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RESEARCH ARTICLE

A NEW PARADIGM OF SCIENCE

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ABSTRACT

We witness an extraordinary success of the two great bastions of 20th century science i.e. Quantum Theory and General Relativity. However, there are serious conceptual and mathematical difficulties rusting in them too. As a result, further growth of fundamental science seems to be at stake. In this work, it is proposed that science continues to grow, but a new dimension is imperative. A thorough recourse into the grass-root level working of science is necessary. We know all the scientific methods are based upon our sense perception, which keeps the outer physical universe as a separate entity; that is something quite independent of the observer. It is, basically, the observer – the knower (human mind) – which makes perception possible. It pretends a person or scientist to recognize or refute the existence of an object or a phenomenon out there. The inclusion of observer in scientific theories, although not easy, yet can certainly spark a revolution in our understanding of nature.

INTRODUCTION

The inquisitive mind of man has been continuously struggling to understand the phenomenal world out there, and his perception of reality is gradually improving over the centuries. Science provides a versatile tool which makes human to see the reality at a close-up. The great new truth revelations by the unbroken diligence of scientists for the centuries have dramatically transformed man's view about himself and his place in the universe. The spectacular success of science particularly in the last century i.e. the two great bastions of science (Quantum Theory and General Relativity) has ascertained human to consider it to be a self-contained world-view independent or inclusive of its entire philosophical foundation. Unfortunately, there are several difficulties in our theories which obstruct us to see the true picture of nature and reality. Along with the scientific knowledge, we have also gathered speculations, debates, and confusions. It seems as we are extending the radius of our scientific knowledge, so have been increasing the circumference of our ignorance and the truth is becoming more and more dispelled.

After struggling for several years a desponded scientist, Albert Einstein, who has a number of pioneering contributions to the development of modern science, uttered: "I used to think when I was young that sooner, or later all the mysteries of existence would be solved and I worked hard. But now I can say that the more we know, the more our existence turns out to be mysterious. The more we know, the less we know and the more we become aware of the vastness... Science has failed in de-mystifying existence; on the contrary it has mystified things even more."

On the other hand, the protagonists and mentors, who are the major directive forces of the entire social dynamics, have overlooked this fact. For them the important thing is how science could be exploited to increase the physical ease of life and serve their vested interests. They are least concerned about the consequent problems faced by society and fundamental science. They even don't hesitate to apply the available scientific knowledge for the purpose of human destruction. It might be their compulsion or their false belief that they can live more comfortably in this way. Ironically, they have guided the entire humanity onto the same vision. As a matter of fact, a soaring level of human happiness has been resulting to the endless lusty desires, which have given birth to a restless world with several problems. The green-earth-environment has been polluted; a massive development of nuclear weapons is taking place. The countries having not enough food-stuff to feed their hunger, but do sustain far-flying dreams to create missiles and atom-bombs.

All the crisis that modern science and humanity are facing today, clearly show that there is something wrong in our conventional way of thinking, the way we understand nature and our relation to it. It may be noted that the thinking and life

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style of protagonists are the product of the existing world-view; which clearly shows that that modern scientific knowledge is inadequate to educate people to live in happy way of life and prosperity. Furthermore, there are serious conceptual and mathematical difficulties rusting in the fundamental science, such that the further growth of fundamental science seems to be at stake. There is a compelling need to understand fully the working of the conventional method of scientific studies.

In this work, the subtle problems of modern science in understanding nature and reality are exposed in the light of views, thoughts and work of experts and a candidate solution has been proposed.

The sections are divided as follows: In section 2, some advancements and difficulties of quantum theory and modern cosmology are discussed. Status of the secret dream of scientists for centuries – Theory of Everything (TOE) – is reviewed in section 3. However, a review into the foundation of science is attempted in section 4. Finally, the conclusions are summarized in section 5.

