

PART II

THE PHYSICAL SPACE AND THE VOID

0 - New Hypotheses on the Nature of the Physical Space of the Universe

0.1 - *Introduction*

All that which is not matter, the “empty” darkness that separates atoms as well as galaxies from each other, the “absolute space” of Newtonian physics, what – in one word – is currently considered as “*the vacuum*”, is here instead renamed “the plenum”, in order to distinguish the space where all physical events are possible (that is the plenum) from the real vacuum (we may dub it “the void”), which is absence of physical space and within which no physical event is possible.

It is assumed that *our physical universe consists substantially in the plenum*, which includes all the phenomena we either can or cannot observe.

0.2 - *The plenum is the only space where physical events take place*

The hypothesis I am here expounding about the plenum differs from other hypotheses concerning the *ether* because of two major features. At variance with the ether, the plenum does not consist of elementary particles, and it is a physical “substance” which possesses in itself neither mass nor energy. Moreover, the plenum is not something that surrounds and/or permeates matter, since matter is substantially homogeneous to the plenum. Actually, matter and energy form a variety of discontinuities or local “anomalous” states in the original uniformity and idleness of the plenum.

Because of its characteristics, the plenum cannot be detected directly. The plenum is everywhere, and everything consists of *local states* of the plenum. But some indirect evidence of its existence could be tried. Proofs have already been provided in testing the Relativity. For instance, the light deflected by gravity fields could appropriately be re-interpreted by a new vision of radiation and gravity based on motion fields of the plenum.

In the early times of modern physics, Augustin Jean Fresnel (1788-1827) made the first systematic attempt to describe the properties of the ether, with a view to providing the waves of his oscillatory theory of light with a physical propagation medium. Fresnel’s ideas about the ether were largely adopted by contemporary physicists though later questioned by some of them. Maxwell, for example, raised criticisms on Fresnel’s ideas concerning the ether, but he didn’t renounce the belief that the ether was

an undeniable reality. Maxwell, however, didn't formulate any alternative hypothesis on the subject.

Later, Hendrik Antoon Lorentz (1853-1928) developed a new theory of the ether, which led him to build the theoretical framework of relativity and to justify the unexpected results of the experiments carried out by Michelson and Morley to detect the ether. However, his hypotheses on the ether, together with the relevant logical implications, were not accepted as an explanation for the failure of the several attempts made by physicists to prove the existence of the ether; whereas substantially identical conclusions, those concerning the "contraction" of matter and time for systems in motion, became eventually accepted when proposed through Einstein's special relativity.

0.3 – Characteristics of the plenum

It is here assumed that the *plenum* is originally a perfectly continuous field whose behaviour is significantly similar to that of extremely dense and incompressible fluids. It is important to stress, however, that the concept of "density" cannot be applied to the fluid of which the plenum consists, because this particular fluid – though capable of generating masses – has no mass. Therefore, also other concepts of physics that are normally involved in the dynamics of material fluids, such as elasticity, dynamic viscosity¹, intrinsic pressure and temperature, do not pertain to the plenum.

In its structural original perfect continuity, the plenum can be addressed as a Euclidean mathematical space, whose points have neither measurable size nor physical dimension. Thus, the density of this fluid, in terms of number of points belonging to it per unit of geometrical volume, is infinite. In other terms, *the fluid plenum does not consist of distinct elementary components*. It is a "whole", which bears in itself a huge amount and a large variety of "discontinuities".

The plenum – in its original state – is immaterial. The concept of immateriality associated with that of physicality is familiar to all the scientists that consider light and radiation as physical as well as immaterial phenomena, to the extent to which they assume, for instance, that photons – the components of radiation – have no mass. Therefore, the idea of an immaterial fluid that forms the matrix of any physical event should not be considered as *a-priori* unacceptable. The basic hypothetical properties attributed to the plenum in its "*rest state*"² are:

¹ The hypothesis of a *kinetic viscosity* of the plenum (instead of an impossible *dynamic viscosity*) is discussed in the *Appendix* to this essay.

² The *rest state* of the plenum is only a theoretical locution, which is here used for definition purposes only. Actually, there is no evidence of the existence of such a

(i) finite extent, (ii) perfect continuity³, (iii) original isotropy, (iv) essential uniformity, (v) incompressibility, (vi) cohesiveness and (vii) fluidity, the latter characteristic entailing the possibility of some kinds of fluid motion.

In addressing the various kinds of motion of which the plenum is capable, it is necessary to think of *fluid kinematics* rather than of hydrodynamics, if the motion of the plenum does not involve matter.

0.4 – Void, plenum and motion

Beyond and beside the plenum, *the void is an unlimited empty space* where no physical event can occur. The void is considered as the “context” of our physical universe. The plenum may include, and includes, spots of discontinuity “filled” by the void (*i.e.*, by the absence of physical space). Yet, as for this hypothesis, the formation of such spots of void within the plenum is a prerequisite for the rise of matter and energy. It is supposed that the formation of void spots in the plenum is one of the inevitable consequences of combined motions of the fluid plenum.

In adopting the plenum as the only possible physical space, a major theoretical issue arises concerning the physical concept of “motion”. In classical mechanics all motions may be conceived and described with reference to an absolutely steady and empty space. Therefore, in classical mechanics the laws of dynamics do not depend at all on the “state” of the vacuum, because this is *there* the “absolute nothingness” by definition. Instead, if I assume that the physical space, in which material objects can move and interact, consists in a fluid “field” that *fluctuates* because of an indefinite number and modes of motions, then the *states* of the plenum determine or affect the dynamics of the matter involved, since matter itself consists of *motion states of the plenum*.

rest state for the plenum. We could assume that our universe began when the plenum put an end to its rest. As far as I know, the term “plenum” of Cartesian cosmology was re-introduced by late Einstein (1954) to mean the *continuous* physical space: See *Relativity and the Problem of Space*, in *Ideas and Opinions*, Crown Publishers, New York 1960, pp. 375-376. Italian scholar Pietro Banna too, in a number of papers published in Italy between 1943 and 1964, used the word “plenum” to indicate the universe’s physical space: for instance, in *Gravitone, Atomo, e Universo*, bimonthly magazine “TEKNE”, Messina, June 1963.

³ “Continuity” is here the term adopted to mean that each point of the plenum is always connected with any other point by infinite points of the same “substance”. In other terms, “continuity” stands for “contiguity” in a mathematical sense. Discontinuities within this fluid space do only mean volumes of true vacuum, *i.e.*, volumes in which the plenum is *absent* (like bubbles within a liquid, to use a familiar image).

Therefore, description and analysis of the plenum in motion and of the motion of matter within the plenum imply unusual difficulties in establishing absolute reference frames. *Dynamics, under the hypotheses made to define the plenum, relates to the motion of matter with respect to the plenum in which it is immersed, not with respect to the void.*

0.5 – Plenum and matter

The plenum, through its internal motions, *can* create particles of matter having measurable mass, and the motion of material particles inside the plenum entails the formation of kinetic energy and forces. But motions of the plenum, in terms of mere fluid streams or fluctuation, do not imply any *inherent* energy unless inside motion of material particles is involved. The plenum in itself is not energy; but it can either create or annihilate energy and matter by transformation or halt of its internal motions.

In this connection, the fluctuating plenum may be considered as a dormant reservoir of an indeterminate amount of *possible* matter and energy.

For the sake of clarity and with a view to minimising the inevitable ambiguity of the language, this essay sticks to the classical definitions given for “force” and “energy”. Inevitably, these classical concepts of physics imply the reference to combinations of mass and speed. According to a basic convention of scientific language, neither **actual force** nor **actual energy** is conceivable without assuming that some kind of mass in motion is involved.

0.6 – Void and matter

As announced above, and the subsequent paragraphs try to explain, a basic hypothesis is that the formation of material particles appears when motions of the fluid determine the opening of discontinuities inside it with intrusion of *void*, i.e., when the motion of the plenum determines and includes the formation of spots of *non-physical space*. These spots of absolute void, along with special velocity fields of the plenum around them, constitute the particles of matter that can be observed or generated. (As a bi-dimensional image to take as a very rough analogy, consider the formation of whirlpools in the water surface of a river: Such whirls – which form spots of “discontinuity” in the otherwise uniform surface of the water stream – consist of a special kind of water rotation around small *empty* cores, where the continuity of the water surface breaks).

0.7 – Plenum, void and mass

To summarise the conceptual implications of the hypotheses expounded above, matter – as well as the energy associated with it – is viewed as a complicated system of motion or vibration fields of the plenum around constellations or systems of void spots. The concept of

"material particle" is therefore reduced to that of a motion field of plenum around nuclei of void, these being the consequence of the particular nature and intensity of the velocity fields involved. The extent (volume) of such void cores may be considered as the *basic mass* (or "core-mass") of the relevant particles.

It is quite a new hypothesis on the formation of mass.

Displacement of mass would then be displacement of *void cores of velocity fields* across the plenum.

The formation of "mass" is still the key question of contemporary physics, since the concept of mass is the subject of endless debates at theoretical level. As one could notice in looking at the history of modern physics, a remarkable confusion has characterized the debate. According to the initial classical definition provided by Newton, "mass" is basically intended as the *constant scaling factor*⁴ between the force applied to a material body and the acceleration the body undergoes because of the applied force. Later, however, something occurred at theoretical level that induced a number of scientists to consider *inertial mass* as different from *gravitational mass*. The reason for this distinction is not that clear, since it appears connected with the frequent identification of the concept of "mass" with the concept of "inertia".

An example of the confusion created by such a conceptual identification is given by the conceptual basis of special and general relativity. An evident indication of this is - for example - in a book written by astronomer Erwin Freundlich in 1919, *The Foundation of Einstein's Theory of Gravitation*, which was endorsed by a preface signed by Einstein himself,⁵ although Einstein's paper of September 1905 did clearly and previously suggest - along with the equivalence between *inertia* and *energy content* of a body - also the *coincidence of mass and inertia*.⁶

Instead, if one considers *inertia* as the *resistance* that a body opposes to any *action*⁷ that modifies the body's state, then *inertia* would almost

⁴ I. Newton, *Philosophiae Naturalis Principia Mathematica*, London 1686 (usually referred to as the "*Principia*"), Book 1, Definition VIII in particular. The "mass", in Newton's definition, is the quantity of measurable matter of the body subject to the force. Therefore, the mass is constant until the matter remains unchanged.

⁵ E. Freundlich, *The Foundations of Einstein's Theory of Gravitation*, first publishing in English version by Cambridge University Press in 1920.

⁶ A. Einstein, *Ist die Trägheit eines Körpers von seinem Energiegehalt abhängig?*, Annalen der Physik 18:639, Sep. 1905.

⁷ The term "action" stands here for "force", according to a rather common and scientifically imprecise wording, for in physics *action* must correctly be intended as energy multiplied by time.

obviously be identified with a *force*, i.e., with the *reaction* resulting from all the forces (either known or unknown) that keep the body in its present state. Newton defined *inertia* as “*vis insita*”, i.e., as a *force intrinsic to any material body*.⁸ The Newtonian assumption that “mass” is a *constant factor* of proportionality between the applied force and the body’s consequent acceleration has naturally induced Newton and followers to associate *mass* with the measurable quantity of matter that constitutes the body; which in my view remains a sensible interpretation of the concept of “mass” for all scientific purposes.

The variation of mass with speed, *as introduced by relativity*, is a further and misleading concept of relativity (corroborated by the “relativistic” mass-energy equivalence), considering that the relativistic increase in the body’s mass does not entail any increase in the quantity of matter that constitutes the body, whatever its speed. On the one hand, it is easy to agree on that any amount of matter, in which any body consists, is the manifestation of the intrinsic energy equilibrium, which results as an effect of the various forces that bind the body’s components to each other. On the other hand, it is also accepted that the body’s intrinsic energy adds with the *kinetic energy* acquired through the body’s motion. The only true question is to establish how the body’s motion can be ascertained, i.e., with respect to what reference the matter moves. Nevertheless, the matter’s mass can be identified and measured wherever the body is subject to acceleration; which is sufficient to maintain the Newtonian definition of mass as consistent and viable. Yet, acceleration means shifting of the body’s state from one speed level to a different one, so that there is no doubt that the body’s matter undergoes changes in its motion and speed as well as in its energy content, irrespective of any reference.

One should never forget that every *scientific* concept in physics is intrinsically tied to measurement operations.

Nowadays’ major experimental efforts aim *at creating* the *particle/field* that, according to the standard model of physics, should be the factor of

⁸ Newton’s *Principia*, (op. cit.), Book I, Definition III: “*The vis insita, or innate force of matter, is the power of resisting by which every body, as much as it lies, continues in its present state [...] This force is always proportional to the body whose force it is and differs nothing from the inactivity of the mass, but in our manner of conceiving it. [...] a body only exerts this force when another force, impressed upon it, endeavours to change its condition; and the exercise of this force may be considered as both resistance and impulse: it is resistance so far as the body, for maintaining its present state, opposes the force impressed; it is impulse so far as the body [...] endeavours to change the state of that other. Resistance is usually ascribed to bodies at rest, and impulse to those in motion; but motion and rest, as commonly conceived, are only relatively distinguished; nor are those bodies always truly at rest, which commonly are taken to be so*”.

mass. This approach to the formation of mass, however, seems seriously questionable.

1 - Radiation and Gravity in the Plenum

There are perhaps two ways for describing radiation. The first way is to consider radiation in itself as a form of energy. The second way is to consider radiation as the *trigger* of the energy that can be detected when radiation meets and interferes with matter. Each way does not necessarily exclude the other one.

In any case, it must be borne in mind that no energy can be detected and measured without presence of matter and without material instruments.

1.1 - Radiation and energy

If I assume that radiation is energy, I must also assume that the propagation of radiation implies the formation and motion of masses, i.e., the formation and motion of material particles. It is an important point to account for in order not to lose the consistency of the discussion.

According to the standard model of the physics of elementary particles, the formation of *photons* is systematically associated with radiation. A historical dilemma arose about the question whether radiation consists in the propagation of *waves* or in the propagation of material particles; and the solution to this dilemma was that radiation consists of particles (photons) *and* vibrating fields (waves). Moreover, according to the principle of complementary formulated by Niels Bohr (1885-1962), all subatomic components of matter may be considered as **both waves and particles**. It is the experimental context that establishes which of the two particular aspects of matter is involved.

However, physicists have been led to assume that the *rest mass* of photons is nil. Such an assumption might be interpreted as a manner to say that photons do not exist out of radiation, rather than accepting the idea that photons are particles without mass.

Another issue regards the question whether photons are individually pushed to move from one place to another of the physical space or - to the contrary - it is only their formation that propagates across the space without displacement of them.⁹ Werner Heisenberg (1901-1976) raised

⁹ See *Quanta and Reality. A Symposium*, Hutchinson & Co., London 1962, which collects papers and discussions written or held - respectively - by a number of historical physicists. Concerning the motion of particles, in particular, see Chapter IV, which reports on a discussion between Maurice Pryce and David

this question concerning the motion of all elementary particles, not only photons. I think that physicists are still uncertain on this issue: Part of them incline to the one thesis, another part to the opposite thesis. Many suspend their comment and limit themselves to abide by the operational concept of photon that pertains to each particular observation in progress.¹⁰

1.2 – Radiation as flux of information

An alternative criterion is to consider radiation as a “signal” that triggers additional energy in matter, but *does not convey* an amount of energy somehow comparable to that generated by the radiation’s impact. A rough similarity is given by the functioning of relays or, more simply, by the information brought by verbal directives that mobilise an amount of energy incomparably greater than that that is necessary to transmit orders. In other words, the effect of the interference of the information with the receiver is the mobilisation of an amount of energy which relates to the nature (form) of the message and not at all to the amount of energy conveyed by the message. Concerning this similarity, the energy of the message may be considered as negligible and not accounted for. However, this similarity is just to provide a trivial example of how energy can be mobilised in matter impacted by radiation coming from any external source, without assuming that the impacting radiation is a flux of energy more or less equivalent to that mobilised in the impacted matter, but thinking of radiation as of something like the transmission of an “appeal” (or of a compulsive condition) to generate energy. The “information” conveyed by radiation may be seen in the various particular forms of oscillatory motion of the plenum.

Conversely, nature and intensity of the radiation depend on the amount and nature of the energy spent to *generate* the radiation. In itself, the fact that a given amount of energy has irreversibly been spent to generate a

Bohm. The latter, in interpreting the known experiment that regards the effects of corpuscles/waves passing through slots in a screen, expresses the idea that electron is not an object that moves through the slots, but something that forms and vanishes alternatively during its propagation across the space.

¹⁰ The definition of “operational concept” was introduced by physicist Percy W. Bridgman, to mean that the concepts of physics (as it is also for mathematical concepts in a different operational context) are indissolubly associated with the *operations and procedures* which are proper to experimental observations and measurement techniques. Out of this specific context, concepts do not more relate to physics, but to philosophy, since they cannot undergo any objective practical check on their significance (P. W. Bridgman, *The Logic of Modern Physics*, MacMillan, New York 1927). The implications of Bridgman’s analysis are important for a better understanding of the relationship between modern science and philosophy.

certain flux of radiation does not necessarily mean that the generated radiation *is* a full transformation of the spent energy into another form of energy. In other words, it could be assumed that radiation is the physical phenomenon of *destruction* of energy, unless part or all of the radiation meets with matter, which catches the radiation "information" and transforms part of its internal energy into different forms or levels of energy. In this connection, I suggest the image of a radiating material body that is completely isolated in the universe and cools down. It is an image suggested by the second principle of thermodynamics. In such a universe there is nothing *to prove* that radiation *is* energy. If it is energy, when the radiation emission ceases because of whatever reason, what is the fate of the radiation energy emitted?

Any motion of the plenum involves the motion of the material particles that are within that space motion. Therefore, the oscillatory motion of the plenum (such as radiation) implies also the oscillation or vibration of the material particles affected by the radiation impact.

The various forms of energy promoted by radiation depend on the nature of the radiation (mainly on its frequency) as well as on the nature of the particles hit by the radiation. The photoelectric effect can provide a good example to illustrate the concept. The effect concerns the interference of radiation with the surface of metal sheets. The impact of radiation on a metal surface causes the emission of electrons from the metal.¹¹ The photoelectric effect takes place when the wave length of the radiation is of an order of magnitude compatible with the electron's wave.¹² The emission speed of the electron is directly proportional to the frequency of the impacting radiation, and *does not* depend on the intensity of the radiation. In other terms, the *kinetic energy* of the expelled electrons depends **only** on the frequency of the radiation, not on the amount of the impacting radiation.

On the other hand, the *number* of expelled electrons depends on the intensity of the impacting radiation.

The *intensity* of impacting radiation depends on the *amplitude*¹³ of the radiation wave.

¹¹ Experiments have proved that an analogous effect regards any kind of matter impacted by radiation.

¹² A specific wave is associated with each electron, as it is for any other elementary particle. "Compatibility" of radiation with electron implies commensurability of the radiation wave frequency with the electron's one.

¹³ More precisely, the intensity of radiation depends on the *square* of the wave amplitude.

Summarising: The kinetic energy of *each* expelled electron depends *only* on the radiation frequency, while the overall amount of kinetic energy in the photoelectric effect depends *also* on the intensity (amount per time unit) of the impacting radiation, that is, on the number of electrons expelled by the metal.

This example draws attention to the significant relation between energy and impact of radiation on matter.

The effect of radiation impact on matter may be generalised to the extent to which the vibration of the physical space caused by radiation does also involve the *thermal* atomic/molecular vibration of the matter impacted, to mean that the *kinetic energy associated with each component* of the matter impacted by radiation depends primarily on the radiation frequency.

In physical terms, the radiation intensity is associated with the *power* of the radiation, i.e., the number of radiation units per time unit generated and transmitted by the source of the radiation. By a rough similarity with a process of information transmission, the power of radiation is comparable to the number of *compulsive appeals* to mobilise kinetic energy that are transmitted per time unit, while the intensity of the caused effect depends, in terms of activated energy, on the number of material components that receive – per each time unit – the orders to mobilise and re-mobilise.

Naturally, it must be expected that each radiation unit mobilises kinetic energy *in addition to* the kinetic energy that is already possessed by the particle exposed to the radiation. In fact, we must also account for the pre-existing state and inertia of the particles, whose motion – excited by the impact of each radiation unit – does not go back to the former condition immediately, as soon as the radiation impact ceases. That is why the temperature achieved by the matter exposed to radiation depends *also* on the duration of its exposure to the radiation.¹⁴ In this connection, one can also understand why the intrinsic energy of any material body does not consist of thermal energy only: When – at the lowest temperatures – the externally induced thermal vibration of molecules ceases, the system of forces that determines the structure both of the atoms and of the molecules is still active, and is itself source of radiation.

1.3 - The definition of energy

Whatever the hypotheses on radiation, and whatever the physical scale considered, energy can only be detected as a quantity that is proportional to the arithmetical product of the mass (as a measure of the matter involved) and the square of the mean velocity of the matter components.

¹⁴ The temperature caused by radiation depends also on a number of other factors, such as matter density, state and structure of the matter, etc.

In physics, there should be no ambiguity on this point. It is, first of all, a question of correct use of linguistic conventions that physics must obey rigorously to avoid any contamination with literary reasoning.

As to the forces associated with energy, we know that they depend on the average level of acceleration undergone by the mass of the particles in motion. In any vibratory motion, the speed of the motion varies between specific maximum values and zero. This means that the vibratory motion, roughly analogous to that of a pendulum, is permanently subject to acceleration, since acceleration is – by definition – the variation of speed with time. Therefore, the acceleration of each vibrating particle of matter, multiplied by the mass of the particle, determines in each instant the force to which the same particle is subjected. The most common example of the kind is the thermal energy of a volume of gas that is partly translated into the pressure exerted by the gas on the surface of its container, as the pressure – in its turn – is produced by the average strength with which the gas molecules hit each surface unit of the container.

1.4 - Radiation and gravity: A possible connection

In thinking of radiation as of the transmission of particular forms of fluid space motion, the idea that also gravity may consist in another kind of motion of the plenum appears spontaneously.

Gravity fields might consist in a special stationary rotation of the plenum around vacuum cores; and the formation of matter might be associated with the possible discontinuities generated by turbulence within the flowing plenum of gravity fields. This hypothesis would imply that matter agglomeration within gravity fields may be seen as *an effect* associated with the formation of the gravity fields, with no implication of mutual *gravitational attraction* between the particles of the matter that agglomerates.¹⁵

Moreover, to the extent to which matter *falls* within or onto gravity fields, the gravity mechanism could be explained in terms of fluid-dynamics.

On the other hand, for the sake of consistency, every kind of interaction between the velocity micro-fields that form the structure of matter should also be thought of a fluid-dynamic nature, though it can be expected that it is not ordinary fluid-dynamics.¹⁶

¹⁵ Similar conjecture has been expressed also by Italian physicist Giuliano Preparata in his book *Dai quark ai cristalli* [From Quarks to Crystals], Bollati Boringhieri, Torino 2002, Page 208. According to Preparata, the *quantum-gravity state* of the physical space determines the mass formation: The generation of gravity fields is not a property of masses.

¹⁶ See G. Preparata, *op. cit.*, Chapters 10 and 11. The agglomeration of matter is described in terms of special resonance effects that take place between electro-

Later in this text, a few arguments are given to doubt the usual interpretation of the gravitational interaction between masses.

2 - A Hypothesis on Radiation

It is assumed that radiation consists in a particular periodic oscillatory motion of the plenum.

2.1 - Fluid oscillatory motion

Since the plenum is by hypothesis incompressible, radiation can only be thought of as a system of closed surfaces of fluid (such as concentric spherical surfaces, for example) that make partial oscillatory motions around the respective geometrical centre (which is tentatively supposed to coincide with the source of the radiation), by the transmission of a periodical inversion of their spinning direction. Or else, to suggest a simpler image, one may think of co-axial cylinders of plenum that move back and forth along the common axis at alternate opposite speeds.

The propagation of this kind of oscillation across the incompressible plenum is in some way analogous to that of the water surface of a pond after dropping a stone into it, or to that of cloth waves created by wind in a flag. In cases like those, the wave propagation is *transversal* to the propagation direction, at variance with the propagation of waves of pressure inside more or less compressible fluids. Typical pressure waves are determined – for instance – by the propagation of sound across fluids. This propagation, in fact, consists of the propagation of periodical alteration in the local state of the fluid pressure, which determines a periodical variation in the local fluid density through a temporary displacement of the molecules from their normal equilibrium bounds. In this sense, the propagation of sound involves an alternate motion of the fluid micro-components along the direction of the wave propagation, which is therefore considered as a *longitudinal* propagation of the fluid vibration.

Instead, pressure waves cannot form if the medium through which the propagation takes place is absolutely incompressible. The plenum, in particular, is absolutely incompressible because, by definition, it is perfectly continuous and does not consist of molecules or any other elementary components to be thought of as in a permanent, intrinsic ad individual oscillatory state. From the physical point of view, any section of compact plenum in motion has in itself no mass that could generate either

magnetic fields and the vibration (quantum-wave) associated with each particular particle of matter.

energy or strength or pressure. That is why it appears necessary to assume that only *transverse* oscillations can characterise radiation.

Different issue is to ascertain whether the transverse oscillatory motion of the plenum can generate masses (*i.e.*, material particles) together with any sort of motion for these. Physicists say that radiation is ineluctably associated with particles named “photons” (according to Einstein’s hypothesis). However, these photons are very special particles: They have no “*rest-mass*”, no electrical charge, no existence at all out of radiation phenomena, but have *spin* equal to 1, which means that photons are somehow characterised by a spin similar to that of infinitesimal tops.

2.2 – Transverse waves.

The propagation of transverse oscillation across the perfectly continuous and incompressible plenum may be figured out by a simplified image of the mechanism of radiation.

Radiation is the joint propagation of electric and magnetic fields across the physical space, and the structure of an electromagnetic field is not a simple one. Actually, the electromagnetic transverse wave consists at least of two transverse oscillations of the space. These two space oscillations (both transversal – *i.e.*, perpendicular – to the propagation direction) are also orthogonal to each other. When the amplitude of one of the two oscillations achieves its maximum, the amplitude of the other one is nil, and vice-versa, periodically.

What kind of motion of the plenum can generate such a wave? What is it actually transmitted from the radiation source through the surrounding plenum?

The attempt to answer these questions requires the formulation of a hypothesis on how the motion of any point of the plenum drags into motion the contiguous points of the same fluid, or how streams of plenum form and drag the adjacent sections of the fluid.

Because of the *perfect* structural continuity and cohesiveness hypothesised for the plenum, no strictly pertinent analogy can be made with common material fluids, to the extent to which the dynamics of common fluids depends on the respective molecular consistence. The distance between the molecules of a real fluid, for example, can be modified by the effect of a variable pressure, whereas the distance between any couple of points of the plenum cannot be modified unless the formation of vacuum spots intervenes.

2.3 – Motion transmission in the plenum

The way in which the motion transmission occurs must be imagined consistent with the fluid’s characteristics. Because of its perfect and

permanent cohesiveness with the adjacent points, any point of the plenum in motion drags these other points into motion too.

The first characteristic of cohesiveness is that points of the plenum *cannot slide* over each other. In this connection, it seems here necessary to postulate that the total length of the route travelled per time unit by any point in motion is also the total length of the route travelled by the adjacent points. In particular, if *all* the points of plenum moving along a *circle line* describe a route whose length is l in time T , then *all* the points together of the contiguous circle lines (either internal or external to the former) travel a length l in the same time too. This is equal to say that the transmitted circular motion speed in the fluid is inversely proportional to the distance from those moving points that are considered as the origin of the motion. It seems the only way to overcome the difficulty of dealing with different infinities of adjacent points.

In simple mathematical terms, let us suppose that all the points of a circle line of plenum make a complete revolution around the circle centre in time T , which means that the complete revolution of each point of the considered circle occurs at the speed of

$$[1] \quad V = \frac{2\pi R}{T},$$

R being the radius of the circle. Let's call "reference circle" this particular circle.

Because of the fluid perfect continuity and cohesiveness, all the points together of any concentric circle line are pulled to make a revolutionary shift in the same sense, to an identical total extent, and in the same time as made by the points of the reference circle.

This implies that each point of any concentric circle with radius r traverses in time T a section of the circle (to which it belongs) that is expressed by $s_r = (2\pi R/2\pi r) 2\pi R = 2\pi R^2/r$. This also implies that the revolution speed of each point of any concentric circle line is expressed by

$$[2] \quad v_r = \frac{s_r}{T} = \frac{2\pi R^2}{rT} = \frac{RV}{r}.$$

With respect to the reference circle defined above, the revolution speed of *external* concentric lines of fluid *decreases* according to the coefficient expressed by ratio R/r , whereas the speed *increases* according to the same coefficient for the points of *internal* concentric circles.

2.4 - Vortex filaments

For $r = 0$, the speed of the fluid would be infinite. This fact leads necessarily to choose among the two following additional hypotheses:

Either [a] below a certain value fixed for r , the fluid starts behaving like a solid, i.e., with the rigidity of a solid body, thus creating a circle line of discontinuity in the fluid;

or [b] below a certain value fixed for r in correspondence with a maximum of possible speed, the fluid lacerates and creates a nucleus of void, i.e., starts revolving around a core of absolute nothingness.

The choice is inevitable. If we assume that an infinite speed is possible at the centre of the fluid revolution, we cannot explain why the speed of the fluid is less than infinite at any distance from the revolution centre.

Hypothesis [b] appears more credible than hypothesis [a], because it does not conflict with the hypothesis of perfect structural cohesiveness adopted in defining the plenum. Moreover, as shown in subsequent Paragraph 3.4, in a plane speed distribution like that described by Equation [2] no point of the fluid can spin at even infinitesimal speed, let alone infinite.

Instead, adopting hypothesis [a], if we imagine the nucleus of the fluid motion as a rotating solid body, we should adopt an additional hypothesis that is inconsistent with the hypothesised properties of the plenum. Not only would the “solid core” of the motion necessarily slide over the surrounding plenum, but also the “rule” of the speed transmission should both cease and be inverted, since the revolution speed of the points in the core would decrease to zero (instead of increasing) in approaching the core centre.

On the other hand, there is something “natural” in choosing hypothesis [b] upon the observation of the whirls that normally form in the surface of material fluid streams: The rotation of fluid around “empty” nuclei holds the cohesiveness of the fluid substance, though each whirl does locally interrupt the continuity of the fluid surface.

The void cores of the plenum revolution motions are discontinuities in the volume of the fluid, but do not imply any discontinuity in the fluid consistence.

Since the revolution speed of the fluid decreases with the distance from the motion origin, the motion of the fluid tends to vanish as the distance from its origin tends to infinity. Nevertheless, we shall not forget that the universal volume of space filled by the plenum is by hypothesis finite.

The above analysis, which concerns the circular motion transmission within the plenum, is limited to the unrealistic case of a flat sheet of plenum. However, it should not be difficult to guess that the conclusions of the preceding discussion can at least be extended to the rotation of coaxial cylinders of fluid space, this being a three-dimension space. In this case, the motion transmission concerns coaxial cylindrical surfaces whose rotation speed around the common axis can still be expressed by

$$[3] \quad v_r = \frac{\rho V}{r},$$

in which ρ represents now the radius of the *void cylindrical core*, and V represents the rotating speed of the cylindrical surface of plenum that delimits and contains the void core. In this equation, it must always be assumed that $r \geq \rho$.

Classical fluid dynamics calls “vortex-line” any kind of fluid rotation around a line.

Cylinders of rotating plenum may be of any shape: They may form cylindrical rings (*annular* or *torus-vortexes*) or any complicated loops, provided the axes of these are “closed” curves. Concerning homogeneous, continuous and incompressible fluids, in fact, an important theorem of fluid-dynamics establishes that vortex-lines cannot remain open lines inside the fluid: They must form closed filaments. The only alternative shapes for vortex-lines are filaments that traverse the fluid volume from one point to another of its boundaries.¹⁷

2.5 – Other coaxial motions

Another possible type of motion transmission is activated by the points of a circle line of the fluid that moves parallel to a central axis (which is orthogonal to the plane of the circle) and describes a cylindrical surface S in time t . This brings any other concentric circle of fluid to move over the adjacent co-axial cylindrical surfaces in the same time.

This kind of motion does still imply that the points of any co-axial cylinder of plenum move with a speed inversely proportional to the distance of the cylindrical surface from the inner origin of the motion.

This kind of fluid motion of the plenum may provide the basis for a model of simple magnetic field.

It is now easy to imagine a combination of the two kinds of co-axial motion described; i.e., the rotary motion of each cylindrical surface of plenum about a void core in conjunction with the shifting of the cylinders along the common axis.

The two velocities of the two motions are orthogonal to each other in every point of the plenum, every point describing now a helix and travelling at a velocity that is the resulting composition of the two component velocities.

¹⁷ See: Horace Lamb, *Hydrodynamics*, (6th Edition), Chapter VII - Dover Publications, New York 1945.

In general, such a combined motion should be thought of as non uniform, and – in some cases – also alternate along the cylinders' axis, in a sort of “back and forth” motion of the cylindrical surfaces of plenum (as already introduced in Paragraph 2.1), similar to the alternate motion of the tip of a plug-drill at work, while the variable oscillating speed is in every point in accordance with the rule expressed by $v_r = \rho V / r$, in which r is the distance from the common axis, ρ is the radius of the coaxial cylindrical void core, and V is the origin speed.

3 - Shift Conservation

The motion descriptions given above express the principle of *shift conservation*. The original amount of space moved per time unit on each concentric surface remains constant in every concentric surface involved by the motion transmission.

Moreover, any motions of concentric surfaces of plenum entail the formation of void cores around the centre (or central filament) of the motion.

3.1 - Formation of void cores

Concerning the simple linear motion of coaxial cylinders of plenum, it seems more difficult to justify the formation of axial cylindrical cores of void, unless the motion origin is a combined motion of points that move according to a cylindrical spiral (or cylindrical helix), *i.e.*, points of the fluid that revolve around a central axis while shifting along a coaxial cylindrical surface. In simpler terms, coaxial cylindrical motion should always be considered as combined with a revolution of the fluid points around the same axis.

In a conceptual alternative, the central void cores of coaxial cylindrical shifts could be replaced by filaments of material particles moving along a line and – in doing so – dragging the fluid around them into parallel motion.

The *postulate* of void cores for concentric or coaxial fluid motions is imposed by the impossibility of admitting that the fluid speed is infinite at the core of such motions, since infinite values make no sense for physical quantities. In this connection, *we assume that the permanent intrusion of a vacuum core occurs wherever an “infinite” rotational motion should appear upon indication of mathematical analyses*.

The formation of void cores – as per the above hypotheses and description concerning the plenum – is here a fundamental assumption. It must also be considered as a basis for attempts to tackle some serious conceptual problems inherent in quantum physics, where no satisfactory

solution has so far been given to the “problem of the infinities”, which regards basic definitions of quantum electrodynamics.¹⁸

3.2 - The ether and the plenum

In Nineteenth Century, Helmholtz first in 1858, and J. J. Thomson in a broader and more accurate way in 1867, worked out a fundamental fluid-dynamics of vortices, which also included “hollow-vortexes”, *i.e.*, vortex-lines or vortex-filaments with void cores. Many other physicists contributed or followed with time to improve and extend the study of vortexes, amongst them Stokes, Rankine, Maxwell, Kirchhoff, Heaviside, and Kelvin. The vortex theory considers fluids with various physical characteristics. Kelvin extended his analysis up to the formulation of a theory of atoms formed by vortexes of *ether*.¹⁹

At that time atomic studies were at their very beginning, and the belief that the universe was permeated with an omnipresent and extra-subtle substance (the *ether*) was strongly rooted amongst physicists, despite that the concept of “ether” was rather vague, since nobody – after the questioned description given by Fresnel – gave or hypothesised a precise description of its characteristics. A complete and self-consistent theory of ether was never written.

The failure of erroneously²⁰ designed experiments made by Michelson and others to prove the existence of the ether led later physicists to

¹⁸ The first form of the “problem of infinities” appeared in connection with the definition of the so called “electron self-mass”. Lorentz, in analysing the influence exerted on the electron by its own electromagnetic field, defined the “electron self-mass” with the formula $\delta m = m - m_0 = e^2/r$, in which δm is the “electron self-mass”, m_0 is the (hypothetical) electron mass deprived of its electrical charge (“bare mass”), m is the actual electron mass, e is the electron electrical charge and r is the electron radius.

