PART I

VACUUM AND MATTER: MYTHS THAT COLLAPSE

A Necessary Premise

Until a few decades ago, the privilege of belonging to the *élite* of professional scientists was not a prerequisite to be entitled to discuss scientific subjects and to publish essays that could be considered as texts of philosophy of science (epistemology). It seems that the increasing complexity of atomic and sub-atomic physics, which brought the specific knowledge to an extremely high specialisation, has implied the exclusion of non specialists from any significant discussion or comment on questions relevant to contemporary physics, including questions of cosmology, due to the heavy involvement of micro-physics also concerning the cosmos' origin and formation. The sophisticated debates that have developed as to the origin of the universe, especially after the *Theory of the Big-Bang* appeared, are one example of the intervened mechanism of exclusion of non-professionals.

For non-professionals, it was still possible to ask significant questions concerning the theoretical achievements of Einstein's Relativity, whereas the first serious barrier against the intrusion of non-specialists was put by the principles and procedures of Quantum Mechanics. Part of the reason for this is in the use both of complicated mathematical formalisms for the theoretical development of scientific hypotheses, and of the complex technology for data collection and processing, which often brings the scientists themselves to skip comments on the findings of their research.

Nevertheless, there is to believe that science cannot be considered as a patrimony of human culture if it escapes questions arising from philosophical reasoning. In human history, philosophy has always played a propelling role through questions about anything, prior to the formation of specialist knowledge as well as after the output provided by specialist works.

If – on the one hand – the limits of philosophy are in the non-use of *effective* specialist languages, on the other hand the language of specialists

has not an end in itself and - sooner or later - does also clash against the wall of ineffectiveness, when new experimental results cannot be explained adequately, or the required crucial experiments cannot be conducted.

To say the best, the nowadays situation in physics of elementary particles (and in astrophysics) doesn't appear substantially different from the paradoxical situation in which the Ptolemaic system was before the Copernican revolution[1]. The Ptolemaic astronomic system, based on the assumption that Earth is the centre of the universe, became extremely complicated because, after every discovery of a new planet, it was necessary to revise the system by the introduction of additional epicycles in such a way so as to avoid compromising the pre-exiting theoretical construction. That system, however, was still effective in predicting astronomic events – and eclipses in particular – with an amazing precision.

A growing number of physicists declare openly that the state achieved by contemporary physics is critical and that a new kind of physics seems necessary for a more adequate explanation for the events observed in the universe.

Looking at some statements released on contemporary physics by renowned scientists makes imagination and philosophy go back to work for formulating suggestions. Professional scientists have normally to be very cautious in expressing the truth they think of, not only because they do not dare to jeopardise their reputation, but also not to create doubts or pretexts in those who can decide the financing of research programs. It is a matter of both professional reputation and survival. Reluctance and reticence may not affect the few scientists that have publicly been hailed as the greatest living minds or unquestionable geniuses, though caution – to a various degree – is a wise habit proper to almost all scientists. However, as history proves, also the best ones among them might be reluctant to re-discuss what cost years of work and frustration unknown to the public.

Therefore, any outsider who can receive, understand and interpret more or less implicitly "subversive" messages from the most outspoken scientists has a sort of moral obligation to process and spread the contents of such messages. There is nothing to lose for the outsider, and – to the opposite – there is some possibility of corroborating the development of ideas that are – from the scientific standpoint – in a mere embryonic state.

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[1] As to the analogy between modern physics and the Ptolemaic system see also R. L. Oldershaw, ***The new physics – Physical or mathematical science?***, American Journal of Physics, 56, 1075, 1988.

From another point of view, both educated and non-educated people have the right to communicate their own philosophical system of thought, built on the basis of all that one has learnt, understood and meditated. Some illiterate persons have been able to build and spread across the world and centuries systems of ideas that have proved or still prove hard to disappear (one example for all: the religious and philosophical thought of Mohamed the Prophet. Mohamed was an illiterate person).

More in general, non-scientific or pseudo-scientific ideologies (such as Marxism, for instance), along with religions of any sort, have been able to capture faith from million people, including top level scientists. This means that philosophy, in its classical meaning, is still and worldwide considered as the necessary and natural humus in which science can – and probably must – thrust its roots for thriving, despite the growing crowd of pseudo-scientists and quacks. These people are *normally* useless but also inoffensive to the extent to which their theories do not turn to politics.

However, the progress of science is possible only if science finds the way to accommodate the criticisms that come from philosophical thought. This, in its turn, renews with the development of science; but syntheses of understanding, opening of views in new directions, processing of acquired knowledge in the light of unavoidable doubts, suggestion of new hypotheses, all remain the non-replaceable function of free and unpredictable philosophical thought.

