Quantum field theory has been established on symmetries, but their fundamentality could be limited as practical calculations of physical observations are not based on interacting Lagrangian. The requirement of Lorentz invariance on vacuum expectation values is contradicted by parity violation with massive fermions and Lorentz violation of the approximation in the standard model is proved. After alternative interpretation of quark mixing and problems of CP violation are addressed, the composite properties of neural meson will be suggested as origin of CP violation with possible experimental tests. In conclusion, fundamental symmetry violation is still inconclusive due to the limited theoretical assumptions and physical observations.

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I. INTRODUCTION.

Symmetry has been playing an important role in the establishment of quantum field theory as a fundamental principle to understand interactions of elementary particles. However, its fundamentality has never been examined thoroughly even when symmetry violation was suggested. There could be a fundamental theory that really governs physics in nature, however, it would be also reasonable and more rigorous to study physics only based on what we can verify through physical observations without a priori of theoretical fundamentality and ambiguous analogies. Here let us limit its fundamentality by physical observations and investigate the fundamental principle of symmetries. This perspective will lead us to view discrete symmetries and their violations with more care and open to other possible interpretations in elementary particle physics.

II. THE FUNDAMENTALITY OF SYMMETRIES

Fundamentality of a theory can be discussed from equations it is founded on and evaluated on its connections to physical observations. Interacting Lagrangian has been considered to be fundamental describing field interactions, and its symmetry has been studied to establish quantum field theory. However, practical calculations of physical observable are not based on this interacting Lagrangian but on the assumption of free fields and their local interactions. This mathematical assumption is that quantum states after interactions are closely related to their initial ones, which ends up with the assumption of free fields in infinite time due to the locality of interactions[1, 2]. The decay rates, for example, would be the same regardless of relatives signs of interaction terms to free field equations. The interactions in this approach should be considered as independent physical events separated from free fields. This point becomes clear with the consideration of more than one interactions. Though they could be included in Lagrangian together, generally what they practically mean is not that these interactions occur in the same physical event but that they represents possible interactions as separated physical events, which can be verified with decay rate calculations; the lifetime of particle is independent of the relative signs between them[3]. Since physical observables are the same even if Lagrangian is not invariant under symmetries, symmetries of interacting Lagrangian is limited to be fundamental. If it is fundamental, parity violation of weak interactions contradicts the unification of electroweak interactions since it implies fundamental difference between these two interactions, which was claimed to be resolved by the standard model but it violates Lorentz invariance as explained later. Its fundamentality is also limited by the arbitrariness of discrete symmetries, since they are defined from one specific interactions of electromagnetic interactions while we could have arbitrarily defined symmetry with weak interactions and found some symmetries of electromagnetic interactions violated.

Local gauge theories, based on interacting Lagrangian, are also limited to be fundamental since the invariance of Lagrangian is not required for the practical calculations of the observations and there is no physical evidences for gauge transformations or local gauge, which is at best an excessive degree of freedom. The gauge invariance was introduced without any physical consequences of the local gauge and gauge transformations, but it was accepted without any doubt even when new fields and interactions were introduced in the gauge transformations[4]. When the assumption that Lagrangian is invariant under gauge transformation is confronted with fermion mass problem, instead of investigating its fundamentality more unfounded assumptions of spontaneous symmetry breaking and Higgs boson were employed to resolve this failure[5, 6]. This resolution, however, made its physical evidences more elusive than before; even if Higgs boson is found, this would not be enough to verify the funda-
mentality of spontaneous symmetry breaking. Since the local gauge symmetry is unnecessary in theory and unfeasible in experiments, fundamental interactions should be investigated rather empirically than by local gauge theories.

Therefore, physical observables of interactions obtained from the practical calculations are irrelevant whether Lagrangian is invariant under symmetries and thus symmetries of Lagrangian is not fundamental to physical observations.

