Article

Quantum Physics and the Existence of God

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Abstract: Interpretations of quantum physics are shown to presuppose the reality of consciousness. But if a minimal realism about the external world is true, then the consciousness presupposed by quantum reality cannot be only that of the scientific observer, cannot be only 'local' but must be 'global'. Global consciousness is argued to have all and only the essential properties of God. Quantum reality depends on God's consciousness and the physical world depends on quantum reality. Therefore, the physical world depends on God's consciousness.

1. Introduction

Interpretations of quantum physics presuppose the reality of consciousness. But if a minimal realism about the external world is true, then the consciousness presupposed by quantum reality cannot be only that of the scientific observer, cannot be only 'local' but must be 'global'. Global consciousness is argued to have all and only the essential properties of God. Quantum reality depends on God's consciousness and the physical world depends on quantum reality. Therefore, the physical world depends on God's consciousness.

We know, from the recent empirical confirmations of Bell's criticism of the Einstein–Podolsky–Rosen experiment (EPR)[1], that quantum reality does not depend on anything classical: there is no macroscopic Newton–Einstein world more fundamental than the quantum level. It follows that consciousness does not depend on, and is irreducible to, anything physical. If the quantum depends on consciousness, and consciousness were to depend on the physical, then the quantum would depend on the physical (via consciousness). But that is precisely ruled out by Bell's criticism of the EPR experiment and by subsequent practical work.[2]

It has often been pointed out that, for reasons peculiar to it, the popular Copenhagen interpretation of quantum mechanics seems to presuppose consciousness. Here, it is argued that *no* interpretation escapes this presupposition. The reasons for this are not always so closely tied to the unique character of the interpretation in question. Nonetheless, interpreters of quantum mechanics are without exception forced to fall back upon consciousness. The presupposition is ontological, not just epistemological: consciousness is entailed by quantum reality, not just by inquiry into quantum reality, by what would make the theory true, not just by the consciousness of the theoretician.[3]

It follows that some salient tenets of modernity are false: consciousness does not depend on and is not reducible to the physical world, in any sense of 'reducible', so consciousness is not a product of evolution. We should not be surprised by this result because, if consciousness were a product of evolution, consciousness would be an emergent property of the brain. But the brain, for all its anatomical complexity, is only billions of atoms in empty space, and billions of atoms in empty space are neither logically nor causally sufficient for consciousness. Consciousness did not evolve.[4]

Some important theses are entailed: the Thomist theses that God is his existence, and God is actus purus, and the idealist thesis that the physical world depends on consciousness. Being, Presence, and Consciousness itself are, fundamentally understood, the persons of the Holy Trinity.

This paper is a summary of an unpublished book manuscript, and I do not pretend that there is not much more to be said about the problems and their putative solutions.

2. Consciousness and Quantum Physics

(1)   The Copenhagen Interpretation ('C')

In C, prima facie meaningful claims of the form: 'Particle Φ has momentum **p** but is not measured' or 'Particle Φ is at position **q** but is not measured' do not have truth values, do not express propositions, or are devoid of literal significance. This anti-realism is motivated by the impossibility of simultaneously measuring momentum and position, at a quantum level.

Observation, or the act of measurement itself, 'realises', makes the case, or makes actual, a definite momentum or a definite position, instantaneously. Of the possible momenta or positions consistent with the wave function, measuring actualises the possibility of Φ having **p** or actualises the possibility of Φ being at **q**, but not both simultaneously.

Because measurement collapses the wave function, it is interaction with an observer outside the quantum system that effects the transition from indeterminacy to determinacy.

Although observation determines reality, a degree of realist explanation is retained by the notion of complementarity. For any two predicates whose application is mutually inconsistent:

'Complementarity' (*def.*) *F* and *G* are complimentary *iff*, at any time, *t*, if *x* is measured to be *F*, *x* cannot not be measured to be *G*, and if *x* is measured to be *G*, *x* cannot not be measured to be *F*, but *x* may be measured to be *F* at *t*, and measured to be *G* at t^1.

For example, the accuracy with which momentum is measured, at a time, diminishes the accuracy with which position is measured and vice versa. One and the same reality may be described as a particle or as a wave, over time, with logical consistency.[5]

Does C Presuppose Consciousness?

In C, observation collapses the wave function. But if there is observation then consciousness exists. Therefore, consciousness exists.

Why is it right that if there is observation then consciousness exists? There is a distinction between the following: [α] some cause brings about some effect, and either (classically) [β] some cause brings about some [effect that is an] observation or (in a quasi-quantum idiom) [γ] some [cause that is an] observation brings about some effect, because each of [β] and [γ] says more than [ά]. What is this extra information? What is it for some cause or some effect to be an observation? If there is observation:

[1]   Something is *something to* someone or other.
[2]   Something is *present to* someone or other.
[3]   Someone is *aware of something as* something or other.

These closely related relations only obtain if observation is essentially conscious observation. To see that [1] to [3] are entailments of consciousness, consider the necessary falsity of their converse. There is consciousness and: *Nothing is anything to anyone. Nothing is present to anyone. No one is aware of anything as anything*.

Admittedly, proponents of C often allow a nonconscious item, such as a Geiger counter, a clock, a photographical plate, or some other object that is not conscious as 'the observer'. However, a Geiger counter, a clock, or a photographical plate is itself a physical system that admits of a quantum description. In C, that description will entail that the state of the physical 'observer' is itself indeterminate until it is observed in its turn. It might be tempting to introduce *another* nonconscious physical 'observer' to bring about the determinate state of the Geiger counter or clock—an eye or a brain perhaps. But to do so reintroduces the same problem, for an eye or a brain is also a physical system that admits of a quantum description. For this reason, C makes sense only if wave-function collapse is in every case

ultimately caused by a conscious nonphysical observer. Indeed, Bell's criticism of EPR rules out any classical or macroscopic physical reality making possible anything quantum.

In addition, it would be vacuously circular to argue that the cause of wave-function collapse is only either classical or quantum: classical physics depends on quantum physics but not vice versa, and any quantum event that causes any quantum event itself ultimately stands in need of non-quantum explanation. We need to know: *why is there a quantum world?*

Any measurement entails some conscious act of observation, because no only physical event is sufficient for wave-function collapse. Anything is only an observation if there is conscious observation. Any putative chain of non-conscious observations has to be arrested in some conscious observation that makes non-conscious observation observation. If there is observation then there is consciousness.

Argument that C presupposes consciousness:

(1) $(\psi \rightarrow \Phi i)$
(2) $(\psi \rightarrow \Phi i) \rightarrow \exists(x)\,(\Theta\,x)$
(3) $\exists(x)\,(\Theta\,x) \rightarrow \exists(x)\,(©\,x)$
(4) $\exists(x)\,(©\,x)$

(2)　The Many Worlds Interpretation (MW)

In MW, there is no quantum indeterminacy because any quantum event splits the universe into two numerically distinct, wholly determinate, universes, one in which a particle has position, the other in which it has momentum (or one in which Schrödinger's cat is dead and one in which Schrödinger's cat is alive). The many universes are proliferations of 'the' universe. There is no wave-function collapse, because there is wave-function branching. Quantum physics applies to the set of universes as a whole, or multiverse, and not to any member of the set, or individual universe. All numerically distinct universes exist in one and the same space–time. In MW, all theoretical, logical, and mathematical possibilities are realised.[6]

The universal wave function obeys the same deterministic, reversible laws at all times. The theory preserves wave–particle duality because nothing has a definite momentum and position simultaneously. In some versions of MW there are no particles but there are waves, because a necessary condition for being a particle is possessing definite momentum and position simultaneously.

Does MW presuppose consciousness?

Proponents of MW sometimes regard it as a merit of the interpretation to eschew the reality of consciousness, at least as seemingly implied by collapse of the wave function in the Copenhagen interpretation. But can consciousness be eschewed?