EVOLUTION OF HUMAN QUEST FOR REALITY

The studies of archaeological survey show that human mind has been always agitating and susceptible to the external stimuli. The numerous developments, as found in the excavations and investigations, dating back to the time roughly 35,000 years ago, show the beginnings of the emergence of a reflective consciousness. Records of stone tools, burial sites, cave art, and of migration patterns evince that a first awakened human culture was born in these glimmerings of personal and shared awareness. There happened a dramatic change in the view of reality and human identity at about roughly 10,000 years ago when our ancestors shifted from a nomadic life to a more settled livings in villages and farms; and then followed by a rise of city-states and the beginnings of civilization at roughly about 5,000 years ago.

A more recent revolution in the human awakening is clearly visible through the vast existing literature, museums and the developments in all the pathways of our life. The birth of science happened roughly 300 years ago with a radical dynamism and materialism of the industrial era. Scientific method is based most assuredly on analysis, that is, scrutinizing every phenomenon and examining every part of it and finding out how it came about.

The scientific revolution gave a totally different awareness to the human understanding of reality. All aspects of life have vividly changed with it, including the work that people do, the ways they live together, how they relate to one another, and how they see their role in society and place in the universe. The leader took advantage of time to shape and mould the social fabric on their concern.

The humanity's prevailing paradigm is changed again by another radical worldview, which was kicked off in the beginning of 20^{th} century with the emergence of a new vision of matter and universe. The modern concept of matter in subatomic physics from quantum theory and the new concept of space-time from the theory of relativity are totally different from the one, of which we were traditionally used to. These new explorations have changed our conception of the universe as whole with life in it.

Quantum Theory

Quantum theory grew out of a series of anomalies in the picture of matter and light offered by classical physics – in particular associated with black-body radiation, the photo-electric effect, and the need to devise a model of the atom consistent with the newly discovered sub-atomic particles. Without quantum physics, we are unable to explain the behaviour of elementary particles, solids, the structure and function of DNA, super-conductivity, properties of super-fluids, and burning of stars etc... There is no doubt that quantum theory has been one of the most profound discoveries of the 20^{th} century development of science. Indeed, this theory has become dramatically successful in order to explain the experimental results, which were, otherwise, impossible to understand in the classical formalism. It is generally agreed that quantum theory is, if not a complete explanation, at least a great step forward in understanding nature.

Despite the extraordinary successes this theory has been plagued by conceptual difficulties too. The debate about the relation of quantum mechanics to the familiar physical world continues. It is not at all clear, what this theory is about and what does it, in fact, describe? [1]. Right from its inception the theory had has a "measurement problem" with the troubling intrusion of the observer [2] in experiments. An Irish physicist J.S. Bell has quoted in his book, "Speakable and Unspeakable in Quantum Mechanics" [3]: "... conventional formulations of quantum theory and of quantum field theory in particular, are unprofessionally vague and ambiguous. Professional theoretical physicists ought to be able to do better."

Albert Einstein was not at all comfortable with the foundation and working of quantum theory, despite the important role he had played in the development of this theory (he was awarded the Nobel Prize for discovering the photo-electric effect). Nevertheless, it is a general conviction among the scientists that Niels Bohr (founder of Copenhagen interpretation of quantum mechanics) vanquished Einstein in their famous, decades-long, debate [4]. On the other hand, till the end of his life, Einstein continued to pretend that perhaps the quantum mechanical description is not the whole story. Erwin Schrödinger, one of the founders of the quantum theory and who is also known as the father of wave function, was one of the most acerbic critics of the theory. He ultimately found this theory as impossible to believe.

The quantum theory which helps us to look deep into the matter is resting on the serious conceptual difficulties. There are following mysteries, puzzles and paradoxes:

- The Schrodinger equation is perfectly linear, propagates continuously in time, but collapses discontinuously when a particle interacts with a classical system at the event of measurement. In fact, there is no dynamical description for the collapse of the wave function.
- A quantum system is described with a complex wave function (ψ) which is an abstract entity, but whose

squared value ($|\psi|^2$) represents its physical properties. This gives a probability distribution for where discrete particles may be found once the wave function is collapsed by an act of observation.

