

Contemporary Physics and Eastern Wisdom

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Abstract

This article presents some general conclusions, which can be drawn from the achievements of contemporary physics and correspond to the ancient Eastern wisdom.

The concepts of particle-wave duality and of the so called “wave function collapse” are considered. Their potential of creating our reality is especially underlined.

The Einstein-Podolsky-Rosen paradox, the idea of Holographic Universe, and the possible existence of a deeper “sub-quantum” field as a base and source of “everything that is” are discussed.

A conclusion is made that what we know (percept) as a solid, static, deterministic, and constant reality of isolated entities is, according to the contemporary physics, rather a fluid, dynamic, synchronistic and changeable reality of mutually interconnected processes which are constantly interacting and exchanging energy and information.

It is pointed out at the end that a parallel can be drawn between all these ideas and the ancient Eastern wisdom.

1. Introduction

The last hundred years of mankind's history are marked by the rapid development of natural sciences and technologies. Physics has played a significant role in this development. The discovery and study of elementary particles, cosmological discoveries, the establishment of the theory of relativity and quantum mechanics as well as the relatively new string theory and M-theory contribute to a radical change in the understanding and description of the world around us. Unfortunately, this change is known to a very small part of humanity. In school programs, mainly the “classical” Newtonian physics is being taught, and the already old “new” theories cannot find a place in them even with their basic ideas. This may be somewhat reasonable from a practical point of view but greatly limits the worldview and, therefore, the achievements of several generations of people: one of the main “windows” to the wonders of the universe and the possibility of their application in the “real” life remains closed to them. However, we must not be surprised at this situation, given that even many scientists find it difficult to look beyond their narrow specialisation and understand the conceptual, philosophical and even spiritual consequences of the development of modern science.

Today we have every reason to affirm that these consequences are really fundamental. Fine and delicate but, at the same time rather insistently, they urge us to abandon our well-known and comfortable vision of the world as a solid, static, determined and unchangeable reality of isolated entities, and to accept a new and seemingly frightening, but ultimately more truthful, liberating and inspiring understanding and feeling of the world around us as a fluid, dynamic, synchronous and changeable reality of interrelated processes that are in constant interaction and exchange of energy and information among themselves. It should be noted here that this new vision is in striking consistency with the way the ancient eastern sages perceived and described the world around them in their scriptures thousands of ears ago. Thus, modern science, using its specific methods of studying reality, gradually reaches the knowledge and insights achieved by the mystics with radically different means. This should be seen as a perfectly natural result if we realise that the subject of the study is the same, and only the ways of its study vary.

In order to tune the readers appropriately to what follows, we offer them a little surprising but indicative quote:

"Reality is merely an illusion, albeit a very persistent one." - Albert Einstein

This sentence directly recalls the concept of “*maya*” in Hindu tradition. Similar analogies are no exception at all.

2. Some general conclusions from the achievements of contemporary physics

We will first discuss at least some of the most general conclusions that can be made on the basis of the achievements of modern physics and resonate directly with ancient wisdom.

1. We and all “objects” around us are “clouds” of vibrating particles or Energy. Even the elementary particles themselves are small “clouds” of energy, not fixed points in a certain position in the space.

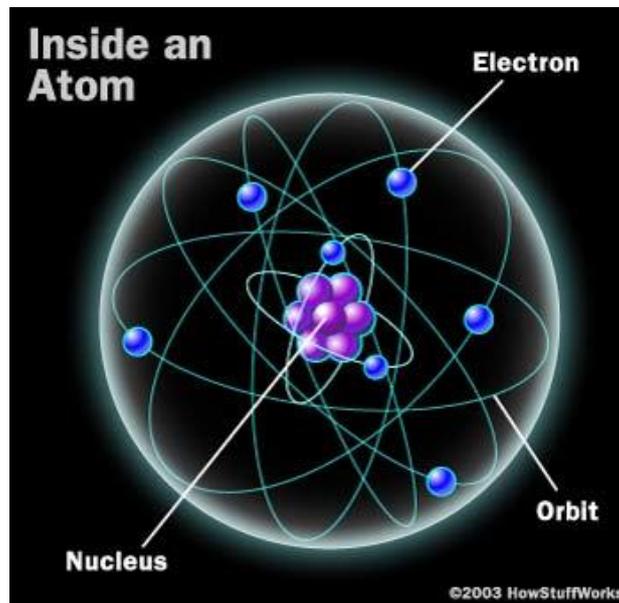


Figure 1. Schematic presentation of an atom

In June 1905, Albert Einstein published a paper entitled “On the Electrodynamics of Moving Bodies” [1], where the special theory of relativity is in fact proposed. It is from this theory that Einstein concludes that the mass of the body is a measure of the energy contained therein and expresses it with his famous equation $E_0 = mc^2$, where E_0 is the rest energy, m is the mass of the body, and c is the speed of light in vacuum. Thus, since more than a century, matter and energy are equivalent in physics.

