Liberating Preons from Four Dimensions

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A possible internal structure of the recently discovered X (Hungarian) boson is proposed as an application of a preon model.

My daughter, if you wish, I will this instant create a new world, more beautiful than this one.

Diary of Saint Faustina, 587

Let us recall briefly the characteristics of the preon model presented in [1,2]: a preon particle, called "mark", is assumed to derive from the "bifurcation" of an electron, in analogy with the process by which a very energetic photon can produce an electron-positron pair.

The term bifurcation is used because it seems to exist a deep relationship between particles and the bifurcation diagram of dissipative nonlinear dynamical systems [3].

When the spin 1 of the photon is halved to the spin ½ of the electron, we see in action a general mechanism that can be applied to all levels of the proposed hierarchy of particles: by this hypotethical process, from an electron (or positron) with spin 1/2 and unitary electric charge derives a pair of marks with spin 1/4 and electric charge 1/2.
This process can repeat, the next step producing particles with spin 1/8 and electric charge 1/4 ("supermarks").

But in 3+1 dimensions only bosonic or fermionic behavior is permitted [4]. Trying to evading this limitation, we assume also a principle of doubling of spacetime dimensions, complementary and parallel to the principle of halving of quantum numbers: the production of a particle pair is accompanied with a doubling of spacetime dimensions. We conjecture that by this dimensional doubling the interactions at the related level can be described properly.

Moreover, our model has another feature: observing that the production of an electron-positron pair involves the appareance of mass and time from the massless and "timeless" photon, and following the intuition of N. A. Kozyrev about the "equivalence" of mass and time, we propose that also mass and time are subject to the principle of dimensional doubling.

These premises done, we are ready to propose the following hierarchy:

- the first passage is from a zero spin particle (possibly a scalar graviton) to a pair of spin one photons (up and down). This passage is accompanied with a passage to a 2D space, from the original dimension one.

- the second passage is the experimentally known electron-positron production. Space-time dimension reaches the four dimensions we know, and time and mass appear.

- the third passage regards the production of marks. At this stage, space-time becomes eight dimensional, two dimensions being time-like, i.e. time becomes a complex quantity. Accordingly, mass can also be described as a complex object.
It can be noted that a particle which possesses a complex mass must be bradyonic and tachyonic at

the same time, a difficult to solve conundrum. We guess that, in a way yet unknown to us, four dimensions can account for the bradyonic behavior and four dimensions can account for the tachyonic one [5].

- at the fourth passage space-time becomes sixteen dimensional. Time and mass must be treated as quaternionic objects. At this stage supermarks appear.

Three quanta of mass

From "balmer-like" [6] empirical arguments we assume that $\mathbf{m_{mark} = 17.5\ MeV}$
and $\mathbf{m_{supermark} = 586.5\ MeV}$.

It can be noted that

$$\mathbf{m_{mark} = m_e/4\alpha}$$

and

$$\mathbf{m_{supermark} = m_{mark}/4\alpha = m_e/(4\alpha)^2},$$

where the mass of the electron is $m_e = 0.511$ MeV and α is the fine structure constant.

For the three massive levels of the proposed hierarchy, observing that both spin and mass obey a scaling relation, we can combine them in the following way:

mass/(2·spin) =
m_e for the electron (level 0),
$m_e/2\alpha$ for the mark (level 1),
$m_e/(2\alpha)^2$ for the supermark (level 2),

i.e. $\mathbf{mass_i/(2\cdot spin_i) = m_e/(2\alpha)^i}$ $(i = 0, 1, 2)$

This relation somehow recalls the tower relation from the Majorana equation [7],
$M(s) \propto (const+s)^{-1}$

Internal structure of the X boson

In 2016 [8] the X boson (aka Hungarian boson or Atomki boson) was discovered. In [9] it can be seen an image which depicts clearly the decay of the particle in an electron-positron pair. This suggests that the boson could be composed of four marks: its mass of about 17 Mev [10] is near to the mass of the mark.
These clues lead us to claim that the X boson is indeed composed of four marks, three of them being in a "hidden" state, i.e. a state where the imaginary part of the mass is predominant.

The concept of "hidden" or "orthogonal" state helps us also to explain a discrepancy observed in [2]: "When the neutron decays, the $4 \cdot 18$ marks lose their stability and undergo a process of bifurcation, giving rise to $8 \cdot 18$ supermarks, i.e. a W boson. As said before, the W boson seems in reality to be composed by $8 \cdot 17$ supermarks".
This discrepancy can be explained by the presence in the W boson of 8 supermarks in "hidden" state.

Quark model and mark model

We want to stress that our model retains the triality of the quark model, only at a finer level. This is suggested from the fact that the proton seems to be composed from 54 marks. We recall that a 4D observer can detect marks only in pairs. So the proton seems to be composed by 27 pairs of marks. It seems thus that the quark triality is only an approximation, quarks being the first level of a recursive structure in which (pair of) marks are linked 3 by 3, and then 9 by 9. A candidate to explain this situation is Efimov physics, where particles are linked like Borromean rings [11].

A Pauli-like exclusion principle

Applying again the principle of doubling used to build up our model, we argue that a Pauli-like exclusion principle holds for the mark and the supermark levels of our hierarchy: we conjecture that at most **four** marks can share the same quantum numbers, and also that the same property is valid for **eight** supermarks.

Supermark family and prime numbers

The particles in the following list have a mass that is an integer multiple of the mass of four supermarks [12].
Let M be the mass of **four** supermarks, i.e. 2.346 GeV. Then we have **roughly**:

- Mass of Dimuon resonance near 28 GeV = 4 x **3** x M [13]
- Mass of W boson = 2 x **17** x M
- Mass of Z boson = 2 x **19** x M
- Mass of Top quark = 4 x 18 x M = Mass of W boson + Mass of Z boson
- Mass of Higgs boson = **53** x M
- Mass of 750 GeV Diphoton excess = 6 x **53** x M (we recall that in 2016 the excess was declared only a statistical fluctuation [14])
- Mass of Madala boson = 5 x **23** x M [15]

The presence of prime numbers in the multipliers is somehow reminiscent of Montgomery-Odlyzko Law about heavy nuclei [16].

Dedication

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