1. What Non-Orthodox Indications from Scientists?

In the attempt to tackle some crucial problems of contemporary physics, the analysis of these problems by a mere technical approach would be a hopeless start. The implicit overall content of the messages from cautious-but-outspoken scientists is that the path to the solutions of the emerging problems can only originate from a capsized general approach. The crucial problems in question regard – on the one hand – the complicated and often inexplicable behaviour of the matter components at the sub-atomic scales; and – on the other hand – the riddle of gravity, which escapes from any attempt to reconcile with the unification of the other natural forces. Despite appearance, Albert Einstein (1879-1955) did not provide an explanation for gravity, but he only gave a new description of it[2]. To cope with these problems by a capsized mode, one should not re-

[2] From the standpoint of positive science, *explanation* differs from *description* in that the former – sooner or later – allows a full control on the phenomena explained, as it is - for example - concerning the practical control-on and use-of electricity by means of the properties of electrons, according to the relevant

start from studying the matter components in a new way, but to re-start from studying the vacuum from which particles of any kind originate and into which they disappear.

For most scientists, such an approach is still a non-sense or a risible claim.

In 1954, during a press-conference held by Enrico Fermi (1901-1954) in Italy a few months before his unexpected death, press reporters asked him**:** "In your view, what the future of physics will consist-of ?". Fermi answered: "The study of vacuum". The reporters insisted to get a clearer explanation for this answer, but Fermi limited himself to reply: "I mean the study of the nothingness". Italian physicist Francesco Melchiorri keeps a record of that press-conference.[3]

Werner Heisenberg, in his book *Physics and Philosophy*, recalls ancient Greek philosopher Anaximander, who said that no component of the perceivable matter must be considered as the basic element of our universe.[4] Rather, the perceivable elements of the universe originate from and are included in an infinite, ubiquitous, eternal, irreducible unperceivable substance. Heisenberg, in commenting on this philosophical concept, holds that – according to modern physics – any sub-atomic particle can be turned into a certain universal substance, which may be named either energy or matter**;** but none of the various sub-atomic particles that can be observed or generated has the right to be considered as the most elementary or basic one.

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scientific theory. As to *gravity*, Einstein's description - with respect to Newton's – does not allow any new direct control on this natural force. The ways to escape from gravity remain those adopted irrespective of *Relativity*. According to hypotheses of this theory, masses bend the space around them. But the theory does provide neither reason for that nor practical indication on how to produce and control the *flexion* of space in order, for instance, to contrast or neutralise the Earth's gravity. If – according to Relativity – there is an effective equivalence between mass and energy (which is - in my view - a potential source of confusion), the universe should be a space under an infinite deformation, since quantum field theory holds that the universe contains an unlimited amount of energy. Something must be wrong in one of the two theories, probably in both. Certainly both theories seem to some extent inadequate.

[3] L. Bonolis, M.G. Melchionni, ***I fisici italiani del tempo presente***, Marsilio Editore, Venezia, 2003, Page 271

[4] Werner Heisenberg, ***Physics and Philosophy***, (Italian Edition: *Fisica e filosofia*), Il Saggiatore, Milan 1956

2. The Strange Vacuum of Contemporary Physics

The concept of "vacuum" has undergone an impressive evolution, much more impressive than any other concept in physics. From ancient times, the word "vacuum" denoted the absolute physical nothingness. From the initial concept of empty space, i.e. of idle space destitute of matter, the "vacuum" of today's physics becomes an effervescent spring of energy and matter.

Walter Thirring, in a paper published in 1968, states clearly that modern physics takes our ideas about matter into a quite new conceptual context. Physics draws now our attention to focusing not on the "essence" of elementary particles, but on the "underlying physical field". The presence of matter is only a perturbation of the intrinsically perfect state of the "underlying field". One may say that matter is something accidental**;** it is only a local singular and "flawed" state of the "field". That is why there are not simple laws to describe both the interactions between particles and the intrinsic nature of each particle. The "field" exists always and independently of matter, and its presence is everywhere**:** it cannot be escaped or eliminated. It is the source and the vehicle of all natural phenomena. It is the "vacuum" from which protons draw mesons π. The existence and disappearance of any particles are only forms of *"field motion"*.[5] Before Thirring, Werner Heisenberg had to state on more than one occasion that the main task for physicists should now consist in finding the fundamental law of the field motion, in order to derive all properties and behaviour of elementary particles.

