Can nature possibly be as absurd as it seemed
to us in these atomic experiments?

Werner Heisenberg

# A comprehensive explanation of quantum mechanics: the keyword is "interactive holography"

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## Abstract

A hardware implementation of the mathematical algorithm for quantum mechanics is outlined. This "high-tech" enterprise is based on "interactive holography", an operational entourage that makes quantum mechanics a "normal" science. The holographic reference beam introduces an additional coordinate of phase leading to the description of states by the four-component vectors: |ψ>. Quantum mechanics arises as a holistic phenomenon, so its conventional treatment in terms of local interactions is essentially inadequate raising irrational philosophical constructions. The intrinsic non-locality of the presented model naturally embraces the entanglement of distant objects. Also, the non-separability of holographic processing produces "exchange interactions" between quantum particles showing different collective properties of boson and fermion types. Interleaved synchronized-desynchronized stages of the clock cycle evoke the wave-particle duality in the context of the fundamental perplexity of "measurement". At synchronization stages, quantum objects evolve as a "superposition" of potentialities, at desynchronization stages, those are probabilistically reduced to one of the characteristic states of the "measurement" apparatus. Such a forced changeover dismisses the uneasy view on quantum world as an emanation of consciousness whatever this means. The given explanation of quantum mechanics generates a battery of original testable predictions that largely confront the existing concept of the Universe.

**Keywords:** superposition, quantum measurement, holographic Universe,
quantum entanglement, interactive holography

Contents

## 1. Introduction

How can a factual discipline as quantum mechanics "have philosophical implications?" [1]. The need for a strange philosophy apparently signifies that the explanation of quantum mechanics requires non-trivial constructive solutions. The inquiry [1] continues: the principles of organization of quantum mechanics are so different from those of every other empirical science that they generate particular perplexities concerning (1) the significance of scientific knowledge; (2) the possibility of gaining objective information about the world; (3) the real nature of physical interactions between phenomena; (4) the proper function of scientific theories – for example, do they just describe phenomena or just predict them, or do they explain them? do they provide representation of them?

Truth is evaluated in three independent aspects: correspondence to facts, pragmatism of applications, and coherence with the outside knowledge. Quantum theory is a computational algorithm impeccable for all practical needs. However, the ultimate goal of a scientific theory is to understand the Nature of Things. There are two extreme alternatives: (1) strange quantum principles actually determine the reality of the Universe or (2) the current physical picture of the quantum world is a complete absurd, and a constructive solution is yet to be found.

In [2], W.E. Lamb said that any discussion on physical properties of matter beyond the rules for calculations almost inevitably becomes rather vague: "it is certainly a convenient fiction to pretend that the usual textbook assumptions about measurement have a meaning, even from operational point of view they do not". He taught quantum mechanics over 20 years: "On beginning the lectures I told the students, "You must first learn the rules of calculation in quantum mechanics, and then I will tell you about the theory of measurement and discuss the meaning of the subject." Almost invariably, the time allotted to the course run out before I had to fulfill my promise". Hopefully, the time is coming when this promise could be carried out.

The Section 2 derives the "hidden variables" for the suggested mechanism of quantum behavior using the general approach of the so-called Holographic Universe (see, e.g., [3]). Intrinsic to our particular model, the clock cycle with interleaved synchronization-desynchronization stages is responsible for the appearance of the wave-particle duality. The interactive holography feedbacks introduce an additional phase coordinate providing a vector space treatment of the quantum states as delineated in Section 3. The transformation of quantum systems is essentially an intermingling of two processes: transitional suspension in a nebulous "superposition" state and probabilistic jumping into one of the definitive eigenvalues of an applied operator. In Section 4, this main quantum mechanics procedure is determined by the synchronization-desynchronization structure of the clock cycle, which disturbs smooth Schrödinger's evolutions by forced interrupts of "measurements". Section 5 explains the most mysterious phenomenon of science – quantum entanglement. This unique explanation comes from the holistic control of the superposition states by the impacts of interactive holography. Section 6 summarizes our findings.

## 2. "Hidden variables" and the clock cycle of interactive holography

Attempts to rationalize quantum mechanics run into various blind alleys. Quantum phenomena are very puzzling – "so puzzling indeed that many physicists doubted that a rational explanation of quantum phenomena would ever be found" [4].

Construction of scientific models almost invariably misses one indispensable engineering component. This component is the clock of driving pulses. Its significance shows up only for primitive operations at the bottom level of the model; at higher levels, the capability of moving forward is taken for granted. An instructive example presents a physical system implemented as a software model; it is hardly recognized that such a model implicitly exploits the clock of the host computer. Any system must have a clock of driving pulses. Interestingly, the whole Universe in view of Aristotle is permeated by a global rhythm. How can it be otherwise?

The peculiarity of quantum mechanics behavior is due to the specificity of the holographic operational clock cycle, which consists of alternation of synchronization-desynchronization stages.

In the center of quantum dynamics is the process of "measurement": transitions from a continuous evolution of Schrödinger's Ψ-function to abrupt stochastic jumps into discrete microobjects. Attempts to comprehend these ghost materializations have attracted fantastic ideas, like branching in a many-worlds universe or influence of human consciousness. In our construction, the "superposition" reality of quantum mechanics arises as a result of forced interrupts imposed by the clock cycle of the holographic control. Other quantum phenomena, including quantum entanglement, go along with the technicalities of these "hidden variables" of interactive holography. Actually, the "hidden variables" of quantum mechanics behavior include the whole physical Universe.
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The considered workings of the mechanism of the Holographic Universe have been derived from our cellular automaton model of the physical world (see Fig.1 and 2). This model named CAETERIS (Cellular Automaton EThER InfraStructure) has been presented in several publications [5-11]. For the sake of convenience, our diverse findings as they pertinent to the realization of quantum mechanics are overviewed below.

### The basics of the CAETERIS model

1. *The scene of mutual synchronization*

A cellular automaton is a regular grid of nodes whose states are transformed in discrete steps depending on the states of surrounding neighbors (see [12, 13]). Organization of the physical world with cellular automata was initially conceived by K. Zuse and E. Fredkin ([14], [15]). The potentials of cellular automata for this purpose are best envisioned with the famous Conway's "Game of Life" (see, e.g., [16]), which generates intriguing patterns using a simple rule. Some of these patterns, like "gliders", present stable relocating configurations. It is challenging to find a cellular automaton rule producing a collection of stable relocating configurations that could be identified with the elementary particles of matter. As long as these material formations are reconfiguring over a medium rather than by passing through it, the absolute nature of their motions is hidden. Thus, to begin with, the notorious confrontation of an ether-like medium with the postulate of relativity is avoided.

Cellular automaton modeling of the Universe encounters two major concerns. First: how to find the rule that generates the whole complexity of the physical world. Second: how can interactions of immediate neighbors furnish quantum non-locality. Considering the cellular automaton model not as an abstract mathematical postulate but as a concrete engineering construction, the desired rule can be found immediately by the aforementioned indispensable requirement for a clock of driving pulses. So, there is little arbitrariness in the choice of the primitive rule for the cellular automaton model of the physical world. Luckily, the obtained rule resolves the second concern too. As expressed in [7], the whole richness of the physical world condenses in a plain sentence: "All physical phenomena are different aspects of the high-level description of distributed processes of mutual synchronization in a network of digital clocks".

