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Quantum Computing Arrives

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Abstract
Quantum computing arrives. Our previous work shows at least 4 quantum properties that are indeed universal in some number systems; here we use them to enable quantum computing. Using the sets N, Z, Q, and Q, one has +4 quantum properties that one can trust, as archetypes of easy communication to friends and foes, to ignoranti or cognoscenti, and for quantum consciousness. Therefore, this work applies to computer calculations, apps in cell phones, algebra, and in the human mind.*

1. Introduction

"Die ganzen Zahlen hat der liebe Gott gemacht, alles andere ist Menschenwerk" Leopold Kronecker.

Quantum computing arrives. This is announced based on the properties of natural numbers, integers in the set N. Therefore, this work applies to computer calculations, apps in cell phones, algebra, and in the human mind. Quantum computing opens to quantum consciousness.

2. Periodicity

Numbers obey a physical law, using periodicity in numbers. As well-known, Peter Shor at the Massachusetts Institute of Technology was the first to say it, in 1994 [cf. 1], in modern times. It is a wormhole, connecting physics with mathematics, has existed even before the Earth existed, and was used, as well-known, by Ramanujan in studying partitions, and others.

So-called "pure" mathematics is, after all, governed by objective laws. The Max Planck Institute of Quantum Optics (MPQ) showed the mathematical basis by recognizing the differentiation of discontinuous functions in 1982, which led to use the set Q to define calculus [1,2].

3. Complex Numbers are Deprecated and This Simplifies Quantum Computation

The above denies any type of square-root of a negative number -- a.k.a. an imaginary number -- rational or continuous [1,2]. Qubits are also denied in [1]. Complex numbers, of any type, are not objective and are not part of a quantum description, as well-known to have been said first by Erwin Schrödinger in 1926 --yet, cryogenic behemoth quantum machines, see Fig.(1), consider a "complex qubit"- two objective impossibilities [1]. They are just poor physics and expensive analog experiments in these pioneering times.

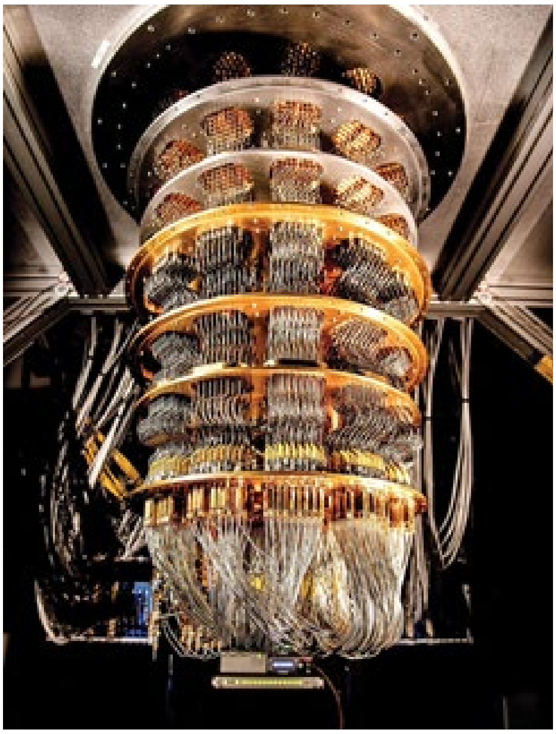

Figure 1: Cryogenic proposal for quantum computing

Quantum computing is, albeit,natural. Atoms do it all the time, and the human brain -- all based on +4 quantum properties of numbers.

Three of these properties are defined in [1]. The fourth quantum property of numbers can be seen in prime numbers, as indistinguishability.

Indistinguishability sets in because one cannot distinguish any specific number among many, e.g., in the prime number

163283381. A prime number is a “blob” and cannot be split in any way, or understood in terms of any of its digits.

This is valid, using the set N, here on Earth and in the star Betelgeuse. It is a universal quantum property, and the fourth. Each point, in a quantum reality, is a point ... not continuous. So, reality is grainy, everywhere. Ontically.

4. Quantum Mathematics

To deal with numbers and objective properties seems contradictory.

