Fourth Generation Leptons in AdS_5

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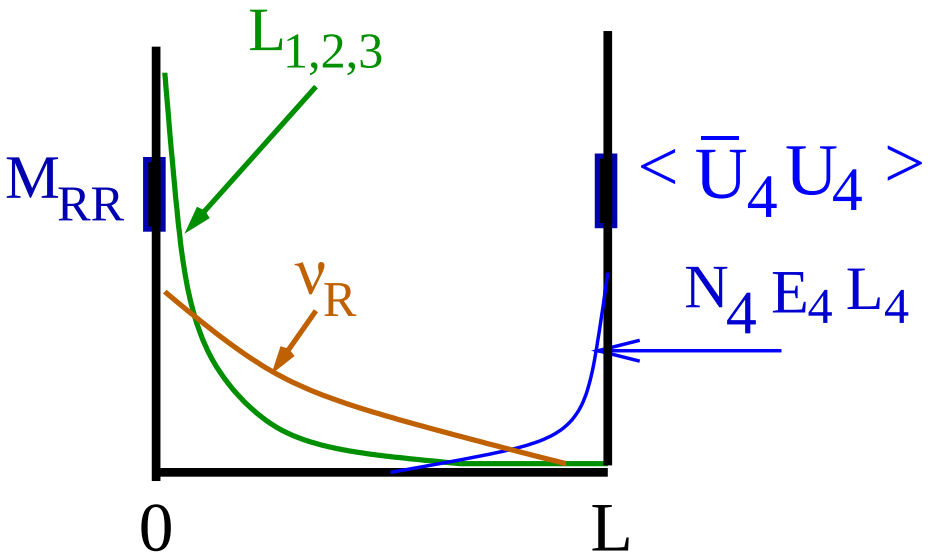
Four Generations in a Slice of AdS_5

- Compact extra dimension with AdS metric
- Bulk gauge theory: $SU(3) \times SU(2)_L \times SU(2)_R \times U(1)_X$
- Four generations of SM fermions:
  - UV-localized light SM fermions
  - Q^3, $t_R \sim$ IR-localized
  - IR-localized 4th Generation

The Fourth-Generation Lepton Sector

$L_4 = \begin{pmatrix} N_4 \\ E_4 \end{pmatrix}_L$, E_{4R}, N_{4R} Acquire masses $O(m_{U_4})$



The Fourth-Generation Lepton Sector

Neutrino Masses and Mixings

- *See-saw*:
  UV-localized Majorana mass term $\Rightarrow$ usual see-saw for light neutrinos.
  See-saw not affecting IR-localized N_4, remains heavy.
- To get V_{MNS}
  $\Rightarrow$ L_4 coupling $\simeq$ equally to the 3 lighter generations
- $\mu \longrightarrow e\gamma$: $V_{4i} < O(0.01)$

The Fourth-Generation Lepton Sector at the LHC

Heavy Lepton pair-production at the LHC
(G.B., Da Rold, Eboli, Haluch, Matheus in progress)

Assuming $m_{E_4} > m_{N_4}$: $N_4 \to \ell^- W^+$, with $\ell = e, \mu, \tau$
For instance using

$$pp \to N_4 \bar{N}_4 \to e^{\pm}\mu^{\mp} W^+ W^-$$

backgrounds: $t\bar{t} + 2j$, $W^+W^- + 4j$

Seeing the Interactions with EW KK Gauge Bosons

- Electroweak KK Gauge bosons are narrower than KK gluon
- They represent more than 1/3 of the cross section
- $\sigma(pp \to N_4 \bar{N}_4 \to e^{\pm}\mu^{\mp} W^+ W^-) \simeq O(\text{few})\ fb$

$E_4^{\pm}$ production

- For $M_{E4} < M_{N4} \Rightarrow E_4^- \rightarrow W^- \nu_i$
- For $M_{E4} > M_{N4}$, 2 body still dominates over $E_4^- \rightarrow N_4 f_1 \bar{f}_2$ if $\Delta M < M_W$ (even for $V_{4i} < 0.01$)
- Larger $\sigma_{\text{prod.}}$ due to γ, $A^{(1)}$

$$\Rightarrow pp \rightarrow E_4^+ E_4^- \rightarrow W^+ W^- + E_{T\,\text{miss.}}$$

Very hard due to backgrounds. Maybe cutting hard on $E_{T\,\text{miss.}}$

$E_4 N_4$ production

- Through the charged current: $W^{(0)\pm}, W^{(1)\pm}$
- Again, 2 body decays dominate independently of sign of ΔM

$$pp \to E_4^- N_4 \to SS2L + W(jj) + E_{T\,\mathrm{miss.}}$$

Backgrounds manageable thanks to SS2L