## 2. *Actors: the all-inclusive cast of elementary particles*

The cornerstone fact is that the CAETERIS model yields a collection of "excitons" in the form of helicoidal traveling wave solutions that exactly corresponds to the spectrum of the stable elementary particles of matter. The monumental properties of the physical world emerge automatically as well. The law of inertia appears because traveling waves synchro formations get their uniform motion for "free" from the cellular automaton mechanism, an upper bound on the speed of the material synchro formations – the speed of light comes from the helicoidal structure of the "excitons", antimatter stems from dual solutions having an opposite sense of rotation, slight asymmetry between matter and antimatter arises from an arbitration protocol, mutual transformations of elementary particles are intrinsic to synchro formations, and much more [5-11].

## 3. *The non-locality backstage and the diffusion waves trains for holography*

Besides the traveling wave "excitons" solutions the CAETERIS model also includes fast spreading diffusion solutions. These solutions show the origin of non-locality of the Universe and produce the "action-at-the-distance" effects of gravitation. The phenomenon of gravitation stays apart from the rest of the physics since the traveling wave "excitons" solutions and spreading diffusion solutions are entirely different. The appeared mechanism for gravitation [11] accounts for amplification of attraction in cosmological scale; in other words, it exhibits the effect attributed to an imaginary "dark matter". In accordance with our findings, the latest results [17] indicate that certain galaxy configurations "cannot possibly contain dark matter" and there is "only one way" to explain these results: "Gravity has to be stronger than predicted by Newton".

The CAETERIS model explains the origin of non-locality with ease and elegance. The ultra fast processes in the Universe originate from the paradoxical property of parabolic equations: the diffusion impact spreads with an infinite speed. The physical reason for this mathematical paradox is that the parabolic equations describe spreading of smoothed macroscopic values, like “temperature”, “density”, or “phase amassment”. Forming these values by averaging incurs temporal delays while outlying microscopic impacts can stretch significantly faster. “Instantaneous” isolated phase propagations occur below the “slow” averaging of phases in the course of mutual synchronization. In a strict physical sense, mathematical idealization of spreading diffusion by parabolic equations is deficient. Behind a simplified presentation of diffusion by parabolic equations there should be a very fast propagating wave mechanism [18].

The opinion that “the action-at-the-distance” is inadmissible from the philosophical standpoint is flawed. There is nothing outlandish in having a system with two types of processes developing in substantially different time scales. It is a typical situation when relatively slow material systems are under an essentially faster information control. This information control is provided by the holographic mechanism of the Universe; the ultra fast diffusion processes associated with mutual synchronization of the cellular automaton grid create the wave trains for this mechanism.

An important circumstance is to be emphasized: proper formation of waves operations in a holographic mechanism is possible only in a three-dimensional space (see [19]).

## 4. *The global structure of the Universe*

A major disorientation of modern physics comes from the incomprehension of non-locality. The speed of light limit is applicable only to straight material processes, the backstage processes associated with the action-at-the-distance in the effects of gravitation and wave trains in holography occur enormously faster.

Globally, the physical Universe presents a cellular automaton medium in the form of a “hypersphere” (a 3D surface of 4D sphere). Figuratively speaking, due to property of non-locality the huge hypersphere of the Universe shrinks in about $10^{40}$ times and thus appears as a reasonable apparatus amenable to a conventional treatment.

The systematic absence of gravitational waves (Laser Interferometer Gravity-wave Observatory, LIGO) and non-detection of the space-time distortions (Probe B) are not failures but important experimental results rejecting the general relativity. The Advanced LIGO will increase the accuracy of observations of the expected gravitational waves by more than an order of magnitude, so validation of the conclusion about general relativity is postponed till 2014 [20].

"The construction of the world seems to be based on two pure numbers, $\alpha$ and $\varepsilon$, whose mystery we have not yet penetrated" [21]. The factor $\alpha$ = 1/137, the fine structure constant, appears in relation to interaction of matter with electromagnetic radiation. The number $\varepsilon \sim 10^{40}$ characterizing the relative strength of gravitational interaction is more mysterious: "A simple mathematical theory may lead to numbers like ½ or 8π, but hardly to a non-dimensional number of extravagant order of magnitude $10^{41}$" [21].

The two dimensionless parameters of the physical world: $\alpha = 1/137$ and $\varepsilon \sim 10^{40}$ are artifacts of the cellular automaton construction. Helicoidal traveling waves correspond to material and electromagnetic processes developing in the interval of speeds $(1/137 - 1) \cdot c$. The stretching diffusion produces an "instantaneous" finite impact at $t \rightarrow 0$. Stretching pulses apply gravitational impact with the velocity, $V_f$, of $10^{40} \cdot c$. It has been determined that a relatively slower removal of this impact by the succeeding rear activity, the desynchronization process, occurs with the velocity, $V_r$, of $10^{32} \cdot c$.

The CAETERIS model features two kinds of global periodic processes: the sequence of slow mater creations in Big Bang style and generation of trains of diffusion waves for the holographic mechanism of the Universe. Accordingly, these processes develop in substantially different times scales with the ratio of periods $(1/137){:}10^{40}$. The "slow" material process presents a succession of Big Bangs alternately creating matter and antimatter at the opposite poles of the Universe with a repetition rate of 60 billion years. The "fast" periodic informational process runs with the $10^{40}$ higher speed producing self-oscillations of synchronization-desynchronizations with a repetition rate about $10^{-11}$ sec.

The succession of Big Bangs in the "slow" periodic process explains the redshifts anomalies with respect to the plain Hubble flow purporting that the far-off galaxies have greater speeds. To explain this enigmatic discovery about a decade ago an accelerated expansion of the Universe had been devised and a special "dark energy" had been introduced to make this happen. In our model the situation is much simpler: slow moving galaxies in the faraway cosmos had come from a previous Big Bang. Remarkably, in a similar way, the perplexing spot of blueshifted galaxies in the nearby cosmos of the Virgo Cluster had also come from the previous Big Bang.

**Informational processes in the Holographic Universe**

1. *The suggestive anisotropy of the Cosmic Microwave Background radiation*

The big picture of Nature offered by modern cosmology is absolutely incorrect (see the critique of this situation in [22-24]). Astrophysical observations bring in mismatching facts that ensue awkward theoretical adjustments, like "dark matter", "dark energy", inflation, anomalous distribution of matter, and so on. In the CAETERIS model all the discordant astrophysical facts fall into a coherent cosmological picture (see [9-11]).

A rather obscure situation presents the fact of the anisotropy of the CMB. According to the standard cosmology the CMB is a post-creation remnant of the cooling down matter, so it is expected that the CMB radiation should have an ideal spherical symmetry.

Thus, the discovery of the anisotropy of the CMB temperature distribution, particularly in a special form of the so-called "axis-of-evil", has come as a big surprise [25]. The confusion is so great that new missions are being undertaken hoping to invalidate the previous conclusions [26].

In the CAETERIS model the CMB appears from a “shock wave” spreading ahead of the current Big Bang. This CMB layer is the place where the holographic recording occurs (Fig. 1,2,3). Our model has predicted the CMB anisotropy several years before its discovery [9, 27]. This anisotropy is an immediate consequence of the eccentric position of the Solar system with respect to the spherically symmetric reference beam of the holographic mechanism. Actually, the holographic mechanism of the Universe cannot be operational without this eccentricity [10]. The eccentric observation first distorts Doppler’s dipole and then leads to its misalignment with the quadrupole and higher components - the appearance of the so-called “axis-of-evil”. With our model the angle of this misalignment can be exactly calculated.