The main difficulty that physicists must tackle is the inappropriateness of the traditional concept of *compound object* related to sub-atomic particles. The only way that physicists have so far followed to unveil the alleged sub-components of these particles has consisted of making them collide violently in very high energy processes, with a view to determining their crushing. When physicists do so, the "fragments" they observe are *never* smaller than the particles from which the same fragments originate through the crush. For example, from the high-speed collision of two protons one can obtain a large variety of "fragments", but *none* of these fragments is a *fraction* of proton in terms of mass. The mass of the top-quark, for instance, which is supposed to be one of the components of proton, is worth 175 proton masses. It is an enormous mass that no explanation can now justify satisfactorily.

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[5] Walter Thirring, *Urbausteine der Materie,* "Almanach der Osterreichen Akademieder Wissenshaften", CXVIII, 1968

In this connection, it would be wiser to assume that collisions between sub-atomic particles do not produce "fragments", but do only generate transformation of their *shapes* and energies into new local *motion states* of the "underlying field".

Moreover, according to quantum field theory, each atom, whatever its state, is continuously hit by *virtual* particles that suddenly appear from and disappear into the "vacuum". Such a situation is a theoretical necessity, not a hypothesis. Should this be true, it would be enough for stating that the "vacuum" of today's physics is a very strange thing. It looks like a magic place or entity with no substance, but in which new material particles can originate or disappear suddenly, in spite of the sacred principle of mass and energy conservation. Yet, for contemporary physics the "vacuum" is – on the one hand - a field at zero-energy level and – on the other hand – the tank of an unlimited amount of energy.[6] Paradoxically, this vacuum is *something* that may be *stimulated*, which reacts to stimuli through the production of particles and energy. Einstein has been the leader of the campaign conducted during the first decades of the 20th century to free physics from the ether of Aristotle and Huygens, but physicists are now compelled to deal with something that is much more bizarre than the exiled ether. [7]

Heisenberg has spent a large part of his life in the attempt to draw the physicists' attention to the appropriate way of facing the new problems met in dealing with atomic and sub-atomic physics. About atomic and sub-atomic phenomena, he pointed out that we address objects and facts that are as real as the daily life facts. But atoms and sub-atomic particles *are not* so real**:** They belong to a kingdom of *possibilities* and *potentialities,* rather than to the world of *objects and facts.* In modern physics, the universe has not been divided into sets of objects, but into *groups of*

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[6] Clear and interesting comments on the strange vacuum of modern physics are in the excellent book by Lawrence Krauss, ***Quintessence: The Mystery of Missing Mass in the Universe***, (Italian Ed.**:** "Il mistero della massa mancante dell'universo"), Cortina Publisher, Milan 2000.

[7] At least from 1904 to 1916 Einstein was the strongest adversary of the ether, perhaps with a view also to stressing the otherwise not substantial difference between his special relativity and the theory of relativity previously outlined by Lorentz, who was instead firmly convinced of the existence of the ether. In later years, Einstein had to change his mind. It's worth remembering that Lorentz – before Einstein – is the author of the mathematical formalism of relativity and of the *transformation formulas* that introduced the use of the speed of light to describe how the quantities of any physical system (including time) change when perceived by an external inertial observer.

connections. The universe appears like a complicated network of events in which different kinds of connections take place, interact, superimpose and combine with each other, thus determining the structure of the whole.[8] It seems worth mentioning that Heisenberg considered it as appropriate quoting the "prophetic words" written by Anaximander in the 6th century before Christ about the "indeterminate substance" (*ἀπειρον*) from which everything originates: "*It is neither water nor any other of the so-called elements. Its extent is infinite and its nature is different from what is visible. All the existing worlds come from it and will return to it according to necessity*".[9]

More recently, a number of physicists suggest reconsidering the vacuum as a medium with physical consistence, as either a sort of super-fluid or a special kind of continuous medium.[10] Italian physicist Tullio Regge, for example, writes: "*We can establish formal mathematical similarities between the standard model and the mechanics of continuous media, and call* ether *the continuous medium described by the standard model. In such a case all known particles, including the electrons and nucleons of which any matter and we also consist, would appear as vibration states of the ether*" […] "*The ether of the standard model is something much more eclectic than Maxwell's, mainly because we cannot consider ourselves as observers external to it*" […] "*…the ether is a medium we can only perceive through its vibrations, but whose absolute motion cannot be detected*".[11]

3. What is the "Vacuum"?

That's the question that has induced me to write this essay, after more than forty years of meditation about this mystery. The reason for such a long meditation is in the belief, which is my own, that understanding the "vacuum" could lead to understand also gravitation, the other "mystery" that is still troubling contemporary physicists, despite the theory formulated on it by Einstein's General Relativity.