The value of “self-mass” δm tends to infinity if electron radius r tends to zero. Lorentz’s theoretical result was later confirmed by quantum electro-dynamics, though the “infinities” took there different forms (in particular, “quadratic infinity” according to I. Walter, and “logarithmic infinity” according to V. Weisskopf) by the use of Dirac’s mathematics. As can be guessed, the same problem regards positron, proton and any particles with an electric charge. The “infinities” of quantum mechanics depend (i) on the assumption that the particles are spherical, (ii) on the lack of any hypothesis concerning the particle’s nucleus, and – most important – (iii) on dealing with sub-nuclear particles as if they were point-like, that is with *no extent*. With a view to bypassing the disturbance brought about by the “infinities”, a rather complex “renormalisation theory” was formulated, which doesn’t solve but only “buries” the problem.

¹⁹ W. Thomson (Lord Kelvin), *On Vortex Atoms*, Philosophical Magazine (4), xxxiv; 20 [Papers], 1867. - J. J. Thomson, *On the Motion of Vortex Rings*, (Adam Prize Essay), London 1883.

overlook the existence of this omnipresent cosmic substance. Einstein, at least from 1905 to 1916, was the strongest adversary of ether and exerted all his influence on this subject. However, it must be stressed that Maxwell's fundamental theory on electricity and magnetism reflects a hydrodynamic conception of electromagnetic fields.

3.3 – Motion and time

At this point in the analysis, it seems worth opening a parenthesis on the meaning of "time". No motion, and no dynamics, can be analysed without using the concept of "time". During the early decades of modern physics the meaning of this concept was considered as an obvious one, though it is not so obvious. Newton postulated the existence of an absolute time that passes by independently of any physical event. Einstein drew the attention to the need to consider time as a variable component intrinsic to any physical reference frame, and he revised physics on the basis of this assumption. Recent criticisms have been raised on the use of "time" in the physics of Einstein's Special Relativity as well as on the lack of a rigorous definition of the concept, which appears nevertheless inevitable in scientific work.²¹

I wish to try an instrumental simplification in the definition of "time", which is instead not a simple issue.

I deem it necessary to accept the idea that "time" does not exist *per se*, but that it is only a set of criteria practically adopted for describing both the extent and the intensity of the changes that occur in the observable configuration of physical systems.

In order to make what I mean clearer, "time" is actually used in a way that is analogous to the way in which we use the concept of "temperature" in physics. In practice, "temperature" is a concept connected with the use of a measurement system, which is conventionally adopted for measuring the mean amount of intrinsic kinetic energy (intensity of motion) of the molecules of which any matter consists.²² There is no "temperature" in itself as an independent physical dimension.

²⁰ It is "erroneously" in my view. The idea that the light's speed across the ether must change according to the direction of any *wind of ether* seems very strange to me.

²¹ Of a particular interest is the book by Paul Davies, *About Time: Einstein's Unfinished Revolution*, Penguin Press, London 1995, in which the author puts into evidence the paradoxes implied by the lack of certainty concerning the concept of "time". In this connection, remarkable is also the content of a few sections of the book by Kip Thorne, *Black Holes and Time: Einstein's Outrageous Legacy*, Norton, New York 1994.

As to time, however, the issue is a little more complicated, since the observable changes in the configuration of physical systems are at least of two kinds, *i.e.*, reversible and irreversible configurations. Moreover, the common measurement of “time”, especially in physics, does not aim at grasping the essence of transformations, but it basically puts the changing position or configuration of objects in relation to the position changes of a given sample-object that is observed during its motion.

Some motions/configurations are normally viewed by classic mechanics as reversible processes, in that the exact opposite of those transformations of state can be described by allowing for negative values of time.²³ Whereas other types of motion or events (such as – for instance – a stone that “spontaneously” rolls down from a mountain) are considered as irreversible processes. (Nobody can observe or imagine or calculate the path of the same stone that “spontaneously” climbs the mountain to regain its original position). Most of Newtonian mechanics is valid also for negative time values.²⁴

Other and more important irreversible changes in the configurations of physical systems are those inherent in biological processes.

The conventional measurement of “time” through the use of clocks is practically generalised, concerning both reversible and irreversible transformations, though such a use should to a large extent be considered as inappropriate as far as irreversible processes are concerned. A more appropriate concept to describe changes in irreversible sequences of physical configurations is “entropy”, or any measurement system suitably associated with the concept of “entropy” (*e.g.*, the spontaneous fall of the stone implies an irreversible increment in its state’s entropy). However, in the daily common practice no attempt has succeeded in replacing clocks and calendars for measuring irreversible processes. One example: Despite that human beings, in different phases of their life, perceive their personal time as passing more or less *fast* or *intense* with respect to clocks and calendars, the *aging* time is expressed in astronomic years, months, days and hours.

²² Instead, “heat” is the measurement that quantifies the *overall amount* of molecular motions (thermal energy content) inside any material body.

²³ Negative values are currently used for time in quantum electrodynamics (*QED*), in which Special Relativity joins quantum dynamics. In *QED*, antiparticles are currently interpreted as particles that move backwards with respect to time. Interactions between particles may occur in any direction of the relevant space-time.

²⁴ The use of “negative values” for time has occurred in the backwards Newtonian calculation of planetary motions, in order to identify – for example – past historical dates of Sun or Moon eclipses.

The reason for identifying an “objective” definition and measurement of time is strictly connected with the needs of social life and organisation, for which nobody can propose the use of personal estimates of “time” as a universally agreed reference. That is why human beings resorted since ever to the apparent motion of Sun or Moon in the sky to regulate the pace of “social time” according to objective criteria. Night darkness and long cloudy seasons have impelled human communities – for daily practical purposes – to replace the motion of Sun and Moon with the motion of the clock’s hands, or with any other more or less “objective and regular” motion such as, for instance, the motion of sand or water in sandglasses or clepsydras.

In this essay, I am using “time” as a conventional relation between any observed process and a pre-fixed reference motion. Example: For the purpose of measuring the time taken by any object to move from a given position *A* to another position *B*, I can define and quantify the *duration* of this shift by the number of conventional rotation units (or relevant fractions) meanwhile completed by another object that rotates regularly²⁵, independently of the particular motion under my observation. The reference motion may be that of the hand of a clock: In this case I can speak of time in degrees of arc or minutes (or fraction or multiples of a minute).

Otherwise, it could also be possible to compare the *duration* of the observed motion from *A* to *B* with the simultaneous amount of water *dropped* from the upper to the lower section of a clepsydra. In this different case I could express the time - taken by the shift of the observed object - in litres (or fractions or multiples of a litre). This way of measuring time, for example, was frequently adopted by Galileo.

Particularly ingenious was the suggestion to take the constant speed of the light’s propagation as a basic reference motion in physics for any analysis that involves time.²⁶

The preceding notes about “time” intend to stress that “time” in mechanics is only a conventional parameter used for an adequate descri-

²⁵ Also the “regularity” of the reference rotational motion is conventional and substantially subjective. It is however sufficient, for measurement purposes, that the regularity is reproducible and agreed to by different observers.

²⁶ A major innovation introduced by Poincaré’s and Minkowski’s relativity consists of expressing “time” as a reference *length* given by product ct , in which c is the constant speed of light and t is any kind of conventionally measured time. The physical dimension of ct is a “length” that can be adopted in physics as a homogeneous fourth spatial co-ordinate axis for time in association with any traditional Cartesian reference frame. A unit for “time” in this four co-ordinate reference frame could for instance be the *light-second* = 2.9979×10^8 metres.

ption of physical changes in the state of objects put under observation. In my view, it is convenient to accept the idea, suggested by Relativity, that time – as an additional reference length – may be considered as a fourth spatial dimension, in an appropriate geometrical description of physical phenomena.

The space of the universe does neither *contain* time nor *consist* of four dimensions. For description purposes, time could in many cases be replaced by entropy. As to Special Relativity, the time dimension is for the observers the motion of their clock's hands, used to calculate *distances* gone by the light.

In general, different approaches to the description of the events we observe may require reference frames of any kind and number, as it happens, for example, in the use of the so-called *phase space*, or in the topological space of the theory of strings.

While it is possible to describe the modified *configuration* of the various components of a physical configuration with reference to any Cartesian three-dimensional system of linear co-ordinates, it is not possible to quantify the *duration* of the process that leads to the configuration changes (*how long* the observed process lasts during the observation interval, *i.e.*, *within the observer's relevant age increment*) without introducing the concept of "compared changes made by different objects in different processes of state modification", which in mechanics is the concept of "time". The fact that the observer is used to measure also his own age by means of clocks and calendars should never imply that the "time" relevant to what he is observing coincides with the irreversible process and progress of his personal age.

Theoretically speaking, it might be remarked that also irreversible changes, which are more appropriately described by the relevant amount of entropy intervened, could be reduced (in an extremely complicated way) to systems of matter components that modify their positions. For the majority of practical purposes, the fact that such *motions* are irreversible is negligible. Nevertheless, in describing any system, *it is of a crucial importance to clearly distinguish and separate the two concepts of "time" and "age of the system"*.

These notes about time reflect some basic ideas expressed by a number of authors that have addressed the subject.²⁷ However, the concept of "time" defined above relates to the motions of the plenum and of objects within the plenum and with respect to the plenum, whereas other definitions of "time" regard the motion of objects within and with-

²⁷ Amongst several authors who wrote about time passionately, Julian Barbour, (*The End of Time. The Next Revolution in Physics*, Cambridge University Press, 2000) has produced a more-than-three-hundred-page book, in which a few clear ideas melt and swell-up in a cream of rather fuzzy concepts.

reference-to the empty absolute space (the Newtonian vacuum). The reference to different spaces has major different implications, which are not discussed here.

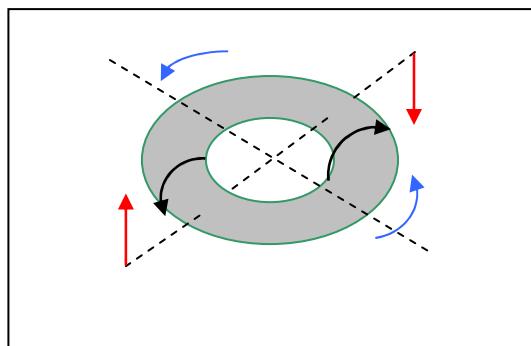
Any particle of matter that changes its position with respect to any reference frame is in our vision physically steady (and doesn't have dynamics), if it does not move with respect to the plenum; which necessarily implies comparison with the speed of light.

3.4 - A schematic model for electromagnetic waves

Different types of fluid motion may combine with each other. In the plenum, like in any fluid, different kinds of motions can take place and interfere with each other without changing their original nature. In particular, the transmission of different waves can take place and combine without losing the respective original structure. (That is why, for instance, we can catch, recognise and understand the voice of our interlocutors during a crowded party where almost everybody is speaking and music is played. Obviously, the overall resulting sound or noise is the effect of the superimposition of the vibrations generated by the various sources).

For example, the motion of a *ring* (annular) *vortex-line* may combine with its rotation around the centre of the ring that it forms, as it has been suggested in the preceding paragraphs. Furthermore, this double motion may combine with an additional rotation of the ring around an axis coincident with a diameter of the same ring. (See **Figure 1** below).

Figure 1



Such a combination of fluid motions brings about the transmission of a resulting double transverse oscillation of the plenum around the centre of the ring, *i.e.*, *two different alternate oscillations* that are orthogonal to each other like *meridians* and *parallels*. This double oscillation propagates like an electromagnetic wave as well as according to the principle of *shift conservation* that has been introduced above (see Paragraph 2.5, in particular). The double-wave frequency depends on the angular velocities involved by the motion combination.

The wave frequency remains constant throughout its propagation, whereas the wave *amplitude* decreases with the distance from the centre of

the combined motion, because of the decreasing extent of the *shift* of each point. The shift declines with the distance from the origin of the motion because of the diminishing oscillation speed of the wave fronts.

To grasp the essential image of this kind of motion transmission, we may simplify it going back to the initial model of transmission of co-axial cylinders of plenum as described in Paragraph 2.5. For instance, if we imagine that the plenum is "dragged" and set in motion by an alternate electrical current in a linear conductor, then an indefinite number of co-axial cylinders of plenum, having the electrical conductor both as the axis and as the motion's origin, is put in a "back-and-forth" motion according to the frequency of the oscillatory velocity of the electrical current, while the plenum's speed decreases with the inverse distance from the electrical conductor (see Equation [3]). Instead, the plenum's oscillation frequency remains constant throughout the whole plenum involved.

Now, let's suppose that the electrical conductor forms a ring, so as to imagine it as "wrapped up" in an indefinite number of *co-axial* toroidal "cylinders" of plenum. The geometrical plane of the conductor ring *cuts* such cylinders in a series of concentric rings of plenum that oscillate like the alternate current in the conductor.

In the plenum's rings the maximum shift made by each point from the respective initial position, which is the *amplitude* of the motion wave, decreases with the point's distance from the origin of the motion (*i.e.*, from the common axis materialized by the electrical conductor), because the speed of each point decreases while the same point has to make a full oscillation spending the same time as that of the source oscillation: The lesser the speed the lesser the shift magnitude per time unit.

A simple mathematical description²⁸ of how – at any time t – the wave amplitude A decreases with the distance r from the origin of the motion is expressed by

$$[4] \quad A = \frac{\alpha R^2}{r}$$

in which α is the initial maximum oscillation angle, and R is the radius of the conductor ring. The shift length s of the oscillating point on its oscillation path at any instant t is expressed by

²⁸ The origin of the reference frame is the geometrical centre of all the concentric rings, and the time taken by a complete oscillation of any point at the motion source (the conductor) may be assumed as the "time unit". This makes it possible to express time in number of complete oscillations made by any point of the plenum involved by the wave propagation.

$$[5] \quad s = r\theta = A \cos\left(\frac{2\pi}{T}t + \phi\right) = \frac{\alpha R^2}{r} \cos\left(\frac{2\pi}{T}t + \phi\right),$$

θ being the angle described by r at any instant t , and ϕ is a constant ("phase") equal to $-\pi/2$.

By the time derivative of s one gets an idea of how the velocity $\vec{v}(t, r)$ of any point of the fluid varies with respect to time t :

$$[6] \quad \left\langle \frac{\partial s}{\partial t} \right\rangle = \vec{v}(t, r) = \left\langle r \frac{d\theta}{dt} \right\rangle = - \left\langle \frac{\omega \alpha R^2}{r} \sin(\omega t - \pi/2) \right\rangle, {}^{29}$$

in which $\omega = 2\pi/T$, is the oscillation frequency, and brackets " $\langle \rangle$ " (borrowed from the formalism of quantum mechanics) are used to indicate that the included quantity identifies a vector.

Frequency ω is constant by hypothesis: This means that a complete oscillation occurs always according to constant period T . As a consequence of $T = \text{constant}$, the wave length, λ , should also be constant in absence of viscosity. Therefore, $\lambda \omega = c$ is the wave propagation speed, which is supposed to be constant across the fluid.

From Equation [6] one obtains

$$[7] \quad d\theta = - \frac{\omega \alpha R^2}{r^2} \sin(\omega t - \pi/2) dt;$$

then, by integration, oscillation angle θ is expressed – for any r – by

$$[8] \quad \theta = \frac{\alpha R^2}{r^2} \cos(\omega t - \pi/2) + \theta_0.$$

This equation shows that the extent of the oscillation angle decreases with the square of distance r .

The derivative of oscillation velocity $\vec{v}(r, t)$ with respect to the distance r from the wave origin shows how the angular velocity $\vec{w}(r)$ of the oscillation varies along the propagation direction:

$$[9] \equiv [7] \quad \frac{\partial \vec{v}(t, r)}{\partial r} = \left\langle \frac{d\theta}{dt} \right\rangle = \vec{w}(r, t) = - \left\langle \frac{\omega \alpha R^2}{r^2} \sin(\omega t - \pi/2) \right\rangle$$

²⁹ The sign "minus" in this notation means that the sign of the angular velocity of the fluid ($d\theta/dt$) is opposite to the sign of angle " θ ".

The angular velocity (i.e., the vector extent of the revolution angle per time unit) of any oscillating point decreases with the square of distance r . Because of the oscillation, the angular velocity inverts its direction every half-period $T/2$.

Equations [5] and [6] verify the equation of harmonic motion for all the oscillating points of the transverse wave, *i.e.* :

$$[10] \quad \frac{d^2 s}{dt^2} + \omega^2 s = 0.$$

If, at any given distance r , the velocity of the fluid revolving together with the origin motion around the common centre were constant in its module (like in the case of the stationary revolution motion expressed by Equations [2] and [3]), it is easily proved that no point of this velocity field can rotate around itself (*i.e.*, no point of the fluid can spin). Considering Equation [3] above, which expresses the revolution speed as a stationary function of distance r from the motion centre, it can soon be seen that

$$[11] \quad \text{rot } \vec{v} = \nabla \times \vec{v} = \left\langle \frac{dv}{dr} + \frac{v}{r} \right\rangle = 0,$$

for, in this case, $v = \rho V/r$ defines the module of vector \vec{v} , in which quantity ρV is constant, ρ being the radius of the void core of the co-axial cylinders.

(**Note:** In commonly used European notation "rot" means "rotor" and stands for "*rotational vector of*", which is often symbolised also by " $\nabla \times$ ", or else by "curl", especially in the United States. It indicates a vector that expresses the amount and direction of the *spinning* motion of any point in space. In the case considered by Equations [7], [9] and [11] the direction of "rot" is orthogonal to the revolution plane that contains velocity vector \vec{v} . The direction of vector "rot $\vec{v} = \nabla \times \vec{v}$ " is parallel to the spin axis of the point considered; symbol " \times " means here "vector product").

Equation [11] shows that in the fluid plenum of this particular torus of cylinders, in the co-axial *linear* motion expressed by Equation [3], there is neither spinning point nor *velocity circulation*³⁰ around it.

The *oscillatory* motion of the points, as in the transverse wave described by Equations [7] and [9], implies a continued variation in their speed

³⁰ *Circulation* around any point in a fluid stream is the *integral* of the fluid velocity vector along any line around the point considered. The concept of *circulation intensity* will later be used in this text to express gravity and gravitation as fluid-dynamic effects.

direction and intensity (*i.e.*, in the velocity vector) everywhere along the respective oscillation paths; their oscillation speeds do not depend on distance r only, but also on time t . Nevertheless, Equation [11] does still apply, as it can soon be verified by use of operator “ $\nabla \times \vec{v}$ ” on Equation [6] (remembering Equation [9]).

However, it is *important* to remark and bear in mind that Equation [11] is true *only* of velocity fields having *cylindrical symmetry*, thus of circular fields too.

According to the classification of conventional mechanics, the velocity fields described in this paragraph are *irrotational vector fields*.

3.5 - Transverse waves and photons

This particular oscillatory motion of the fluid draws attention to specific problems of interpretation concerning the behaviour of the plenum.

Where the fluid transverse oscillation stops and inverts the direction of its motion, there is a sort of *torsion* of the plenum, which may lead one to admit that contiguous points of the plenum slide over each other orthogonally to the wave propagation direction. This is not admissible by hypothesis and may be thought of as not true if the cohesiveness of the plenum is held by local *instant hollow vortex-lines*, *i.e.*, instant vortices around strings of void, periodically created by the particular fluid torsion considered.

The “intrusion” of *instant void strings* is inevitable for, as seen in the previous paragraphs, any point of the fluid in motion can neither slide over adjacent points nor rotate about itself. Such instant vortex-lines should work like *flashing roller-bearings* between contiguous and coaxial surfaces of plenum having not-in-phase oscillation. The strings of void, with the associated instant rotation of the plenum they determine around them, form and disappear periodically, with the same frequency of the wave they transmit. In other terms, the wave fronts consist of coaxial sheets that contain parallel flashing strings of periodical vortex-lines, which are orthogonal to the direction of the wave propagation.

Actually, considering two *contiguous* oscillation paths, we must admit that there is, in a very close proximity to each path end, a point around which the fluid oscillation velocities of the two different and adjacent fluid lines have opposite directions, because the two adjacent oscillations are not simultaneous. Since – by hypothesis – no point of the fluid can rotate without pulling the surrounding points into a rotational motion, we must concede that – at the extremities of each oscillation – there are *singularity points* of the fluid velocity field that imply ephemeral discontinuities. This kind of discontinuities consists of linear holes or void filaments that form the void cores of ephemeral vortex lines.

If we say dr the radius of the cross section of the cylindrical core of every vortex filament, at the *torsion points* we have two different and opposite *flashing velocities* at $r-dr$ and $r+dr$, r being the distance of the void core centre of the flashing filament from the wave origin. With respect to the ephemeral void core centre, the *flashing angular speed* of the plenum at each torsion point may be expressed by

$$[12] \quad \sigma(r, dt, dr) = -4\alpha\omega R^2 \sin(\omega dt) d\left(\frac{1}{r}\right),$$

in which dt is an infinitesimal time added to time $T/4$ and to all the odd multiples of $T/4$.

If we consider the quasi-infinitesimal quantities $dr = \delta$ and $dt = \tau$ as very small finite quantities, Equation [12] can be written

$$[13] \quad \sigma(r, \tau, \delta) = 8\alpha\omega\delta \frac{R^2}{r^3} \sin(\omega\tau)$$

In correspondence with angular speed $\sigma(r, \tau, \delta)$, the *torsion speed* $u(r, \tau, \delta)$ of the plenum around the vacuum core of the vortex filament is

$$[14] \quad u(r, \tau, \delta) = 8\alpha\omega\delta^2 \frac{R^2}{r^3} \sin(\omega\tau).$$

Once again, it must be stressed that no point of the plenum can *rotate* without changing its position.³¹ The rotation of the point can only take place by the opening of a void spot around which the point rolls and – in doing so – the point does also draw the adjacent plenum into the same motion.

It might be thought that the circle cross-section of void of these *flashing* vortex-lines, in their formation process, has variable extent, from zero-diameter, at the beginning of the wave oscillation, to the maximum diameter at the instant τ in which the oscillation inverts its direction. However, sticking to the characteristics fixed by hypothesis for the plenum, one should instead admit that the void core of the hollow vortex-lines forms and disappears instantaneously after the vanishing and inversion of the oscillation velocity of the point. Actually, one should imagine that the plenum's torsion – at each end of the oscillation path – is an extremely rapid rolling-unrolling motion around the void filament, to

³¹ I have here implicitly assumed that the motions are described with respect to a pre-fixed reference frame whose origin coincides with the motion geometrical centre, *i.e.*, with the common centre of the oscillation paths.

proceed on with the oscillating motion that is expressed by Equation [6], at any instant of the oscillation between $nT/4 + \tau$ and $(n+2)T/4 + \tau$, ($n = 1, 3, 5, \dots$). Within these time intervals, in fact, the speed expressed by Equation [6] verifies Equation [11] too.

In other terms, the formation of the void filaments appears and disappears at the opposite ends of every oscillation path through an instantaneous wrap-unwrap motion of the plenum. Therefore, the discontinuity made in the fluid by the intrusion of void is only instantaneous and periodic.

Allowing for the preceding considerations, every "flashing" vortex-filament generates – at the ends of each oscillation path – two effects that are steadily associated with the propagation of the main transverse wave:

(I) The periodic formation of instantaneous ephemeral "micro-masses" (the void volumes of the vortex-filaments) at the "peaks" of each oscillation. These filaments are orthogonal both to the wave's oscillation plane and propagation direction;

(II) The additional formation – at the two ends of the oscillation path – of additional periodic instantaneous sources of fluid oscillation, which has smaller amplitude than, but the same frequency as the main propagating wave; therefore, the latter absorbs the propagation of the former by consonance.

Summarising (I) and (II) above, we may say that the propagation of transverse oscillations across the plenum brings about the periodic appearance of "pulsing micro-masses". The ephemeral "spin" associated with each micro-mass (*i.e.*, the rotation of the plenum around the intruding void at every wave peak point) inverts its direction every half-period during the oscillatory motion of the plenum.

If the preceding description of wave propagation across the plenum can work as a model of a *polarised*³² and *monochromatic*³³ electromagnetic field, the fields around the *pulsing micro-masses* may be considered as a *thought image of photons*.

³² *Polarised* electromagnetic waves are waves that are compelled to propagate only on a plane.

³³ *Monochromatic* electromagnetic waves are pure sinusoidal waves, which do not result from the composition of waves with different frequencies and amplitudes.

4 - A Few Theoretical Implications

The model outlined above for the propagation of radiation is a first minimal test for the consistency of a theory that adopts the hypothesised fluid plenum as a model of the *physical space*.

4.1 - If there is photon energy

In Chapter 1 I have suggested that there probably is a double option in considering radiation as either (i) a means to *trigger* energy or (ii) a *flux* of energy.

A preliminary consideration is that energy can always be expressed as a quantity proportional to the product of a mass and the square of its velocity.

The *intrinsic energy* of radiation should primarily depend on the radiation wave frequency, which – in turn – is closely connected with the *oscillation speed*. This, in the model, is the fluid's speed along its transversal oscillation path.

Secondarily, the *intensity of the radiation*, i.e., the overall amount of energy conveyed by radiation, depends also on the square of the amplitude of the radiation wave.

Therefore, if I choose option (ii) above, I must also assume that:

- (1) The instantaneous mass of *photons* is ephemeral but not nil;
- (2) The periodic ephemeral appearance of photons at the ends of each fluid oscillation path is associated with some *shift* of each photon with respect to the plenum. It's important to bear in mind that *each wave* (i.e., one complete oscillation) implies the formation of *two* photons with opposite polarity, as per the definition of "photon" given above.

Equation [14] multiplied by $2\pi\delta$ describes the intensity of *circulation* $\vec{\kappa}$ of the fluid's velocity around the photon's void core, whose cross-section diameter is 2δ . In fact, the circulation vector is:

$$[14a] \quad \vec{\kappa} = |2\pi\delta u\rangle = -16 \left| \pi\omega\alpha\delta^3 \frac{R^2}{r^3} \sin\omega\tau \right\rangle.$$

This *circulation* is inherent in the oscillating stream, which is the stream of plenum along the oscillation path, whose speed equation is

$$[15] \quad v(r,\tau) = -\omega\alpha \frac{R^2}{r} \sin(\omega\tau).$$

With respect to the “photon” under formation, the *wave oscillating stream* is a *parallel* stream. The local fluid dynamic conditions make the void core filament of the “photon” undergo the *Magnus effect* as formulated by Kutta-Joukowski theorem.³⁴ According to this effect, every circular cross-section of the ephemeral vortex-line of the “photon” undergoes a brief ephemeral acceleration expressed by

$$[16] \quad \vec{q} = (\vec{\kappa} \times \vec{v}) / \pi \delta^2 = |2\sigma v(r, \tau)\rangle = -16 \left| \omega^2 \alpha^2 \delta \frac{R^4}{r^4} \sin^2(\omega \tau) \right\rangle.$$

This acceleration is directed towards the wave source, like a centripetal acceleration, and lasts as long as the photon mass does. Therefore, the ephemeral force that accelerates the “photon” is

$$[17] \quad \vec{P} = p \vec{q} = -16 \left| p A^2 \omega^2 \frac{\delta}{r^2} \sin^2(\omega \tau) \right\rangle$$

p being the mass-element of the “photon”, and A the wave amplitude defined by [4] above.

The rise of this periodic momentary force should imply a momentary shift of the “photon” from its formation position towards the wave origin. Considering that the plenum cannot shrink because of its incompressibility, one should admit that the shift of the “photon” is a momentary centripetal motion of the photon with respect to the plenum. This fact brings the momentary creation of an amount of energy associated with the centripetal shift speed. If the extent of such centripetal shift is $-\iota$ (the shift takes place along the negative direction of r), the amount of this “blinking” energy may be expressed – *for each unit length* of the photon filament – by

$$[18] \quad \varepsilon = -P\iota = -p q \iota = 16 \iota p A^2 \omega^2 \frac{\delta}{r^2} \sin^2(\omega \tau).$$

From kinematics we know that $\iota = q\tau^2/2$, which gives

$$[19] \quad \iota = 8A^2 \omega^2 \frac{\delta}{r^2} \tau^2 \sin^2(\omega \tau),$$

³⁴ The commonly known “Magnus effect” is the *force* described by **Kutta-Joukowski’s** (scalar) equation $dF = \mu \Gamma v ds$, in which μ is the mass density of the fluid, Γ is the circulation of the fluid velocity around a cylindrical body, v is the velocity of the *parallel* fluid stream in which the body is immersed, and ds is the unit element of the cylinder’s length. It must be noted that this important theorem of fluid-dynamics is true irrespective of both the fluid’s nature and the body considered. See H. Lamb, *Hydrodynamics*, op. cit., Page 79 on.

from which also

$$[20] \quad \varepsilon = -P\iota = -p q^2 \tau^2 / 2 = 64 p A^4 \omega^4 \frac{\delta^2}{r^4} \tau^2 \sin^4(\omega \tau).$$

This formula, in an alternative to [18], eliminates parameter ι from the equation for *blinking* energy ε . With a view to simplifying the formula for ε , see that

$$[21] \quad H = 64 p \omega^4 \delta^2 \tau^2 \sin^4(\omega \tau) = (8 \omega^2 \delta \tau)^2 p \sin^4(\omega \tau) = \text{constant},$$

in order to write Equation [20] in a more compact form, as follows:

$$[22] \quad \varepsilon = \frac{H A^4}{r^4} = \frac{H \alpha^4 R^8}{r^8}. \quad ^{35}$$

The physical dimension of factor H is that of energy.

This formula shows that the content of *kinetic energy* of the length-unit of the photon vortex-line oscillates with the wave frequency between zero and a relative maximum, and abates rapidly with the distance r from the radiation source.

4.2 – Mass and shape of the “photon”

The introduction of mass p for the “photon” requires a comment.

In the equation formulated by Kutta-Joukowski to quantify *Magnus effect* the fluid’s density (indicated with symbol μ) is one of the equation’s factors. In the case analysed above I have instead considered the volume of the void core as the basic mass regarded by the centripetal force, because – by hypothesis – the plenum has no mass and therefore no density, whereas the concept of “basic mass” or “core mass” is by hypothesis associated with any volume of void.³⁶

Therefore, in this context, the basic mass of the “photon” is the volume of its void core. As a consequence, the basic mass density of photon is in this case equal to 1.

In general, given any volume V of physical space, the relevant mass density is given by the ratio V_o/V , in which V_o is the volume of the void contained in V .

³⁵ Remember that constant R is the radius of the circle formed by the electrical conductor, which is supposed to be at the origin of the wave, and constant α is the origin maximum oscillation angle.

³⁶ Under the hypothesis of a possible *kinetic viscosity* of the plenum, the relation between size of void core and speed of the surrounding plenum is discussed in the *Appendix*.

The “photon” addressed here may be viewed as a very special particle. Its image cannot be schematised by spherical or quasi-spherical micro-particles. In the model suggested above for radiation, “photons” may rather be imagined like *instant* micro vortex-lines, whose density on the wave front depends on the distance from the radiation source or – equivalently – on the wave amplitude.

In the example of electromagnetic wave origin I have proposed here photons emerge like instant and extremely thin *ring-vortexes* around each co-axial oscillating cylinder of plenum. There is some reason for thinking that the ephemeral life of the photon depends on the impossibility for the relevant vortex string to complete the circular rotation of its torsion; otherwise the ephemeral photon vortex lines could turn into rather stable particles with masses comparable to neutrinos’.

The weakening of the centripetal acceleration undergone by the “photon” and the subsequent shortening of its centripetal shift are the basic causes of the very rapid weakening of the photon’s kinetic energy with the distance from the radiation source.

In correspondence with any given wave length, there is an amount of kinetic energy that can be associated with the photon. The “minimum photon” corresponds to the minimum possible values for δ , τ and ι .

In this connection and in principle, there should be no contraindication in defining Planck constant as $h = 2\pi \delta p \iota / \tau$, (or $\delta p \iota / \tau = \hbar$).³⁷

In non-polarised fronts of radiation waves, the photon vortex-strings appear and disappear alternatively and orthogonally to each other, according to a periodical grid of alternate “meridian” and “parallel” axes.

³⁷ Hypothesis $2\pi\delta p \iota / \tau = h$ (Plank constant) leads to ascertain that the ephemeral *average* speed $v = \iota / \tau$ of the photon’s mass with respect to the plenum is equal to the speed c of the radiation propagation (which – by the way – implies that the photon’s speed can exceed c). Using De Broglie’s definition for the wave length associated with photons, that is $\lambda = c/\omega = h/pv$, it is immediately evident that the photon’s ephemeral **mass** p can be expressed by $p = h\omega/c^2$. For example, if the length of a radiation wave is $0.5\mu\text{m}$ and $c = 3\times 10^8\text{m/sec}$, the photon’s ephemeral mass would be $p \approx 4.417 \times 10^{-36}\text{kg}$ (corresponding approximately to 2.47eV mass-energy), which is about two hundred six thousand times smaller than the electron’s mass ($9.107 \times 10^{-31}\text{kg}$). Therefore, the overall energy born by that photon would also be $pc^2 = h\omega \approx 3.975 \times 10^{-19}\text{kg}\cdot\text{m}^2/\text{sec}^2$. In this connection, one may consider, for example, that $\sim 2.2\text{eV}$ is the estimated mass-energy of the “electron neutrino”. Remarkably greater are the masses estimated for the other two types of neutrino (*i.e.*, the $\sim 165\text{keV}$ “muon” neutrino and the $\sim 15\text{MeV}$ “tau” neutrino).

As to the photon’s possible mass, see also J. P. Vigier, *New non-zero photon mass interpretation of Sagnac effect as a direct experimental justification of the Langevin paradox*, Physical Letters A, 234 (1997), pp. 75-85.

Nevertheless, any radiation impulse consists of both "meridian-photon" and "parallel-photon". Every *normal* electromagnetic wave is the combination of these two kinds of photon. Only exceptionally, when the wave is polarised, the wave transmission is made by only one of the two kinds of photon.

Moreover, it is worth noting that the "**photons**" of this model (apart from their periodic centripetal very short shift made under the instant Magnus effect described above) **do not travel** across the space. What is transmitted from point to point at the speed of light across the plenum is *the formation* of photons, as it is a *local* effect pertaining to each transverse oscillation path.

4.3 – What is the fate of radiation?

The propagation of waves across the physical space creates some conceptual problems.

By a delay that increases with the distance from the radiation source, sooner or later the *flashing* masses of the photons disappear definitively after the radiation emission ceases. Also the energy (if any) associated with the photon disappears with it. If radiation is the transformation of some other forms of energy, one should admit that the disappearance of radiation entails the annihilation of its energy. This seems a crucial remark from the standpoint of the logical consistency. If such a conclusion is logically correct, one should also recognise that the physical principle of mass/energy conservation is perhaps questionable. The only way for safeguarding this principle is to *prove* that **any radiation** - which is not transformed through its impact on matter - **can never vanish**. But such a statement requires a convincing explanation.

Particle physics had to face several decades of troubles in the attempt to square the accounts concerning mass and energy relevant to the decay of nuclei and the interactions between "elementary" particles. The solution to the problems was always found either in "balance radiation" or in postulating the existence of new particles such as, for instance, neutrinos or mesons. I cannot enter the discussion on these extremely difficult problems, which – by the way – are partly looking for more satisfactory solutions. I wish to focus my attention on that radiation *costs* energy, but it doesn't necessarily mean that radiation *is* the energy spent for it. If we admit that not all of the radiation generated in the universe interferes with matter, the question remains on where the dispersed "radiation energy" goes to stay eventually.

There is no doubt that *not all* the radiation produced in the universe is transformed into different forms of energy or absorbed by matter. Most of the radiation, after its source extinguishes, disperses across the physical space up to the universe's limits. This happens irrespective of whether radiation is energy or not, since nobody doubts the rapid weakening of

radiation with the distance from its origin. Quantum physics, in particular, does not admit the existence of any photon carrying a *quantum* of energy below $h\omega$ level, h being the Planck constant, whatever the radiation frequency ω . If the quantum theory is correct, it means that there is no distance from the radiation source beyond which photons can lose further energy: Which means they can never vanish, and we should believe that any photon can continue the radiation wave *propagation* by keeping its energy constant with time and distance perennially, at any possible distance from the radiation source also after its source disappears, as if the photon were a stable material particle bound to roam the universe restlessly.