The correspondence of the CMB emission to the spectrum of the black body radiation does not necessarily signify that the CMB is produced by cooling matter. The same formula used for heat radiation is also applicable to a system of oscillators with equally separated energy levels [28]. Such system is supposed to be involved in holographic recording. For the temperature parameter of the CMB radiation – 2.72 $^0$K the peak frequency of this radiation, following Wien’s law, is about $10^{11}$ Hz. So, the clock cycle driving the quantum behavior is going at this frequency.

2. *The totality of recording*

“The information wondering back and forth inside is devoid of meaning until it is captured by an irreversible process” (John Wheeler). The operational idea behind the suggested Universe construction is that every event is recorded in a holographic manner. Namely, for every elementary particle every event at the interval of $10^{-11}$ sec is recorded. The estimates [10] show that this idea could be feasible. The total recording in the Universe resembles accumulating of information in the Microsoft project “Digital Life”, where storing every piece of information for a given individual during the whole life is within the technological reach. As to the information about all the events in the Universe for an epoch of 1000 billion years, this entire recorded information according to the estimates [10] will be around $10^{100}$ bits.

Employing the totality of recording the problems of control complexity are obviated through immensity. Under holographic feedbacks small particles exhibit behavioral traits of quantum mechanics. Large molecules, like DNA and proteins, gain unusual shared access to the informational infrastructure of the material world, and thus acquire the leverage for biological control ([29]).

3. *The structure of the operational cycle and the origin of Plank’s constant*

The holographic processing of the Universe is steered by the clock cycle with alternating stages of synchronization and desynchronization. At the former stage, the synchronization permeates across the whole Universe from one pole to another with constant phase threads. This occurs at the maximal possible speed of $10^{40}\cdot c$, with which it takes about $10^{-19}$ sec to cross the whole Universe. At the latter stage, the fabric of constant phase threads fades out gradually with a lower speed of desynchronization taking about $10^{-11}$ sec. The succession of synchronization-desynchronization stages splits into different fragments depending on the position of the observation point in the Universe (see [10]). The structure of this cycle at the Solar system includes insets stages of about one thousandth of the synchronization-desynchronization cycle length corresponding to the Solar system displacement from the pole (Fig. 4).

The established clock cycle puts the physical world under the sway of interactive holography. This approach to quantum mechanics has been stirred up by the following observations: (1) the intermittent sequence of synchronizations and desynchronizations stages may correspond to waves at the former stage and to particles at the later, (2) the clock frequency of $10^{11}$ Hz presents a watershed between the realms of classical and quantum physics while also playing a subtle but unyielding role in biological phenomena.

Quantum mechanics starts with the introduction of a new physical parameter - Plank's constant, $h$. A distinctive parameter in a physical phenomenon points to a particularity in its operational scheme. In the CAETERIS model, the typical operational features of the physical world, qualitative and quantitative, are determined by the specifics of distributed mutual synchronization. Thus, the local and global gauge invariances arise because of the periodicity of the phases, broken symmetries are due to built-in protocols for signal arbitration, the speed of light restraint comes from the phase gaps imposed by the fault-tolerance procedure, etc.

Quantization of physical processes is deemed to appear because of the discrete nature of microobjects. Rather than changing continuously, energy is handled in portions: $h \cdot \nu$, where $\nu$ is the wave frequency. This parameter – $h$ – responsible for quantum effects does not come directly from the bottom of the cellular mechanism of the physical world. Instead, it is determined at a higher level – the duration of the clock cycle of the holographic mechanism, $T_{cycle}$ , that happens to be $\sim 10^{-11}$ sec.

Conceivably, with some wild speculations it could be possible to get something like:

$$\Delta E \cdot \Delta t \geq \text{(some coefficient)} \cdot T_{cycle} = h \qquad (1)$$

The quantum mechanics context we live in is not absolutely unique. Certain differences in $h$ and other variations could arise depending on the structure of the clock cycle, which is affected by system's position in the Universe (see [10]).

4. *A new cosmological phenomenon – concomitant generation of material inflows as a result of content-addressable holographic access*

The information dominant construction of the Universe reveals a new phenomenon of Nature in the cosmological scale: a side effect of continuous uniform influx of all types of elementary constituents of mater. Such activities are instigated by the content-addressable access to the holographic memory of the Universe. This phenomenon in the context of biological information processing was introduced in [29].

The key point of the suggested concept of quantum mechanics is that the grand effect of Cosmic Microwave Background (CMB) is a part of this phenomenon of concomitant material influxes. Namely, according to our concept the material influxes accompany cellular automaton activities of retrieving the data already stored in the bulk of holographic memory, while the CMB is an indication of writing down in the memory through recordings in the activated layer (see Fig. 1,2,3). This depiction is in a sharp irreconcilable contrast with modern cosmology. Cosmologists have been greatly confused by the discovery of the so-called "axis-of-evil" pattern imprinted on the CMB. According conventional cosmology such a pattern simply shouldn't exist. Remarkably, in our model this pattern is a token of eccentricity, which is required to facilitate the retrieval from the holographic memory. Note that the CMB radiation we observe had been created billions years ago, whereas the holographic feedbacks for quantum mechanics return from the current recording layer almost instantaneously, in about $10^{-11}$ sec; the CMB radiation generated in present quantum mechanics processes will arrive in billions of years.

Quantum microobjects utilize the immediately recorded signals at the CMB propagating layer, while biomolecules exploit the whole history of the events from the entire holographic memory. The content of the holographic memory of the Universe is engraved in the cellular automaton medium. The memory content may be encoded in the clock frequency, which is an easily adjustable parameter. Thus, we have introduced a new principle for realization of the content-addressable access through beating pulsations. The extensive biological ramifications of this supposition will be considered elsewhere. Here we stress an interesting physical consequence.

The surmised possibility of the content-addressable access leads to additional transformations of the cellular automaton states. These additional activities may generate material formations unrelated to the existing celestial bodies. As a result, we can get an influx of all the varieties of material components coming from nowhere. Quantum mechanics behavior is unavoidably accompanied by generation of pieces of matter as a by-product of establishing the informational feedbacks. One may see a certain analogy with tapping electromagnetic noise from informational processes of a computer by hardware hacking.

The key part of the surmised effect of material inflows is the Cosmic Microwave Background radiation, as discussed above. Other material components coming uniformly from nowhere include the following. Recently, there have been observed a hiss of radio waves peaking at 3 and 8 megahertz [30]. The hiss of electromagnetic waves may be considered as a pale version of the CMB; the CMB is a crisp production of the recording layer, the hiss of radio waves is a lopsided output from the bulk of the memory. It has been already known for a certain time that the Earth is continuously bombarded from all directions by various sorts of high-energy cosmic rays and neutrinos without an identifiable source; the conventional interpretation is that these particles have some cosmological origin, while in our interpretation they may appear from the activities of the content-addressable access. The material influx effect should also include different kinds of light quanta. Presumably, an unaccounted for influx of photons might has been already observed, but might not be properly recognized.