In MW, any quantum event splits the universe into two numerically distinct universes. But what is it for some universe to be 'the' universe? 'The' universe is 'our' universe, the universe that you and I inhabit, and so, in a clear sense, consciousness is presupposed, after all. De Witt (who coined the term 'Many Worlds') says:

> [. . .] every quantum transition taking place on every star, in every galaxy, in every remote corner of the universe is splitting our local world on earth into myriads of copies of itself. (De Witt 1970, p. 33)

Some universe being 'this' or 'the' universe presupposes at least one 'I' user, but there is only an 'I' user if there is self-consciousness and there is only self-consciousness if there is consciousness. Therefore, MW presupposes consciousness.

Also, in MW, there is observation in some universe, which does not extend to any distinct universe. Therefore, in MW, there is observation. But if there is observation, there is consciousness. Therefore, wittingly or not, in MW, there is consciousness.

In MW, universes are therefore epistemologically distinguished by the impossibility of observation (or transference of information) between worlds. In the absence of any other criterion, in MW, the possibility or impossibility of observation (or transference of information) is the sole criterion for individuating worlds. Because observation or

information presuppose consciousness, as MW stands, consciousness has an essential role in constituting universes as distinct.

Argument that MW entails the existence of consciousness:

(1) $\exists(x) (\Theta x, w^1) \, \& \, \forall(w) -(w = w^1) \rightarrow -(\Theta x w)$
(2) $\exists(x) (\Theta x)$
(3) $\exists(x) (\Theta x) \rightarrow \exists(x) (\copyright x)$
(4) $\exists(x) (\copyright x)$

The Consistent Histories Interpretation (CH) (Griffiths 1984)

In CH, there exists a consistent set of possible histories of any quantum system, where a history is a sequence of propositions indexed to times. Probabilities are assigned to the disjunct possible histories. The allocation of probabilities to propositions in a history is only within a theory, or belief system, or web of belief.

There is no wave-function collapse, so no dependence of wave-function collapse on observation or measurement (as exists in C).

Does CH entail the existence of consciousness?

In CH, the allocation of probabilities to propositions in a history is only within a theory, or belief system, or web of belief. If there is a theory, or a belief system, or a web of belief, then there is consciousness. Therefore, there is consciousness.

If there are theories, beliefs, etc., then there is consciousness because there can only be theories, beliefs, etc. if there are theoreticians, believers, etc. and there are only theoreticians, believers, etc. if there is at least one conscious theoretician, believer, etc. For a reductio ad absurdum entertain: 'There are beliefs but no one has ever believed (disbelieved) anything', 'There are theories never held by anyone', etc.

In platonic realism, indeed, there are mind-independent theories, consciousness-independent beliefs, etc. But this is at most plausible only for beliefs only in the sense of the propositional content of beliefs, theories in the sense of the propositional content of theories. Beliefs in the sense of propositional attitudes, theories as they exist in science, presuppose conscious believers, scientists, for their being and for their being what they are.

Argument from belief, that CH entails the existence of consciousness:

(1) $\exists(x) \, \mathrm{B}xp$
(2) $\exists(x) \, \mathrm{B}xp \rightarrow \exists(x) (\copyright x)$
(3) $\exists(x) (\copyright x)$

In CH, at least one history exists. If a history exists, then there is past, present, and future. If there is past, present, and future, then consciousness exists. Therefore, consciousness exists.

It is right that if there is past, present, and future then consciousness exists because any distinction between past, present, and future is a distinction between *someone's* past, present, and future, and being someone entails being conscious.[7] Anyone is only anyone if they are conscious. Any distinction between past, present, and future therefore entails the existence of consciousness.[8] The presupposition is ontological not just epistemological: A history is a history of quantum reality not just a history of the inquirer. Therefore, in CH, quantum reality presupposes consciousness.

Argument, from history, that CH entails the existence of consciousness:

(1) $\exists(x) \, \mathrm{H}x$
(2) $\exists(x) \, \mathrm{H}x \rightarrow \exists(x) (\Theta x)$
(3) $\exists(\Theta x) \rightarrow \exists(x) (\copyright x)$
(4) $\exists(x) (\copyright x)$

In CH, one is left wondering what it consists of for one probable history rather than another to be realised, for one of a range of possibilities to be actual or actualised. Copenhagen measurement is evaded only by leaving the truth values of the propositions

of quantum mechanics at the level of probability. But once we admit actuality, we admit consciousness.

(3)   The Ensemble Interpretation (E)

In E, quantum descriptions do not apply to any individual quantum phenomenon, but only to a large number, or cloud, or 'ensemble', of similar quantum phenomena.[9] Quantum descriptions are only probabilistic and quantum reality is only an abstract statistical quantity that has no ontological status outside mathematics.

Of course, all interpretations use and hence presuppose the existence of mathematics. But, in the case of E, the presupposition is salient because the existence of the quantum world itself is allegedly only mathematical.

Does E presuppose consciousness?

In E, quantum reality has only mathematical ontological status. If intuitionism is correct, the existence of mathematics depends on the existence of consciousness. Intuitionism is correct. Therefore, consciousness exists.

Is there any reason to accept intuitionism? Intuitionism is idealism about mathematics: there is no mathematical truth that outstrips proof. But proving is a conscious activity. So, if there is mathematical truth, there is consciousness. There is no mathematics unless something can be counted. But counting is a conscious activity. So, there is no mathematics without consciousness. Mathematics is constructed not discovered. If there is no construction unless there is conscious construction, again, consciousness is presupposed.

In a sense, intuitionism is an ontologically cautious theory. In interpreting mathematics, we postulate nothing beyond what we strictly know. Intuitionism's realist repudiation arguably violates Ockham's Razor.[10]

If intuitionism (or similar) is false, then mathematics is 'out there'. There is mathematical truth irrespective of the possibility of proof. There are numbers even if there is or could be no counting. Mathematics is discovered, not invented. However, we are still left with: *What is the ontological status of mathematics? Why is there any mathematics? Why is the universe mathematical?* We might well need consciousness anyway, and this time on a global or cosmic scale, to begin to answer these questions.

Intuitionist Argument that E Presupposes Consciousness:

(1) $\exists(x)\,(x = n)$
(2) $\exists(x)\,(x = n) \to \exists(x)\,(© x)$
(3) $\exists(x)\,(© x)$

If mathematics presupposes consciousness, and if the physical world presupposes mathematics, then the physical world presupposes consciousness. The presupposition is ontological.

(4)   The Branching Space–Time Interpretation

BST entails the essentials of MW and may be rightly thought a variant of it. In MW, it is quantum reality which branches within one and the same space–time. In BST, it is space–time itself which branches into numerically distinct space–times. In the cat analogy, space–time branches into two space–times, one in which Schrödinger's cat is dead and one in which Schrödinger's cat is alive. In the terminology of histories, branching into histories pertains to the topology of sets of events standing in causal relationships within space–time.

BST faces the same sorts of logical problems as MW but about space–times rather than worlds.

Does BST Presuppose Consciousness?

BST presupposes MW and MW presupposes consciousness. Therefore, BST presupposes consciousness.

The argument is valid because of the transitivity of 'entails': if *p* entails *q* and *q* entails *r*, then *p* entails *r*. Anything entails all and only the entailments of what it entails.

The argument is not sound if the first premise is false, for example because the two interpretations differ in entailing different numbers of space–times. We could revise the first premise to read: 'BST presupposes the essentials of MW' or 'the part of MW that entails the existence of consciousness', or similar. Then, the argument is not only valid but sound.

Argument that BST presupposes consciousness:

(1) $\exists(x) (\Theta x, s - t^1) \,\&\, \forall(s - t) - (s - t = s - t^1) \rightarrow -(\Theta x s - t)$
(2) $\exists(x) (\Theta x)$
(3) $\exists(x) (\Theta x) \rightarrow \exists(x) (© x)$
(4) $\exists(x) (© x)$

It is the branching of space–time itself which presupposes consciousness, not just any theory or knowledge of this branching. It is therefore quantum reality which presupposes consciousness in BST, not just knowledge of quantum reality.

