Part II

Macro Gravitation

Proposition: Einstein's General Theory of Relativity (GTR) is not applicable to the entire universe.
Proof: Let us assume the opposite, that Einstein's GTR is applicable to the entire universe. Under the assumption that gravitation is the only significant large-scale interaction Einstein's GTR is then the appropriate theoretical tool for attaining a model of the universe. A cosmological model which is based on the assumption that Einstein's GTR is applicable to the entire universe has already been developed; it is the expanding-universe model. The expanding-universe model essentially contradicts three principles embodied in the theory that has been applied for its development:

1. The starting point of physics is the tacit postulate that physical reality can be described quantitatively and that this reality is governed by principles. Contrary to this postulate, it is proven by Hawking's singularity theorem that if Einstein's GTR is universally valid then there necessarily was a "beginning of time" in which the entire universe was in a state of singularity. In a state of singularity physics breaks down and an adequate description of physical reality is impossible. A description of physical reality as singularity essentially contradicts the starting point of physics. [1] Therefore, a consistent physical verification which leads to a picture of space-time singularity indicates nothing but the existence of at least one misleading underlying supposition. [2] Clues to what that supposition might be are provided by the following contradictory results.

2. According to Einstein's Relativity massive matter is always slower than light which is propagated at the massive matter's empty space vicinity. It is possible for massive matter to move at the velocity of light in vacuum and faster ***only if***

[1] Instead of facing the fact that his theorem proves that Einstein's great theory is limited, Hawking later tried to "avoid" singularity by the introduction of an ad-hoc hypothesis.
[2] Gravitational collapse as well, no matter how much mass is involved, ***never*** ends up in singularity. The principal anti-singularity measure is introduced hereafter; the auxiliary measure is introduced in Part III.

the gravitational potential at its vicinity is higher than the gravitational potential at the light vicinity. But under the assumption that Einstein's GTR is applicable to the entire universe, contradictory results are obtained: massive matter which is at sufficient distance from the observer recedes at the velocity of light and faster in spite of the low gravitational potential which is attributed to the past by the expanding-universe picture due to higher density of gravitational mass then. The matter which, with respect to some reference frames is faster than light is slower than light with respect to other reference frames, so it is not tachyon-matter but a severe contradiction to Relativity. A "solution" to that contradiction has been worked out: "…the galaxies are encrusted in space and therefore are not moving relative to space; however, space itself is in motion, expanding and creating more and more room between any two given points as time goes by…" (Magueijo, 2003, p. 87). The expression "relative to space" is of no physical significance, as *only* a material frame can be used as a frame of reference. It was due to that fundamental principle that the "*luminiferous ether*" was abandoned. Reviving the superfluous ether in the form of "expanding ether" contradicts the foundations of Relativity.

3. Einstein's General Relativity embodies the supposition that time is homogeneous, which practically means that all the fundamental parameters of nature are universal constants. Contrary to this tacit assumption, the expanding-universe model has "discovered" a new fundamental parameter whose value is not constant. This parameter, which has no local significance whatsoever, is called, ironically, Hubble *constant* (Walker, 1988).

Conclusion: The expanding-universe model contradicts the theoretical tool that has been employed for its development. Therefore, this model, even if not intentionally developed as such, is a perfect proof by contradiction that *Einstein's General Relativity is not applicable to the entire universe*.

The above three contradictory results are but a few of the inherent contradictions of the expanding-universe model. This model results from the dogmatic application of a limited theory outside the limited domain where it is useful. Consequently, the expanding-universe model is inherently contradictory and superfluous. The expanding universe is essentially similar to the geocentric celestial spheres and to the *luminiferous* ether. Like them, it should be abandoned.

The expanding-universe cosmology is guided by the question: "What is the solution of Einstein's field equations for the entire universe?" The key question is

rather: "Are Einstein's field equations applicable to the entire universe?" The answer to this key question is definitely negative. Einstein's insightful theory is based on a narrow data base—observations of the solar system and actually nothing more. Under the assumption that Einstein's theory is of universal applicability, central observations—of kinds that were not even guessed when Einstein's theory had been formulated—are interpreted as evidences of the existence of invisible, gigantic "physical realities" ("expanding universe", "dark matter", "dark energy", and their byproducts). When the relevant principles of Nature are exposed, these invisible, gigantic "physical realities" are found superfluous, essentially analogous to the "celestial spheres" and to the "luminiferous ether". It is shown in Part I that Einstein's Special Relativity is a simplification of Time-Asymmetric Special Relativity. In this part it is shown that Newton's Universal Law of Gravitation is a simplification of the Magnitude-Controlled Law of Macro Gravitation—a law which approximates macro gravitation to a force whose magnitude is controlled by Nature and can be magnified from the minimal magnitude given by Newton's law. A universally applicable theory of gravitation should be based on the above two non-simplified elementary theories and not, as Einstein's GTR is, on their simplifications.

1. The Large-Scale Structure of the Cosmos

The assumptions that time is homogeneous and that Einstein's GTR is applicable to the entire universe are misleading assumptions. The abandonment of these assumptions leads to time-asymmetric physics which essentially changes the interpretation of the extra-galactic observations. The observations, which are wrongly interpreted as demonstrations of a universal expansion or of continuous creation of variable mass matter (Arp, 1988) are instead interpreted as demonstrations of the non-homogeneity of time. They indicate that during our observable past the value of the variant speed of light with respect to Earth has decreased continuously (this is explained hereafter in section 4). The time-asymmetric interpretation of the cosmological red-shift is the starting point for the understanding of the structure of the cosmos. That structure is the necessary starting point for a universal theory of macro gravitation, in the same way that the heliocentric kinematics of the solar system was the necessary starting point for Newton's theory of gravitation and for its geometrical modification by Einstein.