- Quantum particles can have spooky connections: According to theory, they can communicate over vast distances in an instant, which gave rise to the famous EPR paradox [5] and Bell's theorem [6]. This ghost action violates the principle of the limitation of the velocity of light in relativity theory and the principle of causality.
- There is a profound relationship between measurement and reality, where reality depends heavily on the measurement techniques. Observation would create a different kind of reality than what existed independently. In other words, reality existed in a different way while under observation than it did in itself.
- According to the "Principle of Superposition" the Schrödinger's Cat inside a box [8] is neither dead nor alive, but a superposition of these two states. The wave function thus contains the superposition of all possible states of a system until it is observed.
- A quantum particle can behave as a wave as well as a particle; e.g., in photo-electric effect it shows its particle nature whereas in a double slit experiment it behaves like a wave.
- It is fundamentally impossible to measure the key physical quantities, in certain pairs, e.g., position and momentum, simultaneously to any desired degree of accuracy. Attempts to increase the precision of one measurement result in less precise measures of the other member of the pair: "Principle of Uncertainty."

There were several attempts to falsify this theory on conceptual and experimental grounds, e.g., Albert Einstein with the collaboration of Boris Podolsky and Nathan Rosen proposed a gedanken experiment [EPR Experiment][5] as an attempt to show that quantum mechanics was somehow not complete and that the wave function does not provide a complete description of physical reality. However, they left open the question of whether or not such a description exists. J.S. Bell proved mathematically through an inequality, famously known as "Bell's Inequality"[3], that quantum mechanics does violate special relativity by allowing instantaneous interactions across even the cosmological distances. This weird fact has been observed in an experiment by A. Aspect *et al*. in 1982 [7].

In another attempt, Erwin Schrödinger fabricated a thought experiment [8]: Cat-in-a Box, where the future of a cat paradoxically depends on the random decay of a radioactive atom. Astonishingly, according to quantum theory, the hapless cat is neither dead nor alive but in a state of superposition of the two possibilities, before to be seen actually – which is ridiculous and hard to swallow.

General Relativity: Cosmology

Einstein's theory of general relativity gave a new vision toward the understanding of the dynamics of heavenly bodies and the origin and evolution of universe. In modern cosmology the most popular theory today we have is the big-bang theory [9]. According to this theory there was nothing before the big-bang and all the space-time must have originated there and then ("t=0"). No matter/ energy could exist before this bang, as there was no space and time for it to be in. The theory further describes that this universe evolved from a dense, nearly featureless hot gas and that is expanding and cooling continuously.

Scientific evidences strongly support that the universe had a definite beginning a finite amount of time ago and also prove that the early universe was very hot and that as it expands, the gas within it cools. There are three important observations strongly supporting the big-bang model: 1) The expansion of the universe observed in 1929 by Edwin Hubble. 2) The abundance of the light elements H, He, Li (according to the theory these light elements should have been fused from protons and neutrons in the first few minutes after the big-bang). 3) The discovery of the Cosmic Microwave Background (CMB) radiation. The theory claims that the CMB radiation is the remnant heat leftover from the big-bang and the frequency spectrum of the CMB should have a blackbody radiation form. This was indeed measured with tremendous accuracy by an experiment on NASA's COBE satellite. The recent Wilkinson Microwave Anisotropy Probe (WMAP) mission reveals conditions as they existed in the early universe by measuring the properties of the CMB radiation over the full sky [10].

