The Uni*que*verse

Natural selection as the unique model of evolutionary development of the Universe

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Abstract

The cosmological theories proposed so far do not postulate a common way of creation that can guide the entire line of growth of the universe, from elementary particles to living beings.
But everything consists of the same basic components, combined and regulated differently: elementary particles, atoms and molecules make up celestial bodies, solar systems, single and pluricellular organisms, plants and animals. Common constituents are compatible with a common origin and with an incremental and selective development method.
One possible common mode is that the Universe was formed according to an evolutionary method based on natural selection, the same process which then allowed the differentiation of biological species. This unique process may have guided from the beginning the development of the fundamental constituents of matter in the primitive universe and then created the other cosmic structures through the evolution of those elementary particles, up to organic molecules and biological beings.
A process of this kind is a slow and gradual process, not based on a sudden event but on the progressive increase in the complexity of the structures present in the Universe, regulated by the selection of the most suitable and stable forms. For the relativistic relationship between energy, mass and velocity, we can think that the Universe was formed at the same time as the formation of elementary structures, slowly in a spacetime that was created in parallel: elementary particles created an initial infinitesimal spacetime system that then grew as more matter formed.
The incremental creation of the cosmos would also concern forces and physical laws, which may have undergone the same evolutionary process from the most primordial and simple forms to the present, in proportion to the development of the whole system. This modality could justify the current simultaneous presence of quantum and relativistic laws at different levels (atomic and gravitational), as well as the coexistence of different species in different environments.
This evolutionary modality is reflected in the fact that atoms, celestial bodies, chemical compounds, the general structure of the universe, physical laws and biological beings show the presence of stable entities selected among the many theoretically possible or unstable.

By convention there is sweetness,
by convention bitterness, by convention color,
in reality only atoms and the void.
(Democritus, 460-370 BC)

INTRODUCTION

The cosmological theories proposed so far do not postulate a common way of creation that can explain the connection between the main lines of development of the universe, from elementary particles, to galactic systems, to living beings. But the whole Universe is made up of the same basic components, combined and regulated differently: elementary particles, atoms and molecules make up celestial bodies, solar systems, planets, viruses, mono- and pluricellular organisms, plants and animals.
The same evolutionary process that selected the species most suited to their environment (Darwin 1859) may have guided the development of the fundamental constituents of matter in the early universe, and then created the other cosmic structures through the evolution of those elementary particles up to organic molecules and biological beings. An incremental growth of relatively few common constituents and their derivatives which are selected as suitable and therefore stable.
A process of this kind is a slow process, not based on a sudden inflation event (Peebles 2019 and 2024, Hawking 1988, Riess 2020), but on the progressive increase in the complexity of the structures that were being defined.
A "progressive creation", proportional to the space-time-matter system, suggests an evolution of even the physical laws and forces we know. In the beginning, they were different from what we know today, then progressively changed as the system became more complex, with distances, masses and velocities different from the tiny initial stage. This may be the reason for the not unifiable coexistence of the laws governing the atomic level and those of gravitational physics. The atom system, governed by its own laws and forces, remains as a constituent of the universe system, which in turn has other laws and forces governing it.
Quantum laws apply to the building blocks of the universe, while the complete house is governed by relativistic laws.
A common evolutionary modality of everything we know is also reflected in the fact that atoms (see Segrè chart's Valley of stability), celestial bodies (see Gaia's Hertzsprung-Russell diagram), chemical compounds, the general structure of the universe (see Cosmic Web), physical laws and biological beings (see the Phylogenetic Tree of Life) show the presence of stable entities selected among the many theoretically possible (and unstable).
A “unique” universe in which all structural and functional components develop on the basis of a single evolutionary mode, the natural selection.

We outline this evolutionary pathway from the singularity of a primordial elementary particle to biological beings (Figure 1, which will be quoted in its separate frames a, b, c and d along the text).

