

An undeniable holistic contradiction between quantum theory and experiments and experimental verification of the Copenhagen interpretation

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ABSTRACT. Contradiction between theory and experiment is a threat to the theory. People have paid their attention to regular contradiction (between theory and single experiment) and have found no serious threat. We first propose holistic contradiction, in which one major law of nature (called the bad law) conflicts with each and every quantum experiment. (A) We prove the existence of holistic contradiction (extrinsic-intrinsic contradiction). We show that all known experiments overturn traditional classification of matter and grand unified intrinsic reference space. Namely, the holistic contradiction means that every experiment ever performed by human confirms that (a) the classification of matter depends upon the operability, but not upon the description of larger matter in terms of smaller matter; (b) quantum form we observe is extrinsic but not intrinsic expression of micro-matter; (c) intrinsic and primitive reference system is human's operable classical one but not reference system in micro-scale. The method of proof is traditional, i.e., verification one-by-one experimentally. (B) The holistic contradiction is the biggest threat to quantum physics, because overturning old classification of matter and the uniqueness of intrinsic system means breaking the supporting structure of quantum physics. We present effects of the breaking on quantum theories in three ways. (1) It is commonly accepted that the Copenhagen interpretation (i.e., CI) is philosophical, and to verify it seems to be impossible, since verifying "reality is restricted to observation" seems to be beyond human capabilities. However, we complete the crucial step of verifying CI. The key to our proof is the disproof of the bad law. (2) Overthrowing old classification of matter makes position of the Standard Model in physics to be greatly reduced, since mapping relation between intrinsic and extrinsic form of micro-matter becomes top thesis in quantum theory. This requires reorganizing the Standard Model such that group SU expresses only extrinsic but not the ultimate blocks. Overthrowing the uniqueness of intrinsic system gives evidence against the string theory, since the extrinsic features of quantum form is incompatible to geometry of string theory. (3) We give a simulation model and show that the relevance between intrinsic and extrinsic system is the key ingredient for producing the abstract state space and probability contribution.

1. Introduction

(1) Experimental verification of the Copenhagen interpretation

The Copenhagen interpretation (abbreviated as CI) is widely accepted by physicists. There are various versions of CI. In this paper CI means CI Model (see Sec.4) that is improved version of CI (Heisenberg's version) based on classicality and inequality [1] [2]. It is commonly accepted that CI is a philosophical interpretation, and to verify it seems to be impossible, since verifying its topic "reality is restricted to observation" seems to be beyond human capabilities. However, this paper proposes a brand new approach to the experimental verification of CI, and completes the crucial step

of verifying CI.

(2) Undeniable holistic contradiction between quantum theory and experiment: contradiction of extrinsic description

The contradiction between quantum theory and experiment is a threat to the theory. There are two kinds of contradictions: regular and holistic contradiction. Regular contradiction means the contradiction between theory and single experiment (e.g., collider experiment). People have paid their attention only to regular contradiction, and have found no serious one in collider experiments. This paper first proposes holistic contradiction, which is defined as contradiction between a major law of nature and each and every quantum experiment ever performed by human. The law of nature every experiment denies is in the sense of science invalid (or extremely bad, we call it bad-major law). Invalid law must be taken away from physics, the related traditional theory is overturned, and quantum physics is broken. In contrast, regular contradictions often lead to corrections of the theory. Hence, holistic contradiction is just the biggest threat to quantum theory.

(3) Existence of holistic contradiction and method of proof

The first core problems of this paper are to find the bad-major law in quantum physics and to prove the existence of holistic contradiction. This paper shows that the bad law is such a hypothesis that microscopic reference system is intrinsic and primitive, quantum form of micro-matter is intrinsic and primitive so (see Sec.2). This paper shows that the holistic contradiction (extrinsic-intrinsic contradiction) is that each and every experiment ever performed by human denies the bad-major law. Namely, we show that for every experiment, (a) the classification of matter depends upon the operability, but not upon the description of larger matter in terms of smaller matter; (b) intrinsic and primitive reference system is human's operable classical one but not reference system in micro-scale; (c) quantum form is extrinsic but not intrinsic expression of micro-matter. Physics rests ultimately on experiment. To ensure the existence of the contradiction to be undeniable, we use traditional method of experimental verification but not method of deducing mathematically to prove the existence.

(4) CI Model: a challenge to the Standard Model

Most physicists have accepted one GUT (Grand Unified Theory) only: the Standard Model (i.e., SM), which tries to explore the nature of matter world. However, the main drawback of SM is the inability to answer the following profound questions. (a) Has there been a contradiction between quantum theory and experiment that is related to SM or CI? (b) Which, in physics, is decisive, operable classical matter or ultimate unit of matter based on assumption of absolute matter? (c) Can there be an absolute lab such that all matter forms are intrinsic in the lab? (d) Can we answer physically: why measurement has to correspond to orthonormal basis of abstract state space? (e) Is it possible that CI Model, as a bigger GUT, covers all existing quantum theories, including the Standard Model? (f) Can the CI statements be proved in physics - "reality is restricted to observation" and "quantum picture we observe is not nature in itself (inequality)"? We shall show that CI Model is a solution package for answering the questions above, and is just the most valuable doctrine seeking the mechanism of quantum phenomena.

(5) Holistic contradiction breaks supporting structure of quantum physics

"Quantum expression is intrinsic form in intrinsic coordinate system" is proved to be bad-major law and must be taken away from physics. This fact breaks the supporting structure of quantum physics. The second core problem of this paper is to study the effect of the breaking on micro-physical theories. We restrict our attention to SM, string theory and CI Model, and consider which

theory is discarded, which reorganized, which improved. “Taking away the uniqueness of intrinsic description” means that in micro-region intrinsic description is overthrown and replaced by extrinsic description, and old absolute classification of matter is overthrown and replaced by classification depending on operability. Consequently, the relation between inherent and extrinsic form replaces the ultimate block of matter, and is leading role in micro-physics. Studies have shown: (a) The disproof of the bad-major law supports CI Model such that to verify the Copenhagen interpretation is not very difficult. (b) Overthrowing old classification of matter makes position of the Standard Model in physics to be greatly reduced, forces the Standard Model to discard the ultimate feature of its particles and to become an extrinsic system only dealing with global property of micro-matter. (c) Overthrowing the uniqueness of intrinsic coordinate system provides evidence against the string theory in which extrinsic property in the sense of physics is ignored.

The authors are aware of the challenges in producing credible evidence to these revolutionary topics.

2. Undeniable holistic contradiction between quantum theory and experiment

2.1. Theorem of abstract experiment

The underlying idea of finding the holistic contradiction (i.e., finding the bad-major law, which is so bad that collides with each and every experiment) is very simple. We introduce Theorem of Abstract Experiment (TAE), the proposition that expresses the operability feature, which is independent of experimental data and topology of space, common to every experiment ever performed by human. “Every experiment ever performed by human” is the key concept common to TAE and the holistic contradiction. Thus, the public operability concept in TAE would finally point at the target law of the contradiction, i.e., the bad-major law every experiment denies. To emphasize the relation between TAE and the holistic contradiction, the word “every experiment ever performed by human” will appear repeatedly in this paper.

