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YinYang Bipolar Atom—An Eastern Road toward Quantum Gravity*

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ABSTRACT

Based on bipolar dynamic logic and bipolar quantum linear algebra, a causal theory of YinYang bipolar atom is introduced in a completely background independent geometry that transcends spacetime. The causal theory leads to an equilibrium-based super symmetrical quantum cosmology of negative-positive energies. It is contended that the new theory has opened an Eastern road toward quantum gravity with bipolar logical unifications of particle and wave, matter and antimatter, relativity and quantum entanglement. Information recovery after a black hole is discussed. It is shown that not only can the new theory be applied in physical worlds but also in logical, mental, social and biological worlds. Falsifiability of the theory is discussed.

Keywords: YinYang Bipolar Atom; Bipolar Geometry; Quantum Cellular Automata; Matter and Antimatter; Information Recovery after a Black Hole; Real World Quantum Gravity

1. Introduction

Stephen Hawking's black hole theory originally suggested that the universe would ultimately disappear in a black hole without information preservation. This suggestion was criticized for violating the 2nd law of thermodynamics. To remedy the inconsistency, Hawking proposed black body evaporation [2] and then particle emission [3]. After then he held his position for three decades. In 2004, he finally conceded a bet and agreed that black hole emission does in fact preserve information. But so far it is unclear how to recover the information from the evaporation or particle emission and how the universe will evolve after a black hole. This uncertainty makes quantum theory incomplete and nihilism unavoidable. For instance, M-theory predicts that a great many universes were created out of nothing [4, p. 5].

Equilibrium is a well-known scientific concept that subsumes symmetry or broken symmetry. Since equilibrium is central in the 2nd law of thermodynamics—the paramount law of existence, energy, life, and information where bipolar equilibrium is a generic form, YinYang bipolar equilibrium-based approach to physics and science provides a fundamental super symmetrical alternative for scientific unification. (Note: Equilibrium subsumes equilibrium, non-equilibrium and quasi-equilibrium because local non-equilibriums can form global equilibrium or quasi-equilibrium.)

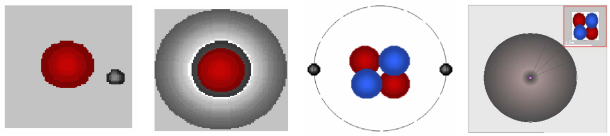
*The idea has been partially presented in Ref. [1].

Atom as a basic unit of matter should follow equilibrium or non-equilibrium conditions. It consists of a dense, central nucleus surrounded by a cloud of negatively charged electrons. The nucleus contains a mix of positively charged protons and electrically neutral neutrons (except in the case of hydrogen-1). The electrons of an atom are bound to the nucleus by the electromagnetic force. Likewise, a group of atoms can remain bound to each other, forming a molecule. In the case of antimatter atom, the cloud is formed with positively charged positrons and the atomic nucleus is negatively charged.

Molecule is an electrically neutral group of at least two atoms held together by covalent chemical bonds. A covalent bond is a form of chemical bonding that is characterized by the sharing of pairs of electrons between atoms. The stable balance of attractive and repulsive forces between atoms when they share electrons is known as covalent bonding.

An atom containing an equal number of protons and electrons is electrically neutral. Otherwise, it has a positive or negative charge. A positively or negatively charged atom is known as an ion. An atom is classified according to the number of protons and neutrons in its nucleus: the number of protons determines the chemical element and the number of neutrons determines the isotope of the element. **Figure 1** shows some examples.

Legendary Danish physicist Niels Bohr, a father figure of quantum mechanics, brought YinYang into quantum theory for his particle-wave complementarity principle.



(a) (b) (c) (d)

Figure 1. (a) Matter hydrogen atom; (b) Proton of a hydrogen surrounded by an electron cloud; (c) Matter helium atom with a nucleus (two protons and two neutrons) and two electrons; (d) Tiny nucleus of a helium atom is surrounded by electron cloud (Creative Commons: by User: Yzmo).

When he was awarded the Order of the Elephant by the Danish government in 1947, he designed his own coat of arms which featured in the center a YinYang logo (or Taiji symbol) with the Latin motto "contraria sunt complementa" or "opposites are complementary".

While quantum mechanics recognized particle-wave complementarity it stopped short of identifying the essence of YinYang bipolar coexistence. Without bipolarity any complementarity is less fundamental due to the missing "opposites". On the other hand, if bipolar equilibrium is the most fundamental form of equilibrium, any multidimensional model such as string, superstring or M-theory cannot be most fundamental. In brief, action-reaction forces, particle-antiparticle pairs, negative-positive energies, input and output, or the Yin and Yang in general are the most fundamental opposites of nature, but man and woman, space and time, particle and wave, truth and falsity are not exactly bipolar opposites. This could be the reason why Bohr believed that a causal description of a quantum process cannot be attained and we have to content ourselves with particle-wave complementary descriptions [5]. It may also be the reason why modern physics so far failed to find a definitive battleground for quantum gravity.

Einstein pointed out: "*For the time being we have to admit that we do not possess any general theoretical basis for physics which can be regarded as its logical foundation*." "*Physics constitutes a logical system of thought which is in a state of evolution*, *whose basis* (*principles*) *cannot be distilled*, *as it were, from experience by an inductive method*, *but can only be arrived at by free invention*."

In the above light, a causal theory of YinYang bipolar atom is introduced in this paper based on bipolar dynamic logic and bipolar quantum linear algebra [6-8]. The theory provides a springboard to an equilibrium-based logical unification of particle and wave, matter and antimatter, relativity and quantum theory, strings and reality as well as big bang and black hole. Information recovery after a black hole is discussed. The logical, physical, mental, biological and social implications of this work are formalized into a Q5 paradigm of quantum gravities [8].

This paper is organized into six sections. Following this introduction, a background review of the mathematical basis of this work is presented in Section 2. YinYang bipolar atom is presented in Section 3. Bipolar quantum cellular automata are introduced in Section 4. Section 5 presents the theory of YinYang bipolar quantum gravity. Section 6 draws a few conclusions as well as philosophical distinctions.

2. YinYang Bipolar Dynamic Logic and Quantum Linear Algebra

2.1. YinYang Bipolar Quantum Lattice and Bipolar Dynamic Logic (BDL)

Aristotle's causality principle became controversial in the 18th century after David Hume challenged it from an empirical perspective. Hume argued that causation is irreducible to pure regularity. YinYang bipolar dynamic logic (BDL) [6,8-10] has changed this situation in a fundamental way. BDL is defined on a bipolar quantum lattice $B_1 = \{-1, 0\} \times \{0, +1\} = \{(0,0), (0,1), (-1,0), (-1,1)\}$ in YinYang bipolar geometry as shown in **Figure 2**. The four values of B_1 form a bipolar set [8] which stand respectively for eternal equilibrium (0,0), non-equilibrium (–1,0), non-equilibrium (0,+1); equilibrium or harmony (–1,+1). Equation (1)-(12) in **Table 1** provide the basic operations of BDL. The laws in **Table 2** hold on BDL. Most interestingly, BUMP makes equilibrium-based bipolar quantum causality logically definable.

