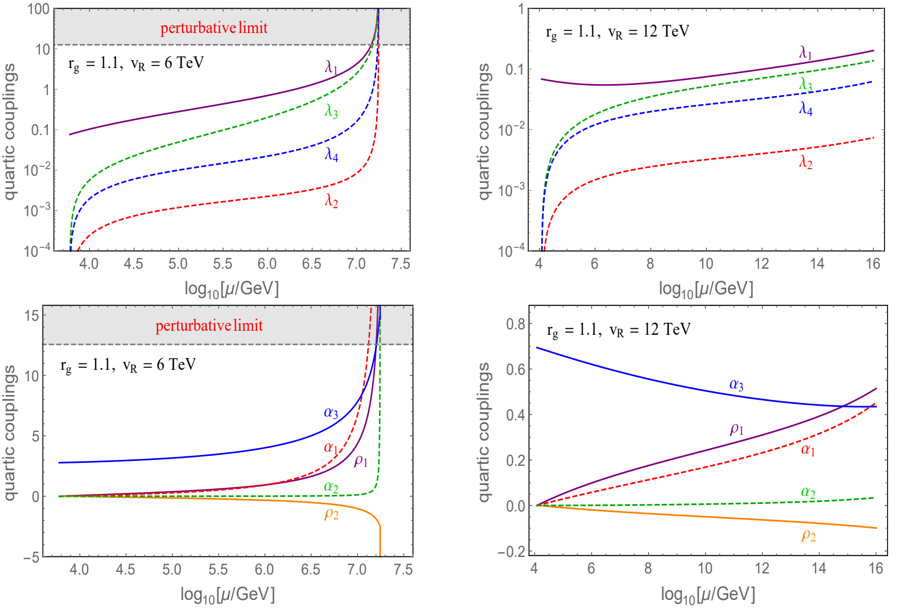

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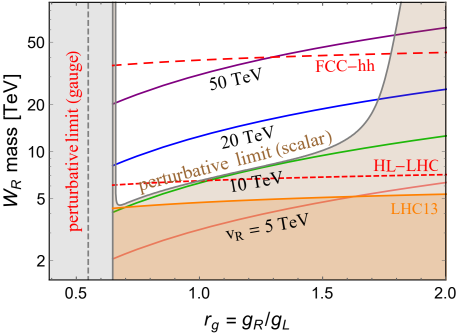

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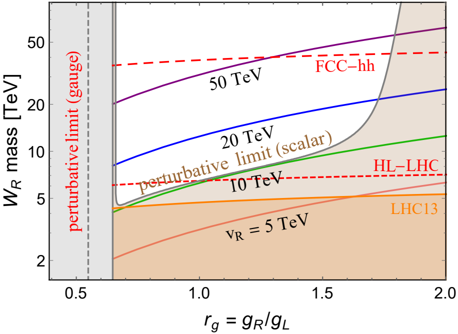

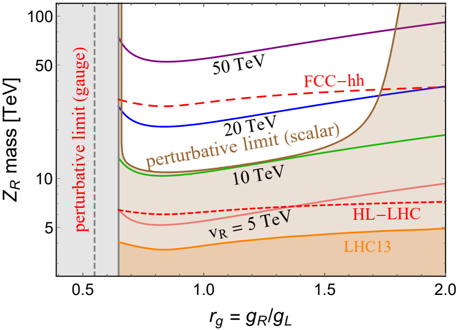

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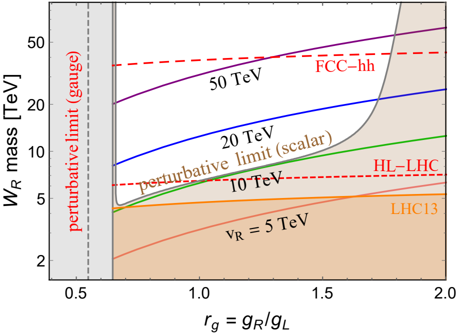

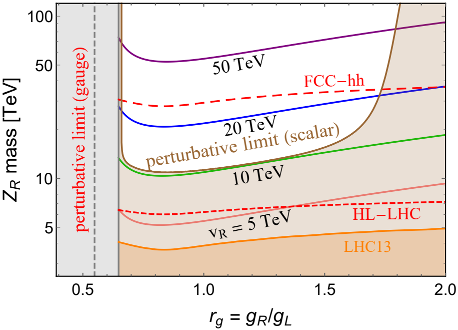

collider	W_R searches		Z_R searches	
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LHC13	–	–	–	–
HL-LHC	[6.09, 6.47]	[10.3, 14.8]	–	–
FCC-hh	[35.6, 42.2]	[38.3, 87.5]	[27.9, 35.4]	[21.8, 26.8]

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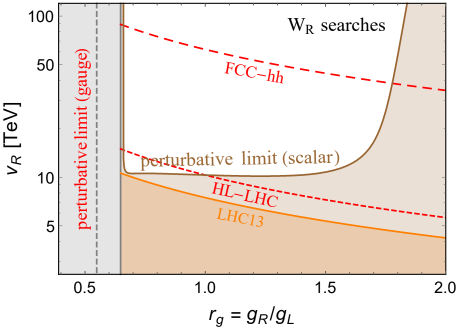

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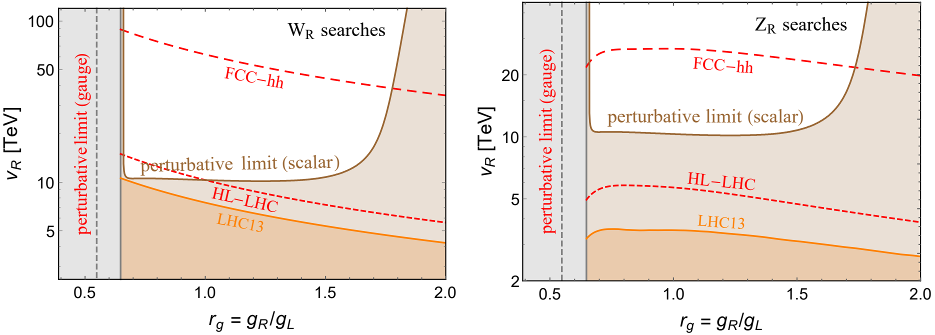

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- For minimal LRSM, we found W_R and Z_R couldn't have been seen at LHC13.
- In case, Z_R is found in HL-LHC run then couldn't be from minimal LRSM.
- The results can be generalized to other gauge group extensions.

Thank you all!