For introducing TAE we need a deep logical analysis of all quantum experiments (Sec.2.2 - Sec.2.5). Our analysis is somewhat similar to Turing’s logical analysis of computation. Turing’s statement of the basic effective procedures is the feature common to every computation performed by human, and has top experiential supportive degree. Likewise, TAE is such a physical statement that has top experimental supportive degree. Turing gave the proof of the existence of “universal” computers [3], however, our goal is to prove the non-existence of “universal” laboratorial system. While Turing does not consider ineffective procedure in his theory, we focus on the relationship between operable (effective) and inoperable measuring procedures. Readers may expect the formulism of TAE. However, TAE is independent of experimental data, and the operability of experiment is too simple to be expressed in terms of formulism. For proving TAE never studied by physicists, we use a method never used by physicists. It, in fact, is very traditional method: to extract what are essential from concrete experiments, and to confirm the essentials for every experiment ever performed by human one-by-one. We shall provide three TAEs in this paper. The first TAE, which deals with the irreducible essentials of experiment, is self-evident. In Sec.4-5 we shall introduce TAE 2 and TAE 3. They concern the operability of quantum experiment, are not obvious, and their experimental proof will be in Sec.3.

2.2. Theorem 1 of abstract experiment

2.2.1. Classical space of reference: classical coordinate system of reference

The central concept of the indicated bad-major law must occur in every experiment. It is just bodies of reference (or space of reference) and its operability. Throughout this paper the underlying idea is to put the effectiveness (operability) in top place. Thus, physicist, as observer, is defined as such a man who does actual experiment in terms of effective procedures but not do thought experiment through thought procedure; physicist's intrinsic coordinate system means his operable system. We recall Einstein's statement: "we cannot speak of space in the abstract, but only of the 'space belonging to a body A'." "we shall speak only of 'bodies of reference,' or 'space of reference'." [4] In this paper, the terms "bodies of reference", "space of reference", "reference system" and "coordinate system of reference" mean the same item (referred to as SR(C)). The examples of SR(C) are range-finder and microscope. We need the three definitions concerning space of reference for physicist (not for mathematician).

Definition SR-1. (1) Classical space of reference (classical coordinate system of reference) means a mathematical coordinate system $O(\xi)$ (ξ means mathematical point) that satisfies the following physical conditions: (a) Bodies of reference are causal rigid bodies, between which there are classical (light) signal responding procedures defined by Einstein's theory. (b) Space of reference is defined as an idealized bodies of reference such that its mathematical form is a coordinate system, the coordinate-point ξ is unit of body of reference (called reference unit), and indicator label of the point ξ is determined in terms of light-signal responding. All reference units are equal in scale, and its size is specified by observer. (2) The identity between two SR(C) means identity between reference units and between signal responding procedures. (3) Let O_C and SR(C) be two classical bodies of reference. A measuring action from O_C to SR(C) means the identity from O_C to SR(C) carried out by observer in terms of common signal responding procedure such that O_C is an intrinsic component of SR(C) and shares the labels in SR(C). We write this action as $O_C \rightarrow \text{SR}(C)$.

Definition SR-2. A reference system (coordinate system of reference) is called operable, if observer is able to manipulate the bodies of reference corresponding to the coordinate system, and to manipulate the signal responding between reference units (points).

2.2.2. Theorem 1 of abstract experiment and Classical matter

"Abstract experiment" means that in TAE we take interest only in reference system and its operability, but no interest in numerical relation between measuring results. The validity of theorem 1 is obvious.

Theorem 1 of Abstract Experiment: Two operability features common to every quantum experiment ever performed by human is as follows. (1) There are operable classical bodies of reference (classical space of reference), and for two SR(C) there is always operable signal responding procedure common to the two SR(C) such that there is one-to-one mapping between the two coordinate systems of indicator-labels. (2) There is operable measuring action from classical object O_C to classical space of reference.

The classical matter (abbreviated as matter(C)) means the classical bodies of reference (including signal responding).

Notes: (1) The classification characteristic of classical matter is: (a) it is operable classical body; (b) for any two bodies, observer can produce a measuring system in terms of signal responding to provide indicator labels. Thus, any classical body of reference is intrinsic for another coordinate system of reference. (2) There is a lower bound for the size of classical matter, which is about several nm in scale, since all quantum experiments show that there is no operable causal lump in scale

smaller than the minimum scale.

2.3. Idealist physics: absolute space reference and absolute matter

2.3.1. Compatibility between two systems of reference

The compatibility between two systems of reference is a key concept of finding the indicated bad-major law. We have to remember that the point ξ of coordinate system of reference is an operable body of reference in definite scale, not mathematician's point.

Definition SR-3. (1) For two reference systems with the same reference unit in scale, the compatibility between them means that their reference units coincide, and their signal systems coincide. (2) For two reference systems with the different reference unit in scale the compatibility between them means that scaling down the large reference unit such that their reference units coincide, and their signal systems coincide.

For example, we call range-finder ordinary SR. For the galaxy in which the star is regarded as mass point, we call it galaxy SR. By scaling down the reference unit of galaxy SR to be coincided with the unit of ordinary SR, we can prove the compatibility between ordinary SR and galaxy SR by means of common optical system. Note that the compatibility between two coordinate systems used by mathematicians cannot be used as a substitute for the compatibility between two reference systems depending on the operability.

2.3.2. Absolute space of reference and absolute matter

Idealist-physicist is such a man who pictures himself as thought-experimenter doing thought experiment without effectiveness. Idealist physics is such a theory that following two speculations came from Newton's physics are taken as fundamental hypotheses unconsciously.

(A) Assumption of absolute space of reference: For matter world, there exists "universal" (absolute) space of reference that can be applied to both micro-matter and matter(C). (a) For matter(C), in terms of public signal responding system, a human observer can make spaces of reference with different reference-unit compatible, and can unify them to one space of reference. (b) People extrapolate (a) from Newton's physics into quantum physics. Namely, people assume that for human's classical space of reference (with its reference unit being about 1000nm), and "universal" space of reference in micro-region (with its reference unit being about 0.01nm), they can be compatible and can be unified to one space of reference (i.e., a unified intrinsic space), regardless of the operability of microscopic measuring procedure. The word "absolute" means that matter of arbitrary scale is intrinsic and can contribute to its inherent labels in this "universal" coordinate system. **(B) Assumption of Absolute Matter:** Matter and its motion are absolute, especially, generations of matter (all matter forms generated from the ultimate unit of matter), is absolute. The word "absolute" means that classification of matter is independent of the operability of reference system, that is, matter and its generation can not be changed in existence form by the restriction of subsequent generation (classical bodies of reference).

The word "space of reference" means that an observer obtains the indicator-label in coordinate system of reference in terms of measuring action. Thus, absolute space of reference implies an imagination that there can be a supernatural observer who can carry out the measuring action from micro-object to "universal" space of reference. Of course, idealist-physicist would tell us he can prove the existence of "universal" space of reference through quantum experiment without supernatural observer. We shall deny his any proof in Sec. 2.5.

2.3.3. Honest physics: SR belonging to classical matter and SR belonging to micro-matter

"The scientist's first claim will always be intellectual honesty (Heisenberg)". For the operability

of reference system, we can't consider it operable if a human-observer is unable to carry out the operation. In honest physics there are three possible reference spaces as follows. (1) SR(C): it belongs to classical bodies and is applied to matter(C) only. (2) SR(U) ("universal" space of reference): it belongs to both classical and microscopic bodies. (3) SR(I) (inherent or intrinsic(micro) SR): it belongs micro-bodies, is attached to a micro-object, and is applied to micro-matter only. It must be pointed out that there are two kinds of intrinsic system of reference now. "Intrinsic(classical) (or intrinsic(C)) system of reference" means the intrinsic one attached to a classical object, and "intrinsic(micro) space" means the intrinsic one attached to a micro-object.