The magnitude of the red-shift in the spectra of galaxies increases, in general, with their distances. This empirical rule, however, does not hold true for galaxies of the

local cluster, in which even a violet-shifted spectrum appears. The time-asymmetric interpretation of this empirical phenomenon is that the observable shift in the spectra of galaxies is due to two separate effects: the time-effect, and the Doppler Effect. (A third effect, which reinforced the red-shift of quasars and of cosmological radio sources, is introduced later in this part.) In our observable past, the magnitude of the red-shift due to the time-effect increases monotonously as the distance of the emission event. The shift due to the Doppler Effect, however, can equally be red or violet and its magnitude (except of supernovas and relativistic jets) lies in the non-relativistic domain. For members of the local cluster, the time-effect is still of the same order of magnitude as the Doppler Effect, and the resultant shift reveals no clear relation to the distance of the emission event. For observations of other clusters the magnitude of the Doppler Effect is negligible in comparison with the magnitude of the time-effect. In that domain, the time-effect dominants, and consequently the observable red-shift monotonously increase with distance. This interpretation, by which the magnitude of the Doppler Effect is non-relativistic implies that *the relative velocities between galaxies are non-relativistic*.

It is commonly believed at the present time that no macroscopic amounts of antimatter exist. This view is based on the fact that no antiparticles was found in the primary cosmic rays—would there be significant macroscopic amounts of antimatter in the universe, this would (as commonly understood today) have its representation in the cosmic rays. [3] This view when combined with the fictitious realm of the big bang leads to the belief in "breaking the matter-antimatter symmetry at the beginning of the universe"—which is nothing but one of the false byproducts of the expanding universe model.

Central in Periodic Physics is the Principle of Supreme Design; it is, among the other things, crucial for understanding why there is no significant amount of antimatter in the primary cosmic rays.

Principle of Supreme Design
The universe is supremely designed, inspected, and controlled, such that at any epoch there are numerous solar systems which host life and numerous solar systems at recycling processes preparing to host life.

The expression "the universe at a certain epoch" is of an absolute significance (read hereafter about absolute simultaneity). "Supremely" here means: done in

[3] Eventually, some tiny amount of antiparticles has been found in the primary cosmic rays.

supreme quality and by principles only (without any material tool). Due to the Principle of Supreme Design the universe is eternally active and full of life. Contrary to Modern Physics' universe which is analogous to a projectile, Periodic Physics' universe is analogous to a modern aircraft; there is a careful flight plan, the flight is continuously inspected and controlled such that the plan is exactly executed. The fact that humans can design or destroy a certain, extremely tiny, part of the physical universe does not mean that everything else is accidental. The origin and the role of cosmic rays are explained in the third and the fourth parts of this book. Cosmic rays maintain the high temperature of Earth's core, which is one of the crucial conditions for life. Significant amounts of antimatter cosmic rays would generate mighty gamma rays which would severely harm life. Cosmic rays are designed, inspected, and controlled to support life; therefore, no significant amount of antimatter cosmic rays approach a matter living planet.

In reality (not only in physical reality) there are plenty of complementary pairs. That many things appear in complementary pairs is a fundamental pattern of nature. Matter and antimatter constitute a complementary pair, and due to symmetry considerations, gravitation-dynamic considerations, and observations of extra red-shifted objects, the two kinds appear evenly in the universe.

The conclusion that relative velocities between galaxies are non-relativistic, and the fact that the observable large-scale distribution of matter in the universe seems to be practically constant, suggest that the universe, on the very large-scale, is static. A static and finite universe, which is impossible according to Modern Physics' theory of gravitation, is possible according to its modification by Periodic Physics. This modification requires also a thorough reconsideration of Modern Physics' view of gravitational mass. The universe is then analogous to a crystal: the galaxies, like ions in a crystal, are bound to their vicinities by restoring gravitation.

The spatial volume where any physical matter can be found is finite; matter galaxies and antimatter galaxies occur evenly; the galaxies are arranged in a "solid" ellipsoid and each galaxy rotates in its vicinity.

2. Observations on Einstein's Theory of Gravitation

Einstein's theory of gravitation, while useful when applied to the solar system and to various kinds of stars, totally fails when applied to the entire universe. The

expanding-universe cosmology is based on the false deduction by which the success of Einstein's theory in the solar system guarantees its universal validity. The application of this theory to the entire universe is not perceived as it should be, as a test of the validity-domain of the theory, but as an operation revealing the facts of reality.

The universal validity of Einstein's theory is usually believed to be beyond doubt. Consequently, central observations which cannot be explained by Modern Physics and are the keys for its modification are, instead, regarded as evidences of the existence of invisible, gigantic "physical realities". Current modern cosmology is in a dead end where rich and highly significant observations, achieved by highly advanced technology, are digested to a fairy tale. In this fairy tale, the observable matter is a marginal 4% character, while the main roles are played by gigantic ghosts. The primal father, "Expanding universe", gives virtual birth to its own "Inflation", to its own "Accelerated expansion", and to the biggest invisible 74% giant, "Dark energy". Misunderstanding of the large-scale propagation of light and partial understanding of gravitation, give virtual birth to the secondary big giant, the invisible 22% "Dark matter".

"Expanding universe", "Dark matter" and "Dark energy" possess the unmistakable properties of superfluous concepts. They ultimately result from treating both the correct and the misleading assumptions of Modern Physics as final set of dogmas, while ignoring the facts that *physics develops in stages* and that *observations of the remote past, of glowing nebula, of globular cluster, and more lie outside the applicability-domain of Modern Physics*. Contrary to the officially declared scientific methods, discrepancies in modern cosmology are regarded as apparent discrepancies and are "explained" by casuistry. The following is an amusing example of how a chain of contemporary cosmological fictions is used to serve very practical interests. "Dark energy" accelerates[4] the "expansion of the universe" such that the "horizon", which prevents observations of violations of physics, gets closer. Thus, there is an urgent demand for large budget intensive observations to record these parts of the universe which are going to "disappear" soon... The expanding-universe model, together with all its byproducts, is essentially similar to the geocentric model and its byproducts. Both models demonstrate that whenever misleading assumptions are dogmatically applied to a physical domain in which they are not useful, a ridiculous mixture of science and myth results.