One may instead hypothesize that radiation waves weaken with the distance from their source and that, from a certain distance on, in disagreement with quantum theory, might propagate without formation of photons, i.e., with no possibility of conveying photonic energy.

The hypothesis I have outlined for the transverse radiation across the plenum includes the case in which the oscillation slows down enough (its frequency is low enough) to avoid the formation of the torsion points at the ends of the oscillation paths. Beyond a certain distance depending on the original amplitude and frequency of the wave, the plenum's transverse oscillation might simply become a sort of "snaking" of the plenum along the direction of the wave propagation. This *radiation tail* could be analytically tested assuming that the plenum is endowed with a kinetic viscosity.³⁸

In theory, however, it may occasionally happen that *photonless* (exhausted) vibrations of the plenum meet and combine with radiation from different sources, with the effect of strengthening the local electromagnetic field. "Exhausted" but in-phase or compatible waves may produce local resonance effects that magnify the respective amplitudes and/or frequencies, to give rise to sort of pulsations or interference beats.

In a case like that, the sudden formation of new photons could be possible. According to this image, the plenum is in a permanent vibratory state, from which sudden formation of particles (involving formation of void holes) seems also possible.

On the other hand, if the *photonless* vibration of the plenum is possible, can one affirm that such a vibration has no effect when it runs into material particles? Some effect should be expected. It seems difficult to believe that however weak vibrations of the plenum may have no conse-

³⁸ This is a way to reconsider either the so-called "empty wave" associated with photon – as per Einstein's hypothesis – or the "virtual field" hypothesized by John C. Slater in 1924. See also Paragraph 3, in **Part I** of this essay as well as the *Appendix* to this essay.

quence on the matter involved. A minimal increment in the agitation of the material particles impacted should still be possible, with a possible – if not necessary – increase in their kinetic energy.

If this reasoning is not completely erroneous, it seems that mutual interference or occasional superimposition of “exhausted” (*photonless*) forms of radiation may still generate forms of energy. In banal terms, there is not a negligible probability that mass and energy may occasionally emerge from something deprived of both mass and energy, *i.e.*, from the physical “false nothingness” that I have named “plenum”.

In 1948, or earlier, Fred Hoyle, Hermann Bondi and Thomas Gold proposed a cosmologic theory according to which matter is continuously emerging from the nothingness. This theory was considered as unacceptable because incompatible with the principle of mass and energy conservation. Questioning the energy conservation principle implies wondering whether radiation *is* energy or not. In the model of radiation that I have suggested, the “photons” have no *rest mass* because they cannot exist out of the radiation waves. Moreover, I suppose that photons cannot form below certain thresholds of energy associated with the wave frequency. Nevertheless, vibration of the plenum cannot be excluded concerning vibration levels below those thresholds. In my description of the physical space, the plenum needs to be excited above a certain minimum level to generate observable physical events.

4.4 – Do matter and radiation coincide?

Thanks to Louis de Broglie (1892-1987), an important theoretical feature of quantum mechanics is that no material particle exists or can be generated if not in permanent association with some specific wave or vibration field. According to De Broglie, a wave length equal to h/mv must be associated with any particle, m and v being its mass and speed, respectively, and h is Planck constant. As Werner Heisenberg (1901-1976) tried first to explain, material particles must not be viewed as isolated objects in an empty space, but as more-or-less steady *states* of the physical space. I doubt he meant “waves of probability” in commenting on the wave function formulated by Erwin Schrödinger, despite probability plays a crucial role in sub-atomic physics. Schrödinger (1887-1961), together with Heisenberg, is considered as a co-founder of quantum mechanics. He – at variance with those physicists who followed Born’s interpretation³⁹ –

³⁹ Max Born (1882-1970) has introduced the now-standard interpretation of Shroedinger’s wave equation. According to Born’s interpretation, the square of the wave amplitude should be considered as the *probability* of finding the relevant particle.

has always refused to interpret his equation waves as "probability waves".⁴⁰

In this connection, I must draw attention to that real electromagnetic waves result from the superimposition of an indefinable number of waves of different frequencies and amplitudes, at substantial variance with the radiation wave described by the "snap-shot model" of the preceding paragraphs. Position and energy of the photons of a real electromagnetic wave can only be described in probabilistic terms. Quantum mechanics states clearly that no other way is possible for an effective description of radiation.

Quantum mechanics describes diffusion of particles in terms of physical configurations that interact and interfere reciprocally, none of them being the cause of the other. Any observed effect is the result of the "superimposition"⁴¹ of a set of innumerable different states of different configurations. Moreover, quantum mechanics tries to explain why any electromagnetic "summation wave" (the detectable resulting wave) cannot be considered as the *effect* of the component waves and how it should instead be considered as only one of the component waves along with any other component wave.⁴²

In an analogy with the formation of photons within radiation waves, one could also assume that any particle of matter is the result of a process inherent in the superimposition of *states (motions)* of the plenum. On the one hand, any portion of matter (*i.e.*, the *state* of the plenum in its local combination with the void) *is just the energy that generates the associated waves*, these being – on the other hand – the effect of the energy inevitably dissipated to keep the particle mass in existence.

Conversely, the *disappearance* of any particle mass *is* the transformation of matter into different particles and/or motions fields of the plenum.

4.5 – Relic radiation or residual radiation?

I wish now to go back to the question whether the fate of most of the radiation generated in our universe is that of vanishing, irrespective of its nature of either energy or "information".

⁴⁰ Still recently (Nov. 2011), the interpretation of the wave function introduced by Born is questioned. See, for instance, the article *The quantum state cannot be interpreted statistically*, by F. Pusey & Al., at <http://xxx.lanl.gov/abs/1111.3328>.

⁴¹ The *principle of superimposition of states* is the basis of quantum mechanics. See Paul A. M. Dirac, *The Principles of Quantum Mechanics*, 4th edition, Oxford University Press, 1958. See also David Z. Albert, *Quantum Mechanics and Experience*, Harvard University Press, 1992.

⁴² Actually, in quantum physics *the concept* of superimposition is not that clear: It is an axiom imposed by laboratory sub-atomic experiments, and nobody seems in condition to explain its meaning *precisely*.

As known, matter has the property of both absorbing and reflecting radiation. In general, the impact of radiation on matter results partly in the transformation of the matter's intrinsic energy (absorption), and partly in the reflection of the radiation along with the transformation of its characteristics. The absorbed portion of radiation goes both to modify the internal energy fields - of which the matter consists - and to generate a new form of radiation, which, along with the reflected radiation, disperses across the space.

When radiation reaches the borders of the physical universe (and part of the radiation does certainly so), the wave motion can only be reflected on the rebound against the "walls" of the infinite shell of void, the unlimited nothingness that wraps our physical universe.

One can imagine that the portion of the radiation reflected by any kind of matter belongs to that section of the impacting waves that cannot pass through the internal structure of matter because of the waves' incompatibility with the *shape* and state (motion fields) of the intermolecular and infra-atomic space. But more important, perhaps, is that *every attempt made by the plenum's wave to penetrate and cross the void cores of material particles is systematically rejected*.

While part of the impacting radiation interacts with the plenum's motion fields that surround the core of any particle, another part of the radiation cannot, for the void core of the particle is an actual barrier against all radiation. Therefore, the incompatible radiation is refused and rebounds by reflection. As largely experienced, material bodies oppose various degrees of resistance against the radiation transmission, such a resistance being proportional to the mass density.

According to the hypothesis I have here suggested, mass density is actually the density of the *nothingness* (*i.e.*, of the void) included in any volume of matter. In physics, mass density is currently determined taking a sample volume of water as a reference mass. Instead, we could assume mass density in terms of volume percent content of absolute void per geometrical volume of matter. (The density of pure void would obviously equal 1). Practically, the result would be the same as now.

It is evident that the percentage of void contained in one cubic meter of gas is remarkably lower than the void density in one cubic meter of led. In one cubic meter of *pure* plenum, the void density is zero; but we have so far no means to assess, for example, the percent content of void in a unit volume of water. This makes it difficult to establish a scale of mass density based on the percent content of void.

The radiation's rebound due to the impossibility to penetrate the walls of the nothingness may be an alternative explanation for the quasi-uniform diffusion of the background micro-wave radiation detected in our physical universe. If radiation energy *cannot* vanish because of the principle of energy conservation, then this restless energy, ever since and

perennially roaming the physical space, might be a credible explanation for the so-called “relic radiation”; this is unceasingly fed by *fresh* roaming radiation, which rebounds against the nothingness that wraps up the universe. Thus, the radiation background may be viewed as the overall *residual radiation*, *i.e.*, the roaming *rebounds* of that part of the radiation emitted by the universe’s activity that could not interact-with or be absorbed by matter in its journey towards the universe’s borders and back. This hypothesis seems much simpler than that associated with the *Big Bang* theory, considering that the *relic radiation* is proposed as the proof that the *big bang* did really happen. (See also the *Second Appendix* to this essay).

On the one hand, it should be assumed that speaking of *historical origin* of our universe does not make much sense, if it is so difficult to speak of *time* as of an irreversible physical dimension: Quantum mechanics does not need resorting either to the principle of causality or to the concept of *historical time*.

On the other hand, the universe’s origin and development depicted by the *Big Bang* theory describes a cosmic process of decreasing entropy, from an undifferentiated, homogeneous, uniform and compact state of matter to the innumerable differentiated cosmic structures and the endless transmutations of matter, as if the universe were a biological organism perennially in the making; which is the opposite of aging.

However, the *Big Bang* theory seems now surviving in a precarious situation,⁴³ while the universe we can observe might even be resulting from the “superimposition” of states of different and mutually interacting universes.⁴⁴

Connected with my hypothesis of *residual* radiation, instead of *relic* radiation, there is also the fact that the validity of the second principle of thermodynamics finds its limits in the impossibility of establishing a

⁴³ The recent “traumatic” discovery (1998-1999) that the expansion of the universe seems to be accelerating (instead of slowing down as per the expectations of cosmologists) has put both General Relativity and *Big Bang theory* in a critical situation. To try urgent remedies against their dismay, not only have cosmologists revived the metaphysical “cosmological constant” disowned by Einstein, but also have attributed to it the suitably “magic” powers necessary to fix the theory and the worries, with an additional support from the newly revealed “mysterious gods” named “Dark Matter” and “Dark Energy”.

⁴⁴ An interesting interpretation of quantum mechanics formulated by Hugh Everett in his doctorate thesis, written in 1958, was elaborated into the *many-world hypothesis* by C.S. Dewitt & N. Graham, *The Many-Worlds Interpretation of Quantum Mechanics*, Princeton University Press, 1973.

perfect and stable final chaos. Chaos is intrinsically unstable: It can partially persist only in association with *effects* of negative entropy.⁴⁵

5 - Gravity and Gravitation

The preceding chapters are principally aimed at introducing a new hypothesis concerning gravity and gravitation. The new hypothesis is also based on the assumption that the physical space is *not* an empty space, but is instead a space (the plenum) that behaves like a very special fluid.

Gravity and gravitation are the *headache* of contemporary physics. The success of all the grand unification theories stops at the threshold of gravitation. It seems that gravitation escapes all the attempts made by physicists to include it in a general and consistent theory of physical phenomena. Einstein's general theory of relativity describes gravitation as an indirect cosmic interaction between "masses" due to their property to deform the physical space around them. But Einstein, as well as the other concerned scientists, could never find the link between *this* kind of gravitation and quantum field theory. Einstein postulates that matter *warps* or *bends* the surrounding physical space in such a way so as to cause the effect we usually dub "gravitation"; whereas quantum mechanics suggests that the gravitation is the *field* determined (constituted) by special particles, named "gravitons", which convey attractive force between masses.

The impossibility of finding the link between General Relativity and quantum mechanics is probably in that both theories do not tackle the problem of defining what the physical space is. To speak of "fields" is only an "operational" way to evade the question, according to the philosophical (but sterile) attitude aimed at not re-proposing any image of physical space that might re-open the "ether paradox": Relativity can perhaps work without the "ether" of Einstein's predecessors, but doesn't work at all without a *physical space that bends and vibrates*, as Einstein himself felt obliged to state, whatever label one sticks to such a physical space.

On the other hand, quantum mechanics attaches fundamental properties to the "vacuum", while in its theoretical context interactions may only occur through "specialised" conveyors (particles), though there is so far no

⁴⁵ Apart from the conspicuous amount of available literature that addresses this unexpected feature of chaos, I had to run across the *absolute instability* of chaos, while dealing with the analysis of complex systems. (M. Ludovico, *L'evoluzione sintropica dei sistemi urbani*, Bulzoni, Roma 1988).

A discussion of mine on the issue is also in *Syntropy: Definition and Use*, online magazine www.syntropy.org, Dec. 2008.

experimental clue of gravitational conveyors (gravitons). The paradox is now shown by the delay in proposing the necessary reformulation of the theory, which should start right from an adequate hypothesis on what the "vacuum" is, and on what the *nature of quanta* is with respect to the nature of the "vacuum". A cost of this delay is the impossibility to attain any credible explanation-for and *control* on gravity. The delay might substantially depend on the comprehensible difficulty to admit that any *quantum gravity theory* is bound to fail.

5.1 – Gravitation issues in brief

The study of atom and atomic nuclei has shown that Newtonian (as well as relativistic) gravitation is such a negligible force that it could be appropriate considering it as non existent at atomic and sub-atomic levels. Even electrical forces are almost ineffective at the level of atomic nuclei, but electrostatic forces are perfectly identifiable at all levels of matter.

Yet, there is no way to identify the role played by gravitation at molecular level. All the fields of force at molecular, atomic and sub-atomic levels *ignore* conventional gravitation, because all the interactions occurring between the fundamental components of matter seem to be other than gravitation. It seems that the physical space – at least at those levels – is fully engaged in much more complicated activities, which do not leave any room to gravitational fields.⁴⁶ So far, there is no way for measuring intermolecular and infra-atomic gravitational forces: At those levels, gravitational force can only be calculated *theoretically*, according to Newton's law. For example, the formation of a spherical drop of liquid has nothing to do with its internal gravitational forces: The liquid molecules attract each other and agglomerate because of forces that overcome also the mutual repulsion due to the liquid thermal agitation. Instead, to propose a different example, no intrinsic gravitational force is effective to impede the dispersion of gas molecules even at the lowest levels of the gas temperature and relevant *intrinsic* pressure.

In simpler terms, there is impressive evidence that the common agglomeration of atoms and molecules that form any kind of matter does not resort at all to the virtues of gravitational forces.

The hypothesis about the mutual attraction of masses could now be questioned in the light of contemporary physics. The fact that bodies of any kind fall *as if attracted* by our planet, along with the gravitation

⁴⁶ As an example, it is worth proposing the following image: The Newtonian *gravitational* force between the masses of two electrons at the distance of one tenth of millimetre (*i.e.*, 0.0001 m) from each other is calculated to be equivalent to the *electrostatic* force between the two particles separated by a distance of 10^{15} km, which is about 100 light-years, twenty times the distance between the Earth and its nearest star out of the solar system.

systems observed in the universe, could be better analysed and explained on the basis of a new vision of the activity of the physical space.⁴⁷

From the quantum mechanics side, there are "acrobatic" efforts in progress since several years to quantize gravity. Quantum mechanics insists in assuming that gravity, in a strict analogy with the other inter-particle forces observed, takes place through sub-atomic exchanges of special particles named "gravitons". These special particles have never been observed, either directly or indirectly. So far, *gravitons* are only a theoretical (as well as sterile) hypothesis. Apart from extreme mathematical complications (which in themselves should discourage scientists to persist on that path), no *viable* quantum gravity theory could so far be formulated. Analogous situation concerns the efforts about gravitation made by the so-called *string* or *super-string theory*, which addresses an eleven-dimension topological space.

As a preliminary remark, it may be said that the *space bending* of General Relativity remains tentatively the most stimulating suggestion to

⁴⁷ The gravitational system formed by Sun, Earth and Moon is one more reason for doubting the internal consistency of Newton's gravitation theory, as Newton himself had to consider. Newton gave up in his attempt to find a complete explanation for lunar "anomalies". A major question is why the Moon, which – according to Newtonian mechanics – undergoes a solar attraction that is, in the Moon's whole orbit, more than twice stronger than the Earth's attraction, prefers to orbit the Earth instead of either falling onto the Sun or having its own independent orbit around the Sun.

Somebody might think that the Moon does actually orbit the Sun, and that the Moon's solar orbit is "*only perturbed*" by the Earth's gravity. But such a thesis would appear untenable, because gravitational orbits - as subjected to "central forces" - must fully lie on a plane, as it is for the Earth's ecliptic and for all the other orbits of the planets in the solar system. The Moon's revolution around the Earth lies actually on a plane that forms a 5° 8' angle with the Earth's ecliptic. This fact proves that the Moon is not *per se* orbiting the Sun, and that the Moon undergoes *only* the Earth's gravity. In fact, the Moon's orbit around the Sun – *as associated with the Earth's revolution around the Sun* – does *not* lie on a plane, but on a humped surface, as it is for the Earth-Moon mass centre too. Actually, the motion of the Moon remains an unsolved puzzle through centuries. Let's mention only one significant datum: Within the Sun-Earth conjunction line, the Earth's *Newtonian gravity* prevails over the Sun's up to only two thirds of the distance between Earth and Moon: Which also leads one to doubt the current explanation given – in the light of Newtonian mechanics – for the terrestrial tides. A complex set of disciplines has been mobilised to outline a "lunar theory", aimed at providing calculation instruments and simulation models for improving forecasts concerning the Moon's motions.

It is worth considering the motion of the Moon as a crucial field to test theories on gravitation.

interpret. In the light of the hypothesis proposed here about the plenum, gravitation is certainly expected to be the effect of a "curved" motion of the fluid space. However, General Relativity is in some way *compromised* with Newton's mechanics: The relativistic *space curvature* is expressed by GM/R^3c^2 , in which M is the Newtonian space-bending mass, R is the distance from the mass centre, c is the speed of light, and G is the Newtonian gravitational constant.

The need for constant G and Newtonian mass M to solve the relativistic field equations should be considered as an indication of non-self-sufficiency of General Relativity. A number of decades ago somebody (unfortunately I do not remember who) wrote that Newton's gravitation theory, after having been expelled (by General Relativity) from the house through the door, did actually re-enter the house through the window.⁴⁸

Finally, there is honestly no conceptual obstacle in interpreting Newton's gravitation as a force associated with the spherical curvature of the physical space around the centre of any mass (see also the *Analytical Attachment* to this *Part II*).

5.2 - Questioning Newtonian constant G

One of my personal problems is the question how can everybody rely so safely on the derivation and determination of constant G . The value for G was determined in 1798 by Henry Cavendish (1731-1810) experimentally. Further measurements were tried many times later, but the value that Cavendish established for G has remained as a basic reference, though repeatedly re-adjusted.

In subsequent Paragraphs 5.2.1 to 5.2.3, both the derivation of the constant G we owe to Newton and other issues concerning the constants in physics are discussed. Before entering that discussion, I would like to start from a few heuristic remarks.

The basic experiment for measuring G consists of an apparatus of two (or two couples of) material spheres placed in the presence of each other in such a way so as to make it possible to observe and measure the shift undergone by them because of the mutual gravitational attraction. Two larger 158kg lead spheres, connected by a rod suspended in its middle through a thin iron thread, were used by Cavendish to *attract* a corresponding pair of smaller lead spheres. The measurement of the

⁴⁸ In calculating star light's deflection, planetary orbits, and Mercury's perihelion precession in particular, Einstein's equations adopt values, both for constant G and for planetary masses, as assessed by use of Newton's gravitational law; which is rather a bizarre situation for claiming that General Relativity constitutes a theoretical revolution.

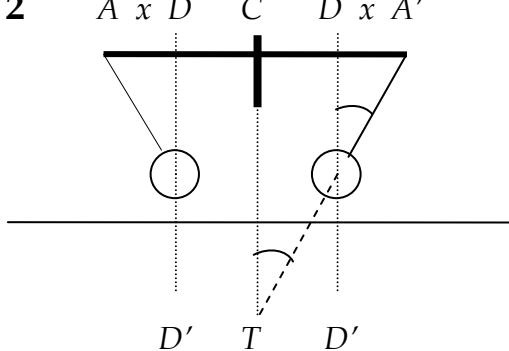
thread's torsion due to the mutual attraction of the spheres was the base for calculating the strength of the attraction.

On three occasions, while I was a student, I had to try to detect the gravitational effect in different laboratories. But I was unlucky: Despite the accurate preparation of the experiments, I couldn't observe any clear effect. This is obviously a true fact concerning my personal story only. However, the fact did surprise me, also because – during the recalled experiments – it should have at least been possible to clearly measure the effect due to Coriolis force⁴⁹. Instead, the torsion balances predisposed for the measurements seemed behaving in uncertain-ambiguous ways, so as not to give any clear significant indication.

There is to doubt that today's extremely sensitive instruments can improve the precision of this kind of experiment, just because of their hyper-sensitivity, which can be influenced by even remote physical vibrations or effects neither perceived nor suspected by the experimenter. New experimental tests are continuously tried though, while the relevant results continue to show rather problematic figures.

I am here proposing to consider a simple thought experiment.

Figure 2



Let's imagine we can prepare the measurement of the Newtonian gravitational effect according to an apparatus substantially similar to that schematically represented by the sketch of **Figure 2**.

The apparatus is supposedly located in a laboratory at the Equator (zero degree latitude), to avoid Coriolis acceleration effects, and consists of two golden spheres of 1000kg each (*i.e.*, more than six times heavier than Cavendish's), which are initially blocked at the extremities *A* and *A'* of a straight rigid horizontal bar. The centres of the spheres are at the distance

⁴⁹ French physicist Gustave Gaspard de Coriolis (1792-1843) has shown that any "freed" bodies, under the combined effects of the Earth's gravity and rotation, deviate their motion or position from the vertical line to a degree that depends on the latitude.

of 0.5m from each other. (Considering that the gold mass density is 19.3gr/cm³, it is easily calculated that the diameter of each sphere is 0.4626m, so as to make the minimum distance between the spherical surfaces equal to 0.0374m).

The two spheres are connected to the respective extremities A and A' of the rigid bar by perfectly flexible and inextensible cables that we can manoeuvre. Then, we let the two hanging spheres fall slowly and simultaneously down to the distance $z = 1$ meter of their centres from the respective initial positions in A and A' . In doing so, we let the Earth's gravity force act along with the gravitational force between the spheres.

Earth gravity in conjunction with the Newtonian attraction between the two spheres produces a resulting force that brings the centre of each sphere to make a mutual approaching shift x .

The cable straight line makes an angle θ with the vertical line CT as well as with its parallel line DD' . Let's indicate with y the distance achieved by the centre of each sphere from the rigid horizontal bar.

Let's say f the spheres' mutual attraction strength, and Mg the force exerted by the Earth on each sphere, $g = 9.78\text{m/sec}^2$ being the Earth's gravity acceleration.

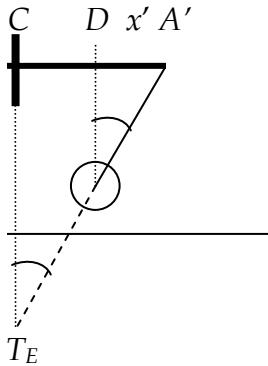
By an acceptable approximation, which eliminates infinitesimal distances, we may now assume that distance y is proportional to the Earth's attraction Mg , whereas shift x is proportional to the Newtonian attraction $f = GM^2/(0.5)^2$ between the two golden spheres. This leads to affirm that $f/Mg = x/z \cos \theta$. Therefore:

$$[23] \quad x = f z \cos \theta / Mg = GM z \cos \theta / (g \cdot 0.5^2) = \\ = (6.67 \cdot 10^{-11} \cdot 10^3 \cdot 1) \cos \theta / (9.78 \cdot 0.25) = (2.7280 \cdot 10^{-8} \cdot \cos \theta) \text{m. (*)}$$

Set this result apart for a moment; let's reconsider the apparatus schematised in the figure above after eliminating one of the two metal spheres, as shown by Figure 3.

The intention is now to calculate x' as the distance covered by the remaining hung sphere, when the cable length is $z = 1\text{m}$, to approach the straight vertical line CT_E , which now represents the distance between C and the Earth's centre T_E .

(*) It might be significant to observe that the order of magnitude of the distance between the atoms of the golden spheres ranges approximately between 10^{-10}m and 10^{-9}m , so that length x calculated by [23] above could be covered by a few tens of atoms (say sixty, more or less) in a line. In a comparison, about 200,000 gold atoms in a line would instead be necessary to equal the thickness of a hair.

Figure 3


In the revised sketch of the apparatus, also the straight line $A'T_E$ represents a vertical line. It is obvious that all vertical straight lines converge in the centre T_E of the Earth.

Say β the angle in T_E formed by the two vertical lines (CT_E and $A'T_E$), and consider that vertical line $CT_E = 6.378 \cdot 10^6$ m coincides with the radius of the Earth, whereas line $A'T_E$ is just a little bit longer. Remembering that length $CA' = 0.25$ m, we can write:

$$[24] \quad \tan \beta = 0.25 / 6.378 \cdot 10^6 = 3.9197246 \cdot 10^{-8}.$$

Because of this extremely small value, we may assume $\tan \beta = \sin \beta$.

Also the straight line parallel - through point D - to vertical CT_E forms an angle β with vertical line $A'T_E$. Therefore, it is possible to write

$$[25] \quad x' : \sin \beta = z : \sin(\pi/2), \text{ so that } x' = (1 \sin \beta) / 1 = 3.9197 \cdot 10^{-8} \text{ m.}$$

This thought experiment shows that not only is the vertical convergence shift x' of the same order of magnitude as the mutual attraction shift x , but also that x' is approximately and paradoxically 44% greater than x . We have also to consider, in fact, that θ is certainly greater than β , and that $\cos \theta < 1$. However, as a correction to the previous approximation made in writing [23], we may also assume $\cos \theta = 1$, to increment x (i.e., the individual shift due to the attraction between the two spheres, as previously considered). In any case, the meaning of this finding does not change.

The above exercise tells that attempts to measure the gravity attraction force between masses in a laboratory make it difficult to believe that both Earth gravity and Coriolis forces, along with any possible unknown environment disturbance, have carefully been isolated and neutralised. By the way, thinking of the times in which Cavendish carried out his first measurements of G , Coriolis forces were not yet known (Coriolis acceleration appeared in analytical mechanics after 1830). These are some

of the reasons why I doubt both the value established for G and the mutual gravitational attraction between any set of material bodies.

In this connection, it seems worth considering that Newton carried out rather correct calculations regarding the orbits of celestial bodies in the solar system, comets included, without using the value of G established by Cavendish. It is clear that the "actual" values of the masses of heavenly bodies depend on the value of G . In other terms, G may take any reasonable as well as conventional value. In Newtonian mechanics there would be no substantial difference.

Newtonian gravitation is an excellent model, though it is in any case possible to adjust the assessment of gravity masses in function of the value chosen for G . The only basic and stable reference data are the distances involved.

To corroborate my doubts, there are a few "surprises" met in using gravimeters in various places of our planet. It has been experienced that there are several anomalies, which oppose the expectations legitimated by Newtonian gravitation law.⁵⁰

⁵⁰ A systematic anomaly is detected by use of gravimeters: The gravity acceleration measured at the sea surface is *in all cases* greater than the gravity acceleration measured on continental soil at the sea level. The opposite is expected, according to Newtonian gravity law, because the mass densities of continents are systematically greater than the sea/ocean densities. In many cases, analogous anomalies have been detected in the presence of local greater mass densities of the Earth. In this connection, recent oceanographic researches have established that the thickness of oceanic solid bottoms is remarkably lesser than expected. Other surprising results come from geophysical investigations: Gravity acceleration measured in deep mines does not match Newton's law. There are many studies and papers concerning unexplainable anomalies detected in various attempts to determine the value of gravitational constant G , which suggest that G is rather an *inconstant* quantity, *as if it were* an empirical simplification of a set of variable quantities neglected by Newton's gravitational equation. See a few references on the issue also in subsequent footnote 66.

An overlooked though significant series of laboratory experiments carried out by Italian physicist Quirino Majorana (1871-1957) between 1919 and 1929 showed that the Earth's gravity is weakened – instead of being strengthened – by the interposition of dense masses, in an evident conflict with Newton's law. Majorana's experiments proved that thick layers of lead or mercury placed under a suspended body cause a measurable loss in the body's weight: Which is paradoxical in the light of Newtonian gravitation law, while it seems an indirect confirmation of the geophysical anomalies mentioned above. Reference to Q. Majorana, *On Gravitation. Theoretical and experimental researches*, Philosophical Magazine, vol. 39, 1920, pp. 488-504; *Sur l'absorption de la gravitation*, Comptes rendus de l'academie des sciences, vol. 173, 1921, pp. 478-479; *Quelques*

Doubts on G reflect also on General Relativity to the extent to which the *space bending effect* is concerned. The analytical procedure followed by Einstein to determine his gravity field equations is based on a couple of postulates aimed at obtaining the Newtonian gravitation equation for masses whose motion is slow with respect to the speed of light, while Einstein's equations applied to the calculation of planetary orbits make use not only of Newtonian constant G , but also of the planetary masses calculated by means of Newton's law⁵¹. Moreover, the fact that masses bend the four-dimension space around them is a postulate.

Yet, relativistic "mass" becomes an unclear concept not only because of the mass-energy equivalence principle accepted after Special Relativity. For Einstein, radiation is energy, but photons should have no mass, and – in this connection – what shall we say about radiation that bends the space that deflects radiation? What should it mean "radiation that deflects radiation"? This is one of the points of General Relativity that require clarification, especially if one considers that the "empty" space is for quantum mechanics the reservoir of an unlimited amount of energy.

A true fact is that the concept of mass – thanks also to Relativity – is nowadays far from a clear definition.

Yet, there is an incredible decision made by Einstein to adjust his field equation to the image of the universe he believed to be the correct one. Sticking to the genuine form of his equations, he had to conclude that the universe, under the mutual attractive forces of cosmic matter, due to the time-space overall deformation, was sooner or later doomed to shrink and collapse. To deprive the universe he theorized of such a fate, Einstein introduced an arbitrary "cosmological constant" in his equations and made it work as a reaction against the universe contraction. This cosmological constant has undergone the only logical interpretation that is possible in the context of General Relativity: The cosmological constant provides the "vacuum" with an immanent repulsive strength that checks

recherches sur l'absorption de la gravitation par la matière, Journal de Physique et le Radium, I, 1930, pp. 314-324.

⁵¹ See P. G. Bergman, *The Riddle of Gravitation*, [Italian Transl. *L'enigma della gravitazione*], A.Mondadori, Milano 1969, Part Two, Chapter 5. In Part Two, Chap. VI, and Part Three, Chapter V of the same book, Bergman reports on observations concerning the precession of the perihelion of Mercury's orbit. According to more accurate analyses, Einstein's prediction does not substantially differ from the explanation given for the precession by various scientists in Century XIX on the basis of Newtonian mechanics, once accounting for an oblate shape of the solar spheroid. P. G. Bergman was during a number of years a close collaborator of Einstein at Princeton University.

the attractive strength of the whole mass of the universe in order to keep this in a permanent equilibrium state.

Despite Einstein's repentance for that improvised decision, cosmologists are now re-considering the cosmological constant as a providential ingenious intuition.

I deem that there is now objective confusion about mass, vacuum and gravitation, which requires virgin attempts to revise the fundaments of physics and cosmology. In particular, there are not negligible reasons for doubting gravitation as a property inherent in masses.

According to the latest astronomical observations, both Newton's and Einstein's gravitation models seem inadequate⁵².

5.2.1 - Where does gravitational constant G come from?

Newton, after establishing the principles of Mechanics (of a basic importance those concerning the definitions of "force" and "mass"), was able to derive his gravitation law starting from Kepler's laws. In particular, the first and the third of these laws, empirically derived, state that the planetary orbits of the solar system are ellipses, in which the Sun is centred on one of the focuses, while the *ratio of the third power of the semi major-axis of the ellipse to the second power of the planet's revolution period is a constant value*, irrespective of the planet considered. This constant ratio, *i.e.*, Kepler's constant, is

$$[25.1] \quad K_S = \frac{R^3}{T^2} \cong 3.355 \cdot 10^{18} \text{ m}^3/\text{sec}^2,$$

in which K_S relates to the Sun taken as the "pivot" of the solar system, R is the *semi major-axis* of the planetary elliptic orbit, and T is the orbital period, whatever the planet considered.

At Newton's time there were a few competing cosmological models of the solar system, basically used for the calculation of the orbits of planets and respective satellites. Most of the models accounted for circular orbits, at variance with Kepler's ellipses, which settled the Sun in one of their

⁵² In January 1998, astronomers found evidence that the cosmos is expanding at an ever-increasing rate. As soon as the new findings were announced, cosmologists from all over the world rushed to try to explain the unexpected discovery. Some of them suggested resorting to Einstein's gravity field equations through a suitable adjustment of the famous "cosmological constant", which was arbitrarily introduced by Einstein to adjust his equations to the formerly undetected cosmos' expansion. It must be remarked that Einstein himself had openly to declare that the introduction of the "cosmological constant" was his greatest blunder. A history and discussion concerning the subject can be found in Amir D. Aczel, *God's Equation*, Dell Publishing, New York 1999.

focuses and – in addition – established the remarkable rule of *equal areas swept by orbital radii in equal times*. Actually, the rules established by Kepler in the first two decades of the seventeenth century achieved an unprecedented accuracy in calculating orbital motions, with the only exception regarding the Moon's orbit, which remains an unsolved theoretical knot still nowadays. Newton himself, after a number of attempts based on the analysis of the perturbation effects of the solar gravity, admitted he was unable to find an exact credible explanation for the Moon's orbital motion.

Between 1669 and 1690, Dutch scientist Christiaan Huygens (1629-1695) issued a number of works aimed at addressing in a mathematical form the theory of gravitational vortices proposed by French philosopher and mathematician René Descartes (1596-1650). Amongst other findings, Huygens formulated and proved the correct equation for *centrifugal force*, which is always counterbalanced by an opposite equivalent force that Newton dubbed “centripetal”.

In the light of Huygens' and Newton's mechanics, orbiting planets are subject to a mean centrifugal acceleration that is expressed by

$$[25.2] \quad a_p = \frac{4\pi^2 R_p}{T_p^2} ,$$

where R_p is the distance of the planet from the Sun, and T_p is the planet's orbital period. This acceleration acts upon the planet in conjunction with an equivalent opposite acceleration that must be consistent with Kepler's orbital rules. Thus, with reference to Formula [25.1], one can express the planet's orbital period as a function of Kepler's constant K_s , to obtain

$$[25.3] \quad T_p^2 = \frac{R_p^3}{K_s} .$$

By substitution of T_p^2 in the denominator of [25.2], the planet's centrifugal acceleration can also be expressed by

$$[25.4] \quad a'_p = \frac{4\pi^2 K_s}{R_p^2} .$$

It must immediately be pointed out that R_p does not coincide with the semi major-axis of the elliptic orbit, unless the orbit is a circle line. Nevertheless, one can mathematically prove (as Newton did, first in history) that conclusion [25.4] is correct concerning *any elliptic orbit*, on the assumption that the Sun is the “cause” and the motion centre of all the planetary orbits, and considering R_p as the varying distance between Sun and planet.

Because of the apparent conflict between equations [25.2] and [25.4], due to the introduction in [25.2] of the third Keplerian law of planetary motion, the question raised on how to conceal the observations with the apparent contradictory forms of acceleration expressed by the relevant theoretical expressions.

Upon challenging invitations to find a solution to the problem, received from contemporary fellow scientists⁵³ Hooke and Halley, Newton wrote, and published in November 1684, *De Motu Corporum in Gyro* (On Bodies in Orbital Motion), a nine page paper in which he demonstrated that bodies simultaneously subjected to equivalent and opposite accelerations a_P and a'_P describe elliptic orbits, if the bodies' speed keeps within certain limits; otherwise, as for lower or exceeding speeds, the orbits may either be parabolas or hyperboles.