An interesting part of the material influx effect may constitute the fluctuations of gravity, a curious upshot in view of non-detection of the gravitational waves [31]. Such fluctuations may be attributed to stochastic gravitational-wave background supposedly created by a number of various unresolved sources in the early Universe [32]. In our model, the background of gravitational fluctuations appears as a part of the effect of the material influx generated as a result of the content-addressable access to the holographic memory. Importantly, the considered material components: radio waves, cosmic ray particles, neutrinos, and photons travel at the speed not exceeding the speed of light. This means that what we observe had appeared billions years ago. On the other hand, gravitational fluctuations are associated with the "action-at-the distance," therefore they do not incur cosmological delays and appear in real-time.

In principle, the discovery of gravitational fluctuations offers a unique possibility for experimentations in the cosmological scale. Sending out a certain pattern of quantum signals, for example carrying a particular frequency, we may expect to recover this pattern in the returned gravitational fluctuations, like it is done in the radar technology. The surmised construction may be instrumental for the realization of the anticipated potentials of quantum computing.

## 3. The framework of quantum algorithmics

To understand quantum mechanics it is necessary in the first place to determine the meaning of the state vectors $|\psi>$. In classical mechanics, an object is described by a triplet of coordinates: (x,y,z), which presents a point in space. Transfer from one point to another constitutes the behavior of the object as a "particle". In quantum mechanics, objects somehow acquire a "wave" type of behavior. The notion of wave does not actually imply the appearance of ripples. In general, any value depending on time and space coordinates can be called a wave [33]. As indicated by Schrödinger himself [34], it is not exactly correct to call his result a wave equation, a more accurate name would be "undulatory" or "amplitude" equation.

The presented model clearly indicates where the extra "wave" component comes from – it is the reference beam of the holographic mechanism that produces it. Thus, for a quantum object the state vector is a quadruple incorporating additionally the phase value of the incident reference beam, $\theta$: (x,y,z, $\theta$). Only phase differences by mod $2\pi$ being effectual, a wave function $\Psi$ presentation of a particle in 3D space coordinates will be:

$$\Psi\,(x,y,z,\theta) = A\,(\mathbf{r}) \bullet e^{i\theta} \qquad (2)$$

By and large, the state vectors $|\psi>$ can also incorporate the phase $\theta$ into generalized coordinates, like, for example, in the situation with the polarization of photons.

The dynamics of a system is described by the rules of transition from one state into another. Correspondingly, for classical and quantum systems these rules will apply to the transitions: $(x, y, z) \rightarrow (x+\delta x, y+\delta y, z+\delta z)$ and $(x, y, z, \theta) \rightarrow (x+\delta x, y+\delta y, z+\delta z, \theta+\delta\theta)$. Both cases looks quit similar that what allowed Schrödinger to derive his famous equation by analogy with classical mechanics. The essential difference between the two cases is determined by how the results of system's evolution are converted into reality. For classical situation this is straightforward - a triplet (x, y, z) corresponds to a certain state of the system. The quantum situation is not as easy - the quadruplet (x, y, z, θ) is a halfway entity that should be somehow projected on the reality.

Besides the state vectors $|\psi>$, the so-called ket-vectors, the description of quantum systems also involves conjugate vectors $<\varphi|$, the so-called bra-vectors. The conjugate vectors are supplemented by the returning holographic beam, which reconstructs the recorded objects in the reverse direction. Thus, the constituents of the micro-world can be described by collections of state vectors in "ket" and "bra" forms. These state vectors establish the well-known complex Hilbert space that is responsible for the specifics of the organization of quantum objects.

The predominant algorithmic riddle in quantum behavior constitutes "superposition" – particles seem to exist simultaneously in more than one physical state and do not exhibit definite attributes until measured. The strangeness of quantum mechanics comes from the attempts for visualization in common terms of something unfamiliar.

**Corroborating remarks**

1. *The factor of memory in quantum control*

The key issue in the presented algorithmic scheme is the involvement of memory in the control of quantum systems. Classical systems are memoryless, their next stage is fully determined by the current stage. Such systems do not keep track of the history of their developments.

The situation with quantum systems is open to discussion. Consider, for example, the events of radioactive decay of quantum particles. If these events were spontaneous the distribution of their occurrence times would be strictly exponential. Any deviation from exponential randomness indicates an influence of memory. Besides feeble experimental evidences for non-exponential decay, it is noteworthy that this possibility can be derived theoretically [33]. This implies that the memory influences are already somehow incorporated in the common algorithmic description of quantum mechanics.

A direct manifestation of the involvement of memory gives the surprising effect of quantum flickering [35]. The distribution of flickering times in all types of quantum dots obeys to a power law rather than an exponential spontaneity. The concrete structure of the dots is not essential. So, this is a fundamental effect showing the workings of memory behind the quantum mechanics organization.

2. *The holistic nature of quantum systems*

The holographic embodiment makes the behavior of quantum systems holistic. The essential feature of this behavior is non-separability – strictly speaking, quantum systems cannot be split into independent subsystems. The traditional consideration of the material world as a collection of distinct particles is only a convenient approximation.

The non-separability of quantum systems is a result of the entirety of their processing by 2D holographic segments. Different parts of a quantum system are components of the same segment, so they are controlled simultaneously irrespective of their distance and position. From the standpoint of common sense that treats systems in terms of reciprocal interactions of their elements the enigmatic collective effects are difficult to imagine.

The presented model of quantum mechanics appears very instrumental in clarifying the two principal manifestations of non-separability:

(1) the peculiar quantum statistics dividing particles into two distinct classes of bosons and fermions;
(2) the long-distance correlations of quantum entanglement.

Both of these issues are addressed in the next two sections.

## 4. The multiplexed clock cycle driving "superpositions" and "measurements"

Evolution of any system, classical or quantum, is a result of applying operators that transform states representations from one moment to another. Quantum mechanics uses different kinds of operators depending on the stages of the operational cycle (Fig. 4). At the borderline between the synchronization stages #3 and desynchronized impacts #4 quantum state vectors cease to exist due to probabilistic collapsing into one of the eigen states of a given operator. The operators at the synchronization-desynchronization borderline materialize hidden quantum activities into various observable physical effects.

At the beginning of the synchronization stage #3 there is one and only one operator that can act upon the quantum state vector. Under the influence of synchronization the efficacy of the material formations is frozen, so at this moment there appears only one operational choice for quantum state vectors – "Waiting". Applying the energy preservation operator **H** – Hamiltonian leads to Schrödinger's equation that performs the waiting:

$$i\hbar \cdot \partial\Psi/\partial t = \mathbf{H} \cdot \Psi \qquad (3)$$

An operator describing system's evolution – "waiting" over a certain time period using a unitary matrix **U** is defined by the Hamiltonian **H** through plain exponentiation:

$$\Psi(t + \Delta t) = \mathbf{U} \cdot \Psi(t) \qquad (4)$$

The components $u_{ij}$ are complex transition amplitudes from a state i to a state j. The interpretation of Schrödinger's dynamics as actions of a "waiting" operator is delineated in [28]. Curiously, magnetic field cannot be straightforwardly incorporated in Schrödinger's equation, supposedly because magnetic field is linked to relativistic effects [28]. Our consideration yields an operational flavor: in a synchronized state the dynamic nature of the magnetic field may conflict with "waiting".