An axiomatization of BDL (**Table 3**) has been proven sound and complete [8]. A key element in the axiomatization is bipolar universal modus ponens (BUMP) (**Table 4**) which is a bipolar tautology, a non-linear bipolar dynamic generalization of classical modus ponens and a logical representation of bipolar quantum entanglement. Thus, BDL generalizes Boolean logic to a quantum logic where $\oplus$ and $\oplus^-$ are "balancers"; $\varnothing$ and $\otimes$ are intuitive "oscillators"; $\varnothing^-$ and $\otimes^-$ are counter-intuitive "oscillators"; & and $\&^-$ are "minimizers." The linear, cross-pole, bipolar fusion, oscillation, interaction and entanglement properties are depicted in **Figure 3**. Bipolar relations and equilibrium relations are defined in [6,8,11,12].

2.2. Bipolar Quantum Linear Algebra (BQLA)

The bipolar lattice $B_1 = \{-1,0\} \times \{0,1\}$ and bipolar fuzzy lattice $B_F = [-1,0] \times [0,1]$ can be naturally extended to the infinite bipolar lattice $B_\infty = [-\infty,0] \times [0,+\infty]$. While B_1 and B_F are bounded complemented unit square crisp/fuzzy lattices, respectively, B_∞ is unbounded. $\forall(x,y),(u,v) \in B_\infty$, Equations (13) and (14) define two major operations.

Tensor Bipolar Multiplication:

$$(x,y) \times (u,v) \equiv (xv+yu, xu+yv); \quad (13)$$

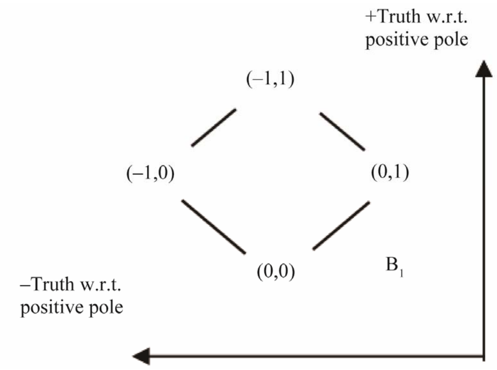


Figure 2. Hasse diagrams of B_1 in YinYang bipolar geometry.

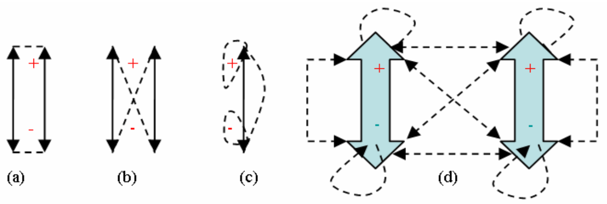


Figure 3. YinYang bipolar relativity: (a) Linear interaction; (b) Cross-pole non-linear interaction; (d) Oscillation; (e) Two entangled bipolar interactive variables.

Table 1. YinYang Bipolar Dynamic Logic (BDL). (Note: The use |*x*| through this paper is for explicit bipolarity only).

Bipolar Partial Ordering: $(x,y) \geq\geq (u,v)$, *iff* $\lvert x\rvert \geq \lvert u\rvert$ *and* $y \geq v$;	(1)
Complement: $\neg(x,y) \equiv (-1,1)-(x,y) \equiv (\neg x,\neg y) \equiv (-1-x,1-y)$;	(2)
Implication: $(x,y) \Rightarrow (u,v) \equiv (x \rightarrow u, y \rightarrow v) \equiv (\neg x \vee u), \neg y \vee v)$;	(3)
Negation: $-(x,y) \equiv (-y,-x)$;	(4)
Bipolar least upper bound (blub):	
$blub((x,y),(u,v)) \equiv (x,y) \oplus (u,v) \equiv (-(\lvert x\rvert \vee \lvert u\rvert), y \vee v)$;	(5)
Bipolar greatest lower bound (bglb):	
$bglb((x,y),(u,v)) \equiv (x,y) \& (u,v) \equiv (-(\lvert x\rvert \wedge \lvert u\rvert), y \wedge v))$;	(6)
-blub: $blub^{-}((x,y),(u,v)) \equiv (x,y) \oplus^{-} (u,v) \equiv (-(y \vee v),(\lvert x\rvert \vee \lvert u\rvert))$;	(7)
-bglb: $bglb^{-}((x,y),(u,v)) \equiv (x,y) \&^{-} (u,v) \equiv (-(y \wedge v),(\lvert x\rvert \wedge \lvert u\rvert)))$;	(8)
Cross-pole greatest lower bound (cglb):	
$cglb((x,y),(u,v)) \equiv (x,y) \otimes (u,v) \equiv (-(\lvert x\rvert \wedge \lvert v\rvert \vee \lvert y\rvert \wedge \lvert u\rvert),(\lvert x\rvert \wedge \lvert u\rvert \vee \lvert y\rvert \wedge \lvert v\rvert))$;	(9)
Cross-pole least upper bound (cglb):	
$club((x,y),(u,v)) \equiv (x,y) \varnothing (u,v) \equiv (-1,1)-(\neg(x,y) \otimes \neg(u,v))$;	(10)
-cglb: $cglb^{-}((x,y),(u,v)) \equiv (x,y) \otimes^{-} (u,v) \equiv -((x,y) \otimes (u,v))$;	(11)
-club: $club^{-}((x,y),(u,v)) \equiv (x,y) \varnothing^{-} (u,v) \equiv -((x,y) \varnothing (u,v))$.	(12)

Table 2. Bipolar laws.

Excluded Middle	$(x,y) \oplus \neg(x,y) \equiv (-1,1)$; $(x,y) \oplus^{-} \neg(x,y) \equiv (-1,1)$;
No Contradiction	$\neg((x,y) \& \neg(x,y)) \equiv (-1,1)$; $\neg((x,y) \&^{-} \neg(x,y)) \equiv (-1,1)$;
Linear Bipolar DeMorgan's Laws	$\neg((a,b) \& (c,d)) \equiv \neg(a,b) \oplus \neg(c,d)$; $\neg((a,b) \oplus (c,d)) \equiv \neg(a,b) \& \neg(c,d)$; $\neg((a,b) \&^{-} (c,d)) \equiv \neg(a,b) \oplus^{-} \neg(c,d)$; $\neg((a,b) \oplus^{-} (c,d)) \equiv \neg(a,b) \&^{-} \neg(c,d)$;
Non-Linear Bipolar DeMorgan's Laws	$\neg((a,b) \otimes (c,d)) \equiv \neg(a,b) \varnothing \neg(c,d)$; $\neg((a,b) \varnothing (c,d)) \equiv \neg((a,b) \otimes \neg(c,d)$; $\neg((a,b) \otimes^{-} (c,d)) \equiv \neg(a,b) \varnothing^{-} \neg(c,d)$; $\neg((a,b) \varnothing^{-} (c,d)) \equiv \neg(a,b) \otimes^{-} \neg(c,d)$

Table 3. Bipolar axiomatization

Bipolar Linear Axioms:

BA1: $(\phi^-,\phi^+) \Rightarrow ((\varphi^-,\varphi^+) \Rightarrow (\phi^-,\phi^+))$;