Thus, gravitational orbits are *conic sections*, i.e., *plane curves* described by *central motions* in which the direction of the *central accelerations*⁵⁴ undergone by orbiting bodies is the same as the direction of the straight-line distance between the orbiting body and the centre of the motion, wherever this centre is located.

Therefore, the hypothesis that the Sun works as a constraining pivot for the planets (also this suggestion comes from Kepler) implies that elliptic orbits, because of kinematical laws, obey both Equations [25.2] and [25.4]. For further detail, see the *Analytical Attachment* to this Part II.

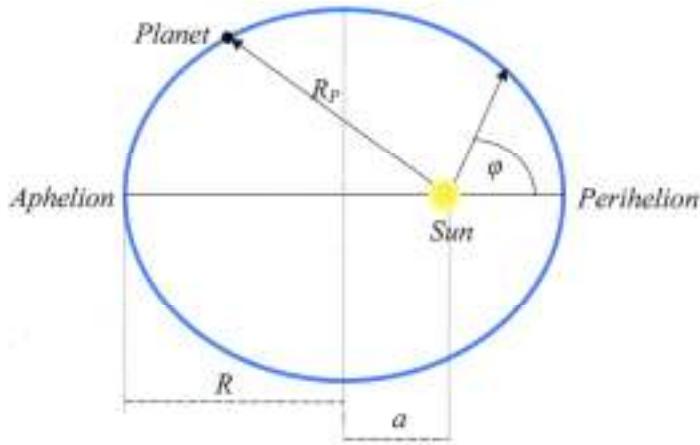
With reference to the sketch of a planetary orbit shown in the next page, the equation of the ellipse described by any orbiting planet is given, in polar co-ordinates, by

$$[25.5] \quad R_P = \frac{R^2 - a^2}{R(1 + \varepsilon \cos \phi)},$$

where a is the distance of each focus from the centre of the ellipse, R is the semi major-axis, $\varepsilon = a/R$ is the ellipse's eccentricity.

⁵³ Robert Hooke (1653-1702), English physicist, who formulated a law on the elasticity of materials; Edmund Halley (1656-1724), English mathematician and astronomer, who also translated from Arabic some of the eight books, *Conicarum Libri*, written on conic sections by Apollonius Pergaeus, great Greek mathematician of the III century b. C.

⁵⁴ Newton called "centripetal acceleration" what later, to avoid confusion, analytical mechanics preferred to define as "central acceleration", considering that the centres of orbital motions do not in general coincide with the geometric centres of either the orbits or the orbital curvature, and that - in general - "centrifugal" accelerations may prevail over opposite "centripetal" accelerations.



The planet's distance R_P from the Sun varies between the minimum at the perihelion and the maximum at the aphelion, i.e., $R - a \leq R_P \leq R + a$, the instant extent of R_P depending on the angle φ that R_P forms with the major axis of the ellipse, constant a being the distance between the Sun and the ellipse's centre.

To express the central acceleration undergone by the planet, the use of Binet's formula⁵⁵ gives:

$$[25.6] \quad a_p = \left(\frac{2A}{TR_p} \right)^2 \left[\frac{1}{R_p} + \frac{d^2}{d\phi^2} \left(\frac{1}{R_p} \right) \right],$$

in which constant $A = \pi R \sqrt{R^2 - a^2}$ is the area of the ellipse, and constant T is the orbital revolution period.

By substitution of R_p in Equation [25.6] with Function [25.5], and accounting also for Keplerian constant K_S , one obtains the conclusion given by [25.4] for acceleration a_p .

⁵⁵ Jacques Ph. M. Binet (1786-1856), French astronomer and mathematician, gave this contribution to analytical mechanics, a significant translation of the variable time parameter into a mere geometrical entity.

Note: this paragraph is only a *likely re-construction* of the logical process that led Newton, through his own original analytical instruments, prevailingly of a geometrical character, to formulate and apply his gravitation law. Actually, Newton did rather prefer to show how Kepler's laws can be derived from the gravitational law he formulated, upon the mathematical consideration that his gravitational equation allows for orbits described by any conic section, not by ellipses only.

On the one hand, the planet's stable orbit indicates that a *centripetal force* acts on the planet so as to counterbalance the relevant centrifugal force. Therefore, both the centrifugal and the equivalent centripetal force f_S can be expressed by Newtonian formula

$$[25.7] \quad f_S = m_P a_P = \frac{4\pi^2 K_S m_P}{R_P^2},$$

in which m_P is the mass of the planet.

On the other hand, Newton observed that there are satellites that orbit planets; which is enough to suggest that forces acting between satellites and respective planets had to be considered as quite analogous to the forces acting between planets and Sun; Thus, just as a colloquial example and in a rough approximation, Kepler's laws could also be applied to the orbit of the Moon around the Earth, albeit the Moon's orbit does not obey Keplerian laws (the Moon's orbit is a gravitational enigma indeed). Using the Moon's orbit as if it were an ellipse, a calculation of Keplerian constant K_E relative to the Earth (taken this as the "pivot" of the relevant gravitational system), gives

$$[25.8] \quad K_E \approx 1.0122 \cdot 10^{13} \text{ m}^3/\text{sec}^2.$$

Then, if "something like a mutual attraction force" determines the planetary orbits of the solar system, as well as the orbits of satellites around planets, it must also be assumed that gravitational phenomena depend on the *sum* of such "mutual attractions".

Therefore, if f_S is the force exerted by the Sun over the planet, the force exerted by the planet over the Sun must be expressed by

$$[25.9] \quad f_P = \frac{4\pi^2 K_P M}{R_P^2},$$

M being the mass of the Sun. This force adds with f_S , giving the resulting mutual attraction force expressed by

$$[25.10] \quad F_{S,P} = f_S + f_P = \frac{4\pi^2}{R_P^2} (K_S m_P + K_P M).$$

At this point in the analysis, it might have been quite reasonable to Newton assuming that the Keplerian constant relevant to each celestial body is directly proportional to the mass of the same body according to an identical coefficient of proportionality; which implies the assumption that the following ratios express the same constant value N , *i.e.*,

$$[25.11] \quad \frac{K_S}{M} = \frac{K_P}{m_P} = \dots = \frac{K_X}{m_X} = N, \text{ constant},$$

for any heavenly bodies S, P, \dots, X . The introduction of “universal constant” N allows one to write, in particular,

$$[25.12] \quad K_S = NM, \quad \text{and} \quad K_P = Nm_p.$$

After substitution of these expressions for K_S and K_p in Equation [25.10], the latter takes the following simplified form:

$$[25.13] \quad F_{S,P} = 8\pi^2 N \frac{Mm_p}{R_p^2} = 2G \frac{Mm_p}{R_p^2},$$

in which *gravitational constant* G is obtained from [25.7] and [25.9] as a product of constant values, after replacing there K_S with NM , i.e.,

$$[25.14] \quad G = 4\pi^2 N.$$

With the introduction of “universal constants” N and G , the acceleration a_p (undergone by the planet because of the Sun’s action), previously expressed by [25.4], becomes now

$$[25.4.1] \quad a_p = \frac{4\pi^2 NM}{R_p^2} = \frac{GM}{R_p^2},$$

which also expresses the “attraction force” exerted by the Sun on any *unit mass* placed at distance R_p from the Sun.

Equation [25.13] depends on Hypotheses [25.9] and [25.11], which inevitably led Newton to associate any mass with the respective “Keplerian constant”. Thus, force $F_{S,P}$ expressed by Equation [25.13] regards only the “co-presence” of any two masses that interact at any given mutual distance. Instead, in the case of planets orbiting the Sun (or – analogously – of satellites orbiting planets), the centrifugal force acting on the orbiting body shall be subtracted from equations like [21.13].

As seen, the centrifugal force undergone by any orbiting planet can be expressed by “minus Equation [25.7]”, to conclude that the resulting force that compels the planet to orbit the Sun is given by [25.4.1] multiplied by the planet’s mass m_p . Equations [25.13] and [25.4.1] imply that all possible orbital trajectories belong to the family of conic sections, which include

ellipses, parabolas, hyperbolas (consider that circle lines are “ellipses” with zero eccentricity⁵⁶).

Other possible orbital motions, such as spirals - for example⁵⁷ - are not allowed for by the Newtonian gravitation law, because geometric curves different from conic sections cannot mathematically be derived from Equation [25.13] or [25.4.1]. That is why the “anomalous” perihelion precession in the orbit of Mercury is one of the critical issues that challenge astronomers and cosmologists. Mercury’s orbit describes a strange “open ellipse” whose major axis rotates on a “pivot” centred on the Sun.

Nowadays, it seems that orbits similar to Mercury’s should be considered as “normal” rather than “anomalous”. In this connection, let’s bear in mind that Newton’s gravitation law, with the relevant derivation of “universal constant G ”, is fundamentally based on Kepler’s laws, for which *all* planetary orbits describe ellipses. Therefore, Newton’s conclusions are bound by such a constraint, which is in turn “flawed” because of the original “inaccurate” observations reported by Kepler.

5.2.2 – Why “ G ” is not a universal constant

The fact that Newton’s law is based on Kepler’s laws leads one to point out that the parameter N expressed by ratios [25.11] may be proposed as a universal constant *only if* each of those ratios relates to an elliptic (or circular) orbit. Instead, if – as also confirmed by accurate observations – *it cannot in general be stated* that gravitational orbits are *perfectly* described by conic sections, then it does not make any sense claiming now that orbits like that of Mercury or of other heavenly bodies are “anomalous”. Substantially, Newton’s gravitation law is both another way to express Kepler’s laws and to explicit some relevant implications in the light of Newtonian dynamics. Furthermore, the analysis of “central motion” addressed by mechanics shows that Newton’s discovery of equal areas swept in equal times by the vector radius of elliptical orbits is true of *any* orbit of a body subjected to a “central force”, whatever the relation between the force and the body’s distance from the focus of the motion.

⁵⁶ Conics, as per the demonstration previously provided by Newton’s *De Motu Corporum in Gyro* (i.e., ellipses, parabolas and hyperboles), can be obtained from any gravitational equation analogous to [25.13], whose right-hand side consists in the ratio of any given constant value to the square of a variable distance. Thus, for instance, orbital conics can also be obtained from Equation [25.10] directly, with no need for *universal* constants.

⁵⁷ For example: a metal sphere falling along the vertical line from the top of a high skyscraper does most likely describe a section of spiral, the Earth’s centre being the spiral’s centre. Instead, according to Newton’s law, the fall should describe a section of either ellipse or parabola. How to prove it experimentally?

If ratios like [25.11] cannot express a property inherent in *any* Sun and in *any* planet, or in any other gravitational body, then no equation like [25.13] and [25.4.1] can be considered as universally valid, since every ratio of the kind $N_p = K_p / m_p$ has *in general* no special signification. As an obvious consequence, in considering Equations [25.7] and [25.10], one should expect that factors like $K_S m_P$ and $K_p M$ vary from planet to planet (whatever Kepler's coefficients K may now mean), so that the resulting coefficient "G" can be **neither** a *universal constant* **nor** a *constant coefficient* even within the solar system.

In this connection, it is necessary to report on the Newton's awareness that his gravitational model is only an *approximate description* of the planetary system observed, when – on the one hand – he concedes that the model would be exact only if "*the Sun were at rest and the remaining planets did not act upon one another*"⁵⁸, but principally – on the other hand – when he remarks that "*by reason of the deviation of the Sun from the centre of gravity* [because of the continuous changes in the position of the solar system masses, (N.o.A)] *the centripetal force does not always tend to that immobile centre, and hence the planets neither move exactly nor revolve twice in the same orbit. Each time a planet revolves it traces a fresh orbit, as happens also with the motion of the Moon, and each orbit depends on the combined motion of all the planets, apart from their action upon each other. Unless I am much mistaken, it would exceed the force of human wit to consider so many causes of motion at the same time, and to define the motions by exact laws which would allow of an easy calculation*".⁵⁹

Summarising: Though one must admit that Newton's gravitation law works rather well as a *first approximation astronomic model*, there is *now* no justification for assuming G as an unquestionable "universal constant" regarding "attraction between masses".

Another issue arises from the consolidated belief that material masses are intrinsically endowed with a physical "attraction power". It is surprising indeed that there are still physicists and cosmologists who neglect (or ignore) the suggestion given by Newton himself: Masses behave "*as if*" endowed with an "attraction power", which – according to Newton himself – does not mean that such a physical property is real⁶⁰. Far from

⁵⁸ I. Newton, *Philosophiae Naturalis Principia...*(op. cit.), Book 3, Propositions 13 and 14.

⁵⁹ A. R. Hall & M. B. Hall, editors, *Unpublished Scientific Papers of Isaac Newton*, Cambridge University Press, 1962, 280. It's a collection of Newton's manuscripts complementary to the contents of the "*Principia*".

⁶⁰ Of a high interest is a letter written by Newton to Richard Bentley on February 25, 1693. In the letter Newton states: << *That gravity should be innate, inherent, and essential to matter, so that one body may act upon another at a distance through a*

shedding light over the subject, General Relativity (which adopts “universal constant G ” unconditionally) has made it remarkably more complicated, translating the “attraction power of masses” into their physical property of *bending* the four-dimension space, with no logical demonstration of why such a property is justified. Yet, the (unexplained) systematic use both of “constant G ” and of Newtonian masses makes General Relativity not only compatible with Newton’s gravitation, but also *uselessly* more difficult to handle for practical purposes.

As to the hyper-celebrated Einstein’s explanation of Mercury’s perihelion precession, one might instead consider or reject (it’s a mere question of personal taste) the proposal made in the 19th century by U. S. astronomer Asaph Hall (1829-1907), who suggested to change the Newtonian law’s square exponent of distance into exponent 2.0000001612;⁶¹ or else prefer the demonstration made by German physicist Karl Schwarzschild (1873-1916), who could show a different analytical way to explain the phenomenon, in a simpler and more elegant way than Einstein’s.⁶²

5.2.3 – *The issue of the constants in physics*

Charles Sanders Peirce (1839-1924), one of the very few philosophers and scientists who gained maximum experience with measurement in physics, carried out an impressive number of experiments for the determination of constant G , to conclude – after many years of intense activity in the field – that the determination of G is clearly affected by *systematic error*. He was rather sceptical with respect to the whole activity of measurement in physics. In his opinion, the most sophisticated

vacuum, without the mediation of any thing else, by and through which their action and force may be conveyed from one to another, is to me so great an absurdity, that I believe no man, who has in philosophical matters a competent faculty of thinking, can ever fall into it. Gravity must be caused by an agent, constantly according to certain laws, but whether this agent be material or immaterial, I leave to the consideration of my reader >>.
In this connection it’s also worth considering that Newton knew the “interaction at distance” between electric and magnetic bodies, which he mentions in his “Principia” to suggest similarities to gravity force (Book 1, Definition VIII). The important work of William Gilbert, *De Magnete Magneticisque Corporibus et de Magno Magnete Tellure Physiologia Nova*, was published in London in 1600.

⁶¹ Newton himself realized and wrote in Section 13 of Book 1 of his “Principia” that gravity around a spheroid does not vary simply in proportion to $1/r^2$; and in Section 9, Book 3, in order to explain the precession of the Moon’s orbit he suggested to consider a force proportional to $1/r^{(2+4/243)} = 1/r^{2.016490905}$.

⁶² As to the perihelion precession of Mercury, a detailed and clear explanation of Schwarzschild’s procedure can be found in Carmen Chicone, *Ordinary Differential Equation with Applications*, Springer, New York 1999, pp. 374-381.

comparisons between masses, lengths and angles are largely less reliable – as to precision – than estimates and accounts in commercial and banking activities. He stated that the determination of “constants” in physics has a level of precision comparable to the measurement of carpets and curtains made by an upholsterer. According to Peirce, the idea that the precision of mathematical calculations can be proved in experimental laboratories is simply ridiculous.⁶³

An analogous attitude was also of French physicist Pierre-Maurice Duhem (1861-1916), who considered “natural constants” as a mere artificial by-product of the use of mathematics. In formulating theories, which inevitably are simplifying representations of the real world, there are *voids* that must be filled by “constants” that *have no real explanation*. The “constants” of physics are convenient numbers used to adjust our theoretical models to the reality we can observe and to describe by mathematical formulas the relations detected between sets of physical quantities observed and measured.

Concerning the *Standard Model* of quantum physics, Lee Smolin states:

“The standard model [formulated in 1970] has a big problem: It has a long list of adjustable constants (...). As far as we know, any value will do, because the theory is mathematically self-consistent, no matter which value we put in. These constants specify the properties of the particles. Some tell us the masses of the quarks and the leptons, while others tell us the strength of the forces. We have no idea why these numbers have the values they do; we simply determine them by experiments and plug in the numbers (...) There are about twenty such constants”⁶⁴.

There is a *Committee on Data of Science and Technology* devoted to a permanent activity of correction, adjustment and revision – when necessary – of all the constants currently used in laboratories of physics and of technological tests. The editors of the continuously updated lists explain how a very large number of data coming from the most important laboratories are processed to re-adjust the constants in use⁶⁵. They have adopted criteria and procedures to classify the constants according to the respective level of precision and reliability. Normally, almost all of the constants used in physics can be derived from one another. The only constant that escapes all consistent classifications is G , which is considered separately and among the least precise ones. G is an *isolated* constant,

⁶³ Excerpts from Peirce’s book *The Doctrine of Necessity Re-examined* (1892) are widely quoted by Ian Hacking in his book *Representing and Intervening*, Cambridge University Press, 1983.

⁶⁴ L. Smolin, *The Trouble with Physics*, Houghton Mifflin, New York 2006, p. 12.

⁶⁵ Cfr. E. R. Cohen & B. N. Taylor, in *Journal of Physical and Chemical Reference Data*, No. 2, 1973, Pages 663-738.

which cannot be derived from any other constant used in physics. A number of experiments carried out during recent decades have shown that there is well-grounded reason for doubting that G is a constant quantity.

Measurements carried out in deep mines and under the sea gave results about 1% higher than the currently accepted values of G . Not only: the greater the depth, with respect to the sea level (either in the sea or in the dry land), the greater the discrepancy.⁶⁶ Other gravity anomalies are worth a mention, though widely over-looked or neglected by mainstream physics.

5.3 – A new hypothesis on gravitation

My basic hypothesis is that in the motion of the fluid plenum is also at the origin of gravitational fields. Furthermore, in my view, everything originates from gravitational fields, which prevailingly consist in macro-ring vortices. Most of the gravitational ring-vortexes are in turn immersed in a larger vortex of the same kind, with major effects on the original shape and properties of the smaller ones.

As an example of gravitational ring-vortex, I can propose the images of *Lyra* galaxy.

If we look at the cross section of a ring-vortex, we can observe that the lines of its velocity field, once projected on the plane of the cross section, are quasi-circular lines that tend to osculate in the proximity of point C , which is the centre both of the cross section and of the vortex ring.

Figure 4 in the following page is a sketch of the cross section of a ring-vortex. In this kind of vortex, the modules of velocity vectors V_P and $V_{P'}$

⁶⁶ Let us recall a few historical references amongst the many published papers and articles concerning major anomalies detected in gravity:

- V. Crémieu, *Recherches sur la gravitation*, Comptes Rendues de l'academie des sciences, Dec. 1906, pp. 887-889; *Le probleme de la gravitation*, Revue Generale des Sciences Pures et Appliquées, v. 18, 1907, pp. 7-13
- Ch. F. Brush, *Some new experiments in gravitation*, Proceedings of the American Philosophy Society, v. 63, 1924, pp. 57-61
- F. D. Stacey & G. J. Tuck, *Geophysical evidence of non-Newtonian gravity*, Nature, v. 292, 1981, pp. 230-232
- S. C. Holding & G. J. Tuck, *A new mine determination of the Newtonian gravitational constant*, Nature, v. 307, 1984, pp. 714-716
- M. A. Zumberge & Al., *Results from the 1987 Greenland G experiment*, Eos, v. 69, 1988, p. 1046
- V. Kierman, *Gravitational constant is up in the air*, New Scientist, 26 Apr. 1995, p.39
- D. Kesterbaum, *The legend of G*, New Scientist, 17 Jan. 1998, pp. 39-42
- P. Spolter, *Problems with the gravitational constant*, Infinite Energy, 10:59, 2005, p. 39

are less than vector module V_c , because the fluid velocities add with each other in approaching the ring centre C. As a consequence, the distance of

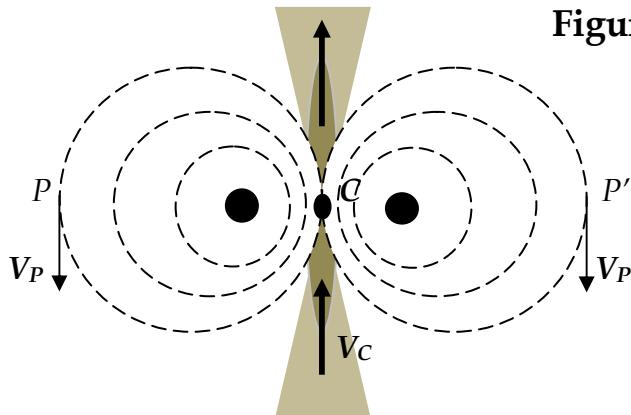


Figure 4

the velocity field lines tends to approach the origin of the vortex motion, according to the law of the inverse distance, as described in preceding Paragraph 2.4. The two black spots in the figure represent the cross section of *the void ring core* of the ring-vortex. As an effect of the speed summation in the proximity of centre C, the radius of *the void ring core* in C tends to drop to a minimum, in correspondence with the maximum speed that is possible for the fluid motion. This maximum speed is also related to the effect of the other component of the velocity vector. If we define V_p and $V_{p'}$ as the "meridian components" of the fluid velocity, the "parallel components", which are orthogonal to the former ones, tend to create a vortex nucleus around the centre C of the ring.

In fact, the characteristics of local velocity field create the ultimate obstacle to the further shrinking of the radius of the ring's void nucleus.

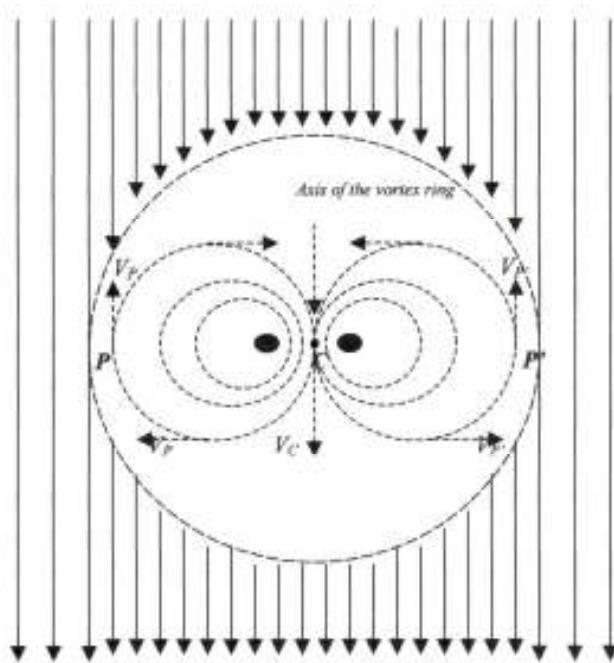
However, it must be supposed that the "parallel components" may in certain cases be absent from the velocity field of a ring-vortex. In such cases, the stop to the shrinking process of the vortex ring radius depends only on the speed limits that are proper to the plenum with respect to the void. As to this possible case, the graph above represents the whole velocity field.

If we imagine the ring-vortex immersed in a parallel fluid stream, the vortex shape tends to become spherical, as shown schematically by the **Figure 5.**⁶⁷

⁶⁷ The mathematical description of a ring-vortex motion across its medium, and of the relevant transformation into a "spherical vortex" because of the parallel stream that runs over the vortex, can be found in Horace Lamb, *Hydrodynamics*, *op. cit.*, Chapter VII, Pages 202-249. The parallel stream velocity is also parallel to the central axis of the vortex ring.

For the purposes of this essay, I limit myself to carry out an analysis on a vortex of this kind, which I will refer to as "spherical vortex", for I deem it is the most common kind of gravitational vortex.

Figure 5



5.4 - Spherical gravitational vortex

As already observed concerning the propagation of an oscillatory velocity field, it is always possible to calculate the circulation of the velocity vector around any closed line of any given velocity field.

We have also seen that the velocity field of plane circular vortexes is non-rotational (i.e., $\nabla \times \vec{v} = 0$), which implies that the circulation of the velocity vector around any closed line in the field's plane is nil, provided that the vortex centre is not included in the closed line considered. Nevertheless, if – because of any reason – a spinning motion pops out in a portion of the fluid inside the field, the same portion of fluid undergoes a centripetal attraction or centrifugal force, according to the algebraic sign of the circulation or rotor vector. In simple terms, the force is repulsive (i.e., centrifugal) if the rotation velocity of the spinning portion of fluid has the same direction of the rotation velocity of the vortex field around it. Instead, the force is attractive (i.e., centripetal) if the rotation velocity of the

In addition to *Lyra* galaxy, the X-ray picture of *Crab Nebula* shows the structure of a large ring-vortex as it may appear immediately before the formation or after the "explosion" of a cosmic body. Extra galactic observations have revealed that large *doughnut-shaped* clouds of gas surround the "super-massive core (*black hole or what?*)" of galaxies.

spinning portion of fluid has direction opposite to the rotation velocity of the surrounding vortex field.

An apparently opposite situation, which instead explains the former, concerns *linear velocities*.

Linear streams of fluid with parallel velocity attract each other, whereas linear streams with anti-parallel velocity vectors repel each other and favour the formation of vortexes along the stream contact lines or surfaces or layers having opposite velocity directions, according to an effect that may give origin to "photons", as per preceding Paragraph 3.6. These vortexes (*contact vortexes*) have all the same spinning velocity⁶⁸. Refer to **Figure 6** below. The formation of vortex void-cores is an additional cause of the mutual distancing effect between the two different parallel streams.

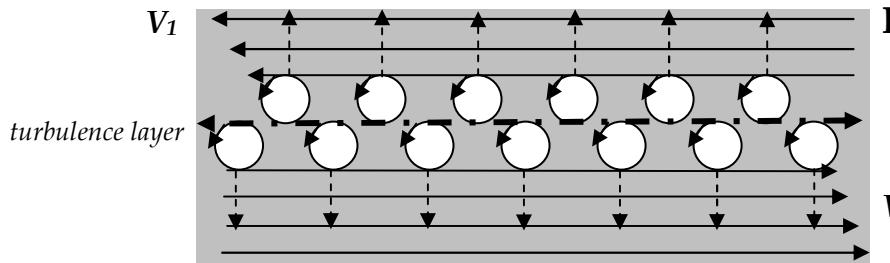


Figure 6

These *contact vortexes* last as long as the anti-parallel flows last. If it is an anti-parallel flux of plenum, the swarm of contact vortexes consists in massive stable photon-like particles associated with standing plane waves.

Together with the formation of contact vortexes, the overall velocity field changes its velocity distribution according to the opposite velocity intensity. The velocity increases with the distance from the contact zone (where the intensity levels are reduced by the friction between the opposite flows) up to regaining the respective original intensity levels.

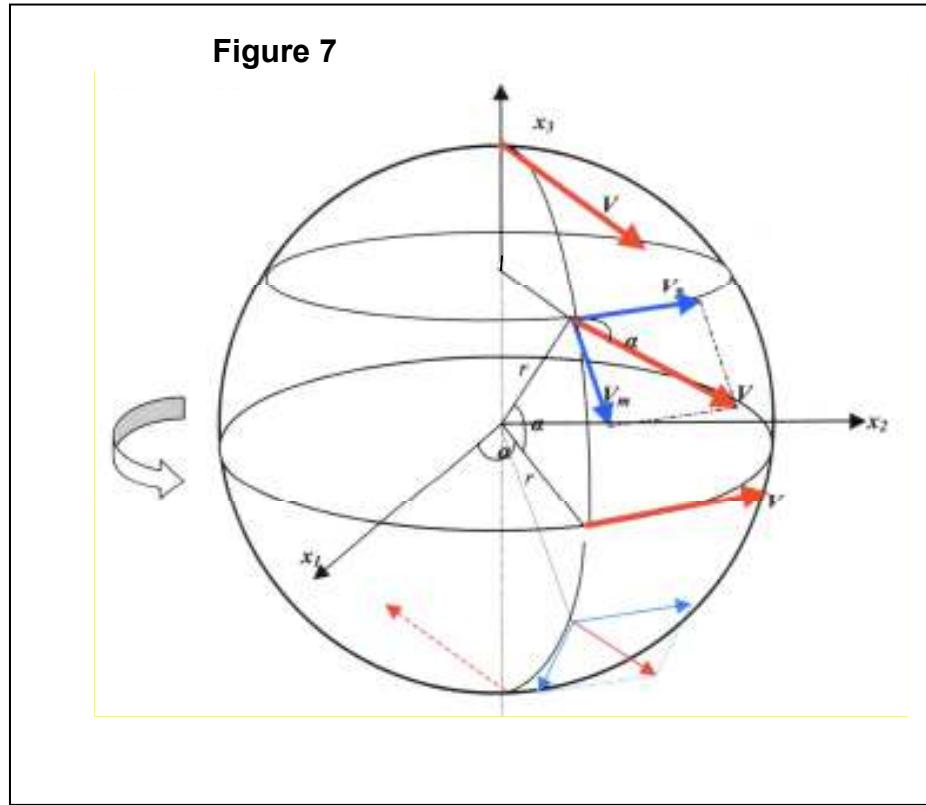
If the anti-parallel velocity vectors have different modules, the slower flux regains its original speed later with respect to the speedier anti-parallel flux.

The preceding notes aim at facilitating the introduction to the analysis that follows concerning spherical gravitational vortexes.

The particular spherical vortex that I intend to analyse is the spherical velocity field generated by a ring-vortex immersed in a uniform parallel fluid stream, as per the sketch of **Figure 5**, in which the velocity of the linear stream is parallel to the axis of the ring-vortex.

⁶⁸ These *contact vortexes* generate also swarms (a sort of *turbulence*) of minor *sub-vortexes* whose spinning motion is partly coincident-with and partly opposite to the spinning direction of the contact vortexes, because of a "compensation principle" inherent in the fluid kinematics. See also *Footnote 70* ahead.

It is worth pointing out that the combination of a parallel uniform stream with a ring-vortex may originate different spherical or quasi-spherical fields of velocities, according to the characteristics of both the ring-vortex and the parallel stream in which this is immersed. Particular kinds of velocity fields are generated when the velocity of the linear stream is not parallel to the axis of the ring-vortex. For simplification purposes, I will consider the spherical vortex as represented by **Figure 7**, which describes a simplified version of the general distribution of velocities in a spherical vortex.



In this figure, the velocity vector \vec{v} that characterises the field is in red colour. It has constant module but different direction, according to the application point on each of the concentric spherical surfaces of the vortex field. In the figure, a few application points are shown for vector \vec{v} : at the proximity of the two poles of the sphere whose radius is r , at any two points of a "meridian" between the poles and the sphere's "equator", and at any one point of the "equator".

The components of vector \vec{v} along the tangents to any "parallel" and any "meridian" of the sphere are, respectively:

$$[26a] \quad \vec{v}_p = \vec{v} \cos\alpha$$

$$[26b] \quad \vec{v}_m = \vec{v} \sin\alpha$$

α being the "latitude" on the sphere.

Module v of vector \vec{v} remains constant as it depends only on its distance r from the centre of the spherical vortex. Module v is given by

$$[27] \quad v = \frac{nV_c}{(n+R)} = \frac{nV_c}{r}$$

where constants V_c and n are the plenum's speed at the surface of the vortex core and the core's radius, respectively, so that

$$[28] \quad (r = n+R) \geq n .$$

In this particular spherical vortex, for the sake of simplicity, I assume that the application point of \vec{v} - for any given r - is identified by simultaneously identical values of the latitude and longitude, both expressed by angle α .⁶⁹

Under the conditions that define this spherical vortex, every concentric fluid sphere of the field rotates around axis x_3 as if it were a solid spherical shell, at the angular speed expressed by

$$[29] \quad \omega = \frac{v}{r} = \frac{nV_c}{r^2} .$$

The trajectory of any point of the field may be seen as the route travelled by the point along a meridian - from the upper pole to the lower pole of each sphere - while the plane of the meridian rotates around axis x_3 with a constant angular speed that decreases with the square of r .

The condition of motion is stationary in every point of the spherical vortex, i.e., it does not change with time, as it is in general true of the motion condition proper to ring-vortexes.

The coordinates of any application point of \vec{v} on the sphere are expressed in function of radius r and angle α as follows:

$$[30] \quad x_1 = r \cos^2 \alpha , \quad x_2 = r \sin \alpha \cos \alpha , \quad x_3 = r \sin \alpha .$$

Meanwhile, the modules of the Cartesian components of the module v of vector \vec{v} depend on angle α as follows:

$$[31] \quad v_1 = v \sin \alpha \cos \alpha (\sin \alpha - 1); \quad v_2 = v (\sin^3 \alpha + \cos^2 \alpha); \quad v_3 = -v \sin \alpha \cos \alpha .$$

⁶⁹ In general - at any instant and for any given distance r - the position of any point in motion in spherical vortex fields is identified by angular coordinates that differ from each other. Constant angular values or simple phase differences between the angular co-ordinates would significantly change Formulas [30] to [36] shown in the pages that follow.

As previously seen, a significant aspect of any velocity field is the variation in the *rotor* (*i.e.*, the $\nabla \times$) of the velocity vector.

As shown in the next page, in the spherical vortex considered the *rotor* of \vec{v} is almost everywhere different from zero, and its value is infinite at the sphere's poles and equator, at variance with the expectation based on the property of the circular vortex described by Equation [11], with reference to Equation [2] in Paragraph 2.3. Apparently, the velocity distribution on the equator plane of the spherical vortex is that described by Equation [2]. Instead, the situation of the fluid point that moves along the sphere's meridian is actually different, as described by Equations [26] and [27]. The modules ρ_1 , ρ_2 , ρ_3 , of the Cartesian components of $\nabla \times \vec{v}$ are:

$$\begin{aligned} [32] \quad \rho_1 &= \partial v_3 / \partial x_2 - \partial v_2 / \partial x_3 \\ \rho_2 &= \partial v_1 / \partial x_3 - \partial v_3 / \partial x_1 \\ \rho_3 &= \partial v_2 / \partial x_1 - \partial v_1 / \partial x_2, \end{aligned}$$

from which, after the relevant calculations,

$$\begin{aligned} 1. \quad \partial v_1 / \partial x_2 &= (2v/r)(\sin\alpha \cos^2\alpha) \\ 2. \quad \partial v_1 / \partial x_3 &= (v/r)[(2\sin\alpha - 1) \cos\alpha - (1 - \sin\alpha) \sin^2\alpha] \\ 3. \quad \partial v_2 / \partial x_1 &= (v/2r)(1 - 3\sin\alpha) \\ [33] \quad 4. \quad \partial v_2 / \partial x_3 &= (v/r)(2\sin^2\alpha - \tan\alpha) \\ 5. \quad \partial v_3 / \partial x_1 &= -(v/2r)[(\cos^2\alpha / \sin\alpha) - (\sin\alpha)] \\ 6. \quad \partial v_3 / \partial x_2 &= -v/r. \end{aligned}$$

For example, when angle $\alpha = 0$, $\alpha = \pi/4$, $\alpha = \pi/2$, the modules of the components of $\nabla \times \vec{v}$ are, respectively:

$$\begin{aligned} [34] \quad \rho_1(0) &= -v/r; \quad \rho_1(\pi/4) = -v/r; \quad \rho_1(\pi/2) = \infty; \\ \rho_2(0) &= \infty; \quad \rho_2(\pi/4) = 0.146447 v/r; \quad \rho_2(\pi/2) = -v/2r; \\ \rho_3(0) &= v/2r; \quad \rho_3(\pi/4) = -1.267767 v/r; \quad \rho_3(\pi/2) = -v/r. \end{aligned}$$

Therefore, the respective values of the rotors ($\nabla \times \vec{v}$) in the field are:

$$[35] \quad \vec{\rho}(0) = |\infty\rangle; \quad \vec{\rho}(\pi/4) = 1.62132 |v/r\rangle; \quad \vec{\rho}(\pi/2) = |\infty\rangle,$$

after considering that the *rotor* of the velocity in the vortex is in general expressed by

$$[34a] \quad \vec{\rho}_{(\alpha)} = \left| \sqrt{\sum_{i=1}^3 \rho_i^2(\alpha)} \right\rangle,$$

Then, the spinning intensity of the fluid at the poles and equator of the spherical vortex is infinite. As to $\alpha = \pi/4$ in particular, bearing in mind also equation [29] and remembering the property of *rotor* as recalled by

Formula [14] above, the module of the angular velocity of the fluid that spins around any point of the sphere is given by:

$$[36] \quad |\omega_{\pi/4}| = \left| \frac{1}{2} \nabla \times \vec{v}_{\pi/4} \right| = 1.62132 \frac{v}{2r} = 0.81066 \frac{nV_c}{r^2} .$$

To note: the modules of rotor [34a] are identical in the two (upper and lower) hemispheres of the gravitational vortex for any equal *absolute value* of α , whereas the corresponding vector orientations are opposite to each other.

