Deriving a Quantum Theory of Consciousness

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Quantum mechanics and relativity are derived from first principles by reframing the theories in terms of consciousness. This is done in response to Carlo Rovelli's challenge in 'Relational Quantum Mechanics' which explains quantum mechanics as an information theory. The emergent model reveals that objective reality can be understood as content in a universal mind, caused by a transcendental agency about which we can say little or naught. The model suggests that the objective universe comes into manifestation by imposing a mathematical limitation on the source of being. The model thus illuminates the limits of thoughts and the origin of natural law. It also shows that the notion that human awareness emerges as a result of brain activity alone, simply cannot be true.

Keywords: consciousness, information theory, realization, relational quantum mechanics, will, light, mind, relativistic quantum mechanics.

I. INTRODUCTION

The interpretation of quantum mechanics (QM) and the attendant reality question continues to be a topic of discussion amongst physicists.

It is suggested that a simple, but surprising, resolution to the QM paradoxes can be found when reframing the entire discussion in terms of consciousness. What emerges is that both relativity and quantum mechanics can be seen as mathematical *limitations* imposed on an infinite sea of being precipitating both consciousness (subject) and the universe (object). The mathematical limitations imposed on the creative sphere of being can be shown to be of such a nature that they cause an unambiguous, and apparently objective, universe to emerge.

Note that due to the subject areas covered this article can neither be labeled as pure physics, pure philosophy or pure psychology since it constitutes a synthesis of all three disciplines.

A. The Principle of Reciprocity

It is suggested that the principle of reciprocity is the general principle ruling both relativity and quantum mechanics, thus unifying them at a conceptual level. By reciprocity is meant that:

> *Reality is co-precipitated by a distributed set of observationally equivalent and mutually dependent orders and instances of awareness, identical in potential yet distinct in realized capacity.*

This definition has a host of implications that I will return to later on. A simpler, yet less complete, articulation of this principle is to say that:

> *Any observation is always relative to a perceiving subject and its point of reference.*

This can be seen as a generalization of the relativistic principle, endowing it with a more subjective significance.

Reciprocity manifests physically as:

- **Observer dependent time** (relativity), and
- **Observer dependent states** (QM).

The consequence of this is that there *is* no such thing as objective reality. Reality is apparently always relative to the perceiving subject, but in such a way that different subjects shall always experience the same factual reality.

B. Rovelli's Challenge

In his 1996 paper 'Relational Quantum Mechanics' Carlo Rovelli discusses the "unease" that exists in the physics community with regard to the prevalent interpretations. He argues that:

> *'...the fact that no interpretation has so far succeeded in convincing the majority of physicists, indicates, I believe, that the problem of interpretation of quantum mechanics has not been fully disentangled, yet.'*

Rovelli concedes that he still lacks:

> *...a small number of simple statements about nature – which may seem contradictory, as the two postulates of special relativity[1] do – with clear physical content, from which the formalism of quantum mechanics can be derived.*

If such simple statements can be identified, and QM derived from them, then this should help to clarify the *meaning* behind QM. Rovelli issues the following challenge:

1. Find a set of simple assertions about the world, with clear physical meaning, that we know are experimentally true (postulates).
2. Analyze these postulates, and show that from their conjunction it follows that certain common assumptions about the world are incorrect.
3. Derive the full formalism of quantum mechanics from these postulates.

[1] Einstein's postulates were: Equivalence of initial observers and the universality of the speed of light.

Achieving this, Rovelli argues, would lead to a more genuine understanding of quantum mechanics.

Despite Rovelli's lack of first principles he succeeds at creating a remarkably lucid interpretation of QM that *does not assume the existence of an objective reality*. In point of fact, he reframes the entire theory in terms of information.

Rovelli calls his interpretation 'Relational Quantum Mechanics,' but it could just as well have been called 'Realizational Quantum Mechanics.' Rovelli has essentially reframed QM as a *theory of consciousness*, only he has not fully embraced the consequences of his discoveries.

The conclusion he succinctly makes is that quantum states *only exists relative to an observer*. Taken at face value, that is equivalent to saying that quantum states only exist relative to a *subject*. That in turn is equivalent to saying that any and all quantum states (and observations) are *content in mind*.

C. Facing the Challenge

At this point it becomes apparent that QM, properly understood, may actually be a *theory of consciousness.* Building on my own earlier work (Modeling the Universe as Content in Mind) and Rovelli's relational quantum mechanics, I will attempt to meet Rovelli's challenge and derive QM from first principles. The way to do this is to reframe QM as a theory explaining physical phenomena as properties of mind.

The fundamental postulates from which the theory is derived are the following:

Postulate #1: There exists a self-aware transcendental cosmic mind which is the cause of both subjective and objective phenomena.

Postulate #2: Cosmic mind has the ability to fragment its awareness and through identification with the fragments birth particular states of consciousness.

Postulate #3: The universal principle governing the precipitation of the universe is the principle of reciprocity.

Postulate #4: Through a self-imposed mathematical limitation, in the form of the universal speed of light, cosmic mind has birthed an unambiguous universe.

Postulate #5: Light is the external face of cosmic mind and all observable phenomena are manifestations of light.

Postulate #6: Accepting the above postulates as premises, allows quantum theory and relativity to be derived from first principles.

This should, according to the terms specified, satisfy Rovelli's challenge – if duly executed. A key point to note, though, is that the postulates are not so much facts that we know *experimentally* to be true, but facts that we know *experientially* to be true. Note also that in the ensuing discussion I use the term mind in a flexible manner, sometimes referring to a cosmic mind and at other times using mind in its usual human connotation. The type of mind referred to should be clear from the context.

D. Fallacies of Present Assumptions

In his challenge Rovelli suggests analyzing the ways in which our present assumptions about the universe are wrong, based on the postulates articulated.

As should be readily apparent, the postulates pretty much fly in the face of most commonly accepted scientific notions.

Most importantly the postulates give reality to a transcendental all pervading creative agency. This seems to suggest the factual existence of a divine power. However, the model refrains from saying anything about this power beyond the fact that it exists.

Secondly it suggests that reality is not the rigidly well-defined place we tend to assume. The reality the model portrays is a pliable sea of constantly changing spectra of possibilities that are influenced by our thoughts and beliefs, although in such a subtle way that the influence is imperceptible to all but the closest scrutiny.

II. TOWARDS A CONSCIOUSNESS THEORY

The postulates suggest a universe which is remarkably different from the prevailing notion of reality. To fully appreciate the implications of this new perspective, we first need to develop a firmer foundation for a theory of consciousness, from which in turn QM and relativity can be derived.