The vacuum became a problem that physics removed after A. Michelson and E. Morley, through repeated experiments conducted between the end of the 19th century and the beginning of the 20th, could *not* prove the existence of the ether.

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[8] W. Heisenberg, ***Physics and Philosophy***, *op.cit.*

[9] Translated from Diels-Kranz, ***I Presocratici***, 12 "Anaximander", Laterza (Rome-Bari 1981), Vol I, Pages 98 on.

[10] See, for instance, G. Chapline, ***Dark Energy Stars***, Proceedings of the Texas Conference on Relativistic Astrophysics, Stanford, CA, December 2004, based on ideas previously expressed by R. Laughlin, P.Mazur, E.Mottola, and D. Santiago.

[11] Tullio Regge, ***Infinito***, Mondadori Publisher, Milan 1996, pp.119-120.

The experiments were based on the assumption that the speed of light varies with the propagation direction of the light with respect to the "relative wind of ether", if the source of light moves across the ether. Until that time the "ether" was practically considered as an obvious reality by all physicists. The failure of Michelson-Morley experiments was considered as something unbelievable, and major scientists paid efforts to provide a credible explanation for the "inexplicable" failure. The existence of the ether appeared necessary to make electromagnetic theory credible, since it seemed impossible to think of physical waves that propagate through a perfectly empty space, especially after H. Hertz in 1887 and G. Marconi in 1901, upon the theoretical indications provided by the elegant electromagnetic theory formulated by J. Maxwell in 1873, could prove that such waves are something real, not only a mathematical model.

The problem was actually removed by Einstein's "theory of special relativity" published in 1905. One postulate of this theory is that the speed of light is constant in all directions of space and independent of the relative motion of its source. Separately, Einstein did also formulate the hypothesis that the light propagates through *photons*, *i.e.*, by means of particles in the form of *quanta of light*, which – on the one hand – provided a persuasive explanation for photo-electric effect (unexplainable by use of Maxwell's theory) and – on the other hand – put in question the *true* meaning of electromagnetic waves. In simple words, Einstein's special relativity made the "ether" an unnecessary transmission medium.

Before Maxwell, Newton assumed that light propagates in corpuscles that travel across the *empty* space. The photons introduced by Einstein became an updated version of Newton's hypothesis, though Einstein did not consider his photons as isolated corpuscles. According to Einstein, each photon must always be considered as associated with an *empty wave, i.e.*, with a wave **[***but what is waving?***]** that does not bear in itself any amount of either energy or impulse. This strange concept is the first formulation of the *corpuscle-wave dualism* riddle. Later, Einstein himself, in commenting on General Relativity, seemed to change his mind about the ether. He went substantially back to Lorentz's stance, and affirmed that denying the existence of the ether is impossible. In 1920 he wrote: "*According to General Relativity, the cosmic space has physical properties: that's why the ether must exist. From the standpoint of General Relativity it is not possible to imagine the space without ether*". And in 1954: "*The four-dimension rigid space of General Relativity may be seen as the analogue of Lorentz's three-dimension rigid ether*".[12]

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[12] See Ludwik Kostro, ***Einstein's conception of the ether***, in *Quantum Uncertainties*, Plenum, London – New York, 1987

Einstein gave a fundamental contribution to the birth of quantum theory, though he spent later almost half of his life in the attempt to prove this theory flawed. And the ether too - that the special relativity left out of the door of science – urged to re-enter somehow through the window opened on the "vacuum" by quantum theory.

In the preceding paragraph, I have already mentioned the amazing vitality and importance that the "vacuum" shows in the practice of modern physics. Thus, nobody may further affirm that the "vacuum" is the "nothingness". To the contrary, as Heisenberg and Thirring suggest, this "bizarre vacuum" seems rather to be "the whole". (See also the *Attachment* to this *Part I*). Nevertheless, all that we know concerning the vacuum does not come from a specific theory of vacuum, but is a set of non demanded theoretical implications of the *standard model* of matter and energy adopted in sub-atomic physics. This part of modern science is now at a crucial point**:** The vacuum appears not only important but also *more* important than the myriad of objects that sub-atomic physics calls "elementary particles". In other words, it seems that the time is ripe for capsizing the analytical approach to the universe. The indication seems to be as follows**:** Let's start from the "vacuum" instead of matter, to better understand what matter, radiation and energy are.

Unfortunately, it seems that new branches of research in theoretical physics prefer to start from an almost opposite side. The general tendency of recent "innovative" theories consists of novel attempts to quantize everything, physical space included. It seems like an obsession**:** Intentionally or not, most of the new research in physics falls onto a sort of coercion to travel over the existing paths by use of new vehicles, *i.e.*, to justify existing tested theories from a higher viewpoint and incorporate them into a theory of everything, as if there were no other possible way to improve *scientific* knowledge in physics. As to gravity, in particular, despite the exciting power of new mathematical languages, there is to fear that any attempt to quantize that force has entered a blind alley.

