No elementary scalars in experimental supersymmetry

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This sheet presents an extreme interpretation of the global SU(5) symmetry that has been gradually discovered in the spectrum of scalar particles of the Supersymmetric Standard Model. It postulates that such scalars are actually the different aspects of the QCD string. If so, only the gauginos and perhaps two neutral higgs particles are candidates for discovery in the LHC.

The Supersymmetric Standard Model is the completion with an N=1 supersymmetry of the particles in the Standard Model. If it is agnostic to the mass generation mechanism, it has two scalars (and two fermionic helicities) less than the MSSM: to build massive N=1 supermultiplets for the Z and W, one must add the equivalent of a N=2 massless supermultiplet, namely one chiral ½ supermultiplet. This supermultiplet gives two scalars, one of them added to the zero helicity of the gauge boson, the another usually incorporated to the tuple of higgses.

In all this article we assume that neutrino oscillation, plus GUT heuristics, assumes that each neutrino is completed to a Dirac neutrino. Then the fermions of the standard model sum a total of 96 helicity states.

The 96 helicity states come 24 of them from leptons, 72 of them from quarks, which in turn are produced by the degeneration of SU(3) colour charge.

The three chiral ½ supermultiplets mentioned above add 6 helicity states that can not degenerate via colour, because the colour interaction does not have any axial-vector component.

Then the scalar, bosonic partners of all these helicity states can be arranged in a very peculiar SU(5) global symmetry:

- first, the 24 sleptons arrange in the **24** irrep that comes from $\mathbf{5}\mathrm{x}\underline{\mathbf{5}}$ of SU(5).
- second, a multiplet of 24 squarks plus the 6 “protohiggs scalars” can be arranged in the $\underline{\mathbf{15}}+\mathbf{15}$ irrep of $\mathbf{5}\mathrm{x}\mathbf{5}$ + $\underline{\mathbf{5}}\mathrm{x}\underline{\mathbf{5}}$
- third, assume that the multiplet in step two is colour degenerated in the squark

submultiplet, but not in the protohiggs sector.

In order to understand this arrangement, is is useful to consider the fundamental of SU(5) as being similar, in colour and electric charge, to the tuple of fermions (d,s,b,u,c). This was developed in the series of papers [1], where it was also noticed that you can not do this magic with any number of generations, it only works with three generations. We refer to these papers for the detailed mathematical focus. Just note that you can always use the similarity in charge of (d,s,b) and (u,c) to decompose SU(5) irreps into sums of the ones of the product SU(3)xSU(2), always as a global flavour symmetry.

The symmetry of the scalar sector could, via susy, explain the composite-like aspect of the masses of charged fermions, noticed by Koide [3] time ago.

And, if we take seriously that the symmetry can be generated by a QCD string terminated in any of the possible combinations of the five light quarks, then either all the scalars of the SSM are to be expected to mix with the QCD string states, or -even worse- they are really the QCD string states, and then we should not expect to discover them... because we have already discovered them, from π to Y. There are only two expectations for discovery:

1. The non scalar particles: the gauginos, as well as the "protohiggsino"
2. The protohiggs sector, whose blindness to colour could allow it to escape from the diquark interpretation.

If the link with QCD is serious, it should also surface in the massive Z and W bosons, because its zero helicity now comes from the same **<u>15</u>** + **15** that QCD diquarks. In fact, the total decay rates of Z and W are, by miracle, in agreement with the ones for mesons of similar mass [2].

Finally, some appreciation should be done of the extra dimensional aspects of the SSM, independently of the interpretation of this SU(5) amusement. Note that the total number of bosonic (or fermionic) helicities is 126: the 96 from the sfermionic sector, plus 24 from the the gauge massless, plus 6 from the "protohiggs". We could add the complection of the higgs to add up to 128, or we could instead to put the two helicities of the graviton in the bag, then the whole multiplet could be tried for connections with N=8 D=4 sugra, or with some other compactification of N=1 D=11 with a different number of spin 3/2 particles.

[1] arXiv:0910.4793 arXiv:0710.1526 arXiv:hep-ph/0512065 by the author
[2] arXiv:hep-ph/0603145 arXiv:hep-ph/0507144 by the author
[3] Phys.Lett.B120:161,1983 Koide: A Fermion - Boson Composite Model Of Quarks And Leptons