The fact that $\nabla \times \vec{v} \neq 0$ in all the points of the vortex is a first indication of discontinuities in the fluid spherical surfaces.

There is to interpret $\rho = \infty$. The meaning of "infinity", which in this case depends on the assumptions for α , is that the nucleus of the spinning fluid has radius equal to zero.

In cases like that, the only way to overcome the difficulty is through the assumption made in Paragraph 3.1, according to which an infinite intensity of the rotational motion implies the intrusion of a *void* nucleus whose radius is greater than zero.

Therefore, for $\alpha = 0$ and $\alpha = \pm \pi/2$, we may re-write

$$[35a] \quad \rho(0) = \xi \quad \text{and} \quad \rho(\pm \pi/2) = \xi ,$$

respectively, ξ being an absolute maximum value for the module of the rotor of the plenum's velocity.

5.5 – Gravitational vortexes and matter

The indication given by [35] suggests that the hypothesis made in Paragraph 3.1 is acceptable, as also applied to describe the formation of "photons". The formation of a net of discontinuity points on the surfaces of gravitational spherical vortexes can be verified by an analysis of the plenum continuity carried out on these vortexes by means of the Jacobian determinant applied to motion Equations [31]. Allowing for the reference coordinates used in **Figure 7**, the relevant Jacobian is defined by

$$[37] \quad J(x_i, \alpha) = \begin{vmatrix} \partial v_1 / \partial x_1 & \partial v_1 / \partial x_2 & \partial v_1 / \partial x_3 \\ \partial v_2 / \partial x_1 & \partial v_2 / \partial x_2 & \partial v_2 / \partial x_3 \\ \partial v_3 / \partial x_1 & \partial v_3 / \partial x_2 & \partial v_3 / \partial x_3 \end{vmatrix} .$$

If the Jacobian associated with the motion of the points of any system is greater than zero in every point of the system, the system is perfectly continuous. As to the spherical vortex of **Figure 7**, determinant $J(x_i, \alpha)$, for any $-\pi/2 \leq \alpha \leq \pi/2$, shows positive and negative infinite values, along

with undetermined values in the form $\pm(0\cdot\infty)$. It is an indication that there is an indefinite number of points in the fluid vortex where the Jacobian is either nil or negative. This is consistent with Equations [34] and [35], which show that *the velocity field of the spherical vortex is rotational in almost every point of the field*, and leads to the conclusion that spherical vortexes, as defined by motion Equations [31], are pervasively punctuated with discontinuities and – therefore – with the intrusion of nuclei of void. This kind of *velocity field* has no vector potential.

A subsequent immediate conclusion is that spherical vortexes of plenum have in themselves the property of stimulating the creation of matter, to the extent to which matter is by hypothesis associated with the formation of nuclei of void.

In turn, each nucleus of vacuum is the core of a more or less complicated field of velocity. The circulation of the gravitational vortex field around such nuclei may either be neutralised by local “nuclear” fields or determine centripetal or centrifugal forces with respect to the centre of the gravitational vortex. Particles of matter may be attracted towards the vortex centre or repelled away from the vortex centre, according to the direction of the Magnus-effect strength acting on them.

The matter particles attracted by the vortex gravity field agglomerate and form concentric layers of matter under different pressure conditions, according to the gradient of the gravity force that pertains to the position of each layer in the vortex field.

Different levels of gravity pressure, and especially high or extremely high pressure and relevant temperature, determine different interaction opportunities between elementary particles, with the subsequent formation of various material elements and matter compounds. To the extent to which local levels of temperature permit, the formation of material elements and compounds does normally *neutralise* the sub-atomic and infra-atomic forces between elementary particles and between atoms in a structured dynamic equilibrium, so as to make the body of the resulting matter a whole subject only to the prevailing contextual gravity force, and to those forces which arise from gravitational motions and from possible external actions.

I deem it important to remark that vortex gravitational fields entail both attractive and repulsive forces⁷⁰. Therefore, it should be concluded that the

⁷⁰ According to fluid-dynamics, the formation of any vortex whose *vorticity* is $\vec{\Omega}$ implies necessarily the formation of one or more other vortices whose overall vorticity is $-\vec{\Omega}$. The formation of nuclei of matter within a large vortex of plenum may be viewed as the formation of a myriad of smaller or much smaller vortex fields, whose overall vorticity counterbalances the vorticity $\vec{\Omega}$ of the larger vortex in which the matter is included. Material nuclei themselves might be

matter of which cosmic bodies consist is the matter that has been *generated and attracted* by the respective gravity fields. There is for sure a great amount of matter that has been expelled or kept away from each vortex gravity field. The velocity of solar wind particles, for example, is not necessarily due to the expulsion speed caused by solar explosions; and much more important is to consider that the gravitation of stars around galactic nuclei, of planets around stars or satellites around planets may prevailingly be due to a dynamical equilibrium state achieved by mutually repulsive gravity vortices, those that have formed stars, planets and satellites, respectively⁷¹.

It should be borne in mind that gravitational vortices are masses, because mass is here by definition any velocity field of the plenum around one or more nuclei of void. In this connection, there is the possibility of accounting for positive and negative masses with respect to the vortex gravity fields. If the vortex field is - for instance - a positive mass, the matter attracted by the field consists of negative masses, and - vice-versa - the matter repulsed would consist of positive mass.

5.6 – Gravity law

In the light of the preceding notes, we can now draft a *gravity law* in a close analogy with the “brief attraction” acting on the “photons” described in preceding Paragraph 3.5.

Let's consider any material body whose elementary components, for simplification purposes, are supposed to be in an overall dynamic equilibrium, so as to involve no “significant” transformation for the body. (“Significant transformation” means accounting for not negligible velocity fields of plenum associated with each constituent particle, whereas, for the purposes of this analysis, we assume that the absolute speed of each constituent particle with respect to the plenum is on an average nil or negligible).

Let us now imagine the body as completely encapsulated in a small sphere whose radius is δ , and whose centre B is at any distance r from the centre of the gravitational vortex (refer to **Figure 8**).

The vortex field circulation around any circle line of the small sphere around the body can be calculated by use of Stoke's theorem concerning circulation, by which one can write

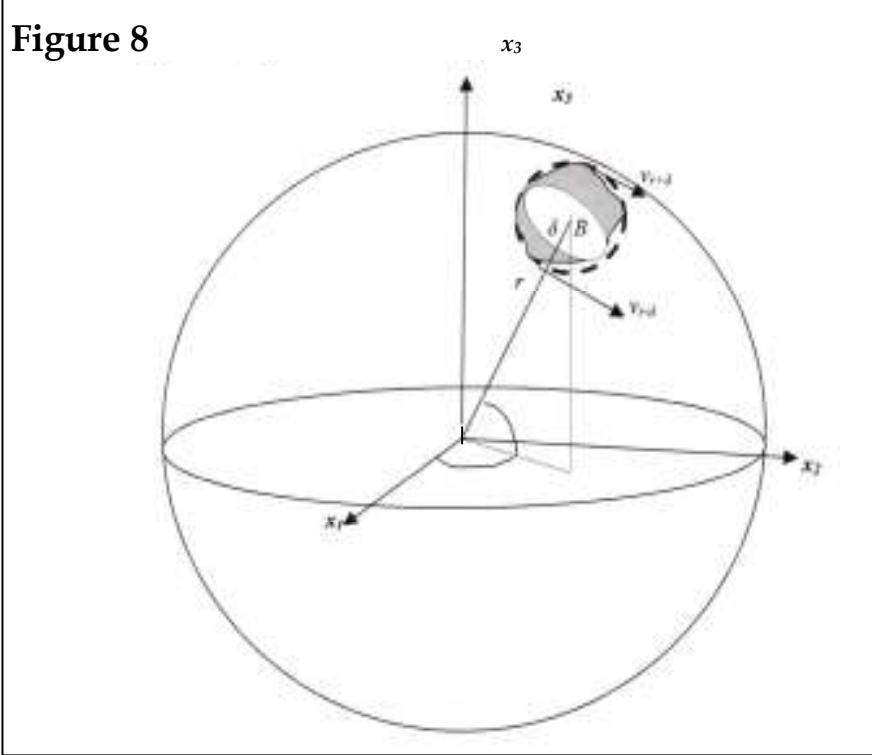
viewed as a variety of systems/combinations of micro-vortices of opposite signs, all together adding up to $-\vec{\Omega}$.

⁷¹ In this connection, one might also remark that the Moon is receding about 3.8 centimetres a year from the Earth, and that the Earth recedes 15 centimetres a year from the Sun. It would be interesting to know about other orbital recessions.

[38] $\vec{\Gamma} = \int_S \nabla \times \vec{v} \times \vec{i} dS ,$

where \vec{v} is the velocity vector of the gravitational vortex stream (the vector's module is expressed by Equation [27]), $S = 4\pi\delta^2$ is the area of the small sphere around the body, and \vec{i} is the unit direction vector orthogonal to S .⁷²

Note: Equation [38] is valid for every elemental component of the body. Actually, every particle of matter is not only *something immersed* in the plenum, for it is basically in itself a *local state* of the plenum gravity field.



Remembering Equations [32] and [33], which define the components of $\nabla \times \vec{v}$, we can write:

[39] $\rho_{i(\alpha)} = f_{i(\alpha)} \frac{v}{r} , \quad (i = 1,2,3)$

$f_{i(\alpha)}$ being the trigonometric functions associated with the modules ρ_i of the rotor components, and v is the module of the vortex stream velocity in B as per Equation [27]. Therefore, Relation [38] becomes

⁷² George Gabriel Stokes (1819-1903), British mathematician and physicist. The theorem transforms the vector circulation along any line l into the integral of the rotor vector orthogonal to any surface S that includes l , multiplied by S . (In this case, $\vec{\Gamma} = \int_{2\pi\delta} \vec{v} dl = \int_S \nabla \times \vec{v} \times \vec{i} dS$).

$$[40] \quad \vec{\Gamma} = \int_S \nabla \times \vec{v} \times \vec{t} dS = 4\pi \left| \delta^2 g_{(\alpha)} \frac{v}{r} \right\rangle,$$

in which

$$[40_1] \quad g_{(\alpha)} = \sqrt{\sum_{i=1}^3 f_{i(\alpha)}^2}$$

In this connection, it is important to remember the conditions fixed by Relations [35a], in order to consider only finite values for $g_{(\alpha)}$.

Let's denote with μ the **density of the void** within the body, as we take this density as the *basic mass density* of the matter involved.

Magnus effect acts on every "slice" of the body formed by a circular section of the small wrapping sphere having thickness $d\delta$ (see *Footnote 34* concerning Kutta-Joukowski equation). It results in the element of "gravity" force expressed by

$$[41] \quad dF = \mu \Gamma v dr = 4 g_{(\alpha)} \pi \mu n^2 V_c^2 \delta^2 \frac{dr}{r^3},$$

after remembering Equation [27] for field velocity \vec{v} .

For simplification purposes, we may assume that the gravity action on the body coincides with the action on its small wrapping sphere. After denoting with m the basic "void mass" of the body, and considering that by definition is $\mu = 3m/4\pi\delta^3$, the total gravity force applied to the body is:

$$[42] \quad F = \int_{r-\delta}^{r+\delta} dF = -\frac{3}{2\delta} g_{(\alpha)} m n^2 V_c^2 \left[\frac{1}{r^2} \right]_{r-\delta}^{r+\delta} = 6H^2 m g_{(\alpha)} \frac{r}{(r^2 - \delta^2)^2},$$

in which $H^2 = n^2 V_c^2$ is a constant quantity that pertains to the gravity vortex considered.

This force – as per Kutta-Joukowski theorem – is orthogonal to velocity v of the plenum and centripetal along the direction of r ,⁷³ provided that the state of the initial motion of the body (*i.e.*, its own initial velocity) doesn't alter the sign of circulation Γ in the surrounding velocity field. Otherwise, the force may become centrifugal because of the body's own velocity, or if the "body" – for example – is a smaller gravity vortex whose plenum rotates like that of the major vortex in which the former is included.

⁷³ That is, in general, according to the sign of the relevant vector circulation, as illustrated in Paragraph 5.7.1 ahead.

It must be remarked that this gravity force, set apart the constant values of H and mass m , depends not only on r , but also on the value of $g_{(\alpha)}$, which varies with the position of the body in the vortex velocity field: $g_{(\alpha)}$ increases remarkably when the body approaches the equator plane of the vortex field, and vice-versa when the body's distance from the equator plane increases.

In principle, it should be remarked that the size or the orientation of any object seized by a gravitational vortex does also matter⁷⁴. However, in almost all cases, when the gravity force is undergone by an object *that is not a smaller gravity vortex*, quantity δ is negligible in a comparison with r . Which makes Equation [42] become

$$[43] \quad F = \frac{6H^2 g_{(\alpha)}}{r^3} m.$$

5.7 - Gravitation

The force defined by Equation [43] is a *central force*, according to the classification of mechanics.⁷⁵ Therefore, and irrespective of its *sign*, this force compels the body to move according to a geometrical path contained in a plane passing through its mass centre and the centre of the vortex. The intensity of the force is inversely proportional to the cube distance from the centre of the vortex, while the force remains a central force in any case, with all relevant mechanical implications, also when it varies in relation to variable $g_{(\alpha)}$.

A preliminary analytical investigation may be carried out assuming that the motion of the body keeps constantly close to the equator plane of the vortex, so as to make the variation of $g_{(\alpha)}$ nil or negligible in a first approximation. By this preliminary assumption, it is possible to write a simple motion equation for the body immersed in the vortex. Let's assume that the polar reference coordinates of this motion have their origin in the vortex centre and lie on the motion plane, and that ψ is the angle between r and abscissa x .

Let's remark that [43] is the module of force \vec{F} determined by acceleration

⁷⁴ Besides relevant aspects of the *Podkletnov Effect* addressed in Paragraph 7.2.1 ahead, it is perhaps worth mentioning also other experiments concerning the body's orientation with respect to the gravity field: See, for example, M. L. Gershteyn & Al., *Experimental evidence that the gravitational constant varies with orientation*, Infinite Energy, 10:55, 2004, pp. 26-28.

⁷⁵ The body in motion is subject to a "central force" if the direction of the force (irrespective of its orientation) is constantly passing through the body's mass centre and the centre of the motion.

$$[44] \quad \vec{h} = -6 \left\langle \frac{H^2}{r^3} g_{(\alpha)} \right\rangle = - \left\langle \frac{d^2 r}{dt^2} - r \left(\frac{d\psi}{dt} \right)^2 \right\rangle ,$$

which acts only along the direction \vec{r} of radius r , so that the body is not subject to any transverse acceleration.

It's worth noting that a **gravitational potential** expressed by

$$[44.a] \quad Q = \int h dr = 3 \frac{H^2}{r^2} g_{(\alpha)},$$

whose physical dimension is [L² T⁻²], can also be associated with the vector field of accelerations \vec{h} . Consider that H is a constant characteristic of each gravitational vortex: It is the product of parameter n , which represents the vortex size (*i.e.*, the radius of the vortex core), and quantity V_c , which represents the origin and maximum speed of the plenum in the vortex.

It is now possible to write the following equation:

$$[45] \quad 6 \frac{H^2}{r^3} m g_{(\alpha)} = m \left[\frac{d^2 r}{dt^2} - r \left(\frac{d\psi}{dt} \right)^2 \right].$$

It is convenient to re-write this equation using Binet's formula for central acceleration, by which [45] is transformed into

$$[46] \quad \gamma^2 \left(\frac{1}{r} \right)^2 \left[\left(\frac{1}{r} \right) + \left(\frac{1}{r} \right) \frac{d^2}{d\psi^2} \left(\frac{1}{r} \right) \right] = 6 g_{(\alpha)} H^2 \left(\frac{1}{r} \right)^3.$$

Constant quantity $\gamma = 2 r^2 \left(\frac{d\psi}{dt} \right)$ represents the *double* of the *area speed*, which is a *constant* relative to any *central motion*. Thus, Equation [45] becomes the following linear homogeneous differential equation of the second order with respect to variable (1/r):

$$[47] \quad \frac{d^2}{d\psi^2} \left(\frac{1}{r} \right) + [1 - 6H^2 g_{(\alpha)} / \gamma^2] \left(\frac{1}{r} \right) = 0.$$

The general solution of this equation with respect to r is expressed by

$$[48] \quad r = \frac{1}{B_1 \exp(i\psi\sqrt{\lambda}) + B_2 \exp(-i\psi\sqrt{\lambda})},$$

in which $\lambda = [1 - 6H^2 g_{(\alpha)} / \gamma^2]$.

B_1 and B_2 are two integration constants that depend on the initial conditions relevant to the position and motion of the body, and $i = \sqrt{-1}$.

This solution represents the trajectory of the body under the gravity effect only, starting from given initial conditions.

To remark soon: Gravitational orbits described by Equations [46] to [48], as well as subsequent gravitational Equations [54] to [56], take masses into no account: Gravitation is described as a mere kinematic effect. The acceleration undergone by the body immersed in the vortex field of velocities depends only on the field, not at all on the body's mass. In the same vortex, all masses undergo the same acceleration expressed by Equation [44].

The force defined by Equations [42] and [43] is the force that is necessary to stop the body's own gravitational trajectory, which corresponds to the body's *gravitational inertia*, viewed as Newtonian *vis insita*. Therefore, *inertia* is not a constant property inherent in matter, for it depends on the state of motion of matter with respect to the plenum.

It is necessary to consider that λ in Equation [48] may be either a positive or negative number.

If $\lambda = 0$, the orbit is a circle line, whose radius is $r_o = 1/(B_1 + B_2)$.

If $\lambda > 0$, the solution to [47] is expressed by

$$[49] \quad r = 1 / [C_1 \cos(\psi \lambda^{0.5} - C_2)],$$

in which C_1 and C_2 are integration constants that depend on the initial conditions considered. In general, this solution represents parabolas focused on the vortex centre.

If $\lambda < 0$, solution [48] represents a spiral whose geometrical line tends to approach its central point asymptotically. Actually, the spiral stops-at or starts-from the surface of the vortex core. The approaching or receding pace of the spiral orbit to or from the motion centre varies with distance r and depends on the values of constants B_1 and B_2 . If B_2 is much smaller than B_1 , the spiral might initially expand up to a certain point and then contract indefinitely. Instead, if B_2 is nil the spiral orbit tends to expand to infinity.

All these orbits neglect the variation of coefficient $g_{(\alpha)}$, because of the simplifying assumption that the orbits lie on planes almost coincident with the vortex equator plane, where the value of $g_{(\alpha)}$ is constant; instead, the effects of variable $g_{(\alpha)}$ cannot be neglected in all other cases.

5.7.1 - Reviewing a principle of dynamics that affects gravitation

As already remarked, Equations [46] and [47] regard only bodies that are not in condition to determine significant changes in the gravity field around them. This is an important point to account for, because the bodies

may also be under dynamic effects different from gravity. In such a case, the motion of the bodies with respect to the vortex plenum doesn't obey Equations [46] and [47] only.

In general, it must be expected that any motion with respect to the plenum determines or alters the fluid-dynamic circulation around the moving body, and motion may not be the effect of a single cause. Concerning the motion of common objects of common experience, I wish to propose an example that may help understand the meaning of the preceding remarks: It's the combination of centripetal and centrifugal forces in determining the trajectory of a stone in a sling.

Against any different expectation, the topic is of a major importance, because it involves the concept of *absolute motion* opposed to the *relativistic principle* that the motion of whatever system of bodies can be detected *only* as *relative* to another system arbitrarily adopted as a reference. There are still scientists, for instance, that deny the existence of centrifugal forces for – in their view – the constrained revolution of any mass about the relevant centre of motion is a mere optical illusion due to the adoption of a local particular reference frame; which could instead be viewed as the condition of a *steady mass* that is seen from the reference system of the fixed stars that rotates together with the “*steady*” mass observed. Although the common sense could deem it bizarre, it is actually the philosophical stance at the basis of General Relativity, which posits that the force one commonly dubs “centrifugal” can instead be “correctly” interpreted as the attraction gravitational force exerted by the whole universe mass that rotates with the observed one. It is the consequence of denying any possible *absolute motion*, all motions being *relative* descriptions only.⁷⁶

⁷⁶ It is worth meditating on the following quotation: “The peculiarity of rotations led Newton to conclude that absolute motions exist. From the *purely kinematical* point of view, however, the rotation of the earth is not to be distinguished in any way from a translation; in this case, too, we *observe* only the *relative* motions of the bodies, and might as well imagine that all bodies in the universe revolve around the earth. Ernst Mach has in fact affirmed that both effects are equivalent not only kinematically, but also *dynamically*: it must, however, then be assumed that the *centrifugal forces*, which are observed *at the surface of the earth*, would also arise, equal in quantity and similar in their manifestations, from the *gravitational effect* of all bodies in their entirety, if these revolved around the supposedly *fixed earth*”(sic!), from E. Freundlich, *The Foundations of Einstein's Theory of Gravitation*, Cambridge Univ. Press, 1920, p. 24, *op. cit.*

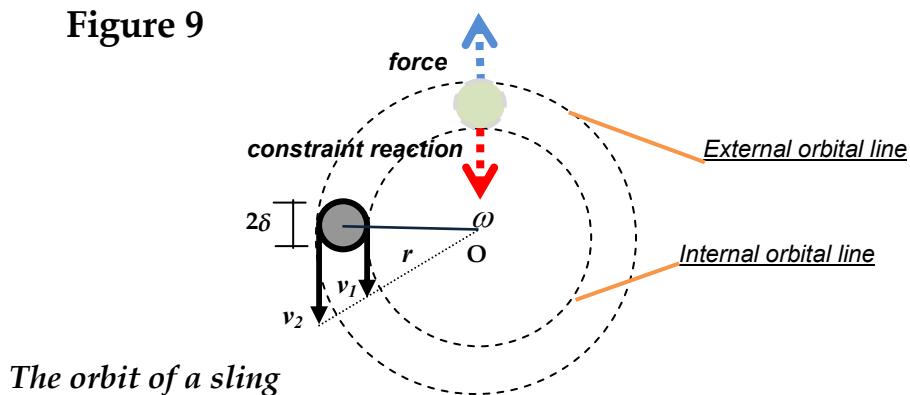
(Set apart millions of vehicles at any instant turning their motion all over the world as well as other innumerable rotating things) if one thinks of a few boys who, spread in various regions of the Earth, whirl slings at the same Greenwich time, how shall the overall cosmic system adjust its rotations around their swirling stones in order to explain so many “apparent” and different centrifugal forces?

It seems to me that Relativity is actually based on a contradiction that mars the consistency of the theory: On the one hand, the theory postulates the impossibility of detecting *absolute* motion; on the other hand, it postulates that the speed of light is intrinsically independent of any motion of its source with respect to any reference frame. But this does clearly establish the principle that any motion can take the path and the space crossed by light as an *absolute* reference: *Doppler effects* detected with respect to any source of light are evident indications of absolute motion *with respect to the path of the light's propagation*. By the way, there is no means other than Doppler-effect to ascertain the *absolute reality* of relative motions between different material systems. In other terms, it seems impossible to avoid admitting that the physical space, through which light propagates, is *actually* an *absolute* reference frame.

*What I intend to explain now, by the example that follows, is that the "physical space", i. e., the fluid plenum, is detected right through the rise of centrifugal forces, which are local special effects of the **absolute** motion of bodies with respect to the plenum.*

Refer to Figures 9 and 10 that follow.

Figure 9



The orbit of a sling

Consider a disk-shaped stone that whirls held by a sling around the wrist of a boy. The orbiting of the sling creates a circulation of the plenum around the stone, because this rotates like a rigid body, and the orbital speed is different at the internal and external orbital lines.

Let's denote with 2δ the diameter of the stone disk, whose thickness is b , and r is the distance between the centre of the stone-disk and the centre O of the sling's rotation.

The relative speed v of the plenum with respect to the disk is directly proportional to the distance of each point of the disk from rotation centre O , i.e., $v = 2\pi r/T = \omega r$, in which $\omega = 2\pi/T$ is the angular speed of the stone with respect to centre O .

In addition to the permanent effect of the Earth's gravity field, the rotating sling determines a circulation $\vec{\Gamma}$ of the plenum around the stone, which is expressed by:

$$[50] \quad \vec{\Gamma} = \oint_{2\pi\delta} \vec{v} \times ds = 2\pi\delta^2 \vec{\omega}. \text{ }^{77}$$

Therefore, according to Kutta-Joukowski theorem, the stone-disk is also under the effect of a fluid-dynamic force whose application line and sign coincide with those of the rotation radius r . The sign of the fluid circulation is also coincident with the sign of angular velocity $\vec{\omega}$, so that the sling and the circulation of the plenum around the stone disk determine a combination of central forces.

If μ is the density of the "basic mass" m of the stone, the *Magnus-effect* strength acting on the disk of thickness b is given by

$$[51] \quad F = \mu \sigma v b = 2\mu \omega \pi v \delta^2 b = \frac{2mv^2}{r},$$

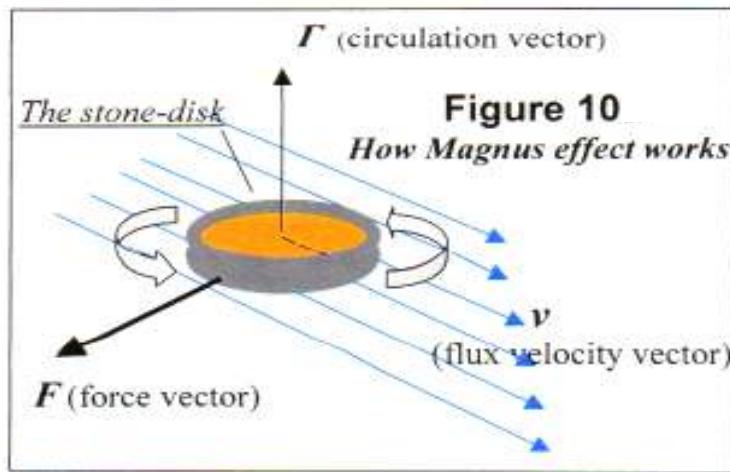
considering $\mu = m/\pi\delta^2 b$, and $\omega = v/r$.

The strength of this force is $F = f + g$, in which f and g denote here the strengths of the centrifugal and centripetal force, respectively ⁷⁸. As long

⁷⁷ Note: In this particular velocity field, circulation vector $\vec{\Gamma}$ depends on δ only, and is everywhere independent of radius r ; ω being constant.

⁷⁸ According to kinematics, any **immaterial** point in uniform motion along a curved line is subject to a *centripetal* acceleration u only. **No centrifugal acceleration can be allowed for.** In dynamics, instead, if m is the mass of the point, the application of acceleration u to m generates a centripetal force $g = mu$ together with the simultaneous rise of a *centrifugal* acceleration w and relevant force $f = mw$, which is equivalent and opposite to "constraint" g . It's worth noting that f , or else g , is not the inertial resistance of m to changing its motion, for it is a couple of real **additional** forces applied to m . So far, there is no convincing explanation for this, since Newton's third law is inadequate for the purpose. *Centrifugal force* is inherent in *non-rectilinear motion of masses* with respect to any reference system, and it seems improper to consider the effect of such forces as a *reaction* analogous to the *recoil* of rockets propelled by gas-jets. For instance, an aircraft in a linear uniform flight, which is hit by lateral wind blows, opposes only its "inertia" to the wind, so that the combination of the different forces, wind actions plus inertia reactions, results in lateral shifts: There is no *simultaneous* and *spontaneous* rise of a push which opposes the force of the lateral wind and is thus capable of keeping the aircraft on its steady course. As an appropriate dynamical similarity, instead, let's imagine the ignition of the engine at the stern of a rocket together with an identical *opposite* force generated by the simultaneous ignition of an engine at the rocket's bow.

as the stone remains in its orbital motion, there is a dynamical equilibrium made by $f = g$.



The *centrifugal force* is in this case expressed by $f = F - g = mv^2/r$. Equivalent and opposite force g is materialised by the resistance of the rope, which – as a centripetal force – constrains the stone to move in an orbit around O . The combined action of the two opposite forces, far from being nil, keeps the stone both under tensile stress *and* in the orbit.

Instead, as soon as $g < f$, the stone abandons its orbit according to a trajectory that is determined by the joint effect of the gravity acceleration and the stone's velocity at the instant at which the stone quits the sling.

In my opinion, *centrifugal force proves both the existence of the plenum and the existence of absolute motion with respect to the plenum*.

I deem it now convenient to introduce an important note that concerns the conventional definition of "force" provided by classical mechanics. As known, the classic general definition of "force" applied to a body is given by formula $F = ma$, *i.e.*, by the product of the body's mass m and its acceleration a . Newton formulated this definition⁷⁹ with respect to an inertial reference frame, or else considering the "fixed stars" as the reference frame. However, this definition is incomplete with respect to any other kind of reference frame. For example, the formula applies to the force necessary to push a luggage trolley, but it neglects that the "still"

⁷⁹ Despite different and – in my view questionable – interpretations of the original text of the "*Principia*", this is the true definitions of momentum and force given by Newton: "... the quantity of motion arises from the celerity multiplied by the quantity of matter; and the motive force arises from the accelerative motion multiplied by the same quantity of matter", (*Principia*, Book 1, Definition VIII). To note, however, that Newton did not use algebraic formulas to express these concepts. By the way, it is worth remarking that "quantity of matter" is Newton's concept of "mass".

trolley, before receiving its user's push, is already in the dynamical equilibrium that results from other physical forces *steadily* applied to the trolley, which include the gravity force in particular. In this case, the user's push $F = ma$ is only an *additional* force that joins other forces already at work. The condition of the trolley is one example of a general condition, in which any material point of our physical universe lies. All material points of our universe must be considered as permanently subjected to a complex system of actions, most of which are unknown. Actually, Newton had also to state: "*Resistance is usually ascribed to bodies at rest, and impulse to those in motion, but motion and rest, as commonly conceived, are only relatively distinguished; nor are those bodies always truly at rest, which commonly are taken to be so*".⁸⁰ I deem it is conceptually impossible to think of a body as in a *perfect rest state*, i.e., free from any influence from the rest of the universe, unless I assume the plenum as the *local reference space*.

In the light of the preceding considerations, the *general* definition of "force" should be formulated as follows:

$$[52] \quad F = ma + f_o,$$

to express the following principle: "*In the physical universe, the effect of any force f that alters the state of any material body adds with the effect of a pre-existing force f_o applied to the same body*". This principle – along with the "innate force" (*vis insita*) of the Newtonian definition of "inertia" – may also be viewed as a generalisation of D'Alembert's principle in Mechanics.

Within my own conceptual paradigm, f_o is the *inertia* of any material body to the extent to which f_o represents the *force* that must be applied to the body for taking it from its present state to its *fluid-dynamic equilibrium state with respect to the plenum*; which happens when the circulation of the plenum's velocity vector around the body is nil.

In this context, *inertia* is not a "property inherent in matter" but a *vector quantity* that depends on the *dynamical state* of a body, in that inertia is the measure of the *induced* variation in the present momentum of the body, according to the direction opposite to the variation direction.

Equation [52] may also be written as $\Delta F = m\Delta a$. Passing from finite to infinitesimal increments, its equivalent form is given by

[52a]

$$m = \frac{dF}{da} .$$

⁸⁰ "*Principia*", Book 1, Definition III. It is a sharp remark made by Newton, which however conflicts with the concept of "linear uniform motion".

Allowing for this definition, we may now generalise Equation [45] by the introduction of a “constraint term” f_o , which may be either constant or variable, according to the study subject. So as to write:

$$[53] \quad 6 \frac{H^2}{r^3} m g_{(\alpha)} + f_o = m \left[\frac{d^2 r}{dt^2} - r \left(\frac{d\psi}{dt} \right)^2 \right].$$

In this equation, and in every non linear motion in general, constraint term f_o includes a central acceleration component.

In particular cases, the acceleration involved by f_o may have the central component only. It is the case, for instance, of an artificial satellite that uses a centrifugal force to counterbalance the centripetal force of Earth gravity. Another possible example is the constraint exerted by the strength of a gravitational vortex immersed in a larger one. (A more accurate analysis of the plenum’s circulation around any minor vortex included in a larger one will be tried in a subsequent section of this essay).

The problem is here simplified considering that any minor vortex that is included in a larger one can either strengthen or oppose the effect of the velocity’s circulation due to the latter. The simplification comes from noticing that the minor vortex tends to accelerate toward the centre of the major vortex if the rotation of the two vortices is discordant; instead, the minor vortex tends to recede from the centre of the major vortex if the two vortices rotate in a concordant way: Which simply means that either centripetal or centrifugal acceleration must be associated with any vortex included in a larger one. See also the caption of **Figure 11** ahead.

For the description of a few gravitational orbits, we assume now that it is possible to neglect those acceleration components of f_o that are different from central acceleration a_o . On this basis, we may re-write Equation [46] as follows:

$$[54] \quad \gamma^2 \left(\frac{1}{r} \right)^2 \left[\left(\frac{1}{r} \right) + \left(\frac{1}{r} \right) \frac{d^2}{d\psi^2} \left(\frac{1}{r} \right) \right] = 6 g(\alpha) H^2 \left(\frac{1}{r} \right)^3 + \frac{f_o}{m},$$

or in its equivalent form

$$[54a] \quad \frac{d^2}{d\psi^2} \left(\frac{1}{r} \right) + \left[1 - 6H^2 g_{(\alpha)} / \gamma^2 \right] \left(\frac{1}{r} \right) - \frac{a_o}{\gamma^2} r^2 = 0,$$

in which $a_o = f_o / m$. This differential equation makes the problem more complicated, because the equation is not linear. If we denote $u = 1/r$, Equation [55] can be written

$$[55] \quad u^2 \frac{d^2 u}{d\psi^2} + [1 - 6H^2 g_{(\alpha)} / \gamma^2] u^3 - \frac{a_0}{\gamma^2} = 0.$$

The integration of this non-linear equation seems difficult. Following a procedure in which $du/d\psi$ is replaced by $y(u)$, it is possible to obtain the pseudo-solution expressed by

$$[55a] \quad \psi = \int \left(\frac{udu}{\sqrt{\lambda u^4 + 2C_1 u^2 - 2 \frac{a_0}{\gamma^2} u}} \right),$$

where, as previously denoted, $\lambda = [1 - 6H^2 g_{(\alpha)} / \gamma^2]$, and C_1 (whose physical dimension is $[L^{-2}]$) is an intermediate integration constant. This equation expresses angle ψ in function of curvature u , which requires a difficult analytical interpretation. Two particular forms of integral [55a] are relatively simple. The first one is obtained if we may assume intermediate integration constant $C_1 = 0$ ⁸¹. In this case, it would be possible to write

$$[56] \quad u = \frac{1}{r} = \sqrt[3]{\frac{2a_0 \{\sin[-1.5\lambda^{0.5}(\psi + C_2)]\}^2}{\lambda \gamma^2}},$$

C_2 being another (dimensionless) integration constant that depends on given initial conditions. The orbits described by this equation vary with the values assigned to its constant parameters. In general, such orbits are parabolas. The equation may also describe a remarkable variety of spiral orbits among which also spirals that either expand or shrink very slowly so as to describe *quasi-circular* orbits, whose varying diameters pivot on the spiral centres.