Although, this theory has passed some scientific tests, there are still many more trials, which it must undergo successfully. In the context of a test of this theory, John Bahcall – a leading solar-neutrino physicist and astrophysicist – writes [11]: "I am happy that the big-bang theory passed this test, but it would have been more exciting if the theory had failed and we had to start looking for a new model of the evolution of universe". In fact, there are many domains of modern cosmology which are far from being settled. The theory is silent about What banged, why it banged, or what happened before it banged. Despite its name, the big-bang theory does not describe the bang at all. The biggest problem of the big-bang theory of the origin of the universe is philosophical – perhaps even theological – what banged and why it banged!

The philosophical base of the theory stands as embarrassing situation for the scientists. Robert Jastrow – the first chairman of NASA's Lunar Exploration Committee– himself admitted [12]: "Astronomers try not to be influenced by philosophical considerations. However, the idea of a universe that has both a beginning and an end is distasteful to the scientific mind". To avoid this initial difficulty the idea of singularity was introduced in which the universe expands from a singular point and collapses back to the singular point and repeats the cycle indefinitely [13]. The idea was appreciated to avoid the philosophical, rather theological base of the theory, but the available experimental evidences indicate that this type of oscillating universe is a physical impossibility. The facts and results suggest the geometry of the universe is flat and will expand forever [14, 10]. So, the attempts behind this idea to avoid philosophical or theistic beginning of the universe all fail [15].

The philosophical origin of the big-bang is hard to quit even in the current attempts that are being made through a highly speculative theory of unification of quantum mechanics with gravity: "Quantum Cosmology". It must be noted that the meaning of "t=0" is highly contextualized by the assumptions and limitations of big-bang theory. In the alternative theories like quantum cosmology, they may well address the problems like "t=0" but the underlying philosophical ideas about space, time, matter and causality, far from being eradicated, might re-emerge in new and distinctive patterns and which will lead to further questions.

THE UNIFIED THEORY

Science works under the principle of economy of understanding nature [16]: when multiple explanations are available for a phenomenon, the simplest version must be preferred. The logical description of a vast range of physical phenomena from a few basic principles is adopted, rather than the memorization of a large number of isolated facts or formulae. Such economy is the strength of modern analytical science.

Scientists have a secret dream to expound nature in the simplest version. They want to explain all phenomena in the universe with the minimum number of particles interacting with a single interaction. Search for such a Theory Of Everything (TOE) is like the quest for the Holy Grail in the Middles Ages. TOE is a beautiful contemplation of theoretical physics and mathematics that fully explains all the known and unknown – everything in entire universe including life – with a single unified equation. Search for such a theory has started from the idea proposed by Isaac Newton. According to him, one great theory might exist that would link all the other known theories and this Grand Unified Theory (GUT) would be able to describe everything including life in the entire universe.

Science has traversed a long way since the time of Newton, and other physicists, including Albert Einstein, began to realize this beautiful idea of unification. This idea became more popular after the revolutionary work of James Clerk Maxwell (1831-1879): The first theoretical unification of the two physical phenomena – electricity and magnetism – into one all-encompassing framework. The next great step was the success of Quantum Electrodynamics (QED) theory (the integration of electromagnetism and quantum mechanics). On the same lines, the unification of electromagnetic and weak nuclear forces known as Electro-Weak theory (EW) took place.

In order to find the most promising road to a GUT there are continuous endeavours to unify all the forces of nature. Mathematically elegant Kaluza-Klein theory does indeed succeed unifying gravity and electromagnetism in a 5-dimensional formalism. Many ideas of this theory are the basis for the several modern unified theories that can by themselves form a GUT, namely string theory, super-gravity and loop quantum gravity. Scientists want to see this theory (GUT) as an unification of general relativity theory, that describes the large scale structure in the universe and quantum theory, that studies the microscopic structures.

Although, the idea of unification seemed quite rewarding, yet the several difficulties at theoretical, experimental and phenomenological level have faded away the hope of realization of this elegant dream: What once seemed very near on the horizon may be further off than imagined. Much of the difficulty in merging these theories comes from the radically different assumptions that these theories make on how the universe works. On the one hand, in conventional GUTs like SU(5) physical particles exist in the flat space-time of special relativity, whereas on the other hand in general relativity space-time is curved and that changes by the motion of mass.