III. CPT SYMMETRY

When we observe particle and antiparticle symmetry through mass and lifetime equality, this observations are made for particle and antiparticle respectively, not involving any kind of physical transformations from a particle to its antiparticle. Since symmetry transformations are not physical ones and it is only an assumption that they transform a field into its corresponding field, its experimental verification is unfeasible. The effort to identify particle and antiparticle symmetry as an symmetry transformations is subjected to more fundamental concept of the mass and lifetime equality that is grounded for determining fundamental equations. The fundamental equations, for example, Dirac equations for particle and antiparticle are determined from the mass and lifetime equality and charge conjugation(C), the relation between a field and its antifield, is determined accordingly. However, the mass and lifetime equality should be applied only to particles not to fields that include quantum states besides the properties of particle, since mass and lifetime of a particle are the same regardless of its quantum states such as spin orientation and helicity if massive. Though particle and antiparticle symmetry should be irrelevant of quantum states, C, supposed to be this symmetry, is defined on fields, not on particles in order to incorporate with time reversal(T) that concerns quantum states considering spin orientations under the reversed flow of time, which is only a theoretical assumption. Therefore, C, and thus CPT, is sufficient but not necessary for the particle and antiparticle symmetry. Since the time reversed spin orientation and the antilinearity of T, introduced to obtain the desired commutation relations of boson, do not provide any physical evidences, it is reasonable to consider T and C arbitrarily defined to satisfy CPT theorem. The interpretation that an antiparticle is the time reversed particle is induced from the interactions of quantum electrodynamics, but this could be contradicted by weak interactions with different fundamental particles involved. This interpretations should be accepted as a fundamental assumption that is limited to its mathematical descriptions. Time reversal in particle physics is applied to interactions by exchanging initial and final states of interactions rather than to particles by physically reversing the flow of time. Though we observe such a symmetry, it does not necessarily mean T invariance since it would be symmetric as long as the interactions are independent of time or instantaneous. Most of T violation claimed in experiments could be interpreted as physical effects from electric dipole moment of nuclei, which is a property of composite particles from charge distributions.

Parity(P) has been considered to be different from Lorentz invariance and helicity has been considered as a fundamental property of particle since what it does to the helicity of massless fermion, neutrino, could not be obtained by Lorentz transformations and that of massless fermion is expected to be the same under Lorentz transformations. However, this should not have been generalized to massive fermions since Lorentz transformations can change their helicities as parity does and thus Lorentz invariance implies parity of massive fermion is conserved. The helicity of massive fermion is not a fundamental property that defines particle since it is not conserved under Lorentz transformations. It would be also excluded for neutrino if massive. Though the change of helicity in neutrino would be extremely hard to be observed due to its small mass, neutrino should be the same particle whether it is left-handed or right-handed as long as neutrino has nonzero mass. Parity should be considered as one kind of Lorentz invariance especially when there is no massless fermion and thus Lorentz invariance of vacuum expectation values is contradicted by parity violation.

In particle physics, we apply the idea of parity to composite particles such as mesons inadvertently. A meson, for example, is supposed to have parity from its orbital angular momentum and an additional sign from its fermion exchange. This additional sign could be explained from quantum mechanics, but it is incorrect since quantum mechanical system is required to have identical particles to be either symmetric for bosons or antisymmetric for fermions. Its Hamiltonian is not symmetric under the exchange of two particles because fermions in a meson are different in masses and charges and thus meson is not an eigenstate of parity. The application of this fermion exchange seems to be valid because either one or three fermions are obtained from fundamental interactions of an initial fermion. The failure of this approximation can be observed in such decays that involve quark hadronizations contributing another sign as in $\tau - \theta$ puzzle. This is because meson is not a point particle but a composite particle so that its decay could involve more than a fundamental interactions.

In the standard model, weak interactions of massive fermions are described as those of fermions with definite helicities in the massless limit, but this violates Lorentz invariance while the fundamentality of helicity is subjected to its approximation. Taking the massless limit neglecting depressed helicity states in the boosted frame is Lorentz violating, since the exact quantum states in the rest frame cannot be achieved by Lorentz transformations of the approximated ones back to the rest frame,
for example,
\[
\sqrt{2E} \left( \begin{array}{c} \xi \\ 0 \end{array} \right) \rightarrow \sqrt{m} \left( \begin{array}{c} \xi \\ \xi \end{array} \right)
\]