Note that the discussion on the nature and origin of consciousness, used to justify the subsequent derivations, is somewhat lengthy and abstract. Readers who accept the premises and are simply interested in the mathematical derivation of QM can skip to section III.

A. Experience and experiment

Taking the primacy of observation seriously, as Rovelli showed we had to, we need to accept that subjective observation is as significant as objective observation. At the end of the day, any 'objective' observation (a dot on a chart) is but a *shared subjective observation*.

An observation (a measurement) influences what is observed. But *sharing* an observation with a colleague does not. The scientific requirement for reproducibility of results, in order to accept them, has proven worth. But in unraveling the mysteries of the quantum world, we must

by virtue of necessity relax this requirement a bit. This is necessary in order to embrace certain states of consciousness that may point to deep truths, but which, due to their subjective nature, cannot be shared in the way that a dot on a piece of paper can. The subjective nature of the observation does not make it less real, though. It only makes it harder to share.

B. The Nature of Consciousness

My first postulate concerns the nature of consciousness itself.

Postulate #1: There exists a self-aware transcendental cosmic mind which is the cause of both subjective and objective phenomena.

While self-consciousness is an all pervasive experience common to everyone, the experience of a *transcendental realm of being* is far less common. However, down through history mystics have universally and consistently reported the existence of such a realm and I believe it is justified to consider it a reasonable postulate. The results emerging from analyzing it will further justify it.

This transcendental cause is neither subject, nor object, but is considered to be the cause of both. I shall name this entity the "synject" – emphasizing its synthetic quality.

The need to make such a postulate points to the reason why an intuitive understanding of quantum mechanics has been so elusive. Due to the absence of a causative transcendental synject, some have believed that:

- **The subject causes the object** (observer created reality), and others that
- **The object cause the subject** (brain creates consciousness).

Both views lead unavoidably to a circular logic which is fragile and ambiguous.

C. Consciousness – More Than Information

A crucial point in relation to expanding upon Rovelli's relational quantum mechanics is that consciousness is more than information.

Information, as defined by information theory [Shannon, 49] and employed by Rovelli, is something that can ultimately be reduced to a series of bits (ones and zeroes). It is therefore something that has *a definite physical meaning.* Consciousness is more than that. The difference between information and consciousness is like the difference between syntax and meaning. This difference can be illustrated by considering a short poem (by Rumi):

If you are in love, you need no proofs.
If you are not in love, what good are all your proofs?

The information content in this poem is easily calculated, as the minimum number of bits that can represent the words. Yet to a human being the meaning goes far beyond the information conveyed. Depending on personal experiences many layers of meaning can potentially be discerned from these lines. However, the layers of meaning are *intrinsically inaccessible* to observation, as they are purely subjective states. The ability to decode these layers of meaning is an attribute of human consciousness.

A computer (a Turing machine) may *simulate* intelligence, but it will never *understand*. The reason for this is that any computer, no matter how sophisticated, can ultimately be reduced to a series of bits. This is not the case of sentient experience and for this reason true artificial intelligence (strong AI) is an impossibility in my view. Regardless of how intelligent a system may *appear* to be, it is but a simulation and it will forever remain trapped in the world of information, being a creature of bits.

The difference between information and meaning is related to Gödel's famous incompleteness theorem, which generally speaking proves that:

> *Any useful formal system will contain certain propositions that can neither be proven nor disproven based on the system's postulates.*

Gödel's theorem hints at a quality inherent in consciousness that goes beyond anything that can be reduced to information (i.e. formalized). This distinction allows us to define consciousness more precisely as the synthesis between:

- **Information** (which can be given a precise physical meaning) and
- **Awareness** about the information which is intrinsically inaccessible to any kind of direct external observation.

D. The Nature of States

It is a well-known fact that when a continuous phenomenon, such as an electromagnetic wave for instance, is subjected to a limitation, such as a cavity, this will induce a quantization of energy and the emergence of distinct states. In this case characterized by a discrete set of wavelengths λ_n, $n=\{1, 2, \dots , N\}$. Through the limitation of the cavity a continuous wave phenomenon has evolved into a set of discrete states.

The synject is per definition limitless and stateless. But when it is confined to a limited body (an atom, a cell, or a human body) I propose that the very embodiment will cause a distinct state of awareness to arise. This brings me to the second postulate which is:

Postulate #2: Cosmic mind has the ability to fragment its awareness and through identification with the fragments birth particular states of consciousness.

The reasonability of this postulate is supported by psychology. We know that the human mind has the ability to create numerous identities. We belong to a nation, a workplace, a family, a social circle, a sports club etc. In each context we have particular roles and responsibilities. All these are ultimately voluntary identifications. They are mental constructs. A human being's basic identity is obviously not experienced as 'just another mental construct.' But that may just be a matter of perspective. To the synject, which is the cause of the identification, it may indeed simply be a mental construct. To the entity that emerges, as a result of the identification, it is all there is. Furthermore, pathologies such as schizophrenia shows that the ability to identify with mental constructs is extremely powerful. The ability of the human mind to create these kinds of identifications makes the above postulate plausible.

E. The Principle of Reciprocity

The consciousness we know as human beings, is characterized by self-aware individuality, distinctness and a well-defined bodily presence in a definite spacetime. If we consider this quality of consciousness, the question arises:

> *What are the necessary requirements for the proposed stateless synject to evolve into objectively embodied self-awareness?*

This brings us to a key postulate which can be justified by the fact that the universe is ruled by relational quantum dynamics, as shown by Rovelli. The postulate is:

Postulate #3: The universal principle governing the precipitation of the universe is the principle of reciprocity.

I would argue that for the stateless synject to evolve into that which we know as 'human consciousness,' a series of fragmentation steps are required that roughly correspond to the model shown in Figure 1. It has been developed based on personal experience and inspiration from consciousness research [Bailey, 62; Bertelsen, 99].

A defining characteristic of the model is, that since every subject mirrors the causative synject, reciprocity is built into the very fabric of the model. The principle of reciprocity may therefore not only pertain to the attributes of the model, but is perhaps even linked to the underlying purpose of evolution itself.

F. The fragmentation of consciousness

The starting point is the stateless synject, poetically referred to as "That about which naught may be said." From this point of non-dual cosmic awareness, layered states of consciousness arise through progressive stages of fragmentation.

