# Pure Logic and its Equivalence with the Universe: A Unique Method to Establish the Final Theory

Abstract: The theme of this study is about establishing a purely logical theory about the Universe. Logic is the premier candidate for the reality behind phenomena. If there is a final theory, the Universe must be logic itself, called pure logic, elements of which include not only logic and illogic but also logical and illogical manipulations between them. The kernel is the revised law of the excluded middle: between two basic concepts are four possible manipulations, three logical and one illogical, whereas only one is realized. The key parameter for an element is aim, including reason, outcome, and neutrality. When an element is a contradiction, it can be located at three positions: reason, outcome, and manipulation, corresponding to three colors of quark. Thus, there is interaction with the SU(3) symmetry keeping the number of the three elements balanced locally. A proposition without contradiction has two independent aims. When one aim changes, there is interaction with the U(1) symmetry. When two aims change together, there

is interaction with the SU(2) symmetry.

Keywords: final theory; pure logic; reality; the Universe

## 1. Pure logic – the unique choice for final theory

Human beings always explore a better logical explanation for their experiences, and the ultimate goal is to establish a final theory in which everything can be explained logically. However, the final theory cannot be empirical. A theory that is established based on some experiences cannot be the final theory because these experiences cannot be explained logically. Logic, including its causes and effects, should be the premier research object of science. Without logic, neither matter nor consciousness could be reliable knowledge; thus, none of them could be fundamental existence. For example, one needs logic to believe memories, sensations, and even ego. The attempt to prove logically that anything is more fundamental than logic is absurd. If J cannot exist without K, one cannot use J to prove K. Reliable empirical knowledge exists only when logic exists; thus, logic is the fundamental existence. This is undeniable because logic is the only requirement for everything, even including the doubting and criticizing of logic.

The first problem for science ought to be "what is logic" instead of "who am

I". Treating ego, the initial experience, as part of logic, the initial logical structure is the best start to recognizing the world. Therefore, it is strange that logic is not viewed as a candidate of reality, while matter and consciousness is. The biggest mistake human beings ever made is treating experiences as existences independent of logic, instead of experiences inside logic. Then, they acquired many experiences, but they exploited them to construct a hypothetical material world, instead of the world of logic.

Therefore, there should be a monistic theory with a strong unifying principle:

Logic=Reality. (1)

Other monistic theories, like materialism, should be called dualism because logic must be an independent part.

To ensure the reliability of logic, the Universe and logic must be identical, no matter how different they appear to be. Otherwise, not only could the final theory not exist but also every logical deduction is doubtful. (For dualism, a logical reasoning is always doubtful because one ever knows why,

when, or where the other independent being would violate logic.)

Besides, there is an empirical method to discover reality. Reality is the reason for phenomena, not the result. Hence, phenomena are never the conditions of reality, and the necessary condition for reality is the following:

reality is universal with every phenomenon. (2)

That everything is logical is one of the few existences satisfying the condition. (Physical laws are always conditional. For example, energy is conservative with the condition of "isolated system".)

Thus, this is the unique way to establish the final theory: using logic to discover rules about logic. It is a historical tendency that science improves from 100% empirical to 100% logical, and logic is no exception. Experience is not the foundation of logic. The logic operated by purely logical rules is pure logic, identical with the Universe.

Pure logic is the correct form of logic and metaphysics, the goal of which should be discovering purely logical truth. However, empirical knowledge

causes many misunderstandings, making classical logic and metaphysics quite different from truth. Ancient Greek scholars recognized the importance of logic partially, whereas influences from experiences kept them from discovering truth. Modern scientists elevate the importance of experience; therefore, they focused on experiments. However, no experiment can clarify the importance of logic without the belief of logic, making it impossible to discover reality or the final theory.

Pure logic is the unique faith for which complete trust is logical. First, other faiths cannot exist without logic; thus, other faiths cannot be trusted alone. Both their origin and application need logic, and faiths without application are useless. Second, if part only of a faith was based upon experiences, either material or spiritual, part of the trust would be based on the quantity and quality of the empirical evidences. Then, such faiths are always doubtful, because they could not be tested with 100% accuracy under all the possible circumstances (like in black holes). However, pure logic is about applying logic to logic, which is impossible to be wrong. (If logic cannot be applied to logic, how can it be applied to other existences?)