[4] Under the misleading assumption that the universe is expanding, certain observations are interpreted as evidences that the expansion is accelerated.

Can physical reality at a certain event be instantaneously affected by physical reality at another event which lies outside its past-cone? Does instantaneous influence, which is not propagated, exist? Einstein believed that Special Relativity excludes instantaneous influence. Special Relativity, however, is concerned with massive particles, light and electromagnetic fields. In other words, Special Relativity is concerned with all kinds of particles: massive particles, photons, virtual field mediators and even tachyons. [5] Thus, Special Relativity is of no use regarding the question: "Does instantaneous influence exist?" Instantaneous influence, if it exists, does not involve mediators, so this topic is not in the domain of Special Relativity.

When the Einstein-Podolsky-Rosen paradox was put to the test, it was found that with respect to the collapse of wave-functions, Einstein's conviction about the impossibility of instantaneous transfer of signals was false. Wave-functions collapse instantaneously; this phenomenon is not a propagated one. That empirical fact, however, was not known in Einstein's time. Fascinated with his great discovery that no observable particle is faster than light, and in light of his quest for unification of gravitation and electromagnetism, Einstein inserted a term to his field equations which converts Newton's instantaneous gravitation into a wavy gravitation which is propagated at the velocity of light. According to Einstein's GTR, physical reality at a certain event is affected gravitationally by the gravitational mass at the surface of its past-cone.

The intensive and prolonged efforts to directly detect gravitational waves eventually yielded a positive result on September 14th 2015. The gravitational waves observed in LIGO150914 were produced in a merging event of two black holes during which about three solar masses had abruptly disappeared. According to Part III of this book, they "disappeared" because in approaching-singularity states, massive matter is converted to its orthogonal form and disappears to the unobservable orthogonal universe. An indirect experimental confirmation for the existence of gravitational waves also exists: the observed reduction in the orbital energy of the binary pulsar PSR 1913+16 which corresponds to emission of gravitational waves. Also in this case, according to Periodic Physics, singularity is prevented by the conversion of massive matter to its unobservable orthogonal form (in a less intensive rate in this case).

[5] Tachyons move faster than light and their mass is imaginary, which means that they are unobservable in principle and cannot transfer any influence; a new view of these particles is introduced in Part III.

Due to the principle of supreme design, Nature controls physical reality such that the supreme design is executed. This is done by controlled gravitation, which instantaneously determines the geometry of space-time. Gravitational waves are definitely not the geometry of space-time; they are only ripples in this geometry. Gravitational waves do not carry energy, and are generated *only* when gravitational mass disappears or vanishes. Gravitational mass disappears when it is converted to its orthogonal form, and it vanishes in thermo-nuclear fusions, nuclear fissions, and radioactive reactions. The difference between the two kinds is that in the first kind everything associated with the gravitational mass is converted to its orthogonal form, while in the second kind the associated inertial mass is converted to other forms of observable energy. In both cases, no energy is carried by the gravitational waves. Matter-antimatter annihilations do not generate gravitational waves; in these processes the total gravitational mass of the system under discussion is zero before and after the reaction.

Einstein misinterpreted his correct field equations. He believed that his field equations were a complete description of gravitation, that gravitation was always propagated, and that gravitational waves carried energy. This is not true. Length-dependent gravitation is of two kinds:

- Instantaneous gravitation—results from the presence of gravitational mass
- Gravitational waves—result only from disappearing or vanishing of gravitational mass

An event of the disappearing or vanishing of gravitational mass results in two gravitational outcomes:

1. An instantaneous change of the gravitational field which is affected by this event.
2. A gravitational wave which is propagated away from this event at the speed of light.

According to this interpretation of gravitational waves, it might be possible to detect gravitational waves at the proximity of nuclear reactors (gravitational mass vanishes there). An optic fiber interferometer with one coil arm around a reactor and the other arm pointing radially away from the reactor might detect a change in the interference pattern when the reactor is shut down.

Einstein's principle of equivalence actually refers to two different states of a reference frame in the instantaneous gravitational field; it is reformulated to the following:

First Principle of Equivalence
Free fall of a purely-matter system or of a purely-antimatter system in a uniformly operated gravitational field is infinitesimally equivalent to uniform motion in a hypothetical universe free of gravitation; stationary state of a purely-matter system or of a purely-antimatter system in a uniformly operated gravitational field is infinitesimally equivalent to uniform acceleration in a hypothetical universe free of gravitation.

The gravitational field might be different for different particles at the same infinitesimal vicinity; but at the default choice of the governing programs, it is uniformly operated—it is uniform for all the physical substance in the same infinitesimal vicinity. Another restriction on the validity domain of the first principle of equivalence is that the frames under consideration should not be mixture of matter and antimatter but purely constituted of matter or purely constituted of antimatter. Due to the first principle of equivalence, observations inside an infinitesimal free-falling frame (in a uniformly operated gravitational field) cannot, in principle, distinguish this frame from a frame which hovers at uniform motion in a hypothetical universe free from gravitation. The free fall creates in the free-falling frame an inverse gravitational field which counteracts the gravitational field which generates the free fall. For non-infinitesimal free-falling frames, like planet Earth, the principle implies that the curvature due to the external field is constantly zero. Consequently, the weight of objects in a free-falling frame is solely determined by the frame itself. Tidal effects can be caused by the gravitational field that generates the free-fall and by objects (moons) that fall freely in the field of a large free-falling frame, but all the exterior gravitational fields do not affect the gravitational field in the frame (have no effect on the weight of objects in the frame). The universal field, which determines the positions of galaxies, vanishes in them; the galactic field, which determines the kinematics of the galaxy's members, vanish in them; the Sun and the Moon do not affect the weight of objects on Earth (otherwise, objects would weight more at midnight, less at noon). Detection of gravitational waves can be used for the distinction of a free falling frame from a frame in uniform motion in hypothetical universe free of gravitation. Thus, Einstein's principle of equivalence does not include gravitational waves and is actually valid only for the instantaneous length-dependent gravitation, which will be called also **macro gravitation**.