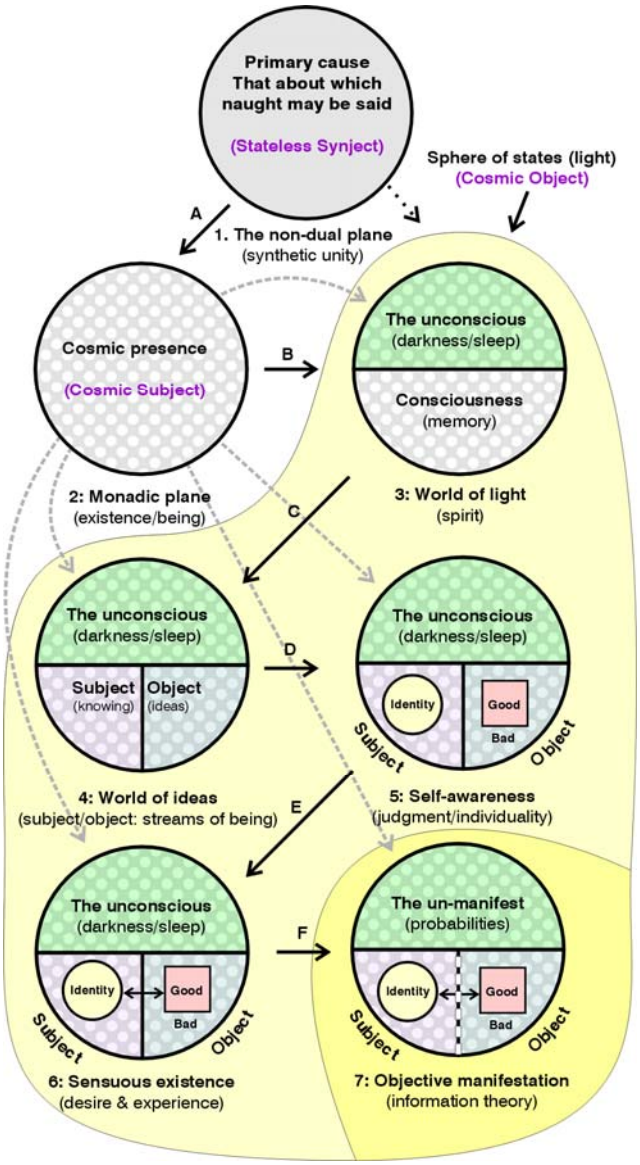

Figure 1: Progressive fragmentation of consciousness leading to the experience of objectivity.

It must be understood, that he proposed model is speculative. The existence of the transcendental synject is taken as a premise and the reality we observe as an experiential fact. What I am trying to do, is to identify some intermediary levels of consciousness that logically ought to exist. It is but a rough outline of a territory that is extremely inaccessible to observation, however. Subjective states of mind are inherently fickle and hard to define. Transpersonal states of mind are correspondingly more so. We are in a sense trying to fathom the unfathomable and describe the indescribable. This produces certain

unavoidable pitfalls. That being said, I believe the model is accurate in the broad outline, although not necessarily in the details.

Very briefly it is proposed that the fragmentation proceeds as follows: Stateless being → Cosmic consciousness → Memory → Knowing → Self-awareness → Sensuous experience → Objective manifestation. These steps are expanded upon in the following.

A. The first fragmentation process required is dividing the stateless synject into (1) a pure field of cosmic awareness and (2) a field of creative imagery – the world of ideas. It is a division of the transcendental synject into cosmic subject and cosmic object – states of light. Referring to the earlier discussion of the difference between information and consciousness, we can see spheres 3-7 as different kinds of light, or states, giving rise to different kinds of awareness through interaction with the cosmic presence (sphere 2). The awareness of states is symbolized by the bubbles in Figure 1. Thus from the non-dual synject emerges cosmic presence (sphere 2) and fivefold creative mind, or states of light (sphere 3-7).

B. The second fragmentation process required is the creation of an awareness that has a history – i.e. memory. This symbolically gives rise to light (awareness of states) and darkness (forgetfulness and sleep). In this sphere some aspects of creation are recalled and others are forgotten.

Drawing upon experiences from psychology I will tentatively equate the darkness in the third sphere with the 'collective unconscious' and memory as 'a world of light.' I believe that the entire objective universe, including all its subjective and objective states, can be equated with a realm of fivefold mind emerging from the Big Bang and gradually crystallizing into manifestation. The Big Bang is here seen as a *physical reflection* of a subjective cosmic event. From this perspective the objective universe, that is visible to our measuring devices, is but a small fraction of the total universe. In the model (Figure 1) the physical universe corresponds to sphere seven alone. The other six spheres are subjective (relative to the physical universe), appearing in QM as the unpredictable influences upon the atom.

C. The third fragmentation process required is a division into: (1) multiple subjects and (2) objects of contemplation – ideas. Knowledge and the synthetic observer is born here. There is now a subject which has knowledge of an object. Something is known and someone is doing the knowing. But there is no individuality at this stage, only an amorphous presence. There are subjects but they are not yet separated from the whole, nor are they initially self-aware. This fourth sphere is the midpoint of the evolution of consciousness from formless non-duality to embodied multiplicity. I propose that awakening to full self-realization at this level, knowing oneself as radiant self-aware presence – distinct yet at the same time non-separate – is the evolutionary goal of sentient humanity.

D. The fourth fragmentation process required is the formation of an individualized self-aware subject identity through a process of judgment and reflection. The subject differentiates itself from other subjects through the content of mind it identifies with.

E. The fifth fragmentation process required is existential immersion into the content of mind that leads to sensuous experience and existential evolution. The experience of 'being in a world,' arises here. This gives rise to dreams and terrors, fears and desires.

F. The sixth and final step required is the synchronization of subjective realities to produce an unambiguous domain of experience characterized by reciprocity. This happens by limiting the perception of mind to certain states, through the imposition of the universal speed of light.

G. Contemplating the Model

Although the steps are described as progressive stages, I actually believe them be a unified simultaneous process more than a serial unfoldment. As cosmic presence experiences the different spheres of light, different states of consciousness emerge. Now, are these six steps all required? Let's ask ourselves the following: Can we have:

- Consciousness without being?
- Memory without consciousness?
- Knowing without memory?
- Self-awareness without knowing?
- Existential evolution without self-awareness?
- Objective self-mastery without evolution?

I believe the answer is no to all of them. The above list also raises the question: Is it sufficient or are further fragmentation processes needed? Overall I believe the model is fairly complete and that the aspects of sentiency listed above are the defining characteristics of life.

The model implies the existence of seven realms of consciousness which are markedly different. If the model is correct, it suggests that human consciousness is characterized by the:

1. Wish for *existence* and by implication an accompanying fear of destruction.
2. Wish to *wake up* and an accompanying tendency to forget and fall asleep.