Exploring truth is a finite process; at least, it can be approached, and the limit is logic (because there is no reason simpler than logic). Logic creates the Universe of logic only, and nothing else could exist logically. If there is an empirical Universe, there must be:

The Empirical Universe= the Universe of Logic. (3)

Thus, logic is reality, not abstraction of thinking. Accidentally, the reaction mechanism of human beings possessed some essential attributes of logic; hence, they evolved in the Universe of Logic better. However, because of faulty thinking, they treated logic as a dividing line to demonstrate their particularity in the Universe, not as the commonality, and thus missed the truth.

In pure logic, truths refer to the logically inevitable results. Therefore, logic is the unique necessity to discover and trust truths. However, logic in one's mind is not pure logic; thus, logic in one's mind can be wrong and can be tested by comparing with the reality of pure logic: the Universe.

This is the correct way to use experience: correcting thinking to conform to pure logic. Human beings are error-prone before they master pure logic. Under the current conditions, experiences are negative for discovering truth: first, they produce wrong rules for thinking, harmful for learning from experiences; second, diversified attempts to discover truths reduce the resources on the unique correct direction greatly.

Human beings have constructed many complex theories about the Universe; however, they utilized too many materials, mostly experiences, instead of picking the right material and abandoning all the others. The final theory is an analytical theory from one material, rather than a synthetical theory with many materials. The very beginning of the final theory is the simplest (truth is simple), while the subsequent theory must be complex and infinite (the world is complicated), as shown in the following reasoning.

## 2. Basic properties of pure logic

Pure logic begins with the concept of "logic", to which every element can be

traced back. Pure logic is composed of the smallest reasoning, called proposition, including three elements (can be viewed as the smallest syllogism): a manipulative element connects two conceptual elements. For example, in a deductive proposition "$\mathrm{L}\rightarrow\mathrm{I}$", the manipulation ($\rightarrow$) connects "prior element logic (L) and posterior element illogic (I)".

In pure logic, a proof is an inevitable outcome of logic, while realization is a realized possibility. For example, it is impossible to uniquely prove LL (representing "logic is logic", or "there is a rule for logic") from L, but can be realized when there is manipulation (M), satisfying $\mathrm{L}\xrightarrow{\mathrm{M}}\mathrm{LL}$ (similar to $1\xrightarrow{+1}2$). (There are infinite ways to realize an element.)

A): The law of excluded middle does not apply to possibility; hence, the possibility of logic does not forbid the possibility of illogic. Then, every element that can be constructed from logic and illogic logically is a possible element.

There is both logical and illogical manipulation. A proposition with logical manipulation is called ordered proposition (or deduction); while that with illogical manipulation is disordered proposition (induction). When two

elements are distinguishable, there is deductive or ordered manipulation between them; otherwise, there is disordered manipulation between them. Thus, two empirical manipulations become purely logical.

B): From any element P, there are possible elements like "P is illogic" (PI) and PL. Thus, there are directions and infinite possible elements, such as $PL_i$ and $PI_i$. Meanwhile, let L=YL, then Y= $L_0$, and $L_0$ is "reason of L along $L_i$ direction"; similarly, from L=ZI, Z is reason of L along $I_i$ direction. There is also $L_{-1}$ satisfying $L_{-1}L=L_0$; thus, x can be negative in $L_x$, and there are both $\mathrm{L}_{x+1} \to \mathrm{L}_x$ and $\mathrm{L}_x \to \mathrm{L}_{x+1}$.

All the possibilities are independent (and propositions can change direction). Both $\mathrm{P} \xrightarrow{\mathrm{M}} \mathrm{PL}$ and $\mathrm{P} \xrightarrow{\mathrm{M}} \mathrm{PI}$ are possible to realize. Because $P=PL_{-1}L$, elements $PL_{-1}$, P and PL are in the same direction, while PI, P, and PL are not. Hence, illogic and logic are independent directions, instead of opposite directions, (similarly, $\to$ and $\wedge$ cannot offset each other). If there is no rule for PL, the direction will change as $\mathrm{P} \xrightarrow{\mathrm{M}} \mathrm{PL} \xrightarrow{\mathrm{M}} \mathrm{PLI}$.