Gravitation is geometry; geometry, even propagated geometry does not require mediators. Gravitons do not exist.

Macro gravitation and length-dependent electricity constitute a complementary pair of two entirely different interactions. [6]

Principle of Difference
Macro gravitation differs from length-dependent electricity in all respects.

This postulate is in conflict with the contemporary view of gravitation, which includes the knowledge that macro gravitation is geometry while macro electricity is force-field, but is not aware of the full implications of this fact. According to contemporary view, gravitation, like electricity, is governed by equations and its magnitude is also a function of the variant distance of the affecting event from the affected event. Also, according to contemporary view, the gravitational influence on an origin has been propagated from the surface of its past-cone at the velocity of light, and that to a gravitational action there is a reaction according to Newton's third law. The principle of difference, however, asserts that macro gravitation differs from length-dependent electricity also in these respects. Macro gravitation is governed by programs, not by equations, and its magnitude is a function of the additional distance (in space-time) of the affecting event from the affected event. The gravitational affecting space is definitely not the surface of the past-cone, macro gravitation is not propagated but instantaneous, and Newton's third law of action and reaction is, in general, not applicable to gravitation.

Internal observations of the solar system can detect only the mutual gravitational interaction between the system's members. In this local domain gravitation currently behaves as if it is governed by equations (this is the default choice of the governing programs), and the gravitationally simultaneous space practically coincides with the electromagnetically simultaneous space, and consequently the modulus of the distance in space-time is numerically equal to the spatial distance. The principle of difference implies, of course, that the unification of gravitation and electricity under one set of equations is impossible in principle; Einstein's idea of unification is one of his few misleading ideas.

Applying his principle of equivalence to photons in a conservative gravitational field, Einstein found that the wave-lengths of photons evolve *as if* they possessed

[6] Inside atoms and inside composite subatomic particles, gravitation and electricity are not length-dependent (see Part IV).

gravitational mass that equals to their total relativistic energy (which is kinetic energy only) divided by the squared speed of light (Einstein, 1952, 99-108). This result has been confirmed experimentally, and its contemporary common interpretation is that photons possess gravitational mass. From that point, and since it has been found before that the inertial mass of a massive particle stands in the same proportion to its total relativistic energy (Einstein, 1952, 67-71), and in light of the classical idea that the gravitational mass of a particle is proportional to its inertial mass, Einstein concluded that every particle, including zero-mass particles, has gravitational mass that is proportional to its total relativistic energy. According to Einstein's scheme every particle has gravitational mass and massive particles also have inertial mass which is proportional to their gravitational mass.

Particles are influenced by an electromagnetic field only if they possess electric charge. Gravitation, unlike electromagnetism, is not a force-field; it is the geometry of space-time. Particles conform to that geometry regardless of whether or not they contribute to it (possesses gravitational mass). The idea that photons possess gravitational mass originates from a false deduction; the fact that the gravitational potential energy of photons is proportional to their kinetic energy does not prove that photons possess gravitational mass.

According to Einstein's scheme, any particle possesses gravitational mass which is proportional to its total relativistic energy (rest energy + kinetic energy). As is explained above, regarding photons, the fact that particles obey the geometry of space-time only confirm the validity of the first principle of equivalence (and of Hamilton principle), this fact tells nothing of the gravitational mass of particles. Experimental tests of gravitational mass of particles should measure their gravitational influence; such tests have been preformed only for macroscopic bodies and they prove nothing more than that the gravitational mass of a massive body is proportional to its time-symmetric rest-mass. The other facts about gravitational mass will be known through tests of the gravitational influence of relativistic particles and of photons, and through tests of the influence of Earth's gravity on antiparticles.

There exists, however, a reason to believe that the gravitational mass of a particle is invariant: Each of the quantities: length, time, mass, and charge is a complementary pair of two different fundamental quantities, a true quantity and an additional quantity: length of rigid rods and length of linear elements in space-time; variant-rate time and invariant-rate time; inertial mass and gravitational

mass; variable charge [7] and electric charge. Ignoring Modern Physics' view of gravitational mass, [8] a pattern can be noticed by which the true quantities are characteristically variant/variable quantities and the additional quantities are characteristically invariant quantities. This pattern of the eight fundamental quantities is assumed to be a principle of Nature and it suggests also that when a particle is replaced by its antiparticle the gravitational mass is transformed like the electric charge, which implies a crucially important consequence: *gravitational repulsion between matter and antimatter*. Thus, the principle of gravitational mass is introduced:

Principle of Gravitational Mass
The magnitude of the gravitational mass of a particle is proportional to its time-symmetric rest-mass; the sign of antimatter's gravitational mass is opposite to the sign of matter's gravitational mass.

In respect to attraction-repulsion, macro gravitation differs from length-dependent electricity not in being only attractive. In this respect it differs in that equal-sign gravitational masses, unlike equal-sign electric charges, attract each other; and in that opposite-sign gravitational masses, unlike opposite-sign electric charges, repel each other. Another difference: due to the invariant nature of the instantaneous gravitational interaction, nothing in the instantaneous gravitation is analogous to magnetism.

Particles whose speed, with respect to the invariant-rate time in their immediate vacuum vicinity, can be changed—possess inertial mass. Particles whose speed, with respect to the invariant-rate time in their immediate vacuum vicinity, is invariant—have no inertial mass. The rest-mass of a massive particle is defined as the inferior limit of its inertial mass when its velocity approaches zero. The inertial mass of photons is zero; consequently their rest-mass is defined zero. The magnitude of the gravitational mass of a particle is proportional to its time-symmetric rest-mass. The time-symmetric rest-mass of a particle is its rest-mass in the time-symmetric description (when only the invariant-rate time is used). According to the principle of gravitational mass the gravitational mass of a particle is independent of its energy content and of the reference frame, light does not contribute to the gravitational field, and antiparticles are repelled by matter's gravity.