3. Wish to *know* and an accompanying tendency to imbue events with meaning (even when absent).
4. Wish for *self-awareness* and an accompanying tendency towards separativeness.
5. Wish to *master* and an accompanying tendency to control.
6. Wish to *live* and an accompanying fear of death.

This brief overview indicates that certain well-known tendencies in the human psyche may in fact be attributable to the very architecture of the universe.

H. The Synject's Motive

An interesting, but difficult, question concerns the synject's motive. Why does it fragment itself thus? This is obviously a highly speculative issue. I believe the short answer is: Because it can!

If I were to speculate beyond that, I would point out that Rovelli refers to a general theorem by Breuer[2] according to which "no system (quantum nor classical) can perform a complete self-measurement." Translated into consciousness terms, this means that *no one can truly know themselves, except through the eyes of others*.

Based on this perspective, it makes sense that the stateless synject has created a world of interrelated subjects, all of whom mirror that which created them. This is much akin to the way an author writes a narrative in order to explore aspects of the author's inner life through the different characters in the story.

I. The Nature of Objectivity

To sum up the previous discussion: The synject, having no states, desires, for some unspecified reason, to become manifest. In order to do so, it has created a domain of experience characterized by reciprocal objectivity.

But what exactly do we mean by objectivity?

I believe that Rovelli's concept of relational quantum mechanics offers us a clear definition of the kind of objectivity we experience in this universe:

> *Objectivity means that any two subjects, observing a given object, will perceive the object's states as identical in terms of its observable properties and its positioning within the space-time continuum.*

This does not mean, however, as Rovelli is careful to point out, that the object *possesses* these attributes in an absolute sense. An observer can only obtain information about an object (or another observer's knowledge about the object) through interacting with the object (or the observer, respectively). By interacting with it, the system is disturbed and influenced by the observer's question.

Rovelli shows how the apparent paradoxes of QM, becomes less paradoxical when liberated from the assumption of an absolute state. Consider the following example given by Rovelli[3]:

An observer O observes the system S. We consider an actual experiment in which the initial state of S is $|\psi\rangle = \alpha|1\rangle + \beta|2\rangle$ where α and β are complex numbers and $|\alpha|^2 + |\beta|^2 = 1$. When performing a measurement on S, O will measure '1' or '2' with the probabilities $|\alpha|^2$ and $|\beta|^2$ respectively. O furthermore has a 'pointer' that can point to the two states. This corresponds to two states in O defined as $|O1\rangle$ and $|O2\rangle$ respectively.

Now, another observer P observes the combined O–S system. If O performs a measurement on S then the two systems (O and S) will be correlated because the O pointer points to the correct value of S. If P immediately thereafter measures the pointing hand of O, P will be able to obtain information about S in this way.

If the observer P knows that a measurement has been performed by O, then P knows that O's pointer points to the correct state and information about S can be obtained by measuring O.

Based on this information P knows that O is in a superposition of two states. In the first $(|1\rangle \otimes |O1\rangle)$ S is in the $|1\rangle$ state and the pointer of O correctly points to '1'. In the second $(|2\rangle \otimes |O2\rangle)$ S is in the $|2\rangle$ state and the pointer of O correctly points to '2'. In order to avoid ambiguousness there must therefore exist an operator M given by:

$$M(|1\rangle \otimes |O1\rangle) = |1\rangle \otimes |O1\rangle$$
$$M(|1\rangle \otimes |O2\rangle) = 0$$
$$M(|2\rangle \otimes |O2\rangle) = |2\rangle \otimes |O2\rangle$$
$$M(|2\rangle \otimes |O1\rangle) = 0$$

This means for instance that the outcome that O points to '1' while S is in the $|2\rangle$ state will never occur. This indeed is the basis of our experience of reality as objective (unambiguous). Rovelli demonstrates that such ambiguities can never arise and this is the basis of his 'relational interpretation,' since this way of approaching quantum dynamics shows how different observers can have different perception of reality – yet whenever it comes to an *actual observation* their factual measurements will always match.

A key point is that when O has made a measurement, it knows what the state of S is. At the same time, while P may know that O made the measurement, P does *not* know

[2] Breuer, 1994, "The impossibility of accurate self-measurement", Philosophy of Science. To appear. Reference from [Rovelli].

[3] These issues are subtle and I refer to [Rovelli] for details.

the result. As a result of this *O* is, relative to *P,* in a superposition of the states $(|1\rangle \otimes |O1\rangle)$ and $(|2\rangle \otimes |O2\rangle)$. *P* has *no way of knowing* which state *O* is actually in without making a measurement and hence disturbing *O*. This pertains to the crucial difference between knowing 'if' and knowing 'what', as pointed out by Rovelli. This difference can likened to the difference between knowing *if* another person knows something about someone, and knowing *what* the other person knows.

A measurement, in Rovelli's interpretation, is thus equivalent to *a correlation of states*. By inference this can be equated with 'being aware of' in an information theoretical sense. It is an interesting consequence of Rovelli's perspective that we cannot differentiate between:

- An observer *O*, who is aware of system *S*, in the sense 'consciously knowledgeable of' and
- An observer *O*, who is merely correlated with the system S, without any awareness of the fact.

Regardless of the cause of the correlation, the *fact* of the correlation allows us to learn about S, by examining *O,* in this case.

J. The Brain

If as a human being, my brain cells are in such a state that I have knowledge of another human being's attributes, then this is considered knowledge. But insofar as information theory is concerned it is simply a *correlation of states*.

I believe that a meaningful model of human consciousness is to say that the information content (bits) representing the factual knowledge in the mind, is encoded in the brain as quantum states. In principle (although clearly not in practice) we should be able to obtain the information in the brain by examining these states.

But a human's *awareness* goes beyond this, as the earlier discussion indicated. Since *any quantum system can be fully described by a sequence of bits* (as Rovelli showed) then this means that the physical brain is *comparable to a computer* in this regard. According to this model the brain can only store *information*. It cannot store meaning. Yet the human mind is clearly able to process and recall meaning, indicating that it must be more than an information processing device. *Therefore the idea that human awareness emerges as a result of brain activity alone simply cannot be true.*

I therefore believe we need to distinguish very sharply between two domains of consciousness:

- One is the aspect that can be described by Shannon's information theory and which is subject to the laws of mathematics.
- The other is an aspect that is perhaps best described as intuition or pure knowing.

What we perceive as 'consciousness' is a mix of these two very different orders of consciousness that blend seamlessly together in our unified mind-brain experience.