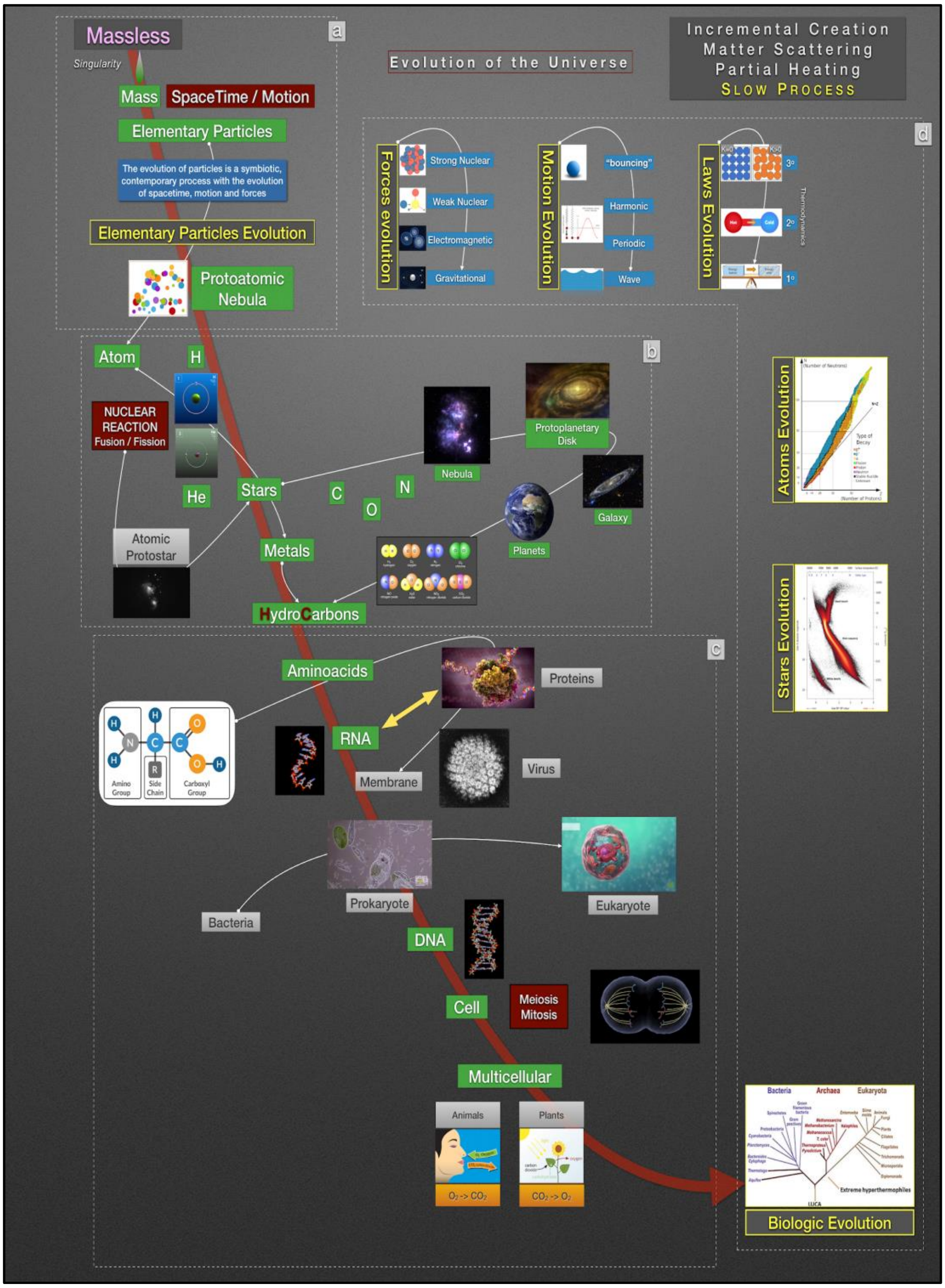

Figure 1: Schematic graphic depiction of evolutionary modality for the development of the Universe.
Green Labels: Key elements; describe the entities that have given impetus to the evolutionary process.
Gray Labels: Key steps; describe the points of no return in the evolutionary process.
Red Labels: Evolutionary mechanisms; describe the ways in which evolution took place.
Yellow Frames: Special areas of evolutionary development.
Dotted Gray Frames: four major areas of evolution. In particular: a) from the original elementary particle to the atom; b) from the atom to the stars and derived compounds; c) from organic compounds to evolved living beings; d) from simple to complex forms of motion, forces, laws, atoms, stars and life, selected as stable and suitable.
Abbreviations: H, He, C, O, N: atomic symbols. RNA, DNA: ribonucleic acids