[7] The variable charge is introduced in Part IV; it is crucially required for a consistent particle physics.
[8] This view involves a logical flaw, and has not yet been experimentally tested.

3. Controlled Gravitation

In order to describe the operation of macro gravitation, we first have to define the different regions of space-time. With respect to any arbitrary event as an origin space-time is primarily divided into three regions: [9]

1. The **past of the origin** is the set of all the events from which a massive particle or a photon can, in principle, immerge to the origin. It is called the "past cone" of the origin. The invariant distance of a past event from the origin along any possible connecting world-line is of a negative real value (this distance is minus zero when the connecting particle is a photon).
2. The **future of the origin** is the set of all the events to which a massive particle or a photon from the origin can in principle immerge. It is called the "future cone" of the origin. The invariant distance of a future event from the origin along any possible world-line is of a positive real value (this distance is plus zero when the connecting particle is a photon).
3. The **extended present of the origin** is the set of all events which in principle cannot be connected with the origin by world-lines of massive particles or of photons. It is the region outside the past and the future cones. The invariant distance of an extended present event from the origin along the geodesic between them is of non-vanishing imaginary value (its sign is discussed in the following).

In the extended present region there exists the **absolute present of the origin**. It is the set of all the events which happen together with the origin (this absolute simultaneity is not known to Modern Physics). All the events of a collapse of a wave-function occur at one absolute present. The electromagnetic simultaneity, as defined by Einstein, is of physical significance for macro electromagnetism. For macro gravitation and for wave-functions the absolute present, which can be called also the absolute simultaneity, is the relevant simultaneity. When at a certain event the variant speed of light, with respect to a certain reference frame, assumes a certain value, it assumes the same value, with respect to that frame, in the entire absolute present of that event. Different reference frames, especially when they are from different cosmological regions, can assign different time-densities to the same absolute present, but for each of them the time density there

[9] This division is absolute; it does not depend on the frame of reference.

is uniform. The absolute present of the origin separates between its **past-present** and its **future-present**. The past-present is the region between the past cone and the absolute present. [10] The imaginary invariant distance of a past-present event from the origin along the geodesic between them is designated by a minus sign. The future-present is the region between the absolute present and the future cone.[11] The imaginary invariant distance of a future-present event from the origin along the geodesic between them is designated by a plus sign.

The minus sign of an invariant distance from the origin designates an event which happened before the origin. The origin, therefore, cannot in principle affect any event of minus-sign distance. *Every* event of minus-sign distance, however, can in principle affect the origin. Past events (negative real distances) can affect the origin by massive or mass-less particles. *Past-present events (negative imaginary distances) can gravitationally affect the origin*. The plus sign of an invariant distance designates an event which is yet to occur when the origin takes place. The origin, therefore, can in principle affect *any* plus-sign event. A plus-sign event, however, cannot in principle affect the origin. Future events (positive real distance) can be affected by massive or mass-less particles from the origin. *Future-present events (positive imaginary distance) can be gravitationally affected by the origin*. The origin can affect absolute present events gravitationally, or by causing collapses of wave-functions. Absolute present events can affect the origin in the same two ways (the origin is also in their absolute present). An absolute present event can affect the origin and also can be affected by it. That property is designated by assigning a plus-minus sign to the imaginary distances of absolute present events. Thus when, in addition to world-lines of particles, collapse of wave-functions and gravitation are also taken into account, the four-dimensional continuum with respect to any arbitrary origin is absolutely divided into *five* regions: past, past-present, absolute present, future-present, and future.

In the unified region of the past-present and the absolute present a **gravitationally simultaneous space** (GSS) exists. A gravitationally simultaneous space is the set of events which are gravitationally simultaneous to the origin and instantaneously affect it. The gravitationally simultaneous space of each event is determined by Nature such that the supreme design of the universe is executed, and such that when gravitation is uniformly operated the first principle of equivalent holds true.

[10] For any world-line the past-present interval takes place after the past cone event and before the absolute present event.

[11] For any world-line the future-present interval takes place after the absolute present event and before the future cone event.

Unlike the electromagnetic simultaneous space, the gravitationally simultaneous space is absolute. Note that nothing moves along geodesics of imaginary lengths. Instantaneous gravitation is not propagated in space. When the origin is gravitationally affected by a certain event, this is not done through any propagation, but is the immediate consequence of the fact that that event is at the GSS of the origin. At the default choice of the governing programs the GSS of an event coincides with its absolute present. Deviations of the GSS from the absolute present and operation of non-uniform gravitation are mainly required during the construction of cosmological systems.

Let us apply the time-asymmetric modification to Newton's law of gravitation. In the absence of relative motion, a force viewed from different time densities is proportional to the variant speed of light at the event of observation (I.18). Let us consider point-like gravitational masses m_1 and m_2 in a region of the four-dimensional continuum where the value of the variant speed of light is practically uniform. According to the principle of gravitational mass and Equation I.10, gravitational mass and length are invariants under a time-transformation. Thus the gravitational force $\vec{F}_{1,2}$ exerted by m_2 on m_1 satisfies the above law of transformation when it is given by:

$$\vec{F}_{1,2} = -\frac{\mathrm{v}}{c} G \frac{m_1 m_2}{\vec{r}_{1,2}^{\,2}} \hat{r}_{1,2} \qquad \text{(II.1)}$$

Where G denotes the gravitational universal constant, $\vec{r}_{1,2}$ denotes the position of m_1 with respect to m_2, and $\hat{r}_{1,2}$ is the corresponding unit vector. The gravitational fundamental parameter is a **dependent variant** whose value is $\frac{\mathrm{v}}{c}G$ in a region in which the value of the variant speed of light is v. It is assumed that *the relevant value of the gravitational dependent-variant depends only on the time-density at the affected event with respect to the affected matter, and does not depend at all on the time-density at the affecting event*. Thus, even when the affected event and the affecting event are at different time-densities (they are not in the same absolute present), only the time-density at the affected event matters.