Albeit, we take the mathematical position of Gottlob Frege. Using Frege himself, in his historical words, but now interpreted under the discoveries of numbers by quantum computing.

By that we mean the +4 quantum properties of numbers, presented in Section 3.

The reference of a sentence is its truth value, whereas its sense is the thought that it expresses. Frege justified the distinction in a number of ways.

Sense is something possessed by a name, whether or not it has a reference. For example, the name "Odysseus" is intelligible, and therefore has a sense, even though there is no individual object (its reference) to which the name corresponds.

The sense of different names is different, even when their reference is the same. Frege argued that if an identity statement such as "Hesperus is the same planet as Phosphorus" is to be informative, the proper names flanking the identity sign must have a different meaning or sense. But clearly, if the statement is true, they must have the same reference. The sense is a 'mode of presentation', which serves to illuminate only a single aspect of the referent.

Much of current analytic philosophy is traceable to Frege's philosophy of language.

Frege's views on logic (i.e., his idea that some parts of speech are complete by themselves, and are analogous to the arguments of a mathematical function) led to his views on a theory of reference; which we use for treating numbers as semiotic quantities -- using the +4 quantum properties of numbers.

These properties must be obeyed by the sets B={0,1}, N, Z, Q, and any other set based on them, e.g., the new set Q* we propose elsewhere.

All begins with two elements: 0 and 1, and we add angle in the set Q*.

Any physical system can be represented only with the set B, and that is why computers can calculate anything. Humans can work more efficiently and intuitively using the set Q*, as we propose elsewhere. There is no imaginary number, or infinitesimal numbers.

One can see a number as pointing to its truth value (called a value) and expressing a thought (called its digit in the base used). The digit is the sense, the meaning of the number.

The digit can change at will, subjectively, but the value stays objectively fixed. And, they can exchange positions.

Thus one can write F in hexadecimal, while the value is 15 in base 10. The number is this 1:1 mapping between a name ("F") and a value (15). Or, in reverse, exchanging positions, one can use 15 for the name, pointing to the value F.

Or, one can use 1111 in 64-bit signed binary for the name, pointing to the same value (15). A number is seen as this flexible semiotic concept, very used in computers, and for quantum computing.

Note also the absence of the sets R, C, the irrational numbers; and the p-adic numbers, e.g. There is no classical epsilon-delta in the description, as the +4 quantum properties of each number provide a natural empty neighborhood around each 0-dimensional pont.

To imagine a continuous point is to imagine a "mathematical paint" without atoms, as described by Nahin [cf. 1]. Take an AFM microscope ... atoms appear!

The atoms, an objective reality, imply a graininess. This quantum description includes at least, necessarily (Einstein, 1917), three logical states -- with stimulated emission (coherent), absorption, and emission. Further states are possible, as in measured superradiance.

Mathematical complex numbers or mathematical real-numbers do not describe objective reality [1]. They are continuous, without atoms. They are not computable according to Gisin [cf. 1].

Poor math and poor physics. Without any philosophical considerations, shows that numbers must have physical significance in order to model physical processes [1].

Numbers work without physical considerations as well, but the results are not trustworthy, as physically valid. Such as defining distance using the well-known p-adic numbers, when one gets the incorrect physical measurement.

It is easy to see that multiplication or division "infests" the real part with the imaginary part, and in calculating modulus -- e.g., in the polar representation as well as in the (x,y) rectangular representation. The Euler identity is a fiction, as it trigonometrically mixes types … one can avoid it. The FFT will no longer have to use it, and FT=FFT (to be published).

The complex number system "infests" the real part with the imaginary part, even for Gaussian numbers, and this is well-known in third-degree polynomials. Complex numbers, of any type, must be deprecated, they do not represent an objective sense. They should not "infest" quantum computing.

5. Discussion

Quantum computing is better without complex numbers. Software makes R,C=Q --> B={0,1}, and digital hardware calculates. Some results are immediate, like 0n = 0 and 1n =1, for any n in the set N. That is more than an exponential increase, as some results become immediate with quantum computing.

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