Noticing that a class of GUT quantum theories proposed in 1980's and later [17] couldn't pass even the first test in the laboratory: In 1999, Superkamiokande experiments reported that they had not detected proton decay as predicted by the GUTs [18]. Also none of the generic predictions of these theories, the existence of topological defects such as monopoles, cosmic strings, domain walls etc... has been observed yet. As a result, not a single such quantum theory is currently universally accepted.

On the other hand, the very complexity of Einstein's general relativity was first noted by himself as leading to a very serious impediment on its further development. In fact, after publishing his famous paper in 1916, he conceded that this arose from the mathematical difficulties involved in the complexity of its nonlinear coupled equations and their huge number of terms. In 1952 he expounded it as an acute frustration: "The generalization of the theory of gravitation has occupied me unceasingly since 1916." Obviously, at this stage of debates and confusions, unification of all the four interactions is extremely difficult.

THE ROLE OF OBSERVER

In scientific methods we observe, describe and establish the truth on ocular demonstration and verify it with experiments which anyone may undertake without the least faith in ultimate results. In light of these ruthless difficulties, as discussed above, a question arises whether this is the end of growth of fundamental science? The optimistic answer is "it should NOT be"! It is believed that science will continue its growth and progress in a consistent way once the grass-root level working of science is revisited.

We argue that a serious flaw is pinching in the foundation of science [19] and necessity to understand completely the working of the conventional method of scientific studies is vital. It is well known that all scientific methods are based on Cartesian Partition approach i.e. relying upon ordinary sense perception, which keeps the outer physical universe as a separate entity; to be an independent existence that is something quite independent of the observer. Notice that here we are separating the real observer from the observation and only relying upon the sense perception of human body.

In order to make a perception possible there must be a subject – the knower– who can observe a phenomenon or an event with the help of a connecting principle. In fact, it is not the physical part of human brain which acts as the observer (the knower) and makes the perception possible, but there exists a subtle

playback entity; a consciousness being – Mind. The human mind is the doer, the observer which interprets the messages collected from outside by the brain with the help of sense organs and instruments. It is evident that the mind is a part of nature and an essential component of our observations, and there is no reason of partition or eliminating the observer from the measurement process.

Some Annotations

We ponder upon some observations/ annotations encouraging THE ROLE OF OBSERVER in the measurement of reality. It is shown how human mind can be an inevitable target of scientific contemplation in order for the further growth of fundamental science.

1. Recalling that the classical physics, the study of macroscopic world, is based on the principle of Cartesian Partition. Given that in the last century's development of science, there came up a well corroborated fact that the classical physics is an incomplete understanding of nature. This suggests that our scientific research based upon 'Cartesian Partition' approach must be incomplete or erroneous.

    - Nevertheless, to a first approximation this approach is fine. It is simple and workable, so far, as evidenced by the success of science. However, as we enter deep into the matter –the domain of quantum theory- we have to face the weird responses of nature to our questions. Some people called this as the 'intrusion of observer' in the act of measurement [2]. On their lines, it is straightforward to argue that this acute ascendancy of observer in the measurement process experimentally confirms the prevailing importance of the functioning of human mind – the actual observer – in the definition of reality. In this way its scientific contemplation is inevitable. Interestingly, the relationship of mind and matter, which eliminate Cartesian partition, has already been widely discussed in literature [24].

2. It has been witnessed by the gradual growth of science; the several interfaces among its different branches have been emerging out. For example, genetic-engineering and the associated reproductive technologies on plants, animals and human have brought forth ethical issues calling social scientists and environmentalists for greater regulation to hold. New disciplines like Bio-Physics, Bio-Chemistry, Ecology, Neuro-quantology etc... are already in their establishments.