We proceed in considering the factors which constitute the original Newtonian law. The gravitational fundamental parameter, G, is a universal constant; its physical units in the time-asymmetric description are different from its physical units in the familiar, simplified description; otherwise, its constant numerical value is the same in both descriptions. The gravitational masses of the two bodies,

m_1 and m_2, are proportional correspondingly to the time-symmetric rest-masses of the bodies. By the principle of difference, *the squared spatial distance is modified into the squared* ***gravitational distance*** *of the gravitationally affecting event from the gravitationally affected event; it is the modulus of the connecting geodesic between the two events*. The invariant distance of an affecting event from an affected event is denoted "s", and its modulus is the gravitational distance. The gravitational distance of a certain affecting body from a certain affected event has a maximal value and it can assume any positive value which is smaller than that maximum, depending on the controlled choice of the affective event (the gravitational distance approaches zero as the gravitationally affecting event approaches the past cone of the affected event). Where $\hat{r}_{1,2}$ denotes a spatial unit vector pointing at the spatial projection of the tangent to the geodesic connecting m_2 to m_1 at the edge of m_1. We have the following **law of controlled gravitation,** description of macro gravitation approximated to a force:

$$\vec{F}_{1,2} = -\frac{\mathrm{v}}{c} G \frac{m_1 m_2}{s s^*} \hat{r}_{1,2} \qquad \text{(II.2)}$$

Each of the fundamental quantities length, time, and mass is a variant-invariant complementary pair:

Variant length (of rigid rods)
Invariant length (of linear elements in space-time)
Variant-rate time (time-asymmetric magnitude of time-intervals)
Invariant-rate time (time-symmetric magnitude of time-intervals)
Variant mass (inertial mass of particles)
Invariant mass (gravitational mass of particles)

Let introduce notations of their units correspondingly:

$[L_{VA}]$ $[L_{IV}]$ $[T_{VR}]$ $[T_{IR}]$ $[M_{VA}]$ $[M_{IV}]$

It can be inferred from equation II.2 that the units of the gravitational universal constant in time-asymmetric physics are:

$$[G_{TA}] = \frac{[M_{VA}][L_{VA}]}{[T_{IR}]^2} \frac{[L_{IV}]^2}{[M_{IV}]^2} \qquad \text{(II.3)}$$

Time-symmetric physics uses the same unit for the two different kinds of mass and the same unit for the two different kinds of length. In addition, time-symmetric physics is not aware at all of the variant-rate time. Thus, the SI units of the gravitational universal constant are:

$$[G_{SI}] = \frac{[L]^3}{[M][T]^2}$$

A direct consequence of the fact that macro gravitation is not mediated by particles is that *Newton's third law (action and reaction) is not valid, in general, in the gravitational case*. The fact that body *A* at event *a,* is gravitationally affected by body *B* at event *b*, does not necessarily mean that body *B* at event *b* is gravitationally affected by body *A* at event *a*. That Newton's third law is useful in the solar system is due to the fact that, in general, during the life-condition phase of a system gravitation operates at its default mode, and also due to the fact that gravitation is instantaneous.

Let us describe the gravitational interaction from the largest level, the intergalactic level, to the level of a solar system. At each level the interaction is between the relevant members. And, by the first principle of equivalence, the internal interactions inside each member are not affected at all by the interactions at the upper level(s).

The intergalactic interaction: Matter galaxies and antimatter galaxies are evenly distributed in the universe. Gravitation between galaxies operates mostly at its default choice mode (the Newtonian mode). Matter galaxies and antimatter galaxies are distributed such that the universal solid ellipsoid is a **gravitational crystal**, and each galaxy rotates in its region due to **restoring gravitation.** Unlike an electric crystal, in a gravitational crystal there are two kinds of attractions and one kind of repulsion. The phenomenon of quasi crystals is known in electric crystal; it is most likely that quasi crystals exist also gravitationally. It is explained in the next section that the radiation emitted in quantum energy transitions of antimatter is hardly absorbed by matter and that mainly the **cyclotron/synchrotron radiation** emitted by antimatter can be absorbed by matter. Cyclotron/synchrotron radiation consists of virtual field-mediators which have turned to real photons while accelerating/decelerating charged particles by electromagnetic fields. Antimatter galaxies can be observed mainly by their cyclotron/synchrotron radiation. *This suggests that cosmological radio sources might be antimatter objects, and in particular that quasars are nuclei of antimatter galaxies*. Another relevant rule, which is also explained in the next section, is that photons

emitted by antimatter are gravitationally affected (attracted) only by the gravitational mass of antimatter. Thus, when we observe quasars, we observe antiphotons that were emitted at the immediate proximity of very massive antimatter black holes and are observed at a matter galaxy very far from any antimatter galaxy. That practically maximal potential difference reinforced the red-shift due to the time-effect and results in the extreme red-shift of the quasars. An antimatter galaxy around a quasar looks faint because the emission of cyclotron/synchrotron radiation is faint relative to the quantum transition emission, and also due to the reinforced red-shift. Quasars' distances are not essentially different from those of matter galaxies; quasars of the lowest red-shift are probably members of the local cluster. This interpretation predicts that quasars' radiation is not deflected by the gravity of the sun; a prediction that should be tested during a total solar eclipse. In his book *Seeing Red: Redshifts, Cosmology and Academic Science*, Halton Arp describes observations of quasars which are aligned along two straight lines from both sides of a galaxy (Arp, 1998). Probability calculations indicate that that straight alignment is not accidental. The smaller the angle between the quasar and the galaxy, the higher is its red-shift (the farther it is). This means that there are two lines of antimatter spiral galaxies from both sides of the central matter galaxy, and probably a line of matter galaxies hidden behind that central galaxy. Such observations provide important information about the structure of the gravitational crystal.