The purpose of this essay is to show an alternative way to address the "vacuum" with a view to attaining both an explanation-for and a control on gravity.

In *Part II* of this essay, I outline a hypothesis on the nature of the physical space of the universe.

The basic assumption is that there is a "plenum" in which the *physical* space consists.

The "plenum" is the fundamental essence of our universe and the matrix of all possible physical phenomena. The "plenum" has a finite

extent, whereas the *true* vacuum that I dub ": *the void*" (*i.e.*, the absolute nothingness) is unlimited and "contains" the plenum.

The "plenum" combines in infinite ways with *the void*; this is the "space" where no physical phenomenon is possible. To better express the concept by just one example**:** Within the void no propagation of light is possible. However, this *void* is the infinite *non-physical space* that contains, surrounds and partially permeates the physical as well as *immaterial* plenum.

The physical "plenum" is a finite continuous *whole,* which does not consist of component particles or elements. In addition, I assume that the *plenum* behaves like a homogeneous fluid without mass. Material elements and compound matter appear when the plenum establishes a variety of fluid motions around spots of void. More precisely, the plenum in fluid motion may "break" and open spots of *void*, and the presence of void spots inside a contextual motions of the plenum – from which the spots of void spring out – determines the formation of matter and energy. As a consequence of these hypotheses, the concept of "mass" inheres in the presence of various volumes of *absolute nothingness* (*i.e.,* nuclei of void) inside the plenum.

Oscillatory motions of the plenum determine radiation effects.

The plenum can generate vortexes, and particular types of vortices form gravitational fields. We may credit Kepler (1571-1630) with having first expressed such a hypothesis.

Because of the unceasing complex activity of the plenum, intrusions of void spots into the plenum are largely spread throughout the universe, and their number is constantly increasing. In *Part II*, as a sort of provocative start, a few analytical examples are given on how radiation and gravitation may be described on the basis of such hypotheses. A simple test is also suggested to corroborate or falsify the hypothesis on gravity that I have there expounded.

A more adequate introduction to my theoretical exercise should have had included a review of the state of nowadays physics, with the due attention paid to the efforts, partially successful, of the theorists in search of a *grand unified theory*. A special mention deserves the theory of strings, or super-strings, or M-Theory. But there are excellent texts on these subjects, and I cannot usefully summarise stuff of that calibre by the hurried synthesis of a draft essay like this.[13]

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[13] As to the appropriate introduction that I cannot summarise, I wish to suggest at least a few books, the reading of which can provide anyone with a complete and clear picture of the state of physics, including cosmology. The first book, written by Lawrence Krauss, ***Quintessence: The Mystery of the Missing Mass in***

4. My philosophical push

The main intent of this essay is to focus on physical effects associated with the formation of "gravitational vortices" of plenum**;** though I do also try to draw attention to the theoretical potentials inherent in the *dialectics* between the turbulent activity of the cosmic continuum plenum and the infinite contextual void. A cosmos-wide spread *dust* of nothingness – for instance – poses new questions as to the study of all the phenomena we can either observe or imagine. A basic question regards the formation of *mass* in association with the formation of matter and energy.

It is necessary to point out that my system of ideas concerning gravitational vortices shall be considered as a working model only, which – by the way – has nothing to do either with the gravitational vortices theorized by René Descartes (1596-1650) or with the theory of cosmological vortices that Carl Weizsäcker (1912-2007) formulated to explain the origin of solar systems. Rather, my approach to the issue connects with the systematic analysis started by Herman von Helmholtz (1821-1894) on the mechanics of vortexes, as continued by a remarkable number of physicists

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the Universe, has already been recalled by Footnote 6, Page 8 above. The second book is by Brian Greene, ***The Elegant Universe – Superstrings, Hidden Dimensions, and the Quest for the Ultimate Theory***, (It. Ed. by Giulio Einaudi Publisher, Turin 1999).