The quantum mechanics probability, $P_{qm}(\boldsymbol{\alpha},\boldsymbol{\omega})$, for transition from a state $\boldsymbol{\alpha}$ to a state $\boldsymbol{\omega}$ is presented as a square of the modulus of the transition amplitudes over all $\boldsymbol{\alpha}$ to $\boldsymbol{\omega}$ paths:

$$P_{qm}(\boldsymbol{\alpha},\boldsymbol{\omega}) = \sum_{\substack{\text{all pairs}\\ \text{of paths}}} (u_{\alpha i} \dots u_{j\omega})\cdot(\bar{u}_{\alpha k} \dots \bar{u}_{l\omega}) \qquad (5)$$

Trying to rationalize quantum events we have constructed a regular stochastic process that could imitates these transition probabilities [5, 6]. We have considered an abstract situation where a quantum particle splits into two fragments that perform independent random walks carrying some phase information. Taking the matrix **U** we can put together a real matrix with non-negative elements $\sqrt{u_{ij}\cdot \bar{u}_{ij}}$. Having such a matrix it is possible to form a stochastic matrix with transition probabilities for a Markov chain. Two fragments starting at α have a certain probability to meet at ω, final probability of materialization of a particle in this Bi-Fragmental process, $P_{bf}(\boldsymbol{\alpha},\boldsymbol{\omega})$, is supposed to be determined by the phase difference accumulated along these paths:

$$P_{bf}(\boldsymbol{\alpha},\boldsymbol{\omega}) \sim \sum_{\substack{\text{all pairs}\\ \text{of paths}}} (\sqrt{u_{\alpha i}\, \bar{u}_{\alpha i}} \dots \sqrt{u_{j\omega}\, \bar{u}_{j\omega}})\cdot(\sqrt{u_{\alpha k}\, \bar{u}_{\alpha k}} \dots \sqrt{u_{l\omega}\, \bar{u}_{l\omega}})\cdot \underset{\substack{\text{this pair}\\ \text{of paths}}}{|\cos\Delta\varphi|} \qquad (6)$$

We can establish a one-to-one correspondence between the two types of categories of addends in (5) and (6): individual addends containing the same path and pairs of addends containing conjugate pair of paths. With certain assumptions the sums of the addends in corresponding categories in (5) and (6) are proportional, so these relationships present the same probability distributions.

At the initial introduction of the above scheme, the physical meaning of the description of quantum transitions by the Bi-Fragmental random walks was unclear. Actual split of particles would add even more confusion to the already existing strangeness. So, it was light to assume that the Bi-Fragmental random walk is a sort of a pilot-wave control, which is also supported with the "instantaneous" cellular automaton impacts [36].

However, the organization of quantum mechanics is more demanding – primarily, it has to account for the "measurement" process. This requirement can be incorporated considering the Bi-Fragmental random walks performed by a particle and its conjugate counterpart provided by the interactive holography feedback (see Fig. 2). The expressions (5) and (6) for quantum transitions and their Bi-Fragmental emulation go congruously up to the last point, the completion step is more or less loose. The suggested conjecture that straightens out the situation with the last step in the transition scheme constitutes the core of the new quantum mechanics paradigm.

Consider a snapshot on the quantum transition process where it is just one instance from the last hit at the final state - see Fig. 5. As the quantum system reaches this final state the "waiting" stops and the system is caught in a "superposition" state, and a particle is to be created by an act of "measurement". In the traditional way, it could be theorized that a particle exists simultaneously in several different places, then by an act of "measurement" it precipitates in some place while others possibilities disappear. Sometimes, quantum world is interpreted as an instrumentally created reality brought into being by the acts of "measurement". It is difficult to take this apparently discordant situation literally, so understanding of quantum mechanics in essence stumbles over this "measurement" problem [37, 38].

Let us ponder over again the last step of quantum transition from the standpoint of the Bi-Fragmental emulation. The genuine particle fragment and its conjugate counterpart are spread with certain probabilities over the different places of the synchronized scene. At the next instance, the synchronization stage ceases to exist and "measuring" occurs: the original particle probabilistically emerges in some position as an aggregation of the fragments. Thus, what is called a "superposition" state is not a logical contradiction of a particle being simultaneously in different positions, but a realistic semi-finished product with a probabilistic yield. The completion of this semi-finished product is done not *ad libitum* with a "measurement" apparatus, but forcefully at a fixed point in time of the operational clock cycle. The "superposition" – "measurement" mode of handling of the events can be extended beyond one synchronization-desynchronization cycle as soon as the intermediate processing results can be retained in the holographic memory.

The suggested organization of quantum transitions applies also to a system of particles. The semi-finished product presented by a "superposition" state can be materialized by a "measurement" operator equally well either in a single particle, or in a system of particles. Thus, quantum mechanics comes out as a holistic phenomenon: quantum systems present something more than a sum of their components. Unusually, a set of particles may be involved in cooperative activities without explicit identification of interactions among the particles. It appears as if quantum particles can influence each other by emanating imperceptible imaginative fluids of the so-called "exchange interactions". This operational quality has far-reaching consequences for the material and information processes in the physical Universe.

**Corroborating remarks**

1. *Bosons and fermions*

One of the intriguing questions of quantum mechanics is the existence of two different classes of particles: bosons and fermions. The bosons and fermions exhibit completely different types of behavior: former tend to clamp together producing macroscopic quantum effects (lasers, superconductivity, superfluidity etc), later tend to keep separately producing chemistry structurization (Pauli principle, Mendeleev's periodic table, and so on). There is no satisfactory explanation for this property. The book [28] says: "The explanation is deep down in relativistic quantum mechanics. This probably means that we do not have a complete understanding of the fundamental principle involved. For the moment, you will have to take it as one of the rules of the world". Our Bi-Fragmental scheme of quantum transitions shows where this rule comes from.

In common view, the difference between classical and quantum particles is determined by the property of "distinguishability". Thus, distributing K distinguishable classical particles over N energy levels will yield $N^K$ possible configurations; for K indistinguishable quantum particles the number of possible configurations will be much less. However, the introduction of indistinguishability is not an operational move: without clearly discernable particles to set up an algorithmic scheme is not possible. This is the same as trying to create a database without unique identification of all possible records. From the operational standpoint, the energy levels are filled out by discernable particles, but the number of efficaciously different configurations is less because certain configurations are equivalent.

The number of configurations for K indistinguishable quantum particles, bosons, over N energy levels is given by the well-known formula of quantum statistics:

$$\text{(Number of boson system configurations)} = C(N+K-1, K) \qquad (7)$$

Using operational viewpoint, particles are treated as distinguishable, but all configurations invariant under particles permutations should be equivalent. The number of equivalent classes is determined by the famous Polya theorem (see, e.g., [39]), and it is the same as the number of configurations for indistinguishable particles:

$$\text{(Number of equivalent classes)} = (1/K!) \sum_{\Pi} N^{\Pi(\text{cycle})} = C(N+K-1, K) \qquad (8)$$

where $\Pi$ is the set of all permutations of K particles and $\Pi$(cycle) is the number of cycles in a given permutation. Recognition of the formula (8) brings in an algorithmic flavor in the consideration of the behavior of quantum particles.

Quantum transitions appear as "precipitations" of fragments from "superposition" states. In this holistic process the precipitating fragments do not necessarily fuse with their actual counterparts, they may re-combine with other fragments as well. The difference between bosons and fermions is determined by the particularity of their Bi-Fragmental decomposition: the bosons fragments constitute an unordered pair, the fermions fragments constitute an ordered pair. In other words, bosons can be reconstructed out of any two fragments, fermions can be reconstructed from fragments of different ordering status – first and second.