BA2: $((\phi^-,\phi^+) \Rightarrow ((\varphi^-,\varphi^+) \Rightarrow (\chi^-,\chi^+))) \Rightarrow$
$(((\phi^-,\phi^+) \Rightarrow (\varphi^-,\varphi^+)) \Rightarrow ((\phi^-,\phi^+) \Rightarrow (\chi^-,\chi^+)))$;

BA3: $(\neg(\phi^-,\phi^+) \Rightarrow (\varphi^-,\varphi^+)) \Rightarrow ((\neg(\phi^-,\phi^+) \Rightarrow \neg(\varphi^-,\varphi^+)) \Rightarrow (\phi^-,\phi^+))$;

BA4: (a) $(\phi^-,\phi^+) \& (\varphi^-,\varphi^+) \Rightarrow (\phi^-,\phi^+)$;
(b) $(\phi^-,\phi^+) \& (\varphi^-,\varphi^+) \Rightarrow (\varphi^-,\varphi^+)$;

BA5: $(\phi^-,\phi^+) \Rightarrow ((\varphi^-,\varphi^+) \Rightarrow ((\phi^-,\phi^+) \& (\varphi^-,\varphi^+)))$;

Non-Linear Bipolar Universal Modus Ponens (BUMP)

BR1: IF $((\phi^-,\phi^+)*(\psi^-,\psi^+))$, $[((\phi^-,\phi^+) \Rightarrow (\varphi^-,\varphi^+)) \& ((\psi^-,\psi^+) \Rightarrow (\chi^-,\chi^+))]$,
THEN $[(\varphi^-,\varphi^+)*(\chi^-,\chi^+)]$;

Bipolar Predicate Axioms and Rules of Inference

BA6: $\forall x,(\phi^-(x),\phi^+(x)) \Rightarrow (\phi^-(t),\phi^+(t))$;

BA7: $\forall x,((\phi^-,\phi^+) \Rightarrow (\varphi^-,\varphi^+)) \Rightarrow ((\phi^-,\phi^+) \Rightarrow \forall x,(\varphi^-,\varphi^+)$;

BR2-Generalization: $(\phi^-,\phi^+) \Rightarrow \forall x,(\phi^-(x),\phi^+(x))$

Table 4. Bipolar Universal Modus Ponens (BUMP).

$\forall \phi=(\phi^-,\phi^+)$, $\varphi=(\varphi^-,\varphi^+)$, $\psi=(\psi^-,\psi^+)$, and $\chi=(\chi^-,\chi^+) \in B_1$,
$[(\phi \Rightarrow \varphi) \& (\psi \Rightarrow \chi)] \Rightarrow [(\phi*\psi) \Rightarrow (\varphi*\chi)]$.

Two-fold universal instantiation:

1) Operator instantiation: $*$ as a universal operator can be bound to $\&$, $\oplus$, $\&^-$, $\oplus^-$, $\otimes$, $\varnothing$, $\otimes^-$, $\varnothing^-$. $(\phi \Rightarrow \varphi)$ is designated bipolar true or (-1,+1); $((\phi^-,\phi^+)*(\psi^-,\psi^+))$ is undesignated.
2) Variable instantiation:
$\forall x, (\phi^-,\phi^+)(x) \Rightarrow (\varphi^-,\varphi^+)(x)$; $(\phi^-,\phi^+)(A)$; $\therefore (\varphi^-,\varphi^+)(A)$.

Bipolar Addition:

$$(x,y) + (u,v) \equiv (x+u, y+v) \quad (14)$$

In Equation (13), $\times$ is a cross-pole multiplication operator with the infused non-linear bipolar tensor semantics of --=+, -+=+-=1, and ++=+; + in Equation (14) is a linear bipolar addition or fusion operator. With the two basic operations, classical linear algebra is naturally extended to BQLA with bipolar fusion, diffusion, interaction, oscillation, and quantum entanglement properties. These properties enable physical or biological agents to interact through bipolar fields such as atom-atom, cell-cell, heart-heart, heart-brain, brain-brain, organ-organ, and genome-genome bio-electromagnetic quantum fields as well as biochemical pathways. Thus, the bipolar properties are suitable for equilibrium-based bipolar dynamic modeling with quantum aspects where one kind of equilibrium or non-equilibrium can have causal effect to another.

Given an input bipolar row vector matrix $E = [e_i] = [(e_i^-, e_i^+)] \in B_\infty$, I = 1, 2, ⋯, k, and a bipolar connectivity matrix $M = [m_{ij}] = [(m_{ij}^-, m_{ij}^+)]$, i = 1, 2, ⋯, k and j = 1, 2,⋯, n, *we have* $V = E \times M = [V_j] = [(v_i^-, v_i^+)]$. While E is the input vector to a dynamic system characterized with the connectivity matrix M, V is the result row vector with n bipolar elements following Equation (15).

$$V = E \times M = \left[V_j\right] = \left[\left(v_j^-, v_j^+\right)\right];\ V_j = \sum_{i=1}^{k}\left(e_j \times m_{ij}\right) \quad (15)$$

Equation (15) has the same form as in classical linear algebra except for: 1) e_j and m_{ij} are bipolar elements; 2) the multiplication operator is defined in Equation (13) on bipolar variables with bipolar (quantum) entanglement; and 3) the Σ operator is based on bipolar addition defined on bipolar variables in Equation (14).

BQLA provides a new mathematical tool for modeling YinYang-n-elements with explicit bipolar equilibrium, quasi- or non-equilibrium representation for energy and stability analysis. Energies in a row matrix can be considered as physical or biological energies of any agents such as quantum or cosmological negative and positive energies, repression and activation energies of regulator proteins. Energies embedded in a connectivity matrix can be deemed organizational energies that bind the agents together. The following laws hold for any physical or biological systems [7,8,13].

YinYang Bipolar Elementary Energy. Given a bipolar element $e=\left(e^-,e^+\right)$,

1) $\varepsilon^-(e) = e^-$ is the Yin or negative energy of e;

2) $\varepsilon^+(e) = e^+$ is the Yang or positive energy of e;

3) $\varepsilon(e) = (\varepsilon^-(e), \varepsilon^+(e)) = (e^-, e^+)$ is the YinYang bipolar energy measure of e;

4) The absolute total $|\varepsilon|(e) = |\varepsilon^-|(e) + |\varepsilon^+|(e)$ is the total energy of e;

5) $\varepsilon_{\text{imb}}(e)=|\varepsilon^+|(e) - |\varepsilon^-|(e)$ is the imbalance of e;

6) $\text{EnergyBalance}(e) = (|\varepsilon|(e)-|\varepsilon_{\text{imb}}(e)|)/2.0 = \min(|e^-|, e^+)$;

7) $\text{Harmony}(e) = \text{Balance}(e) = (|\varepsilon|(e) - |\varepsilon_{\text{imb}}(e)|)/|\varepsilon|(e)$.