K. The Atom

When a human wills his body to move, then at some point between the mind and the muscles moving, some atoms (and cells) must have responded to the will. If the atom did not possess this ability then no atoms (and hence the human body) could not respond to human will. That is inescapable.

Since we are forced to make a distinction between information and meaning, in the realm of the human mind, it seems natural to wonder whether this distinction should also be made in the realm of atoms.

The appropriateness of such distinction in the subatomic realm would imply that the atoms could not be fully described using information theory. And that is indeed the case. Besides what can be explained by information theory there remains a residual unpredictability in the subatomic realm. By inference it would seem logical to assume that atoms have a faculty that corresponds to human intuition – a faculty of pure knowing that influences their behavior in ways that are *per definition indescribable in terms of mathematics* because they belong to the realm of consciousness. Put plainly – the atom must logically possess some measure of consciousness, and this is what appears to the scientist as the unpredictability of the atom.

L. The willing subject

In the context of offering a consciousness theory to account for QM, I would like to offer a novel interpretation of the wave function Ψ as well. In the famous discussions between Bohr and Einstein, on the meaning of QM, one of Einstein's key objections was that Ψ did not represent the entity itself, but only the *possibility of its appearance*. This is, in my mind, a very valid objection.

From the present perspective a very simple interpretation offers itself, which fully addresses this issue. From this perspective Ψ is simply considered *a representation of the range of choices of interaction available to the quantum system represented by Ψ.* The collapse of the wave function can be seen as an act of will, either caused by an inner volition or precipitated from outside by an observer demanding an answer and hence forcing the subject Ψ to make a decision and enter an eigenstate.

All physical attributes of macroscopic objects such as humans have their basis in atomic properties – all except

consciousness. Consciousness is the *only* attribute that has *no correspondence what-so-ever* in the subatomic realm. If, however, we accept a broader definition of consciousness, and accept that in addition to observable states, particles may also have a subjective aspect, a rudimentary kind of awareness of its environment, then the whole theoretical fabric becomes much simpler.

If we furthermore consider the spectrum of natural phenomena, in order of increasing complexity, from atoms, over molecules, crystals, bacteria, plants, insects, reptiles, mammals, humans and whole ecosystems, where can one justly say that intelligence is first apparent? It seems to me that there is no such place. There is no point at which intelligence can clearly be said to begin. It is a spectrum of being.

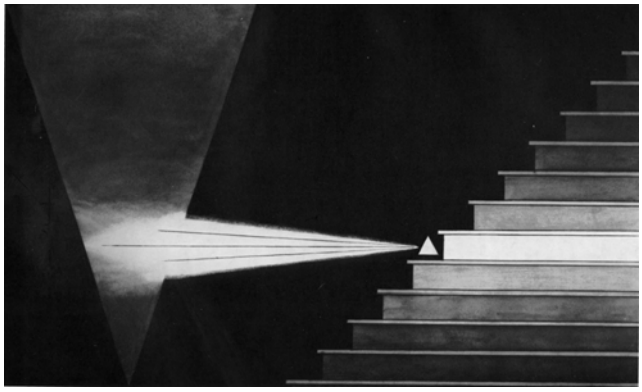

Figure 2: Symbol by the Danish mystic Martinus. It symbolizes the spectrum of consciousness available to a particular entity.

If we accept that all life has a measure of consciousness it becomes obvious that any being only possesses a certain spectrum of awareness (as illustrated in Figure 2). Thus human awareness, cellular awareness and atomic awareness must be considered as completely different *kinds* of awareness. In each of these realms choices are made. The sum total of the intelligence unfolding at all levels of existence is what engenders life.

If observer *O* observes the system *S*, then the observation forces the system *S* to decide which state it is in. In this way the interaction influences *S* by making it collapse to an eigenstate. It is analogous to a person coming to a fork in the road – a decision must be made. *But a subjective entity cannot make choices concerning possibilities it is not aware of.*

If we accept that cells and atoms embody some level of intelligence, then it should be clear that the human mind would short-circuit if it had to *consciously* address the trillions of decisions required every microsecond in order to keep the body running. Fortunately this task is delegated to the lesser lives – the cells and atoms. Thus in this perspective, the 'collapse of the wave function' happens at all levels of existence all the time. Every time some entity makes a choice a collapse takes place. This offers a very intuitive understanding of the working of intelligent systems at all scales of evolution.

M. Understanding Reciprocity

As the model reveals, the principle of reciprocity implies the following:

- In an absolute sense, there exists but a single observer – the cosmic subject (CS).
- The CS invests sparks of itself in bodies of manifestation thus precipitating the emergence of multiple observers of lesser scope.
- Each body of manifestation belongs to an order of consciousness (human, cell, atom etc.).
- Each order of consciousness manifests through a collection of specialized instances of lower order beings – i.e. a human body consist of groups of specialized cells, each cell consists of groups of specialized atoms and so on.

In this model three essential kinds of relationships emerge:

- Relations to 'superior lives' – beings on which *we are dependent* – i.e. the human being lives inside the planetary sphere.
- Relations to 'independent lives' – beings who exists *independently* of us – other organisms and objects within the universe.
- Relations to 'dependent lives' – beings who are *dependent on us* – i.e. the cells which make up our body of manifestation.

If considering Rovelli's example with observer *O*, observing *S,* and *P* observing the combined *O–S* system, then this example pertains to categories of *independent* lives and the rules of observation they are governed by.

If *S* was *dependent* on *O* (i.e. *S* is a cell in the body of *O*) then the dynamics change a bit. Now the $|1\rangle$ state can be considered an *intent* governing *S* rather than a record of an observation of *S*. The $(|1\rangle \otimes |O1\rangle)$ and $(|2\rangle \otimes |O2\rangle)$ states become manifested states of the *O1* and *O2* intents.

Let us, in this light, contemplate the principle of reciprocity, articulated at the beginning:

> *Reality is co-precipitated by a distributed set of observationally equivalent and mutually dependent orders and instances of awareness, identical in potential yet distinct in realized capacity.*

The principle can be split into the following elements:

1. A distributed set of observationally equivalent subjects.

This is the part of the principle that manifests as observer dependent time and states. It means that the

ability to observe, and the attendant powers, are distributed amongst a collection of subjects.

2. Mutually dependent orders of awareness and mutually dependent instances of awareness.

What this means, is that reality is co-precipitated by sets of subjects that are mutually dependent in terms of the manifested reality, yet independent in terms of their ability to choose. The mutual dependency concerns:

- **A vertical interdependence**, between different orders of being (cell and human for instance).
- **A horizontal interdependence** amongst entities of similar kind (humans for instance).