A second integration of Equation [54a] is relatively easy if one considers the particular case in which $\lambda = 0$, i.e., when it is possible to assume $6H^2 g_{(\alpha)} / \gamma^2 = 1$.

Then, the differential equation becomes

$$[54b] \quad u^2 \frac{d^2 u}{d\psi^2} - \frac{a_0}{\gamma^2} = 0,$$

which can be solved through two changes of variable, first by replacement of $du/d\psi$ with $y(u)$, and after by replacement of $[C_1 u - (a_0/\gamma^2)]^{1/2}$ with z ;

⁸¹ It is worth considering that the case of $C_1 < 0$ seems meaningless, because of the physical dimension of C_1 .

$C_1 > 0$ still being an intermediate integration constant (whose dimension is $[L^{-2}]$) that depends on border conditions.

The solution is obtained in the form of the following inverse function:

$$[57] \quad \psi = \sqrt{\frac{2}{C_1^3}} \left\{ \sqrt{\frac{C_1^2}{r^2} - \frac{a_0 C_1}{\gamma^2 r}} + \frac{a_0}{2\gamma^2} \ln \left[\sqrt{\frac{C_1}{r}} + \sqrt{\frac{C_1}{r} + \frac{a_0}{\gamma^2}} \right] \right\} + C_2,$$

in which C_2 is another (dimensionless) integration constant.

The interpretation of this equation is not easy. However, real values for ψ are possible only if $C_1 - a_0 r / \gamma^2 \geq 0$, or $r \leq C_1 \gamma^2 / a_0$, which also implies $a_0 \geq 0$ for any $C_1 > 0$, since $\gamma^2 > 0$ always. This means that central self-acceleration a_o (if it is not nil) must here be considered as centrifugal.

If $a_o = 0$, then angle $\psi = (2/C_1)^{0.5}/r + C_2$. In such a case, as expected (see [54b]), the orbit becomes a spiral, which represents the line of fall of the attracted body.

Condition $\lambda = 0$ imposes also (remembering definition $H^2 = n^2 V_c^2$ after Formula [42], Page 90) that $\gamma^2 = 6 n^2 V_c^2 g_{(a)}$. Thus - given any $a_o > 0$ - the above constraints for r are $n \leq r \leq 6 C_1 n^2 V_c^2 g_{(a)} / a_o$; from which also the constraints for self-acceleration a_o , i. e., $0 < a_o \leq 6 C_1 n^2 V_c^2 g_{(a)} / r$.

Nothing more can here be said about the gravitational orbits relevant to the particular case ($\lambda = 0$) described by [57], except that r , due to its constrained extent, and under any given $a_o > 0$, must describe orbits that cannot expand beyond certain distances from the orbital focus; while it is to consider that the extent of r - in correspondence of any ψ - depends also on local changes in the value of $g_{(a)}$ (which, in this special case, is constantly positive).

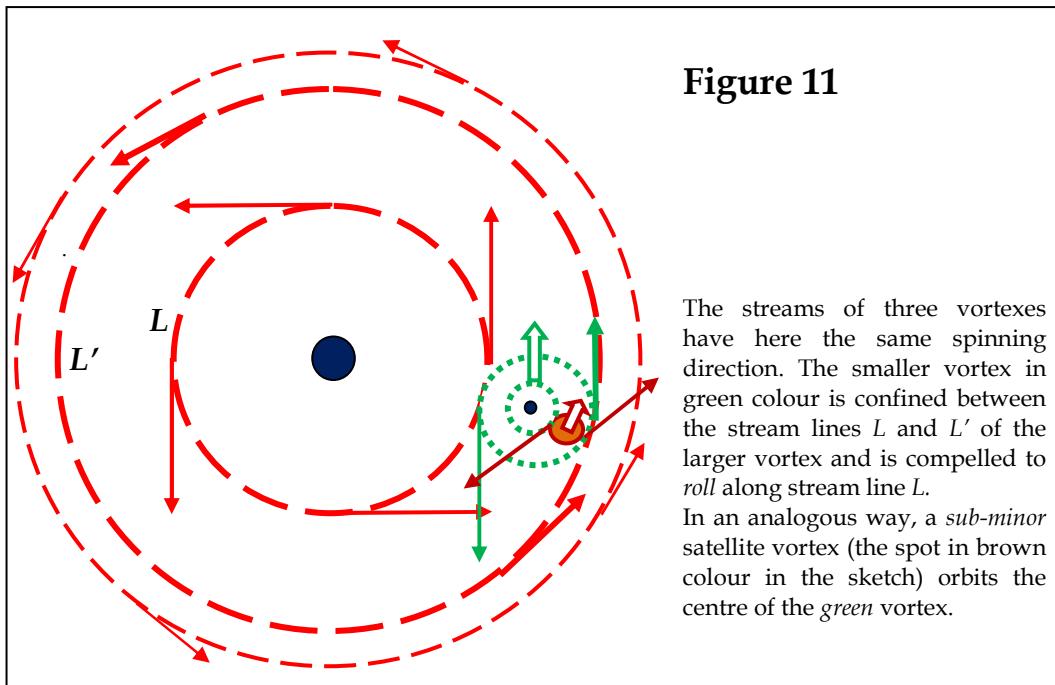
5.7.2 - Vortex against vortex

Equation [54] should not be used to describe the gravitation of a smaller vortex included in a larger one, the two vortex streams having either parallel (or anti-parallel) angular speeds. In cases of the kind, parameter δ in Equation [42] (i.e., the average radius of the minor vortex) may not - in general - be considered as negligible with respect to r , and Equation [41] shall also account for the "self-circulation" inherent in the minor vortex, which combines with the plenum's velocity distribution on the spheroid border surface (the *boundary shell*) that separates the field of the smaller vortex from the *inclusive* field of the larger one.

Figure 11 in the next page gives a schematic representation (in a draft equatorial cross-section) of a gravitational vortex that includes smaller vortices, all vortices spinning concordantly.

In that particular situation, the vortexes repel each other. However, an equilibrium orbit may be established for each of the smaller vortices,

whose stream boundaries are delimited by the fluid velocities that are compatible with those of the larger inclusive vortex. With respect to the centre of the latter, the external boundary of the smaller "green" vortex is where its stream has the same velocity as that of the larger one. The internal boundary L is where the two flux velocities have identical intensity but opposite direction. The resulting effect is as if the smaller vortex were compelled to roll like a fluid wheel along its internal boundary L , following the flux of the major vortex.

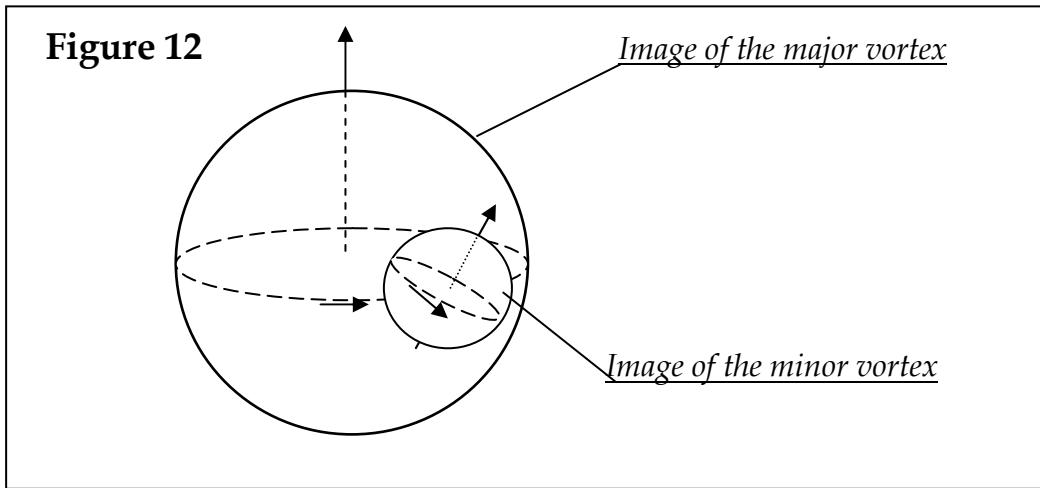


Equation [54a] in Page 99 presents a simplified description of the gravitation of any smaller *included* vortex whose activity generates a central self-acceleration a_o . At variance with the situation schematised by **Figure 11**, if the spin of the smaller vortex is opposite to that of the larger one the former tends to "fall" toward the core of the latter. In this case the sign of central self-acceleration a_o of the minor vortex is negative.

In all cases, the variability of coefficient $g_{(a)}$ must be accounted for. The effects of $g_{(a)}$ become negligible only if the gravitation orbits lie on planes on which either $g_{(a)}$ is constant or opposite values of $g_{(a)}$ find mutual compensation. (Gravitational Equations [54] and [54a] refer to polar co-ordinates whose origin is in the centre of the major vortex).

Figure 11 drafts the layout of three vortices that have equal spinning direction and whose polar axes are parallel to each other. The equator plane of each minor vortex coincides there with the equator plane of the major vortex. The situation, however, doesn't change significantly - except for the effects of $g_{(a)}$ - if the equator planes of the two vortices are remarkably different, provided that the angle between the two polar axes

is less than $\pi/2$, as shown – for example – by **Figure 12** below. What matters is the resultant circulation of the velocity field around the minor vortex, which determines an either positive or negative central acceleration in all cases.



Instead, if the angle between the two polar axes is greater than $\pi/2$ the spinning of the two vortices must be considered as having opposite sign, and the mutual gravitational action becomes “attractive”.

The analysis of the interaction that is possible between any smaller vortex *included* in a larger one is complicated by the many different situations that can be hypothesized; so as to make it difficult to formulate a general mathematical description of the occurring interaction.

A simplified form of the general gravitational equation relevant to any *included vortex* might be as follows:

$$[54a] \quad \gamma^2 \left(\frac{1}{r} \right)^2 \left[\frac{1}{r} + \frac{d^2}{d\psi^2} \left(\frac{1}{r} \right) \right] - 6H^2 g_{(\alpha)} \frac{r}{(r^2 - \delta^2)^2} - a_{o(r)} = 0,$$

in which parameter δ must be considered as the *variable* average radius of the smaller included vortex, whose central self-acceleration $a_{o(r)}$ may also vary with r .

Set mathematical difficulties apart, a few general observations seem possible.

Equation [42] suggests that the force exerted by the larger vortex on the smaller one tends to increase with the surface of the *boundary shell*, i.e., with the radius (δ) of the fluid shell that *wraps up* the *included* vortex. In the example above, there is to account for the opposing effect of the spin of the smaller vortex, as well as for the tendency of the shell’s average radius δ to expand with distance r from the centre of the larger vortex. Thus, it seems reasonable to assume that an orbital equilibrium may be achieved by the “included” vortex - while developing its motion - within a strip of the orbital plane delimited by two distances r_1 and r_2 , which are

associated with the minimum and maximum repulsion force, respectively, undergone by the smaller vortex, whose centrifugal self-acceleration a_o tends to decline as distance r increases. Therefore, it is also reasonable to assume that the centrifugal acceleration of any *included* vortex could be expressed, case by case, as a function $a_o = a_o(r)$ of distance r .

It is important to bear in mind that the velocity fields of gravitational vortexes determine local stationary states of the plenum, at variance with electromagnetic fields, which instead create more or less periodical changes in the local state of the plenum. The existence of the velocity field of any gravitational vortex is intrinsically permanent, according to the fluid-dynamic theorem proving that vortices, once formed, keep stable. In other terms, gravitation determined by vortices cannot be viewed as an effect of *transmitted* attraction or repulsion forces: It is instead a sequence of *local* effects due to particular permanent states of the plenum. (In an analogy: A rubber ball immersed in a water basin is pushed up to float not because *attracted* by the atmosphere but as an effect of a stable pressure gradient in the water).

Therefore, the state of the plenum in a gravitational vortex is a permanent kinetic deformation of the physical space, which can be detected only through the permanent acceleration to which both matter and radiation are subjected in that kind of velocity field.

5.7.3 – Size of gravitational vortexes and core circulation speed

The volume of the void core of the vortex is the source of the vortex size and strength. Basically, the vortex core is represented by the black spots shown in **Figures 4** and **5**, which indicate the cross sections of the ring void cores of the relevant gravitational vortexes. The size of the *void ring* of any vortex, and the diameter of its cross section in particular, gives an indication of *where* the plenum's rotation around it starts.⁸² Then, accounting for the "law" that makes the rotation speed decrease with the distance from the core surface, it is easy to understand that the greater the core's diameter the farther (and stronger at any fixed distance) the effects of the gravitational field established by the plenum in motion.

For the sake of simplicity, however, one may *tentatively* assume that the speed of the plenum rotation at its void core surface is the same for all possible vortexes, irrespective of the core size. Such a speed, which might (questionably) be considered as the maximum *rotation speed* of the plenum with respect to the void, could be viewed as one of the intrinsic properties of the plenum. The circulation of the plenum about its void core surface determines a sort of standing transverse wave that propagates through the

⁸² For a more accurate description of the "structure" of a gravitational vortex see the *Appendix*.

medium at constant speed c , such speed being characteristic of the medium and supposed to be as equivalent to the speed of light. If $2R$ is the diameter of the void core, the circulation speed at the core surface is expressed by $V_c = 2\pi R/T$, in which T is the period of the "core-wave". The transverse "standing" wave length is $\lambda = cT$. It is now evident (because of Equation [3]), that the fluid circulation period T_λ at distance λ from the core surface is expressed by $T_\lambda = T(\lambda/R)^2$, to conclude that the relevant fluid speed is $V_\lambda = 2\pi R^2/T^2 c$, or $V_\lambda = V_c^2/2\pi c$, from which also

$$[58] \quad V_c = (2\pi c V_\lambda)^{1/2}.$$

6 – Supremacy of Experimentation

All that I have proposed in the preceding chapters and paragraphs should be considered as *not an unreasonable* suggestion to modify the approach to the analysis of the properties of the physical space of our universe.

I am not a professional scientist and I have no skill for mastering the mathematics that might be necessary or fit for developing a complete and persuasive theory of the active plenum. Actually, I belong to the crowded community of outsiders that cultivate more or less foolish philosophical ambitions. Nevertheless, I deem that the ideas I have here expressed might to a various extent be shared by renowned professional scientists as well as by young brilliant and innovative minds devoted to scientific research.

What is in my view important concerns the supremacy of any experimental activity aimed at giving direct or indirect evidence to the existence and properties of the plenum.

In Paragraph 5.7.1 I have indicated centrifugal force as an effect of the existence and fluid-dynamic properties of the plenum.

Scientists, especially those working in theoretical physics, should never forget that modern science thrives thanks to the supremacy of experimentation. No theory should be considered as a scientific one until it is corroborated by experimental evidence.

There are now several indications that the belief professed by the XIX Century's physicists about the "ether" was justified, though roughly expressed. The behaviour of light and electromagnetic fields in general provides the first sound basis to the hypothesis that the physical space is prevailingly characterised by the active presence of a fundamental support, which is *not* material but is anyhow *physical* and absolutely different from a vacuum conceived as a physical "nothingness".

Others before me have already suggested revising the foundations of physics starting from the study of the "vacuum" *as if it were the opposite of*

the nothingness. This is now more-than-a-reasonable necessity, after that even Einstein (the aggressive “killer” of the ether⁸³) had to change his mind about the ether. In the light of both the achievements and the riddles born by the field quantum dynamics, responding to such a necessity becomes no more deferrable.

The problem for professional physicists, especially for those belonging to the younger generation, is the risk of compromising their scientific career, if they undertake research works that are not agreed to or not appreciated by the scientific community that matters. Too original initiatives in scientific research are a luxury for almost all of the active scientists. This is an additional reason for justifying the boldness of outsiders like me, who have neither reputation to lose nor career to put in jeopardy.

6.1 – Evidence of the plenum

The propagation of light is the first indication of a medium that conveys vibrations. I think that human minds cannot achieve new knowledge without resorting to mental models based on the observations of similarities between different phenomena. Certainly, it is on the basis of similarities with the propagation of sound in the air that XIX Century physicists thought of the ether as of the propagation medium of light. Surprisingly, however, most or all of them had nothing to object to the strange idea that motivated the experiments designed and carried out by Michelson and Morley. The experiments aimed at proving the existence of the ether through the different speeds of the light that propagates leeward or windward in a stream of ether. The idea was strange because no scientist would seriously carry out an analogous experiment to prove the existence of the air by use of the speed of sound. In fact, for any given state of the transmission medium, the *speed* of sound may *apparently* vary with respect to the surface of the Earth but not with respect to the air in which it propagates: What *actually* varies with respect to the Earth’s surface is instead the *frequency of the sound wave*, as commonly learnt through the experience of Doppler-effect.

Therefore, if two persons speak to each other staying one at the prow and the other at the stern of the upper-deck of a navigating boat, the sound of their voices travels across the air at the same speed in both directions, though the navigation wind makes the leeward sound “speedier” with respect to the boat deck. However, and for sure, the voice

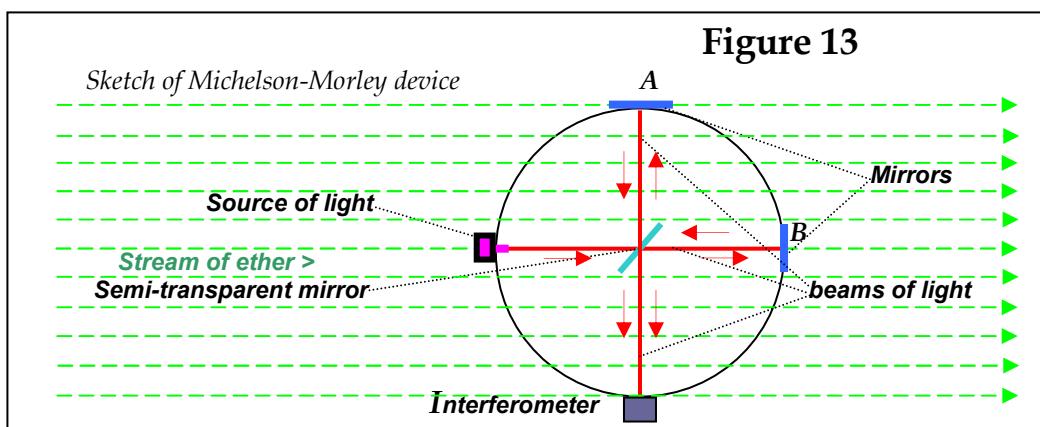
⁸³ A book written by K. C. Cole, *The Hole in the Universe*, Harcourt Inc., New York 2001, may also give an idea about the personal campaign against the ether conducted by Einstein in the first two decades of the past century.

that starts from the mouth of the person at the stern doesn't add the speed of the boat with the speed of the sound. *The sound does only travel two different distances in going – at an identical speed – two opposite paths.* (To use a more familiar image: The speed of the noise generated by a supersonic airplane that nosedives toward you does not add with the speed of the airplane, so that you are hit by its missile before hearing the sound of the airplane's engines. Instead, the speed of the missile adds with the airplane's speed).

For the sound itself, the air – as a transmission medium – is steady, and the *frequency shift* (*i.e.*, the Doppler-effect) is only due to the fact that the bow moves *along with* the acoustic wave, whereas the stern moves *across* the sound wave on arrival: *i.e.*, the stern moves in a direction opposite to that of the arriving wave propagation. The number of *wave-picks met per time unit* by the sound receiver increases if the motion is toward the acoustic source, and decreases if the motion is in the opposite direction (off the source). This motion of the sound-perceiver across the wave field changes only the *perceived* frequency of the sound waves, which instead remains unchanged with respect to the air.

Differently, if the two speakers dialogue standing in the corridor of a train-coach in motion no particular effect can be detected concerning the sound transmission, because the air – which is still the sound transmission medium – travels along with the coach and with the acoustic interaction between the speakers.

Quite analogous expectations should regard the behaviour of light. The experiments conducted by Michelson and Morley were based on the assumption that Earth moves across the ether like a boat upper-deck across the air. Michelson and Morley prepared a measurement device to make two different beams of light interfere with each other: One beam sent and reflected along the leeward/windward direction of the stream of ether, the other beam (control beam) along the direction orthogonal to the former. (See **Figure 13**)



In Michelson's view, the two mutually orthogonal beams reflected by mirrors *A* and *B* should travel across the stream of ether according to different speeds with respect to the observer (the interferometer in the figure above), thus generating interference fringes.

In my view, in an analogy with the preceding example of propagation of sound through the air, no interference fringe should have been expected.

What is certain is that no person had to raise criticism on the technical aspects of Michelson-Morley's experiments, and I do not know the technical details of those experiments. I guess that the physicists' expectations were wrong in at least two ways: First, they were wrong to the extent to which they could believe that the speed of light across the ether (or the plenum) adds with the speed of the source of light (with respect to the observer), since they would not have expected this as far as the sound in the air is concerned;⁸⁴ Secondly, because they refused to imagine (as instead was suggested for explaining the failure of the mentioned experiments) that Earth - in its rotation - travels along with the "ether" in which it is immersed.

Another well-known aspect of light is that it generates Doppler-effects when sources of light approach or recede from the observer: It is nowadays common experience for astronomers who measure the speed of galaxies in the cosmos, and it is also a remarkable indication of the existence of the plenum. As far as I know, in Michelson-Morley experimental reports there is no mention of Doppler-effect (while it is worth noting that the recession of galaxies was detected much later with respect to Michelson's experiments).

It seems that more precise and sophisticated experiences of the kind have been made in 1979 by A. Brillet and J.L. Hall who have used laser beams and a Fabry-Perot interferometer.⁸⁵ Their findings could be interpreted according to the old hypothesis of plenum *pulled* into rotation along with the Earth's rotation. (The opposite is suggested by the hypotheses of this essay: It is the vortex of plenum that draws Earth into its spinning motion. However, as to the effect, the two explanations are equivalent).

⁸⁴ Einstein's Special Relativity, which gave "an explanation" for the failure of Michelson-Morley's experiments, is based on the postulate that the speed of light does not add with the speed of either the source or the observer. The speed of light is constant in every directions of the physical space and independent of the motion of observers immersed in the electromagnetic field (which - in an analogy - is also true of the speed of sound in the air).

⁸⁵ Mentioned by Bill Hamilton (Xontek Corporation, US Centre of Advanced Studies) in web-site http://www.Ether_Electrogravitics. No wonder if almost nobody pays attention to these experiments nowadays.

6.1.1 - Fundamental evidence

In Paragraph 5.7.1 I have suggested that both inertia and very familiar forces, such as – for instance – centrifugal force, may be interpreted as fluid-dynamics effects associated with the motion of bodies with respect to the plenum. This is to a certain degree obvious, since it would be paradoxical not to relate aspects of “normal mechanics” to the existence of the plenum. According to the hypothesis of this essay, the plenum is the matrix of all motions and material elements.

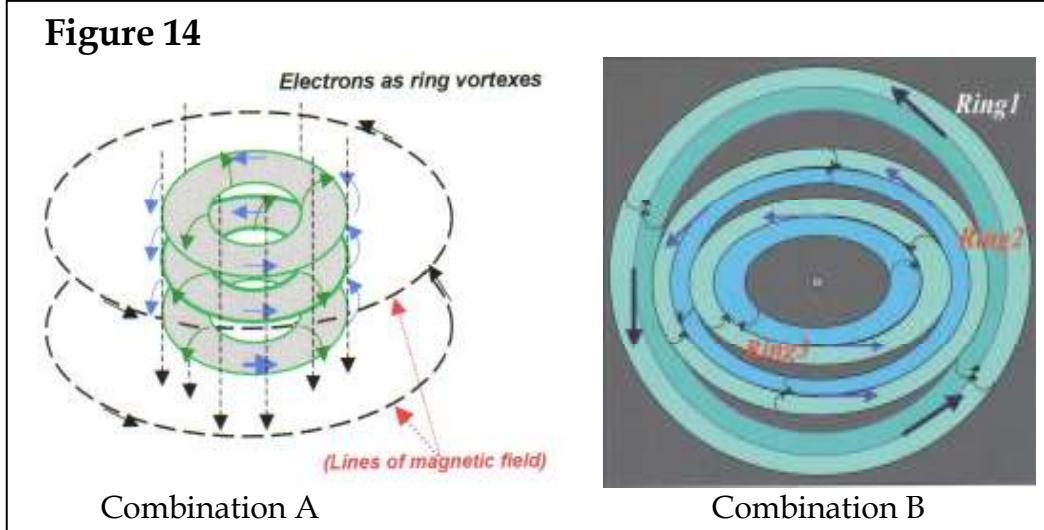
Three U.S. scientists, Hal Puthof, Bernard Haish (Lokheed Martin Astrophysics Lab of Palo Alto), and Alfonso Rueda (University of California) have proposed to address the vacuum as it were not an empty space, but a space filled with newly-defined ether. According to the paper they have in 1994 published in *Physical Review*, such “ether” can be detected only through changes in the motion of bodies (i.e., through matter under acceleration). These authors provide the theoretical “proof” that the resistance (i.e., the drag) opposed by the ether to the motion is directly proportional to the acceleration! It is a change in the approach to classical mechanics.⁸⁶ Newton postulated the principle; the three mentioned authors “prove” the Newtonian principle by postulating the existence of the cosmic ether. I have mentioned the case to stress again that the hypothesis of the existence of the plenum entails a necessary re-interpretation of the basic principles of classic mechanics.

In my opinion, as already suggested about electromagnetic fields, magnetic fields might also be viewed as special velocity fields of the plenum. The interpretation of these fields by means of the plenum can explain why it is impossible to detect individual magnetic charges (either positive or negative charges). The “monopole magneton” does not exist, because magnetism does not depend on the exchange of interaction particles, but on the orientation/polarisation of fluid streams associated with particular states of electrons.

Therefore, with a view to explaining magnetism, it is necessary to pass through a hypothesis concerning the *shape* of electrons. In this connection, I incline to believe that hypotheses suggested initially J. J. Thomson could still be adopted.⁸⁷

⁸⁶ This news is taken from magazine *Science et Vie*, no.1029, June 2003, Page 58 on. It seems interesting to note that the formula for *fluid-dynamics drag* is substantially coincident with the formula for *fluid-dynamic lift*, like that – for instance – I have described in Paragraph 5.7.1 to explain centrifugal force.

⁸⁷ By two articles published in 1919, Nobel Laureate physicist Arthur H. Compton (1892-1960) could endorse J. J. Thomson’s hypothesis that the electron is shaped like a toroidal ring, on the basis of experiments concerning interactions between X-rays and electrons (*The Size and the Shape of the Electron: the Scattering of High Frequency Radiation, I & II*, Physical Review, S2 V14 N1, July

Figure 14

Following Thomson's suggestion, electrons could be thought of as small ring-vortexes of plenum, closed vortex filaments of the kind I have defined in preceding Paragraphs 2.4 and 2.5, and sketched in **Figure 1**. These very small ring-vortexes may have various diameters. If so, electrons might not be micro-balls that orbit the atomic nucleus. It seems more likely that such ring vortexes *include* the atomic nucleus, like concentric ring-shaped buns of various diameters include a cherry-nut in their central hole.

These ring-vortexes can combine with each other according to various configurations, following the accordance or discordance of the plenum motions of which they consist. **Figure 14** above suggests two possible combinations of ring-vortexes.

Combination A shows a set of polarised electrons. The vortex rings are arranged according to a *co-axial* combination, which brings about a parallel helicoidal flux of plenum, combination of the vertical flow with the horizontal flow of plenum, the former being dragged by the rotation (spin) of the vortexes (small green arrows) around the respective ring axes. ("Spin" is here defined as the rotation of the plenum around the ring-axis of the vortex filament). In this case, a mutual equilibrium distance is achieved by the electrons through the attractive effect of the concordant fluid rotation of the ring-vortexes (blue arrows) with respect to the common axis passing across all of the ring centres. This combination of electrons is typical of magnetic fields, whose field lines are coaxial with the electron rings, as it is also caused by the current in the coils of an electromagnet.

1919; and Physical Review S2 V14 N3, September 1919). The diameter assessed by Compton for the electron's ring is $1.85(\pm 0.05) \times 10^{-10}$ cm, about 100 times the average diameter of an atomic nucleus.

Parallel linear chains of electrons similar to the one shown in *Combination A* may form in metals, and the resulting magnetic field intensity ultimately depends on the number of such parallel linear chains of electrons. The *polarity* of the magnetic field is given by the "vertical" components of the flux (dotted vertical arrows in the figure), which determine a draft of plenum that pulls/threads other electrons into the polarisation chain. Every polarized electron is an elemental magnet.

Combination B represents a hypothesis of atomic *concentric* electron rings, which may have non-coplanar *though* concentric layouts, as it must be expected if either the ring-vortexes have concordant rotation (as indicated by the blue arrows) or not. In general, like in the example of **Figure 14**, the electron rings of an atom lie on different planes while having the same centre. Each ring consists of the coupling of two electron vortexes, which are kept bound to each other by the respective opposite annular spins (indicated by the black small curved arrows) and by a concordant orbital speed around the atom's nucleus.

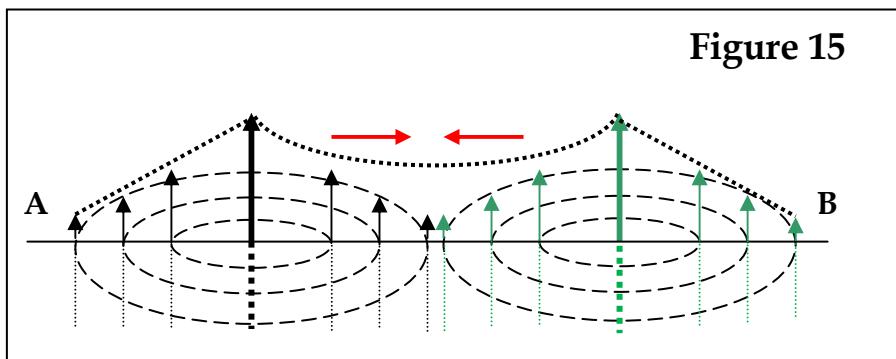
Combination B suggests that the *orbits* of electrons inside atoms consist mainly of the annular flows of vortex rings of different diameter. It may however be expected that the combination of concordant and/or opposite orbital speeds causes further rotations of the rings around one or more of their respective diameters. It is assumed that the electron annular spin, i.e., the plenum's rotation around the annular axis, is a constant absolute value, while the "orbital" speed of the electrons tends to drop as the diameter of the respective ring increases.⁸⁸ Therefore, the orbital speed of each electron vortex within the atom decreases with the distance from the atomic nucleus. As soon as they are freed from the respective atomic position, the most external electronic rings minimise their diameters, which also induces one to assume that all *free* electron rings have the same minimum size.

It would be an honest attitude trying a model of nuclear organisation of the electric charges in the protons, in an attempt to give a complete and consistent picture of the atomic structure. Such a purpose, however, is too ambitious in this context; whereas my basic intention is only to achieve a *credible model* of gravity based on the interactions between different motion fields of the plenum, with a view to outlining suggestions on how motion of the plenum could be determined in order to oppose and overcome gravity force.

⁸⁸ According to quantum field theory, the electron's *wave* is both three-dimensional and distributed in space: *i.e.*, the electron should be thought of as *distributed around* rather than *orbiting* the atom's nucleus. See also Kenneth W. Ford, *The Quantum World*, Chap. 9, Harvard University Press, Cambridge 2004.

As partially anticipated in Paragraph 2.5, any linear electrical current drags the surrounding plenum into a motion distributed along co-axial cylindrical surfaces, according to a speed intensity that is inversely proportional to the distance from the line of the electrical current.

Two parallel electrical conductors bearing electrical currents, in which all the electrons move in the same direction, determine a summation of the speeds of the plenum between them. This is equivalent to create velocity circulations (*Magnus-effects*) with respect to the electrical conductors, resulting in an attraction force that makes the two electrical conductors approach to each other.



The contrary happens if the two electrical currents have opposite direction, for the velocities induced in the plenum between them subtract from each other, which results in a local slowing down of the flux of plenum. In this case, the circulations of the velocity field invert their algebraic signs with respect to the former case, and the action between the two electrical current lines becomes repulsive.

Figure 15 above shows the distribution of the plenum's velocity in the magnetic field that establishes between two electrical conductors that bear parallel electrical currents running in the same direction. The circulations of the velocity vectors distributed along cross section A-B determine an attractive force between the conductors.

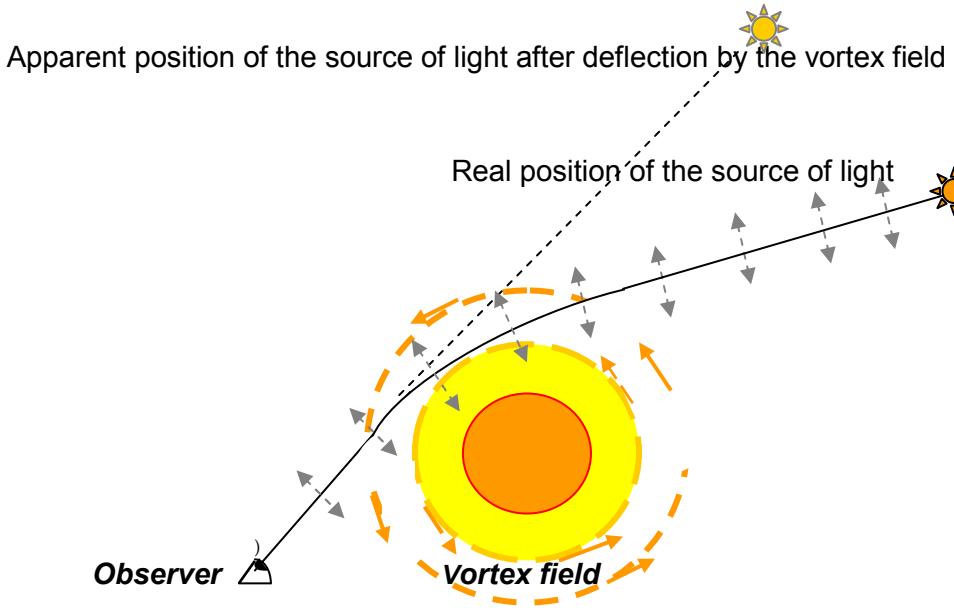
The effect represented in **Figure 15** is analogous to that concerning the vortexes described in Paragraph 5.7.2.

Further evidence of the plenum may be seen in that the speed of light (and electromagnetic propagation in general) decreases with the density of the matter through which light propagates. This fact is consistent with the hypothesis that "density of matter" means "density of void space" inside the plenum. Apart from the filtering barriers, which case by case are opposed by the structuring force fields of the matter, the route traversed by a beam of light that crosses matter becomes more complicated and longer as the amount of void holes per volume unit increases. For the beam of light, the geometrical thickness of a stratum of matter to cross does not correspond to the actual route of the beam. The actual route is much longer than the thickness of the matter. The strength of the radiation

declines rapidly with the actual route accomplished, not with the Euclidean geometrical distance from the radiation source.

Moreover, a large fraction of the radiation that enters matter rebounds against the void nuclei and is transformed into mechanical energy, or reflected as a radiation that differs from the incidental one.

Figure 16



Finally, evidence of the plenum is given by the deflection of any beam of light that crosses a gravitational vortex.

The oscillation plane of the propagation transverse wave of light is always orthogonal to the propagation direction. Refer to **Figure 16**.

When the wave oscillation plane enters a curved current of plenum, the oscillation plane cannot avoid adjusting its orientation orthogonally to the direction of the flux of plenum it comes across, since the propagation of light can only occur through its propagation medium. If the propagation medium is a fluid that flows along a curved path, then everything that propagates through it does also deflect. The effect is as more evident as closer to the vortex core is the beam's trajectory.⁸⁹

⁸⁹ It is actually a *refraction effect*, as if the beam of light propagates across a "density gradient" of the plenum.