2.4. Exclusivity theorem – TAE 2

TAE 2 deals with operability of matter, which is ignored completely in the bad law of nature. It must be emphasized that in TAE 2, an observer is either able to do an operation, or unable to do it, but nothing in between. For classical object O_C and micro-object O_{mic} , we divide all possible operations to two classes: (1) operation that concerns classical matter only; (2) operation that concerns non-classical matter directly. We must point out a special kind of classical objects, which corresponds to a micro-object O_{micro} , and represents the micro-object. We call it classical counterpart of O_{micro} , written as $C(O_{micro})$. We shall see that there is no operable measuring procedure to characterize correspondence between $C(O_{micro})$ and O_{micro} .

Theorem 2 of Abstract Experiment (Exclusivity theorem): An operability feature common to every quantum experiment ever performed by human is exclusive operability of classical matter. Namely, (1) A human observer, in a micro-region, is unable to operate directly on "universal" reference system SR(U) and SR(I), including the measuring actions relying on SR(U) and SR(I). To be more accurate, the observer is unable to manipulate reference-unit of microscopic coordinate system of reference; unable to manipulate signal responding between two reference-units. The observer is unable to carry out the measuring action $O_{micro} \rightarrow SR(C)$ (from micro-object O_{micro} to classical reference system SR(C)), including the measuring action from O_{micro} to $C(O_{micro})$. (2) A human observer is able to operate on classical reference system SR(C) only, and carry out classical measuring action from classical object O_C (including classical counterpart $C(O_{micro})$) to SR(C) only. (The proof of TAE 2 will be in Sec. 3)

TAE 2 shows that matter(C) firmly restricts the operability of measuring operation by a human observer. Honest physics tells us that it is impossible to have a technological revolution such that a human experimenter may become a wizard with a macroscopic size ruler, who then can turn into atomic size and measure an electron. We ask: now that the measuring action from micro-matter to matter(C) is inoperable, why do we believe the idealist assumption that the exclusive operability of matter(C) can't restrict the forms of micro-matter?

2.5. Inequality theorem - TAE 3

Idealist-physicists believe that the compatibility between classical and "universal" SR and the intrinsic description of micro-system can be confirmed by quantum experiments without operable exchange of microscopic information and without supernatural observer. TAE 3 refuses their confirmation.

Theorem 3 of Abstract Experiment (Inequality theorem): An operability feature common to every quantum experiment ever performed by human is that (1) there exists no "universal" intrinsic system of reference, that is, the reliability of the compatibility between "universal" and classical SR

assumed in quantum theory is undecidable, the microscopic coordinate system of reference assumed in quantum theory is not intrinsic; (2) the description of quantum events given in quantum theory is extrinsic, but not intrinsic.

To explain TAE 3, let's consider a quantum experiment E_1 , such as a neutrino experiment. We prove that TAE 3 is valid for E_1 as follows.

(1) Nobody ever showed the existence of “universal” reference system by effectively operating on it.

(2) Let T_1 be the theory of neutrino, in which the compatibility is assumed between “universal” reference system and classical reference system of the classical device. The micro-observables in this “universal” reference system are also assumed. People verify the agreement of T_1 with E_1 , and conclude that the compatibility is reliable. However, the following analysis shows that the reliability is undecidable. According to TAE 2, in experiment E_1 the final data are provided by the classical counterpart of neutrino. The relation between neutrino and its counterpart concerns Cherenkov radiation, signal amplification, etc. Let the theory of Cherenkov radiation be T_2 , and the related experiments be E_2 . According to TAE 2, E_2 leads to new classical counterpart, then, to theory T_3 and E_3 Thus, we end up with: (a) it is the classical counterpart that provided data; (b) the experimental proof is circular based on a series of classical counterparts (we define this circular as CC-recursion): (T_1, E_1) , (T_2, E_2) , (T_3, E_3) , ... We recall Heisenberg's assertion: “This again emphasizes a subjective element in the description of atomic events, since the measuring device has been constructed by the observer, and we have to remember that what we observe is not nature in itself but nature exposed to our method of questioning.” We define the micro-region characterized by CC-recursion as extrinsic micro-region or mapping micro-region, define the point in the extrinsic micro-region as scaled down classical reference body but not intrinsic(micro) body. (As pointed out in section 2.3.3, we must distinguish term “intrinsic(micro)” from “intrinsic(C)”). This extrinsic micro-region is a theoretical extrinsic reference system that is not directly operable. In this paper SR(C) can be read as classical space of reference with extrinsic micro-region (sometimes written as $SR(C)_{ex}$). Therefore, the above analysis shows that (1) the reliability of the compatibility between “universal” and classical SR assumed in the quantum theory is undecidable; (2) By CC-recursion, the quantum event expressed in quantum experiment must be read as extrinsic event (mapping event to classical bodies of reference), and there is the inequality between extrinsic event and intrinsic(micro) event in intrinsic(micro) coordinate system. We shall prove that TAE 3 is valid for every quantum experiment ever performed by human in Sec. 3.

It must be pointed out that in differential geometry the terms “intrinsic” and “extrinsic” concern embedding in a bigger space, in which there is a defined corresponding between intrinsic and exterior points. However, the term “extrinsic” we use in this paper is not the term “extrinsic” in the sense of differential geometry, because the point expressed in terms of CC-recursion is not equal physically to inherent point in micro-region, and there is no operable corresponding between them.

2.6. An undeniable holistic contradiction between quantum theory and experiment: extrinsic - intrinsic contradiction

Now the two theorems lead to the indicated holistic contradiction. This contradiction reflects the following collisions between idealist and honest physicist. (1) Idealist believes in the indicated bad-major law, that is, (a) that the compatibility of two different coordinate systems of reference is independent of their operability; (b) the intrinsic feature of microscopic coordinate system related smaller matter is primitive, and is independent of the effectiveness of coordinate system of reference.

(2) Honest physicist refuses idealist's speculation, and insists on (a) that the compatibility demands the operable coincidence of reference units and of signal responding systems; (b) the dependence of intrinsic feature on the effectiveness of coordinate system of reference.

Holistic contradiction between quantum theory and experiment (extrinsic-intrinsic contradiction): (1) Physicists accept the following bad-major law of nature: (a) for human-observer there is unique and unified intrinsic coordinate system of reference, microscopic coordinate system related smaller matter is primitive. (b) Quantum events we observe happen in unified intrinsic reference system $SR(U)$, and are intrinsic. (2) By TAE 2 and TAE 3, every quantum experiment ever performed by human is contradictory to (1), and confirms the following inequality: (a) the existence of "universal" reference system is undecidable, for human-observer the reference system in micro-region we use is not intrinsic; (b) the quantum form based on CC-recursion is extrinsic, is not equal to intrinsic(micro) form, and is not the extrinsic form embedded in $SR(C)$ stated by differential geometrician so.

This inequality leads the following possibility: $SR(I)$ is not compatible to $SR(C)$, there is intrinsic(micro) form of micro-matter and a specific mapping from the intrinsic(micro) form to extrinsic quantum form. This holistic contradiction is confirmed by every experiment ever performed by human, and is undeniable. The holistic contradiction demands us to take away the indicated bad-major law from physics. Namely, we must overthrow the assumption that microscopic coordinate system is equivalent to human-observer's intrinsic coordinate system, and overthrow the assumption that quantum picture is intrinsic.

2.7. Experiment machine and its distinction from Turing machine

Based on the three TAEs, we can define experiment machine (**E-machine**) as follows. (1) There are two inputs: possible measuring actions of all units of classical coordinate system, action measuring the measured object. (2) The black box consists of a processor and a memory. The processor compares the input of the measured object with the information in the memory, and determines the output. (3) The output consists of two decisions: (a) to decide which reference unit to share its indicator-value with the measured object; (b) to decide the indicator-value to be intrinsic or extrinsic in classical coordinate system. The common ground between E-machine and Turing machine is that the latter deals with effectively computable numbers, the former deals with operable experimental procedures. The difference between them is that for E-machine the smallest operable unit of the system is not the smallest component of physical system.