It is easy to understand the nature of the vertical interdependence when considering the cells of the human body. Once the human dies, the cells die as well and the flesh decomposes, because the cells are dependent on their host organism.

The horizontal interdependence reveals itself in the self-organizing capability that can be observed in cells and in human communities. By specializing and cooperating the collective can achieve far more than otherwise possible.

3. Identical in potential yet distinct in realized capacity.

What this means is that all orders of consciousness are mirrors of the CS and hence in principle equivalent. In practice the degree of mastery over reality varies, however. Thus the atom, cell and human are made of the same essential substance, but represent different stages of subjective evolution.

This concludes the discussion on the subjective aspect of the model. As should be readily apparent, it has many implications in relation to the subjective dynamics of the universe and hence the subjective sciences.

III. DERIVING QUANTUM MECHANICS

Now, that we have covered the basics of a new understanding of consciousness, we arrive at the next postulate:

Postulate #4: Through a self-imposed mathematical limitation, in the form of the universal speed of light, cosmic mind has birthed an unambiguous universe.

The starting point in deriving QM and relativity from first principles is thus the premise that the laws of physics emerge from limiting the information any given subject can obtain about the subjects co-inhabiting the universe. Specifically it is done by imposing two essential limiting conditions on consciousness.

The conditions are:

- Limiting what we can know about events happening in other points of space-time through the imposition of the constant speed of light.
- Limiting what we can know about the states of other objects in such a way that no contradictions in perception can arise.[4]

The first condition gives rise to spacetime. As I will show this alone, combined with the next postulate, allows us to derive the relativistic Klein-Gordon equation governing the time evolution of quantum systems. The postulate is:

Postulate #5: Light is the external face of cosmic mind and all observable phenomena are manifestations of light.

This postulate follows from the first postulate. If everything in the universe is truly emanations of mind, then light too must be an aspect of mind. Being an aspect of mind, it must obey mind. That light is an aspect of mind may also be intuited from the role 'seeing' plays subjectively and objectively. *Seeing is creating* as QM reveals. Seeing is not a passive act of observation but a participatory act of creation. This insight hints at the intimate relation between light and mind.

A. The Amazing Mind

That the mind is able to produce very convincing illusions is a known fact. Your nightly dreams alone should convince you of this. From the realization that a human mind can produce spectacular dreams, it is not a great leap to imagine that a cosmic mind can create a spectacular universe.

But can we find clues to the origin of the physical universe in the way the mind operates? If the first postulate is correct this would be expected.

Try to imagine a spoon. Does it have space around it? Of course it does. Otherwise you would be unable to contemplate it. At the level of consciousness, creative imagery and space are apparently irrevocably intertwined. Space without content, is meaningless and objects without space around them are literally inconceivable. It seems therefore that space and the ability to "see" something – even in the mind's eye – are intimately related.

[4] As far as I can see, the second condition actually follows from the first condition combined with the quantization of action. Certainly both follow from the principle of reciprocity. This issue deserves further elucidation.

B. The basic Limitation

Let's try to clothe these insights in the language of mathematics. The limitation of the universal speed of light, imposed on mind, dictates that the relationship between space and time as perceived in the seventh sphere (the objective universe) is governed by:

$$x = ct \Leftrightarrow \frac{dx}{dt} = c \tag{3.1}$$

Above is given the 1-D relationship. This can also be expressed as the invariant relativistic distance in 4-D spacetime:

$$S^2 = x^2 + y^2 + z^2 - c^2t^2 \tag{3.2}$$

Where *x, y, z* represent the three spatial coordinates and *t* the time. The condition for light being:

$$S^2 = 0 \Leftrightarrow x^2 + y^2 + z^2 = c^2t^2 \tag{3.3}$$

It is well-known that light can move in a linear pattern creating space. But what if light were also able to curve? How would that appear to us? It would appear as localized particles of energy.

What I am suggesting is that we accept that everything in the universe is emanations of mind. For this reason everything is made from light. From this follows the idea that light can move in:

- **A linear pattern**, creating space, and
- **A curved pattern** creating matter.

An analysis of this idea will reveal that the requirement that everything in the universe is mind, moving at the speed of light, results in a mathematical limitation on the curved light which produces the Klein-Gordon relativistic wave equation. On top of that it also produces the relativistic mass relations and an intriguing explanation of the origin of gravity – all derived from the postulates.

C. Linear space

To begin with, the equation governing light (Eq. 3.4) can be shown to be a direct *mathematical* consequence of definition 3.1. If we define a function ψ to represent an object on the 1-D spacetime domain (x, t) subject to the relation Eq. 3.1 then it follows from the chain-rule of differentiation that

$$\frac{\partial\psi}{\partial t} = \frac{\partial\psi}{\partial x}\frac{\partial x}{\partial t} = c\frac{\partial\psi}{\partial x} = c\psi'$$

$$\frac{\partial^2\psi}{\partial t^2} = \frac{\partial\psi'}{\partial t} = \frac{\partial\psi'}{\partial x}\frac{\partial x}{\partial t} = c\frac{\partial\psi'}{\partial x} = c^2\frac{\partial^2\psi}{\partial x^2}$$

yielding the basic 1-D wave equation (easily extended to 3-D):

$$\frac{\partial^2\psi}{\partial t^2} = c^2\frac{\partial^2\psi}{\partial x^2} \tag{3.4}$$

This equation, which is a *direct* consequence of 3.1, shows us that the object has a wave nature.

D. The Dynamics of Curved Light

If we contemplate the dynamics of a curved photon then, due to self-interference effects, it must be presumed that the radius of such a movement must be subject to a condition that

$$R = n\frac{\lambda}{2\pi} \tag{3.5}$$

with *n* being a whole number greater than zero. The smallest possible radius is given by *n*=1 yielding R=λ/2π. This requirement establishes and explains the condition for the quantization of action. As we shall see, the wavelength, in the case of the electron, λ=2πR turns out to be the Compton wavelength λ_c.

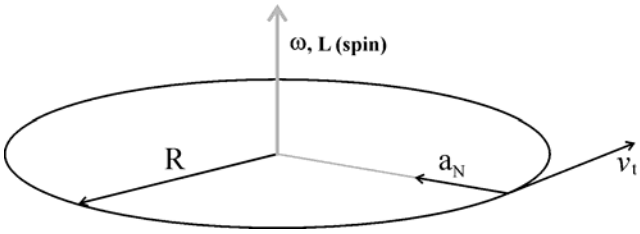

Figure 3: Illustration of how a photon can be thought of as performing a localized oscillation or rotation in order to appear in spacetime as an object.

