LFV from GUT see-saw models and from TeV see-saw models

discussion

1. A rationale for neutrino flavour parameters

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2. Origin of the neutrino mass: Seesaw or alternatives, GUT or TeV scale

3. Charged LFV in the MEG experiment

A rationale for neutrino flavour (I)

- How can flavour mixing be implemented? Is it possible to define some "benchmark" scenarios? If so, which ones?
  - tri-bi-maximal mixing, if confirmed, calls for a symmetry
  - how hard is to conciliate tri-bi-max and GUT?

A rationale for neutrino flavour (II)

- Is it possible to come up with plausible arguments for the precisions required for θ_{13}, δ_{CP}, and the Majorana phases?
  - can theorists "control" the dynamics of family symmetries down to the future experimental precisions?
- What information on the origin of neutrino masses can be obtained from the mass hierarchy measurement?
  - hard to believe that two (three) quasi-degenerate states are accidental

Origin of the Neutrino Mass (I)

- Is it possible to discriminate between GUT and TeV see-saw models?

  - Neutrino FV: did we observe the signature of a GUT? will we observe one?

  - Charged lepton FV: clear predictions for the mass-insertions δ_{ij} from the running between M_{Pl} and M_{GUT}? between M_{GUT} and M_{seesaw}?

  - Is LFV mediated by TeV seesaw particles distinguishable from other sources of LFV? non-unitarity effects? direct detection at colliders?

Origin of the Neutrino Mass (II)

- How do these models inscribe into a more general theory?
  - complementary observations in other sectors are needed to discriminate among models
- Where does the smallness of neutrino masses come from, and does it require fine-tuning anywhere?
  - could (should) one use naturalness to prefer a large seesaw scale? is TeV seesaw unexpected?

Many TeV Models For Neutrino Masses

- Dim-5 operator LLHH/M may be absent, dim-7 operator LLHH($H^\dagger H$)/M^3 present instead: TeV messangers for 10^{-3} Yukawas

  Babu, Nandi, Tavartkiladze, 0905.2710

- $U(1)_{B-L}$ (or even the full LR symmetry) broken by the RH sneutrino VEV, which is bound to the soft SUSY breaking scale

  Barger, Fileviez Pérez, Spinner, PRL 102, 181802 (2009)

- U(1)' forbidding neutrino Yukawas; SUSY breaking induces "wrong" Higgs Yukawas suppressed by $F/M^2_{mess} = m_{soft}/M_{mess}$: tiny Dirac neutrino masses

  Demir, Everett, Langacker, PRL 100, 091804 (2008)

MEG expectations for BR($\mu \to e\gamma$)

- Present bound (MEGA 90%C.L.): 1.2 10^{-11}
- MEG data taking started in September 2008, Summer 2009 bound could be already below 10^{-11}:
  single event sensitivity = (3-5) 10^{-12}
  $\Rightarrow$ 90% bound = (7-12) 10^{-12} , if bkg is negligible
- Final goal (3 years): 2 10^{-13}

MEG interpretation

- What a negative result would tell us?
  - SUSY flavour problem getting worse
  - SUSY explanation for $(g\text{-}2)_\mu$ tenable
- If a signal is found, how to discriminate different models?
  - polarized muons + positron angular distribution to measure $(A_L^2 - A_R^2)/(A_L^2+A_R^2)$; with photon polarization also $\mathrm{Im}[A_L A_R]$ ...
  - roughly, A_R from GUT thresholds, A_L from seesaw thresholds, could be distinguished