where \( \xi \) is an arbitrary two component spinor. No massive fermion can be represented with only one definite helicity in the boosted frame without Lorentz violation and the mixed states of helicity should have been carefully considered in experimental tests for parity violation\[23, 24\]. Since Lorentz invariant observables should be the same regardless of the frame of reference, there is no good reason to perform their calculations in the boosted frame approximately when exact calculations are available in the rest frame and helicity and chirality of massive particles are not well defined neither under Lorentz transformations nor in the rest frame. This approximation allows to view weak interactions as the interactions of fermions with definite helicity, but they were originally interpreted as interactions with a certain structure\( (1 \pm \gamma^5) \), which is well defined in the rest frame\[23, 24\]. Unlike the proper interpretation, this approximated one makes the unification of electroweak interactions possible avoiding the difference between these interactions in the fundamental symmetry violation of parity, but this should not have been justified because of its Lorentz violation.

The conclusion of parity violation is also premature due to the neglect on the approximation of composite particles to point particles and inaccurate concept of parity from the assumption of massless neutrino. The beta decay of nuclei\[23\] was suggested as an experimental proof for parity violation. What they called pseudoscalar term is a product of electron momentum and spin of nuclei. When they found it asymmetric under parity, they concluded that parity was violated\[23\]. However, it is of question whether this interaction is fundamental since nuclei is assumed to be a point particle ignoring its charge distribution. The electric dipole moment of nuclei, claimed to be induced by this symmetry violation, could also be interpreted simply as a composite property of nuclei from its charge distribution. The parity violation in the experiments on \( \pi \rightarrow e + \nu \) decays\[23, 30\] would be contradicted if neutrino is massive. Helicity of massive particle is neither a fundamental property nor its parity since the orientation of spin is relative to the direction of motion not to the inertial frame as parity is. Since neutrino is the same whether it is left-handed or right-handed if massive, there is neither parity violation nor C violation between \( \pi^+ \rightarrow e^+ + \nu \) and \( \pi^- \rightarrow e^- + \bar{\nu} \) but helicity asymmetry one could call. If parity of neutrino is violated because there is no corresponding antiparticle, CPT is also violated in this way since it does not hold without corresponding antiparticle.

CPT theorem states the existence of such a symmetry that satisfies spin and statistics, but no connection between this symmetry and its constituent discrete symmetries\( (C, P, T) \) has been verified and the definitions of its constituent symmetries and thus CPT are arbitrary\[5\]. This theorem is proved based on assumptions of Lorentz invariance of vacuum expectation values and free fields and their local interactions\[31\]. The introduction of infinity from the assumption of free fields makes it seemingly plausible to consider interactions as physical events over finite time, but this requires excessive physical interpretations that may not be necessary for instant physical events. The interactions of fields are represented by vacuum expectation values and they are expected to be Lorentz invariant\[32\]. Its requirement of Lorentz invariance is induced from field commutators of free field propagators with the assumption of microscopic causality, but field commutators are limited as an approximation of averaged fields over finite time since it is inconsistent with field interpretation as a measurement at one point for causality\[33\]. Vacuum expectation values are considered to be physical observables and thus required to be Lorentz invariant. However, practical physical observables are decay rates, which are proportional to the squared vacuum expectation values so that they are independent of whether vacuum expectation values are symmetric or antisymmetric. Also, their analogies as propagators fail in interactions, since interactions or their measurements are not expected to propagate from one point to another but to be invariant in each spacetime requiring all spacetimes to be the same, and fields with different masses could make interactions as in weak interactions while propagators require them to have the same mass. Therefore, it is rather decay rates than vacuum expectation values that should be physical observable and required to be Lorentz invariant. However, we are still inconclusive on physical requirement of vacuum expectation values; besides doubts on parity violation, the assumption of free fields and local interactions may oversimplify interactions; The assumption of free fields is only approximately valid since free quarks are unavailable and composite particles such as mesons could be different from free fields in their interactions and underlying structures. The assumption of final states after interaction as the unitary transformation of initial ones\[1, 2\] is doubtful; quarks obtained from weak interactions could differ from the initial quarks in masses and charges, photons from electron and positron annihilation are not fermions but bosons. There must be a set of principles for interactions even if they are instantaneous, but the requirement of physical interpretation should be placed with care considering the limits of fundamental assumptions while some unphysical concepts are allowed generally in quantum field theory: virtual photon and imaginary mass for Hermitian physics and nonzero self interactions. Even if they are infinitesimal, these theoretical remedies for calculations should not be justified to be rigorous. Though the mathematical verification of CPT theorem is doubtful, the consequences of CPT theorem could be considered to be a fundamental assumption as pauli’s principle is.