Internal interaction in spiral galaxies: In spiral galaxies the gravitational attraction is balanced by angular momentum (centrifugal "force"). A lot of matter which does not emit light (dense dying stars, planets, asteroids, and dust) contributes to the galaxy's gravitational mass. Due to the large-scale propagation of light (see next section), this "dark matter" does not significantly block the propagation of light. The rest of the "missing mass", if needed, is virtually created by shortening of gravitational distances inside the spiral galaxy.

Internal interaction in spherical galaxies: A spherical galaxy is hold up by controlled restoring gravitation. Any escape attempt of a member from its proximity is immediately balanced by shorting of gravitational distances to other members which are at the opposite direction. In order to hold the outside shell members in place, shorting of gravitational distances to external objects is required. In this case the external gravitational field is not uniformly operated.

Internal interaction in globular clusters: Globular clusters are compact spheres of hundreds thousands stars. These objects are stannic demonstration of controlled restoring gravitation.

Internal interaction in solar systems: In solar systems during the life-condition phase, gravitation operates at its default choice mode and the systems are stable due to their angular momentum.

Creation of new systems from recycled materials: In systems under construction gravitation operates at the non-uniform mode. Things like the chemical composition of planets, their orbits, their spins and so on are executed according to the supreme design.

In maintaining the solar system, macro gravitation operates mainly in its default-choice mode**.** The observable consequences of operation in the uniform mode are that relative motions inside a system result only from interior gravitational influence, and that influence is such that all the interior GASs practically coincide with the corresponding absolute presents. Gravitation is also the tool to carry out special tasks. Special tasks demand operation in the **non-uniform mode** of gravitation**.** The creation of our planet, for example, involved many special tasks. Not one of the typical features of Earth is accidental. Things like the chemical constitution, the geometrical dimensions, the average distance from the sun, the angel which Earth's axis creates with the ecliptic plain, the angular velocity about its axis, and many other details, are all supremely designed, inspected and controlled with the intention of providing adequate conditions for life. The tool for executing the supreme designing plan is macro gravitation, which, when required, operates in its non-uniform mode.

The maintenance of a living planet involves mainly uniform gravitation, but also here there is room for special tasks. Due to tidal effects, the calendar day becomes longer. That process is under supreme inspection. When danger of a too-long calendar day approaches, Nature exerts an adequate torque along an adequate time interval such that in spite of the tidal effect the calendar day does not get too long.

Some cosmological features do not fulfill an essential role in the physical operations of nature. They function as "learning aids" to help improve human knowledge. The non-living planets of the solar system, for instance, do not have a crucial physical function. In their absence, however, it would have been much harder to make the first step in solving the riddle of gravitation. There may also be some local clues to the non-uniform mode of gravitation. Some observers, starting with Maurice Allais in 1954, claim to observe that pendulums swing in unusual ways during eclipses (Schilling, 28). These observations cannot be

explained by the current theory of gravitation. My view is that, if they are indeed observed, these anomalies exist as clues to help humans understand that gravitation is governed by Nature and can be operated also at a non-uniform mode. Non-uniform gravitation is applied mainly during the recycling and reconstructing phase which is discussed in section 6. During eclipses, which are out-of-routine events, human beings are provided with hints about the ability of Nature to create a state in which the gravitational influence on a certain body is different from the gravitational influence on its vicinity. That ability is not usually applied in the solar system during the life-conditions phase, and the unusual event of an eclipse provides a "stage" for instructive demonstrations of its existence.

4. The Cosmic Odyssey

Due to the even distribution of matter and antimatter in the universe, the large-scale average curvature of space-time is zero. In spite of this fact, no massive particle and no photon can escape certain finite vicinity of the universal solid ellipsoid. Outside the universal solid ellipsoid, the gravitational field is not uniformly operated; massive matter particles experience inward attraction due to shortening of the gravitational distances of matter bodies, and massive antimatter particles experience inward attraction due to the shortening of the gravitational distances of antimatter bodies. Thus, each massive particle (matter or antimatter) is attracted inward to the solid ellipsoid and escape is impossible.

Non-virtual photons are bound by the following principle:

Principle of Cosmic Odyssey
Most of the non-virtual photons in empty space eventually return to their emitting systems in converging superpositions which are equally distributed over the whole solid angle.

Non-virtual photons are of seven types:

1. **Transition-photons** (emitted in matter's quantum energy transitions)
2. **Transition-antiphotons** (emitted in antimatter's quantum energy transitions)

3. **Transition-mixedphotons** (emitted in mixed atoms' quantum energy transitions [12])
4. **Exmediation-photons** (field-mediators of pure matter origin which became real)
5. **Exmediation-antiphotons** (field-mediators of pure antimatter origin which became real)
6. **Exmediation-mixedphotons** (field-mediators of mixed origin which became real)
7. **Annihilation-photons** (emitted in matter-antimatter annihilations)

Unlike the virtual photons, which are bound within the electromagnetic fields that create them, all the real photons exist independently of electromagnetic fields. Descriptions of the physical reality of virtual photons, the mediators of the electromagnetic field, are irrelevant for real photons.

Photons of both kinds are detached from the gravitational influence of antimatter and are gravitationally affected (attracted) only by the gravitational mass of matter.

Antiphotons of both kinds are detached from the gravitational influence of matter and are gravitationally affected (attracted) only by the gravitational mass of antimatter.

Photons and antiphotons are gravitationally affected (attracted) only by matter or only by antimatter. Thus, they experience a closed universe. When in empty space, their wave-functions evolve such that only a tiny part of them is absorbed on the way, and most of them return back to their free-falling cosmological sources.

A transition-mixedphoton is a superposition of a transition-photon and a transition-antiphoton. Thus, also most of the transition-mixedphotons return to their free-falling cosmological sources.

An exmediation-mixedphoton is a superposition of an exmediation-photon and an exmediation-antiphoton. Thus, also most of the exmediation-mixedphotons return to their free-falling cosmological sources.