Having 2K similar fragments for K bosons, they can be re-combined in pairs into N energy levels yielding exactly the same number of possible configurations:

$$\text{(Number of configurations of fragment pairs)} = C\,(N+K-1,\ K) \qquad (9)$$

The equality of the results (7) and (9) is a textbook combinatorial practice (see e.g. [39]). Generating functions for these cases, $g_1(x)$ and $g_2(x)$, are:

$$g_1(x) = 1/(1-x)^N \qquad (10)$$

$$g_2(x) = 1/(1-x^2)^N \qquad (11)$$

The desired numbers (7) and (9) are the expansion coefficients for $x$ in the power K and 2K respectively. Apparently, they are the same.

Furthermore, look into a composite boson particle consisting of $b$ bosons. According to our consideration, the number of the obtained configurations will be determined by distributing $2Kb$ indistinguishable fragments over N energy levels, where a collection of any $2b$ fragments will combine into a composite boson particle. The generating function for this distribution - $1/(1-x^{2b})^N$ provides the same result (9).

Fermions are considered as the particles that re-combine asymmetrically from different fragments presenting "front" and "back" parts of the particles; similar fragments cannot constitute a fermion particle. This particle formation differs from the mere pairing of bosons - fermions tend to keep separate. We can envision, for example, the formation of fermions as dispersing of unproductive placements of non-compatible types of fragments, to which other type of fragments have to accede. For N energy levels and 2K asymmetric fermion fragments this would lead to the corresponding formula in quantum statistics:

$$\text{(Number of fermion system configurations)} = C\,(N,\ K) \qquad (12)$$

2. *Information retrieval speculations about lingering in the "superposition" state*

The developed model elucidates the long anticipated connection between quantum mechanics and biology. The difference between the dead and living matter is in the intensification of the control due to interactions of macromolecules with the holographic memory. The organization of biological information processing invokes two basic operations: content-addressable access and resolution of multiple responses. The former operation is a "hardware" issue as considered in Section 2; the latter operation incorporates some "intelligence" as a "software" issue. The "intelligence" implies that the outcomes from the memory essentially depend on its contents as a whole. Traditionally, the resolution of multiple responses was aimed at increasing the matching accuracy, the contemporary approach puts a greater emphasis on ranking the outputs through information items "reputation" (see, e.g. [40,41]). The most effective solution to this problem was given by Google's PageRank algorithm. In contrast to other methods, it employs extraordinary mathematics calculating eigen vectors for a stochastic matrix.

The unprecedented success of Google is determined in the first place by the amazing effectiveness of the PageRank algorithm. Such a success indicates a deep insight into the real essence of the information retrieval. This stirs up the idea that activities similar to PageRank may be involved in the workings of human brain. However, computations of natural systems are more suitable for logical bit manipulations than for mathematical calculations. Our initial supposition [42] was that the ranking facilities of the brain are delivered by a stream algorithm converting some partial order on a set of information items into a total order. This may not be quite efficacious. The way from Boolean bit manipulations to mathematical calculations can be paved with random choice procedures that can output real values in the form of probabilities. The multiplexed scheme for quantum transitions can be expanded to biological information processing, which takes more intensive matrix manipulations under the control from the holographic memory. Incorporating the selection procedure based on random walks outputs, the suggested computational model of the brain [42, 43, 8] would be enhanced with the mathematical flavor of the PageRank.

The content-addressable memory works in two steps: first – retrieve a subset matching a given access criterion and second – select one of the elements of this subset. For quantum systems the holographic response results in a Hamiltonian establishing a transition scene of Bi-Fragmental random walks. Then, quantum systems "collapse" into one of the eigen states of the applied operator. Analogously, for macromolecules in biological information processing the retrieved subset should be also treated as a sort of a scene established by Hamiltonian matrix. Thus, the retrieved subset in biological information processing is captured in a "superposition" state, from which the multiple responses are resolved by "collapsing" in some eigen state associated with the corresponding random walks.

In view of the empirically proven fact of the efficiency of the PageRank for resolution of multiple responses the idea that the computational model of the brain can employ the quantum mechanics collapse of the wave function for the realization of this functionality is enticing. Importantly, ranking the retrieved item leaves the subsequent pickup of a singular item to an extraneous intelligent individual; in reality, the implementation of algorithms needs an effective selection of one and only one item. The random walks "precipitation" of biomolecules actually produces such a required singular selection: the "precipitation" from a Hamiltonian play a role of Google's "I'm Feeling Lucky" button, which delivers one, perhaps, most relevant item.

## 5. Quantum entanglement

Among the many mysteries of modern science there protrudes one without any clue for an explanation. It goes about the Universe non-locality as exposed by the effect of quantum entanglement. Nowadays, this subject matter is abundantly presented in special and popular literature; quantum entanglement has been indeed recognized as "the greatest mystery in physics" [44] and as "science's strangest phenomenon"[45].

The idea of non-locality refers back to the Einstein-Podolsky-Rosen *Gedanken Experiment* of instantaneous correlation of distant quantum objects. This paradox has been confirmed renouncing the restrictions of the so-called Bell's inequalities (see [46]). Incredibly, "entanglement may connect particles irrespective of where they are, what they are and what forces may they exert on one another – in principle, they could perfectly well be an electron and a neutron on opposite sides of the galaxy" [47]. Quantum entanglement was detected also for elementary particles without initial contact [48], and even for complex objects, like images [49]. To add more peculiarity, recent experiments have revealed the entanglement of particles' pattern of motion [50].

Our explanation of quantum entanglement is natural, straightforward, and simple. It follows immediately from the organization of holographic information processing. As seen in Fig. 2, quantum processes are controlled by the feedbacks composed in a given holographic slice. The dynamics of the physical world is determined by transformations of holographic slices as a whole; so, quantum behavior is intrinsically a collective phenomenon. Figuratively speaking, quantum entanglement is a primary effect; consideration of the physical world without entanglement, i.e. as a system of independent particles, is only an approximation to the given holistic construction. Collective transformations in application to macromolecules constitute an essential factor for biological information processing in epigenetics [29]. At this time, portraying quantum entanglement in then framework of interactive holography is, apparently, the only available approach to the explanation of this phenomenon.

Quantum entanglement looks like a very exotic phenomenon, but as a part of quantum computing ventures it already has found a commercial application for secure computer communications [51]. Quantum entanglement is used for Public-Key Cryptography where two parties, a sender and a receiver, openly exchange some information to obtain a secret key for encoding/decoding. In general, it is always possible that a third party, an eavesdropper, can reconstruct the secrete key from the overheard information. The confidence in the conventional Public-Key Cryptography relies on a plausible assumption that the required amount of computations is prohibitively large. Quantum cryptography gives an impression that public key distribution through manipulations with quantum entanglement is absolutely reliable. Practically this is, of course, correct. But from a higher theoretical standpoint this cannot be true. A third party that has an access to a sophisticated equipment to pick up gravitational fluctuations could, in principle, extract the secret quantum entanglement key from the holographic memory of the Universe.

**Corroborating remarks**

1. *On the reality of non-local Universe*

Quantum mechanics begun on the agitated debate between Bohr and Einstein about the nature of physical reality. They consented on the unfeasibility of non-local interactions; the only disagreement was on what this actually implies. Einstein insisted that quantum mechanics is incomplete as its upshots contradict to relativity; Bohr was adamant that the behavior of the micro world shows up a novel type of "quantum philosophy".