When C violation was suggested, it was shown that the lifetime of particle and antiparticle is the same in spite of
this violation. This implied that particle and antiparticle symmetry, the mass and lifetime equality, is related to CPT instead of CP. However, following its proof, we can even generalize this theorem to prove that the lifetime of particle would be the same whether any symmetry including CPT is violated or not as long as interaction terms are the same for particle and antiparticle. Though their proof is insufficient in the sense the application of symmetries and definitions of particles and fields are not well defined when they are violated, its consequences are still valid from practical calculations of decay rates. Therefore, it fails to establish any connections between CPT and the mass and lifetime equality when C is violated. It would be more appropriate to call particle and antiparticle symmetry when one implies the mass and lifetime equality rather than CPT symmetry, which concerns CPT theorem for commutation relations satisfying spin and statistics. Particle and antiparticle symmetry and CPT theorem could be accepted as fundamental assumptions of quantum field theory without providing a mathematical proof derived from supposedly more fundamental assumptions of quantum field theory. Therefore, quantum field theory could be well established without mathematical verification of CPT theorem.

IV. QUARK MIXING

In the standard model, quark mixing is expressed in terms of Cabibbo-Kobayash-Maskawa (CKM) matrix, 3×3 unitary matrix that connects the weak eigenstates and the corresponding mass eigenstates. However, the existence of the weak eigenstates has not been verified and no feasible experimental test for its verification is available. The mass eigenstates, physical ones, are described in a matrix representation as if it were consist of quarks, but the analogy of rotation on quark states is insufficient for its justification since there is no physical quantum state corresponding to it and, in practical calculation the interactions of quarks are described by those of individual quarks, not those of a combination of these quarks. CKM matrix could have been investigated as coupling constants of individual quarks first, but this has been neglected for the unification of interactions and CP violation. The unification of interactions suggests that weak interactions should be described by a single coupling constant, but this is only an interesting theory yet to be verified. The phase of CKM matrix allowed in a matrix representation has been considered as a possible origin of CP violation, but it is inconsistent with the interpretation of CKM matrix elements as coupling constants since this implies a complex coupling constant, which violates the conservation of charge. While the unitarity of CKM matrix is required in quark mixing, it is not if the elements of CKM matrix are coupling constants. As the violation of this unitarity is shown in recent experimental results, this perspective of CKM matrix as coupling constants should be considered for its analysis.

V. CP VIOLATION

CP violation theory is based on the effective Hamiltonian from the Weisskopf-Wigner approximation. The time evolution of the neutral meson (denoted by \(P^0\), \(T^0\)) can be described by

\[
i\frac{d\Psi}{dt} = (M - \frac{i}{2}\Gamma)\Psi
\]

where two hermitian matrices \(M\) and \(\Gamma\) in the basis of \(P^0, T^0\) are

\[
M = \begin{pmatrix} M_{11} & M_{12} \\ M_{12}^* & M_{22} \end{pmatrix} \quad \text{and} \quad \Gamma = \begin{pmatrix} \Gamma_{11} & \Gamma_{12} \\ \Gamma_{12}^* & \Gamma_{22} \end{pmatrix}
\]

The matrix \(M - \frac{i}{2}\Gamma\) has eigenvalues

\[
M_{S,L} - \frac{i}{2}\Gamma_{S,L} = M_0 - \frac{i}{2}\Gamma_0 \pm \sqrt{(M_{12} - \frac{i}{2}\Gamma_{12})(M_{12}^* - \frac{i}{2}\Gamma_{12})}
\]

where \(M_{11} = M_{22} \equiv M_0\) and \(\Gamma_{11} = \Gamma_{22} \equiv \Gamma_0\) under the assumption of particle and antiparticle symmetry invariance. The corresponding eigenstates are given by

\[
|P_S\rangle = \frac{[\langle 1 + \epsilon_P + \delta_P\rangle|P^0\rangle + \langle 1 - \epsilon_P - \delta_P\rangle|T^0\rangle] \sqrt{2}}{|\langle 1 + \epsilon_P - \delta_P\rangle|P^0\rangle - \langle 1 - \epsilon_P + \delta_P\rangle|T^0\rangle| \sqrt{2}}
\]