3. Proof of theorem 2 and 3 of abstract experiment

3.1. Method of the proof

The proof (verification) of TAE is not mathematical deduction, but examination of every experiment ever performed by human one-by-one. It must be emphasized that the proof method of one-by-one verifying, which is never used by physicists, is legal and traditional in physics. As an experiment gets abstracted, only reference system, measuring action and their operability remain, that is, E-machine remains. There are two steps of proof: (1) Choosing several experiments that are representative of the full range of experiments, and prove that for each of them TAE 2 and TAE 3 are valid. (2) To demonstrate that the above proof actually covers all possible experiment categories, and applies to each and every quantum experiment ever performed by human. Since TAE concerns only with the operability of measuring operation, the proof shall be deemed to be complete as long

as the following two points is justified: (a) To confirm that physicist is able to carry out $SR(C)$, $O_C \rightarrow SR(C)$ and $C(O_{mic}) \rightarrow SR(C)$, and is unable to carry out $O_{mic} \rightarrow SR(C)$. (b) To confirm that there is CC-recursion for measuring.

3.2. Crucial experiments: representative experiments of the full range of experiments

3.2.1. Stern-Gerlach experiment [5]

Verification. In the experiment a beam of silver atoms from an oven was directed through aligned slits and through magnetic field region, falls finally on photographic emulsion, and two separate lines were showed. Abstracting the experiment, we consider operability only as follows. (1) All the classical devices (oven, magnetic field region, and emulsion) are abstracted as classical systems of reference. (2) The counterpart of silver atom is the visible trace in the emulsion. All data (length, time, temperature, gradient, etc.) are provided by the classical systems of reference. All measuring actions are identity between the counterparts (including related classical objects) and the classical system of reference. Namely, physicist is unable to directly operate on a “universal” reference system in micro-region, and is only able to carry out $O_C \rightarrow SR(C)$ and $C(O_{atom}) \rightarrow SR(C)$. The correspondence between the atom and “universal” reference system is not operable. (3) The calculation of deflection of silver beam concerns quantum character (such as Bohr magneton) and other quantum experiments, and there is CC-recursion. The compatibility between $SR(U)$ and $SR(C)$ is undecidable. The picture expressed in terms of experimental data is extrinsic form exposed to classical bodies of reference. Therefore, TAE 2 and TAE 3 are valid, and there is extrinsic-intrinsic contradiction.

3.2.2. Neutrino experiment [6]

Verification. Abstracting the experiment, we consider operability only as follows. (1) All the classical devices (cylindrical stainless-steel tank, ultra-pure water, photomultiplier, tubes (PMT), computer, monitors) are abstracted as classical systems of reference. (2) The counterpart of neutrino is the indicating signal provided by PMT. All measuring actions are identity between the counterparts (including related classical objects) and the $SR(C)$. Namely, physicist is unable to carry out “universal” reference system in micro-region, and is only able to carry out $O_C \rightarrow SR(C)$ and $C(O_{neutrino}) \rightarrow SR(C)$. The correspondence between the neutrino and “universal” reference system isn’t operable. For the neutrino the measuring action $O_{neutrino} \rightarrow SR(C)$ is inoperable. (3) The compatibility between $SR(U)$ and $SR(C)$ is undecidable (see Sec.2.6). There is CC-recursion. The picture expressed in terms of experimental data is extrinsic one exposed to classical bodies of reference. Therefore, TAE-2 and TAE-3 are valid, and there is extrinsic-intrinsic contradiction.

3.2.3. Experiment of tripping individual quantum system [7]

Verification. Abstracting the experiment, we consider operability only as follows. (1) All the classical devices (box preparing Rydberg atoms, Ramsey cavities, the cavity under QND Detection, interferometer, ionization detector, computer, etc) are abstracted as classical systems of reference. (2) The counterpart of photon is the indicating signal, including red and blue bars. All measuring actions are identity between the counterparts (including related classical objects) and the $SR(C)$. Namely, physicist is unable to carry out “universal” reference system in micro-region, and is able and only able to carry out $O_C \rightarrow SR(C)$ and $C(O_{photon}) \rightarrow SR(C)$. For the photon the measuring action $O_{photon} \rightarrow SR(C)$ is inoperable. The correspondence between the atom and “universal” reference system isn’t operable. (3) The quantum theory concerns JC Model, QND Detection and signal multiplier in micro-region. By CC-recursion, the reliability of the compatibility between $SR(U)$ and $SR(C)$ is undecidable. The picture expressed in terms of experimental data is extrinsic. Therefore,

TAE-2 and TAE-3 are valid, and there is extrinsic-intrinsic contradiction.

3.2.4. Large Hadron collider (LHCb) experiment

Verification. Abstracting the experiment, we consider operability only as follows. All the classical devices (Tracker, Electromagnetic calorimeter, muon chambers, Cherenkov detector, vertex detector, magnet, computers, etc) are abstracted as classical systems of reference. (2) and (3) are similar to the above two experiments. An abstract LHCb experiment, in fact, is covered by Neutrino experiment and experiment of tripping individual quantum system. The reliability of the compatibility between SR(U) and SR(C) is undecidable. The picture given by experimental data is extrinsic. Therefore, TAE 2 and TAE 3 are valid, and there is extrinsic-intrinsic contradiction.

3.2.5. Wave experiment of the fullerene C60 [8]

Verification. Abstracting the experiment, we consider operability only as follows. (1) All the classical devices (Oven, two slits, SiNx grating, laser, channeltron electron multiplier, conversion electrode etc) are abstracted as classical reference systems. (2) The counterpart of C60 is the indicating signal. All data are provided by the SR(C). All measuring actions are identity between the counterparts and SR(C). Physicist is unable to carry out “universal” reference system in micro-region, and is only able to carry out $O_C \rightarrow SR(C)$ and $C(O_{C60}) \rightarrow SR(C)$. The correspondence between the atom and “universal” reference system isn’t operable. (3) The quantum theory concerns diffraction, ionization and signal multiplier in micro-region. By CC-recursion, the the compatibility between SR(U) and SR(C) is undecidable. The picture given by experimental data is extrinsic. Therefore, TAE 2 and TAE 3 are valid, and there is extrinsic-intrinsic contradiction.

3.3. Conclusion

The above experiments, as representative ones of the full range of experiments, cover all possible matter (including photon, neutrino, hadron, atom, large-molecule), cover all possible experimental tools (emulsion, photomultiplier tube, ionization detector, muon chambers computer, monitor, etc.). **Therefore, TAE 2 and TAE 3 are valid in each and every quantum experiment ever performed by human. We have proved the existence of extrinsic-intrinsic contradiction.**

3.4. Physics is broken

The all experimental facts overturn traditional classification of matter. According to the traditional classification, all matter is intrinsic, and matter can’t be changed in existence form by the restriction of subsequent generation. According to the two theorems, classical matter determines the classification of all matter; there are two kinds of matter only: classical matter and micro-matter. The classification characteristic of classical matter is that it is the unique operable matter which can express itself independently, and classical matter is intrinsic. The classification characteristic of micro-matter is that it cannot contribute directly to its inherent labels in classical devices, and is forced to express its properties in terms of classical matter. Micro-matter is extrinsic. The classification of matter provided by these two theorems is confirmed by every experiment ever performed by human, and is the most important law of nature.