In 1801, 114 years before General Relativity and Einstein's analogous prediction, German astronomer Johann Georg von Soldner calculated in $0''.84$ of arc the light beam deflection due to its passage close to the solar mass. That result, obtained on the basis of Newton's gravitation theory, is quite similar to the first one got by Einstein in 1915 through his General Relativity ($0''.87$ of arc modified into $1''.75$ in a subsequent paper). Consider also that the measurements

If, as seen in Paragraph 5.7.3, the plenum circulation speed near any vortex void core is greater than the speed of light, then it should happen that any gravity field - in the proximity of the void core - can *entrap* the propagation of light within the speedier plenum's rotation flux, thus determining something quite like a "black hole".

7 - What Anti-Gravity Might Be

I am approaching the end of this essay with the moral obligation to suggest a way to check gravity by use of the same physical principles that bring gravity into existence. It is a difficult task that I cannot avoid, if I do really believe it is worth proposing the ideas I have so far expressed.

7.1 - Magnetism as an aspect of gravity

The interpretation given in the previous paragraph for the magnetic effect between two electrical conductors suggests that magnetic force cannot substantially be different from gravity force⁹⁰. Magnetic force is common experience since centuries, and it is considered as an action between electrons only. I doubt it is so. The velocity field created in the plenum by an electrical current involves not only electrons but also the other atomic components. For the sake of consistency, if we accept the hypothesis that the plenum is the actual medium of any action between different bodies, it would be impossible to explain why components of matter different from electrons are insensitive to what is so effective between two electrical currents. Also protons, at least as particles that bear electric charges, are affected by magnetic fields. In any case, I deem that no matter can escape the effects brought about by velocity fields of the plenum, irrespective of whether the matter is electrically charged or not.

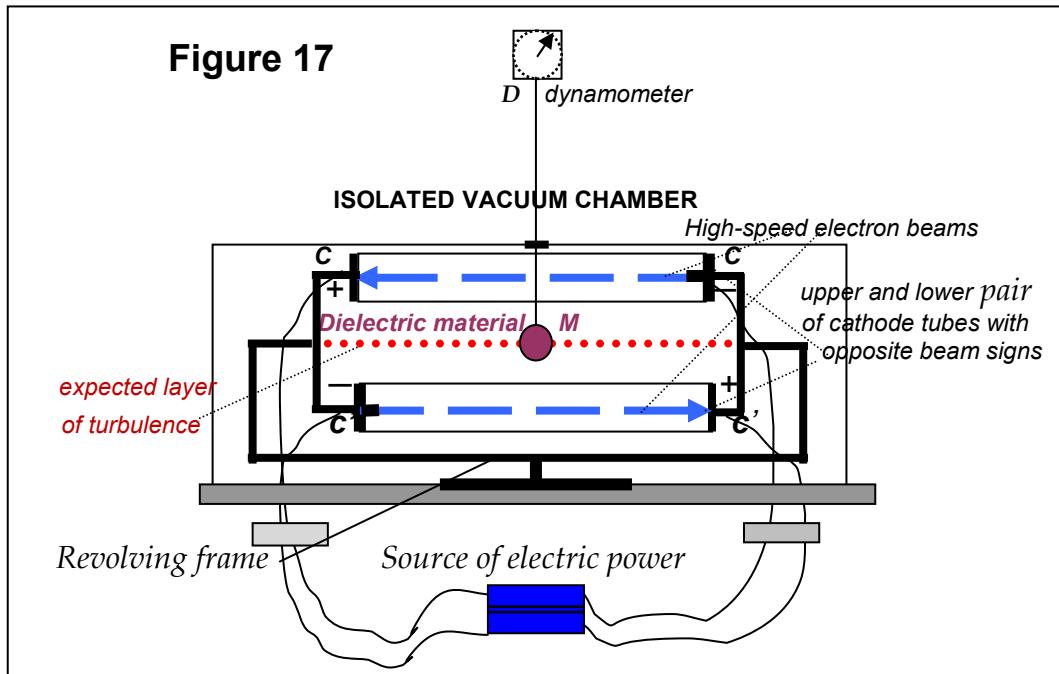
Electrons are particularly "light and sensitive" components of matter, relatively "free" to roam metals and a number of various fluids and fluid solutions. Protons and nucleons in general are strongly bound to each other, which makes them affected by a remarkable inertia against external actions. On the other hand, where electrons enjoy a sufficient degree of liberty, their response to magnetic fields is strong enough to drag - through the medium they mobilise - also the other components of the

of stellar light deflection, published after Eddington's 1919 expedition and aimed at confirming Einstein's prediction, have been seriously questioned later.

⁹⁰ In 1919, Polish physicist Theodor Kaluza - in a paper addressed to Einstein - expressed the idea that magnetic and gravity forces are of a same nature. Later, in 1926, Swedish physicist Oskar Klein developed Kaluza's suggestions in a new theory, which may be considered as the early basis of the theory of strings.

associated matter which are not (or are much less) sensitive to magnetic fields.

If gravity is the effect of velocity fields of the kind described in the preceding paragraphs, then *anti-gravity* should also consist in a different velocity field of the plenum capable of neutralising or overcoming gravity force.



The only suggestion I can now provide on the possibility of creating an antigravity field regards the draught of plenum associated with a flux of very speedy electrons like the one expected along a cathode beam generated by a very high electric potential. The electrons should flow at a speed greater than 30,000 kilometres per second. The beam's amperage depends on the cathode's structure, but it is much less important than the electron's speed. The electron beam *drags* the adjacent plenum into a coaxial cylindrical distribution of space velocities, which is actually an intense magnetic field. Then, as a preliminary and simple experiment, I can suggest the following.

Refer to the sketch of **Figure 17**.

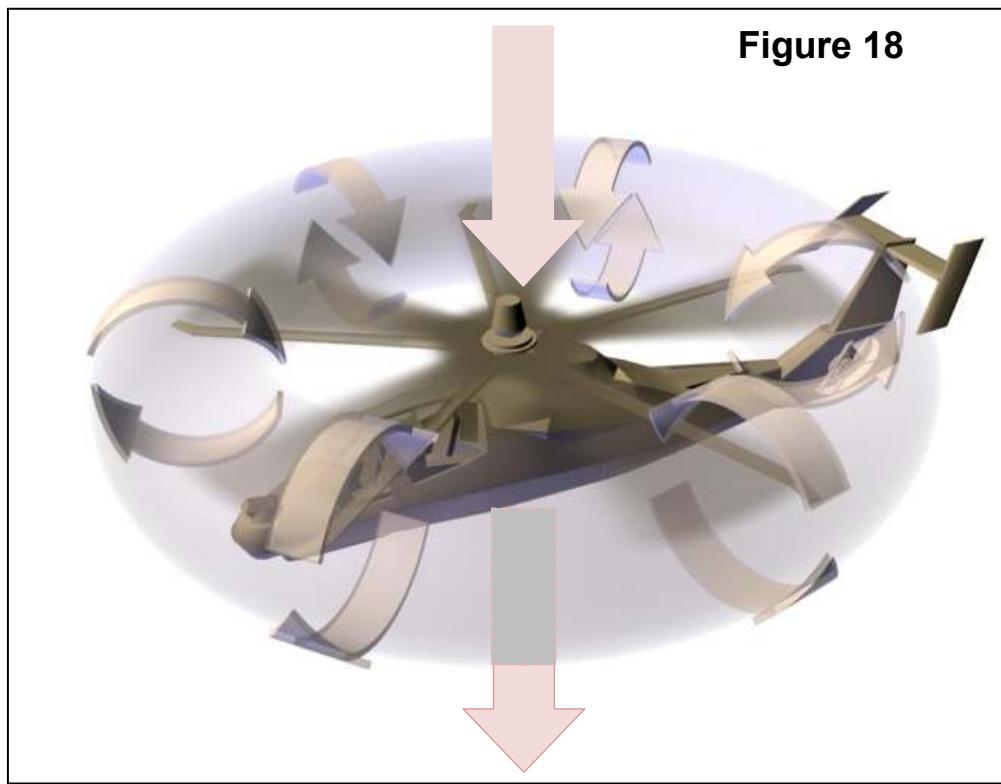
Take a piece of dielectric material *M* and hang it by a thread on a very sensitive dynamometer *D*. Place *M* between *two pairs* *C* and *C'* of cathode-ray horizontal tubes to be kept parallel to each other on two different planes, both planes orthogonal to the vertical planes that minimise the distances between the upper and the lower pairs of tubes. A difference of electric potential of at least 15,000 to 20,000 Volt should be established inside each cathode-ray tube so as to produce two pairs of parallel electron

beams with opposite flow directions, with a speed ranging from 72,000 to 84,000 km/s. When the cathode sparks are released, a change in the weight of M should be recorded by dynamometer D , if not immediately, at least after less than one minute, since the atoms of the dielectric material need time to re-adjust to the new plenum velocity field involving them.

The weight of M should increase or decrease according to the horizontal direction of cathode tubes C and C' with respect to the rotation of the Earth.

This experiment should prove that the high-speed electron fluxes in C and C' interfere with the flux of plenum of the gravity field. There should be a position of C and C' which minimises the weight of M . The measurement of the variation in the weight of M in relation to the electric potential that generates the high-speed electron beams should provide the searched indications on the anti-gravity effect. By an approximate calculation, 18,000 Volt potential should be sufficient, at the most favourable orientation of the cathode tubes, to neutralise the weight of about 150 grams of a chalk spherical sample having 5cm diameter, whose mass centre is at 7.5 centimetres from both the above and below cathode rays.

Other simple experiments could be suggested, though the relevant results may lend support to different interpretations.⁹¹



⁹¹ Another simple experiment is mentioned in my article, *A Few Notes on Gyroscopes and Antigravity*, (2011), readable in Natural Philosophy Alliance web-site <http://www.worldsci.org/php/index.php?tab0=Abstracts&tab1=Display&id=6324>

In case of significant success of the experiment with cathode tubes, one might even imagine an antigravity propeller in an analogy with the lifting power of the revolving wings of a helicopter. The whirling of those wings determines a flux of air around them that has the shape of a ring vortex, which "sucks in" air from the upper side of the ring and expels air downward, thus reproducing the self-propulsion and motion of a ring vortex across its own fluid medium. See **Figure 18**.⁹²

The idea is to create (one or two) couples of very-high-speed electron circuits controlled by magnetic coils, each couple with one electron circuit at each extremity of a connecting bar, which can revolve around a vertical axis in the centre, according to the following sketch:

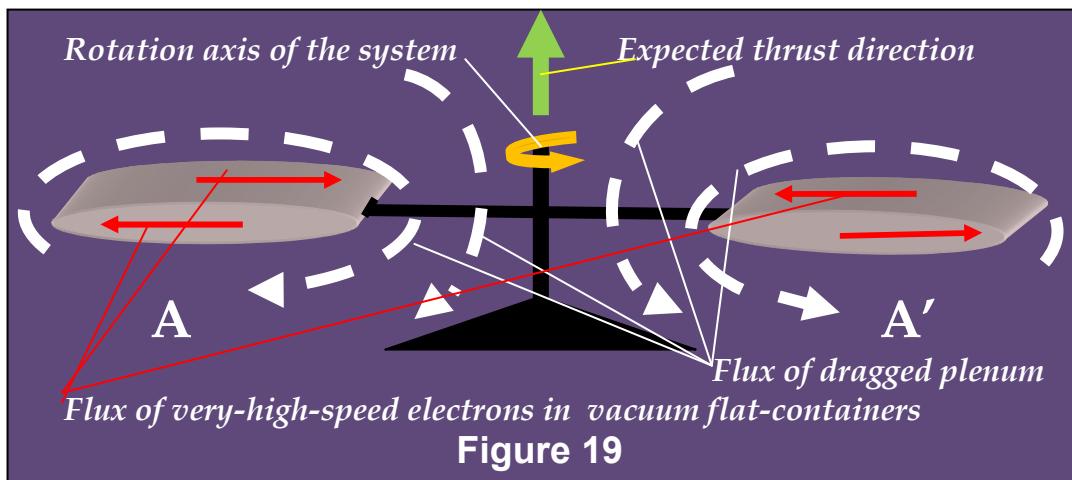


Figure 19 schematizes, through an analogy with the ring-vortex of air generated by the whirling wings of a helicopter, the expected ring-vortex of plenum induced by couples of high speed electron circuits - produced in suitably flat torus shaped vacuum containers - that rotate around a common axis. The circuit of each electron beam can be shaped by adequate magnetic coils that wrap the band of the flat shaped "doughnut" forming each vacuum container. The whirling of each couple of vacuum containers around a common axis aims at multiplying in space the effect of the device sketched in **Figure 17**, irrespective of the orientation of the cathode tubes.

Obviously, it is only the draft suggestion for an attempt that entails important engineering details and difficulties, which are completely overlooked here.

7.2 - News about antigravity effects

During the last years I got news from the Internet web sites on experiments that concern antigravity. These experiments – as far as I

⁹² The image is from "en.wikipedia.org/wiki/File:Vortex_ring_helicopter.jpg"

understand – do not have yet right of citizenship amongst most members of the world community of physicists. The Internet, if explored under “antigravity”, provides plenty of articles and reports written by a few professional scientists and many amateurs. Along with a large number of questionable writings there are also a few intriguing indications about not negligible experiments, which put interesting interpretation problems. I deem it worth quoting or summarising here sections of the most significant papers copied from The Internet concerning experiments that “shield” or “overcome” Earth’s gravity field.

7.2.1 - Podkletnov Effect

The first kind of experiments relate to an original experience made in Nineties at the university of Tampere (Finland) by Russian physicist Evgeni Podkletnov.

The text that follows is entirely taken from the relevant Internet pages.

<<

E. E. Podkletnov

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Abstract

A high temperature $YBa_2Cu_3O_{7-x}$ bulk ceramic superconductor with composite structure has revealed weak shielding properties against gravitational force in the state of levitation at temperatures below 70° K. A toroidal disk was prepared using conventional ceramic technology in combination with melt-texture growth. Two solenoids were placed around the disk in order to initiate the current inside it and also to provide rotation about its central axis. Samples placed over the rotating disk demonstrated a weight loss of 0.3 – 0.5 %. When the rotation speed was slowly reduced by changing the current in the solenoids, the shielding effect became considerably higher and reached 1.9 – 2.1 % at maximum.

Introduction

The behaviour of high temperature ceramic superconductors under high-frequency magnetic field is of great interest for practical applications.

Crystal structure seems to be the key factor determining all physical properties of bulk superconductors, and the interaction of this structure with external and internal electromagnetic fields might result in quite unusual effects.

Despite a large number of studies ⁹³, the nature of these interactions still remains unresolved.

Our recent experimental work⁹⁴ clearly indicated that under certain conditions single-phase bulk dense $YBa_2Cu_3O_{7-x}$ revealed a moderate shielding effect against gravitational

⁹³ A.B. Riise, T.H. Johansen, H. Bratsberg and Z.J. in *Applied Physics Letter*, 2290 (1992);, E.H. Brand, *American Journal of Physics*, 43,(1990); S. Lofland, M.X. Huang and S.M. Bhagat, *Physica*, 271 (1992).

Also E. Podkletnov and R. Nieminen, *Physica*, 441 (1992)

⁹² G. Modanese, *Europhysics – Letters*, 413 (1996)

⁹³ M. Bull, M. De Podesta, *Physica*, 199 (1995); C.S. Unnikrishnan, *Physica*, 133 (1996)

force. In order to obtain more information about this unusual phenomenon, a new installation was built which allowed to operate with magnetic fields up to 2T and frequencies up to 10^8 Hz at temperatures from 40° to 70° K. A new experimental technique was applied to modify the structure of the ceramic superconductor. All these efforts yielded a larger value of the ceramic superconductor. All these efforts yielded a larger value of the shielding effect (up to 2%) and provided good hopes for technological applications.

A gravitation shielding effect of this strength has never been observed previously and its theoretical explanation presents serious difficulties (see G. Modanese for references and an analysis of some hypotheses).

Thus, great attention was devoted to the elimination of any possible source of systematic errors or of spurious non-gravitation effects. The small disturbances due to air flows pointed out by some authors were eliminated weighing the samples in a closed glass tube. The entire cryostat and the solenoids were enclosed in a stainless steel box. But probably the best check for the truly gravitational nature of the effect is the observed independence of the weight reduction (in %) of the mass and of the chemical composition of the tested samples.

According to public releases, the NASA group in Huntsville, Alabama, is presently "cloning" our experiment. This is a difficult task, especially because of the sophisticated technology involved in the construction of the large ceramic disk and in the control of its rotation. We are also aware that other groups, though still at an unofficial level, are working at the experiment with smaller disks.

Basic Experimental Data

(a) The construction of the Disk

The shielding superconducting element was made of dense, bulk, almost single-phase $YBa_2Cu_3O_{7-x}$, and had the shape of a toroidal disk with the outer diameter of 275 mm, the inner diameter of 80 mm, and the thickness of 10 mm. The preparation of the 123-compound consisted of mixing the initial oxides, then calcining the powder at 930° C in air, grinding, pressing the disk at 120 MPa and sintering it in oxygen at 930° C for 12 hours with slow cooling down to room temperature.

After that the disk was kept in a furnace at 600° C and the upper surface was quickly heated to 1200° C using a planar high-frequency inductor. During this last heating the gap between the sample and the inductor was chosen precisely to provide only the heating of the upper 2 mm thick layer of the disk, though the high heat conductivity of the material caused the heating of some parts of the material below the layer.

Finally the disk was slowly cooled down to room temperature in a flow of oxygen and treated mechanically in order to obtain a good balance during rotation. A thin (1 mm) metal foil of magnetic material was attached to the upper surface of the disk using plastic glue, in order to obtain the disk rotation as described below. The phase and crystal structure of the superconductor were studied using X-ray diffraction analysis (XRD) and a scanning electron microscope (SEM) equipped with an energy dispersive spectral (EDS) analyser. The samples were cut layer by layer from the bulk ceramic disk.

The transition temperature T_c was determined from the resistive transition in a variable temperature cryostat, under zero magnetic field, using an AC current and sputtered golden contacts. The critical current density was measured for samples cut from the top and from the bottom of the super-conducting disk. Measurements of J_c were carried out at 5° K using an AC current, four-probe method and direct transport measurements. The analysis of the cross-section of the ceramic $YBa_2Cu_3O_{7-x}$ disk revealed the existence of two zones with different crystal structure. The upper part of the disk (6-7 m thick) had an

orthorhombic structure typical of the quench and melt growth process⁹⁵, and consisted mainly of single-phase orthorhombic 123-compound. The material was dense and had pure and hardly visible grain boundaries. The size of the grains was less than 2 μm , and 75% of the grains were oriented with c-axis parallel to the surface of the disk. The transition temperature for the material as defined by direct measurements was 94.2° K. The lower part of the disk, which was in a close contact with the water-cooled base during the high-frequency heat treatment, had a structure with randomly oriented grains whose average size was 5 to 15 μm . The porosity of this zone was from 5 to 9 %. The transition temperature T_c was equal to 60.5° K and the material contained about 40% of the tetragonal phase. Crystal lattice parameters for these two layers as calculated from XRD are listed below [...omitted...]. The first (upper) layer was quite homogenous with even distribution of elements in the volume of all the samples. EDS analysis showed the presence of small inclusions of $\text{Y}_2\text{Ba}_2\text{Cu}_3\text{O}_7$ in the lower layer.

(b) Operation of the Apparatus

Two identical solenoids were placed around the superconductor using fibreglass supports. The gaps between these solenoids and the disk were large enough for it to easily move about 20 mm in each direction. The toroidal disk was placed inside a cryostat equipped with a set of three coils, which could keep it levitating when it reached the super-conducting state.

High-frequency electric current (10^5 Hz) was first sent to the two main solenoids around the toroidal disk, initiating the current inside the ceramics at room temperature. Then the system was slowly cooled down to 100° K by liquid nitrogen and then quickly cooled by liquid helium vapors to the temperature of 65°-70° K so that the disk became super-conducting. The main solenoids were switched off.

After that, the current (10^5 Hz) was sent to the coils below the disk and the superconductor raised up (about 15 mm) because of the Meissner effect. Then a small current (10^5 Hz) was sent to the main solenoids and the disk began to rotate counter-clockwise with increasing speed. The rotation speed was increased up to 5000 rpm. At this moment the measurement of weight for various objects were taken.

Finally the rotation speed was slowly reduced by changing the current in the main solenoids. The rotation speed was controlled by means of a laser beam reflected by a small piece of plastic light-reflecting foil attached to the disk. The measurements of weight were taken constantly during this period, too.

The frequency of the electromagnetic field was varied from 10^3 Hz to 10^8 Hz. Samples made of various materials were tested, including metals, glass, plastic, wood and so on. All these samples were placed over the cryostat hanging on a thread connected to a sensible balance. The distance from the samples to the cryostat varied from 25 to 1500 mm in the first run and up to 3 meters in the second run. The weight of the samples was typically from 10 to 50 grams. Every precaution was taken to avoid any possible disturbance including induced magnetic fields and airflows. The samples were placed inside a closed vertical glass tube in order to eliminate the influence of air flows.

(c) Results

The levitating disk revealed a clearly measurable shielding effect against the gravitational force even without rotation. [This bold font is mine (ML)] The values of the weight loss for various samples were within the range of 0.05 – 0.07 % in this case.

⁹⁵ H. Murakami, M. Morita, K. Doi, K. Miyamoto and H. Hamada, *Japanese Journal of Applied Physics*, 399 (1989)

As soon as the main solenoids were switched on and the disk began to rotate in the vapors of liquid helium, the shielding effect increased, and at the speed of 5000 rpm the air over the cryostat began to raise slowly up to the ceiling. The boundaries of the air flow could be seen clearly and corresponded exactly to the shape of the toroid.

The weight of various samples decreased no matter what material they were made of. Samples made of the same material but with different masses lost the same fraction of their weight. The weight loss depended on the shape and the position of the sample. The maximum loss of weight could be reached when the sample was parallel to the surface of the disk, so that its projection had the maximum area. [*This seems an interesting annotation, since it suggests the presence of a fluid-dynamic effect (ML)*]. The best measurement gave a weight loss of 0.5 %, while typical values were from 0.3 to 0.5 %. The areas close to the inner edge of the toroid (5-7 mm from the edge) gave lower values of shielding, from 0.1 to 0.25 % only.

During the time when the rotation was decreased from 5000 to 3500 rpm using the solenoids as braking tools, the shielding effect reached maximum values and the weight loss of the samples was from 1.9 to 2.1 %. depending on the position of the sample with respect to the outer edge of the disk. These pick values were measured during 25-30 seconds as the speed decreased rather quickly. Because of the considerable vibration of the disk at the rotation speed of 3000-3300 rpm, further braking was done very quickly in order to avoid unbalanced rotation, and the weight measurements could not be carried out.

Remarkably, the effect of the weight loss was the same when the samples together with the balance were moved upwards to a distance of 3 m, within the projection of the toroidal disk. No weight loss at all was observed below the cryostat.

The maximum shielding properties were observed for maximum current inside the super-conducting disk. According to preliminary measurements the upper layer of the disk was able to carry over $15000\text{A}/\text{cm}^2$. The maximum weight loss of the samples was observed only at high frequencies of the magnetic field in the interval from 3.2 to 3.8 MHz.

The shield decreases slightly the gravitational force within the vertical projection of the disk and creates a kind of vertical cylindrical tunnel in the air with slightly reduced air pressure. (The observed effect also works in various gases and liquid media).

The difference between the atmospheric pressure over the cryostat and the pressure below it was measured with high precision using a mercury barometer. It was equal to 8 mm for the maximum shielding effect. Such a pressure difference produces a lifting force on the cryostat, which in the present case is however of no practical interest (of the order of 10^2 kg/m^2).

Discussion

The interaction of a super-conducting ceramic body with the gravitational field is a complicated process and cannot be characterised by one single law or physical phenomenon. Also, an overwhelming explanation of the mechanism of high-temperature superconductivity has not been found yet. Still these facts do not make the observed phenomenon less interesting.

In our previous work⁹⁶ the loss of weight of the sample over the levitating superconductor was smaller and varied from 0.05 to 0.3 %. At that time it was difficult to exclude entirely any influence of the radio-frequency field because the sample was

⁹⁶ E. Podkletnov and Riemenen, *Physica*, 441 (1992)

separated from the disk and the magnets by a thin plastic film. Now the superconductor was situated in a stainless steel cryostat and the influence of non-gravitational factors causing levitation should be negligible.

The modification of the crystal structure of the superconductor allowed to obtain a composite body with a dense and oriented upper layer and a porous lower layer with random orientation of the grains. The upper layer is able to carry high J_c current under considerable magnetic field, while the lower layer cannot conduct high currents and is not resistant to the external magnetic field. The lower part of the disk with wide inter-grain boundaries is also a source of a great number of Josephson junctions and is responsible for the direct and reverse, primary and secondary Josephson effect. The presence of tetragonal non-superconducting phase allows interaction with the external magnetic field.

The combination of two different crystal structures with different behaviour under magnetic field creates a composite ceramic body with new properties. According to Faraday law the placement of a normal conductor in a magnetic field causes electric current inside it. Usually during levitation the magnetic field does not penetrate into a superconductor for more than a penetration depth, thus the interaction with the field is extremely small. But in the described experiment the superconductor also carries high frequency electric current modified by Josephson effect. It is possible to admit that some interaction between the composite ceramic body and the external magnetic field takes place. This interaction depends on the coherence length, the flux pinning, the field frequency and the field force, the penetration depth and the parameters of the crystal lattice. These characteristics are interrelated in a complex way.

According to the experimental data (compare with cited Unnikrishnan⁹⁷), where only a static field was applied) the ceramic superconductor kept at a temperature below 70° K does not reveal any unusual shielding if it has no contact with the AC magnetic field.

As analysed in Takizawa and others⁹⁸, pinning centres with different origins may exist inside the super-conducting disk, and fluxes will be trapped at some of them. Fluxes trapped at weak centres will begin to move first while those trapped at strong centres will not move until the Lorentz force exceeds the pinning force. The overall current will be composed of the superimposition of flux motions with different speeds. Generally speaking, the quantized fluxes move as a bundle locally formed in a flux lattice by the magnetic interaction between them.

The temperature is also of a great importance as it determines the thermodynamic functions and in particular the order parameter and the free energy inside a superconductor. The shielding effect was observed only below 70° K, while the ceramic disk became super-conducting already at 94° K.

The electric interactions inside the superconductor below T_c change under the conditions of the experiment and this might alter the behaviour of the whole atomic structure in such a way that the interaction with the gravitational field becomes different. Then, in order to keep a stable level of energy and a stable atomic and crystal lattice structure, the superconductor might exchange some energy with the gravitational field and slightly decrease it. There are no grounds to claim that the rotation momentum of the disk interacts with gravitation force, but it seems that fast rotation is favourable to the stabilisation of the shielding effect.

According to BCS theory, in weak bond conditions electrons of conductivity and phonons in the crystal lattice interact from time to time: particles collide but they still

⁹⁷ C.S. Unnikrishnan, *Physika*, 133 (1996)

⁹⁸ T. Takizawa, K. Kambara, M. Morita and M. Hashimoto, *Japanese Journal of Applied Physics*, 774 (1993)

preserve their individual positions and properties. If we deal with strong bond the interaction takes place all the time and free electrons and phonons exist no longer giving birth to a certain mixture called electron-phonon liquid. This liquid has specific properties and the behaviour of the electron-phonon mixture under various conditions is not yet studied. It is possible to admit that this liquid has some properties similar to those which are typical for magnetic liquids, especially if we take into consideration that magnetic field hysteresis is characteristic for high T_c compounds. Also the experimental equipment described above has much in common with magneto-hydro-dynamic (MHD) generators.

The first attempt at a theoretical explanation of the effect has been done by G. Modanese⁹⁹. Further investigations are in progress and will help to prove, change or complete the present understanding of the observed phenomenon.

Conclusions

A super-conducting ceramic levitating disk of $YBa_2Cu_3O_{(7-x)}$ with composite structure demonstrated a stable and clearly measurable weak shielding effect against gravitational force below 70° K and under high-frequency electromagnetic field. A combination of the high-frequency current inside the rotating toroidal disk and the high-frequency external magnetic field, together with electronic pairing state and super-conducting crystal lattice structure apparently changed the interaction of the solid body with the gravitational field. This resulted in the ability of the superconductor to modify the energy of the gravitation force and yielded a weight loss of various samples up to 1.9 – 2.1 %.

Samples made of metals, plastic, ceramic, wood etc. were situated over the disk and their weight was measured with high precision. All the samples showed the same partial loss of weight, no matter what material they were made of. In order to obtain the maximum weight loss the samples should be oriented with the flat surface parallel to the surface of the disk. The overall maximum shielding effect (2.1%) was obtained when the rotation speed and corresponding centrifugal force were slightly decreased by the magnetic field.

It was found that the shielding effect depended on the temperature, the rotation speed, the frequency and the intensity of the magnetic field.

At present it seems early to discuss the mechanism and to give a detailed analysis of the observed phenomenon as further investigations is necessary. The experimentally obtained shielding value might be of a primary interest for scientific and technological applications.

Acknowledgements

The author is grateful to the Institute for High Temperature of the Russian Academy of Science for the help in the preparation of the unique superconducting ceramic disks and for the possibility to use their technological equipment.

The effect was first observed and studied at Tampere University of Technology. >>

⁹⁹ G. Modanese, Europhysics – Letters, 413 (1996); G. Modanese and J. Schnurer, **Possible Quantum Gravity Effects in a Charged Bose Condensate under Variable Electromagnetic Field**, report UTF-391/96, Los Alamos database nr. gr-gc/9612022

7.2.2 - My comment in a few notes

In my opinion, Podkletnov's experiment is a significant example of the close connection between magnetic and gravity fields.

So far, Podkletnov effect cannot enjoy any satisfactory explanation by use of the officially accepted theories of physics.

In the experiment described by Podkletnov everything suggests that the effect is of a fluid-dynamic nature. Everything depends on both the electrons' speed in the disk and the spinning speed of the disk itself. However, the effect – although attenuated – can be observed *also if the disk does not spin*. This fact also is particularly significant.

The different material structure of the upper and lower sections of the disk suggests that in the upper section of the disk the electric current is speedier than in the lower section of the same disk. This difference in the electrons' speed implies a different speed distribution in the plenum that is set in motion by the electrical currents. The overall motion condition of the plenum around the sample hung above the disk undergoes a modification in the circulation of the velocity vector of the field, which reflects on the intensity of the gravity force acting on the hung sample body. The rotation of the disk works as a co-factor in dragging or braking the flux of plenum associated with the electric currents.

The fluid-dynamic nature of Podkletnov effect seems to acquire more evidence through the different intensity of the effect with respect to the varied positioning/orientation of the hung sample. This means that also the *shape* of the sample body matters. So far, neither official nor "clandestine" physical theory can explain this particular fact, except a theory that would account for a "fluid vacuum" (or "plenum") that works fluid-dynamically in generating both electromagnetic and gravitational phenomena. Gravity and antigravity effects seem strictly analogous to the aerodynamic effect that lifts kites and airplanes.

7.2.3 - Brown Effect

Once more, from the Internet sites I have got interesting news concerning a flying disk-shaped high-voltage capacitor constructed and improved by Townsend Brown, starting from the early Fifties of the past century. The relevant Internet pages can be searched and found by use of "Electrogravitics" or "Antigravity" as key words.

In the *Air Force Manual* written by Wright-Patterson AFB, there is a definition of *Electrogravitics* along with a description of the discovery made by Townsend Brown.

"Electrogravitics" may be defined as a synthesis of *electrostatic energy*, used to generate mechanical propulsion (either vertical or horizontal), and *gravitics* or *dynamic counterbary*, by which energy is also used as a *local*

gravitational force, independent of Earth's gravity. The use of electrostatic energy for propulsion purposes was thought of as a possible means for building propellers for the navigation in cosmic space. Electrostatic engines were theorised in 1925, but electrogravitics did actually begin after World War II, when Townsend Brown was able to improve the pre-existing proposals for electrostatic engines up to the construction of an object capable of flying by use of electrostatic energy.

Upon his own initiative, Brown gave evidence to the possibility of obtaining this kind of motion by use of a capacitor formed by two parallel metal disks coupled by means of an interposed dielectric material. This capacitor is connected to a pole by an electrical feeding cable that works also as a bridle to keep the flying capacitor rotating around the pole.

The first complete report on the experiment was issued in 1952 as an initial output of the *Winterhaven Project* undertaken by the Gravity Research Foundation of Boston.

Substantially, electrogravitic propulsion is based on a very high electric positive charge in one of the two disks of the capacitor, to which corresponds a negative charge in the other disk. The core of the problem is in the capability of maintaining the capacitor's charge and in the use of a dielectric material capable of resisting very high electric potential. A potential of about 30,000 Volt could be sufficient to generate supersonic speed of the capacitor.

The original device built by Brown flew at the speed of 30 feet per second (about 275 m/sec or 988 km/h) and used a potential of 50,000 Volt maintained by a weak current of a few m. ampere.

Nobody could so far illustrate a clear and detailed relationship between the Winterhaven Project and gravity. Somebody made the hypothesis that the interaction particles that characterise gravitational fields might coincide – as to the effects – with the flux of electrons that springs from the electrostatic field of the capacitor.

Brown's experience seems anyhow a realistic approach to the practical implementation of a craft set and kept in motion by electrostatic propulsion. Whatever the findings achieved by the Gravity Foundation of Boston may be about gravity, a complete and clear understanding of gravity is not essential to experiments conditioned by inadequate theoretical explanation and support. According to comments read on this subject, it seems that a few unmentioned French scientists have reproduced Brown's experiment in vacuum chambers, to belie some scientific remarks according to which the flight of Brown's capacitor was caused by the effect of air ionization. It is necessary to repeat such an experiment to dispel unavoidable doubts.

My personal comment is as follows. If the charge of Brown capacitor is very high and the dielectric can resist the charge completely, then the electrostatic field created between the external parallel sides of the capacitor's disks resembles a dipole (similar to that shown by **Figure 4**), with vortex lines - polarised by electrons - going from one disk to the other and dragging plenum along them. The system would then result in something very similar to a spherical gravitational vortex of the kind I have described in Paragraph 5.3. The velocity field around the capacitor combines with that of the gravity field. The resulting effect should depend on the position of the positive electric charge of the capacitor with respect to the earth surface. Actually, according to the available reports, the lifting (anti-gravity) effect can be observed only if the negative charge is loaded on the upper disk of the capacitor. Unfortunately, the description of Brown's flying capacitor given by the relevant literature in the Internet is incomplete, which determines substantial uncertainty as to the correctness of my interpretation. The interpretation I have tried above could perhaps be more appropriate if the capacitor would be shaped like a doughnut, i.e., with a relatively large hole in its centre that crosses both the parallel metal disks and the dielectric. The doughnut shape I suggest for the capacitor should in any case produce the same effect as that of Brown's capacitor, though by a possible inversion of the positive and negative charges on the hollow disks.

Besides all that I have reported above, it seems important to me that a number of scientists and technicians have devoted or continue to devote resources and years of their life to produce physical effects that appear of a noticeable interest to all those who are committed to study any possible control on gravity.

At this point in history, I deem that it is preferable to doubt the reliability of official science rather than ignoring and scorning experiences like the ones to which Podkletnov and Brown strive to draw our attention. Illusions may sometimes appear like reality, but real facts can be reproduced and observed again and again. If some facts do not match our scientific knowledge, it should be wiser doubting our theories rather than doubting "inexplicable" facts.

8 - Conclusions

A long series of accurate astronomic observations show that something doesn't work in current cosmological theories. For instance, the very high rotation speed of galaxies poses a problem. It is necessary to assume that very high gravity forces prevent the galactic materials from escaping the centrifugal force caused by galaxy rotation. The calculations carried out

according both to General Relativity and to Newtonian mechanics prove that the detectable galactic materials (stars, planets, dust, gas, etc.) have normally an overall mass that is approximately ten times less than the mass it would be necessary to secure galaxy cohesion. This conclusion is independent of the type of galaxy considered, whether spiral or globular galaxy; while analogous conclusions relate to the analysis of galaxy clusters. Astrophysicists can try just two ways to cope with such "anomalies": The first one is hypothesising the existence of large amounts of undetected *dark matter* housed inside each galaxy and galaxy cluster. The second one is assuming that both General Relativity and Newtonian mechanics are inadequate theories and that a new theory is needed which matches the observation findings. Actually, at these cosmic scales there is no test which corroborates either classical mechanics or General Relativity.