1 - Description of the main evolutionary steps

Mass Singularity

Since the relativistic connection between energy, mass and velocity has been confirmed up to us (Einstein 1905), we can postulate that the known Universe is related to the production of a particle having mass. This "birth" of infinitesimal mass simultaneously created a relative, infinitesimal spacetime. This elementary particle with mass therefore acquired a (relative) motion, a (negative) charge and a spin. This generates a force and the particle could interact towards its origin, tending to restore the equilibrium and creating an on-off process (birth-death cycle).
For some reason, this return to the original state was not possible, otherwise the particle would have been annihilated and everything would have gone out, without following up on anything. Instead, the "disturbance" linked to the primordial mass triggered a progressive chain reaction that has continued to the present day. Let us imagine that the primordial particle with mass created a space-time correlated to it, acquiring a characteristic (charge) different from the rest and a movement (rebound) permitted by the infinitesimal space-time. Therefore the process has continued, it has been repeated, leading to the creation of other particles, to the increase of the possibilities and modalities of interaction, to the expansion of the space-time system: in short, to the evolution of the system itself (Figure 1, frame a).
Repetition is the primordial form of reproduction, all that repeats itself can exist and last. These first steps created the main characteristics of the universe we know in an infinitely small primordial system: mass, motion, spacetime, life cycle (birth and death), interactive forces (laws) and repetition (reproduction).

Matter and Spacetime

The expansion of the primordial system may have occurred proportionally to the formation of several elementary particles with mass. An infinitesimally small elementary particle is related to a infinitesimally small space, in which a limited movement is permitted during an infinitesimally small time; then, as the mass increases, the other quantities regulated by general relativity also increase: more particles create more spacetime and larger spacetime allows more particles to form and move (Figure 1, frame a).
The lifespan of elementary particles is inversely proportional to their mass: the smaller they are, the longer they last. For example, the electron has a mass of 0.51 MeV and an almost infinite life; the Top Quark has a mass of 173000 MeV and a lifespan of $5x10^{-25}$ seconds. The interpretation could be that the simpler most primordial particles have been selected as stable and do not undergo "perturbations", therefore they have a long "life expectancy"; while the more advanced and complex ones are more unstable, therefore decay more easily. It is obvious, however, that even these unstable particles continue to exist because the decay of particles is a useful mechanism for their evolution. We find an analogy in the evolutionary line in the genetic mutations present in the biological world, forms

that may not last long but which increase the variability of the species, favoring its diversification and therefore adaptability.

When several elementary particles were generated, they could interact each other as well as with the previous state: particles can collide each other, approach and move away, assume relative motions, rotate around each other. The laws of physics that we know were taking shape, evolving as the mass-space-time system grew. The relativistic relationship between energy, mass and speed has its deep roots in this primordial initial system: it is a basic, original relationship, closely connected to the essence of the universe and for this reason it has remained ingrained in all its expressions.

Imagine seeing an extremely desiccated sponge, with rough edges that slowly rehydrates, swelling and developing. In reality this sponge is created gradually, growing irregularly: this is what we call the "expansion" of the universe, an incremental irregular and grossly spherical creation of the space-time-mass system with the possibility of incremental motion as well. Its primordial nature remains the same but its development allows for an increase in the complexity of its products. It allows for evolution.

Atom

The first atom may have been defined by a nebula of elementary particles (a sort of primordial protoatomic disk), a primordial process similar to what we will find later in the formation of a protoplanetary disk and a solar system from a stellar nebula (Figure 1, frame b). The elementary particles selected as stable joined in the proton; others that remained free formed neutrons and electrons, creating the first (and simplest) evolved structure (hydrogen). This mode of growth (the aggregation of some elementary particles that became part of the atom and disappeared as singles) was positively selected. The union of particles gave stability to the atom, allowing it to last (to survive). This mode of absorption of some constituents in others is the first form of nutrition: the inclusion of simple elements allows the growth of new compound elements.