Besides, there is a brilliant book by David Lindley, ***The End of Physics*** (Basic Books, New York 1993), which is an easy and complete introduction to the understanding of the situation that entangles both basic modern physics and cosmology. As samples of its content, to provide efficacious "sketches" of nowadays physics, I deem it worth quoting a few paragraphs of this book, also with a view to indicating one justification for my work. "*Present attempts at theories of everything rely on an abundance of fundamental principles (which themselves may or may not be independently testable) and suffer at the same time from a deficiency of details: the theories must be augmented with "compactification" of extra dimensions, symmetry breakings to distinguish the various particle interactions from each other, and so on. This ornamentation does not emerge naturally in any of the theories of everything …and all of it has to be added in* by hand*, to make the theory come out the way we need it to come out."*[Page 251]. " *(…) physics itself, in the form of the venerable structure of thermodynamics, will make it impossible for physicists to do any but a tiny fraction of the experimental work that would be needed to test a theory of everything".* And further on: "*The theory of everything, in precise terms, will be a myth. A myth is a story that makes sense within its own terms, offers explanation for everything we can see around us, but can be neither tested nor disproved. A myth is an explanation that everyone agrees on because it is convenient to agree on it, not because its truth can be demonstrated. This myth will indeed spell the end of physics. It will be the end not because physics has at last been able to explain everything in the universe, but because physics has reached the end of all the things* it has the power to explain". [Page 255].

up to the current days concerning the mechanics of continuous and incompressible fluids. Actually, in the physics of the second half of the ninetieth century the notion of "vortex" played a significant role both in developing the theory of electromagnetism[14] and in the initial attempts to understand the structure of matter. Of a particular interest are the theoretical studies carried out by Joseph J. Thomson (1856-1940) regarding vortices of incompressible fluids, which led to the experimental discovery of electrons, which Thomson predicted and described like elemental micro vortex rings of ether[15].

My own theoretical initiative consists of: *(a)* introducing, with the term "plenum", a complete definition of the concept of "physical space" as opposed to the void or physical nothingness; *(b)* bringing the notion of vortex ring ("*ring vortex*" of plenum) from the micro-scale, addressed by the mentioned predecessors, to the cosmological scale, with a view to modeling gravitational effects; and *(c)* in positing the presence of an *absolute nothingness* ("the void") that forms the "spine bone" of both vortexes and matter.

If my suggestion is worth anything, the study of the plenum's behavior would call for every investigation instrument fit for identifying and describing the invisible and complex states of motion of the *immaterial continuum* in which the basic cosmic essence consists, along with the kinematical interferences between different motion states of the plenum in the co-presence of different volumes and shapes of the void.

In *Part II*, by a mere hypothetical attempt, I dare drafting a model of how photons and electrons might form, although my intention is not even suggesting a theory of everything, in which I do not incline to believe.

I am fully aware that a host (several thousands) of science dilettantes or philosophers – also grouping in well organized associations – comes up by the side of a few out-of-the-mainstream brave professional physicists, variously claiming to have found the "true" explanation for everything. Contemporary world-wide media system magnifies the "noise" of this immanent variegated background of the scientific research in physics and cosmology, with the prevailing effect of contributing to spread confusion

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[14] J. C. Maxwell (1831-1879) formulated a theory of electromagnetism based on the concept of "molecular vortex" previously suggested by W. Rankine (1820-1872). Maxwell's theory is expounded in *A Treatise on Electricity and Magnetism*, Clarendon Press, Oxford 1873, 2nd edition reprinted by Dover, New York 1962.

[15] J. J. Thomson, *A Treatise on the Motion of Vortex Rings,* McMillan, London 1883.

of ideas and theories, rather than facilitating the progress towards viable solutions.

On the side of mainstream physics, however, there is also to allow for the political issue of justifying the employment of *too* many professional physicists and high level mathematicians. It is a social problem whose solution seems possible only through research projects that stick to "the orthodoxy" via large academic consensus, in the light of the severe difficulties to overcome for obtaining the necessary (sometimes huge) financial resources. Because of such a dominant policy, which emerged in the second half of the past century and is proper to all major research institutions and organizations, individual or isolated innovative researches have actually very few chances to attract active curiosity and attention; especially as far as theoretical research is concerned, in a contrast with highly skilled professional theorists who, in most cases, prefer to put their abilities at the service of well financed projects, whatever the relevant scope.

Nowadays, in my view, what matters is instead to encourage the use of any reasonable means to divert the experimentation in basic physic from following an obsessive belief of privileged theorists, according to which the way to "the truth" is in more and more costly contrivances for crushing/smashing particles, sub-particles, sub-sub-particles at higher and higher energies, thus wiping and stirring the physical space in the search for (or production of) mythical bosons and/or *super-symmetric* "elementary" components and/or whatever else should in the future be "predicted" by quantum theories, particularly concerning gravity and gravitation.

It seems to me there is little awareness that such artful as well as expensive "fireworks" might push a sterile game to continue *ad infinitum*, with no likely success in finding a viable control on gravity though.