The complex parameter \(\epsilon_P\) represents a CP violation with \(T\) violation, while the complex parameter \(\delta_P\) represents a CP violation with CPT violation (accurately, particle and antiparticle symmetry). These parameters are expected to be zero at initial time for orthogonality since symmetry violations come from weak interactions later in time.

Though CP violation theory has been successful, there are some problems that should be resolved in order to be consistent; The effective Hamiltonian of neutral meson is inconsistent with Weisskopf-Wigner approximation since initial quantum states are presumably assumed to be eigenstates in Weisskopf-Wigner approximation from the start while those of the effective Hamiltonian are not. There is no proper definitions of off-diagonal elements in the decay matrix(\(\Gamma\)) since from which particle they are decayed is ambiguous. CP violation phase of CKM matrix is not necessary for CP violation and any phases could be allowed, since the effective Hamiltonian is non-hermitian even without CKM matrix phase. From the perspective of viewing CKM matrix elements as individual coupling constants, this phase means a complex coupling constant for fundamental interactions, which makes weak interactions violate the conservation of charge. It is also not clear how physical particles evolve in time.
with their own eigenvalues while they are not orthogonal which implies one state can be observed as the other state at any given time. Because mesons are not point particles but composite particles, we have some decays that could be from either a meson or its antimeson such as 2π and 3π decays. In semileptonic decays, only one of quark is dominating interactions in a way that final states have the same properties of initial particles so that they are distinguishable as in interactions of elementary particle while, in 2π and 3π decays, both quark and antiquarks involve so that initial mesons in decay amplitude are indistinguishable from final states. It is these decays that are responsible for CP violation since, if we have only semileptonic decays, there would be no interference terms when decay rates are summed over. Therefore, CP violation could be explained from the fact that neutral mesons are not fundamental particles but composite particles consist of quark and antiquark with underlying structure.

VI. CP VIOLATION WITH EFFECTIVE MASS

Neutral mesons produced by strong interactions are successfully described by approximation of two free quarks, but if mesons are produced by weak interactions in neutral meson oscillations, its underlying structure could make its mass effectively different from that of meson from strong interactions. Let us consider, for example, a neutral meson produced from strong interactions as a ground state. Its antimeson, another quantum state, is obtained by neutral meson oscillation exchanging quark to antiquark and vice versa. The exchange of quarks makes its electric dipole moment reversed. Though its total charge remains the same, this antimeson state could be different from the ground state and thus have different mass since it is more likely to be unstable considering valence quarks interacting with other ones in its underlying structure. Though its mass is effectively different, its decays and other interactions should be the same since they are determined by its valence quarks. Since the mass of neutral mesons produced by strong interactions is the same, particle and antiparticle symmetry is valid. Here CP violation effects will be explained by this effective mass based on Shrodinger equation. Though no fundamental symmetry violations including CP violation are implied, it will be referred to as CP violation with effective mass for convenience. Among other possible theoretical predictions with different choices of phase, here most interesting calculations and their experimental tests will be illustrated.

Let us consider two close quantum states of neutral mesons ignoring other possible states. The Shrodinger equation of the neutral meson is given by

\[
\frac{d}{d\tau} \Psi = M \Psi
\]

where hermitian matrix M in the basis of \(P^0, \bar{P}^0\) is

\[
M = \begin{pmatrix}
M_0 - \Delta E/2 & M_{12} \\
M_{12}^* & M_0 + \Delta E/2
\end{pmatrix}
\]

for the initial state (the ground state) is \(P^0\).

\[
\bar{M} = \begin{pmatrix}
M_0 + \Delta E/2 & M_{12} \\
M_{12}^* & M_0 - \Delta E/2
\end{pmatrix}
\]

for the initial state (the ground state) is \(\bar{P}^0\). The matrix \(M\) and \(\bar{M}\) has eigenvalues

\[
M_{S,L} = M_{S,L} = M_0 \pm \sqrt{\Delta E^2 / 4 + |M_{12}|^2}.
\]