The Segrè chart's (Mackintosh 2001) Valley of stability (Figure 1, frame d) shows a selection of stable atoms among other more unstable or definitively transient. These are the atoms that were able to "survive" thanks to their characteristics that allowed the stability of the nucleus. The region of proton and neutron combinations outside of the valley of stability is referred to as the sea of instability (Seaborg 1979).

Stars and other Celestial Structures

Two hydrogen atoms are enough to generate nuclear fusion, so they are like an infinitely small, biatomic, primordial star. This process was then only amplified by the increasing number of hydrogen atoms (Figure 1, frame b) and by the energy itself released in the nuclear fusion process. Probably the first forms of stars were "star clouds", with low concentrations of hydrogen atoms that formed helium, and then moved on to larger and denser, spherical forms. Density has remained as a

fundamental parameter of the life cycle of stars: in fact the older (or "dead") ones are the densest.
The metals, fundamental for the development of biological life, originated from the life cycle of stars. This can be defined an "open" life cycle, following the principle of Lavoisier (Lavoisier 1789), and is also present in biological beings.
We can assimilate galaxies to animal societies, or plant forests, being based on the complex interaction of beings with a life cycle: within galaxies there are simultaneously stars (individuals) at various ages of their life cycle, as well as children, adults and elderly people coexist on a human level.
The Gaia's Hertzsprung-Russell diagram (Figure 1, frame d) can be imagined as a stellar family portrait: stars are plotted according to their colour (on the horizontal axis) and brightness (on the vertical axis) and are grouped in different regions of the diagram depending mainly on their masses, chemical composition, ages, and stages in the stellar life cycle. The large diagonal stripe across the centre of the graph is known as the main sequence: most stars are contained in this region, representing the most stable forms among those possible (ESA Gaia Mission, https://sci.esa.int/s/wKdy4dW).

Chemical Compounds

The hydrocarbon compounds, derived from the most common chemical elements in the Universe (hydrogen, oxygen, nitrogen, carbon), have found a suitable system for their development in suitable planets. Methane (CH_4) is a trade-union between the purely chemical world and the biological one, being the union of the most frequent atom in nature (H) with that of carbon, at the basis of all biological molecules. Hydrocarbons will therefore form a part of many amino acids, then organized into increasingly complex molecules thanks to the progressively less extreme conditions in our planet (chemical aggregation). Some of these molecules have become the matrix for the formation of their own progeny (RNA), passing from repetition to reproduction as a means of durability over time through a genetic inheritance (Figure 1, frame c).

Life

Life is the result of the evolution of complex atoms and molecules, composed by precisely the most widespread atoms in the universe, as if it were a natural consequence of the abundance of such atoms that easily interact with each other. Some proteins have been selected to protect the coding RNA within them (thanks to a cell membrane), creating the first viruses. They need other cells to reproduce and this has favored the genetic mutation, amplifying it. From the union of organisms equipped with their own genetic material we obtain prokaryotes and from the development of safer genetic material (DNA) we obtain eukaryotic cells (Figure 1, frame c). Some unicellular organisms were eaten by others but not digested, and became a symbiotic part of them (similarly to what happened for the elementary particles inside the atom). This process is known as endosymbiosis (mitochondria and chloroplasts).

The constitution of the eukaryotic cell is a fundamental evolutionary step, as was the formation of the atom. It represented the next stable and self-sufficient basic component in the evolutionary scale, from which more complex organisms were formed, with great adaptability and differentiation (mutations and genetic mixing). Then two great evolutionary paths separated, extremely favourable to each other and therefore chosen by natural selection: the celled beings that produced CO_2 from O_2 (animals, respiration) and those that produced O_2 from CO_2 (plants, photosynthesis).
The speed of evolution is very slow but not necessarily linear (Monod 1971). Primordial forms such as pro-prokaryotes were present long before more evolved forms appeared. So elementary particles probably existed a long time before creating an atom. But at certain times, the appearance of particularly stable and suitable beings has given impetus to faster evolutionary lines. For example, man has evolved in 18 million years, a much shorter time than the evolution of life estimated at 3.9 billion years.
The tree of life (Figure 1, frame d) is a graphic representation of the evolution of different living species starting from a common ancestor (LUCA, last universal common ancestor). This graphic form shows living beings (or plants) positively selected among all possible or extinct ones (Darwin 1859).

