On CPT Theorem and Violations

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Abstract. C, P and T transformations in QFT, as a pointwise S^0 physics theory, are not adequate for modeling the symmetries of baryons and mesons of Standard Model (SM), as a quark / qubit theory based on S^2. String Theory (ST), based on S^1, is of course the transition theory between the above two types of theories.

The symplectic versus complex structure of QFT/CFT reveal the dihedral group D_4 as the group of symmetries of the above elementary particles, viewed in the context of the quark model.

This point of view introduces Hodge structures as central algebraic structures, which in fact are representations of $U(1) \to SU(2)$, when passing from commutative to non-commutative case.

Conformal transformations, i.e. $U(1)$-equivariant, play a central role in quantum theories, like CFT and ST; they are directly related to Hodge structures viewed as representations of $U(1)$.

1 Introduction

Charge, parity and time reversal are discrete symmetries of Quantum Field Theory, which is a theory describing particle interactions modeled as pointwise entities. When considered in the context of the Standard Model, where now elementary particles like baryons have 3D-structure, as described by the quark model, then these symmetries do not hold anymore; first parity was experimentally observed not to hold as a symmetry, then CP was observed not be a symmetry of sertain reations.

It is expected that passing from a point S^0 to a spherical space of states S^2, the discrete symmetries of quantum processes in ambient space may change.

An analysis of Mirror Symmetry at the level of linear algebra [1], i.e. isolating the non-linear manifold dependent aspects of the said MS[1], suggests that at the

[1]This requires considering de Rham spectral sequence on the cohomological side and Floer ho-

(c0)tangent, linearized level, one in fact compares the symplectic structure and complex structure. This can be understood by considering the doubling construction $R \to C \to H$ viewed as cotangent spaces $C = T^*R$ and $H = C \oplus C = T^*C$. More details are included in the above reference.

But then the discrete symmetry group of the commutative diagram with opposite vertices R and $H = T^*T^*R$ and intermediary vertices T^R vs. C, i.e. symplectic vs. complex structure on R^2 is the dihedral group.

Then it is natural to expect being able to identify the relation between the classical C, P, T and the symmetries of the dihedral group.

2 C,P, T vs. Dihedral symmetries

The importance of Mirror Symmetry in general, and Quantum Mirror Symmetry D_4 in particular, suggests trying to understand the relation between CPT transformations as the group Z_2^3 and D^4.

C is the symmetry of $U(1)$-gauge group; P, T is that of $H = R^{3,1} = R^3 \oplus R$. Lorentz transformations can be viewed as Mobius transformations, completing the above picture of Quaternions as space-time or qubit space.

Note already that P and T symmetries require splitting $C \oplus C$ as a space-time, or alternatively, by identifying the rotation group as quaternion conjugation. $H = R \oplus R^3$ is in fact a central extension of the Lie group $(R^3, \times)$.

On the other hand the 2nd doubling $H = C \oplus C$ interpreted as a cotangent space T^C, again requires defining a Lagrangean subspace, or alternatively what space vs. momentum are.

Once a Lab frame is defined and a time is measured by some clock-devise, C, P and T transformations are also defined. Together with this, (co)tangent spaces T^* and sympletic structures are associated. On the other a SM process is a Quantum Computing process, where local time does not exist, and the complex structure is primary (Qubit space). When a local frame R, G, B of colored quarks as a 3D-frame is introduced, as in the Quark Model, the correspondence between the two $R^{3,1} = H = C \oplus C$ ensues.

Now it remains to analyze the symmetries of the QC description, which is usually modeled within a braided modular category [2] in a parallel with the SM Quark Lines Diagrams[2], and then compared with the global description of QFT, as in the context of Feynman diagrams. The pertinence of D_4 as a discrete group of symmetries in this context should be apparent, and justifying why C and CP violations should be a reachable goal.

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mology on the other.

[2]This is left to the reader as a project

3 Conclusions

Physics evolved from point-wise models, e.g. Classical Physics, Point-form Quantum Field Theory (see Weinberg's QFT), where particles are points S^0 with properties, to String Theory based on S^1 and finally to QC and SM where elementary particles are modeled by S^2.

Hopf bundle $U(1) \to SU(2) \to S^2$ is the local quantized Space-Time with quantum phase allows to model periodic time at a certain proper frequency, and Bloch sphere S^2 is the quantum unit of local Space. The Quantum Network allows to introduce an $SU(2)$ discrete connection between pixels of S-T. This is the adequate framework for quantization of General Relativity, implementing quantum versions of Einstein's clocks and local space frames; the Hopf bundle is the unit of Quantum Space-Time, compatible with QM and SM.

This last stage, corresponding to Qubit Model of SM (except for being a continuum in the current version of SM), allows to model Gravity as a weak correction of the Electroweak Theory. Fermionic generations and quark flavors are Platonic geometries, and have a different discrete group of symmetries D_4 replacing the point-wise physics of Z_2^3 group of C,P,T symmetries.

Further consequences of Platonic Model of baryons, and the way they assemble in nuclei, support reports of cold fusion, even in biological systems.

The current technologies will lead to Gravity Control transportation [3, 4] and industrial productions of needed chemical elements, via cold fusion, with clean energy sources as a byproduct [5].

References

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