

FQXi's 2017-2018 Essay Contest
'What Is "Fundamental"'

THE STRANGENESS OF FUNDAMENTAL

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Nature is immense and complex

But it is not impermeable to the intelligence

Primo Levi: the Periodic Table

Abstract

The evolutionary process of the Material World leads to more complexity and diversification. In order to understand and study better our environment, we humans have segregated the various evolutionary processes, according to certain emergent properties or qualities, which characterize them.

These processes are classified in hierarchical levels of complexity. In the process of evolution from one level to the next, some physical quantities disappeared or became hindered and new ones emerged from the properties of the previous ones. A new level of complexity with new behavior and properties arises from the level below.

We argue that Fundamental may be defined as something that binds and maintains indissoluble a specific group in the course, of the congruent evolutionary process.

1 Introduction

What is the difference between ***Deep***; a word used mainly by the Old Testament Chaos or abyss in greek and ***Vacuum*** (or Quantum vacuum); a technical term used by Physicists?

When we refer to *Space* we mean the container of all heavenly objects. Is Space-Time an emergent phenomenon from the Deep? Can space exist without time or vice-versa?

What is the force that guides salmons to return up to the rivers, where they were born, or swallows to return to their birth nests? If the expanding rate of the universe stops is it possible that universe someday will return to its birth place (big crunch)?

What is the force that endows some people with a certain talent, i.e. to compose a divine music like Mozart did?

Astronomers found evidence that stars consume its own offsprings that is their planets, like Cronos, who swallowed his children as they were born. What is the force that guides some galaxies to cannibalize other galaxies and create some more stable offspring? Is it the same fundamental process that guides humans to cannibalize other humans? This behavior is consider mainly as a religious rite; in order to acquire the knowledge and wisdom of those they cannibalized (Holy Communion is a manifestation of this kind). Human sacrifice is also another manifestation of cannibalism, where religious rite is obvious. There is also sexual cannibalism, «*female mantis*» eats their mates after copulation, even though the male knows his destiny, but it is ready to be sacrificed for the next generation. Even languages cannibalize other languages, consider the English one. Why do they do it? maybe Cannibalism is a fundamental process for better offsprings?

Nature. Once it creates an animal, plant/star, galaxy etc. via some channels, it endows them with numerous weapons to survive. However immediately after its creation, Nature tries to destroy what it has made, with some other weapons it possesses. Remember the numerous mass extinctions in the biodiversity on earth that happened in the past. Is there something fundamental beneath this irreversible process of "*la naissance , la vie et la mort* "; both in animate and inanimate matter? This process of natural cycle of "birth, growth, decay" presupposes a distinction between past and future. Is time Fundamental or an emergent phenomenon? A Question that tantalizes scientists.

From what has been said and mentioned, is there something Fundamental that can explain all these behaviors of Nature? Is that Fundamental "something" guiding not only our lives, but the universe as a whole?

Some people answer that Fundamental is nothing but God. They argue that if they were wrong about the mere existence of God, then they were doing only one mistake, but they can explain subsequently everything else loud and clear.

2 Levels of Organizations in Nature

The material world is organized at certain levels of complexity. In the transition from one level to a higher level some physical quantities (fields or forces) disappear and some others emerge. For example, Elementary particles exist on their own, due to some forces and exclusion principles; this level of material world gives rise to the next more complicated level: the atoms, atoms to molecules etc.

It seems however that some abilities of inanimate matter have been inherited to animated matter by some unknown fundamental process. Birth and Death is a inherited process from the beginning of the universe and it seems that the emergence of life throughout the universe is inevitable.

Notice, that each level is more complex than the previous one and the increase of complexity is due mainly to the passage of time. The tendency toward, more complexity is also inherent inside each level and especially in complex adaptive systems.[1],[2].

3 Void versus Vacuum

Philosophers and Theologians contemplate the idea of creation out of nothing since time immemorial, leading them to the notorious question of "Why there is something rather than nothing". Nowadays, with the novel scientific methods we have reached at the same conclusions as before, plus some properties which have been endowed to the Vacuum, and maybe defined as Fundamentals.

Higgs field may be considered as a fundamental property of the vacuum that imparts mass to the elementary particles, otherwise they will travel with the speed of light, only photons are not affected by this field. Casimir effect, and Shielding effect, are some demonstrations of the internal structure of Vacuum, giving rise to something (particles, fields, forces) even though, all these things seem to erupt out of nothing.

Dark matter (DM). Maybe it is another possible manifestation of the internal structure of the Vacuum. It is hoped that a consistence theory can be found which will bring an end to the long lasting hunting of the DM-particles. As G. Borner (2003, p.479) describes this : *"An elementary particle that does not exist in particle theories should also not exist in cosmology"* [3]. Maybe virtual particles that lurk within the Quantum Vacuum and pop into and out of existence are responsible for the extra gravitational effect observed on the galaxies, which means the vacuum gravitates. Recall the Shielding effect, where the central role of nucleus is now played by the Galaxies themselves, but at a much bigger scale. New studies link the solar activities with dark matter [4]. Even though virtual particles are not directly observable in the laboratory, their effect is demonstrated when the total energy of these particles can be added together. Dark energy (DE) may also be linked with these particles. Notice also, Dark Energy and Virtual Particles do not dilute at all as Universe expands as the ordinary matter does. If DM does not dilute either, then probably its origin comes from the Vacuum itself. There are some opponents to the DM and DE existence and they consider them similar to the ether problem. If this is the case a new physics is needed with new fundamentals quantities.

