

# FOREVER CHALLENGED: MODELING COSMIC PROCESSES

## 1. SETTING THE STAGE: BUILDING THE BACKGROUND THINKING

### ***1.1. Diverse thinking models in knowledge development, which are triggered by our intentions & influenced by our subjective cultures.***

Knowledge development about the objective realities of the universe is a subjective endeavor because of the diversity of our bio-genomic subjective minds. The issue is how we can keep ourselves moving towards the path of understanding the objective reality, while perpetually zig-zagging our way, using our flexible logics created by our subjective minds. “How could science be different?” has to be analyzed given this inevitable subjectivity of human minds. The topic is timely because many top physicists have been writing that the observable universe is our illusion! [1, 2] “The laws of physics are same everywhere” is actually close to accepting the objective existence of the universe.

The purpose of physical sciences is to model and explain the engineering processes behind all the observable physical transformations taking place across the cosmic system and in our biosphere, so that we can *engineer our ways* towards our desire to keep living and evolving forever through the successions of our progenies as humans, as we have succeeded, so far. The “Global warming” demands more engineering thinking from us. However, eventually we will have to find our homes in other planets around other stars as the Solar Warming starts engulfing all of our planets, starting probably within a couple of billion years, before its ultimate demise in another couple of more billions of years. The preliminary engineering initiatives of searching for the right star have already started by the Astrophysicists; but the appropriate technology development for our real deep space journey has not started.

Our early introspective forefathers started from a platform of zero knowledge to understand the laws that are behind the engineering processes guiding all the natural physical changes. Our current knowledge about the very complex biological evolution, happening over 3 to 4 billion years on earth, indicates the necessity and importance of the species-diversity. Similarly, as human intellectual capacity evolved to the level of modeling the working rules behind the perpetually evolving universe, we have smartly allowed for the diversity of conceptual approaches. Like the role of the species-diversity in assuring the Biospheric sustainability, the *human-concept-diversity* will assure the convergence of the diverse subjective human concepts (theories) towards identifying the final set of objective rules the universe. We have yet to figure out the ultimate truth about our universe – its meaning, its purpose and the role of humans in it. Collectively, we are still the Buddha’s “born blind men”, persistently, iteratively trying to visualize the Cosmic Elephant [3].

### ***1.2. Identifying the diversity of conceptual approaches:***

The minds of the early *spiritualists* found immediate comfort in the *postulate* of one benevolent creator-theory. The creator takes care of us as the ruler of the earth within this magnificent

universe. The *intention* of the spiritualists has been to manage the well-being of their members by learning to “behave ourselves” as a group, as a tribe. However, the tribal (race, country, etc.) competitions, engendered by the innate Darwinian drive of the competition for the “survival of the fittest” intensified the desire for cultural, economic, political and intellectual dominance, and hence the fight for the freedom from dominance by other tribes. Broad spiritualism shifted to god-theories and multiple *religions* emerged. Our evolved tribal mind is so strongly “concept driven” that some of us, even today, are very comfortable in killing other humans in the name of our individual god-theories, or the evolving socio-economic theories.

*The philosophers*, right from the beginning, took a more pragmatic approach with the *intention* to really understand how nature works as a materialistic system. They found a logical, orderly and recurring consistencies in natural phenomena. Their *postulates* kept grouping natural phenomena based on logical congruencies and conceptual continuities. These early philosopher-theorists eventually split out into modern philosophers and modern scientists. The modern philosophers are still continuing to use *human-mental logics* to directly grasp the *cosmic logics* and explain everything that is happening and could happen around us.

*The scientists* have evolved out of the early philosophers. This group has been aggregating the observable similar behaviors in nature to create a common set of *postulates* and validate them by demonstrating reproducible experiments. This scientist group reached the modern maturity by inventing mathematics, consisting of geometry, algebra, differential and integral calculus, etc. Because of the built-in rigidity of *mathematical logics*, the scientists have been steadily formulating multiple powerful theories, by framing unique set of *postulates* for each separate theory that models a particular set of observables, yielding precise and reproducible experimental data. We now have Evidence Based Science (EBS), supported by mathematical theories, strengthened by reproducible experimental validations. Today, we know more about the atoms, molecules and the stars and the galaxies, and their life-times, than any other centuries since the first emergence of the Homo sapiens. Persistent successes of these modern mathematical theories assures us that nature definitely operates as a highly reproducible logical system. This is a critically important understanding because we must preserve and leverage the strength of math-logics, irrespective of the needs to keep developing newer theories.

