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

SESSION SUMMARY

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Model building and model predictions

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- A rationale for neutrino flavour parameters

- Origin of the neutrino mass:
Seesaw at GUT scale or TeV scale

Interpretation of Neutrino Flavour (I)

- Flavour mixing "benchmark" scenarios
  - tri-bi-maximal (HPS) mixing, if persistent ($\theta_{13} << \theta_c$, $0.45 < \sin^2\theta_{23} < 0.55$), calls for a symmetry
  - to justify tri-bi-max with a symmetry requires some technicalities, in GUT it is even harder but possible
    - arrange a specific VEV alignment in the family symmetry breaking sector
    - right-handed neutrino sequential dominance // double seesaw to cancel the Yukawa hierarchy

ROSS// SCHMIDT

Interpretation of Neutrino Flavour (II)

- Precisions required for θ_{13}, δ_{CP}, and the Majorana phases
  - the dynamics of family symmetries is controlled up to the size of the expansion parameter < θ_{13}^{CHOOZ}

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  - high energy values undergo RGE evolution, which may be strong but is computable

SCHMIDT

- Theoretical impact of the mass hierarchy measurement
  - hard to believe that two (three) quasi-degenerate states are accidental
  - if Katrin sees ν mass, hierarchy is not so relevant

Origin of the Neutrino Mass (I)

- Tests of seesaw in SUSY GUTs
  - Only signature of GUTs in lepton flavour parameters is ... charged lepton mass hierarchy
  - LFV in GUTs: specific predictions (and close to present bounds) (i) for the mass-insertions δ_{ij} due to the running between M_{Pl} and $M_{GUT}(M_{seesaw})$; (ii) for the misalignment of soft-terms in flavour models with familons

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  - Strong dependence on the SUSY breaking pattern: discovery of SUSY at LHC is crucial

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Origin of the Neutrino Mass (II)

- Naturalness of TeV scale seesaw
  - No serious obstruction, but strong belief that a symmetry (lepton number) is needed, to be broken at the TeV scale

    MA
  - Inverse seesaw: TeV scale is technically natural because of a $U(1)_L$, possibly gauged; smallness of $U(1)_L$ breaking can be justified as a loop effect

    MA
  - Symmetries to lower the seesaw scale may provide a stable neutral particle as a byproduct: e.g. take Ns and one extra Higgs doublet odd, SM particles even: candidate WIMPs, in the right ballpark

Even more TeV Models For Neutrino Masses

ROSS, MA

- 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 (related talk by **KHALIL**: radiative B-L breaking)

  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)

Origin of the Neutrino Mass (III)

- There are well-motivated TeV models to generate neutrino masses, with no fine-tunings
- Is TeV seesaw easier to test? Type I, dealing with gauge singlets only, is hard: suppressed LFV, suppressed non-unitarity effects, suppressed LNV at LHC, barring special textures
- Type I with extra gauge interaction, type II, etc... will provide much easier signals, but not obvious to show that they are related to neutrino masses