Memorandum on Supersymmetry

Alejandro Rivero*

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Abstract

Some thoughts on supersymmetry, for further research

1 Diquark susy

The main motivations to look for a fundamental SUSY symmetry are to control the cuadratic corrections to masses of the higgs sector and to refine the fit of the coupling constants at the GUT scale. It seems that in order to fit these goals with a Diquark-based susy [1] we should need direct couplings between diquarks and higgs. Or the higgs sector should be more interesting... top composite or something so?

On the other hand, the higgs field itself seems a very complicated issue: if it is going to give mass to the diquarks, it means it is giving mass to the mesons, a role reserved to the colour force. That could be related to the top quark too.

In counting degrees of freedom, some details:

-Leptons are to be included. They are SUSY partners to quark/antiquark Diquarks. It is to be seen if the electron has a partner or if it lies in some vacuum representation, spontaneously broken. But as for the other two, simple inspection of meson masses is enough hint of a supersymmetry principle.

-The top could be excluded, then getting a different count of degrees of freedom for down-like quarks (related to charged leptons, eg Koide's) and up-like quarks. Note also that the +4/3 diquark does not seem to exist (even experimentally?), or at least it hasn't got a parner.

2 NCG and broken susy

The mechanism of susy breaking could be the substitution in superspace of grasmannian coordinates, akin to infinitesimals, by discrete differences. This later setup is very well known, and it corresponds to Connes-Lott (and related, Coquereaux etc) models. Besides, Connes formalism is also able to operate with infinitesimals. The main problem is that the higgs sector is too simple in Connes-Lott.

Susy will appear as we switch down the interactions. We suspect that moving Sommerfeld $\alpha \to 0$ drives to zero the electron sector and to infinity the electroweak one; the pion mass is undefinite because f_π goes to ∞ too (the pion

*Zaragoza University at Teruel. arivero@unizar.es

becomes stable). So it could either pair with the electron at zero mass or with the muon. In a second step, we should shut down the colour interaction and see what does it happen with the relative mass between tau and muon. The first step could be done maintainig Koide's relation –or Foot's, which extend to up quarks if we angle against (1,1,0)–. The second step could to violate Koide's, the role of colour being relevant then.

Alternatively in the SUSY/NCG setup, some restoration should occur when we replace the Dirac operator by an infinitesimal object. Naively it should mean that susy is restored when the higgs sector is driven to infinity, independently of the consideration in the above parragraph.

References

[1] S. Catto, "Algebraic realization of quark-diquark supersymmetry," arXiv:hep-th/9811069.

D. B. Lichtenberg, "Whither hadron supersymmetry?," arXiv:hep-ph/9912280.

[2] E. Ma and M. Raidal, "Three active and two sterile neutrinos in an E(6) model of diquark baryogenesis," J. Phys. G **28** (2002) 95 [arXiv:hep-ph/0012366].

Z. Chacko and R. N. Mohapatra, "Supersymmetric SU(2)L x SU(2)R x SU(4)c and observable neutron antineutron oscillation," Phys. Rev. D **59** (1999) 055004 [arXiv:hep-ph/9802388].

[3] http://blogia.com/conjeturas/index.php?idarticulo=200507201