The universe we live in is united and amazingly dynamic. Everything in it is in a constant, unimaginable movement. Even seemingly the most immobile objects are “loaded” with this impressive dynamism.

We perceive ourselves and the “objects” around us as separate, solid and comparatively static due to the limitations of our physical senses and also because of our education and training (we are taught to do it this way) – it is something like a shared illusion.

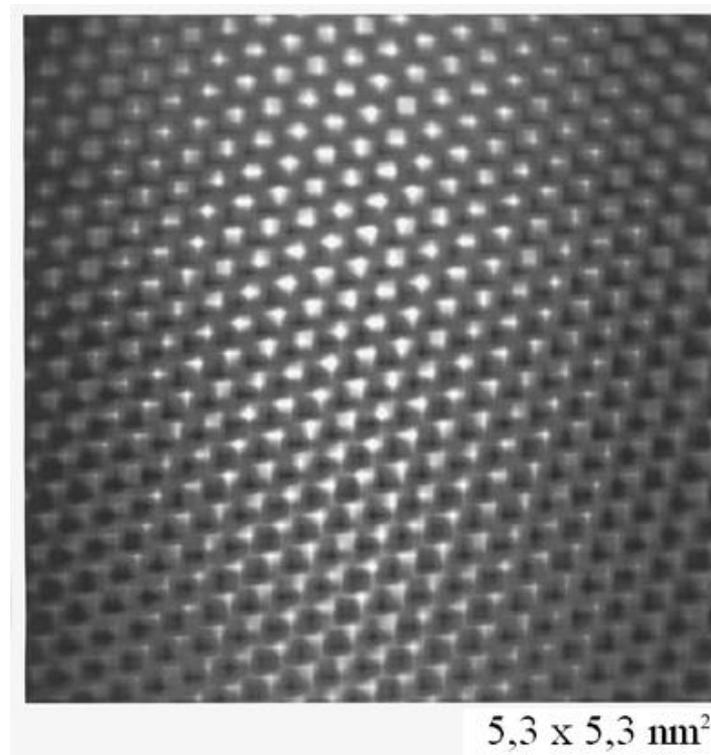


Figure 2. A high-resolution transmission electron microscopy (TEM) image of a solid-state material showing the individual atoms in its crystal lattice

A good analogy in this respect is the perception of a forest from a bird’s eye view as a big green spot – because of the limitation of our vision, we are not able to distinguish the vast variety of trees, bushes, flowers and grass, the animals and the birds in it. Similarly, the chair on which I am sitting now is not a rigid, static, limited and unchangeable entity, but a fluid, dynamic, fuzzy and constantly changing cloud of vibrating particles, or energy. It manages to keep my body from falling on the floor, not because it is strong and firm enough (although such a description is possible but fundamentally false) but because the relationship between the energy structures of the chair and my body allows this.

Hopefully, after this brief introduction, the following statements will not need further clarification.

- 2. We and all “objects” around us do not have any borders (limits) – we are all borderless and limitless.** Although we seem localized to a particular place in

space, at a deep quantum (energy) level, we do not begin and do not end anywhere – we have no boundaries.

Here, we can make a good analogy with the air. Although the air at every particular place has its own specificity, special properties, even its own aroma, it neither begins at the beginning of this place nor ends at the end of it. It is just everywhere. Similar is the situation with all of us and the “objects” around us – we have our unique features that distinguish us from others, but in fact we neither begin nor end somewhere, we are inseparable from everything else in the universe.

3. We and all “objects” around us are not separated – we are all constantly connected and interacting. Our “separation” is only apparent – in the universe there is no any system that is absolutely isolated from its surroundings.

We are literally immersed in an ocean of energy and we are an inseparable part of it. Life is a process of constant interaction and exchange of energy and information (which is in fact structuring, modulation of the energy), in which everything constantly changes. That is why change is the essence of life.