However, the common people have always been at the foundation of our sustainable evolution. They are always grounded as simple but intelligent *engineers*, always inventing better ways for agriculture, house-building, animal husbandry, etc., etc., while emulating nature allowed processes, without struggling to discover the unifying fundamental laws of nature. Now we need the scientists and the common engineers to move closer and work together

### ***1.3. What is missing?***

The serious slowdown in the progress of our current physics [4-8] can be traced to the over emphasis on the human invented math-logics (beauty, symmetry, elegance, etc.), while actively undermining attempts to visualize the invisible interaction processes that generate the theory-validating data in our instruments. This essay will strengthen EBS by focusing on *Modeling Interaction Processes* behind every evidence generating data. Since nature is a creative system engineer, our successful evolution will be assured if we can emulate nature’s practical engineering processes.

In reality, all living things, from viruses to humans, are surviving and thriving by intelligently executing innumerable quantum-chemistry-driven interactions every minute inside their cells. Some of them are master engineers in building their protective shelters around their own bodies; others build exquisite external abodes; complex tall buildings constructed by both the termites and the modern humans, are excellent examples.

#### ***1.4. What is confusing?***

The Cosmosphere is “*Entangled*” by Electromagnetic and Gravitational fields; but nature’s local interaction principle remains “*Local*”. Nature is dialectical. All interactions are “entangled” (guided) by some force of interaction. This is the locality of Interaction Principle. The neglect of this engineering-thinking and over-emphasis on pure mathematical logics, have ushered in the new physics of “entanglement”, where co-generated physical entities can influence each other through either “spooky action at a distance”, or no interactions at all!

All the biological bodies remain highly *localized* as individual entity even when they are mating to reproduce and exchange complex molecules and cells, which carry out newer quantum chemical transformations. There is nothing *nonlocal, unreal, or “spooky action at a distance”* in our biological evolutions, even though driven by quantum chemical engineering. Orderly evolution, from atomic to galactic scale, thrives on approximate but definitive *local interactions* between different entities, guided and defined by the distance-dependent force-laws of nature. Yet, the entire universe is always remaining “entangled” by the electromagnetic and gravitational force laws, as is evident from the formation of clusters of galaxies and individual galaxy out of billions of stars.

#### ***1.5. Re-emphasizing the importance of our engineering skills that dictate the direction of our evolution***

Let us recall the two engineering innovations that have been playing as very powerful accelerators of human evolution.

The first invention was the *generation of fire on demand*. It was one of the most crucial and the first engineering feat for humans to accelerate our own evolution as the dominant species on the earth. This had happened several hundred thousand years ago [9]. This engineering invention helped the humans not only to drive away the big predators, but also allowed us to eat cooked food to enhance our capability to absorb ample storable energy and have free time to start thinking and contemplating about our future, and about the universe. These early humans did not have any knowledge of math or science, not even have a matured language! Yet, we are here today because of their *innovative engineering minds* and patiently perfecting the trial-and-error technique. Today’s quantum physics helps us appreciate the physical processes behind this ancient fire generation. Rapid rubbing of dry woods, or sharply striking stones, ionizes the molecules of the solid surfaces. Then the free-electrons from the air cascade down through the quantum energy levels to re-neutralize the molecules while releasing, from infrared to UV radiation, some of which are directly responsible to heat up and ignite the combustible chemicals of dry grass! Today, one can buy such a compact device for \$1! Without mastering the visualization of the multi-step physico-chemical processes behind this fire generation, we could not have built this modern

mini-lighters. These visualizations became possible only after the developments of QM formalism of 1925!

Consider the next great leap-forward engendered by the humans. This transformation started very recently, during early 1990's. We have now created a Global Village out of our vast globe using the fiber optic communication network. Note that the generic engineering functions behind this fiber-optic-network is empowered by the four basic engineering functions – (i) generate, (ii) modulate, (iii) propagate and (iv) detect the signal-carrying electrons and photons. However, we still cannot decisively model and describe what electrons and photon exactly are! Our engineers could not have accomplish these goals without the development of optical science and engineering over the last several centuries, beside the QM of 1925.

## **2. RESPONDING TO THE FOUR QUESTIONS SET BY THE ORGANIZERS**

### **2.1.-Q1. To what degree is the science we have today necessarily the way it is versus contingent on the particular history and human societies in which it originated?**

All human enquiry driven thinking, whether purely creative or grounded on pragmatic needs, have been guided by the history of the individual human cultures. Therefore, considering the global aggregate of the current state of science-thinking, it is a mixture of both the “necessarily the way it is” and the “particular history of human societies”. Objective separation of the two is difficult.