YinYang Bipolar System Energy. Given an $k \times n$ bipolar matrix $\text{M} = [m_{ij}] = (\text{M}^-,\text{M}^+) = (\left[m_{jj}^-\right],\left[m_{jj}^+\right])$, where M^- is the Yin half with all the negative elements and M^+ is the Yang half with all the positive elements,

1) $\varepsilon^-\left(\text{M}\right)=\sum_{i=1}^{k}\sum_{j=1}^{n}\varepsilon_{ij}^- =\sum_{i=1}^{k}\sum_{j=1}^{n}m_{ij}^-$ is the negative or Yin energy of M;

2) $\varepsilon^+\left(\text{M}\right)=\sum_{i=1}^{k}\sum_{j=1}^{n}\varepsilon_{ij}^+ =\sum_{i=1}^{k}\sum_{j=1}^{n}m_{ij}^+$ is the positive or Yang energy of M;

3) the polarized total, denoted $\varepsilon(\text{M}) = (\varepsilon^-(\text{M}), \varepsilon^+(\text{M}))$ is the YinYang bipolar energy of M of M;

4) the absolute total, denoted $|\varepsilon|(\text{M}) = |\varepsilon^-|(\text{M}) + |\varepsilon^+|(\text{M})$, is the total energy of M;

5) the energy subtotal for row i of M is denoted

$$|\varepsilon|\left(\text{M}_{i*}\right)=\left|\sum_{j=0}^{n}\varepsilon_{ij}\right|;$$

6) the energy subtotal for column j of M is denoted

$$|\varepsilon|\left(\text{M}_{j*}\right)=\left|\sum_{i=0}^{k}\varepsilon_{ij}\right|;$$

7) $\varepsilon_{\text{imb}}\left(\text{M}\right)=\sum_{i=1}^{k}\sum_{j=1}^{n}\varepsilon_{imp}\left(m_{ij}\right)=\sum_{i=1}^{k}\sum_{j=1}^{n}\left(m_{ij}^+-\left|m_{ij}^-\right|\right)$ is the YinYang imbalance of M;

8) balance or harmony or stability of M is defined as $\text{Harmony}(\text{M}) = \text{Balance}(\text{M}) = \text{Stability}(\text{M}) = (|\varepsilon|(\text{M}) - |\varepsilon_{\text{imb}}(\text{M})|)/|\varepsilon|(\text{M})$;

9) the average energy of M is measured as $h = (\varepsilon^-(\text{M})/(kn), \varepsilon^+(\text{M})/(kn))$ where $kn = k \times n$ is the total number of elements in M.

Law 1. Elementary Energy Equilibrium Law. $\forall(x,y) \in \text{B}_\infty = [-\infty, 0] \times [0, +\infty]$ and $\forall(u,v) \in \text{B}_\text{F} = [-1,0] \times [0,1]$, we have

a) $[|\varepsilon|(u,v) \equiv 1.0] \Rightarrow [|\varepsilon|((x,y)\times (u,v)) \equiv |\varepsilon|(x,y)]$;

b) $[|\varepsilon|(u,v)<1.0] \Rightarrow [|\varepsilon|((x,y)\times (u,v)) < |\varepsilon|(x,y)]$;

c) $[|\varepsilon|(u,v)>1.0] \Rightarrow [|\varepsilon|((x,y)\times (u,v)) > |\varepsilon|(x,y)]$.

Equilibrium/Non-Equilibrium System. A bipolar dynamic system S is said an equilibrium system if the system's total energy $|\varepsilon|\text{S}$ remains in an equilibrium state or $\text{d}(|\varepsilon|\text{S})/\text{d}t = 0$ without external disturbance. Otherwise it is said a non-equilibrium system. A non-equilibrium system is said a strengthening system if $\text{d}(|\varepsilon|\text{S})/\text{d}t > 0$; it is said a weakening system if $\text{d}(|\varepsilon|\text{S})/\text{d}t < 0$.

Law 2. Energy Transfer Equilibrium Law. Given an $n \times n$ input bipolar matrix $\text{E} = [e_{ik}] = [(e_{ik}^-, e_{ik}^+)]$, $0 < i, k \le n$, an $n \times n$ bipolar connectivity matrix $\text{M} = [m_{kj}] = [(m_{kj}^-, m_{kj}^+)]$, $0 < k, j \le n$, and $\text{V} = \text{E} \times \text{M} = [\text{V}_{ij}] = [(\text{v}_{ij}^-, \text{v}_{ij}^+)]$, $\forall k, j$, let $|\varepsilon|(\text{M}_{k*})$ be the k-th row energy subtotal and let $|\varepsilon|(\text{M}_{*j})$ be the j-th column energy subtotal, we have, $\forall k, j$,

a) $[|\varepsilon|(\text{M}_{k*}) \equiv |\varepsilon|(\text{M}_{*j}) \equiv 1.0\ ] \Rightarrow [|\varepsilon|(\text{V}) \equiv |\varepsilon|(\text{E})]$;

b) $[|\varepsilon|(\text{M}_{k*}) \equiv |\varepsilon|(\text{M}_{*j}) < 1.0\ ] \Rightarrow [|\varepsilon|(\text{V}) < |\varepsilon|(\text{E})]$;

c) $[|\varepsilon|(\text{M}_{k*}) \equiv |\varepsilon|(\text{M}_{*j}) > 1.0\ ] \Rightarrow [|\varepsilon|(\text{V}) > |\varepsilon|(\text{E})]$.

From the above, it is clear that without YinYang bipolarity, classical linear algebra cannot deal with the coexistence of the Yin and the Yang of nature and their causal interactions in bipolar quantum entanglement.

Law 3. Law of Energy Symmetry. Let $t = 0, 1, 2, \cdots$, $\text{Y}(t+1) = \text{Y}(t) \times \text{M}(t)$, $|\varepsilon|\text{Y}(t)$ be the total energy of an YinYang-N-Element vector $\text{Y}(t)$, $|\varepsilon|\text{M}(t)$ be the total energy of the connectivity matrix $\text{M}(t)$, $|\varepsilon|\text{M}_{i*}(t)$ be the energy subtotal of row i of $\text{M}(t)$, $|\varepsilon|\text{M}_{*j}(t)$ be the energy subtotal of column j of $\text{M}(t)$.

1) Regardless of the local YinYang balance or imbalance of the elements at any time point t, the system will remain a global energy equilibrium if, $\forall t$, $\text{d}(|\varepsilon|\text{Y}(t))/\text{d}t \equiv 0$, or (a)$\forall i,j$, $[|\varepsilon|(\text{M}_{i*}) \equiv |\varepsilon|(\text{M}_{*j}) \equiv 1.0]$ and (b) no external disturbance to the system occurs after the initial vector Y(0) is given.

2) Under the same conditions of (1), if, $\forall t$, $|\varepsilon^-(\text{M}_{*j})| > 0$ and $|\varepsilon^+(\text{M}_{*j}))| > 0$, all bipolar elements connected by M will eventually reach a local YinYang balance $(-|\varepsilon|\text{Y}(t)/(2\text{N}), |\varepsilon|\text{Y}(t)/(2\text{N}))$ at time t.

Law 4. Law of Broken Symmetry (Growing). For the same system with Law 3, if, $\forall i, j$, $|\varepsilon|(\text{M}_{i*}) \equiv |\varepsilon|(\text{M}_{*j}) > 1.0$, regardless of the local YinYang balance or imbalance of the elements at any time point t, the system energy will increase and eventually reach a bipolar infinite

$(-\infty,\infty)$ or fission state without external disturbance or we have, $\forall t$, $d(|\varepsilon|Y(t))/dt > 0$.