Classical logic requires the elimination of paradoxes and contradictions. Nevertheless, from L and $\overline{\mathrm{L}}$, paradox $\mathrm{L} \to \overline{\mathrm{L}} \to \mathrm{L}$ ($C^L$) and contradiction

$\bar{L} \wedge L$ ($U^L$) are possible elements. Thus, paradox and contradiction are purely logical existences, and there are four possibilities at the element (though only one can be realized).

Conversion is an independent direction; thus, there is $PC^L_i$. $P \to PC^L$ represents "P is a paradox". (It is a reasonable deduction: if there is no rule for P, there is the largest freedom for P, and the largest freedom is a rule, and thus there is a rule for P, whereas the rule is "no rule".) Thus, there are three equal directions for realization, $L_x$, $I_y$ and $C^L_z$, each of which provides an independent logical reasoning.

C): It is impossible to prove that one element is superior to another; thus, elements are equal, and an element can be the prior element, the posterior element or the manipulation. Then, all the possible elements form a unity. Otherwise, if an element could be the prior element only, it would not emerge; if it could be the posterior element only, it would be a dead end from which there is no deduction.

D): Without the influence of other propositions, a proposition sustains without end. Thus, a manipulation is possible theoretically to be endless.

Then, $L_x \xrightarrow{M} L_{x+1}$ is a more reasonable manipulation than $L_1 \xrightarrow{M} L_2$. However, because interactions are actually inevitable, it can never reach infinity. Thus, every proposition will change direction, and +1 forever is just an idealized manipulation that never happens. Moreover, there are propositions like $PL_{x+1} \to PL_x$; thus, it is possible to lose the existing deduction (there is no memory for logic other than the existing structure). Meanwhile, there should be sequence equality because of the element equality. Then, if there are some finite quantities, the probability for a quantity to be infinity is infinitely small, equivalent to a ban. Similarly, a physical quantity cannot be infinity.

E): From element equality, there is no minimum separation. Interpolation is always possible for a sustaining proposition. For $PL_x \xrightarrow{M} PL_{x+1} \xrightarrow{M} PL_{x+2}$, $L_{x+1}$ can be renamed as $L_{x+2}$ and a new $L_{x+1}$ must exist, similar to gauge invariance. Moreover, $PL_{a(n)} \xrightarrow{M} PL_{b(n)}$ can be viewed as a closed interval $[a_n, b_n]$; then, the existence of close nested interval represents the fact that there is always logical manipulation $PL_{a(n+1)} \xrightarrow{M} PL_{b(n+1)}$ inside $PL_{a(n)} \xrightarrow{M} PL_{b(n)}$. Thus, it is reasonable to suppose that a logical sequence

is a real continuum.

Moreover, a proposition is a continuous distribution (wave function) without discontinuous border, and the proposition never situates sharply at one element (uncertainty principle). If there were a clear border for a proposition, there would be a discontinuous manipulation. Thus, precise propositions, like $L_x \xrightarrow{M} L_{x+vt}$, are prohibited.

F): An element exists with its opposite, such as logic and illogic. Reality should be defined purely logically as the "purely logical existence," not the real existence behind the empirical world. Then, the relation between reality and its opposite, R and $\overline{R}$, is the premier question, and equality is the logical choice: to make reality a logically necessary existence, the best and perhaps unique logical way is to ensure the existence of a conversion between R and $\overline{R}$, including $\overline{R} \to R$ and $R \to \overline{R}$, then, both reality and its opposite will be indestructible. Moreover, the three parts, conversion, R and $\overline{R}$, should be symmetrical to ensure the indestructibility of every part of reality.

G): For a sustaining proposition, there are two basic models. One is repetitive; the other is non-repetitive, corresponding to spin and linear motion,

respectively. The realized non-repetitive proposition is one-dimensional, while the repetitive proposition is two-dimensional. For example, if P sustains to be logical (representing non-repetitive motion along $PL_x$), there is conversion between the other two directions.