In general, the corresponding eigenstates are given by

\[
|S\rangle = [(1 - \delta_P)|P^0\rangle + (1 + \delta_P)|\bar{P}^0\rangle]/\sqrt{2}
\]

\[
|L\rangle = [(1 + \delta_P)|P^0\rangle - (1 - \delta_P)|\bar{P}^0\rangle]/\sqrt{2}
\]

for the initial state of \(P^0\) and

\[
|\bar{S}\rangle = [(1 + \delta_P)|P^0\rangle + (1 - \delta_P)|\bar{P}^0\rangle]/\sqrt{2}
\]

\[
|\bar{L}\rangle = [-(1 - \delta_P)|P^0\rangle + (1 + \delta_P)|\bar{P}^0\rangle]/\sqrt{2}
\]

for the initial state of \(\bar{P}^0\). The real part of new CP violation parameter \(\delta_P\) represents the mass difference between the ground state and the first excited state and its imaginary part corresponds to a phase allowed in two state Hermitian matrix.

\[
\delta_P = \frac{\Delta E/2 + i\text{Im}M_{12}}{\text{Re}M_{12} + \sqrt{\Delta E^2/4 + |M_{12}|^2}}
\]

From the eigenstates we obtained, we can set up the effective Hamiltonian

\[
i\frac{d}{d\tau} \Psi = (M - i/2 \Gamma) \Psi
\]

where two hermitian matrices \(M\) and \(\Gamma\) in the basis of \(P^0_S, P^0_L\) are

\[
M = \begin{pmatrix}
M_S & 0 \\
0 & M_L
\end{pmatrix}
\quad \text{and} \quad
\Gamma = \begin{pmatrix}
\Gamma_S & 0 \\
0 & \Gamma_L
\end{pmatrix}
\]

\(\Gamma_{S,L}\) will obtained from decay rates explaining the difference in lifetimes. The initial states will evolve in time to be

\[
|P(t)\rangle = (1 - \delta_P)e^{-im_S t - \gamma_ST/2}|S\rangle
\]

\[
+ (1 + \delta_P)e^{-im_L t + \gamma_LT/2}|L\rangle
\]

\[
|\bar{P}(t)\rangle = (1 - \delta_P)e^{-im_S t - \gamma_ST/2}|\bar{S}\rangle
\]

\[
+ (1 + \delta_P)e^{-im_L t + \gamma_LT/2}|\bar{L}\rangle
\]

where \(\Delta m = \Delta m, m_{S,L} = m_{S,L}^\pi,\) and \(\gamma_{S,L} = \gamma_{S,L}^\pi\).
The decays of neutral mesons can be classified into two types: $2\pi$-like decays, where its transition amplitude is contributed by $P^0$ and $\bar{P}^0$, the others, only contributed by either of both such as semileptonic decays. The semileptonic decay rates for $P^0$ will be

$$R_f(t) = \frac{|F_f|^2}{4} \left[ (1 - 4\text{Re}\delta_P)e^{-\gamma_f t} + (1 + 4\text{Re}\delta_P)e^{-\gamma_f t} + 2\cos\Delta m t e^{-\gamma_L t/2} \right]$$

$$R_{\bar{f}}(t) = \frac{|F_{\bar{f}}|^2}{4} \left[ e^{-\gamma_f t} + e^{-\gamma_L t} - 2\cos\Delta m t e^{-\gamma_L t/2} \right]$$

to the first order of CP violation parameters. The first will be referred to as the right sign decay and the later as the wrong sign decay. The semileptonic decay rates for $\bar{P}^0$ will be the same as before respectively for the right and wrong decays. In $2\pi$ decays, assuming its decay amplitudes are the same for $P^0$ and $\bar{P}^0$, the decay rates will be

$$R_{2\pi}(t) = \frac{|F_{2\pi}|^2}{4} \left[ (1 - 2\text{Re}\delta_P)e^{-\gamma_f t} + |\delta_P|^2e^{-\gamma_L t} + 2\text{Re}\delta_P \cos\Delta m t + \text{Im}\delta_P \sin\Delta m t e^{-\gamma_L t/2} \right]$$

$$R_{\bar{2}\pi}(t) = \frac{|F_{\bar{2}\pi}|^2}{4} \left[ (1 - 2\text{Re}\delta_P)e^{-\gamma_f t} + |\delta_P|^2e^{-\gamma_L t} + 2\text{Re}\delta_P \cos\Delta m t - \text{Im}\delta_P \sin\Delta m t e^{-\gamma_L t/2} \right]$$

