Very Special Relativity and TGD

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One might think that Poincare symmetry is something thoroughly understood but the Very Special Relativity [1] proposed by nobelist Sheldon Glashow and Andrew Cohen suggests that this might belief might be wrong. Glashow and Cohen propose that instead of Poincare group, call it P, some subgroup of P might be physically more relevant than the whole P. To not lose four-momentum one must assume that this group is obtained as a semi-direct product of some subgroup of Lorentz group with translations. The smallest subgroup, call it L_2, is a 2-dimensional Abelian group generated by $K_x + J_y$ and $K_y - J_x$. Here K refers to Lorentz boosts and J to rotations. This group leaves invariant light-like momentum in z direction. By adding J_z acting in L_2 like rotations in plane, one obtains L_3, the maximal subgroup leaving invariant light-like momentum in z direction. By adding also K_z one obtains the scalings of light-like momentum or equivalently, the isotropy group L_4 of a light-like ray.

The reasons why Glashow and Cohen regard these groups so interesting are following.

a) All kinematical tests of Lorentz invariance are consistent with the reduction of Lorentz invariance to these symmetries.

a) The representations of group L_3 are one-dimensional in both *massive* and massless case (the latter is familiar from massless representations of Poincare group where particle states are characterized by helicity). The mass is invariant only under the smaller group. This might allow to have left-handed massive neutrinos as well as massive fermions with spin dependent mass.

b) The requirement of CP invariance extends all these reduced symmetry groups to the full Poincare group. The observed very small breaking of CP symmetry might correlate with a small breaking of Lorentz symmetry. Matter antimatter asymmetry might relate to the reduced Lorentz invariance.

The idea is highly interesting from TGD point of view. The groups L_3 and L_4 indeed play a very prominent role in TGD.

a) The full Lorentz invariance is obtained in TGD only at the level of the entire configuration space which is union over sub-configuration spaces associated with future and past light-cones (space-time sheets inside future or past light-cone) [B1, B2, B3, B4]. These sub-configuration spaces decompose further into a union of sub-sub-configuration spaces for which a choice of quantization axes of spin reflects itself at the level of generalized geometry of the imbedding space (quantum classical correspondence requires that the choice of quantization axes has imbedding space and space-time correlates) [C7, C8]. The construction of the geometry for these sub-worlds of classical worlds reduces to light-cone boundary so that the little group L_3 leaving a given point of light-cone boundary invariant is in a special role in TGD framework.

b) The selection of a preferred light-like momentum direction at light-cone boundary corresponds to the selection of quantization axis for angular momentum playing a key role in TGD view about hierarchy of Planck constants associated with a hierarchy of Jones inclusions implying a breaking of Lorentz invariance induced by the selection of quantization axis [C7, C8]. The number theoretic vision about quantum TGD implies a selection of two preferred axes corresponding to time-like and space-like direction corresponding to real and preferred imaginary unit for hyper-octonions [E2, E3]. In both cases L_4 emerges naturally.

c) The TGD based identification of Kac-Moody symmetries as local isometries of the imbedding space acting on 3-D light-like orbits of partonic 2-surfaces involves a selection of a preferred light-like direction and thus the selection of L_4 [C1].

d) Also the so called massless extremals representing a precisely targeted propagation of patterns of classical gauge fields with light velocity along typically cylindrical tubes without a change in the shape involve L¡sub¿4¡/sub¿. A very general solution ansatz to classical field equations involves a local decomposition of M^4 to longitudinal and transversal spaces and selection of a light-like direction [D1].

e) Zero energy ontology is fundamental for the interpretation of quantum TGD [C2] and could give rise to a spontaneous CP breaking in the sense that for zero energy states positive energy part of the state could correspond to matter whereas negative energy part would correspond to antimatter identified as the analog of phase conjugate laser beams possessing negative energy and propagating towards geometric future. Negative energy part of the state is usually interpreted as a final state of the particle reaction whose detection in TGD framework corresponds to a detection of a zero energy state. S-matrix represents in this framework time like entanglement between positive and negative energy parts of the state: this makes sense only in the quantum theory based on hyper-finite factors of type II¡sub¿1¡/sub¿ [C7] since infinite-dimensional unit matrix ($SS^\dagger = Id$) has unit trace for them.

Phase conjugate matter could be regarded as a generalization of phase conjugate laser beams. CP breaking would occur for each space-time sheet separately and the antimatter created in laboratory would reside on space-time sheets different from those usually carrying ordinary matter. The reduction of the Lorentz group to the little group would be a necessary prerequisite for this kind of CP breaking. The arguments of N-point functions in TGD framework indeed correspond to the tips of future and past light-cones depending on whether they represent incoming or outgoing particles.

f) The parton model of hadrons assumes a preferred longitudinal direction of momentum and mass squared decomposes naturally to longitudinal and transversal mass squared. Also p-adic mass calculations rely heavily on this picture and thermodynamics mass squared might be regarded as a longitudinal mass squared [TGDpad]. In TGD framework right handed covariantly constant neutrino generates a super-symmetry in CP_2 degrees of freedom and it might be better to regard left-handed neutrino mass as a longitudinal mass.

This list justifies my own hunch that Glashow and Cohen might have discovered something very important.

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