Additionally, the conversion is not unique ($\mathrm{PI} \to \mathrm{PC^L} \to \mathrm{PI} \to \mathrm{PC^L}$). For any P, not only PL and PI but also $PL_{-1}$ and $PI_{-1}$ are adjacent elements. Thus, there are two continuous models of conversion (helicity):

$$\mathrm{PI_1} \to \mathrm{PC^L_{\ 1}} \to \mathrm{PI_{-1}} \to \mathrm{PC^L_{\ -1}} \to \mathrm{PI_1}, \tag{4}$$

and

$$\mathrm{PI_1} \to \mathrm{PC^L_{\ -1}} \to \mathrm{PI_{-1}} \to \mathrm{PC^L_{\ 1}} \to \mathrm{PI_1}, \tag{5}$$

Similarly, basic fermions, including leptons and quarks, have two spin components along a direction.

H): Time is necessary in pure logic. Relative to $\mathrm{J} \wedge \mathrm{K}$, there is priority and

posterity in $J \to K$. The law of excluded middle is valid for realized manipulation: between any two elements, there is only one realized manipulation (showing incompatibility between $\to$ and $\wedge$). Thus, it is necessary to introduce the time concept, and the two manipulations become $J(t) \to K(t+dt)$ and $J(t) \wedge K(t)$. Meanwhile, linear motion and spin is not tautology and logic loop anymore (logic never repeats because every element is changing).

Thus, ($L_x$, $I_y$, $C^L{}_z$, $T_t$) maps with (x, y, z, t) to describe the position of propositions. Geometry is the result of logic. However, classical logic did not exploit the potential of logic fully; hence, geometry is overrated.

## 3. Basic properties of proposition

I): Aim is the symbol for a realized proposition. In a proposition, both reason and outcome can be the posterior element; thus, it is necessary to introduce the aim of an element, including both reason P(R) and outcome P(O). The proposition

$$P(R,t) \xrightarrow{A(R\text{-}O)} P'(O,t') \rightarrow P'(R,t') \xrightarrow{A(R\text{-}O)} P''(O,t'') \quad (6)$$

keeps on searching outcomes, similar to a theory searching applications, and the proposition can be noted as $e^-$. Then, $e^+$ is

$$P(O,t) \xrightarrow{A(O\text{-}R)} P'(R,t') \rightarrow P'(O,t') \xrightarrow{A(O\text{-}R)} P''(R,t''), \quad (7)$$

similar to searching explanations of a fact. Besides, there is also invariance A(I), satisfying

$$P(R,t) \xrightarrow{A(R\text{-}O)} P'(O,t') \xrightarrow{A(O\text{-}R)} P''(R,t'') \xrightarrow{A(R\text{-}O)} P'''(O,t''') \quad (8)$$

A(I) and its opposite is differentiated by spin; hence, there is $A^+(I)$ and $A^-(I)$, representing neutrino and its antiparticle. If (8) is viewed as $P(I) \xrightarrow{A(I\text{-}I)} P'(I)$, the general form for the above three propositions is

$$P(X) \xrightarrow{A(X-Y)} P'(Y) \quad (9)$$

M(X-Y) annihilates P(X) and generates P′(Y). X and Y can be R, I, and O. Hence, these propositions, corresponding to leptons, have two variables, and can change one or two variables.

J): Unlike the deliberate thinking in our mind, change of aim requires a reason in pure logic. When manipulation between aim and anti-aim is ordered, it is a fermion, as in (6), (7), and (8); when it is disordered, it is a boson. Fermion requires boson to change aim. The simplest reaction between fermion and boson is

$$\overline{A} \wedge A' + A \rightarrow A' \quad (10)$$

representing element with aim A absorbs boson $\overline{A} \wedge A'$ and becomes aim A′ (because there are various reasons and outcomes). (10) is a reaction with the U(1) symmetry.

The interactions changing two aims have the SU(2) symmetry. A(X-Y)

represents a lepton, and there ought to be three bosons to convert leptons with each other. For example, particle $W^+$ can convert $e^-$ to neutrino ($e^- + \bar{\nu} \rightarrow W^+$). Additionally, $Z^0$ is the manipulation that satisfies $e^- + e^+ \rightarrow Z^0$, or $e^+ \xrightarrow{Z^0} e^+$, can be viewed as the two-dimensional form of (10).