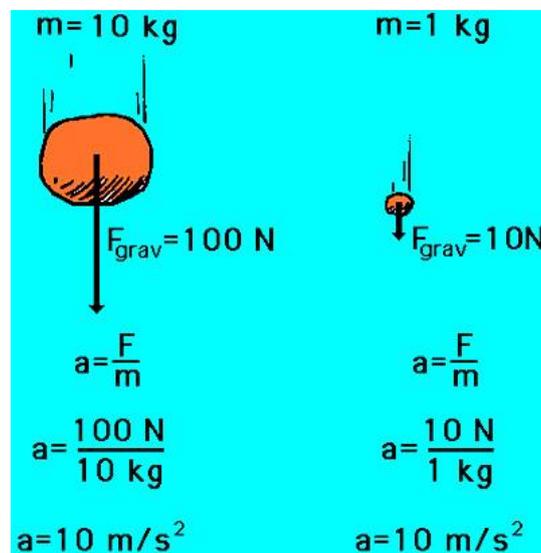


Figure 3. Illustration of the experiment for measuring acceleration as a result of gravity

Very indicative of the inability to completely isolate anything in the universe is the extremely precise experiment of measuring acceleration as a result of gravity, carried out years ago by the Canadian Standardisation Council – one of the most powerful standardisation institutes in the world. For months, the Council’s significant human and material resources were focused on planning, providing, and conducting the experiment. Every detail was thought of as precise as possible. Stringent measures have been taken to isolate the experiment from all sorts of

influences of the universe in order to create ideal and reproducible conditions for its conduct. Despite these enormous efforts, the result of each measurement differed from the others. Even after processing with the best statistical methods, there were significant variations in the average results of the individual measurement series.

This experiment (and not only it) definitely shows the inviolable interconnectedness of everything in the universe.