The decay rates in $3\pi$ decays can be obtained in the same way assuming its decay amplitudes have the opposite sign for $P^0$ and $\bar{P}^0$. Though the interference terms($\text{Re}\delta_P \cos\Delta m \pm \text{Im}\delta_P \sin\Delta m$) in $2\pi$ are different from that of usual CP violation($\pm \cos\Delta m$), they can be easily fit to experimental data with proper choice of phase. Therefore, most of experimental observations will be successfully explained by CP violation with effective mass. The difference between the lifetimes of $P_3$ and $P_L$ can be explained from decay rates. Let us consider only semileptonic decays($f$ and $\bar{f}$) and $2\pi$ and $3\pi$ decays for simplicity.

$$\Gamma_S = (|F_{2\pi}|^2 + \frac{|F_f|^2}{2})(1 - 2\text{Re}\delta_P) + |F_{3\pi}|^2|\delta_P|^2$$

$$\Gamma_L = (|F_{3\pi}|^2 + \frac{|F_f|^2}{2})(1 + 2\text{Re}\delta_P) + |F_{2\pi}|^2|\delta_P|^2$$

In $K^0$ meson, for example, $2\pi$ decays are dominating over the other decays and $\Gamma_S$ is roughly $10^{-3}$ times larger than $\Gamma_L$. Since $\delta_K$ is about $10^{-3}$, this predicts $2\pi$ branching ratio of $K_L$ to be order of $10^{-3}$ and $3\pi$ one of $K_S$ to be order of $10^{-9}$. Though experimental results for $3\pi$ in $K_S$($order of 10^{-7}$) is larger than this prediction, they are in good agreement for its simple estimation.

Though various experimental tests for this theory could be suggested, there are normalization issues to be resolved between $K$ and $B$ physics since theoretical assumptions for experimental measurements are conflicting. The most distinctive test for this theory would be charge asymmetry of $K^0$, since it predicts charge asymmetry of $K^0$ and $\bar{K}^0$ to be symmetric while usual CP violation theory does not and their difference would be order of $10^{-3}$.

VII. CONCLUSION

We have discussed the limits of symmetry studies from the fact that interacting Lagrangian fails to represent practical calculations of interactions accurately. Parity of massive particle should have been considered as a kind of Lorentz invariance and thus Lorentz violations is implied by parity violation. The approximation of taking the massless limit in the standard model for the unification of electroweak interactions was proved to be Lorentz violating. The interpretation of CKM matrix as coupling constants should be considered as recent experimental tests against the unitarity of CKM matrix are reported. Since decays responsible for CP violation are allowed because meson is not point particle, this could be the origin of CP violation. CP violation is explained from composites properties of meson and possible experimental tests is suggested. Considering the limits and inconsistencies of theoretical assumptions and physical observations, fundamental symmetry violation is still inconclusive.

