Yijing: Metaphysics and Physics – Mathematical Supplement

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Introduction

This supplement provides some additional mathematical background to the main paper. In the first part, I explain the physics of the quantum vacuum in more detail, and in the second part I describe the mathematical model of the implicate order that is derived from the lattice structure of the *Yijing*.

From Wuji to Taiji

The mathematical physics paralleling the emergence of *Taiji* from *Wuji* and the subsequent discrimination of *Yin* and *Yang* involves two separate equations. These are, firstly, the relationship between the mass and energy of a particle; and secondly, Heisenberg's uncertainty principle.

The Energy of a Particle

Einstein's famous equation tells us how mass and energy are related.

1. $E = mc^2$

This says that the energy E of a particle is its mass m times the speed of light c. Thus, when we come to consider the spontaneous creation of particles from the quantum vacuum, we will be able to determine the required energy.

Heisenberg's Uncertainty Principle

Heisenberg's *Uncertainty Principle* relates certain pairs of observable properties as being complementary. For any such pair, the more precisely one property is measured, the less precisely the other can be measured. For normal (real) particles the following inequality relating position X and momentum P must hold:

2. $\Delta X \Delta P \geq h/4\pi$

so, knowing position to an accuracy of ΔX means that

3. $\Delta P \geq h/4\pi\Delta X$

which tells us what the uncertainty of the momentum is.

The Quantum Vacuum

Another Heisenberg pair of properties is the energy of a particle (pair) and its life time. That is, for real particles, we have the following inequality:

4. $\Delta E \Delta t \geq h/2\pi$

For virtual particles the direction of the inequality is reversed, meaning that the uncertainty must be less than the given threshold. When this is the case, the particles do not exist for long enough to violate conservation of energy:

5. $\Delta E \Delta t \leq h/2\pi$

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This means that one or more particles with energy in the range ΔE may spontaneously appear for small times Δt. Let m_e be the mass of an electron, then for an electron-positron pair to emerge as virtual particles in the vacuum, we know from Equation 1 that:

6. $E_e = m_e c^2$

therefore, for a pair composed of a positron and an electron, the uncertainty with respect to the energy at a point in the quantum vacuum must be at least:

7. $\Delta E = 2m_e c^2$

so, putting this into Equation 5 and rearranging, we know that:

8. $\Delta t \leq h/4\pi m_e c^2$

This gives us the upper bound on the length of time that a virtual electron-positron pair can exist as the result of spontaneous creation from the quantum vacuum.

Bohm's Holographic Reality

The mathematical description of the implicate/explicate structure presented here uses the basic Boolean algebra described in Schöter (1998) and draws extensively on the material in Schöter (2005). I also assume familiarity with basic set theory.

The Totality

The whole of reality, including both the whole of the implicate order and explicate order is defined as a Boolean lattice structure over the *gua* 卦. For symbols of size n, this is named as $\mathcal{L}_n$. For simplicity, any free variables in an expression are assumed to be universally quantified over $\mathcal{L}_n$.

The Explicated Moment

At any given moment, some particular sublattice of $\mathcal{L}_n$ will be explicate. Where P is the current circumstance and Q is the scope of the awareness of change:

9. $\mathrm{sub}(P, Q) = \{G : P \vee (P \times Q) \geq G \geq P \,\&\, (P \times Q)\}$

The scope of difference in an explicate sublattice is given by Q – that is, each symbol in sub(P, Q) differs from the others on at least one dimension in Q. However, regardless of apparent difference, each element presented to awareness in an explicate sublattice is considered to be synordinant in the context of the implicate order. Because what makes the different symbols synordinant is outwith the scope of their differences, the scope of their synordinance must be defined as $\sim Q$. Further, because:

10. $\forall G,H \in \mathrm{sub}(P, Q),\ G \,\&\, {\sim}Q = H \,\&\, {\sim}Q$

then, what is actually synordinant in sub(P, Q) is represented by a *gua* given by

11. $\mathrm{syn}(P, Q) = P \,\&\, {\sim}Q$

Note that the synordinant element of an explicate sublattice is itself a member of that sublattice.

12. $\mathrm{syn}(P, Q) \in \mathrm{sub}(P, Q)$

13. $\mathrm{syn}(P, Q) \in \mathrm{basis}(Q)$

In fact, it is the bottom element of the sublattice.

14. $\mathrm{syn}(P, Q) = \mathrm{bot}(\mathrm{sub}(P, Q))$

This suggests that in any particular situation, we could learn to perceive what makes the disparate elements synordinant if we could make the scope of our awareness perfectly receptive.

Unfolding the Implicate Order

An *exhaustive unfolding* of reality, relative to some particular scope of awareness Q is defined as follows. Firstly, the basis of synordinance for such an unfolding is defined:

15. $\mathrm{basis}(Q) = \{G : {\sim}Q \geq G\}$

This defines the set of patterns of synordinance for the unfolding. Each of the individual explicate sublattices in the unfolding will have a synordinant pattern from this set. The following definition then gives the exhaustive unfolding:

16. $\mathrm{unf}(Q) = \{\mathrm{sub}(P, Q) : P \in \mathrm{basis}(Q)\}$

Therefore, an unfolding partitions the whole lattice into a set of disjoint sublattices, where each sublattice represents a synordinant cluster of elements. These sublattices can be arranged into a number of distinct sequences based on the lattice adjacency of their synordinant

The notion of being *synordinantly adjacent* is defined for any pair of sublattices in an unfolding:

17. $S_i, S_j \in \mathrm{unf}(Q)$ are synordinantly adjacent iff $\mathrm{bot}(S_i) \prec \mathrm{bot}(S_j)$ or $\mathrm{bot}(S_j) \prec \mathrm{bot}(S_i)$

If S_i is the currently explicate sublattice, then when S_i is enfolded, then next sublattice to be unfolded and made explicate will be synordinantly adjacent to S_i.

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