K): Since the elements are divisible, there are two independent styles for fermion A(X-Y).

$$\left[ \bigwedge_i P_i(X) \right] \xrightarrow{A(X-Y)} \left[ \bigwedge_i P_i'(Y) \right] \tag{11}$$

represents disorder before order.

$$\bigwedge_i \left[ P_i(X) \xrightarrow{A(X-Y)} P_i'(Y) \right] \tag{12}$$

represents order before disorder.

The former interacts with the U(1) symmetry; the latter interacts with the SU(2) symmetry. Then, the two patterns are related with left-hand and right-

hand fermions in physics.

L): If an element can be R and O, it can also be $\mathrm{R} \to \mathrm{O}$ and $\mathrm{R} \wedge \mathrm{O}$. The latter represents contradiction (U), which is logical existence in pure logic. If the aim of the elements can be contradiction, (9) is not the unique style of fermion. There are three kinds of contradictions (three colors): reason ($U^e$), manipulation ($U^m$) or outcome ($U^o$). There can be one or two contradictions in a proposition; thus, there are two kinds of quarks and their antiparticles. For example:

$$\mathrm{P(R)} \xrightarrow{\mathrm{M(R\text{-}O)}} \mathrm{U(O)} \tag{13}$$

represents a proposition with $U^O$. Charge of contradiction is zero; thus, (13) has -2/3 charge, corresponding to antiparticle of Up quark.

Color can also be negative. For instance, when reason and manipulation are contradictions, the color is:

$$\mathrm{U^R + U^M = U^{-o} = \overline{U^o}}\,. \tag{14}$$

M): The disorder manipulations between contradictions are gluons, noted as $U^{i,-j}$.

$$U_e^{i,-j} = U_e^i \wedge \overline{U_e^j} \tag{15}$$

$$A_e^i \rightarrow U_e^{i,-j} + A_e^j \tag{16}$$

It describes a proposition with color i releasing a gluon with color i(-j) and becoming a proposition with color j. When three elements in a proposition are equal, there is the SU(3) symmetry and there are eight independent bosons. (When i=j, there are two independent bosons instead of three because there is no strong interaction when color remains unchanged, like releasing $U^{1,-1}$ $U^{2,-2}$ and $U^{3,-3}$ simultaneously.)

A contradiction cannot be independent, and it cannot move by itself. However, it must belong to a proposition, and other normal elements must drag it.

N): By exchanging gluons, propositions stick together to be white.

$$U^{R} + U^{M} + U^{O} = U^{W} \tag{17}$$

$U^{W}$ is white color. It reflects a key principle about logic:

number of realized reasons, manipulations, and outcomes are equal locally.

(18)

The law can be broken in a proposition. However, the larger the broken area is, the stronger the interaction is (related with asymptotic freedom of quarks). A proposition with a contradiction can be viewed as lacking an element, like $P(R) \xrightarrow{A(R\text{-}O)} ?$. For example, an experience without explanation has $U^{R}$; hence, keeping on explaining one experience with another cannot satisfy (18), and there must be a short-range solution.

The motivation of logical reasoning comes mainly from contradictions, much stronger than the motivations to sustain reasoning. Similarly, it is also the

source of energy in the Universe.

O): For a reaction,

$$Q(x,t) \xrightarrow{M} Q'(x',t'), \tag{19}$$

Its symmetrical process is

$$\overline{Q}'(x',t') \xrightarrow{\overline{M}} \overline{Q}(x,t), \tag{20}$$

instead of

$$\overline{Q}(x,t) \xrightarrow{M} \overline{Q}'(x'+t') \tag{21}$$

or

$$Q'(x',t') \xrightarrow{\overline{M}} Q(x,t). \tag{22}$$

$M\text{-}\overline{M}$ is the reflection of manipulation, corresponding to space-time reflection; $Q\text{-}\overline{Q}$ is the reflection of aim, corresponding to reflection of charge. (20), (21), and (22) are converse-negative, negative and converse proposition, respectively. Thus, the symmetry between a logical process and its converse-negative process is the purely logical reason for CPT transformation symmetry in physics.