[1] B.A. Lippmann and J. Schwinger, Phys. Rev. 79 (1950) 469.
[2] M. Gell-Mann and M.L. Goldberger, Phys. Rev. 91 (1953) 398.
[3] T.D. Lee and C.N. Yang, Phys. Rev. 106 (1957) 340.
[4] C.N. Yang and R.L. Mills, Phys. Rev. 96 (1954) 191.
[5] P.W. Higgs, Phys. Rev. 145 (1966) 1156.
[6] T.W.B. Phys. Rev. 155 (1967) 1554.
[7] G. Lüders, Ann. of Phys. 2 (1957) 1.
[8] R.P. Feynman, Phys. Rev. 76 (1949) 749.
[9] J.S.M. Ginges and V.V. Flambaum, Phys. Rept. 397 (2004) 63.
[10] T.D. Lee and C.N. Yang, Phys. Rev. 105 (1957) 1671.
[11] V. Barger et al., Int. J. Mod. Phys. E 12 (2003) 569.
[12] W. Buchmüller, P. Di Bari and M. Plumacher, Nucl. Phys. B 665 (2003) 445.
[13] Super Kamiokande Collaboration, M.B. Smy, Nucl. Phys. Proc. Suppl. 118, (2003) 25.
[14] A.L. Hallin et al., Nucl. Phys. Proc. Suppl. 118, (2003) 3.
[15] Super-Kamiokande Collaboration, K. Eguchi et al., Phys. Rev. Lett. 90, (2003) 021802.
[16] GALLEX Collaboration, W. Hampel et al., Phys. Lett. B 447, (1999) 127.
[17] GNO Collaboration, M. Altmann et al., Phys. Lett. B 490, (2000) 16.
[18] SAGE Collaboration, J.N. Abdurashitov et al., J. Exp. Theor. Phys. 95, (2002) 181.
[19] B.T. Cleveland et al., Astrophys. J. 496,(1998) 505.
[20] S. Weinberg, Phys. Rev. Lett. 19 (1967), 1264.
[21] A. Salam, in Elementary Particle Theory (Nobel Symposium No.8, ed. N. Svartholm, Stockholm, 1968) 367.
[22] S. Glashow, Nucl. Phys. 22, 579 (1961).
[23] E. Derman and W.J. Marciano, Ann. Phys. (Berlin) 121 (1979) 147.
[24] E158 Collaboration, P.L. Anthony et al., Phys. Rev. Lett. 92 (2004) 181602.
[25] R.P. Feynman and M. Gell-Mann, Phys. Rev. 109 (1958) 193.
[26] E.C.G. Sudarshan and R.E. Marshak, Phys. Rev. 109 (1958) 1860.
[27] C.S. Wu et al., Phys. Rev. 105, (1957) 1413.
[28] T.D. Lee and C.N. Yang, Phys. Rev. 104, (1956) 254.
[29] R.L. Garwin, L.M. Lederman and M. Weinrich, Phys. Rev. 105, (1957) 1415.
[30] V.L. Telegdi and A.M. Friedman, Phys. Rev. 105, 1681 (1957).
[31] O.W. Greenberg, Phys. Rev. Lett. 89 (2002) 231602.
[32] H. Lehmann, K. Symanzik and W. Zimmermann, Nuovo Cimento 1, (1955) 1425.
[33] N. Bohr and L. Rosenfeld, Phys. Rev. 78, (1950) 794.
[34] G. Barenboim et al., J. High Energy Phys. 0210 (2002) 001.
[35] H. Murayama, Phys. Lett. B 597 (2004) 73.
[36] R.D. McKeown and P. Vogel, Phys. Rept. 394 (2004) 315.
[37] N. Cabibbo, Phys. Rev. Lett. 10 (1963) 531.
[38] M. Kobayashi and K. Maskawa, Prog. Theor. Phys. 49 (1973) 652.
[39] S.L. Glashow, J. Iliopoulos and L. Maiani, Phys. Rev. D 2 (1970) 1285.
[40] H. Abele et al., Phys. Rev. Lett. 88 (2002) 211801.
[41] V.F. Weisskopf and E.P. Wigner, Z. Physik 65, (1930) 18:63, (1930) 54.
[42] T.D. Lee, R. Oehme and C.N. Yang, Phys. Rev. 106 (1957) 340.
[43] G.V. Dass and W. Grimus, Phys. Rev. D 67, (2003) 37901.
[44] Particle Data Group, D.E. Groom et al, The European Physical Journal C15 (2000) 1.
[45] J.C. Yoon, hep-ph/0104079.
[46] BaBar Collaboration, B. Aubert et al., Phys. Rev. Lett. 92 (2004) 251802.
[47] Belle Collaboration, T.R. Sarangi et al., Phys. Rev. Lett. 93 (2004) 031802.
[48] CPLEAR Collaboration, A. Angelopoulos et al., Phys. Rept. 374 (2003) 165.