From another side, calculations inherent in the quantum field theory lead to conclude that the universe is *everywhere* permeated by an infinite density of *negative* energy which – at cosmological scale – should cause matter expansion instead of matter agglomeration. However, quantum field theory is affected by a methodological and structural flaw named "renormalisation", which – according also to major promoters of the theory – makes quantum field theory not a *fundamental theory*, but only an effective model.

All attempts to reconcile General Relativity and Quantum Field Theory are showing insuperable limits. Theory of strings is the latest attempt, but it seems impossible to take this approach seriously. String theorists manipulate ideas as if these were real things, though such an attitude is – to some extent – common to every scientific theory. The point is that the theory of strings – apart from its not demanded hyper-complexity – has most of the features that characterise metaphysics: Nobody can see how the *strings* may facilitate the need for keeping physical events under control through experimental work.

My theoretical suggestions reconnect to hypotheses differently and previously made by several scientists (including the late Einstein) about the nature of the physical space, but such hypotheses were put in the shade by the overwhelming success of the General Relativity in the form this was presented and spread in 1916.

Basically, my own suggestion introduces the hypothesis that *the physical space* consists in a finite and perfectly continuous fluid incompressible *plenum*, which variously combines with an infinite *void space* (i.e. the *absolute nothingness*) deprived of any physical property. All dynamics relates to *systems* of *void nuclei* and velocity fields of the *plenum* around them; so that addressing physical space *also* with the conceptual instruments of fluid-dynamics may be a successful path to the understanding of gravitation and to the control on gravity.

In particular, as far as gravitation is concerned, I suggest that gravitational fields are generated by *spherical* or *oblate-spheroid vortices* of plenum, which form when *ring vortices* move across the plenum. The field proper to this kind of vortices is characterised by a *scalar* distribution of the plenum's *speed* v expressed by $v = H/r$, in which r is the distance of any point P of the field from the centre O of the vortex, and H is a constant quantity inherent in the particular vortex considered; whereas the velocity *vector* field varies with the position of P in the vortex.

A vector field of centripetal accelerations expressed by vector

$$\vec{h} = - 6 \left| \frac{H^2}{r^3} g_{(\alpha)} \right\rangle,$$

along with the relevant *potential* expressed by

$$Q = 3H^2 g_{(\alpha)} / r^2,$$

can be associated with speed distribution v in the vortex, $g_{(\alpha)}$ being a parameter that depends on the latitude of point P in the sphere (or spheroid) of the gravitational vortex considered.

[Incidentally, it is worth considering that the fluid-kinematics of any ring-vortex may conventionally be described through the concept of *dipole*. The velocity field of a fluid dipole implies the existence of a *field potential* defined by

$$Q^* = \eta \phi \sin \theta / r^2,$$

in which ϕ is the rate of the fluid flow through the ring's centre along the straight length unit of the dipole's axis, which is orthogonal to the ring's plane, r is the distance of any point P of the fluid from the same ring's centre, θ is the "latitude" of the point with respect to the ring's centre (which also means with respect to the plane of the ring's circle), and η is a constant quantity that depends on the characteristics of the fluid.

In conjunction with Q^* , a *vector field of accelerations*, as expressed by

$$\vec{E} = \text{grad}Q^* = - 2 \left| \frac{\eta \phi}{r^3} \sin \theta \right\rangle$$

is also identified, in a close analogy with the definition of \vec{h} recalled above.

Actually, it must be considered that the *scalar* field of the fluid *speed* in a dipole obeys the law of the inverse distance, as expressed by Equation [3], though with no consideration of variable distribution of the velocity *vector*.

If the velocity vector is constantly orthogonal to the circular axis of the ring vortex - as per **Figure 6** - then the vortical stream is everywhere irrotational, with the consequence that the circulation vector of the velocity around any intruded body is nil, unless the body itself is spinning.

Absence of circulation of the velocity vector around any non-spinning body implies that no force is exerted on it by the mass-less fluid stream. This fact has induced me to start from scratch in describing ring vortices, assuming that the sketch of **Figure 6** refers to a particular case, which is the case of an *irrotational* ring vortex.

In this connection, it might be interesting to analyse the implications of the hypothesis that an *irrotational* ring vortex (*i.e.*, a fluid dipole of plenum) determines an electric-like field, as maintained by a few authors^{*}. Instead, in my view, gravity fields are rather similar to magnetic fields].

I also suggest that the “gravitational law” could be expressed by a reviewed use of Kutta-Joukowski’s equation for the fluid-dynamic lift (*Magnus effect*)¹⁰⁰. This very simple equation, which I have recalled in Paragraph 4.2, Footnote 34, and used in Formula [41], Page 90, quantifies the force undergone by a cylindrical or spherical/spheroidal body immersed in the velocity field of any fluid. This force is orthogonal to the prevailing direction of the velocity in the field, and depends on the fluid density as well as on the distribution of the fluid velocity around the body.

If the body is neither cylindrical nor spherical, Kutta-Joukowski’s formula could case-by-case (if necessary) be corrected by a specific *shape coefficient* (as it happens, e.g., for the cross section profiles of airplane wings in aerodynamics).

When translated for the fluid “plenum” to describe gravitational force, the *fluid density* in Kutta-Joukowski’s equation should be replaced by the mass density of the body, since the fluid plenum has - by hypothesis - no mass. “Mass density”, in this context, is the ratio of the volume of *absolute void* contained in the material body to the body’s overall geometrical volume.

However, logical implications of the hypotheses, on which this theoretical construction rests, have led to gravitational equations that *do not*

^{*} Updating note: Amongst a number of various works on this subject as addressed by different authors, it seems worth mentioning a paper by Dmitri Rabounski, *The Theory of Vortical Gravitational Fields*, Progress in Physics, Vol. 2, April 2007 (submitted in September 2006), in which the author, through an industrious analysis, strives to prove that the nature of a vortex gravity field is electric.

¹⁰⁰ See also **Figures 9 and 10**, Pages 95 and 96.

require the use of the concept of “mass”. Gravitational forces are intrinsic to the kinematics of the fluid space (the plenum) in its relationship with nuclei of *void*, these being *holes* in the physical space, *i.e.*, places where the local particular kinematics of the fluid determines *absence of plenum*.

The behaviour of bodies or vortices within gravitational fields of plenum depends only on local velocity fields as well as on states of kinematical acceleration.¹⁰¹ In other words, gravitational forces are not inherent in the matter itself, so that the co-presence of material objects of any size does not imply *per se* any interaction of a gravitational nature. In general, physical attraction or repulsion between material objects depends only on the fluid-dynamic action exerted either by vortices or by any of the other *velocity fields* (including oscillatory fields) that enliven the plenum at all scales.

Summarising: Gravitational effects occur because of *particular local states of the fluid plenum* within the field of the plenum’s velocities generated by a gravitational vortex. In this theoretical framework, *also material elements* are basically viewed as *local kinematical states* that develop around nuclei of *void*,¹⁰² as determined by the fluid motions characterizing the gravitational vortex that includes them, and are *therefore affected* by local gravitational effects.

Then, concept of mass and matter is associated with local either micro or macro-fields of velocities of the plenum around variously shaped “skeletons” of absolute nothingness.

I have come to propose a gravitational equation for *bodies* immersed in the velocity field of a vortex, the centre of the vortex being the origin of the polar reference frame. The equation can be written as follows:

¹⁰¹ In describing *central forces*, the use – made in this essay – of Binet’s formula allows one to transform the current definition of acceleration into a pure geometrical definition, which doesn’t require the use of variable “time”. The *time variable* is replaced by one of the co-ordinates of the polar reference frame, *i.e.*, by the *variable angle* described by the orbit’s variable radius with respect to the position of the motion centre (which is also the centre of the polar reference frame). See also the *Analytical Attachment* herewith.

¹⁰² It is of a major interest to me to apprehend that in 1853 German mathematician Bernhard Riemann (1826-1866) assumed that the gravitational ether is an incompressible fluid, and that matter components shall be thought of as of sort of holes or sinks - opened in the ether - where the ether disappears. It is as if in such “holes” the ether is destroyed, or as if through them it moves into another physical dimension. Each “hole” creates a converging stream of the surrounding ether, similar to the water flow that empties a tub through its sink. Riemann was too a great mathematician not to treat the subject in a rigorous way. Thus, his hypothesis led him to conceive gravitation as the grouping of “sinks” under the fluid kinetic unbalance determined by the disappearance of ether (*Neue mathematische Prinzipien der Naturphilosophie*, in “*Bernhard Riemanns Werke und gesammelter Nachlass*”, (a posthumous collection of Riemann’s papers), Leipzig 1876).

$$[59] \quad \left(\frac{1}{r}\right)^2 \frac{d^2}{d\psi^2} \left(\frac{1}{r}\right) + \lambda \left(\frac{1}{r}\right)^3 - k = 0,$$

in which:

r is the distance between the centre of the gravitational vortex and the centre of any material body or (in a first approximation and only if its average radius is *negligible* with respect to r) any minor vortex included in the gravity field of the former,

ψ is the angle described by r during the motion (orbit) of the body,

$\lambda = 1 - 6 H^2 g_{(\alpha)} / \gamma^2$, where H is a local constant of the field and $g_{(\alpha)}$ is in general a variable that depends on the orbital plane inclination with respect to the "equatorial" plane of the gravitational vortex (α is the "latitude" of a point in the vortex spheroid: $g_{(\alpha)} = \text{constant}$ only if $\alpha = 0$);

γ is the constant that expresses the double of the area speed of r ,

$k = a_o / \gamma^2$ may be either a known constant or – to the contrary – a variable function of r that accounts for the "autonomous" central acceleration (or *self-acceleration*) a_o , if any, of the body involved.

It is important to remark that Equation [59] does not *in general* regard the behaviour of smaller vortices *included* in larger ones, for this equation is based on the assumption that the size of any material body immersed in a gravitational vortex is negligible with respect to the distance between the body and the centre of the vortex. Actually, perhaps in most cases, the size of *included* vortices should not be considered as negligible with respect to their distance from the centre of the *including* vortex. For example, according to calculations reported in following Part III of this essay, the radius of the terrestrial vortex is only 0.3% the distance of this vortex from the centre of the solar one (*i.e.*, the ratio of 3 millimetres to 10 metres); whereas the radius of the lunar vortex is nearly 13% the distance between Earth and Moon. In the former case, one may assume that the size of the terrestrial vortex can be neglected in order to apply Equation [59] for a first approximation determination of the orbit of the Earth's vortex around the Sun, after identification of the appropriate function for the central self-acceleration $a_o = a_o(r)$ of the Earth's vortex. Instead, in the latter case, the size of the lunar vortex is too large to be neglected in determining its orbit around the Earth, and Equation [59] cannot be applied: in such a case, it is necessary resorting to an orbital equation of the kind expressed by [54a].

My suggestion is only a methodological proposal, in the light of the considerations made in Part I of this essay concerning the "vacuum".

The limits intrinsic to my views are typically in the way of making assumptions by use of analogies, since I do believe that any final *true* description of the *real* world is and remains unlikely. In my opinion, human knowledge is structurally constrained by the nature and limits of human languages, including mathematics obviously. These are the only instruments through which we can try to improve our *representation* of the universe, and our task will probably remain that of choosing the languages, *i.e.*, the conceptual systems, which make our knowledge-of and control on the world more and more effective.

"We can see that there are two extremes in the way scientific research can be conducted. One way is to assemble as many facts and as much data as seem relevant to the problem at hand, in the hope that the appropriate mathematical relations will pop out, or at least will be perceived by the trained and reactive scientific mind. The other way is to find mathematical laws whose beauty and simplicity have some particular appeal, and to attempt to fit the world to them. (...) Beautiful theories are preferable to ugly ones, but beauty alone does not make a theory correct: facts are to be collected and taken note of, but the judicious scientist knows when to ignore certain contradictory facts, realizing that a tentative theory cannot explain everything and anticipating that all will be well in the end. (...) Some of the blame, unfortunately, for this shift back toward the old Pythagorean ideal [*of a universe that responds to the perfection and harmony of geometry and mathematics*] must go to Albert Einstein. His general theory of relativity is the prime example of an idea that convinces by mathematical structure and power, and for which experimental verification is something of an afterthought. Despite its extraordinary success, general relativity remains even today one of the least well tested of physical theories. (...) Einstein became more and more fond, as he grew older, of using aesthetic justification as a criterion for scientific correctness. When asked what he would have thought if Eddington's expedition had not found the bending of light by the Sun, he said <*Then I would have been sorry for the dear Lord; the theory is correct*> (...) The danger of Einsteinian style to science is that most physicists have never possessed his inner compass in the first place, but use his methods as an excuse for playing at mathematics, constructing theories that look good but are essentially empty of deeper justification. The lure of mathematics is hard to resist. When, by dint of great effort and ingenuity, a previously vague or ill formed idea is encapsulated in a neat mathematical formulation, it is impossible to suppress the feeling that some profound truth has been discovered. Perhaps it is, but if science is to work properly, the idea must be tested, and thrown away if it fails" ¹⁰³.

¹⁰³ David Lindley, *The End of Physics* (Basic Books, New York 1993), Page 7, 8, 11, 12, 13; *op. cit.*

In my opinion, there are nowadays two myths that hamper a more profitable progress in our control over nature: the myth of the "Grand Unified Theory"(GUT), and that of "precision". As to the former, the words written by David Lindley, quoted above, seem an adequate comment. As to "precision", the myth is either a consequence-of, or a philosophical dogma/preconception in the quest for the "theory of everything".

The amazing effectiveness of scientific achievements is undoubtedly due to the substantial "precision" of theories and formulas, when these are applied to predict experimentation outcomes or to promote techno-logical development. Nevertheless, one cannot overlook the fact that precision is in all cases defined within "reasonable" approximation limits, which inhere in the instruments used and in the "practical" significance of the measurements effected. Normally, no physicist or engineer would speak of absolute and definitive precision, because this is systematically out of our reach, and practically useless. Moreover, "precision" is celebrated with a special reference to the measurement of rather simple or elementary events¹⁰⁴, whereas major problems arise when more complex sets of events are observed and measured, like those - for example - of a meteorological or biological nature.

As to gravitation, General Relativity has been hailed as a revelation also in consideration of its "precision" in assessing Mercure's perihelion precession; but it is only a "good" approximation to what has been detected by observational measurements. This should not be considered as a "better explanation" for the phenomenon, which can also be "explained" or "predicted" with an analogous precision by Newton's theory (much simpler than Relativity), once the polar contraction of the solar sphere (*i.e.*, the oblate solar spheroid) is also allowed for along with the associated planetary perturbation analysis. Not to mention other possible corrections

¹⁰⁴ Quantum mechanics, which deals with a number of elementary particles observed at extremely small scales, has corroborated the myth of "scientific precision", so as to induce some quantum physicists to believe that the theory is not only an effective model of what they study, but also a *true* description of reality. Such a philosophical belief, however, contradicts at least the *principle of indetermination*, on which quantum mechanics is based. In the light of that principle, physicists should know very well that their observations and tests do inevitably distort the study reality. Therefore, what they observe and theorize on is not the reality in itself, but the *distortion* they have caused. Nevertheless, sophisticated observation and experimentation instruments - along with specific rules of measurement, description and control - have created quite a special "game environment" which, yes, is *almost* self-consistent and exceptionally precise.

to Newton's gravitational equation in the light of the remarks presented in Paragraphs 5.2.1 and 5.2.2.

Remarks of the same kind regard the "bending effect" encountered by beams of light when they cross gravitational fields. The phenomenon can also be "explained" by Newton's theory, though with a probably lower level of approximation. In any case, for practical purposes, Newtonian theory is much more usable than General Relativity.¹⁰⁵ We have recently experienced, for example, that the theoretical "improvement" in our knowledge brought by General Relativity about gravitation has implied no improvement in our control over gravity, so that – for technical use – we substantially rely still upon the gravitation model formulated by Newton.

What I do here mean is that "precision" is naturally associated with both the effectiveness of observation instruments *and* practical needs.

The idea or hope to attain a "final theory" capable of a final and absolute precision might reveal a very expensive illusion.

As a conclusion, I deem it unwise renouncing the variety of very effective theoretical *models* for the sake of a "grand unified theory". If scientific theoretical instruments aim basically at improving our practical control over physical phenomena, then various specific theories (or models) could be much more useful than a complicated unified theory that aims instead – whatever the cost in terms of usability – at obtaining a logical reconciliation between the innumerable aspects of the whole.

The purpose of a "grand unified theory" is perhaps to achieve the ultimate truth, which remains a noble philosophical objective. Nevertheless, I incline to believe that the probability of achieving such a goal is close to nil.

I disagree with all those who believe that "God" has used mathematical equations to design the universe and that our task is to find the *true equations*. Galileo, like Pythagoras two thousand years before him, was probably wrong concerning this point: Nature does not seem written in mathematical terms. In my opinion, there is a serious prejudice that might

¹⁰⁵ "The experiments of Eddington and his co-workers had only 30% accuracy, and succeeding eclipse experiments were not much better: the results were scattered between one half and twice the Einstein value, and the accuracy was low": Clifford Will, *The Renaissance of General Relativity*, Page 12, in "The New Physics", edited by Paul Davies, Cambridge University Press, UK, 1989. This means the Newtonian model can still compete with Einstein's.

In this connection, see also Footnote 89, Page 113, concerning the gravitational deflection of light calculated in 1801 by Von Soldner by use of Newton's gravitation law.

hamper the healthy development of science. In this connection, I deem it worth quoting also Italian physicist Tullio Regge:

"Mathematics cannot be considered as a closed and complete set of axioms and theorems. The world of mathematics is open and unlimited. No finite set of postulates and deductions can give us all the answers we may look for. Gödel's theorem [*the theorem of incompleteness*], enunciated more than half a century ago, has brutally put an end to all attempts to condense mathematics in a limited list of axioms whence every true or false assertion can be derived. If even the language of mathematics – which is used by physics to describe the world – is intrinsically incomplete, it is not reasonable to expect that the entire universe could be described starting from a finite set of natural laws. Many dislike the incompleteness of mathematics and – therefore – of physics. However, Gödel's theorem is not at all a defeat of positive science, since – to the contrary – it is an intellectual thrust toward more and more profound achievements".¹⁰⁶

Yes; provided we renounce once and for all to tie our imagination to dogmas and myths.

According to what we have learnt through our historical experience, mathematics – where applicable – is certainly the best language to formulate hypotheses and to prove the relevant implications, because it minimises ambiguities, yields very useful results through calculation, and has the power of giving unexpected but certain evidence to invisible *logical truths* hidden inside hypotheses. However, what this tautological aspect of mathematics indicates clearly is that the capability of conceiving fertile hypotheses is just the mental activity that matters. Such a capability, in its turn, is the result of the physiological language inherent in the largely unknown system of "chaotic" relationships that bind us to the world, of which we are nothing but a few of the innumerable components.

Finally: I think we should avoid taking Newton's gravitational law as a dogma against the mental attitude of Newton himself, or considering General Relativity as the *final* or *best theory* of gravitation. Einstein himself had most likely to realise that his theory is not self-sufficient and leads to not negligible contradictions, such as, for example, the *rigid and immobile physical space* ("something like" the "ether" he felt obliged to reconsider after years of contempt for it),¹⁰⁷ which should however *wave* with photons

¹⁰⁶ Tullio Regge, *Infinito*, Mondadori, Milano, 1969, Pages 17-18, *op. cit.*

¹⁰⁷ Einstein had to write: "*I would have been more correct if I had limited myself, in earlier publications, to emphasizing only the non-existence of an ether velocity, instead of arguing the total non-existence of the ether, for I can see that with the word 'ether' we say*

and be *warped* by masses and energy. Moreover, how can the motion of masses (whatever these were for Einstein) avoid displacing the ether around them, especially if oscillating masses shall generate gravitational waves? Nevertheless, it must also be acknowledged that Einstein – out of any formal theory – came eventually to *imagine* the *physical space* as the matrix of everything and even that gravitational fields, along with the occurrence of electromagnetic phenomena, shall be considered as the cosmic sources of matter; which is a baffling intuition that clashes with the basic “Newtonian” assumptions of his General Relativity.

From the other side, that of quantum physics, *scientific activity* is sterile as to gravity and gravitation: Quantum physics experimentation has so far provided no indication on what gravity is, while theoretical activity has in certain cases entered a “mathematical delirium”, which takes theorists to range far and wide in the regions of metaphysics and myth.

In 1954, in an accidental consonance with Einstein’s ultimate philosophy, Enrico Fermi, a few months before his death, declared publicly that the future of physics shall root in the study of the “vacuum”. I deem it is quite a reliable prophecy.¹⁰⁸

nothing else than that space has to be viewed as a carrier of physical qualities”, and: “*This rigid four-dimensional space of the special theory of relativity is to some extent a four-dimensional analogue of H. A. Lorentz’s three-dimensional ether*”; as well as: “*Physical space and ether are only different terms for the same thing; fields are physical states of space. If no particular state of motion can be ascribed to the ether, there do not seem to be any grounds for introducing it as an entity of a special sort alongside space*”; quoted by Ludwik Kostro in his book *Einstein and the Ether*, Apéiron, Montreal 2000, pp. 123, 124, 150.

¹⁰⁸ On the subject, see also Attachment to Part I: *Physicists and the Vacuum*.

An Analytical Attachment to Part II

A1 - A determinant contribution from Newton

What expounded in Paragraph 5.2.1 about Newton's mechanics deserves a special attention, since one of the most ingenious Newton's achievements consists of proving that Keplerian orbits imply *central accelerations*. Any *central* acceleration, which in general - according to analytical mechanics - does not coincide with *centripetal* acceleration, is a kinematical property inherent in any motion that obeys Kepler's laws, and the Keplerian second law in particular regarding the constancy of the *area speed*, i.e., the area of the orbit's sector "wiped" per time unit by the vector radius that connects the planet to the Sun. This appears to be obvious if one considers any circular motion that occurs at a uniform speed, but it is not obvious as to any other non-uniform motion along different paths such as - for instance - the elliptic orbits of planets and satellites.

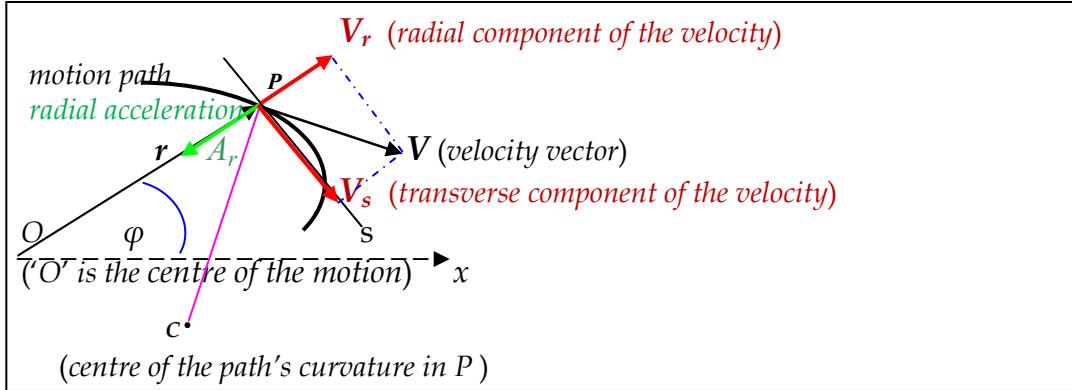
Kepler's laws are of a *kinematical* nature. Kinematics shows how a constant *centripetal* acceleration is associated with a point in uniform motion along a circular path. In any circular uniform motion it's the only possible acceleration, to mean that - as to kinematics - there is *no* centrifugal acceleration if the point in motion has no mass. *Centrifugal acceleration* intervenes with a *force* only if a measurable mass affects the point in motion, as Huygens proved, and according to Newton's second and third laws of dynamics. At Newton's time, however, kinematics was still rather primitive, because the mathematics to describe motion was not fully adequate for the purpose, which led Newton to cast the basis of differential analysis, while his analytical instruments remained substantially of a geometrical nature.

If the circular motion occurs at a *variable speed*, then the point in motion undergoes a varying acceleration that is no more only centripetal, but changes according to the *composition* of the *centripetal* acceleration with the *tangential* acceleration perpendicular to the former. In such a case, there is no compliance with Kepler's second law; therefore, as we shall see, there is *no central acceleration* as this is defined by the concept introduced by Newton.¹⁰⁹

A2 - Recalling concepts about plane motion

Consider point P in motion along a plane curve, and describe it by means of a fixed polar reference frame, where O is the origin of the polar co-ordinates, r is the vector radius, and φ is the angular co-ordinate. Say \vec{V} the velocity vector of the point in motion.

¹⁰⁹ In Newton's terminology, the term "centripetal" must nowadays be translated into "central", to mean accelerations and forces constantly directed toward a fixed centre.



The figure above is the representation of a point that moves along any plane path, at a variable velocity \vec{V} expressed through the relevant vector notation:

$$[A1] \quad \vec{V} = \vec{V}_r + \vec{V}_s = \frac{dr}{dt} \vec{r} + r \frac{d\varphi}{dt} \vec{s},$$

in which vectors \vec{V}_r and \vec{V}_s are usually dubbed “radial vector component” and “transverse vector component”, respectively, of vector velocity \vec{V} .

In general, the acceleration \vec{A} undergone by point P is obtained through the derivative of [A1] with respect to time t , and is expressed by

$$[A2] \quad \vec{A} = \left[\frac{d^2 r}{dt^2} - r \left(\frac{d\varphi}{dt} \right)^2 \right] \vec{r} + \frac{1}{r} \frac{d}{dt} \left(r^2 \frac{d\varphi}{dt} \right) \vec{s}$$

in which

$$[A2.1] \quad \vec{A}_r = \left[\frac{d^2 r}{dt^2} - r \left(\frac{d\varphi}{dt} \right)^2 \right] \vec{r} \quad \text{is the radial component of the acceleration and}$$

$$[A2.2] \quad \vec{A}_s = \frac{1}{r} \frac{d}{dt} \left(r^2 \frac{d\varphi}{dt} \right) \vec{s} \quad \text{is the transverse component,}$$

perpendicular to the former.

As to kinematics, the relations written above pertain to any kind of plane motion.

Now suppose that the motion path followed by point P is that of a planetary orbit. In such a case, the quantity expressed in [A2.2] by

$$[A3] \quad r^2 \frac{d\varphi}{dt} = D$$

is a constant quantity as per Kepler's second law, since D expresses the double of the area speed of vector radius r , which radius is now the distance between planet P and the center O (the Sun in this case) of the

planetary motion. To conclude that *all orbital motions* are “*central motions*” as far as the transverse acceleration is nil, since

$$[A4] \quad \frac{d}{dt} \left(r^2 \frac{d\varphi}{dt} \right) = \frac{dD}{dt} = 0.$$

Therefore, in any kind of **orbital motion**, i.e., **irrespective of the orbit's shape**, there is a systematic *central acceleration* \vec{A}_C - constantly directed toward the center of the motion - which is associated with a *central force* directly proportional to the mass of the planet (Newton's second law of dynamics). This force applies to any material body together with the relevant reaction, i.e., with the opposite and equivalent *centrifugal force*, as per Newton's third law of dynamics.

Newton, using his own differential notation, was the first to identify and formulate relations [A1] and [A2].

The concept of *central acceleration* defines the concept of *central motion* in kinematics, and is indissolubly associated with the concept of *central force* in dynamics.

A3 - An important contribution from Binet

Mathematical analysis and calculus, which are substantially due to Gottfried Leibniz (1646-1716)¹¹⁰, had an amazing development during the 18th, 19th and 20th centuries, thanks to the cardinal contributions from a remarkable number of ingenious mathematicians. Italian-French mathematician Giuseppe Luigi Lagrange (1736-1813) published - among a number of other fundamental works - the first complete treatise of analytical mechanics (*Mécanique Analytique*, 1788), which included the analysis of the gravitational “three-body problem” along with the theory of the “perturbation analysis”, used to determine the mutual influence between the celestial bodies of the solar system. In that context, the translation of central acceleration \vec{A}_C from its kinematical formulation [A2.1] into a mere geometrical formulation, as given by French mathema-

¹¹⁰ German philosopher, precocious and ingenious mathematician, Leibniz created the methods and the notation for the derivation of any mathematical function as we still use today, along with methods and notation for integral calculus.

As it may happen to humans, his life was troubled by the long and harsh controversy with Newton (clumsily conducted by Leibniz) concerning the priority in founding infinitesimal analysis and calculus. Beyond that, Leibniz's work *Nova methodus pro maximis et minimis itemque tangentibus...*, Acta Eruditorum, Leipzig 1684, was published three years before the publication of Newton's “*Principia*”.

Leibniz can also be considered as the founder of modern formal logic.

tician Jacques Binet (1786-1856), shall be viewed as an important contribution, largely used in this essay.

In this connection, consider that the derivative of the vector radius r with respect to time can be expressed in function of the variation of angle φ during **any central motion, to write, also accounting for [A3]**,

$$[A5] \quad \frac{dr}{dt} = \frac{dr}{d\varphi} \frac{d\varphi}{dt} = \frac{D}{r^2} \frac{dr}{d\varphi} = -D \frac{d}{d\varphi} \left(\frac{1}{r} \right);$$

from which, in an analogous way, also

$$[A6] \quad \frac{d^2 r}{dt^2} = -D \frac{d\varphi}{dt} \frac{d^2}{d\varphi^2} \left(\frac{1}{r} \right) = -\frac{D^2}{r^2} \frac{d^2}{d\varphi^2} \left(\frac{1}{r} \right).$$

It is then possible to re-write *radial acceleration* \vec{A}_r , as *central acceleration* \vec{A}_C after replacing, in the second term of \vec{A}_r , also $\frac{d\varphi}{dt}$ with D / r^2 (see [A3] above), in order to obtain

$$[A7] \quad \vec{A}_C = -\frac{D^2}{r^2} \left[\frac{1}{r} + \frac{d^2}{d\varphi^2} \left(\frac{1}{r} \right) \right] \vec{r}.$$

In this formula for *central* acceleration the time parameter has been eliminated, thus obtaining a mere geometrical expression for acceleration by use of the only variables proper to the polar reference frame adopted, thanks to the area constant D inherent in *central* motions. The measurement of time has here been replaced by that of angles, in an analogy with the measurement of time reported by the hands of a clock.

It is also worth observing that *central* motions do not pertain to Keplerian orbits only: *central* motions include any other plane motions (for example, spiral, parabolic or hyperbolic motions) which comply with the law concerning the *constancy of the area speed*.

An immediate and important mathematical implication of \vec{A}_C is that *central* motions can **only develop on a plane** (for instance, a "spherical" *central* motion is impossible). Amongst other things, it is the principle on which the dynamics of gyroscope stability is based.

A4 - A simple verification

Equation [A7] may be used for a quick verification of the general validity of the Newtonian formula [25.4] introduced in Paragraph 2.5.1, which expresses the strength of each of the joint central and centrifugal accelerations undergone by any planet in the respective elliptic orbit.

Let's start bearing in mind that the double of the area speed, in any planetary elliptic orbit, *i.e.*, constant D , is given by

$$[A8] \quad D = \frac{2\pi R \sqrt{R^2 - a^2}}{T} = \frac{2\pi R b}{T},$$

where R is the ellipse's major semi-axis, b is the semi minor-axis, a is the distance of each focus from the ellipse's center, and T is the planet's revolution period. The orbit's variable vector radius r verifies the ellipse's equation that – in polar co-ordinates – is given by

$$[A9] \quad r = \frac{b^2}{R(1 + \varepsilon \cos \varphi)},$$

ε being the ellipse's eccentricity. Let's use this equation to substitute r in the section between square brackets of Equation [A7], to write

$$[A10] \quad A_C = \frac{4\pi^2 R^2 b^2}{T^2 r^2} \left[\frac{R(1 + \varepsilon \cos \varphi)}{b^2} + \frac{R}{b^2} \frac{d^2}{d\varphi^2} (1 + \varepsilon \cos \varphi) \right];$$

to conclude immediately that

$$[A11] \quad A_C = \frac{4\pi^2 R^2 b^2}{T^2 r^2} \frac{R}{b^2} = \frac{4\pi^2 R^3}{T^2 r^2}.$$

Because of the Keplerian second law, it is $T^2 = R^3/K_S$, in which K_S is the Keplerian constant relative to the Sun; so that [A11] coincides with

$$[25.4] \quad A_C = \frac{4\pi^2 K_S}{r^2} = a_P = \frac{4\pi^2 K_S}{R_P^2}.$$

It seems evident that Equation [A7], established by Binet for *central acceleration*, is a generalization of Equation [25.4] found by Newton, since the latter is *per se*, already, a translation of a kinematical definition of "acceleration" into a mere geometrical formulation of the concept, in which the time variable is not allowed for. Actually, Newton's Equation [25.4] identifies a *stationary field* of acceleration whose strength depends only on the distance from the Sun.

Considering that $K_S = NM$ and $G = 4\pi^2 N$, Equation [25.4] can lead to interpret the *gravitational acceleration* as a quantity directly proportional to the product of mass M and the *space spherical curvature* $1/r^2$ at any distance r from the mass center, G being the constant of proportionality; for, as already seen in Paragraph 5.2.1, gravitational acceleration is expressed by

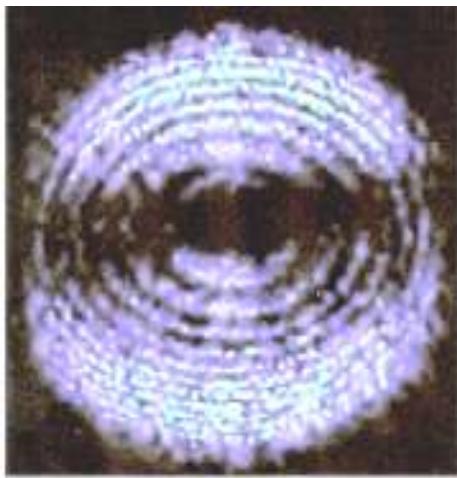
$$[A12] \quad A_{grav} = GM/r^2.$$

Thus, we realize that Newton's *gravitational dynamics* consists in the spherical *geometry* of the physical space centered on any mass, in that Equation [A12] is a function of the relevant *spherical curvature*. Shall we think it is the mass itself that *bends* the physical space around?

UPDATING ATTACHMENT TO PART II
February 2008 - The Electron's Portrait

By the end of February 2008, European media spread the news concerning a top achievement of micro-technology. According to the news, physicists of the University of Lund in Sweden have been able to shoot a film of one single electron, after having pulled it away from its atom.

The image of the electron published by press as well as on the Internet is shown here below. Scepticism might be expressed as a first reaction to the news. According to quantum physics, the probability of localising and imaging an electron is nearly zero, because both of the extremely small size of this particle and of the not negligible distorting effects caused by the impacting photons used to see it. Therefore, some might be of the reasonable opinion that the regarded image doesn't show an electron, but instead the effect of the impact of photons on the electron. The technical explanation that is so far available reports on a laser technique which is usual in ionising atoms. Laser fields with electromagnetic waves of an appropriate frequency can produce a resonance effect in atoms, which causes the scattering of electrons away from the atoms. The point is to keep a freed electron under control, in order to drive and keep it within the visual field of an optical detector, accounting for the extremely high speed of the electron's motion. Lund's physicists avoid speaking of "image of electron", since instead they prefer to point out that the filmed sequence shows "the electron's momentum distribution in space". The sequence of the film, however, shows a series of almost identical images, caught and impressed through a stroboscope-like effect. A stroboscopic sequence can fix, for instance, a series of images of the blades of a propeller in motion: in such a case we might also speak of distribution of the blades' momentum in space, though it would probably be simpler to state that each image portrays a propeller. Lund physicists' paper abounds on highly specialist technical details concerning method, equipment and procedures adopted in the experiment.^{*}



^{*} J. Mauritsson, P. Johnsson & Al., *Coherent Electron Scattering Captured by Attosecond Quantum Stroboscope*, Physical Review Letters 100, 073003-Feb. 2008. (The above image of electron is taken from <http://www.livescience.com>, February 2008).