The localized oscillatory pattern can, in the case where we observe it from an inertial frame at rest in relation to it, be described by the equation:

$$-R\frac{d^2r}{dt^2} = Ra_N = c^2 \tag{3.6}$$

which describes a photon with a constant acceleration a_N towards the center of rotation (shown in Figure 3). It must be made clear that the photon is not *governed* by Eq. 3.6, but it can be *described* by it. The photon is governed by the will of cosmic mind. This equation furthermore suggests that light has a constant curvature when manifesting as matter.

As Einstein proved in the general theory of relativity one cannot differentiate between acceleration and a gravitational field. The curved motion of the photon therefore generates a gravitational field which explains the

origin of gravitational mass. As a curious thing, we note that space is not curved by gravity, but gravity is caused by the photon's curvature.

Using the expression for the normal acceleration $a_N=\omega^2 r$ we can write Eq. 3.6 as:

$$Ra_N = (R\omega)^2 = c^2$$

The instantaneous speed of a point at the periphery (the tangential velocity) is of course $v_t=R\omega=c$, for an observer at rest in relation to the center of the oscillation

In the general case, the orientation of spin L (shown in Figure 3) and the direction of the spatial velocity (v_x) do not coincide. In a more realistic model, it will therefore be more appropriate to consider v_x as expressing a time averaged velocity, resulting from the net translation in space due to at large number of oscillations.

If, however, for the sake of simplicity, we assume that they *do* coincide we can model the combined movement of the localized oscillation and the movement through space as

$$v_t^2 + v_x^2 = c^2 \qquad (3.7)$$

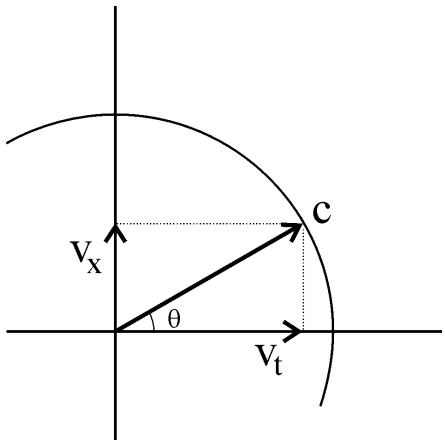

Figure 4: The tangential (rotational) and spatial components of the photonic velocities.

At non-relativistic velocities we have $v_x << v_t$. In the case where both v_t and v_x are non-zero their relationship can be depicted as in Figure 4.

E. The Zitterbewegung Phenomenon

This highly oscillatory motion corresponds exactly to a phenomenon called zitterbewegung. The zitterbewegung phenomenon was predicted in 1930 by Schrödinger who pointed out that the Dirac theory implies that, superimposed on the observable linear motion of an electron, there is a circular motion about the direction of its spin with a radius equal to half the Compton wavelength

$$R = \lambda\!\!\!^{-}_0 = \frac{\lambda\!\!\!^{-}_c}{2} = \frac{\hbar}{2mc} = 1.9\cdot 10^{-13} m$$

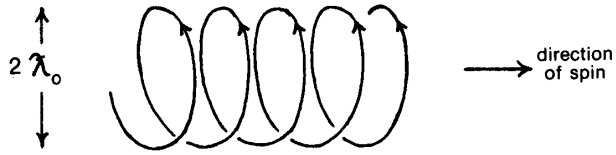

Figure 5: A spiraling helical movement of the free-electron. The phenomenon is called zitterbewegung.

This means that while the average speed of an electron is less than c (the speed of light), its instantaneous speed is always $\pm c$. For an electron moving at the speed of light about a mean position this entails an angular momentum

$$\lambda\!\!\!^{-}_0(mc) = \hbar/2 \qquad (3.8)$$

Calculating the radius of a photon due to the c^2 curvature of space yields

$$E = \hbar\omega = mc^2 \Leftrightarrow \omega = \frac{mc^2}{\hbar} \qquad (3.9)$$

$$(R\omega)^2 = c^2 \Leftrightarrow R = c/\omega = \frac{\hbar}{mc} = \lambda\!\!\!^{-}_c \qquad (3.10)$$

λ_c being the Compton wavelength. We thus see that the model yields the correct value of the spatial extent of the wave nature of the electron except for a factor ½. The reduced radius is thought to be related to relativistic effects, causing the circumference of the rotation to contract to zero length, because the instantaneous peripheral velocity is always equal to c.

If we contemplate a rotating disk (Figure 6) then, as the velocity of the periphery approaches c, it will contract according to the Lorentz contraction:

$$L' = L\sqrt{1 - v_x^2/c^2}$$

The radius will not contract, however. This means that the disk will curl up and become a sphere with the center as one pole and the circumference as the other when the velocity reaches c because the circumference will have zero length at this point. The effective radius of the sphere will be half the radius of the disk explaining the missing factor two in the calculated Compton wavelength.

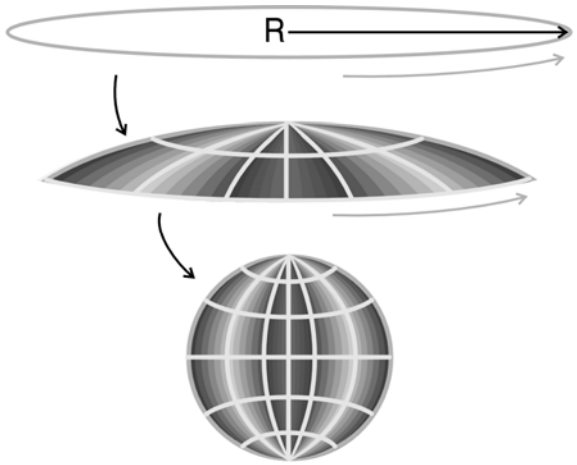

Figure 6: Illustration of a rotating disk curving due to relativistic effects. R does not contract, but the circumference does.