Law 5. Law of Broken Symmetry (Weakening). For the same system as for Law 3, if, $\forall i, j$, $|\varepsilon|(M_{i*}) \equiv |\varepsilon|(M_{*j}) < 1.0$, regardless of the local YinYang balance or imbalance of the elements at any time point t, the system energy will decrease and eventually reach a (0,0) or decayed state without external disturbance or we have, $\forall t$, $d(|\varepsilon|Y(t))/dt < 0$, until $|\varepsilon|Y(t) = 0$.

3. Bipolar Strings and Bipolar Atom

3.1. YinYang Bipolar Strings

Fundamentally different from the mainstream string theory or "theory of everything", BDL and BQLA provide the logical and physical bipolar bindings for the "strings" of reality but retain the open-world non-linear dynamic property of nature tailored for open-ended exploratory scientific discovery. While strings are far from observable reality, the non-linear dynamic property of BDL and BQLA do not compromise the law of excluded middle—a unique basis for a scalable and observable alternative bipolar string theory.

Since $(-1,0) \otimes (-1,0) = (-1,0)^2 = (0,1)$ and $(-1,1) \otimes (-1,1) = (-1,1)^2 = (-1,1)$, $(-1,0)^n$ defines an oscillatory non-equilibrium and $(-1,1)^n$ defines a non-linear dynamic equilibrium. Such properties provide a unifying logical representation for particle-wave duality. For instances, $\phi(P)(f) = (-1,0)^n (3 \times 10^{12})$ can denote that "particle P changes polarity three trillion times per second"; $\phi(P)(f) = (-1,1)^n (3 \times 10^{12})$ can denote that "The two poles of P interact three trillion times per second."

As strings can be one-dimensional oscillating lines or points, a bipolar string can be defined as an elementary bipolar variable or quantum agent $e = (-e,+e)$ and characterized as $\phi(e)(f)(m)$ where $\phi(e) \in B_1$ or B_∞, f is the frequency of bipolar interaction or oscillation, and m is mass. If e is massless we have m = 0. The two poles of e as negative and positive strings are non-exclusive, reciprocal, entangled, and inseparable. Thus, bipolar strings cannot be dichotomous and bipolar string theory is a non-linear dynamic unification of singularity, bipolarity, and particle-wave duality.

3.2. YinYang Bipolar Atom

Figure 4 shows a YinYang-n-element bipolar quantum cellular automaton (BQCA), where each link and each element is characterized with a bipolar value (n,p). A negative side n can indicate output of an element or repression of a link weight; a positive side p can indicate input of an element or activation of a link weight. A set of dynamic equations have been derived based BQLA for characterizing the cellular structure in **Figure 4**. The set

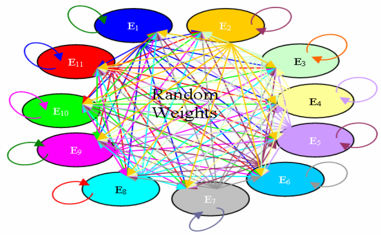


Figure 4. A YinYang-n-element cellular structure.

of equations can be simplified as $\mathbf{Y}(t+1) = Y(t) \times M(t)$, where $Y(t)$ is a bipolar vector at time t and $M(t)$ a connection matrix at time t. Now, our questions are:

1) How to use a YinYang-n-element cellular structure to describe and unify matter and antimatter atoms?

2) How to use a YinYang-n-element cellular structure to unify particle and wave?

3) How to use a YinYang-n-element cellular structure to describe and unify quantum theory and relativity?

4) How to integrate multiple YinYang-n-element cellular structures together?

5) How to use BDL, BQLA and BQCA to unify big bang and black hole as well as space and time?

Dramatically, BQLA and BQCA can be used for representing both matter and antimatter atoms as well as particles and waves. **Figure 5(a)** shows the bipolar representation of a hydrogen atom. **Figure 5(b)** is a redrawn of **Figure 4** by omitting connectivity. The positrons can be regrouped to the nucleus of a matter atom as shown in **Figure 5(c)**, where the negative signs can character electrons or electron cloud. Similarly, an antimatter atom is shown in **Figure 5(d)**. Thus, both matter and antimatter atoms can be characterized using Equation (15) in BQLA.

It is evident from **Figure 5** that YinYang bipolar atom has the potential to bridge a gap between black hole and big bang in a cyclic process model because it allows particles and antiparticles emitted from a black hole [2,3] to form matter and antimatter again. While Laws 1 - 5 provide the axiomatic conditions for energy equilibrium, growing, and degenerating, we introduce a new law of oscillation [1] in the following:

Law 6. Law of Oscillation. Let $t = 0, 1, 2, \cdots$, $Y(t+1) = Y(t) \times M(t)$, $|\varepsilon|Y(t)$ be the total energy of an YinYang-n-element vector $Y(t)$, $|\varepsilon|M(t)$ be the total energy of the connectivity matrix $M(t)$, if, $\forall i, j$, $|\varepsilon|(M_{i*})(t_k) \equiv |\varepsilon|(M_{*j})(t_k) > 1.0$ and $|\varepsilon|(M_{i*})(t_{k+1}) \equiv |\varepsilon|(M_{*j})(t_{k+1}) < 1.0$, the system's total energy will be alternatively increasing at time k and decreasing at time $k+1$.

Evidently, any particle or wave form can be represented with Yin energy, Yang energy, or unified YinYang form. But without YinYang, the bipolar coexistence and interaction of the two poles can't be visualized. The four cases of equilibrium, growing, degeneration and oscillation are simulated in **Figures 6-9**.

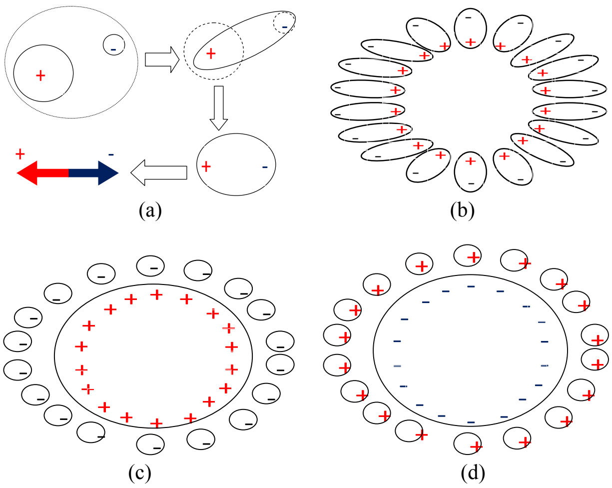


Figure 5. (a) Bipolar representation of a hydrogen; (b) Bipolar representation of YinYang-n-elements; (c) Matter atom; (d) Antimatter atom.

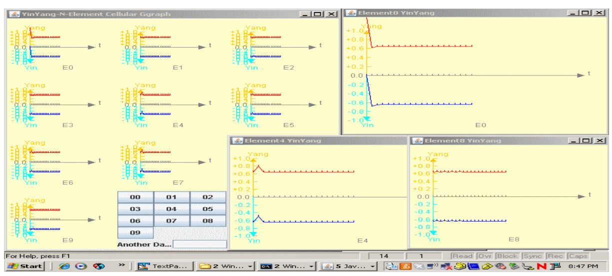


Figure 6. Bipolar energy rebalancing wave forms after a disturbance to one element [8].