ATTACHMENT TO PART I

Physicists and the Vacuum

In the preceding pages of *Part I* a number of references have been provided as to the opinion of a few major physicists concerning what the vacuum may be. This attachment intends to give the subject some additional room, considering that, for physicists, the importance of the vacuum is nowadays greater than the matter's, while maximum uncertainty is nevertheless affecting science as to the physical nature of the vacuum, and reluctance prevails in reconsidering the physical space according to a new concept of ether.

Dutch physicist Christiaan Huygens (1629-1695) was amongst the major upholders of the existence of the ether, which he believed to be the medium of the waves of light addressed by his theory. Moreover, inspired by Descartes' theory of gravitational vortexes, Huygens designed mathematically a much more exact vortex model of gravitation based on the behaviour of the particles that – according to him and to Descartes – constitute the ether. After Huygens, physicists and philosophers did not deepen the concept of ether, assuming its existence as an almost obvious axiom. It must be noted, in particular, that Isaac Newton's stance with respect to this point was instead uncertain: He did not exclude the existence of the ether as a medium either of the light's propagation or of the gravitational interaction. As to gravitation, however, Newton devoted much of his work to the criticism of the vortices of Descartes and Huygens.

As already recalled, the physicists of the eighteenth and ninetieth centuries did not question the existence of the ether, whereas it seemed necessary to find an appropriate experimental way to prove its physical existence. Such a need promoted the experiments carried out by Michelson and Morley[16]

Robert Laughlin remarks that the connotation of the word "ether" in physics is extremely negative, for it is immediately associated with the academic opposition initially met by the theory of Relativity, which suggested that the "ether" is not needed by physics, whence the concept

[16] Albert A. Michelson (1852-1931) and Edward W Morley (1838-1931) carried out a sequence of experiments that showed the impossibility of proving the relative motion of the Earth with respect to the ether.

associated with "ether" should be considered as void of scientific significance

Such an attitude is now a conceptual handicap, because the word "ether", once deprived of that historical connotation, seems particularly fit to express most of the characteristics that physicists attach to the vacuum.

Actually, Relativity says nothing about the existence or non-existence of a special "substance" that pervades the universe, since the theory limits itself to affirm that any substance of the kind should obey a relativistic symmetry. Surprisingly, physicists had later to admit that such a *substance* does really exist, when researches on radioactivity begun to show that the vacuum is characterized by a spectroscopic structure which is analogous to that of fluids and quantum solids. In the practice of contemporary physics, this means that the idea of "vacuum", as day after day experimentally confirmed, corresponds to the concept of "relativistic ether". Nevertheless, the term "ether" seems to remain a *taboo.* [17]

To shed light on the hundred-year historical controversy that affects the use of the word "ether", there is the worthy book by Ludwig Kostro, *Einstein and the Ether* (Apeiron, Montreal 2000), already mentioned in *Part I*. The book draws attention to the following facts**:**

(1) Einstein was continuously troubled with the most appropriate interpretation of his general relativity;

(2) Einstein changed his mind several times about the consistence of the physical space, moving from a definite refusal of the ether to a definite assertion of its existence as a *continuous physical space* (not consisting of elementary components) ;

(3) After 1920, the scientific community overlooked almost all of the research activity carried out by Einstein, and the last interesting suggestions coming from Einstein were completely neglected.

As to the ether, the following sequence of statements, made by him in subsequent moments of his lifetime, may outline and summarize the history of Einstein's meditations.

(a) << The electromagnetic fields that constitute light no longer appear as states of a hypothetical medium, but as autonomous forms that are emitted by sources of light, just as in Newton's theory of the emission of light. As in the latter theory, any space not crossed by radiation and without ponderable matter appears to be really empty >> (*Entwicklung unserer Anschauungen über das Wesen und die Konstitution der Strahlung*, PHYSIKALISCHE ZEITSCHRIFT, 10, 1909), quoted by Kostro, Page 37 of his book. In

[17] Robert Laughlin, ***Reinventing Physics from the Bottom Down***, Basic Books, New York, 2005, Chapter 10.

the same page, however, Kostro observes that Newton developed his theory of light by the introduction of "waves of ether" apt to explain the phenomena of penetration and reflection of light (and, in this connection, it is worth remarking that Einstein too felt later and strangely impelled to associate "an empty wave" with photon).

(b) << For me it is absurd to attribute physical properties to "space". The totality of masses generates a field $g_{\mu\nu}$ (gravitational field), which controls the development of every process, including the propagation of light and the behaviour of measuring rods and watches >> (Albert Einstein, letter to Ernst Mach, undated, 1913), quoted by Kostro, Page 54.