It is remarkable that both of them have definitely agreed "on one point: that of course there can be no question of a genuine physical non-locality" [47]. Revealing the non-locality of the physical world came as a great surprise for the scientific community (see, in particular, [52]). This effect is not easy to admit and difficult to teach; traditional thinking would look more "logical" if this effect had not been surfaced.

The global holographic mechanism of the Universe patently exposes the absolute meaning of non-locality. Testing the absolute attributes of this mechanism offers a number of experiments challenging the concept of relativity.

2. *Experimental tests confronting the relativity*

The concept of relativity lends to two interpretations: according to Einstein the absolute frame of reference does not exist, according to Lorentz and Poincaré the absolute frame of reference does exist but is undetectable. This dispute seems as a scholastic exercise, but, strictly speaking, it relates only to the undetectability of uniform translational motion in mechanical, optical, and electromagnetic experiments. The possibility of observing other attributes of absolute space in other types of experiments, particularly for biological effects, is not excluded (see, e.g., [8]).

Being guided by the holographic mechanism, the behavior of quantum systems could be affected by their arrangement with respect to the absolute space. For example, if the line connecting the entangled objects is placed in parallel with the front of synchronization-desynchronization waves in the Universe then the correlation between quantum particles would be increased, if this line is placed orthogonally to the front of synchronization-desynchronization waves then the correlation between quantum particles could be decreased. In the latter case the entanglement effect may even disappear for sufficiently large distances. Thus, we can anticipate a "Michelson-Morley" situation for the entanglement effect: it could be stronger in one direction and weaker in the orthogonal direction. These directions are being exactly determined in advance.

Another interesting possibility is twisting fiber optics connection of measuring devices for entangled particles with respect to each other similarly to Möbius strip deformation. In this case, the "quantum measurement" operators delivered by the synchronization-desynchronization wave could hit the particles from opposite sides in a different order leading to different results if the operators do not commute. Possibly, such a trick may reduce some constraints of the uncertainty principle.

Following [53], macroscopic quantum effects could be affected by periodic disturbances at $10^{11}$ Hz. In some aspect, this conjecture can hit the concept of relativity in its highest philosophical sense. The main point of relativity is that every characterization of system's elements must be given in comparison to other elements, like positions and velocities. Quantum mechanics describes objects with four coordinates: $(x, y, z, \theta)$. It seems that the additional coordinate of phase $\theta$ has only a relative meaning. However, in our model the phase $\theta$ acquires an absolute sense in relation to the global synchronization-desynchronizations that drive the holographic processes. Supposedly, it might be possible to detect the absolute phase, for example, through periodic impacts on photon polarization. This would reveal the topmost absolute attribute of Nature – the global rhythm that according to Aristotle permeates the whole physical Universe.

## 6. Conclusion

**The keyword for understanding quantum mechanics is interactive holography**.

Small objects in the microscopic scale under minutiae control of the holographic mechanism show quantum mechanics behavior. Bulk objects in the macroscopic scale are averaged out to the plainness of classical mechanics. The behavior of intermediate objects of outsized molecules in the mesoscopic scale acquires broader access to the holographic memory leading to the sophistication of biology.

"Holographic" explanation of the major quantum trait of "non-separability" is unique:
(a) the idea of superposition "is almost as unsettling today as it was 80 years ago, when Erwin Schrödinger ridiculed superposition by describing a half-living, half-dead cat"[54];
(b) "to truly understand what entanglement is and how it works is for now beyond the reach of science"[44].

**High-Tech Universe vs. Electro-Mechanical Universe**

Science advances technology. The reverse is true as well: novel technological ideas help to understand fundamental science. The regular attempts to rationalize quantum behavior have missed the magnificent technological achievement of our times - the Internet Infrastructure and Cloud Computing. The behavior of objects using these underlying resources would appear peculiar to an unaware outside observer not accepting effects without identifying their cause. Yet from inside the behavior of the given objects looks normal. Thus, our answer to Heisenberg's question in the epigraph is definite "No".

The same "black hole" of the High-Tech Universe that sucked in typewrites, vinyl records, film photo-cameras, etc could also absorb the obscure obsolete low-tech contraptions around unsuccessful interpretations of quantum mechanics.

***Ex uno disces omnes* – understand one thing, and you will understand everything**

The picture of the physical Universe portrayed by modern cosmology is completely deficient. The recent article [24] expresses a pessimistic opinion: "there is a sense of foreboding that it may never be possible to understand our cosmos". Albert Einstein opposed quantum mechanics, especially its non-locality, since, in his opinion, it is a flagrant absurd contradicting the relativity. He said that if quantum mechanics "is correct, it signifies the end of physics as a science" [55].

So, physics surely needs a new paradigm, and the time for the paradigm shift has come.

The developed concept shows great similarities in the organization of information control in quantum mechanics and biology. Thus, comprehending biology in the first place requires essential departure from the conventional physics paradigm (see [56, 57,58]).

**Experimental verifications**

The developed model suggests a battery of interesting tests in conjunction with quantum entanglement and absolute positioning of the holographic mechanism.

This model predicts a new physical phenomenon in the cosmological scale - a continuous influx of material formations, which is a side effect of holographic content-addressable access. This phenomenon offers a unique possibility for an active real-time cosmological experiment analogous to radar detection: a certain pattern of a signal created by quantum activities in a macroscopic scale may be recovered observing fluctuations of gravity. Besides creation of various material formations this concomitant phenomenon might point to new ways of generation of energy from the underlying infrastructure of the material world (pay a particular attention to the suggestive effect of the ball lightning).

Currently, several monumental physical investigations are underway, among them looking for gravitational waves, searching for dark matter, and checking on the CMB anisotropy. Each of those constitutes an *Experimentum Crucis* for the presented model. This means that if a slightest hint of a gravitational wave activity is observed, if a single piece of dark matter is found, or if the intrinsic anisotropy of the CMB is ruled out then the suggested concept of quantum mechanics should be immediately discarded.

Thus, our development is ready to confront the testing with cast-iron predictions.

(a) **Non-detection of gravitational waves, waiting till 2014**

The Advanced LIGO will be operational by 2014. Says Jay Marx, LIGO director: "Will be able to see 1,000 times as many sources of gravity waves as the current LIGO. Either we'll see a signal or Einstein's general theory of relativity will be wrong" [20].

(b) **Absence of dark matter**

In our concept, the dark matter does not exist for two reasons. First, the inner part of the holographic mechanism of the Universe offers an explanation for the amplification of gravity [9]. Second, the CAETERIS spectrum of stable elementary is exhaustive, it includes all known particles and nothing more.

(c) **The "Axis-of-Evil" is for good, it is a token of quantum mechanics operability**

The "Axis-of-Evil" anisotropy of the CMB is one of the most perplexing mysteries [59]. To iron out this problem there are hopes that it could be dismissed as a systematic error. In our model, the "Axis-of-Evil" anisotropy will stay showing the eccentricity of the Solar system as imprinted in the holographic construction of the Universe.

## 7. Acknowledgements

In 1982, when I started working on computer communications it occurred to me that there might be an analogy between packet switching and quantum dynamics. Namely, the delivery of split messages may resemble traveling of quantum objects without a trajectory. It turned out that this process with splitting into two fragments can be described by Schrödinger equation. In September 1983, I called to Caltech and having been connected asked whether I could speak to Dr. Richard Feynman.

- That's what you are doing
- Dr. Feynman, I found an explanation for quantum mechanics
- For one particle or many?
- For one.
- For one it is not interesting, it is already known
- What happened since it was not known?
- The problem is not with one particle but with many particles
- What is the difference?