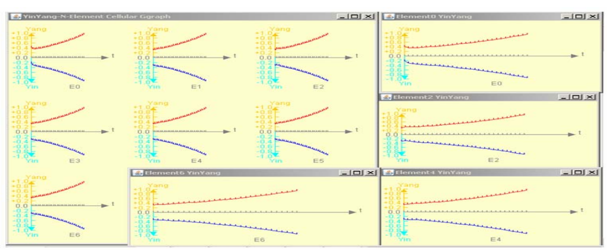


Figure 7. YinYang bipolar energy growing [8].

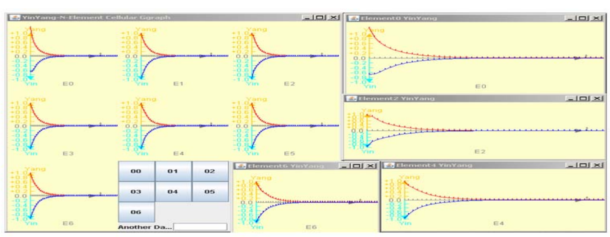


Figure 8. YinYang bipolar energy decreasing [8].

4. Bipolar Quantum Cellular Automata

YinYang bipolar atom leads to bipolar quantum cellular automata (BQCA) for advancing research in cosmological and molecular interactions. YinYang as the basis of

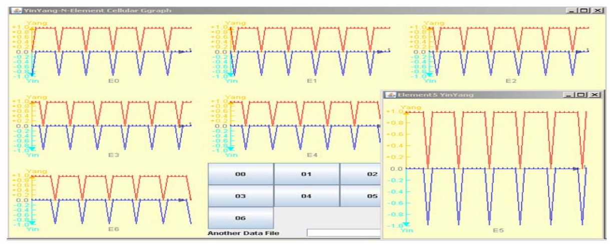


Figure 9. YinYang bipolar energy oscillation [8].

traditional Chinese medicine (TCM) has been in the dilemma of lacking a formal logical, mathematical, physical, and biological foundation. On the other hand, despite one insightful surprise after another the genome has yielded to biologists, the primary goal of the Human Genome Project—to ferret out the genetic roots of common diseases like cancer and Alzheimer's and then generate treatments—has been largely elusive. Although quantum mechanics provides a basis for chemistry and molecular biology, it so far has not found unification with Einstein's relativity theory. This situation provides an opportunity for YinYang to enter modern science and play a unifying role. For instance, given the cellular structures in **Figure 10**, we have the question: "How to model the integration, interaction, and equilibrium conditions?"

Law 7 (Following Law 3). Law of Integrated Energy Symmetry. Given **Figure 10**, let $t = 0, 1, 2, \cdots$, $Y(t+1) = Y(t) \times M(t)$, $|\varepsilon|Y(t)$ be the total energy of the integrated BQCA vector $Y(t)$, $|\varepsilon|M(t)$ be the total energy of the integrated connectivity matrix $M(t)$, $|\varepsilon|M_{i*}(t)$ be the energy subtotal of row i of $M(t)$, $|\varepsilon|M_{*j}(t)$ be the energy subtotal of column j of $M(t)$, the integrated BQCA can satisfy the following two global conditions:

1) Regardless of the local YinYang balance/imbalance of the subsystems at any time point t, the integrated system will remain a global energy equilibrium if, $\forall t$, $d(|\varepsilon|Y(t))/dt \equiv 0$, or

(a) $\forall i,j$, $[|\varepsilon|(M_{i*}) \equiv |\varepsilon|(M_{*j}) \equiv 1.0]$;

(b) no external disturbance or input/output to/from the system after the initial vector Y(0) is given;

(c) no internal disturbance or energy creation and consumption in the system after the initial vector Y(0) is given. That is, all the k component BQCA satisfy the condition, $\forall t$, $d(|\varepsilon|Y_k(t))/dt \equiv 0$, or, equivalently, $\forall i, j$, $[|\varepsilon_k|(M_{i*}) \equiv |\varepsilon_k|(M_{*j}) \equiv 1.0]$. Otherwise, there will be internal disturbance.

2) Under the conditions of (1), if, $\forall t$, $|\varepsilon^-(M_{*j})| > 0$ and $|\varepsilon^+(M_{*j}))| > 0$, all components connected by M will eventually reach a local YinYang balance $(-|\varepsilon|Y(t)/(2K), |\varepsilon|Y(t)/(2K))$ at certain time point t.

Law 8 (Following Law 4). Law of Integrated Energy Broken Symmetry (Growing). For the same integrated BQCA as for Law 7, if, (a) $\forall i, j$, $|\varepsilon|(M_{i*}) \equiv |\varepsilon|(M_{*j}) > 1.0$; (b) no external disturbance after the initial vector

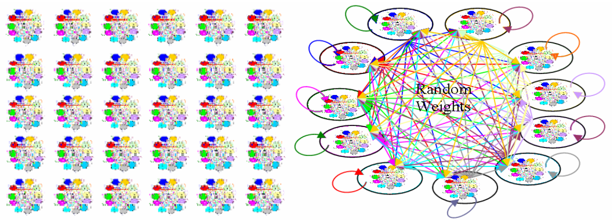


Figure 10. Integration of bipolar cellular subsystems.

Y(0) is given; (c) no internal disturbance or energy creation and consummation after the initial vector Y(0), regardless of the local YinYang balance or imbalance of its local component BQCAs at any time t, the system energy will increase and eventually reach a bipolar infinite $(-\infty,\infty)$ or $\forall t$, $d(|\varepsilon|Y(t))/dt > 0$.

Law 9 (Following Law 5). Law of Integrated Energy Broken Symmetry (Weakening). For the same system as for Law 7, if, (a) $\forall i,j$, $|\varepsilon|(M_{i*}) \equiv |\varepsilon|(M_{*j}) < 1.0$; (b) no external disturbance to the system after the initial vector Y(0) is given; (c) no internal disturbance or energy creation and energy consumption after the initial vector Y(0) is given, regardless of the local YinYang balance/imbalance of its local component BQCAs at any time t, the system energy will decrease and eventually reach an eternal equilibrium (–0,+0) state or, equivalently, $\forall t$, $d(|\varepsilon|Y(t))/dt < 0$, until $|\varepsilon|Y(t) = 0$.

Law 10 (Following Laws 3-9). Necessary and Sufficient Conditions for Collective Bipolar Adaptivity. The two conditions of Law 3 are necessary for collective bipolar adaptivity of any simple or integrated BQCA into equilibrium and symmetry; the two conditions are sufficient for collective bipolar adaptivity of any simple BQCA but not for integrated BQCAs; the two conditions in Law 7 are both necessary and sufficient for collective bipolar adaptivity of any simple BQCA or integrated BQCA into equilibrium and symmetry.