(c) <<Two of the main results of the theory of relativity will be mentioned here, which should also be interesting for the laymen. The first is that the hypothesis of the existence of a space-filling medium to support the propagation of light (the luminiferous ether) must be abandoned. According to this theory, light appears no longer to be a state of motion of an unknown carrier, but a physical object to which a completely autonomous existence must be attributed >> (Albert Einstein, *Vom Relativitätsprinzip,* DIE VOSSISCHE ZEITUNG, 26 April 1914).

(d) << In 1905, I was of the opinion that it was no longer allowed to speak about the ether in physics. This opinion, however, was too radical, as we will see later when we discuss the general theory of relativity. It is still permissible, as before, to introduce a medium that fills the space, and to assume that the electromagnetic fields (and matter as well) are its states. But it is not permitted - by an analogy with ponderable matter - to attribute to this medium a state of motion at each point. This ether may not be conceived as consisting of particles that can be individually tracked in time>> […]. << Once again, "empty" space appears as endowed with physical properties, *i.e.*, no longer as physically empty, as seemed to be the case according to special relativity. One can thus say that the ether is resurrected in the general theory of relativity, though in a more sublimated form. The ether of general theory of relativity differs from the one of earlier optics by the fact that it is not matter in the sense of mechanics. Not even the concept of motion can be applied to it. It is furthermore not at all homogeneous, and its state has no autonomous existence, but depends on the field-generating matter […]. Since, according to the new theory, the properties of space appear as determined by matter, space is no longer a pre-condition for matter >> (Albert Einstein, *Morgan Manuscript*, New York 1921), quoted by Kostro, Page 78.

Kostro observes that Einstein, up to Year 1921, identifies physical space with gravitational field, whereas the electromagnetic field is for him something completely different and independent of the gravitational one. In fact, Einstein wrote**:** <<…a portion of space without an electromagnetic field, in contrast with the gravitational field, seems in a sense to be connected with the ether only in a secondary way, in as much as the formal nature of the electromagnetic field is by no means determined by the gravitational ether >> (Albert Einstein, *Äther und Relativitätstheorie*, J. Springer, Berlin 1920, pp. 13-15), quoted by Kostro, Page 97.

In 1924 a dramatic change occurred in Einstein's mind concerning the ether.

<<…one can defend the view that the motion of ether includes all objects of physics, since - according to a consistent field theory - ponderable matter and the elementary particles from which it is built also have to be regarded as "fields" of a particular kind or as particular "states" of space>>.

<<…we will not be able to do without the ether in theoretical physics, *i.e.*, a continuum which is equipped with physical properties**:** for the general theory of relativity […] excludes direct distant action. But every contiguous action theory presumes continuous fields, and therefore also the existence of an "ether">> (A. Einstein, *Über den Äther,* VERHANDLUNGEN DER SCHWEIZERICSCHEN NATURFORSCHENDEN GESELLSCHAFT, 1924, pp. 85-93; English translation *On the Ether,* by Saunders & Brown, in *The Philosophy of Vacuum*, Clarendon Press, Oxford 1991).

<< Physical space and ether are only different terms for the same thing>>.

<< Fields are physical states of space >>.

<< We may summarize in symbolic language. **Space**, brought to light by the corporeal objects and made a physical reality by Newton, has in the last few decades swallowed ether and time and also seems about to swallow the field and the corpuscles, so that it **remains as the sole carrier of reality** >>.♦

<< According to the general theory of relativity, **space without ether is unthinkable;**♦ for in such space not only would there be no propagation of light, but also no possibility of existence for standards of space and time (measuring rod and clocks), nor therefore any space-time intervals in the physical sense >> (Albert Einstein, *Mein Weltbild*, Querido, Amsterdam 1934), quoted by Kostro, Page 124 and Page 195.

It is evident that Einstein, in developing his theory, went across some noticeable uncertainty or even conceptual confusion, only relying upon his

♦ [The **bold font** is mine]

own honest, sharp as well as fickle, intuition. However, in his mature age, for sure between his 45 and 57, he stabilized his conviction that the "physicality" of the "vacuum" is the predominant feature of our universe.

Perhaps, the neglect of the consolidated conviction expressed by Heisenberg, Thirring and others, and even by late Einstein, about the fundamental role of the so-called vacuum is the main cause of present major troubles with basic physics.

<< Today the vacuum is recognized as a rich physical medium […]. A general theory of the vacuum is thus a theory of everything, a universal theory. It would be appropriate to call the vacuum "ether" once again […] >> (S. Saunders & H. R. Brown, ed., *The Philosophy of Vacuum*, Clarendon Press, Oxford 1991, Page 251).