4. We and all “objects” around us are expression, manifestation of the same Energy; we are all made of the same stuff.

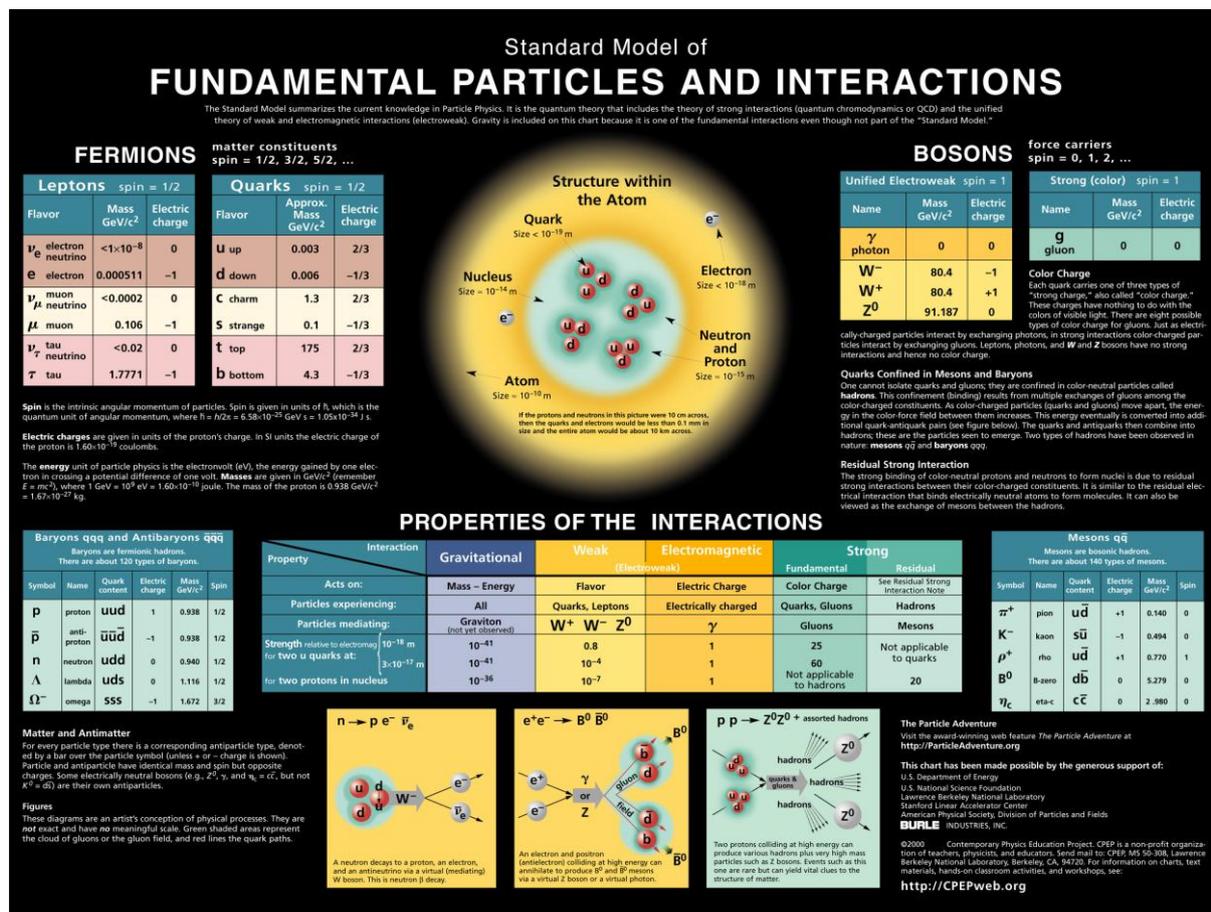


Figure 4. Schematic presentation of the fundamental particles and interactions

There is a growing but still limited number of elementary particles that “build” everything known to us in the universe – the visible matter – from the smallest dust, to the largest galaxy, from the simplest organism to the “crown of nature” man. All of us, without exception, regardless of our size, complexity or simplicity, are composed of the same limited number of elementary particles, we are all “brothers and sisters” in matter, in energy. If we take into account the fact that all the visible matter was created shortly after the Big Bang around 14

billion years ago, we may say that we are made of a very old matter and we are “brothers and sisters” in matter not only with everything that exists now but also with everything that has ever existed after the Big Bang and that will ever exist. In this sense we are very old and probably also eternal beings.

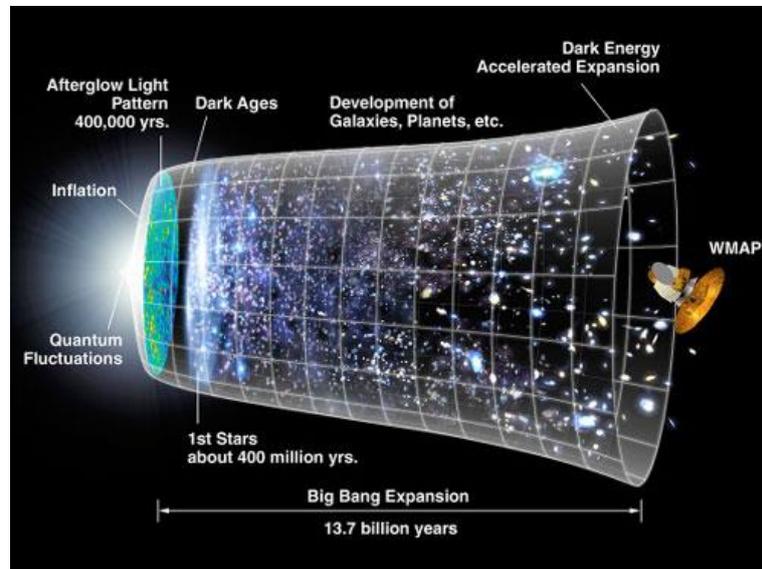


Figure 5. Development of the universe after the Big Bang

5. We and all “objects” around us are One.

Already Einstein regarded the universe as a huge organism, every part of which is a manifestation of the whole. More and more physicists share the idea that there is a single, non-linear quantum field, and all apparently separate and independent objects or phenomena are only fluctuations, local excited states that exist for some time and re-merge with it. From this it can be concluded that separation is an illusion even on a physical level.



Figure 6. Oneness of the universe

3. The wave-particle duality and the collapse of wave function.

In this part of the paper we will consider two particular concepts of modern physics that correspond directly to the ancient Eastern wisdom. The first one is the wave-particle duality. The meaning of this a bit complicated term is that elementary particles have a dual nature: they appear as both corpuscles and waves. Which of these two “faces” they will turn to us depends entirely on the actual process of observation (measurement), that is, from the choice of the observer (our choice).

WAVE-PARTICLE WEIRDNESS

When quantum objects such as electrons are fired one by one through a pair of closely spaced slits, they behave like particles: each one hits a screen placed on the far side at exactly one point. But they also behave like waves: successive hits build up a banded interference pattern exactly like that generated by a wave passing through the slits (right). This wave-particle duality is described by a mathematical tool known as the wavefunction.