(5) The de Broglie–Bohm Interpretation (B-B)

In B-B, any particle has a definite position and a definite momentum. Position and momentum are hidden variables because the investigator cannot know them both simultaneously and precisely, because of Heisenberg's uncertainty principle.

The wave function depicts the configuration of the universe as a whole. Causation is non-local, and so satisfies Bell's inequality and is deterministic. The momentum of a particular particle depends on the value of the guiding equation, which depends on the configuration of the universe as a whole, minus that particle, that is, the position of every other particle. Particles are guided by the 'pilot wave': $\psi (q, t) \in \mathbf{C}$. The wave function does not collapse, because collapse is only phenomenological collapse, not 'real' or 'objective' collapse.

The measurement problem is putatively solved because, at any given time, any particle has definite position and momentum. B-B only entails the existence of one space–time and one world, so does not suffer some of the logical drawbacks of MW, CH, and BST.

The strategy is to save both classical determinism and realism: Causes necessitate their effects, and events either happen or do not, irrespective of the existence or nature of their observer. Uncertainty is only epistemological, not ontological. If B-B is correct, two of the apparent consequences of quantum physics which appalled Einstein are avoided: God does not play dice, and the physics is not subjective but 'out there'. B-B is a hidden variable theory. In a plausible construal, Bohm's interpretation entails that, if anything exists, it exists now (in a classical sense).[11]

Does B-B Presuppose Consciousness?

In B-B, wave function collapse is only phenomenological wave function collapse. But, if there is any phenomenology, then consciousness exists. There is phenomenology. Therefore, consciousness exists.

Argument that B-B presupposes consciousness:

(1) $Bx [(|\psi> \rightarrow | \Phi_i>)] \,\&\, -(|\psi> \rightarrow | \Phi_i>)$
(2) $Bx [(|\psi> \rightarrow | \Phi_i>)] \rightarrow \exists(x) (\Theta x)$
(3) $\exists(x) (\Theta x)$
(4) $\exists(x) (\Theta x) \rightarrow \exists(x) (© x)$
(5) $\exists(x) (© x)$

If there is any phenomenology, then consciousness exists, because there is no phenomenology unless something is something *to* someone and so, in an obvious sense, present to consciousness.

Of course, this sort of argument applies to *any* theory that grants the existence of phenomenology. It is characteristic of B-B to make phenomenology conspicuously essential to quantum physics but the presupposition is what we are calling 'epistemological', i.e., presupposed by the epistemology, rather than 'ontological', i.e., presupposed by quantum reality itself.

Argument that Bohm's interpretation presupposes consciousness:

(1) ∃(x) (Φx) & ∃(y) (Dy) & Rxy
(2) ∃(x) (Φx) & ∃(y) (Dy) & Rxy → ∃(z) (© z)
(3) ∃(z) (© z)

Suppose Bohm's interpretation entails that, if anything is true, it is true *now*. A point of time classically conceived is not sufficient for that time's being now, for its being 'the time it is'. What else is necessary?

If anything exists, it exists now. Something exists. Something exists now. 'Now' means 'when I am' so a time's being now is its being simultaneous with when I am or when some 'I' user is. Being an 'I' user entails being conscious. Any time's being now entails the existence of consciousness. Therefore, consciousness exists.

We may imagine robotic simulations of I-use but, in the absence of consciousness, they remain simulations.

(6) Relativistic Quantum Physics (RQP)

In RQP, a system might be in a single, 'collapsed', eigenstate to an observer at a time but in a superposition of two or more states to a different observer at that time.

'State' refers to nothing intrinsic to the observed system itself, but denotes the relation, or correlation, between that system and its observers. States of *all* objects and events are really relations between observer and observed (irrespective of whether they are Newtonian, quantum, conscious, etc.). The state vector of quantum physics is construed as a description of the correlation between the observed system and some degree of freedom in the observer.

In RQP, a detection event establishes a relation between the quantised field and the detector, thus avoiding the wave–particle ambiguity in Heisenberg's uncertainty principle. Any measurement event is an ordinary physical interaction, the establishing of the correlation between measuring device and measured.

RQP exploits the relativity of simultaneity in the special theory of relativity: the same events might appear temporally ordered in a different way to different observers: *e* might appear simultaneous with *e*1 to A but earlier than *e*1 to B and later than *e*1 to C.

Does RQP presuppose consciousness?

In RPQ, if there exists a particle with at least one property then there exists an observer of that particle, thereby necessarily related to that particle. There exists a particle with at least one property. Therefore, there exists an observer. If there exists an observer, then consciousness exists. Therefore, consciousness exists.

For the soundness of the argument, we rely here on (∃(x) (Θ x) → ∃(x) (© x) as an assumption.

Argument that Relativistic Quantum Physics presupposes consciousness (I):

(1) ∀(x) ((Φ*x* & F*x*) → ∃(y)(Θ y) & (R*xy*)
(2) ∃(x) ((Φ*x* & F*x*)
(3) ∃(*y*)(Θ *x*)
(4) ∃(y) (Θ *x*) → ∃(x) (© *x*)
(5) ∃(x) (© *x*)

In RQP, there exists a particle and a detector of that particle. If a detector exists, then consciousness exists. Therefore, consciousness exists.

Is it right that, if a detector exists, then consciousness exists? Clearly, there may exist a physical system internally related such that one part receives a pattern of causal impacts from another, for example, a distribution of particles fired from a source, hitting a photographic plate. However, it is only right to call the photographical plate 'a detector' if there is awareness of it and the pattern of causal impacts it receives (either by it or by something else). (a) 'D detects a pattern of causal impacts' says more than: (b) 'D is subject to a pattern of causal impacts'. (a) entails (b) but (b) does not entail (a). (We envisage the impacts in (a) as *on* D.) If (b) is insufficient for (a), then what else is necessary? 'There is consciousness that D is subject to a pattern of causal impacts' is sufficient for (a).

Argument that Relativistic Quantum Physics presupposes consciousness (II):

(1)　$\forall(p)\, p \rightarrow pt^{o}$
(2)　$\exists(p)\, p \rightarrow pt^{o}$
(3)　$\exists(p)\, p \rightarrow pt^{o} \rightarrow \exists(y)(\Theta\, x)$
(4)　$\exists(y)\, (\Theta\, x) \rightarrow \exists(x)\, (\copyright\, x)$
(5)　$\exists(x)\, (\copyright\, x)$

The presupposition of consciousness in RQP is ontological, not just epistemological, because in RQP quantum reality is essentially related to an observer but the existence of an observer presupposes consciousness (at least somewhere along the line). Therefore, quantum reality itself presupposes consciousness.

(7)　The Quantum Information Interpretation (ontological) (QI(O))

In J. A. Wheeler's 'it from bit' ontology, a quantum state is a mental construct of the observer and quantum realities are consequences of information.

Does QI(O) presuppose consciousness?

In QI(O), a quantum state is a mental construct of the observer. But if there is an observer there is consciousness. Therefore, consciousness exists. More directly: if there are mental constructs, then consciousness exists. There are mental constructs, so consciousness exists.

Common sense and classical physics are committed to the mind-independent existence of the physical world. However, QI(O) calls this independence into question. If QI(O) is correct, we need a theory of the observer. Berkeleyan idealism, or something close to it, is then a plausible quantum philosophy.

Argument that QI(O) presupposes consciousness (I):

(1)　$\exists(x)\, (\Theta\, x)$
(2)　$\exists(x)\, (\Theta\, x) \rightarrow \exists(x)\, (\copyright\, x)$
(3)　$\exists(x)\, (\copyright\, x)$

In QI(O), quantum realities are consequences of information. If information exists then consciousness exists. Therefore, consciousness exists.