By one-by-one verifying, we disprove the following principle about coordinate system, which is just the indicated bad law of nature: intrinsic(micro) and classical coordinate system are identical, the quantum picture we observe is intrinsic in our intrinsic coordinate system; the traditional classification of matter. This disproof demand us read coordinate system in formulism of state space as classical coordinate system $SR(C)_{ex}$ with extrinsic micro-region (see Sec.2.5.5), but not intrinsic(micro).

One should never underestimate the significance of the disproof completed in this section. We

must take the invalid law of nature away from physics. This breaks physics in the two ways. (1) For the same micro-region the reference system is not unique and there are two incompatible reference systems. (2) The classification of matter primitiveness does not agreed with classification of matter effectiveness. We would remember that in Newton's physics the primitive matter-class is agreed with effective class. As a result, for the relevance between extrinsic data provided by collider and the intrinsic ultimate block assumed by physicist its experimental basis is broken. Therefore, this disproof requires us to reevaluate and reorganize the related major theories. This is a biggest challenge to physics.

The breaking and reorganizing allow us to choose the following scheme, which is not even contemplated in modern physics. (1) To make away absolute matter, universal intrinsic coordinate system of reference and intrinsic description of quantum system from physics. (2) To accept the possibility allowed by extrinsic-intrinsic contradiction that there exists intrinsic(micro) reference space SR(I) belonging to micro-matter, matter(C) restricts and changes the form of the higher generation of matter in its coordinate system of reference, and quantum picture is an extrinsic mapping-effect of inherent micro-matter into classical matter. (3) To reorganize the Standard Model such that it yields to the holistic contradiction.

3.5. Extrinsic description thesis

Extrinsic description thesis consisting of TAE 2 and TAE 3 is a challenge to philosophy. The extrinsic description thesis parallels with Gödel theorem. (1) Turing thesis and Gödel theorem show that effective (intrinsic) procedure is the starting point of reasoning system; TAE 2 and TAE 3 show that operable coordinate system of reference is the starting point of physical system. However, we show that physical system is not a unified intrinsic system. (2) Gödel theorem showed that no workable foundation of mathematics can ever be strong enough to prove or disprove the most profound problem. Extrinsic description thesis shows that no workable experimental foundation within classical matter can ever be strong enough to prove or disprove the most profound problem, i.e., problem of extrinsic form of intrinsic(micro) matter. Essentially, extrinsic description thesis leads the topic "reality is restricted to observation" to an exact statement that there do not exist such an intrinsic physical system that can confirm all possible matter forms, especially exterior matter form.

4. CI Mode: a GUT that can challenge to the Standard Model

We define Grand Unified Theory (GUT) to be such a theory that it gives an ultimate description of all the possible observable matter-forms and all the possible spaces of reference. The classification character of the Standard Model is: Absolute Matter + Absolute intrinsic space. Now, the all experiments ever performed by human support TAE 2 and TAE 3, and allow us to establish such a GUT that challenges absolute matter and absolute space of reference, and to the Standard Model. The two topics of Heisenberg version of CI - classicality and inequality - correlate closely with TAE 2 and TAE 3. The experimental facts lead us from CI to a definite model, a GUT (called CI Model). CI Model is the opposite theory to the Standard Model. The holistic contradiction supports CI Model, but not the Standard Model based on the uniqueness of intrinsic reference system. This means that the latter would be governed by the former. CI Model is divided into two parts: operability part and numeric part. Operability part deals with the classification of matter. Numeric part (i.e., part of physical picture) deals with extrinsic micro-physical picture. We accept the revolutionary scheme

allowed by the holistic contradiction between quantum theory and experiments.

CI Model:

(1) Operability part: classification feature of intrinsic(classical) matter.

Principle CI-1.

- **Feature-1** All measuring operation can only be carried out with classical system of reference, and measuring action must be from classical body (including the classical counterpart) to classical system of reference (i.e., TAE 2). In other words, intrinsic matter is and only is classical matter for human-observer.
- **Feature-2** The compatibility between “universal” SR and classical SR is undecidable, the microscopic coordinate system of reference used by experimenter is not intrinsic and his quantum description is extrinsic in classical coordinate system (i.e., TAE 3).

In the sense of the Features above, any quantum theory based on experiments performed by human must be consistent with CI Model.

Principle CI-2. Quantum matter is classified to be such an extrinsic matter that satisfies the following conditions: in any experiment it is an extrinsic form, i.e., it is not to be a classical coordinate system of reference, and its components are measured only by means of its classical counterpart.

- **Feature-3** The difference between micro-matter and matter(C) due to operability is as follows. The dividing line between inherent micro-matter (first generation matter) and matter(C) (second generation matter), i.e., dividing line between inherent reference space and classical reference space, is a cliff-like line (no intersection between the two).

There is no so-called quantum-to-classical transition (i.e., no such matter that is both intrinsic(classical) and extrinsic body of reference), and no intrinsic coordinate system applied to all matters.

(2) Numeric part: dependence of extrinsic form on intrinsic(micro) form

“Universal” intrinsic coordinate system is taken away from physics. A topic of differential geometry is to deal with the relevance between intrinsic and extrinsic properties of surface. However, in section 2.5, we pointed out that “extrinsic form” in CI Model is entirely different from “extrinsic form” in differential geometry. CI-3 is the following scheme to deal with the relevance between extrinsic form and intrinsic(micro) global properties of micro-system.

Assumption CI-3: (a) There is no grand unified intrinsic reference space. For the same micro-region there are intrinsic(micro) reference space SR(I) and classical reference space SR(C) (i.e., SR(C)ex). There is intrinsic(micro) physical system in SR(I) (called inherent and is noted by P(I)). Quantum form Q(C) we observe is an extrinsic form of micro-matter in SR(C), is not equal to the corresponding P(I). There is mapping from P(I) in SR(I) into Q(C) in SR(C). Hence, a complete micro-physical theory consists of pair (SR(I), SR(C)) and mapping T(I)→Q(C). (b) Matter(C), in terms of its exclusive operability, imposes its classical property on the physical unit (mathematical unit also) of the extrinsic form. (c) The dependence of the extrinsic quantum form Q(C) on intrinsic(micro) form T(I) is that mathematical global characters of T(I) remains invariantly in the new form. This dependence concerns representation of group. There are key points as follows (Supplementary details will be given in Sec. 5.). 1) Backward succession of physical quantity and local property, extrinsic succession of intrinsic(micro)

global property. 2) The extrinsic quantum picture we observe is a mapping-effect from SR(I) to SR(C). The abstract state space originates from the invariance of specific global property of intrinsic(micro) structure under SR(I)-SR(C) mapping. 3) The unification of electromagnetic, weak, strong interactions and gravitation is a compatible coexistence. Isomorphism between algebraic structure of global property of micro-system and the corresponding extrinsic form under mapping from SR(I) to SR(C) would be described in terms of representation of group.

Remarks: (a) CI-1 and CI-2 are improved version of Heisenberg-Bohr's classicality (any experiment must ultimately be expressed in terms of classical concepts); CI-3 is improved version of Heisenberg's inequality. CI-1 and CI-2 are physical principles, since they are the statements with top experiential supportive degree. (b) The proof of CI-1 was in Sec. 3. The proof of CI-2 will be in Sec. 5. For CI-3 we shall provide such an intuitive and non-microphysical model that the mapping between SR(I) and SR(C) can be observed simultaneously by a third party in Sec.7. (c) CI Model deals with both intrinsic and extrinsic space of reference, where the observer is required to prove the reliability of an extrinsic picture expressed in terms of the intrinsic operations. We may remember that Einstein dealt with equivalent exchange of information between two intrinsic inertial systems, and ask: how he would deal with the information exchange between intrinsic measuring system and extrinsic micro-matter? (d) For quantum system there is no so-called physical version of Church-Turing thesis, because it is impossible to describe the extrinsic system governed by CI-3 in terms of effective operations of the intrinsic system.