2 - Special evolutionary settings

Evolution of Motion

The original rebound was probably a repetitive motion back and forth through an equilibrium, a harmonic motion. The next step, when spacetime was simultaneously increased, is periodic motion (harmonic motion with a frequency). The next step in the evolution of the motion is the wave motion, the propagation of motion from place to place in a regular and organized way. At this point the spacetime was large enough to allow the primordial particles to move further away from each other and to rotate around other nearby particles. The rotary motion is fundamental and was consolidated by the atom: since then this motion is found everywhere in the cosmos. Electrons revolve around the nucleus, planets revolve around their own sun, each sun revolves around the center of its own galaxy: the same phenomenon occurs on an ever larger (evoluted) scale (Sun 2024). The rotary motion was positively selected and transmitted to the entire system, as will happen for example after a long time for the genetic coding of living beings (Figure 1, frame d).

Evolution of Forces

This primordial level was regulated by the laws of quantum physics (Bohr 1915). The first force to be created could have been the strong nuclear one, the one that held the atomic nucleus together (relative strength = 1); then the electromagnetic (relative strength=10^{-3}), the weak nuclear (relative strength=10^{-16}) and lastly the gravitational one (relative strength=10^{-41}). In the original phase there was not enough spacetime to allow the particles to move away from each other: they had to stay close together, so the force of attraction was very high. Then spacetime gradually increased and the attraction strength of the particles "weakened", making possible the organization of larger structures. The passage from quantum to gravitational laws could be linked to an evolution of the system "universe". The latter do not replace the former, but are applied to a more evolved system (Figure 1, frame d).
The gravitational force, as an example, is defined as a weak force (Newton 1686), but is able to hold together boundless galaxies, such as the Milky Way which has a diameter of about 100,000 light years ($9.4\text{x}10^{17}$ km). It could be considered the same nuclear force applied to the larger spacetime (atom diameter is 10^{-10} m, that of the Milky Way 10^{21} m).

Evolution of Thermodynamics Laws

At zero Kelvin the energy was stable, ordered and without entropy: in this state, therefore, only what we now call the "third law" of thermodynamics could be applied, the system was governed only by it, being in a primordial state. Then, after the initial perturbation of the singularity, the entropy began to grow incrementally and with one direction, from hotter to colder objects ("downhill"), unless energy is supplied to reverse this direction: this new, more evolved and dynamic state follows what we now call the "second law". The current status of the evoluted Universe is an isolated system in which the total energy is defined constant and now follows mainly the "first law". However, the different laws remained (as rules applicable to different states), even if today the zero Kelvin can no longer be obtained. Even in this case, evolution is irreversible and the subsequent states move so far away from the primordial one that it is no longer reproducible. Just as we cannot regenerate a dinosaur, even if we have its genetic material. (Figure 1, frame d).

3 - Main general implications of evolutionary theory

Age of the universe

If this hypothesis were true we would have to deduce that the Universe is much older than 13.7 billion years. Some recent discoveries from the Webb Space Telescope would confirm this hypothesis (Gupta 2023, Greene 2024), known as the problem of "impossible early galaxies". It can be deduced that the universe could also be much larger than known. Furthermore, the big bang hypothesis would no longer be valid. The evolutionary mode is precisely compatible with the absence of initial inflation, with an extremely slow process, a roughly spherical, non-homogeneous and irregular expansion and with a variable speed of evolution, accelerated when decisive evolutionary steps occur (atoms, fusions, stars , cells, DNA etc.).

Universe Expansion = Separation

According with an incremental creation, the expansion of the Universe could be compared to the dispersion (diffusion, separation) of the newly generated matter in the simultaneously forming spacetime. It would be like pouring continuously created sugar into a liquid medium that takes shape at the same time.