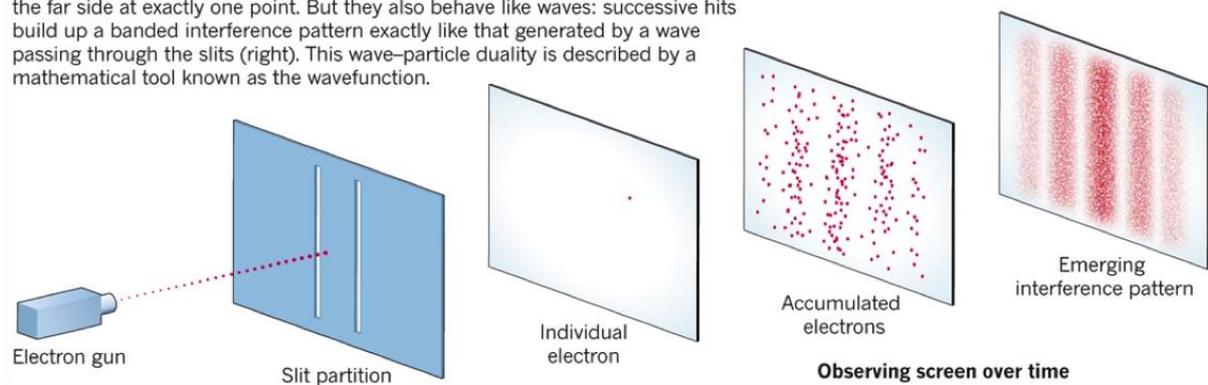


Figure 7. Wave-particle duality of elementary particles (electrons in this case)

The second concept is about the so-called “wave function collapse” and is largely related to the first. In quantum mechanics, all events have probabilistic nature and are described with the probability of their realisation. Thus, elementary particles are typically represented by wave functions describing the amplitudes of probabilities for realisation of their various possible states under given conditions. In reality, however, only one of these possible states is realised, i.e. there is a transition from potentiality to actuality, and a specific mechanism is needed for this.

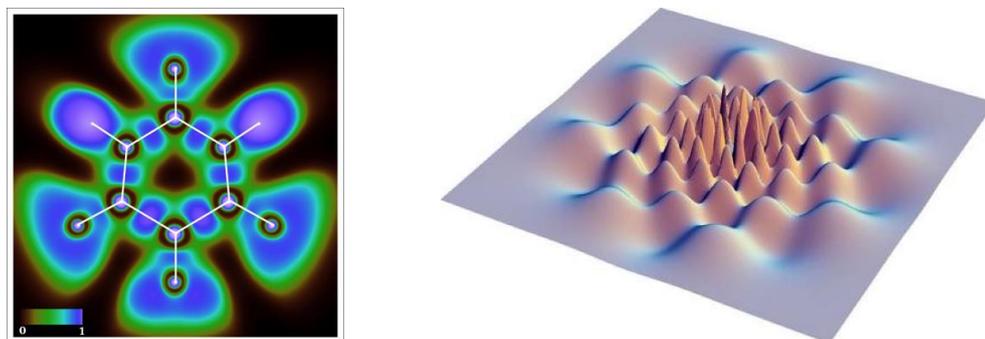


Figure 8. Images of wave functions

Here quantum mechanics encounters serious conceptual problems that are dealt with differently from its different strands or interpretations. The most common among them is the so-called “Copenhagen Interpretation”, which originated around 1927 [2] and was associated primarily with two of the fathers of the quantum mechanics – Niels Bohr and Werner Heisenberg, who at that time worked together in Copenhagen. According to this interpretation, all possible states of a given quantum system coexist until the moment of measurement of the system and at that moment only one of these states is realised. This is the so-called "wave function collapse", that is, a transition from the multiple potential states of the system to one actual state. Therefore, in this interpretation, the observation process and the observer her/himself occupy a central place – they are the ones that determine (in a specific way) which of the all possible states of the quantum system is realised, i.e. play a creative role or literally create the particular reality.

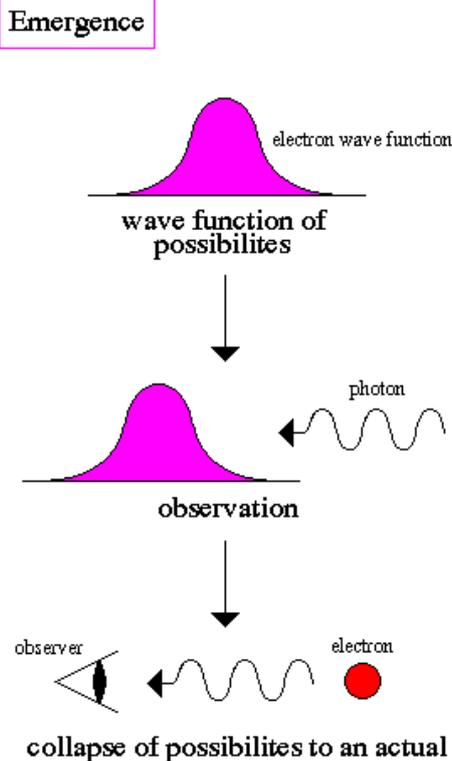


Figure 9. Wave function collapse mechanism according to Copenhagen Interpretation

The second most popular among physicists is the Many-Worlds Interpretation of quantum mechanics, created in 1957 by the American physicist Hugh Everett [3,4] and subsequently widely popularised by another American physicist, Bryce DeVitt [5,6]. According to this interpretation, the collapse of the wave function to a certain state of the quantum system is only apparent. In the process of measuring a system (its interaction with the surrounding

environment) one of its possible states is getting connected with the measuring system (the environment) and it is realised at the concrete conditions (in the particular world). All other states of the system, however, do not “disappear” as in the Copenhagen Interpretation, but coexist in their own worlds, which in principle cannot communicate with each other due to the so-called "quantum decoherence" (non-connectivity; lack of interference, interaction). Thus, according to this interpretation, every act of observation (interaction of the quantum system with its surrounding environment) leads to a kind of tree branching or "budding" of more and more new universes that coexist in a common "multiverse".