5. An Eastern Road to Quantum Gravity

5.1. Q5 Paradigm

Since acceleration is equivalent to gravitation under general relativity, any physical, socioeconomic, mental, and biological acceleration, growth, degeneration or aging are qualified to be a kind of quantum gravity. It can be further argued that as a most fundamental scientific unification not only can quantum gravity be applied in physical science, but also in computing science, social science, brain science, and life sciences as well. This argument leads to five sub-theories of a *Q5 paradigm* of quantum gravities: *physical quantum gravity*, *logical quantum gravity*, *mental quantum gravity*, *biological quantum gravity*, *and social quantum gravity* [8]. In the Q5 paradigm, the theory of physical quantum gravity is concerned with quantum physics; logical quantum gravity is focused on quantum computing; mental quantum gravity is focused on the interplay of quantum mechanics and brain dynamics; biological quantum gravity is focused on life sciences; social quantum gravity spans social sciences.

The Q5 paradigm may sound like a mission impossible. It actually follows a single undisputable observation and a single condition: 1) bipolar equilibrium or non-equilibrium is a generic form of any multidimensional equilibrium from which nothing can escape; 2) bipolar quantum entanglement is logically definable with BUMP that unifies truth, being and dynamic equilibrium with logically definable causality.

Roger Penrose described two mysteries of quantum entanglement [14, p. 591]. The first mystery is the phenomenon itself; the second one is: "*Why do these ubiquitous effects of entanglement not confront us at every turn*?" Penrose remarked: "*I do not believe that this second mystery has received nearly the attention that it deserves*." It is contended that YinYang bipolar quantum entanglement provides a resolution to the first mystery and the Q5 paradigm provides a resolution to the second.

Since the Yin and the Yang are two reciprocal opposite poles or energies that are completely background independent, YinYang bipolar geometry is fundamentally different from Euclidian, Hilbert, and spacetime geometries. With the background independent property, the new geometry makes quadrants irrelevant because bipolar identity, interaction, fusion, separation, and equilibrium can be accounted for in it even without quadrants (**Figure 11**).

Defined in YinYang bipolar geometry, BDL and BUMP make quantum causality logically definable as equilibrium-based quantum entanglement. It simply states: For all bipolar equilibrium functions ϕ, φ, ψ, and χ, IF $(\phi\Rightarrow\varphi)$ & $(\psi\Rightarrow\chi)$, THEN the bipolar interaction $(\phi*\psi)$ implies that of $(\varphi*\chi)$. With the emergence of space and time, BUMP leads to a completely background independent theory of YinYang bipolar relativity defined by Equation (16) [8]. $\forall$a,b,c,d,

$$\begin{aligned}&\left[\psi\left(a\left(t_x,p_1\right)\right)\Rightarrow\chi\left(c\left(t_y,p_3\right)\right)\right]\&\\&\qquad\left[\phi\left(b\left(t_x,p_2\right)\right)\Rightarrow\varphi\left(d\left(t_y,p_4\right)\right)\right]\\&\Rightarrow\left[\psi\left(a\left(t_x,p_1\right)\right)*\phi\left(b\left(t_x,p_2\right)\right)\right.\\&\qquad\left.\Rightarrow\chi\left(c\left(t_y,p_3\right)\right)*\varphi\left(d\left(t_y,p_4\right)\right)\right]\end{aligned}\tag{16}$$

In Equation (16), $a(t_1,p_1)$, $b(t_1,p_2)$, $c(t_2,p_3)$, $d(t_2,p_4)$ are any bipolar agents where $a(t,p)$ stands for "*agent a at time t and space p*" (t_x, t_y, p_x and p_y can be the same or different points in time and space). An agent without time and space is assumed at any time t and space p. An agent at time t and space p is therefore more specific.

The symmetrical property of YinYang bipolar geome-

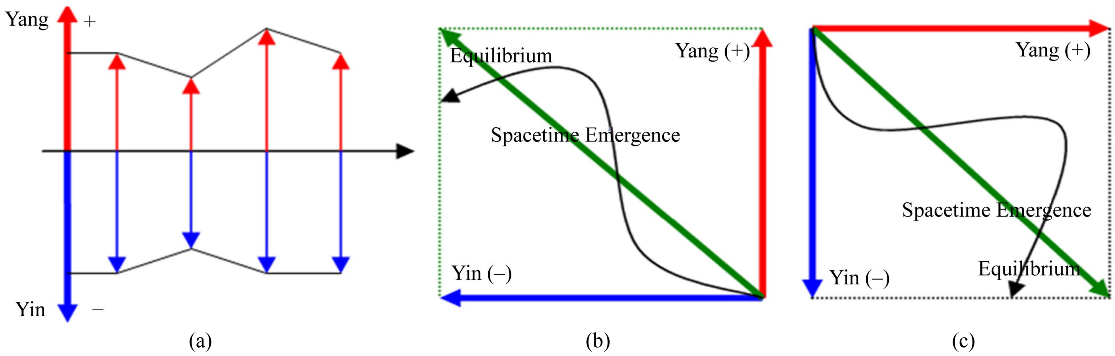


Figure 11. Background-Independent YinYang bipolar geometry: (a) Magnitudes of Yin and Yang; (b) Growing curve; (c) Quadrant irrelevant property.

try enables information to be passed through large or small scale quantum entanglement with or without passing observable energy or mass. When photon or electron is passed the speed is limited by the speed of light that has been proven in physics. Physicists have so far failed to experimentally verify the existence of graviton and the speed of gravity. If all action-reaction forces are fundamentally equilibrium-based and bipolar quantum entangled in nature, gravity would be logically unified with quantum mechanics in the form of Equation (16) [8].

For instance, based on general relativity, gravity "travels" at the speed of light and the effect of a disturbance to the Sun (S) could take 499 seconds to reach the Earth (E). Let $f(S) = f(E) = (-f,f)(S) = (-f,f)(E)$ be the gravitational (*reaction*, *action*) forces between S and E; let time t be in second; let p_1 and p_2 be points for S and E, respectively; let (0,0) (S) be the hypothetical Sun's vanishment or eternal equilibrium; we have

$$\left[f\left(S\left(t,p_1\right)\right)\Rightarrow f\left(E\left(t+499,p_2\right)\right)\right]$$
$$\Rightarrow\left[f\left(S\left(t,p_1\right)\right)\blacklozenge(0,0)\Rightarrow f\left(E\left(t+499,p_2\right)\right)\blacklozenge(0,0)\right] \quad (17a)$$

If $f()$ is normalized to a bipolar predicate, ♦ can be replaced with $*$, and the binding of &, $\&^-$, $\otimes$, $\otimes^-$, $\varnothing$, or $\varnothing^-$ to $*$ in Equation (17a) would lead to the vanishment of the Sun and then the disappearing of the Earth from its orbit after 499 seconds. Thus, bipolar quantum entanglement and general relativity are logically unified under equilibrium-based YinYang bipolar relativity [8]. Here bipolar relativity can host space and time emergence following agents' arrivals.