'Consequence' is ambiguous between 'causal consequence' and 'logical consequence'. Construed causally, quantum reality is an emergent property of information. Information, in some way, is causally sufficient for quantum phenomena. Construed logically, quantum reality is essentially constituted of information or analytically reducible to information. The first reading yields a Cartesian dualism, the second a Berkeleyan immaterialism. In either reading, consciousness is straightforwardly presupposed, so long as the existence of information entails the existence of consciousness.

But: What is information? What is it for some cause or some effect to be information? Information is intellectual or perceptual content which informs.

[1]　Information is *information to* someone or other.
[2]　Information is *present to* someone or other.
[3]　Someone is *aware of information as* something or other.

These closely related relations may only obtain if information is essentially information for consciousness. If you are acquainted with information, it is something to you, rather than just something there is. It is present to you, both in the sense of being 'here' and in the sense of being 'now'. Somewhere being here, and some time being now, directly presuppose consciousness. 'Here' means 'where I am' and 'now' means 'when I am', where being an 'I' user entails being a conscious being.

There is information without consciousness only if chains of information are arrested in information present to consciousness. Why is this right? There is a distinction between the following:

[á] Some cause brings about some effect.

$$\exists(x)\,\exists(y)\,(Cxy)$$

and either (classically):

[β] Some cause brings about some [effect that is] information.

$$\exists(x)\,\exists(y)\,(Cxy)\,\&\,(i\,y)$$

or (in a quasi-quantum idiom):

[γ] Some [cause that is] information brings about some effect.

$$\exists(x)\,\exists(y)\,(Cxy)\,\&\,(i\,x)$$

If there is information, then consciousness exists, because there is information without consciousness only if chains of information are arrested in information present to consciousness. If there is information, some consciousness is *informed*.

Argument that QI(O) presupposes consciousness (II):

(1) $\exists(x)\,\exists(y)\,(Cxy)\,\&\,(i\,x)$
(2) $\exists(x)\,(i\,x)\rightarrow\exists(x)\,(©\,x)$
(3) $\exists(x)\,(©\,x)$

Quantum reality presupposes information but there is no information unless consciousness exists, so quantum reality itself presupposes consciousness. The presupposition is ontological, not only epistemological.

(8)   The Quantum Information Interpretation (Epistemological) (QI(E))

In QI(E), quantum mechanics is true of an observer's knowledge of the world, not the world itself, because there is no such thing as the collapse of the wave function over and above an observer acquiring information from the measurement of some event.[12] The 'reduction of the wave-packet' takes place in the consciousness of the observer, not because of any physical process which takes place there, but only because the state is a construct of the observer. It is not an objective property of the physical system.

A state is information, obtained from knowledge of how a system was prepared, used for predicting future measurements. A state is not a state of anything objective in the sense of 'observer independent'. A quantum mechanical state is a summary of the observer's information about an individual physical system's changes by dynamical laws whenever the observer acquires new information about the system through the process of measurement. The state vector is not an objective property of the system.

Does QI(E) presuppose consciousness?

Quantum physics is nothing over and above, or reducible to, the knowledge of quantum physics. If there is knowledge then consciousness exists. There is knowledge. Therefore, consciousness exists. The existence of certain quantum mechanical facts is the existence of certain items of knowledge. So long as knowledge entails the existence of consciousness, consciousness is clearly presupposed.

Argument that QI(E) presupposes consciousness:

(1) $\exists(p)\,(Kxp)$
(2) $\exists(p)\,(Kxp)\rightarrow\exists(x)\,(©\,x)$
(3) $\exists(x)\,(©\,x)$

In a sense, the presupposition of consciousness in QI(E) is epistemological. But this is because, in QI(E), quantum reality itself is only epistemological: it does not exceed the knowledge of it. Quantum reality is not 'out there'. But, in so far as there is quantum reality, consciousness is presupposed.

(9) The von Neumann/Wigner Interpretation (N/W)

In N/W, consciousness collapses quantum reality and, in von Neumann's version, the entire physical universe is subject to the Schrödinger equation (the universal wave function). In N/W, physics needs consciousness in order to be complete.

Does N/W entail the existence of consciousness?

N/W overtly implies that quantum physics presupposes consciousness, because consciousness collapses the wave function. There is wave-function collapse and, if there is wave-function collapse, then consciousness exists. Therefore, consciousness exists.

Argument that N/W presupposes consciousness:

(1) $[(|\psi> \rightarrow | \Phi_i>)]$
(2) $[(|\psi> \rightarrow | \Phi_i>)] \rightarrow \exists(x) (© x)$
(3) $\exists(x) (© x)$

In N/W, the entire physical universe is subject to the Schrödinger equation (the universal wave function) and so dependent on its holding. But the Schrödinger equation holding depends on consciousness. Therefore, the entire physical universe depends upon consciousness. The inference is valid because of the transitivity of 'depends on': if *a* depends on *b* and *b* depends on *c*, then *a* depends on *c*.

Argument that the entire physical universe depends upon conscious observation:

(1) $\exists(x) (x = w) \rightarrow (|\psi> \rightarrow | \Phi_i>)$
(2) $(|\psi> \rightarrow | \Phi_i>) \rightarrow \exists(x) (© x)$
(3) $\exists(x) (x = w)$
(4) $\exists(x) (© x)$

Obviously, if the entire physical universe depends on conscious observation, then consciousness is presupposed ontologically, not just epistemologically, in our senses of these terms.

(10) The Wheeler/Stapp Interpretation (W/S)

In W/S, consciousness is essential to bringing the universe into existence and, although the universe began, consciousness has always existed.

Does W/S entail the existence of Consciousness?

In W/S, consciousness is essential to bringing the universe into existence. The universe came into existence. So, in W/S, if there is a universe, then consciousness exists and a universe exists. It follows that consciousness exists.

We do not know with certainty that the universe did come into existence, even though at the time of writing most physicists think the universe began with the Big Bang. It is hard to rule out a priori the existence of a universe infinite in backwards time. Plus, even if this universe began, it is hard to rule out a priori a chain of predecessor universes.

Is the final inference valid? Logically and theoretically, consciousness could bring the universe into existence but then itself cease to exist. There seems no incoherence in such a supposition. On the other hand, if consciousness is necessary to sustain the universe, then consciousness has to exist at least so long as there are quantum events. If consciousness is necessary for time (say, because quantum reality is necessary for time), the assumption that there was a time when there was no consciousness must be false. At any time, 'There is consciousness' is true (even if consciousness is intrinsically atemporal). Either way, consciousness exists at least sub specie aeternitatis in W/S.

Argument that W/S entails consciousness:

(1) $\exists(x) (x = w) \rightarrow \exists(x) (© x)$
(2) $\exists(x) (x = w)$
(3) $\exists(x) (© x)$

Because, in W/S, consciousness is essential to bringing the universe into existence, consciousness is presupposed ontologically not just epistemologically.

(11) The Many-Minds Interpretation (MM)

In MM, the mind of the observer splits into distinct minds, none of which is (numerically identical with) the mind that splits (one, say, thinking that Schrödinger's cat is dead, the other thinking that Schrödinger's cat is alive). A mind that results from a split occupies a different universe from any other mind that results from the same split.

MM entails a version of MW. But what it consists of for such universes to be distinct is those minds being distinct. In MW, the universe splits into distinct universes, none of which is numerically identical with the universe that splits. In MM, a mind splits into distinct minds, none of which is numerically identical with the mind that splits.

Does MM Presuppose Consciousness?

In MM, there exists a mind. But, if there are any minds, then consciousness exists. Therefore, consciousness exists.

One might object to 'If there are any minds, then consciousness exists' that there is artificial intelligence: computation which in many respects outstrips human achievements, exhibited by non-conscious systems. If a capacity to solve complex computational problems, speedily and accurately, is sufficient for the existence of a mind, then computers are or have minds.