    - It appears that finally all the branches of science, including social and behavioural sciences, are going to meet at some point of time. There can no longer be "pure" science – every branch of science reacts with others [20]. As all the fields of science are developing, they are converging, and the mysteries of human mind in almost each of them are coming up into light [21]. This clearly implies a global necessity for understanding the functioning of human mind. It seems obvious that a scientific contemplation of human mind could bring all the fields of knowledge on a common platform, and certainly impel human awareness a leap forward.

3. As has been already mentioned above, modern scientific advancement has influenced all the sectors of our day-to-day life including our thoughts and culture. There is no doubt that along with the enormous physical comforts, mental restless and all the problems at personal, social, and global levels that we face today are also related to our scientific understanding of nature. So, there exists essentially a crisis of understanding of our own minds and nature – a crisis of true perception of reality. In order to maintain both peace and prosperity together we have to understand the functioning of our minds and learn to eliminate the causes which promote human toward destruction.

    - According to Melvin Calvin [20], a Nobel laureate in chemistry, that it is apparent that for the welfare of mankind, scientists must understand the basic knowledge of other fields than their own, and, in addition, must understand world about them in terms of the humanist as well. And, conversely, the student of humanities must understand the interrelationships of his own specialty (for example, of urban planning, with the humanitarian, or aesthetic, provisions for peace of mind and of environment) as well as the relationship of his specialty to new knowledge advanced in the area of science.

4. We know that our thoughts and emotions do influence our brain chemistry and other biological activities, yet for no significant reasons we don't treat them in the definition of reality. The mind composed of thoughts and emotions do influence our observations and measurements. In this way mind-independent measurement of reality is erroneous and incomplete. So understanding the functioning of human mind is must for our scientific methods in order to understand the true picture of reality.

5. The most creative physicists have always emphasized that human consciousness (mind) is at the foundation of the scientific method behind physics. According to American physicist Eugene Wigner: "The next revolution in physics will occur when the properties of mind will be included in the equations of quantum theory". Luis De Broglie – who proposed the idea of the wave-nature of particle – said: "The structure of the material universe has something in common with the laws that govern the working of the human mind". Erwin Schrödinger felt deeply that human mind is a sole constructor of all the observations and quoted as: "Our picture of the world is, and always will be, a construct of the mind". In order to construct reality

mind has been thought responsible for the collapse of wave function [22].

6. A radical change in the human understanding of nature and objective reality is expected by unveiling the mysteries of human mind. This revolution of human consciousness is quite probable and supported by the several leaps already happened in the history of evolution [19].

In summary, these are some facts which are interpreted as the compelling evidence for the scientific contemplation of human mind, and therefore a need to expand our world-view in order to include human mind in the definition of reality is propounded.

CONCLUSIONS

Although, classical physics has failed to explain the dynamics of the microscopic particles, yet, ironically, modern scientific researchers are based upon the prejudice posed by classical physics i.e. Cartesian Partition– keeping the outer physical universe as a separate entity. Indeed, the quantum physics experiments have knocked the door of a new paradigm through the troublesome intrusion of observer – human mind – in the act of observation. The prevailing role of observer, as suggested by the quantum physics experiments, is one of the physical proofs substantiating the idea proposed in this work as a solution of the problem in hand.

Several observed facts have been analyzed and annotations have been discussed, which favour the scientific contemplation of human mind in order to facilitate the further growth of science with peace and prosperity. Although, the scientific contemplation of human mind is a great challenge for the scientists yet, it there are strong possibilities that a fruitful collaboration of the experts from all disciplines of life could spark and may facilitate the accomplishment of the holistic cause.

In the light of the indicative conjecture, once some concrete steps are made in this direction, the solutions to the various problems related to the difficulties and growth of modern science, and peace and prosperity of humanity would start showing up. Finally a paradigm-shift is evinced, which has the potential to dramatically transform our view of reality, identity, social relationships and human purpose.

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