5. Verification of CI-2

The proof of CI-2 consists of two parts: cliff-like separation in individual quantum experiment, and in classes of quantum objects.

5.1. Part 1: cliff-like separation between quantum and classical matter in every quantum experiment

It must be emphasized that the theoretical foundation of proving CI-2 is the definition of quantum matter. The essential difference between CI Model and idealist physics is that the former has a rigid definition of quantum matter, while the latter doesn't. In CI Model, matter(C) is intrinsic and quantum matter is extrinsic, we define quantum matter is such an object that we are unable to take it as operable coordinate system of reference and its data must expressed in terms of the corresponding classical counterpart in any experiment. The definition of quantum matter implies the cliff-like separation between quantum and classical matter. In the proof of CI-1, we have shown that there is no operable exchange between micro-matter and classical object (including the counterpart) in every known experiment, and the information of micro-matter must be expressed in terms of classical objects, that is, is extrinsic. Therefore, in the sense of CI Model, in every quantum experiment there is a cliff-like separation between quantum and classical matter (between extrinsic and intrinsic object), i.e. no intersection.

5.2. Part 2: cliff-like separation between quantum and classical matter for classes of quantum objects

5.2.1. Macroscopic, microscopic and mesoscopic region

(1) All known experiments show that in macroscopic region there is no quantum matter, and the dividing line between classical and quantum matter is not in this region. A.N.Cleland reported that

the mechanical resonator coupled to a qubit would possess quantum-like property [9]. The mechanical resonator, clearly, does not satisfy the definition of quantum matter. It is an induced quantum system provisionally instead of an independent quantum system.

(2) All known quantum experiments show that in microscopic region, there is quantum objects only, including fermion, boson, atom and molecule, but no classical matter. The dividing line between classical and quantum matter is not in this region.

(3) We focus on the separation in mesoscopic region, which is defined as in the range of 1nm (about the size of fullerene) to 200nm (the minimum size of a bacterium).

5.2.2. Quantum experiments of C60 (fullerene) and related class

For fullerene (C60) we have the following results. (1) Although fullerene can be described in terms of 3-dimensional geometric structure, all known experiments show that it is not a classical body of reference. This is because its components are not classical lump-units, and there is no operable responding procedure between its components. To be more specific, there has been no such an experiment that an observer is able to manipulate one fullerene as a coordinate system of reference. (2) Every experiment concerning stereoscopic structure of C60 is based on the theory of crystal diffraction, in which the classical counterparts of its components must be used, and there is CC-recursion. Therefore, in all known related experiments, it can be confirmed that fullerene satisfies the definition of quantum matter, and is an extrinsic form. The interference of de Broglie wave of C60 molecules was reported [8]. It must be emphasized again the difference between CI Model and idealist physics. Since in idealist physics there is no rigid definition of quantum matter, C60 seems to be almost classical body sometimes, to have quantum character sometimes. In CI Model, for classical body there is no de Broglie wave and C60 is a quantum object. The experiment of C60 can be used to cover all similar quantum experiments in which the micro-object is of large molecule scale (about 0.7nm in diameter). In other words, the separation between quantum and classical matter (i.e., between extrinsic and intrinsic matter-form) is cliff-like, but no so-called quantum-classical transition exists.

5.2.3. Class of Quantum experiments of myoglobin [10]

For myoglobin (a protein molecule, about 4nm in diameter), we have the following conclusions. (1) Although myoglobin can be described in terms of 3-dimensional geometric structure, all known experiments show that it is not a classical body of reference. That is because its components are not classical lump-elements, and there is no operable responding procedure between its components. There has been no such experiment that an observer is able to manipulate one fullerene as a coordinate system of reference. (2) Every experiment concerning stereoscopic structure of protein molecule is based on the theory of crystal diffraction, in which the classical counterparts of its components must be used, and there is CC-recursion. Therefore, all known related experiments confirm that myoglobin satisfies the definition of quantum matter, and is an extrinsic form. (3) Myoglobin experiment can be used to cover all similar quantum experiments in which the micro-object is protein molecule (about 1nm to 100nm in diameter). On the other hand, the minimum size of a bacterium, which satisfies definition of classical reference system, is about 200nm. Thus, in mesoscopic scale, for protein molecules, all quantum experiments show that there is a cliff-like separation between quantum and classical matter. In other words, the separation between quantum and classical matter (i.e., between extrinsic and intrinsic matter-form) is cliff-like, but no so-called quantum-classical transition exists.

5.3. Significance of the verification of CI-2

We have considered the two classes of quantum matter, and logically, the conclusion of cliff-like separation can be applied to all classes of micro-matter. The verification of CI-2 is crucial for CI Model, because it forces idealist model (including the Standard Model) to make additional assumptions in order to explain why the transition from micro-matter to lower generation is cliff-like. The proof of CI-2 shows that the empty-intersection between microscopic and classical matter contradictions with absolute generations of matter, so that extrinsic mapping effect from microscopic to classical matter is a natural scheme. From a logical perspective, because of the undecidability and exclusivity of matter(C), it is wrong that physicists define quantum matter, and then define classical matter as a classical limit of quantum matter. For instance, “decoherence” theory assumes that state collapses in “universal” space of reference. Heisenberg and Bohr asserted: any experiment must ultimately be expressed in terms of classical concepts. This implies the doubt about whether micro-matter is extrinsic. TAE 2 and TAE 3 show that the invariance of classification feature of classical matter is the most general law of nature. They show that classical matter is the only operable matter that can express itself independently and is intrinsic, while micro-matter cannot express itself independently and is extrinsic. CI Model denies the intrinsic characteristics of micro-matter, and denies that the theory of Broglie wave could be applies to classical matter.

Now we have completed verification of CI-1 and CI-2, and have completed the crucial step of verifying the Copenhagen interpretation.

6. Supplementary definition of CI Model

We now introduce the supplementary definition of CI-3 as follows: the effects of CI Model on the Standard Model and string theory, extrinsic succession of quantum system, unification of four interactions.

6.1. Effects of CI Model on the Standard Model and string theory

We consider the effects of CI Model on the Standard Model and string theory. CI-1 and CI-2 (or the holistic contradiction) break logical structure of quantum physic, and the complete micro-physical theory must consist of pair (SR(I), SR(C)) and mapping $T(I) \rightarrow Q(C)$. This fact requires us to reform the Standard Model and to reevaluate string theory.

(1) The biggest threat to the Standard Model (i.e., SM) does not come from the paradoxical experiment of collider, but from the crucial experiment of its opposite CI Model. CI-1 and CI-2 confirmed by experiments break quantum physics. SM, in fact, is poor model, because of its lack of physical and philosophical foundation of answering the following questions: why matter(C) masters the first generation matter, why there is no universal intrinsic reference system, and why quantum picture is extrinsic. The experimental foundation of SM is data analysis but not direct experimental fact. The truth of high-energy experiments is that the particle of SM is expressed in terms of extrinsic responding procedures in classical laboratory, and is not foundation element of nature in itself, but abstract element sharing classical property of the reference unit. Based on the holistic contradiction and CI Model, we consider SM is an one-sided theory, because (a) it does not describe SR(I) of the pair(SR(I), SR(C)); (b) it does not describe mapping $T(I) \rightarrow Q(C)$, but the results of the mapping in SR(C). Therefore, SM is not leading role in structure of matter world, its particles are neither intrinsic member of micro-system nor ultimate elements of matter. In reformed SM, gauge group SU don't express the generations of the particles, but extrinsic succession of global property of inherent micro-matter under the restriction of local property of matter(C) (an extrinsic expansion of the related

intrinsic group). As a result, the extrinsic form provided in collider reproduces a specific global property of micro-system in the classical stage. Our conclusion is that the reformed Standard Model, which gets around the extrinsic-intrinsic contradiction, is a sub-structure of CI Model.