Different global cultures had given different priorities and emphasis on modeling the universal laws of nature. Hence, their contributions to modern physics have been very different. Today's evolved state of knowledge of the universal laws of nature (Physics) has been shaped dominantly, over the last seven hundred years, by the Western World. Fortunately, our cosmic system has only one set of inviolable laws. Hence, all cultures, all the modes of thinking (spiritual, philosophical, scientific, engineering, etc.) eventually will have to be converging to become an integrated, or a consilient knowledge system [10].

### **2.2.-Q2. What could a science free of prejudice and bigotry have looked like?**

If we carefully analyze the diverse globally “matured” cultures of today, it is impossible to think that any of the human societies could have evolved completely free of “prejudice and bigotry”. Darwin's appreciation of the “survival of the fittest” has been working at every level of human social evolution from the earliest times, besides being true for the greater biosphere. Even today, we have prejudice and bigotry, relating to the roles of females, the historically oppressed races, the born-genetically as “non-binary people” in any races, etc. Fortunately, thoughtful members of most of the major countries, developed and developing, have been quietly nurturing and providing opportunities to all human beings of their societies. All the professional societies and many big and small corporations are also actively promoting diversity and equity. These individuals and organizations understand that the genomic guiding structures of every human neural network, consisting of eighty-billion neurons, have the very high potentials to contribute in their own diverse ways to human cultures and sciences. If we do not nurture all the human capabilities, i.e., all the human capitals, human society cannot develop to its full potential.

However, Physics is now essentially a “mono-culture”, maintained by the global knowledge-keepers of the economic enterprise of the sciences. This mono-culture, effectively, is a much

more serious form of *prejudice* in physics than the social prejudices, which is getting the benefit of socio-political movements for corrections. But, the scientific mono-culture is steadfastly preserving the “purity of science” developed over the last 120 years. *A paradigm shift is overdue.*

Classical physics, Newtonian and Maxwellian, have been thriving and guiding an enormous number of daily engineering functions in our daily lives, maintain the global fiber optic network, space explorations by space-faring countries, etc., etc., without suffering any serious controversies regarding the foundations of the theories, even though these theories cannot provide direct guidance about the engineering functions in the domains of quantum physics. However, it is almost a hundred years that QM formalisms have been developed. Yet, the field has been continuously generating some serious papers and books [11] underscoring the interpretational problems built into QM formalisms, right from the beginning. And, yet we do not see the normal and historical Kuhn’s [12] paradigm shift taking any root. Is the prejudice of the scientific monoculture immune to “grassroots” conceptual diversities, while the socio-cultural prejudices are not?

### **2.3-Q3. What can it look like in the future?**

First, we need to overcome all the prejudices and bigotry, including in the scientific thinking modes. We have to evolve out of our prevailing Darwinian instincts of “individual freedom first”, and its egotistic derivative, “our, or my idea must dominate”, must culturally be replaced by the collective-self-interest of evolving together. We will have to learn to appreciate and visualize the sustained individual benefits we gain when we consciously act towards collective benefits. A few brilliant individuals cannot survive, if the biosphere cannot anymore support the diversity of lives. The same concept is also applicable to the survival of human intellectual endeavors. We cannot develop and implement the best methods for assured sustainability of the biosphere unless we consciously allow for the diversity of concepts to compete and some concepts mature as better solutions. This is pure *collective-self-interest on a grand scale!*

The knowledge of the definite demise of the Sun should proactively inspire human beings to usher in a new mode of evolution, that I would call, “Consciously constructing purposeful evolution” (CCPE) [13, 14]. Only prejudice-free engagements of all creative human beings will accelerate our collective thinking towards our proactive move to become CCPE humans. Given the certain death of the Sun, the humans do not have much alternative left but to proactively graduate out of the Darwinian mode to CCPE mode. Fortunately, we have plenty of time to bring about this transformation slowly and steadily, without the need for any revolution. Revolution is a destructive human concept, which emerged out of our natural Darwinian mode of evolution, “fight or flight” response. Human mental volition accelerated the evolution of human consciousness and the human intellect. We are now the ruler of the biosphere. We are now matured enough to understand that we have no other enemies on the earth, except ourselves. We are now responsible for the sustainability of the biosphere. Excessively hyped “individual freedom” has been a product of Darwinism. “Individual responsibility” to the collective wellbeing of the entire society is a much more matured thinking to evolve into the CCPE-mode. “Individual freedom” to enjoy our lives still remains open to us through our volition as to how we use our talents to serve the society that makes us really happy. In fact, the younger generation has already been thinking and choosing their professions accordingly. We just need to keep nudging our wealth creation and wealth

distribution process in more equitable ratio, while recognizing the necessary diversity of intelligences.