Equation (17a) assumes that the speed of gravity equals the speed of light based on general relativity. This assumption is actually questionable. If we assume gravitation is a kind of large scale quantum entanglement of action and reaction forces, gravity could have a minimum lower bound of 10,000 times the speed of light [15] and would travel from the sun to the Earth in less than 0.0499 second and we would have Equation (17b).

$$\left[f\left(S\left(t,p_1\right)\right)\Rightarrow f\left(E\left(t+0.0499,p_2\right)\right)\right]$$
$$\Rightarrow\left[f\left(S\left(t,p_1\right)\right)\blacklozenge(0,0)\Rightarrow f\left(E\left(t+0.0499,p_2\right)\right)\blacklozenge(0,0)\right] \quad (17b)$$

A comparison of Equations (17b) with (17a) reveals an equilibrium-based logical "*bridge*" from relativity to quantum mechanics—a bridge toward quantum gravity. Why cannot other logical and statistical systems be used for the above unification? The answer is that without bipolarity a truth value in {0,1} or a probability $p \in [0,1]$ is incapable of carrying any shred of direct physical syntax or semantics such as equilibrium (–1,+1), non-equilibrium (–1,0) or (0,+1), quasi-equilibrium (–0.9, +0.9), eternal equilibrium (0,0) and, therefore, unable to represent non-linear bipolar dynamic interactions such as bipolar fusion, fission, oscillation, quantum entanglement, and annihilation.

Bipolar relativity can also support causal reasoning with time reversal because the premise of Equation (16) could be a future event and the consequent a past one. Although time travel in physics and cosmology is highly speculative in nature, time reversal analysis has been proven very useful in many other scientific, technological, and engineering research and development.

The equilibrium-based interpretation leads to a number unifying features for particle-wave, matter-antimatter, strings and atom as well as black hole and big bang. Evidently, Law 6 provides the basic condition for both waves and particles; YinYang bipolar atom provides the unification for matter and antimatter. Since **Figures 5(a)-(d)** are redrawing of a bipolar representation like **Figure 8** (different only in the number of elements), BQLA, BQCA, and Laws 1 - 6 all apply to the unipolar representations of **Figures 5(c)** and **(d)**. Thus, BQCA presents a unifying mathematical model for matter and antimatter atoms as well as particles and waves. In turn, it makes the unification of black hole and big bang possible because the theory allows particles and antiparticles emitted from a black hole [2,3] to form matter and antimatter again. Thus, it bridges a major gap in quantum cosmology and set the stage for another cycle of a cyclic process model of the universe. The unifying features are made possible by the complete background independent property of YinYang bipolar geometry (**Figure 11**).

YinYang bipolar elements and sets [8] provide an alternative interpretation for strings as well. Different from mainstream string theory, bipolar strings are scalable and can be the makings of bipolar atoms (**Figure 5**). Thus, the alternative interpretation brings strings into the real world of matter and antimatter for the first time.

Since action and reaction or negative and positive energies can be electromagnetic or gravitational in nature, YinYang bipolar atom can serve as a basis for real world quantum gravity. If we treat the centrifugal and centripetal forces of a planet similarly as that of an electron (or positron) rotating around its nucleus, gravity can be a superposition on quantum interaction. In either case, since nothing can escape bipolar equilibrium or non-equilibrium, renormalization is made possible in equilibrium-based terms using BQLA and BQCA.

The YinYang negative-positive energies also provide a possible unification for the many universes in M-theory. It can be argued that the multiverses have to follow the same equilibrium or non-equilibrium conditions of the 2nd law of thermodynamics and become one universe. Otherwise, the two energies can't form the regulating force of the multiverses. Thus, the different laws followed by different universes as described in *The Grand Design* have to be unified under the same 2nd law of thermodynamics.

Different from other approaches to quantum gravity, the equilibrium-based approach is rooted in the real world. Due to YinYang bipolarity in mental health, bioinformatics, life and social sciences [6-13,17-23], physical and logical quantum gravity can be naturally extended to mental, biological and social quantum gravities [8]. Thus, it is contended that the new approach has opened an Eastern road toward quantum gravity.

5.2. Falsifiability

Falsifiability is a must for any viable physical theory. It is of course correct that bipolar quantum entanglement needs experimental verification. However, 1) bipolar atom finds its equivalent representation in classical atom theory (**Figure 5**); 2) bipolar quantum entanglement or BUMP is physical and logical; 3) unlike the predicted but unverified existence of monopoles in string theory, dipoles are everywhere. Thus, we have:

Postulate 1: *Bipolar quantum entanglement is the most fundamental entanglement in quantum gravity.*

Postulate 2: *YinYang bipolarity is the most fundamental property of the universe.*

The two postulates are actually logically provable axioms. For Postulate 1, if a bipolar element (**Figures 4** and **5**) characterizes the energy superposition of gravitational and quantum action-reaction, an atom would be a set of bipolar elements. As the total must be equal to the sum, without bipolar entanglement there would be no atom level entanglement. Postulate 2 follows Postulate 1.

Postulate 3: *YinYang bipolar atom is a bipolar set of quantum entangled particle and antiparticle pairs*.

Postulate 4: *Gravity is fundamentally large or small scale bipolar quantum entanglement*.

Postulate 5: *The speed of gravity is limited by the speed of quantum entanglement and not by that of light*.

According to Einstein, "*Evolution is proceeding in the direction of increasing simplicity of the logical basis* (*principles*)." "*We must always be ready to change these notions—that is to say*, *the axiomatic basis of physics—in order to do justice to perceived facts in the most perfect way logically*." While string and superstring theories up to 11 or more dimensions failed the simplicity measure, YinYang bipolar atom and bipolar quantum entanglement are simple and logically comprehendible with definable causality in BUMP. The bipolar quantum interpretation coincides with MIT Professor Seth Lloyd's startling thesis that the universe is itself a quantum computer [24]. According to Lloyd, the universe is all about quantum information processing. Once we understand the laws of physics completely, we will be able to use small-scale quantum computing to understand the universe completely as well. Could YinYang bipolar quantum entanglement or BUMP be such a basic law?

6. Conclusions

Based on YinYang bipolar dynamic logic and bipolar quantum linear algebra, a logically definable causal theory of YinYang bipolar atom has been introduced. The causal theory has led to an equilibrium-based super symmetrical quantum cosmology of negative-positive energies. It is contended that the new theory has opened an Eastern road toward quantum gravity with bipolar logical unifications of matter-antimatter, particle-wave, strings and reality, big bang and black hole, quantum entanglement and relativity. It has been shown that not only can the theory be applied in physical worlds but also provides a Q5 paradigm of physical, logical, mental, biological and social quantum gravities. Furthermore, it provides a logically consistent cyclic process model of the universe with information recovery after a black hole.

The strength of the equilibrium-based approach is its interpretation and unification aspects. The strength comes from the background-independent property of YinYang bipolar geometry that transcends spacetime. The strength would also be a weakness should YinYang be exclusive of spacetime geometry. Fortunately, the new geometry is not exclusive but inclusive. It promotes equilibrium, harmony and complementarity by hosting, regulating or integrating background-dependent models as emerging parameters for more challenging scientific explorations and unifications.

This work is limited to qualitative simulation, interpretation and unification. A major research topic is bipolar quantization and space emergence. The negativepositive energies of an electron-positron pair under certain condition provides a candidate bipolar unit for quantization with space emergence as a result of particle-antiparticle interaction.

Finally, the equilibrium-based approach to quantum gravity is fundamentally different from other approaches in philosophical basis. Since all beings must exist in certain equilibrium or non-equilibrium, a scientific reincarnation of philosophy is predicted [25].

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