This cut off the conversation dispelling my inveterate illusion that the wave-particle duality is the pivotal problem of the whole physics. A deeper scrutiny of the introduced scheme of quantum transitions was inspired.

I continued to pursue physical analogies in my computer research with Bendix, then AlliedSignal, Advanced Technology Center. I deeply indebted to the directors of this institution Jack Martin and Pat Keating for their invariable support and to my colleagues C. Wlison, C. Walter, S. Haaser, and H. Yee for cooperation. Especial appreciations go to R. Potter for stimulating commentaries and ideas.

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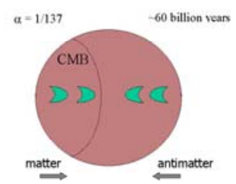
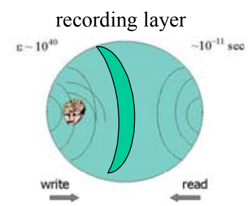
**Two global periodic processes corresponding to dimensionless parameters: α = 1/137 and ε = $10^{-40}$**




Cycles of matter formation

Redshifts anomalies in periodic Big Bangs vs. accelerating galaxies and "dark energy"

Cycles of diffusion wave trains

Holographic reference beam and recordings for quantum mechanics control

Fig. 1

Towards the Information Dominant Holographic Universe

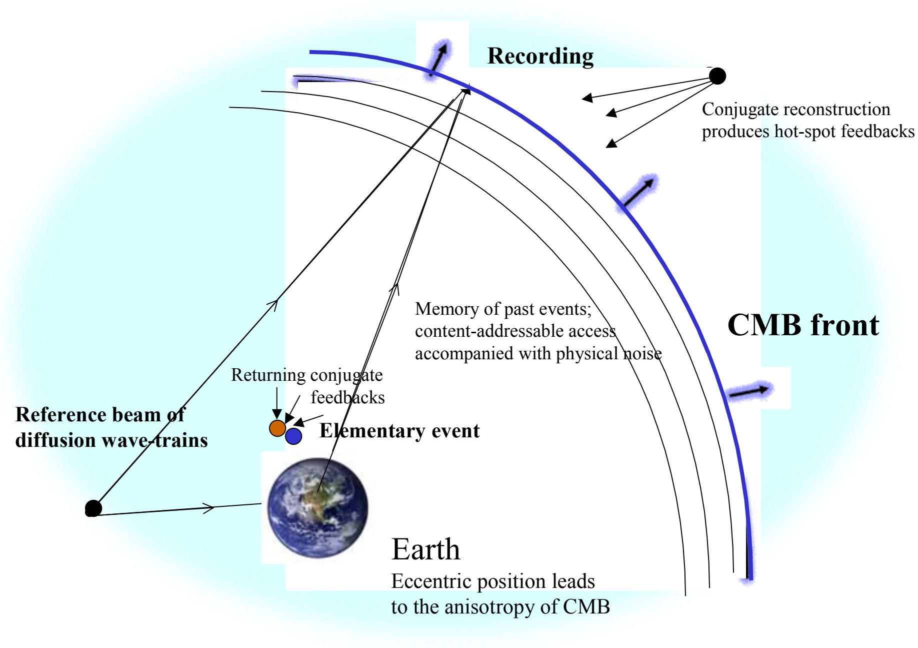



Fig. 2

The scheme of interactive holography underlying the physical world

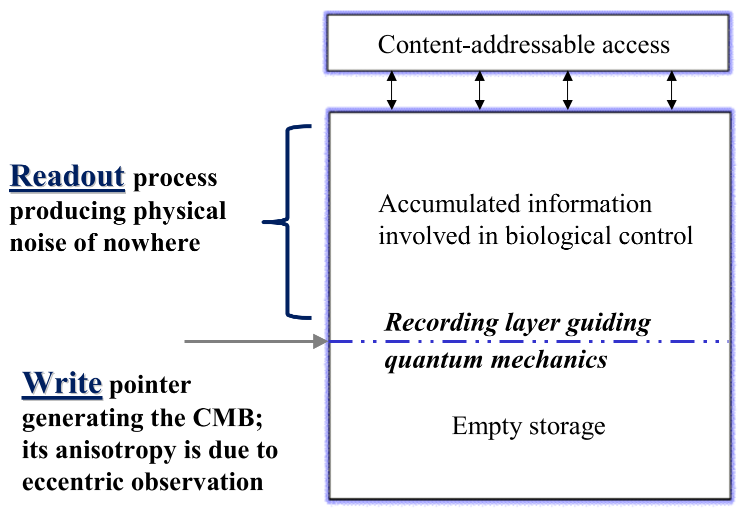
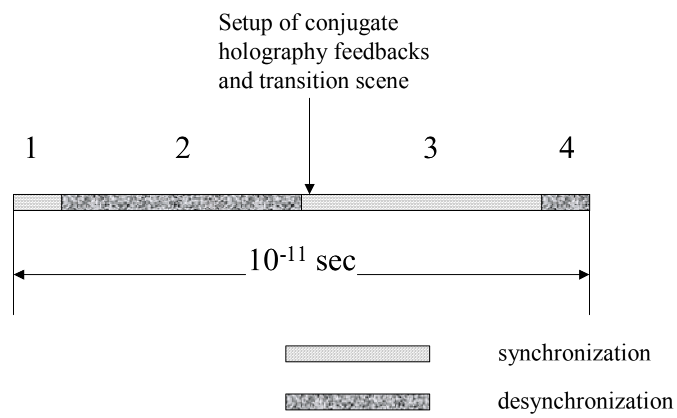



Fig. 3

Physical and informational processes in the Holographic Memory of the Universe




1 --- Synchronization impact for holographic recording
2 --- Desynchronized “particle” stage with local interactions
3 --- Synchronized “wave” stage with unitary evolution
4 --- Desynchronization impact for the reduction of the wave function

Fig. 4

The operational cycle of the interactive holography stages

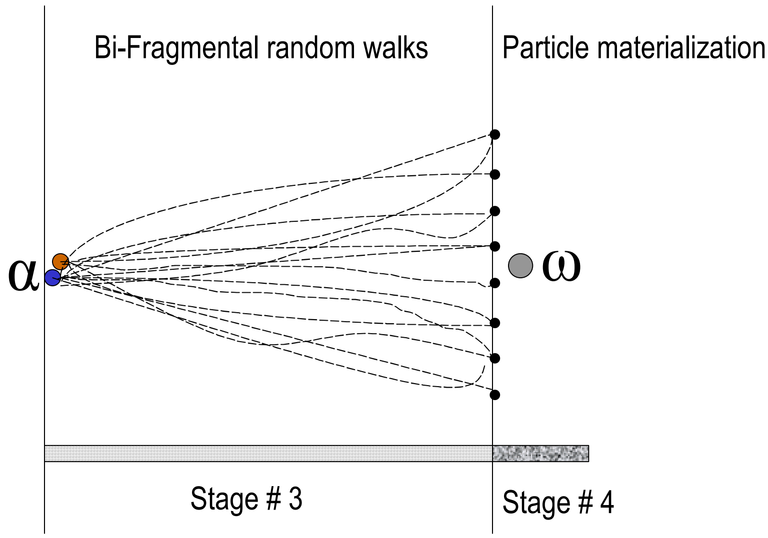



Fig. 5

The anatomy of quantum transitions