On the other hand, a computer is not aware of anything whatsoever. We may simulate self-awareness by programming it with information about itself, equipping it with self-scanning devices, etc. but it remains without one iota of consciousness. There is a drastic sense in which any computer does not know what it is doing. It has not the slightest *awareness* of what it is doing. The many-minds interpretation requires minds that are aware, and minds, so understood, entail the existence of consciousness. Some people argue that (some) computers are or could be conscious. But, if they are right, the existence of conscious computers does not undermine but lends support to the premiss: 'If there are any minds, then consciousness exists'.

Argument that MM presupposes consciousness:

(1) $\exists(x) (Mx)$
(2) $\exists(x) (Mx) \rightarrow \exists(y) (\text{©}\, y)$
(3) $\exists(y) (\text{©}\, y)$

Like MW above, MM presupposes consciousness ontologically, not just epistemologically. Quantum reality, not just knowledge of quantum reality, presupposes consciousness.

(12) The Relational Interpretation (R)

R is a version of M. In R, quantum mechanical descriptions are generated from different perspectives, are equally objective, and correspond to physical reality. The physical world is essentially or fundamentally relational. In particular, relations do not depend on anything non-relational.[13]

Does R presuppose consciousness?

Any quantum description is derived from a 'perspective'.[14] A perspective presupposes consciousness. Therefore, consciousness exists.[15]

Argument that R presupposes consciousness (I):

(1) $\forall(p)\, Kxp \rightarrow \exists(x) (\text{perspective } x)$
(2) $\exists(x) (\text{perspective } x) \rightarrow \exists(x) (\text{©}\, x)$
(3) $\exists(x) (\text{©}\, x)$

Any quantum description is derived from a 'perspective'. But any perspective is someone's perspective.[16] A perspective essentially belongs to an observer and an observer is essentially conscious. Therefore, consciousness exists. Rovelli himself recognises the role of the observer in our making sense of quantum physics.[17]

Argument that R presupposes consciousness (II):

(1) $\forall(p)\ \mathrm{K}xp \rightarrow \exists(x)$ (perspective x)
(2) $\exists(x)$ (perspective x) $\rightarrow \exists(x)\ (\Theta\ x)$
(3) $(\Theta\ x) \rightarrow \exists(x)\ (\copyright\ x)$
(4) $\exists(x)\ (\copyright\ x)$

Any quantum description depends on a measurement.[18] But any measurement essentially presupposes an observer. An observer is essentially conscious. Therefore, consciousness exists.

Argument that R presupposes consciousness (III):

(1) $\forall(p)\ \mathrm{K}xp \rightarrow \exists(x)$ (measurement x)
(2) $\exists(x)$ (measurement x) $\rightarrow \exists(x)\ (\Theta\ x)$
(3) $(\Theta\ x) \rightarrow \exists(x)\ (\copyright\ x)$
(4) $\exists(x)\ (\copyright\ x)$

Indeed, Rovelli himself takes the view that the results of measurement only have meaning in relation to an observing system or observer.[19]

Any quantum description is derived from 'actuality'.[20] Actuality presupposes consciousness. Therefore, consciousness exists.

Argument that R presupposes consciousness (IV):

(1) $\exists(x)$ (actuality x)
(2) $\exists(x)$ (actuality x)$\rightarrow \exists(x)\ (\Theta\ x)$
(3) $(\Theta\ x) \rightarrow \exists(x)\ (\copyright\ x)$
(4) $\exists(x)\ (\copyright\ x)$

Any quantum description entails a transference of information. Information presupposes consciousness. Therefore, there is consciousness.

Consciousness is someone's consciousness, say 'our' consciousness. But: who are 'we'?[21] Could there not, after all, be information but no observer?[22] But even in a Humean or Buddhist 'no-self' theory that there is no self, subject, soul, conscious centre, or 'owner' of experience, there is experience, so consciousness. The existence of consciousness is required for mere events to be experiences and for mere processes to be information.

Argument that R presupposes consciousness (V):

(1) $\exists(x)\ (ix)$
(2) $\exists(x)\ (ix) \rightarrow \exists(x)\ (\copyright\ x)$
(3) $\exists(x)\ (\copyright\ x)$

In R, quantum reality is essentially related to consciousness, so consciousness is presupposed ontologically.

(13) The Time-Symmetric Interpretation (TS)

In TS, there is backwards causation: future events bring about past events, as past events bring about future events. A single measurement cannot fully determine the state of a system (so the theory is a hidden variable theory). But, given two measurements performed at different times, it is possible to calculate the exact state of the system at all intermediate times. The collapse of the wave function is therefore not a physical change to the system, just a change in our knowledge of it due to the second measurement. Similarly, entanglement is not an objective physical state but an illusion created by ignoring backwards causation. The point where two particles appear to 'become entangled' is just a point where each particle is being influenced by events that occur to the other particle in the future. Modification of the equations of quantum mechanics are symmetric with respect to time reversal.

Does TS presuppose consciousness?

In Ts, future events bring about past events, as past events bring about future events. So, in Ts, there is history. If there is history, then there is consciousness. Therefore, there is consciousness.

Argument that TS presupposes consciousness (I):

(1) $\exists(x)\,(Hx)$
(2) $\exists(x)\,(Hx) \rightarrow \exists(x)\,(\Theta\,x)$
(3) $(\Theta\,x) \rightarrow \exists(x)\,(©\,x)$
(4) $\exists(x)\,(©\,x)$

The collapse of the wave function is just a change in our knowledge of it. So, in TS, there is knowledge. If there is knowledge, then there is consciousness. Therefore, there is consciousness.

Argument that TS presupposes consciousness (II):

(1) $\exists(x)\,(Kxp)$
(2) $\exists(x)\,(Kxp) \rightarrow \exists(x)\,(\Theta\,x)$
(3) $(\Theta\,x) \rightarrow \exists(x)\,(©\,x)$
(4) $\exists(x)\,(©\,x)$

In TS, entanglement is an illusion. So, in TS there is illusion. If there is illusion, then there is consciousness. Therefore, there is consciousness.

Argument that TS presupposes consciousness (III):

(1) $\exists(x)\,(ix)$
(2) $\exists(x)\,(ix) \rightarrow \exists(x)\,(\Theta\,x)$
(3) $(\Theta\,x) \rightarrow \exists(x)\,(©\,x)$
(4) $\exists(x)\,(©\,x)$

In TS, consciousness is presupposed ontologically, because history is the history of quantum reality and history presupposes consciousness, so quantum reality presupposes consciousness.

(14) The Quantum Bayesian Interpretation (QB)

In QB, quantum reality is a measure of the observer's degree of belief about or knowledge of the behaviour of the observed system.[23]

Does QB presuppose consciousness?

Quantum reality is a measure of the observer's degree of belief about the system.
There is belief. If there is belief, then there is consciousness. Therefore, there is consciousness.

Argument that QB presupposes consciousness (I):

(1) $\exists(x)\,(Bxp)$
(2) $\exists(x)\,(Bxp) \rightarrow \exists(x)\,(©\,x)$
(3) $\exists(x)\,(©\,x)$

In QB, quantum reality is a measure of the observer's knowledge of the behaviour of the system. So, there is knowledge. If there is knowledge, then there is consciousness. Therefore, there is consciousness.

Argument that QB presupposes consciousness (II):

(1) $\exists(x)\,(Kxp)$
(2) $\exists(x)\,(Kxp) \rightarrow \exists(x)\,(©\,x)$
(3) $\exists(x)\,(©\,x)$

Some systems are observed systems. If anything is observed, then there is consciousness. There is consciousness.

Argument that QB presupposes consciousness (III):

(1)   Some systems are observed systems.
(2)   If anything is observed, then there is consciousness.
(3)   There is consciousness.

(1) $\exists(x)\,(\Theta\,x)$
(2) $(\Theta\,x) \rightarrow \exists(x)\,(\copyright\,x)$
(3) $\exists(x)\,(\copyright\,x)$

In QB, the presupposition of consciousness is in a sense epistemological: quantum reality does not exceed the measure of the observer's degree of belief about or knowledge of the behaviour of the observed system, and allocations of probability are subjective (that is, are only degrees of belief by the inquiring subject). Yet, to the extent to which quantum reality exists in QB, consciousness is presupposed.