P): Motion differentiates propositions with identical aims. Similarly, in the Universe, many particles can originate from a small area. (Maybe, all propositions can be traced back to an outburst from "what is logic", corresponding to the Big Bang.)

## 3. General rules

To recognize the Universe, recognize order and disorder first. Order and disorder are almost identical with logic and illogic, respectively. Just like pure logic, pure order is ordered everywhere. Pure order is not a sequence because the existence of the sequence must be the result of an order.

Pure disorder is disorder in the background of every sequence (or description), instead of in one sequence. For example, random distribution is ordered fairly in the description of the distribution function. Disorder is not "no order", and thus is more or less describable: first, there is local order (like the Sun in the Universe); second, freedom is the largest in pure disorder and is an order.

Neither order nor disorder can be thorough. The principle for both order and disorder is the largest freedom: to have more order or rules, the order cannot be the result of order; to have less order or fewer rules, there is no rule of more disorder than the largest freedom. Besides, the conversion between order and disorder exists: disorder increases, and order becomes the result of order. Thus, I suppose:

pure order, pure disorder and pure logic should be identical, and should follow the largest freedom principle. (23)

They follow the largest freedom principle:

propositions choose states to make freedom the largest. (24)

In physics, freedom is defined as a negative quantity (the main part is a mass term, $-\int m_0 ds$); then, there is the least freedom (least action) principle. To date, its sophisticated mathematical details cannot be explained fully (showing the complexity of quantifying freedom). (In physics, negative action is roughly the phase in wave function, and a wave function can always be viewed as conversions. Thus, it is a reasonable assumption that freedom is measured by cycles of various conversions.)

Various aims co-exist and interact with each other. For instance, when opposite aims meet, they increase the freedom for each other, and attraction arises.

In classical logic, propositions are static; hence, there is no freedom. To change that, there must be a focus on the law of the excluded middle. Several points must be clarified about the law of the excluded middle. First, the law does not apply to possible states. Second, conversion is an

independent state. Third, contradiction is necessary. Hence, the law is modified as follows:

Between the two concepts, there are four possibilities: three ordered manipulations and one disordered manipulation. At most, one manipulation realizes. (25)

This is the key difference between pure logic and classical logic. Thus, for A and $\overline{\mathrm{A}}$, not only A and $\overline{\mathrm{A}}$ can sustain, but also order and disorder manipulation between them. With the largest freedom principle, none of the four possibilities can be ruled out.

Now there are two quarks, two leptons and their antiparticles, while there ought to be six. I supposed that there is a hidden logical manipulation. Fermions participate in the order manipulation, thus having three generations. The bosons participate in the disorder manipulation, thus having one generation.

Manipulation between a realized proposition and a possible proposition is a

possible answer, such as

$$\left[\mathrm{X(P)} \xrightarrow{\mathrm{A(M)}} \mathrm{Y(P')}\right] \rightarrow \left[\mathrm{P} \xrightarrow{\mathrm{M}} \mathrm{P'}\right] \tag{26}$$

and

$$\left[\mathrm{X(P)} \wedge \overline{\mathrm{Y}}\mathrm{(P')}\right] \wedge \left[\mathrm{P} \wedge \mathrm{P'}\right]. \tag{27}$$

For fermions, there is a conversion between realization and possibility, producing the intermediate concept of "risk". The three generations can be viewed as risky, plain and risk averting.

Moreover, through the conversion, a realized proposition creates probability (chance), and then attracts other propositions, corresponding to gravity. Similarly, logical manipulations of human beings are attracted to hot areas because hot areas provide more chances.

Conclusion

The main difficulty of the theory is replacing various empirical existences with purely logical existences. The world is constructed by logic and illogic. Not only can elements and manipulations between them be both logic and illogic, but also manipulations between manipulations can be both logic and illogic. Logic endows the Universe with logical inevitability: making itself an enormous existence with the largest freedom principle. The future of logic depends on many factors; however, logic never dies.

It is impossible to establish a final theory apart from pure logic. Logic is everlasting, omnipresent and inevitable; thus, the creator meets the definition of the ultimate faith. The problem is as follows: can human beings abandon the wrong faith of experience to believe logic uniquely?