Due to the self-referencing aspect, consciousness is placed in a unique non-computable position among natural phenomena. Non-computable consciousness was previously analyzed on the basis of self-referential cyclical time. This paper extends the cyclical model of vacuum observation and posits that choice, or the experience of reality, may be expressed as the initial part of the self-referencing loop, while the conscious awareness of the experience is the other part of the loop. In particular, the inseparability of the two sides of the loop is established through the cyclical time process, which bears a resemblance to Heidegger’s analysis of existence. The cyclical looping model is also discussed in terms of Wittgenstein’s analysis of language as attaching semantic meaning, or continuous or infinite conscious awareness, to physical reality. We also discuss the proposed model of subjectivity and cyclical time - as opposed to objectivity and linear time - which may be considered similar to Hebrew thought.

I. INTRODUCTION

With recent advancements in the field of artificial intelligence (AI), much of what was formally unthinkable has been achieved by a computing machine, such as winning the quiz show Jeopardy [11] or beating human chess or Go champions [8, 22]. The inquiry then arises as to how far the development of AI can proceed. Indeed, one of the intriguing questions in this regard is whether it would ever be possible for a computer to have a conscious ego, a term also known as strong AI. There are divided opinions [12, 21] regarding this question. For example, Penrose argued [17] that the Gödel-type non-algorithmic process, i.e., the non-computable element, may be present in consciousness. In [23], it was found, as suggested by Penrose, that there does exist a non-computable element in consciousness, which follows the logic of self-referencing. A number of studies have suggested [6, 15, 20, 29, 30, 35, 36] a close relation between nature and computation. If we accept this analogy, then it is rather odd that consciousness, which is considered part of nature, has a non-computable element. One attitude toward this awkward situation is to accept that consciousness is simply different from the rest of nature. The other approach may be to examine whether there is something amiss with the way in which the rest of nature is considered and whether the rest of nature could be modified such that it is consistent with consciousness. The intention of this paper is to accomplish the latter.

II. TEMPORAL

In general, an observation in quantum theory involves a state vector and a reference frame. In the case of self-observation, the state vector, which is the object, is the same as the reference frame or the observable. In that case, the active and passive approaches are not generally equivalent [28], therefore, self-observation is not computable in a linear time model.
Irreversible Nondeterministic

FIG. 1: [i] The irreversible computation [13] refers to the process whereby either input 0 or 1 is set to 0, i.e., erasing one bit of information. The nondeterministic computation [ii] is the time-reversal process of [i].

Thus, while the classical experience is done in a time-forward manner, the second part of the loop involves the quantum reference frame as evolving backward in time. In [28], it was shown that the discrepancy in the cosmological constant problem should correspond to the difference between the energy resulting from the classical computation moving in a time-forward manner and the energy resulting from the quantum evolution - or the Dirac-type negative sea of consciousness [26].

III. INSEPARABLE

We now wish to extend the case of the cyclical looping model of vacuum observation to the process of experiencing physical reality. Reality refers to something that can be directly experienced in classical space, such as energy, mass, etc. In [13], Landauer showed that the process of irreversible computation erasing a bit yields energy, \( E_0 = kT \ln 2 \). If we assume that

\[
\mathcal{E} = N \cdot E_0
\]

then the process of experiencing the reality of \( \mathcal{E} \) may be considered with the following looping process:

1. Experiences the reality of \( \mathcal{E} \) through classical irreversible computation

2. Conscious awareness of the experience of \( \mathcal{E} \) through quantum nondeterministic computation

The first part of the loop corresponds to the classical reference frame of performing an irreversible computation, i.e., the classical choice is being made (Fig. 2). Since the irreversible computation is associated with energy, this implies that the choice made by the observer corresponds to the experience of energy \( \mathcal{E} \). Note that there have been numerous discussions suggesting the relation between symmetry and physical reality [10, 14, 31]. The second part of the loop corresponds to the conscious understanding or awareness of the experience of reality \( \mathcal{E} \) through the evolution of the quantum reference frame.

The proposed model is similar to the philosophical analysis of existentialism. For instance, Heidegger noted [9] that the reality of the observed and the conscious observer are not separable; as such, he advanced the notion of \( \text{dasein} \), i.e., being-in-the-world. In particular, he addressed the being’s nature with time, i.e., past, present, and future together compose the being. The above model (Fig. 2) shows the experience of physical reality, i.e., the experience of choice, as being inseparable from the conscious realization of the physical experience through the cyclical process of time.

IV. LANGUAGE

The argument in [7] was that classical probability theory may be considered equivalent to quantum theory, except for the aspect of continuity. Moreover, [25] argued that one can exploit this idea such that classical probability theory can be considered to involve a classical choice made by the observer, whereas continuity is associated with the quantum part. Thus, while the experience of physical reality is discrete or finite, conscious awareness, which corresponds to quantum evolution, is continuous. Therefore, one may consider that the semantics of the finite, i.e., the experience of reality, are associated with continuity or infinity, i.e., conscious realization.

As noted earlier, there have been various discussions regarding the relation between information and reality (Fig. 3). In [14], Landauer explained the physical nature
It is remarkable that one is able to communicate or learn the meaning of infinity with only a finite array of binary bits. This suggests that the continuity or infinite aspect may not be something that is transferred or learned, i.e., the semantic aspect of language ought to be innate and shared. Indeed, as indicated earlier [25], this continuous or infinite side of consciousness may be associated with universal grammar, which argues that all languages have a universal structure that is not learned but is innate in human nature [26, 27]. A similar argument of the shared Dirac-type negative sea of consciousness was discussed [27] in terms of entanglement and nonlocality.