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The existence of the scientist, in the most intimate and direct sense, implies the existence of consciousness and quantum physics is fundamental science. So, it follows that there is no science without the scientist so no science without consciousness. Throughout history, there could not have been the investigations we call 'science' without scientific investigators. Science does not have the *method* it has without consciousness.

But quantum physics forces upon us a new and far more radical conclusion: science does not have *the subject matter* it has without the scientist. Consciousness *actualises*.[24]

Bell's criticism of the EPR experiment showed that there is no deterministic, macroscopic physical layer of reality which makes the quantum world possible. There is, therefore, nothing physical for the consciousness presupposed by the quantum world to depend on or be reducible to. Suppose 'prior' and 'fundamental' are understood like this:

[PR] 'prior' (*def.*) *a* is prior to *b* *iff* if not *a* then not *b*;

[F] 'more fundamental than' (*def.*) *a* is more fundamental than *b* iff if not *a* then not *b* but not if not *b* then not *a*;

[AF] 'absolutely fundamental' (*def.*) *a* is absolutely fundamental *iff* if not *a* then there is not anything but nothing except *a* is necessary for *a*.

It remains to be seen whether consciousness is absolutely fundamental. But consciousness is not just prior to, but ontologically more fundamental than, anything physical.

Given these conclusions, there is a clear need for science to admit a new category, even more fundamental than energy or matter: *consciousness*. A Theory of Everything, to be worthy of the name, will have to entail a theory of consciousness.

3. The Existence of God

Call the consciousness that exists if the quantum world exists 'quantum consciousness'. Quantum consciousness makes the universe possible. In traditional monotheism, God makes the universe possible. So, is quantum consciousness God? There is no wholly uncontroversial definition of 'God' but suppose God is this:

'God' (*def.*) *x* is God *iff* *x* is the unique, infinitely powerful, infinitely knowing, infinitely benevolent, necessary, omnipresent, atemporal ground of everything, a person, and the Creator and sustainer of the universe: pure actuality.

Quantum consciousness *ontologically* inherits those properties entailed by being necessary for quantum reality.[25] Quantum consciousness, like anything, also presupposes whatever is necessary for there being anything whatsoever but in a special way: as properties of itself. So far as the finite mind may discern, the conjunction of these two sets of properties is all and only the essential properties of God, as understood in the great monotheistic religions. The existence of the universe entails, if not exactly God, then something so close to God as to be indistinguishable from God.

For brevity, I write 'quantum' and 'universe'. But physics is open to the existence of more than one universe and regards the classical Newton–Einstein universe as itself quantum, as the macroscopic limiting case of the quantum. So, I use 'quantum' to include 'classical' and by 'universe' I mean 'any universe with a quantum constitution'.

(a)   Omnipresence

'Omnipresent' (*def.*) x is omnipresent *iff* x is, and there is not anywhere x is not.

If a minimal realism about the external world is true, quantum events appear not only within the experiments of the physicist. It is empirically well established that physical reality always and everywhere possesses a quantum constitution. Anything quantum is present to the quantum consciousness which pervades it. So, quantum consciousness is not only local but global: there is not anywhere consciousness is not.[26]

It might seem hard to rule out a priori some existence not dependent on quantum reality and so not dependent on quantum consciousness. But (unlike a physical object or event) consciousness is in itself intrinsically unbounded, so quantum consciousness has that pervasive presence ascribed to God in Psalm 139 8: 'If I go up to the heavens, you are there; if I make my bed in the depths, you are there'.

(b)   Actus purus

'Actus purus' (*def.*) x is actus purus *iff* x is pure actuality.

If anything quantum is present to quantum consciousness, then quantum consciousness is actus purus: pure actuality.[27] Distinguish the nunc fluens from the nunc stans, happening, changing, from the time never not being Now.[28] Unlike any present event, the Now, or nunc stans, is not bounded or limited. Quantum consciousness as nunc stans actualises quantum events as the nunc fluens. Quantum consciousness is pure actuality (actus purus) or the Eternal Now.[29]

Quantum consciousness, or anything, entails Presence and, if quantum consciousness is everywhere, there is no *ontological* room for Presence to be the presence of anything other than quantum consciousness.

(c)   Omniscience

'Omniscient' (*def.*) x is omniscient *iff*, for all p, x knows that p.

If quantum consciousness is omnipresent, it is thereby acquainted with anything quantum anywhere. There is not anything quantum it is not aware of. Intuitively: it *misses* nothing. All the information in the universe or universes is present to it.

It is hard to rule out a priori that there is some non-quantum reality with which quantum consciousness is not acquainted. But, so far as may be discerned by a finite mind, quantum consciousness is omniscient in the propositional sense of knowing the truth values of all the propositions there are, $\forall(p)\, Kxp$, and so has that property ascribed to God in 1 John 3: 20: 'God [...] knows all things'.

(d)   Creator

'Creator' (*def.*) x is the Creator *iff* only x makes what is be.

On pain of circularity, whatever caused or causes the space–time universe of physical objects and events, is not spatio-temporal, not physical, and not an event or set of events. Quantum consciousness is at least necessary for the universe and arguably sufficient. It follows that quantum consciousness is not spatio-temporal, not physical, and not an event or set of events. But lacking these features is characteristic of God.

How is this creating done? Quantum consciousness is actus purus and pure actuality *actualises*: effects the transition from possible to real, potential to actual. Quantum consciousness created the universe, so has that property ascribed to God in Genesis 1 1: 'In the beginning, God created the heavens and the earth'.[30]

(e)　Sustainer

'Sustains' (*def.*) *x* sustains *y iff y* cannot continue (to be) without *x*.

In a sense, the universe is constantly beginning afresh *now*. Quantum events begin to be ex nihilo, and cease to be in nihilum. The exploding spontaneity of the present is sustained by quantum consciousness, by, as we are putting it, non-local consciousness.[31] Quantum consciousness actualising explains why anything happens, from moment to moment. Indeed, we would still need quantum consciousness to explain why there is a universe even if there has always been a universe. Consciousness would be required to show why there is an eternal universe rather than no universe whatsoever.

Quantum consciousness sustains the universe in existence from moment to moment, and actualises everything in it by effecting the transition from possibly being to being, from Being to beings.[32] Quantum consciousness therefore has the property ascribed to God in Hebrews 1: 3 and Colossians 1: 17: 'In him all things hold together'.

(f)　One

One (*def.*) *x* is One *iff x* is but does not in principle admit of plurality.

In physics, distinct experiments, on distinct occasions, involve distinct conscious observers. But the universe is a unified multiplicity and any multiplicity may only be unified by unity, by that which is one and only one. Quantum consciousness unifies the universe by being its ground, so quantum consciousness is one and only one. As one, quantum consciousness ontologically resists *duplication*. Quantum consciousness therefore has that property ascribed to God in Deuteronomy 6: 4: 'The Lord is one', Job 23: 13: 'He is unique', Mark 12: 29 'The Lord our God is one Lord', and Mark 12: 32: 'He is one'.

(g)　Simplicity

'Simple' (*def.*) *x* is simple *iff x* has no parts.

Consciousness has no parts, so quantum consciousness is simple and therefore has that property ascribed to God above in being one. As one, quantum consciousness *ontologically* resists *division*.

(h)　Infinity

'Infinite' (*def.*) *x* is infinite *iff*, if *x* is *F*, there is no limit to the degree to which *x* is *F*.