F. Momentum Relations

If we model the electron as a curved photon we find that the photon has momentum $p=cm$ at all times, m being the mass corresponding to the photonic energy according to $m = h\upsilon / c^2$ (and subsequently the electrons mass). Acting on this rotating photon with a force F along the line of the current velocity (seen from the reference frame, for instance the laboratory), so as to increase its translational velocity, we get:

$$F = \frac{dp}{dt} = \frac{d(mc)}{dt} = c\frac{dm}{dt} \tag{3.11}$$

This shows that a change in the absolute amplitude of momentum requires a change of mass. Defining

$$p = mc \Leftrightarrow p^2 = (mc)^2 = m^2(v_t^2 + v_x^2) = p_t^2 + p_x^2 \tag{3.12}$$

allows us to identify $p_x = mv_x$, $p_t = mv_t$ with p_x being the spatial momentum and p_t the tangential momentum. Now in the case of the free particle observed from a non-accelerated inertial frame the particle will only be subject to the acceleration that comes from the helical movement, and the rotational properties (i.e. the angular momentum) will therefore not change regardless of the relative translational velocity (v_x). For this reason the intrinsic angular momentum cannot change. This implies that

$$p_t = mv_t = m_0 c = p_0 \tag{3.13}$$

with m_0 being the mass of the electron at rest. Based on this Figure 4 allows us, from geometric considerations, to define

$$p_x = \sin(\theta)p$$
$$p_t = \cos(\theta)p$$

with θ being the angle shown in (Figure 4). Expressing p_x in terms of p_t yields

$$p_x = \frac{\sin(\theta)}{\cos(\theta)} p_t = \tan(\theta)p_t \tag{3.14}$$

And

$$\tan(\theta) = \frac{v_x}{v_t} = \frac{v_x}{\sqrt{c^2 - v_x^2}} = \frac{v_x}{c\sqrt{1 - v_x^2/c^2}} \tag{3.15}$$

Resulting in

$$p_x = \frac{v_x}{c\sqrt{1 - v_x^2/c^2}} m_0 c = \frac{v_x m_0}{\sqrt{1 - v_x^2/c^2}} = v_x m \tag{3.16}$$

with m being the "emergent mass", corresponding to the usual relativistic mass

$$m = \frac{m_0}{\sqrt{1 - v_x^2/c^2}} \tag{3.17}$$

Note that the relation between the rest mass and the emergent mass can be understood as a geometric relationship between curved light and straight light, or between matter and space. As the translational velocity (v_x) grows towards c, the spiral (Figure 5) is stretched out and in the limit curved light tends towards straight light.

Straight light (space) exists in a timeless realm of simultaneity in relation to curved light (matter) since straight light moves at the speed of light in relation to any material observer. The barrier separating the two kinds of light is therefore the barrier between the realm of awareness *in* time and awareness *of* time. It is the barrier between *contemplating* the world of ideas and *experiencing* the world of ideas. It is therefore the limit of thought itself in a very real sense.

If expression 3.17 is squared and both sides multiplied by $c^4(1 - v_x^2/c^2)$ one obtains the well-known energy-momentum relationship of Einstein

$$E^2 = (p_x c)^2 + E_0^2 \tag{3.18}$$

Recalling that $p_x = \hbar k_x$ this can also be written as

$$(\hbar\omega)^2 = (\hbar k_x c)^2 + (m_0 c^2)^2 \Leftrightarrow$$
$$\omega^2 = k_x^2 c^2 + \frac{m_0^2 c^4}{\hbar^2} \tag{3.19}$$

which is the dispersion relationship for the Klein-Gordon relativistic wave equation.

$$\frac{\partial^2\psi}{\partial t^2} = c^2\frac{\partial^2\psi}{\partial x^2} - \frac{m_0^2c^4}{\hbar^2}\psi \qquad (3.20)$$

The key point here is that the dispersion relation (Eq. 3.19) and the Klein-Gordon equation *emerge* as a direct result of modeling the electron as curved light. Eq. 3.20 is therefore a natural consequence of the postulate of the constant speed of light and the conceptual framework. This allows us to interpret quantum mechanics as a manifestation of intelligence subject to the constant speed of light (Eq. 3.1).

The relativistic Dirac wave equation and the non-relativistic Schrödinger wave equation can both be derived as approximations to the Klein-Gordon equation. The Schrödinger equation emerges via a Taylor expansion of Eq. 3.20 for small *k*, equivalent to non-relativistic velocities. The Dirac equation emerges by requiring the right hand side of Eq. 3.20 to be a perfect square, whereby one arrives at a first order differential equation by taking the square root of each side. It turns out that this is possible if ψ is a 4 element matrix, yielding the Dirac matrix solutions.

If we accept that the Klein-Gordon equation can be seen as a natural consequence of the curved photon model, then this model, explains the essential nature of quantum mechanics.

This concludes the derivation from first principles, since the entire formalism of QM can be derived from the essential physical relations revealed in the equations above. Combining this with the second limiting condition, reflecting the measurement problem, the defining characteristics of relativistic quantum mechanics has been derived from first principles. This validates the last postulate:

Postulate #6: Accepting the above postulates as premises, allow quantum theory and relativity to be derived from first principles.

IV. DISCUSSION

The proposed model has far reaching implications for science, philosophy and psychology but can it be proven? This question essentially boils down to: How can a scientist differentiate between intelligent atoms that behave unpredictably and unintelligent atoms that behave randomly?

I would propose looking for proof of the model in weak effects of intelligence in complex systems. If there truly is an intrinsic intelligence in nature, then it should reveal itself in the evolutionary dynamics of natural systems. Based on stochastic models, one could conceivably predict the speed at which a given system would be expected to evolve if the orthodox premise of quantum randomicity is true. The speed of evolution would be the speed at which intelligent solutions, that provide some evolutionary advantage, are identified. If it can be shown that natural systems evolve at a pace that cannot be fully explained by stochastic models then this is proof that nature possesses an intrinsic intelligence, as the current model suggests.

But as the adage goes, "absence of proof, is not proof of absence." Even if such proof cannot be obtained, strong philosophical arguments for the model remain, since it provides an explanation of the origins of consciousness. By explaining everything that the existing QM interpretations do, while adding the consciousness model, the present interpretation would appear to be more complete.

V. CONCLUSIONS

The purpose of Rovelli's challenge was to illuminate the true physics underlying QM. The present derivation does not so much reveal the physics as it reveals the consciousness dynamics underlying the theory. Apparently this was what truly needed illumination. Insofar as the postulates are based in experiential observations, and offers a simple derivation of quantum mechanics from first principles, Rovelli's challenge has been met.

In terms of the physics of the system, the derivation reveals that Rovelli's picture of reality, driven by information dynamics, is the most accurate amongst the prevalent mainstream interpretations. It furthermore suggests that the proper understanding of the wave function Ψ is to regard it as a wave of possibilities that represents a spectrum of choices available to the sentient quantum particle. The spectrum of choices continually changes according to the equations of motions (Eq. 3.20).

The model reveals that, in terms of the layers of consciousness revealed in Figure 1, the aspects of reality accessible to the methods of physics are limited to the seventh sphere of manifestation (objectivity). The other six spheres manifest exclusively as subjective states, inaccessible to physical measurement.

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