(2) String theory is a mathematical-physical theory developed by differential geometrician. Its underlying idea is that there are six internal dimensions to Einstein's four-dimensional space-time, and some desirable quantum character would be produced in terms of particular topological property. As well-known, differential geometry is such a subject that seriously distinguish intrinsic property from extrinsic one. For string theory there is a major deficiency as follows. First, the extrinsic form in differential geometry and the extrinsic form expressed by the extrinsic-intrinsic contradiction are totally unrelated. Second, universal reference space assumed by string theory conflicts with double reference space (SR(I), SR(C)), and assumed topological structure is completely disconnected with the operability of experimental procedure. The string theory violates physicist's top credo "physics rests ultimately on performable experiment". We tend to consider the string theory is not a well-formed theory for physicist.

6.2. Significance of supplementary definition

In the Standard Model based on "abstract matter", all matter forms are intrinsic, and the generational succession of physical property and global property is absolute without being affected by the exclusivity of matter(C). On the contrary, in CI Model matter(C) imposes its classical property on micro-matter in terms of its exclusive operability, and it thwarts the generational succession of physical property of micro-matter. The quantum picture is extrinsic one, i.e., mapping picture from the first generation of matter to the second generation. The topic of CI-3 is the relevance between extrinsic description and global property of intrinsic(micro) system. The supplementary definition deals with the following problems concerning the relevance. (1) For classical actress (classical reference unit) who plays role of intrinsic(micro) object, what is the property imposed by matter(C) in the classical stage? (2) For the scenario (i.e., the extrinsic description) in which the actresses perform a show about intrinsic(micro) picture, what is the restriction to information of global property of intrinsic(micro) system?

6.3. Backward succession of extrinsic unit and extrinsic succession of global property

The relevance between extrinsic description and global property of intrinsic(micro) system concerns two kinds of the generational succession.

(1) Observer get the extrinsic property of quantum matter by means of classical counterpart, and the sources of physical property and local property are classical matter (second generation), but not intrinsic(micro) one of first generation. (a) Backward succession of physical property of extrinsic unit is defined as such a succession that by the exclusive operability, matter(C) forces a quantum object to succeed the physical property of its classical counterpart. In particular, the backward succession requires that the source of mass of micro object is classical matter, instead of intrinsic(micro) property of first generation. The backward succession of mass means that mass is not intrinsic property of a micro-object, i.e. all extrinsic particles (including neutrino) have mass due to classical matter. (b) Backward succession of local property of matter(C) is defined as such a succession that by the exclusive operability, matter(C) forces a quantum object to succeed the local algebraic property of matter(C), such as local Lorentz covariance, so that it possesses the local algebraic property.

(2) Extrinsic succession of global property of micro-matter is defined as such a succession that by the exclusive operability, the succession of global property (algebraic property) of micro-system is

relative, that is, is performed in classical SR in terms of the backward successions provided by (1).

6.4. Unification of the four interactions

In CI Model, the quantum picture (including electromagnetic, weak, strong interactions) is an extrinsic (mapping) system in classical space of reference, is an extrinsic succession of specific global algebraic property of micro-matter. In classical space of reference the gravitation is intrinsic system, the three micro-interactions are extrinsic system. Therefore, in CI Model, the unification of gravitation and the three micro-interactions means that they are a compatible coexistence instead of being combined into one system.

The following remarks are necessary: (1) CI Model does not change the existing gravitation theory. (2) Similar to TAE 3, we could not accept the reliability of the compatibility between a human-observer's reference system and universe scale reference system, because the reliability would be undecidable to calculate the behaviors of universe scale matter in terms of the human observer's limited reference system.

7. Verifying CI-3

7.1. Quantum model outside micro-physics

A simulation experiment of CI Model will be given. There are three considerations. (1) A logical defect of quantum theory is that microphysical quantum model is an isolated case of quantum formulism in nature. We ask: whether there is a quantum model outside micro-physics such that the quantum model is a general case in nature. (2) It is really beyond the ability of human to verify the relevance between extrinsic and intrinsic(micro) description (i.e., mapping from micro-matter to classical matter), because TAE 3 doesn't allow revealing the intrinsic form in micro-region. The theoretical foundation of the simulation model is the generality of quantum formulism. For proving CI-3 we need a quantum model that satisfies the following two conditions. (a) In it both SR(I) and SR(C) can be observed concurrently by the third party. (b) It demonstrates that matter(C) restricts and changes the form of the higher generation of matter, and it shows that quantum picture, as a mapping-effect, is an extrinsic succession of specific global property of micro-matter. (3) This simulation model is a counter-example for physical version of Church-Turing thesis.

7.2. Fundamental assumption: (SR(I), SR(C))

(1) Let SR(I) be 3-dimensional intrinsic(micro) space, and A_{micro} be an observer in SR(I). Let $T(I) = \{\sigma_x, \sigma_y, \sigma_z\}$ be a 3-dimensional signal system, in which σ_x, σ_y and σ_z are 1-dimensional periodic signal systems orthogonal to each other. Assume that signal unit is 1 and -1 in SR(I). The global property of $T(I)$ is the algebraic relation of the three axils, and is represented in terms of cross-product as

$$A_x \times A_y = A_z, \quad A_y \times A_z = A_x, \quad A_z \times A_x = A_y. \quad (6.1)$$

(2) Let SR(C) be intrinsic(classical) space, 1-dimensional classical space of reference, for observer A_c . Let X, Y and Z be 1-dimensional signal system, which correspond to σ_x, σ_y and σ_z respectively. Assume that signal unit is 1000 and -1000 in SR(C).

(3) There is no "universal" space of reference, both SR(C) and SR(I) can be observed concurrently by the third party.

(4) According to CI-1 and CI-2, in SR(C) there are only classical objects (including classical counterpart $C(O_{\text{micro}})$ of micro-object O_{micro}), and micro-object O_{micro} is outside SR(C). There is a

cliff-like separation between SR(C) and SR(I), so that observer A_C is unable to carry out operation in micro-region, and unable to decide the dimension of SR(I).

7.3. CI-3: mapping $T(I) \rightarrow Q(C)$

7.3.1. Information exchange (1): coupling and multiplication

The exclusivity of matter(C) forces the information exchange between SR(I) and SR(C) to be expressed through classical counterpart, and we make the following two assumptions. (a) The counterpart $C(O_{\text{micro}})$, unit of which is 1000, is produced through avalanche multiplication similar to micro-quantum experiment. (b) The coupling between classical and inherent measuring system is restricted to 1-dimensional coupling. First, measuring operation in SR(C) induces the corresponding operation in SR(I). Second, in SR(C) for two 1-dimensional operations X and Z , there are only successive operations, such as performing first X and then Z immediately.

7.3.2. Information exchange between SR(I) and SR(C) (2): producing orthonormal basis

According to CI-3, for producing abstract state space and orthonormal basis, the key steps are as follows. Eventually, mapping effect produces junior qubit system, such as orientation and phase, which is independent of exchange of energy-quantum.