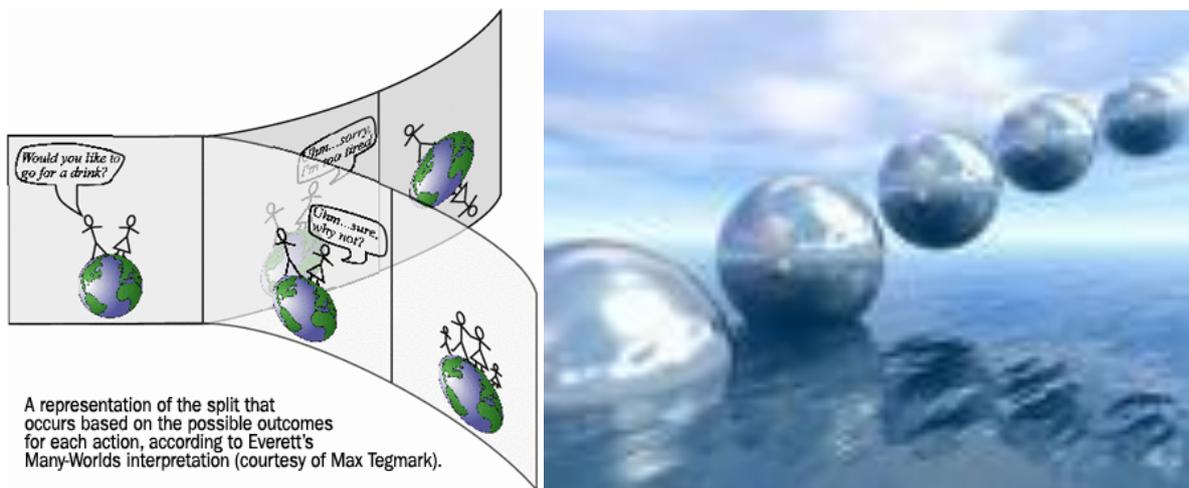


Figure 10. Schematic presentation of Many-Worlds Interpretation

From the brief overview presented here, it can be seen that the concepts of wave-particle dualism and the collapse of wave function confirm the understanding of the ancient Eastern sages for the unity of the observer, the observed and the process of observation itself, which is also one of the insights of quantum mechanics.

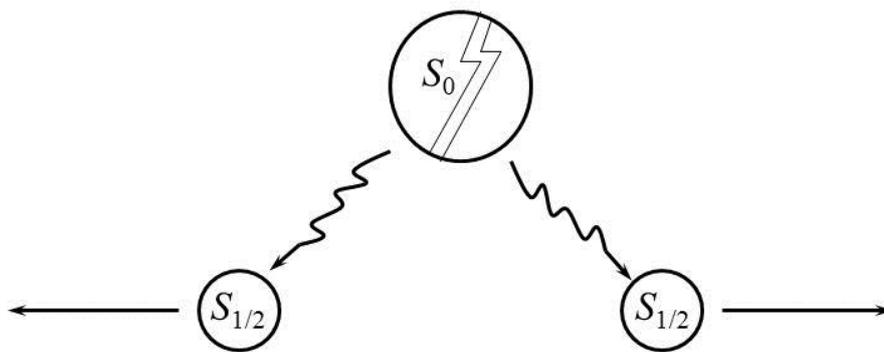
4. Einstein-Podolsky-Rosen paradox and holographic nature of our universe

We will consider here a very interesting and fruitful idea – the idea of the holographic nature of our universe. A brief explanation: a hologram is a three-dimensional “photo” of an object recorded on a two-dimensional media – a photo plate or tape. When the “photo-media” (the hologram) is illuminated with the appropriate light, a three-dimensional image is produced, completely repeating the original object, which changes with a change in the viewing angle – just like a real three-dimensional body.