Although the Einstein universe is spatio-temporally finite but unbounded, the universe is in other ways infinite. The universe is mathematical (and so may be described by physics). Mathematics contains infinities. Therefore, so also, in a sense, does the universe. The universe contains an infinite number of facts or truths. The ground of anything infinite is itself infinite. Quantum consciousness is the ground of the universe. Therefore, quantum consciousness is infinite.[33],[34] Quantum consciousness therefore possesses the property ascribed to God in Psalm 147: 5 of being 'beyond measure' or, in Ephesians 1: 19, that of having 'infinite might'.[35]

(i)　Timelessness

'Timeless' (*def.*) *x* is timeless *iff* no temporal predicates apply to *x*.

Quantum reality grounds space–time and quantum consciousness grounds quantum reality. Therefore, quantum consciousness grounds space–time. On pain of circularity, temporal predicates do not apply to the cause of time. Quantum consciousness is eternal, not in lasting infinite time, not in being 'sempiternal', but in *not being in time at all*. Quantum consciousness therefore possesses that property ascribed to God in Deuteronomy 33: 37, 1 Timothy 1: 17, of being 'eternal' or, in Romans 1: 20, of having 'eternal power and character'.

(j)　Good

'Good' (*def.*) *x* is good *iff x* is conducive to happiness or (*vel*) the elimination of suffering.

Prima facie, quantum consciousness could be morally neutral or evil. However, that there is a universe is better than if there were no universe, and the cause of a good universe is itself good. Quantum consciousness is the cause of the universe, so quantum consciousness is itself good.[36] Admittedly, the existence of the universe is a necessary condition for evil and ugliness, but it is also necessary for good and beautiful things. It is better that both good and evil should exist than that no good exists. Quantum consciousness therefore has the property ascribed to God in Psalm 34: 8, Mark 10: 18, of being 'good' and is at least consistent with this rather utilitarian motive in Matthew 5: 45: 'so that you may be sons of your Father who is in heaven; [. . .] He causes His sun to rise on the evil and the good, and sends rain on the righteous and the unrighteous'.

(k)   Necessary Being

The existence of any particular being looks contingent. It is hard to justify prefacing the existential quantifier with '□' or to find a value of '*x*' that would allow construing any inference from

$$\exists(x)\,(Fx)$$

to

$$\Box\exists(x)\,(Fx)$$

as valid.

But, if God is Being, rather than 'a' being, then God is necessary because Being cannot not be. 'There is nothing' (in the sense of 'Nothing has existence') is incoherent. Necessarily, there is either Being or Nothing. So, there is necessarily Being. If God is Fundamental, then God is Being or, more accurately, Being is the Being of God.[37]

Quantum consciousness, or anything, entails Being and, if quantum consciousness is everywhere, there is no *ontological* room for Being to be the being of anything other than quantum consciousness. Primordial Being is *l'être pour soi*. Quantum consciousness

therefore has that property ascribed to God by God in Exodus 3: 14: 'I am that I am'.[38]

This 'am' entails but exceeds any 'is'.

Being cannot not be, and so Being is uncreated, and so has the property ascribed to God in Psalm 90: 2: 'Before the mountains were born Or You gave birth to the earth and the world, Even from everlasting to everlasting, You are God'.

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If these arguments are sound, quantum consciousness is the unique, infinitely powerful, infinitely knowing, infinitely benevolent, necessary, omnipresent, atemporal ground of everything, a person, and Creator and sustainer of the universe: pure actuality. These are all and only the essential properties ascribed to God within the world's great monotheistic religions. It follows that quantum consciousness is God. Fundamentally understood, God is Being, Presence, Consciousness: the Holy Trinity.[39]

God is not an extravagant postulate but an ineliminable presupposition.[40] If the quantum universe exists, God exists. A Theory of Everything, worthy of the name, entails a theology.

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Nomenclature

p, q, r	propositional variables
&	conjunction
-	negation
→	material implication
≡	biconditional
x,y	name variables
∃ (x)	existential quantifier
∀ (x)	universal quantifier
∃!	There exists at least and at most one . . .
a, b, c	name letters
F, *G*	predicate letters
◇	'It is possible that'
□	'It is necessary that'
w	possible world
∈	'is a member of'
x	object variable
Φ	particle
p	momentum
q	position
t	time
ψ	wave
Ψ	wave function
F	force
C	'is a causally sufficient condition for'
IC	'is an initial condition for'
n	'number'
NC	'is a causally necessary condition for'
K	'It is known that'
B	'It is believed that'
Θ	'observes'
©	'is conscious'
i	information
I	'is intelligent'
O	'occurs'
P/	'the probability of'
P	projection operator on a Hilbert space
H	history
H	Hilbert space
v	vector

Notes

1   Einstein et al. (1935). Einstein said: "*Die Theorie liefert viel, aber dem Geheimnis des Alten bringt sie uns nicht näher. Jedenfalls bin ich überzeugt, daß der nicht würfelt.* (The theory delivers much, but it brings us no nearer to the mystery of the Old One. I, at any rate, am convinced that He does not play dice.)" (Einstein [1926] 1971, p. 91). (Translation amended.) The theory is quantum mechanics. The Old One is God. Although the experimenters set out with the explicit aim of finding the classical determinants of quantum reality, Einstein had, in the end, to renounce this scepticism about quantum indeterminism. John Bell showed mathematically that there are no local hidden variables which would eliminate the intrinsically indeterminate and probabilistic nature of quantum entanglement, and its threat of action at a distance and even transmission of information faster than the speed of light. Bell's refutation of Einstein is confirmed by the experimental work of the 2022 Nobel Prize winners, Alain Aspect, John F. Clauser, and Anton Zeilinger (See Bell 1964).

2   Allocate the value 'consciousness' to 'a', 'quantum level' to 'b', and 'physical world' to 'c', and read 'if not x then not y' as 'x is a necessary condition for y'. If not a then not b, and if not b then not c, but not: if not c then not b, then not: if not b then not a. Otherwise: if not c then not b (because if not c then not a, and if not a then not b, then if not c then not b, by the transitivity of 'if not'). But 'If not c then not b' is ruled out by Bell's criticism of EPR.

3   It is sometimes put to me, by way of objection: "Some of the presuppositions you identify are not peculiar to quantum physics but are presuppositions of any theory, or even presuppositions of *anything*". The observation is correct, but does not count as an objection to 'Consciousness is a presupposition of quantum physics'. If p is a presupposition of any theory, or of anything, then p is a presupposition of quantum physics.

4   I therefore cannot endorse the central thesis of Dennett (2017), because, if consciousness is a product of evolution, then consciousness is an emergent property of the brain. But consciousness is not an emergent property of the brain, so consciousness is not a product of evolution. Nevertheless, if the thesis that quantum reality presupposes consciousness is correct, then consciousness is 'already there' if atoms exist and, given that extra premise, it is right after all that the existence of atoms is sufficient for the existence of consciousness. But then it would remain wrong to claim that consciousness is any kind of product of evolution. Consciousness exists *anyway*.

5   Bohr says 'Far from containing any arbitrary renunciation of customary physical explanation, the notion of complementarity refers directly to our position as observers in a domain of experience where unambiguous application of the concepts used in the description of phenomena depends essentially on the conditions of observation' (Bohr 1958, p. 99).

6   This claim requires more clarification and defence than it has received. For example: In MW, the logical possibility that MW is false is not realised, neither is the theoretical possibility that the Copenhagen interpretation is correct or the mathematical possibility that there exists only one universe. Moreover: suppose p is possible, and *not p* is possible, but *both p and not p* is impossible. Is p then realised? Or is *not p* then realised? In MW, there seems nothing to force this one way or the other. Perhaps God does play dice.

7   Here we may adduce all Sartre's grounds for the past being 'personal', i.e., indexed to some present consciousness. (Priest 2001, 163 ff.)

8   Olley Pearson has argued, in rigorous detail, that a tensed account of time is (a) rationally unavoidable and (b) entails that the self is non-physical. See (Pearson 2018).

9   Einstein says: 'The attempt to conceive the quantum-theoretical description as the complete description of the individual systems leads to unnatural theoretical interpretations, which become immediately unnecessary if one accepts the interpretation that the description refers to ensembles of systems and not to individual systems' Einstein, in (Schlipp 1970, pp. 671–72).