(A) Collapse of dimensionality and signal multiplication

Matter(C) imposes its classical property and 1-dimensional feature on the new observable form. Coupling makes the 3-dimensional system in SR(I) to collapse to observable 1-dimensional system in SR(C). Similar to quantum mechanics, we define measurement X_Z as the result of performing measurement X first, then measurement Z immediately. We decompose the collapse into two sub-collapses of dimensionality. (a) First sub-collapse: Coupling between X_Z and $\sigma_{x\sigma_z}$ means collapsing 3-dimensional system to 2-dimensional system expanded by σ_x and σ_z , that is, unobserved y -axis is removed from further consideration. (b) Second sub-collapse: By measurement X_Z , collapsing 2-dimensional information at orientation σ_x and σ_z onto 1-dimensional system R so that it becomes observable in SR(C) (by Malus law).

Signal multiplication produces observable classical counterparts $C(m)$. Assume that in SR(I) there are a large number of micro-systems oriented in a random way, and measurement X_Z produces avalanche effect of the micro-systems. Each of the micro-systems, through the above collapsing process, is eventually projected onto 1-dimensional system R . The positive/negative projections of micro-systems onto R have accumulated. As the sum of these projections onto R in turn reaches its maximum strength (i.e., value 1000 required by $C(m)$), an observer obtains related pulses expressed by $C(m)$ in his space of reference. Observer A_C repeats measurements X_Z , and obtains a series of pulses for X_Z .

(B) Extrinsic succession of global property

Finally, for probability contribution of all measuring results of the simulation experiment, by introducing abstract state space, it is ease to verify that measurement X_Z , Y_Z and Z_Z correspond to Pauli operator σ_1, σ_2 and σ_3 respectively, i.e., to three orthonormal basis of state space. The physical meaning of eigenvalue and eigenvector of the operators is similar to quantum mechanics. The mapping effect $T(I) \rightarrow Q(C)$ produces junior qubit system $Q(C)$, such as orientation and phase, which is independent of exchange of energy-quantum. For Pauli operators there are algebraic relations

$$\sigma_x \sigma_y = i \sigma_z, \quad \sigma_y \sigma_z = i \sigma_x, \quad \sigma_z \sigma_x = i \sigma_y. \quad (6.2)$$

(6.2) is isomorphic to the algebraic relations (6.1) in SR(I) under the mapping $T(I) \rightarrow Q(C)$ (neglecting phase factor). The isomorphism shows extrinsic succession of global property of

intrinsic(micro) system.

7.4. CI Model in reference space SR(C)

In the simulation model above, for observer A_C in $SR(C)$, there is a CI Model similar to quantum mechanics. (1) There is a weakened form of superposition principle: measurement X_Z carries over micro-system expressed by the counterparts into the corresponding probability contribution in statespace. However, there is no arbitrary superposition of statevectors. (2) This simulation model intuitively provides intrinsic-to-extrinsic effect from $SR(I)$ into $SR(C)$, and demonstrates that the source of abstract basis is the invariance of global algebraic structure under the mapping $T(I) \rightarrow Q(C)$. The isomorphism between (6.1) and (6.2) means that quantum picture reproduces the perpendicular vectors in $SR(C)$ in terms of probability contribution. The third party could decide 3-dimensional structure of micro-system, but A_C could not judge between 1-dimension and 3-dimension of intrinsic(micro) space.

7.5. No physical version of Church-Turing thesis

In Gödel theorem and Church-Turing thesis, only effective procedures from within the system are used to deal with the statements of that system. The simulation model above gives relevance between outer system and effective intrinsic system, which cannot be described in terms of the effective procedures from within the intrinsic system. Thus, we provide a counter example to physical version of Church-Turing thesis, i.e., there is no physical version of Church-Turing thesis that deals with outer non-effective system in terms of effective procedure. Therefore, physical system contains procedures that human observer is unable to carry out, that is, world of matter is far bigger than world of computation procedures. The essential difference between physics and mathematics is that primitive unit can be identical to the effective unit in mathematics, and mathematics deals only with effective procedures within the system. In physics primitive blocks could be outer object which cannot be carried out by observer.

7.6. Verifying CI-3 through verifying the backward succession

The above intuitive CI Model demonstrates the generality of quantum formulism, that is, there can be applied CI Model which is detached from micro-physics. We ask: is there simulation model with exchange of energy quantum, is there simulation models with state-vector collapse? For any finite group is there the corresponding quantum model? We may consider confirming CI-3 through verifying the backward succession of classical property. Our question is: can observed quantum object succeed the relativity level of micro-object to its counterpart: (1) Does the interference of de Broglie wave of micro-object depend upon the relativity level of micro-object scale to its counterpart scale? (2) Can the level of equality of classical counterparts succeeded by related micro-objects?

8. Conclusion

Quantum theory, including the Copenhagen interpretation, was the greatest scientific achievement of the last century. The Copenhagen interpretation has tried to explore what reality is, why matter form is restricted to observation. We continue the exploration of the Copenhagen interpretation, discuss the four problems below.

(1) Holistic contradiction between experiment and theory We prove that there is a holistic contradiction between quantum theory and experiment that every experiment ever performed by human overturns traditional classification of matter and grand unified intrinsic reference space. This contradiction breaks the logical structure of physics. Consequently, the physical topic of quantum

physics becomes the relevance between intrinsic global property of micro-system and extrinsic quantum form.

(2) Invariance of classification feature of classical matter: a top law of nature Our discussion shows that the invariance of classification feature of classical matter is the most general law of nature which is worthy to govern all theories of physics. The classification feature provides a criterion of distinction between physical and mathematical theory. Quantum physics, in which the smallest operable unit of physical system is not ultimate block, deals with extrinsic form outside observer's operable measuring system. Therefore, logic of physics is logic of operable experimental procedure and matter classification, and must be distinguished from logic for mathematician. In this sense, there is no mathematical solution for Hilbert's sixth problem, and the string theory getting around operability of coordinate system is not a foundation of physics.

(3) Matter world is far bigger than world of effective procedures Idealist-physicists believe that matter and its generations are absolute, and that all matter forms are intrinsic, objects would contribute their data to our devices regardless of their size. Idealist-physicists believe that we must know, we will know the ultimate structure of matter world. We reject the above idea. The two theorems of abstract experiment we have proved show: here is no absolute intrinsic space; classical matter is the unique operable matter which can express itself independently; classical matter prevents micro-matter from contributing its inherent labels directly to classical device and forces it to express its properties in terms of classical matter; quantum matter is not intrinsic matter within classical space of reference, but extrinsic matter. Extrinsic description thesis is parallel to Gödel theorem, and shows that for an observer who is within classical matter and observes extrinsic micro-matter, no rules of measurement can be both reliable and complete. Matter world is far bigger than world of effective procedures, any matter form is unknown except for observable macro-matter and micro-matter.

(4) The Copenhagen interpretation can be verified We have improved the Copenhagen interpretation to CI Model, a GUT, and show that the main part of CI Model is equivalent to classification features of matter, and agrees with all experiments ever performed by human. Our work shows that the Copenhagen interpretation can be verified, demonstrates that the SR(I)-SR(C) mapping is the key ingredient for producing abstract state space and probability contribution, and is theoretical foundation of reorganizing the Standard Model to be a specific extrinsic expression.

It remains to be understood whether inherent nature, which is three-dimensional (we do not believe the existence of many-dimensional world), is causal or not. We expect that more experiments will be carried out to verify the topic of the Copenhagen interpretation: classical matter (including its operability) is the starting point of physics, there is no absolute space of reference, no absolute generations of matter in one intrinsic space of reference, the quantum world we observe is not nature in itself, but an extrinsic nature exposed to classical matter.

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