The story of this idea most probably begins in 1935, when Albert Einstein, Boris Podolsky and Nathan Rosen published an article [7] in which, through thought experiments, they proved that quantum mechanics would yield results, which are in disagreement with the

classic understanding of reality. In particular, the article considers a pair of related (entangled) elementary particles. The measurement of one of the particles, where a given parameter takes a given value, determines what value the same parameter of the other particle will take. This means that both particles “know” or immediately “understand” what happens to the other. This connection is present even when they are arbitrarily distant from each other, which implies some instantaneous interaction between them, regardless of distance. Such a result is in contradiction with the special theory of relativity and its postulate that nothing can move at a speed higher than the speed of light. This inconsistency has been called the Einstein-Podolsky-Rosen (EPR) paradox, and it has been for a long time a serious challenge for the minds of physicists.

Einstein-Podolsky-Rosen (EPR) Paradox



$$QM: \quad |\psi\rangle_{12} = \frac{1}{\sqrt{2}} \left(|\uparrow\rangle_1 |\downarrow\rangle_2 - |\downarrow\rangle_1 |\uparrow\rangle_2 \right)$$

- Particle 1 in spin \uparrow or \downarrow is 50% and so is particle 2.
- The two particles must have opposite spin states.
- Their spin states won't be known until measurements.

Figure 11. Schematic presentation of Einstein-Podolsky-Rosen paradox

Nils Bohr, one of the fathers of quantum mechanics, has suggested as a possible solution to this paradox the idea that the particles in question might not actually be separate particles but merely different aspects of the same particle. Numerous unsuccessful attempts have been made to make the thought experiment reproduced in reality, while in 1982, with advances in technology and equipment, physicists' efforts have succeeded. At the University of Paris, a team of scientists led by Alain Aspect found that under certain circumstances a pair of

associated photons (the smallest particles or “quanta” of light) can communicate with each other instantly. Irrespective of the distance between them, each of the two quanta always “knows” what is going on with the other one “in real time” [8].

This experiment is one of the most significant events in physics and science in the 20th century, and its impact on our worldview is yet to be fully realised. Its results, subsequently repeated in other laboratories and interpreted differently, show that there is some deeper, unknown to physics at that time, “non-local” connection between elementary particles. Some of the scientists go even further and argue, as Bohr has previously suggested, that what we perceive as separate particles are in fact only different aspects (projections) of a single reality.

Among the most ardent supporters of this idea was David Bohm – very interesting and productive theoretical physicist and thinker, one of the brightest minds of the last century, influenced deeply by Einstein. He illustrated the idea by an analogy with an aquarium in which there is fish observed by two cameras – one directed to the front wall of the aquarium, the other – to one of the side walls. The signals from both cameras are projected on two separate monitors. Watching only the monitors, we will decide that we see two different fishes because the cameras are located at different angles to the aquarium. However, after longer observation, we may notice that there is some kind of dependence between the fishes. If we do not know what is actually happening, it is possible to conclude that the two fishes are instantly communicating with each other, but that does not correspond to the truth. The fish is one, and on the screens we see only two different sides (projections) of the fish. According to Bohm, the same happens in the experiments of Aspect.



Figure 12. Bohm's fish

It should be noted that well before 1982, Bohm gradually came to the idea of the holographic nature of our universe (see e.g. [9]). Here we will discuss the main points of this theory and the philosophical implications that it has, which derive from two important features of the hologram in general. However, it is necessary first to clarify a small language problem: in most languages, the term hologram is used for both the two-dimensional “light recording” (“photo”) of the “real” object on a particular medium (a photographic plate or tape) as well as for the three-dimensional image of the object reproduced from this medium using light. So, the first characteristic is the illusory nature of each hologram as an image reproduced from the “light recording” – no matter how true and close to the “real” object, it is actually just a play of light. The second characteristic is the indivisibility of the image itself: you can break a hologram (its carrier) into thousands and millions of pieces, and yet each of them, no matter how small, will keep the entire image within itself and the hologram can be restored from any of the pieces.