#### **2.4-Q4. And how could the process of science be better?**

##### ***2.4.1. Appreciating the foundational limits of all working theories***

We need to recognize that our successes in developing the Evidence Based Science (EBS) has been based upon our *prejudice of ignoring* some foundational limits of EBS. We can develop the corrective mechanism by properly identifying them, while overcoming some of the prejudices of ignoring our inevitable and lingering ignorance.

##### ***2.4.2. Lack of uniqueness of the postulates***

The very first *foundational ignorance* is that we had to start from a platform of zero knowledge, hence we cannot access complete knowledge of the universe by exploiting pure logics only. This prejudice has been a major “gift” to us for the development of our current platform of EBS. The genius scientists recognized the orderly behavior among a certain set of related natural phenomena and constructed a set of *postulates* that seem to logically connect them together. Then, they developed, through trial and error, a cause-effect relating mathematical theory. When diverse experimental measurements validate the theory, we accept them as an EBS theory. However, postulates are intelligent guesses; they cannot be proven directly. Therefore, at least in principle, it is possible to generate another set of self-congruent and self-consistent set of postulates and build an alternate theory. We do not know how many such alternate theories were wisely thrown away by the proponents of the current working theories.

This is why the future theory unification should start at the bottom. First, keep iteratively unifying the different sets of major foundational postulates of the working theories into one self-congruent set of postulates that has conceptual continuity built into them. Let this newer set of postulates guide the re-development of the individual theories into a more consilient set. The approach has to be iterative to gain more knowledge in each step. The extremely complex universe is an emergent system out of simple to more and more complex systems, most likely, would not yield to a Theory of Everything (TOE).

##### ***2.4.3. Incompleteness of mathematical theories***

Similar to framing the starting postulates of physics, axioms are the foundation of all mathematical theories. Axioms are very wise guesses, but unprovable. This is why, Gödel has demonstrated, through his “Incompleteness Theorem” [15] that no theories can ever be a complete theory.

##### ***2.4.4. Incompleteness of gathered data***

EBS also suffer from another incompleteness problem; the incompleteness of the experimental data we gather. The theory validating data emerges as a number in our smartly designed instruments due to the quantity of energy exchanged between a pair of detector and detectee, chosen to validate the specific force of interaction between them. For our analysis, we normally consider the “detector” as the “known object” and the “detectee” as the unknown object under study. However, since we had to start from complete ignorance about this universe, the known

“detector” is really never completely known to us. We still do not know with complete detail and complete certainty all the properties of protons, electrons or photons. However, as our overall knowledge keeps advancing iteratively, we can keep refining our experiments with better technologies and improved theories, while taking guidance from the extra enquiring tool of interaction process mapping.

#### ***2.4.5. Persistent difficulty in our direct visualization of the live interaction processes in the micro universe.***

We have another fundamental problem. We cannot directly visualize the details of the invisible interaction processes in nature. We have remained satisfied with EBS. However, our innovative engineers would very much appreciate the knowledge of the interaction processes to become more efficient innovators. Had we been able to directly see or visualize the details of every interaction processes in nature, we would not have been continuing with the debate of the Wave-Particle Duality since it started with Newton and Huygens starting around late 1600. We can directly validate Newton’s parabolic law of parabolic path of a projectile by making a quantitative video record of a projectile, from the launching state to the stage of hitting the distant ground. However, we cannot yet photograph a live electron in its orbit around its nucleus, or its transition from higher to lower energy level. So, we are happy with the very indirect verification of Schrodinger’s equation through spectroscopic measurement of the frequency of the light emitted by an ensemble of similarly excited atoms. Therefore, Schrodinger’s wave equation models only a partial behavior of atoms. More detailed theory needs to be developed that can give more detailed picture. We are still living with the controversies like the instantaneous “wave packet reduction”, which is not a causal explanation of the light *emission process*. Declaring that the purpose of physics is no more than EBS-validation, we are prejudicing the mindset of the next generation of physicists to accept the current limited theories as the final ones. Fortunately, many engineer-scientists did not stop trying to visualize the micro world with more details. Today’s optical and electronic technologies have advanced enough to create instruments where we can visualize molecules and atoms [16]. We are experiencing explosive growths, over the last several decades, in biosciences which is being empowered by Biophotonics, through *visualization of the living organs and living cells* [17].

