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PREONS AS PRESPINORS

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The preon-model with preons of the single prespinor type is discussed here. The preon-hypothesis was suggested [1, 2] to resolve the dilemma of the quark-lepton unification.

Preons are built as subquarks of a certain grand unified symmetry group. Every preon serves to give an attribute to quarks and leptons. Flavons (f_i) carry only flavour, while chromons (c_j) carry only colour, etc. But quarks and leptons themselves are viewed as composites of the preons $q_{i,j}=f_i+c_j+\dots$

The problems which now appear are:

1) What is the grand unified symmetry itself and does it really exist? The answer is not likely to be definite until the results of current experiments on neutrino oscillations and on proton decay are obtained.

2) What is the nature of the force which binds the preons to build quarks and leptons? It must act simultaneously both on flavour and on colour. For this and some other reasons the preon binding force must lie outside of the familiar $U(1)\times SU(2)\times SU(3)_{col}$ symmetry of electro weak and strong interactions. For instance, the Heisenberg-Ivanenko nonlinear spinor interaction is reasonably proposed by the discussion on the role of this force [1].

3) What is the origin of the preon differentiation in flavons, chromons and others? Step by step the number of the types of preons tends to increase up to 20—30 [2]. Such a proliferation of preons defeats the suggested preon-idea itself.

To resolve these problems the other preon-picture may be suggested. Within the now proposed scheme leptons and quarks are viewed as composites differing from preons of the single prespinor type (in the sense of Salam's spinors [2]).

Our prespinors are defined as the objects possessing the simplest transformation group $Z_2=(s,1;\ s^2=1)$, which is able to match the simplest logic operations "yes—no". The illustrative model of a prespinor may be the two-component spinor with states marked (+) and (−), and Z_2 acts as the spin-flip group.

The symmetry groups of prespinors systems prove to be various Coxeter groups, whose generators are elements $\{s\}$ satisfying the law $s^2=1$. These systems are described in mathematical terms of categories of Coxeter groups [3].

The connection of this prespinor model with the preonic models derive from the fact that the well-known Weyl groups of simple Lie algebras are finite Coxeter groups. The finite dimension representations of these algebras including those, which describe the multiplets of particles, can be built as representations of the Weyl groups themselves [4].

Thus Coxeter groups apparently are able to describe any version of the grand unified symmetry, but the prespinor can play the role of a universal preon.

In particular, the Coxeter group A_n, being the Weyl group of the Lie algebra $sn(n+1)$, described the symmetries of the n-colour (or n-flavour) multiplet

For example $SU(2)$-flavour leptons may be viewed within the prespinor model as composites of two prespinors. Their multiplet possesing the Coxeter symmetry group $A_1 = Z_2$ consists of right and left singlets $(++)_R$, $(--)_L$ and of one doublet $\{(+-), (-+)\}_{R,L}$. The flavour group Z_2 acts as the group of permutations of prespinors $(ab) \to (ba)$. But the prespin flip group Z_2 acts as P-reflections: $(++)_R \longleftrightarrow (--)_L$, $\{(+-) \longleftrightarrow (-+)\}_{R,L}$. Herewith in this model the spontaneous flavour Z_2 symmetry breaking involve the breaking of the P-reflection symmetry.

In the same prespinor terms $SU(3)$-colour quarks are represented as composites of three prespinors and their multiplet consists of right and left singlets $(+++)_R$, $(---)_L$ and of right and left triplets $\{(++-), (+-+), (-++)\}_R$, $\{(--+), (-+-), (+--)\}_L$. The colour symmetry Coxeter group A_2 is the group of prespinor permutations too. But its spontaneous breaking entails no left-right anisotropy.

Thus Coxeter groups of permutations of prespinors may play the role of internal symmetries, while the prespinor flip group corresponds to external symmetries.

The functor from the category of Coxeter groups describing prespinor systems into the category of topological spaces may be defined in such a model. In the topological category, Coxeter symmetry groups are realized as first-homotopy groups of some topological spaces. Then it seems attractive to attach the sense of topological models for various prespinor composites to these spaces. For example, such a model of the prespinor itself is a one-dimension real projective space RP^1, but other models are built by different glueing of projective spaces RP^1.

These topological model consideration correlate with a modern hypothesis on the possibility of the topological origin of particle attributes [5]. The glueing of spaces may also be the model of the supposed topological nature of the prespinor binding force. Dynamically such a force is probably realized by different fluxes of the vector fields with non-trivil topological numbers and, for example, by fluxes imitating the magnetic charge [2].

Space rotation-translation groups are Coxeter groups too. They are generated by reflections in different hyper-planes of the space and may be considered as localized prespin flip groups of some prespinor systems. As a consequence, these systems can be provided by the structure of corresponding Grassman manifolds, and inversely they may be the origin of one or another structure of the space. In other words, prespinors may also play the role of "space preons" in the spirit of Wheeler's "pregeometry".

This corresponds to our earlier proposal to unify external and internal degrees of freedom (prematter + pregeometry), which is now revived especially in connection with the modern program for a superunification including gravity.

Thus being still preliminary, but preserving at the same time the basic ideas of the Heisenberg-Ivanenko non-linear spinorial prematter, the prespinor model proves to be able to describe the different sides of the grand (and super) unification program. One is therefore inclined to see in the prespinor model a promising tool to resolve various fundamental unification problems.

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