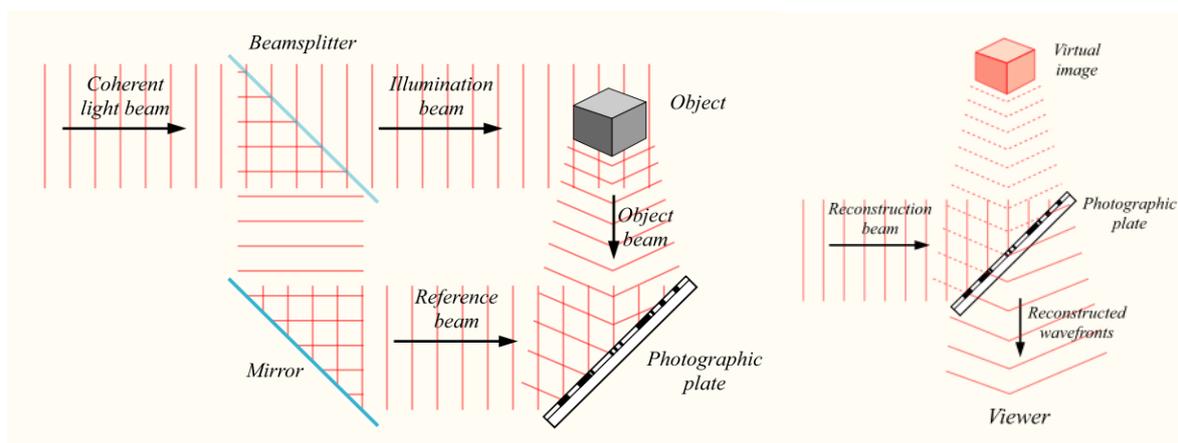


Figure 13. Schematic presentation of recording and reconstruction of a hologram (By DrBob at the English language Wikipedia, CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=18103933>)

Having in mind these properties of the hologram, Bohm claims that objective reality does not exist. Our universe, regardless of its apparent solidness and density, is in its deep essence an illusion (another statement that directly corresponds to the concept of “maya” in the Hindu tradition), a gigantic and extremely detailed hologram. According to Bohm, there is a deeper level of reality, a more complex dimension beyond ours, in the existence of which we are not “initiated”. We perceive objects, such as elementary particles, as separated from one another, since we are in touch only with a part of their reality. We can imagine it as a tree of which we see only the crown but not the stem. All branches, leaves and petals seem to be quite separate

and we cannot assume that they are just parts of a single whole. Likewise, elementary particles are not separate “entities”, but aspects (sides, projections) of a deeper and more fundamental unity, which is essentially holographic and indivisible. Since everything in the “physical reality” consists of these “phantom” elementary particles, the whole universe is also just seemingly real and is in fact a projection, a hologram.

If the apparent separateness of elementary particles is illusory, it means that at a deeper level of reality all things in the universe are infinitely interconnected. Everything penetrates within everything else and all the various phenomena in the universe, all divisions are necessarily superficial and artificial, and the whole nature is in its essence a single “tissue”.

This also applies to us as inseparable parts of the hologram.

We have to note here another interesting thing from a philosophical point of view: in a holographic universe there are no limits for the extent to which we can change the „reality”. What we perceive as reality is actually something like a canvas, waiting to paint on it every picture we want. In such a world, everything is possible, because in it our ability to create a new reality depends mostly on our ability to imagine the reality we want.

Thus, we come to the possible existence of a deeper reality, of a “sub-quantum” field – an idea that is increasingly perceived in modern physics. It is supposed that in this field all the things of the manifest universe are infinitely interconnected. Everything that exists comes from it. All “things” and “phenomena” have their fundamental unity exactly in this field, they are indistinguishable in it. Here all the pairs of opposites disappear. The very indissoluble unity of the manifested “things” in this “sub-quantum” field allows them to reside permanently in immediate, instantaneous and unabated relationships. This field is their (and our) True Nature.

What are the evidences of the existence of such a field? In this area it is very difficult to talk about evidences. However, there are many hints for its existence: such are the non-local phenomena in physics; the delayed-choice experiments; the instant synchronicity in the behaviour of a flock of birds or passage of fishes; the telepathic connection between close people (mother and child, twins, lovers, friends); the sense of pets for their owners; the ongoing link between cells removed from a living organism and their "donor"; the synchronic events that each of us experiences more often or less often; even the very birth, development, and functioning of a human body – a real miracle that begins with the merger of only two cells and then, driven by a flawlessly functioning program that is not yet completely

understood by the science, reaches the vast number of a hundred billion (10^{14}) cells working together in an astonishingly perfect synchrony.

Based on the properties of this field, analogies can be made between it and some fundamental notions of philosophy and religion: God, Dao, Void, Brahman, Creative Consciousness, Cosmic Consciousness, Kingdom of Absolute, Field of Pure Potentiality.

5. Conclusions

Contemporary physics shows us that what we know as a solid, static, determined and unchanging reality of isolated entities is rather a fluid, dynamic, synchronistic, and changeable reality of interconnected processes that are in a constant interaction and exchange of energy and information. In such a reality, separation is an illusion even on a physical level. It is plastic and modellable. Moreover, it is, perhaps, our own creation. Beyond this “known” manifested reality there might be a seemingly other, unmanifested reality that is the “source” of everything that exists. It is supposed that in this reality all manifested “things” have their fundamental unity and they are indistinguishable in it. It is their (and our) True Nature. We are an inseparable part of it and at the same time we contain it in ourselves.

All of these ideas are in good agreement with ancient Eastern wisdom.

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