We can define the property of vacuum to give rise to particles, fields and forces as a fundamental one. We wonder whether this property can give rise to a Bang, that is Big or Small, or is it the fundamental property of another preexisting entity that we can call it *VOID* ? The fundamental property of this void is to raise vacuums with a bang. If this is the case, we cannot reject the question what God was doing before the creation of the world as St. Augustine did. It is easily then to explain what was before the Big Bang and why there is only one Bang and no others during the lifetime of the Universe.

We have so far defined the Vacuum with the fundamental property to create things out of nothing and the Void with the fundamental property to create Vacuums with a Bang. One Level below Void, lurk the Deep which can be defined as having the ability to rise the voids via another fundamental process. We can follow this argument all the way down, but let's stop here and leave the properties of the Deep to Philosophers or to Theologians to contemplate..

If on the other hand spontaneous symmetry breaking was a fundamental process of the quantum vacuum, then some new bangs must have been appearing during the lifetime of the universe. Since no Bangs have been detected so far, we are forced to conclude that spontaneous symmetry breaking is a fundamental process characteristic only of the void. If this is the case, we have to accept the many vacua multiplicities of the Multiverse. Therefore the time that our Big bang happened can be explained as a Statistical Phenomenon, as an answer to the popular question "why didn't the Big Bang happen sooner?" [5] (p.46)

4. Emergent Phenomena

If we accept axiomatically the transition of the fundamental property from one level of organization to the next one, as a hidden one, and the appearance of a dominated new fundamental one, then we can explain some emergent phenomena.

So far we have accepted the void to be equipped with the fundamental property to create quantum vacua with a bang and our vacuum to produce something out of nothing. For this purpose vacuum is equipped with fields and forces as emergent phenomena, but it has also the inherited ability to create Bangs under certain conditions. If this is true, can we consider Gamma Ray Bursts (GRBs) as some kind of a failed small bangs? Remember that there is not known process in the universe that can produce so much energy in such a short time. GRBs are of extragalactic origin and the location of the sources remain unknown, mainly because their path are deflected by magnetic fields as they travel through Cosmos.

Fundamental is the inherited characteristic from the previous level of the organized matter and the emergent one in the new level which is to be inherited to the next one, but in disguise form with some new properties and capacities.

5 Examples

It seems that the behavior of inanimate and animated matter may have some common characteristics and that nature does not make any distinction between them. This common behavior is manifested better in huge agglomeration of matter, like galaxy clusters, schools of birds and fishes.

Amoebae feed on bacteria by engulfing them and multiply by mitosis (dividing in two). When food sources are exhausted, amoebae begin to aggregate into a number of collection points. These points are points of high concentrations of a chemical which they themselves secrete. [6]. The same argument applies to galaxy formation. Likewise matter moves preferentially towards relatively high *Gravitational Field*, which they themselves secrete. Although stars and amoebae are discrete collections of matter, the same differential equations describe their behavior [7].

Stars collapse after some time, the same happens also to civilization without an obvious cause, examples are Maya civilization, Mycenae, Rapa Nui, not on account of intruder theory. [8], [9]. Plato noticed (Laws) that all created things must decay and cannot last for ever. Is this property some fundamental process that characterizes

all living and non-living things and transforms them into some other more stable offsprings as circumstances and values change?

The collective coherent motion of a group of stars or galaxies resembles the motion of a large number of self-propelled organisms [10]

Dust to dust , ashes to ashes ,it can be said also for the conversion of interstellar medium gas into stars and the return of gas from stars to interstellar medium. A cycling between gas and stars that is perpetual, a process that enrich stars with metals and makes a new generation of stars capable to create planets to harbor life .[11]

Therefore we may state that: "The Universe has been evolved as a self-organized system given the initial condition. It has the ability of reproduction and the power of multiplication". This statement puts the carbon on equal footing with all the other elements.

Life in our Universe is therefore is not an accidental phenomenon but it is closely related with the structure of the universe according to some emergent parameters.

5. Conclusion

In order to crack the code of the universe we have to concentrate our effort to determine exactly what is fundamental in every level of evolutionary process.

To this end we may define Fundamental as, something that binds and maintains indissoluble a specific group for the evolutionary process.

But do not forget, whatever Fundamental is, the commitment of Creation is the emergence of intelligence life and vice-versa. The majority of scientists agree that life in our Universe is widespread based on evidence found in fossils [12].

"World is wearing out; but you must remember

Hades and Dionysus are the same".

by George Seferis (Nobel prize in literature 1963)

Note: Hades the God of underworld, of the dead and Dionysus the God of wine, festivity and madness in Greek Mythology.

Compare: Hathor in Egyptian Pantheon, was a Goddess of joy, dance, music and the wardress of tombs, welcoming the dead into the next life. Egyptians believed that the dead lived for ever inside their tombs and for this purpose they put all their belongings in there.

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