Nature is a marvelously creative system engineer. Both the Biospheric and the Cosmospheric evolutions, are driven by the same basic functional principle of “dust to dust”. Cosmic dust slowly coagulates to become a glowing star, and then, after living for 8/10 billion years, becomes dust again. Similarly, biological plant and animal lives are recycling through earthly “dust to dust”. These are well organized engineering processes.

The purpose of physics should be re-defined as developing visual models for every step of these dust-to-dust transformations. Our innovative engineers will then succeed in developing all the engineering technologies necessary for human beings keep living in this biosphere as long as possible, and then start moving to other livable planets before the Solar warming starts vaporizing the earth.

All younger generation of physicists should be taught that all of our working theories are necessarily incomplete, as they have been formulated based upon insufficient knowledge of the existing universe. Based on our current successes of physics theories, we have accepted that the laws of science are same everywhere in the universe, yet we do not have a complete understanding

of the universe. We will have to keep iterating our progress. Our intention must be re-directed to model nature as a creative system engineer. But how?

#### ***2.4.6. Putting everything together; implementing the paradigm shift***

The reality of the observables is not in question. Their emergence out of the background cosmic tension field still remains *elusive*. But, they are not illusions. Our prolonged successes of EBS has established that the laws of the universe are same everywhere. Our desire is to find out the real (objective) *Cosmic Logics* behind the evolution. We have been progressing, using the well-constrained (objective) *Math Logics* (theory), strengthened by the reproducible (objective) experimental evidences. The final act is the interpretations of the EBS data using the variable and subjective human *Mental Logics*. This is our Achilles'-Heel. Nature's interaction operations, or the interaction processes, albeit invisible, *must be actually taking place*. Then the mathematical *operators* in the working theories must be able to guide our creative minds to close the gap by visualizing the interaction process. We must learn to utilize our evolution-given strong and creative visualizing minds to close the gap between the observed data and *the math operators, which embed the invisible interaction processes*.

This approach will have to be slow and iterative, but necessary to open up the progress in physics. It will also save us from staying stuck with the prevailing non-causal interpretations of many simple experiments. Young's double-slit interference experiment of 1802 firmly established the wave nature of light, later validated by Maxwell by his wave equation of 1876. Mathematically, the experiment represented the physical superposition of *two sets of complex amplitude parameters*, diffractively evolving while propagating through air, cannot be carried out by a single stable and fixed-energy entity. We are neglecting three mathematical operations that generate actual EBS data, built into our correct math: (i) Huygens-Fresnel diffraction integral ( $\int$ ), a math-operator, quantitatively describes the evolution of two single slit diffraction patterns that arrive on the far-field detector array. (ii) The plus-operation (+) between the two single-slit complex amplitudes. And (iii) the energy transferring square modulus operation ( $|\cdot|^2$ ), executed by a properly matched physical detector. This last operation cannot be executed by the arriving signal themselves. Light does not interact with light. Currently, we are ignoring all these three physical operations by introducing mathematically allowed tricks of normalizing a pair of abstract quantum amplitude functions, while dividing by  $\sqrt{2}$ , so that the *mathematical square modulus operation*, would yield the correct energy of a single "photon". However, we cannot physically execute this normalizing operation, because our current state of technology does not yet allow us any operational access to manipulate the *amplitude* of an imagined "energy bullet photon". This happens after the registration by the release of a QM-bound electron inside a detector. Further, we never detect a "photon", we detect highly amplified current pulse out of the original quantum electrons, the quantum of energy for the release being provided by EM waves. Thus, logically and mathematically, there cannot be any "single photon interference". So, Bell's inequality does not represent any *physical process*!

Removal of such unnecessary and non-causal interpretation will actually strengthen the real successes (beauty) of QM. We just need to visualize the physical process executed by the detectors to generate the data.



### **3. CONSCIOUSLY CONSTRUCTING PURPOSEFUL EVOLUTION**

Developments in sciences, including physics, must not be separated out from all the other intellectual endeavors that human society is engaged in. Knowledge from different fields empowers the evolution of each other [10]. We have developed highly advanced consciousness, but we are miserably failing to *evolve consciously* [13, 14] and collectively as Biospheric humans because of extreme compartmentalization of our knowledge systems. This is also the major reason why we have developed such a wide variety of prejudices and bigotry, including those in scientific thinking. We have become the master of the biosphere, but we have been failing to evolve and accept the responsibility of the biosphere. It is time for the human species to start constructing an inclusive global culture for all sciences and arts, and consciously construct paths towards our purposeful evolution, just as we tend to consciously raise our children with purposeful futures for themselves.