10   For persuasive arguments for intuitionism, see: (Dummett 1975; Wright 1982, 2004).

11   Maudlin points out that: 'Bohm's theory is deeply congenial to an ontology which maintains that all that exists exists now, i.e., at a point of time classically conceived' (Maudlin 2002, p. 124).

12   Paul Davies claims: 'It is not a wave of any substance or physical stuff, but a wave of knowledge or information. It is a wave that tells us what can be known about the atom, not a wave of the atom itself. Nobody is suggesting that an atom can ever spread itself around like an undulation. But what can spread itself around is what an observer can know about the atom' (Davies 1983, p. 107).

13   If this is right, does matter exist? Feynman says: 'You can't say A is made of B or vice versa. All mass is interaction'. Richard Feynman Note (c. 1948), quoted in (Gleick 1992, pp. 5, 283).

14   Rovelli says 'If I observe an electron at a certain position, I cannot conclude that the electron is there: I can only conclude that the electron as seen by me is there' (Rovelli 2005, p. 116).

15   Rovelli thinks 'the "observer system" O in quantum mechanics need not be human or have any other property beside the possibility of interacting with the "observed" system S' (Rovelli 2005, p. 120). But, as we have seen, any chain of non-conscious observers has to be arrested in a conscious observer or there are no observers.

16   One might object that a camera (for example) has a perspective but is not conscious. But it is only right that a camera (or similar) has a perspective if someone could, in principle look through it (or, perhaps, through some camera or other). Consciousness is, therefore, presupposed. This holds even if a given camera can be triggered automatically or with no-one looking through it.

17   Rovelli gives 'The Reason for the Apparent Paradoxes'. He says 'The incorrect notion that generates the uneasiness with quantum mechanics is the notion of observer-independent state of a system, or observer independent values of physical quantities' (Rovelli 2005, p. 120).

18   See Note 14 above.

19   Rovelli draws a distinction between 'the measured system S and the measuring system O' (116) and says '[...] the central tenet of relational quantum mechanics is that there is no meaning in saying that a certain variable of the system S takes the value q: rather, there is meaning in saying that this variable takes the value q for O, or with respect to O' (Rovelli 2005, p. 116).

20   For example, Rovelli discusses 'this relativisation of actuality' (Rovelli 2005, p. 116).

21   Rovelli endorses 'Shannon's definition of information' and says 'According to this definition, the statement that O has information about S actually means that we shall observe O and S in a subset of the set formed by the Cartesian product ['OF'chECK] the possible states of O and the possible states of S' (Rovelli 2005, p. 120).

22   Rovelli says 'I reformulate the problem of the interpretation of quantum mechanics as the problem of deriving the formalism from a set of simple physical postulates. I consider a reformulation of quantum mechanics in terms of information theory. All systems are assumed to be equivalent, there is no observer–observed distinction, and the theory describes only the information that systems have about each other; nevertheless, the theory is complete' (Rovelli 2005, p. 119).

23   The Bayesian interpretation was developed by Christopher Fuchs, Carlton Caves, and Rüdiger Schack.

24   I argued that classical science cannot explain the scientist presupposed by its practice, in a talk given in Trinity College, Cambridge, in 1988. I thank Mike Brearley, Adrian Moore, and John Wisdom for comments. It was written up as Priest, "Scientist". (Priest 1993).

25   All and only those logical inferences with Fundamental Ontological import are *ontological*.

26   Penrose says 'It seems to me that consciousness is something global' (Penrose 1997, p. 133). Penrose says 'I share the discomfort of many others that the "Wigner view" seems to imply a markedly different physical behaviour in our own small corner of the universe from that which would be taking place almost everywhere else, in the absence of local conscious observers to keep things under control' (Penrose 1987, p. 110).

27   'Pure act' is not a perspicacious translation, because it implies that God exists in time. But the immanence of God is the Eternal Now, the unchanging present, the nunc stans. The nunc fluens is Creation.

28   Shimony says: 'I share Roger [Penrose]'s scepticism about all attempts to interpret away this mystery, for example, by many worlds interpretations, decoherence, hidden variables, etc. At some stage or another in a measurement process the unitary evolution of the quantum state breaks down and an actualization occurs. But at what stage? There are many possibilities' (Shimony 1997, pp. 156–57).

29   Schrödinger says 'Mind [. . .] I venture to call it indestructible since it has a peculiar timetable, namely mind is always *now*. There is really no before or after for mind. There is only a now that includes memories and expectations. But I grant that our language is not quite adequate to express this, and I also grant, should anyone wish to state it, that I am now talking religion, not science' Schrödinger (QQ: 87)

30   Interestingly, it follows that consciousness is not a product of evolution. Consciousness does not evolve.

31   Davies says 'Science, which by definition deals only with the physical universe, might successfully explain one thing in terms of another, and that in terms of another and so on, but the totality of physical things requires an explanation from without' (Davies 1983, p. 47).

32   Omnès says 'In his [Heidegger's] opinion, one cannot reach [the] Being by experiment, because [the] "Being withdraws itself as soon as it is disclosed in the instant". Whatever the meaning of this poetic sentence, it strangely looks when reading it in its context like a transmutation from potentiality to actuality that is not so foreign to physics' (Omnès 1994, pp. 519–20).

33   Rees says 'It is indeed remarkable that the external world displays so many patterns that our minds can interpret in mathematical "language"—especially when these are so remote from the everyday experiences and phenomena that our brains have evolved to cope with' (Rees 1997, p. 160).

34   Planck says 'All matter originates and exists only by virtue of a force which brings the particle of an atom to vibration and holds this most minute solar system of the atom together. We must assume behind this force the existence of a conscious and intelligent mind. This mind is the matrix of all matter' (Planck 1944, Abt. Va, Rep. 11, Nr. 1797).

35   Heisenberg says 'If we wish to approach the "one" in terms of a precise scientific language, we must turn our attention to that center of science described by Plato, in which the fundamental mathematical symmetries are to be found. In the concepts of this language we must be content with the statement that "God is a mathematician"; for we have freely chosen to confine our vision to that realm of being which can be understood in the mathematical sense of the word "understanding", which can be described in rational terms' (Werner Heisenberg 1985, p. 54).

36   It has been argued persuasively by the Canadian philosopher John Leslie, in a rather Neo-Platonic way, that *the reason why* there is a universe is that it is better that there should be a universe rather than no universe. See (Leslie 1979).

37   Here 'Being' does not mean 'the totality of what is' (or similar). 'Being' is understood as 'Pure Being'. Being is the Being of Parmenides and sharply *ontologically* distinct from any or all beings.

38   It follows that the Thomist thesis that God is his own existence is correct. (Aquinas 1953, VII. II; 1993, 202 & ff.) "Oportet ergo quod hoc quod est esse, sit substantia vel natura Dei", "Therefore that which is Being, must be the essence or nature of God" (translation amended.) VII. II. 11.

39   Roger Penrose comes close to expressing this doctrine and (no doubt unknowingly) engages in quasi-Hegelian dialectic, in (Penrose 1997, pp. 137–39). He uses the image of a triangle (138) to describe the relations between three 'worlds' (96) and three 'mysteries'. [1] Platonic; [2] Mental; [3] Physical. Penrose argues that each 'emerges' from the other. Penrose says 'There is something distinctly mysterious about the way that these three worlds interrelate with one another—where each seems almost to "emerge" from a small part of its predecessor' (Penrose 1997, p. 139).

[40]   Einstein notoriously resisted the more counter-intuitive implications of quantum physics for years. Nevertheless, Einstein understands, better than most, that serious science presupposes consciousness. Einstein says '[...] everyone who is seriously involved in the pursuit of science becomes convinced that a spirit is manifest in the laws of the universe—a spirit vastly superior to that of man, and one in the face of which we with our modest powers must feel humble' (Einstein [1926] 1971, p. 33).

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