Universe Cooling = Partial Heating

In the zone(s) where matter and spacetime are created, the energetic process heats up the system a little. As it expands, the heat generated is diluted. The cosmic background radiation (McKellar 1941, Penzias 1965, Dicke 1965), would not be the result of the cooling of the Universe from the big bang onwards but its tenuous warming due to the energetic processes of stars. The energy created is unable to heat, except irregularly and locally, the enormous cold space that separates the nuclear fusion celestial bodies.

PERSPECTIVE

The mode of evolution by natural selection is present in all biological forms. There is nothing to prevent that it has also led the development of what precedes biological forms, being constituted by the same fundamental entities. The similar points are many, as shown, and the entire evolution may have followed a Gaussian distribution of events, with the extremes selected negatively and the average carried forward in the path of compatibility with the environment, which forms and evolves simultaneously, with a two-way interaction.

This hypothesis differs from that of Smolin (Smolin, 1977), the only scientist who talks about the evolution of the cosmos ("cosmological natural selection, also called the fecund universes"). Smolin argues that the laws of nature we observe may be partly the result of a natural selection process that occurred before the big bang. Evolution would affect the universes after the first, in a kind of refinement of the system. However, this involves a very complex process of universes having a closed loop, at the end of which the residual black hole generates, before evaporating, a "white hole" that gives new origin to a singularity and a new big-bang. However, it does not explain what would be the modality of "hereditary transmission" of features from the previous universe that should be selected and refined in the next one.
Instead, the present hypothesis identifies the evolutionary process by natural selection as the basis of our universe, believed to be unique from the beginning. In this way, the contents of the universe can be selected as the system evolves and carries with it the transmission of the most suitable forms as time unfolds.

Perhaps the greatest peculiarity of this hypothesis is that natural selection also acted on the physical laws, fundamental forces, motion and all the functional characteristics of the universe, not just its structural constituents. The physical laws also evolved, as did the fundamental forces. In its initial state, the tiny space-time system could only allow for the strong nuclear force, or the third law of thermodynamics. Later, the incremental creation of a larger space-time made possible different interactions and thus different laws and forces, e.g. adding the electromagnetic and gravitational force.
In this view, the coexistence of quantum and relativistic physics is possible, as "superimposed" incremental states of an evolving system in which different levels follow similar but differently scaled laws.

The Universe is no longer what it was at the beginning. Near absolute zero temperature, hydrogen is in solid state and helium in liquid state: probably chemistry and physics were originally the same "science". The 3d structure of the visible Universe combined with the data from the cosmic web (Cautun 2014, Jones 2014) gives a non-uniform image of it, testifying for a zone development, proportional to the amount of stable matter produced, with non-uniform timing, as is the case for biological beings.

The electron has a life span estimated as 66000 yottayears (6.6×10^{28} years), about five-quintillion times the current estimated age of the Universe. If the electron lives longer than the Universe it can mean that the electron is "eternal", so it has always been there; otherwise it can mean that when the electron was born, the Universe was not there yet.

Certainly we should broaden some definitions, consider also atoms and stars as forms of life, think of physical forces as adaptable to different environments, accept that many intermediate forms have been lost in the evolutionary path.

The cultural interest of this hypothesis is broad and touches many fields of human knowledge. A reinterpretation of knowledge in this key leads to the identification of common mechanisms throughout the evolution of the whole Universe. In conclusion, a new vision that could unify the whole knowledge of the Universe and follow Occam's razor also in a novel Theory of Everything.

The recent data from the James Webb Telescope, the diminishing support for the Big Bang theory, and the lack of direct evidence for string theory, all lead to look for other cosmological hypotheses. Given the likely impossibility of experimentally reproducing the beginning of the Universe, we should rely on the evidence around us to deduce, backwards, a probable path of development. Evolution, natural selection and adaptation to the environment are evident throughout the known world and have ensured the survival of everything we see. The hypothesis that such a mechanism has been present from the very first forms of "living" matter and is also applicable to physical laws should at least be scientifically considered.

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