V. REMARKS

In [24], the suggestion of subjective reality was drawn from the argument of consciousness, that is, only in the case of consciousness are the object and the observer the same. This phenomenon is unique, considering that the observation or measurement results from the relative difference between the object being observed and the observer. Consequently, it has been suggested that because of consciousness, one should stop considering the observer and the object as separate entities.

Conventional thought has often distinguished between the observer and the observed, mind and physical, etc. This approach is consistent with the scientific endeavor, at least until the arrival of quantum theory, in seeking an objective reality. However, this has not been the case in Hebrew thought, i.e., the description of subjective reality has often been used [1]. The proposed model [24], which is based on quantum theory and consciousness, bears a resemblance to the Hebrew conception of reality. In particular, the concept of cyclical time, through which the subjective reality has been placed on firmer ground, as discussed in this paper, is often found in the Hebrew language as well (Fig. 4).

One of the mysteries in physics has been the apparent discrepancy between classical and quantum theories. This is because quantum theory involves many elements not seen in classical physics [18], such as wave/particle duality, superposition, entanglement, nonlocality, etc. There is also a historical reason for this confusion; quantum theory was introduced in the twentieth century, and its descriptions of certain behaviors were presumed to replace many previously considered classical behaviors. This explains why one of the largest efforts in the theoretical physics research community is now being directed toward trying to come up with a quantum version of classical theory, namely, gravitation. However, contrary to the common perception, the classical aspect may be an integral part of the whole picture. Indeed, the presented cyclical model shows the manner in which the classical and quantum aspects are interconnected through time.
[1] Boman T. Hebrew thought compared with Greek. WW Norton & Company, 1960.
[2] Carroll S. The cosmological constant. Liv Rev Rel 2001; 4: 1-80.
[3] Chomsky N. Aspects of the theory of syntax, MIT Press, 1965.
[4] Chomsky N. Rules and representations, New York: Columbia University Press, 1980.
[5] Cook VJ and Newson M. Chomsky’s universal grammar: an introduction, Wiley-Blackwell; 3rd edition, 2007.
[6] Deutsch D. Quantum theory, the Church-Turing principle and the universal quantum computer. Proc R Soc London A 1985; 400: 97-117.
[7] Hardy L. Quantum theory from five reasonable axioms. 2001. arXiv:quant-ph/0101012
[8] Hassabis D. Artificial intelligence: chess match of the century. Nature 2017; 544: 413-414.
[9] Heidegger M. Being and time. New York: Harper and Row, 1962.
[10] Jacobson T. Thermodynamics of space-time: the Einstein equation of state. Phys Rev Lett 1995; 75: 1260-1263.
[11] Jones N. Quiz-playing computer system could revolutionize research. Nature online 15 Feb 2011.
[12] Kurzweil R. The singularity is near. Viking Penguins, 2005.
[13] Landauer R. Irreversibility and heat generation in the computing process. IBM J Res Dev 1961; 5: 183-191.
[14] Landauer R. Information is physical. Phys Tod 1991; 44: 23-29.
[15] Lloyd S. Programming the universe. Alfred A. Knopf, New York, 2006.
[16] Padmanabhan T. Thermodynamical aspects of gravity: new insights. Rep Prog Phys 2010; 73: 046901.
[17] Penrose R. Shadows of the mind. Oxford University Press, New York, 1994.
[18] Peres A. Quantum theory: concepts and methods, Kluwer, Dordrecht, 1997.
[19] Reynolds M. Axiomatisation and decidability of F and P in cyclical time. J Phil Logic 1994; 23: 197-224.
[20] Schmidhuber J. Computer universes and an algorithmic theory of everything. arXiv:1501.01373
[21] Searle J. Minds, brains and programs. Behavioral and Brain Sciences 1980; 3: 417-457.
[22] Silver D et al., Mastering the game of Go with deep neural networks and tree search. Nature 2016; 529: 484-489.
[23] Song D. Non-computability of consciousness. NeuroQuant 2007; 5: 382-391.
[24] Song D. Einstein’s moon. Phys Usp 2012; 55: 942-943.
[25] Song D. Remarks on nondeterministic computation, choices, and formal language. NeuroQuant 2016; 14: 702-707.
[26] Song D. Comment on information and dualism. NeuroQuant 2017; 15: 141-144.
[27] Song D. Relational decision-making processes. (to appear) NeuroQuant 2017.
[28] Song D. Decision-making process and information. arXiv:1701.08641 [physics.gen-ph].
[29] ’t Hooft G. Quantum gravity as a dissipative deterministic system. Class Quant grav 1999; 16: 3263-3279.
[30] Vedral V. Decoding reality: the universe as quantum information. Oxford University Press, 2010.
[31] Verlinde EP. On the origin of gravity and the laws of Newton. J High Energy Phys 2011; 1104: 029.
[32] Wheeler JA. Information, physics, quantum: the search for links. In Zurek ed., Complexity, entropy, and the physics of information. Redwood City, California: Addison-Wesley, 1990.
[33] Wittgenstein L. Tractatus logico-philosophicus. trans. C.K.Ogden, London: Kegan Paul, 1922.
[34] Wittgenstein L. Philosophical investigations. London: Macmillan, 1953.
[35] Wolfram S. A new kind of science. Wolfram media, 2002.
[36] Zizzi P. Spacetime at the Planck scale: the quantum computer view. arXiv: gr-qc/0304032