[12] Two examples of mixed atoms are positronium and antiprotonic-helium.

Annihilation-photons are an exception. They are gravitationally affected by matter and by antimatter (in a way that satisfies the conservation of energy as described hereafter) and are controlled similarly to massive particles.

For all the photons from the first six types the universe is positively curved. The wave-function of each photon/antiphoton from these types is a superposition of different routs arranged in a cap (a superposition of two caps in the case of the mixed types). The cap continuously expands such that upon arrival at neighboring stars its area is larger than the areas of stars' cross sections (about absorption by other stars, see the next paragraph). The cap expands all the way outside the cosmic ellipsoid, and then each of its components takes a different route back to the emitting system such that they approach it in a converging spherical superposition. A long-traveling photon moves in a superposition of many routes. Although every direction in the universe is sooner or later blocked by massive matter, the probability for absorption of light by remote matter decreases much more rapidly than it is usually thought to; the probability for an interaction at those relatively small parts of the huge superposition, which come in touch with massive matter/antimatter, decreases rapidly. Distances estimated by the magnitude of observed illumination should be re-estimated in light of the principle of cosmic odyssey—*distances in the universe are different from those estimated by Modern Physics (not to mention the fantastic distances which are estimated by the misleading Hubble law)*.

All the photons emitted within some solid angel have some tiny chance to be absorbed by anther star. An absorbed photon emitted by a distant star very rarely did its way along the shortest optical line between the two objects, but when absorbed it preserves the optical information about its cosmological source and behaves as if it came along that shortest optical line. The images of stars which are on the same line of sight, are accumulated one on top of the other. This is the reason for the fuzzy images of galaxies. Preservation of optical information does not hold at the returning-back stage of the cosmological Odyssey; at this stage the optical information about the source is lost.

The principle of cosmic Odyssey says nothing about the absorption of transition-antiphotons by matter and nothing about the absorption of transition-photons by antimatter. In the case that transition-antiphotons can be absorbed by matter, there would be observations of antimatter cosmological objects whose transition-light is not deflected while passing near the sun. Since such a phenomenon has not been observed (during total solar eclipses), it is more likely that transition-antiphotons are barely absorbed by matter, and, vice versa, that transition-photons

are barely absorbed by antimatter. Observations at ALPHA-2 in CERN apparently contradict this conclusion, but several antihydrogen atoms trapped in a magnetic field of matter and intensively illuminated by exact laser beams do not represent the reality of macroscopic antimatter in the cosmos. Astronomical observations, as interpreted hereafter, tell that transition-antiphotons are barely absorbed by matter. On the other hand, exmediation-radiation of any kind, due to the fact that it is field mediators that become real, is observable by matter and by antimatter. Consequently, an antimatter cosmological object can be observed mainly by its exmediation-radiation. Thus, cosmic radio-sources are most likely antimatter objects. According to Periodic Physics' interpretation, quasars are nuclei of antimatter galaxies; from their radiation, we observe mainly the exmediation-radiation part, which is known to be intensive from galaxies' nuclei. In the quasars' case, the red-shift due to the time-effect is intensively reinforced due to the fact that the emission takes place at the immediate proximity of super massive antimatter black holes, while the absorption is at a matter galaxy very far from any antimatter galaxy (it is the highest possible gravitational potential for anti-photons since they are gravitationally affected only by antimatter). Thus, in general, the red-shift of all antiphotons which are absorbed at a matter galaxy is reinforced. The exmediation radiation and the barely observed transition-radiation from the rest of an antimatter spiral galaxy are so faint that when wrongly interpreted as matter radiation they are attributed imaginary-large distances. Periodic Physics' interpretation of the quasars yields a prediction that the light of quasars is not deflected when passing near the sun. *The whole electromagnetic spectra emitted by matter can, in principle, be absorbed by matter, but all the electromagnetic spectra emitted by antimatter, except for exmediation-antiphotons, can barely be absorbed by matter*.

In most matter-antimatter total annihilations, two photons are created. Both are gravitationally affected by matter and by antimatter and both can be absorbed by matter and by antimatter. The wave-function of a pair of annihilation-photons is a superposition of two states. In one state photon A is attracted by matter and repelled by antimatter (gravitational mass $+0$ with respect to matter and antimatter), and photon B is repelled by matter and attracted by antimatter (gravitational mass -0 with respect to matter and antimatter). In the other state photon B is attracted by matter and repelled by antimatter and photon A is repelled by matter and attracted by antimatter. Thus, if one photon is emitted towards Earth and the other away from Earth, there is 50% chance that both of them gain kinetic energy and 50% chance that both of them lose kinetic energy.

GM_{1x2}, the gravitational-mass vector of a photon, describes its absorbability and the way it is affected by gravitation:

GM_1 —the gravitational mass with respect to matter
GM_2 —the gravitational mass with respect to antimatter

The gravitational mass of a photon with respect to matter/antimatter can assume one of four different zeroes:

- No-sign zero—the photon is absorbable by the relevant substance but is not gravitationally affected by it.
- Plus zero—the photon is absorbable by the relevant substance and is gravitationally affected by it similarly to matter.
- Minus zero—the photon is absorbable by the relevant substance and is gravitationally affected by it similarly to antimatter.
- An h-zero—the photon is hardly absorbable and is not gravitationally affected by the relevant substance.

The gravitational mass vectors of the seven types of non-virtual photons:

$$GM(\#1) = \begin{pmatrix} +0 \\ h0 \end{pmatrix}$$

$$GM(\#2) = \begin{pmatrix} h0 \\ -0 \end{pmatrix}$$

$$GM(\#3) = \left(\begin{pmatrix} +0 \\ h0 \end{pmatrix} \quad S.P. \quad \begin{pmatrix} h0 \\ -0 \end{pmatrix} \right)$$

$$GM(\#4) = \begin{pmatrix} +0 \\ 0 \end{pmatrix}$$

$$GM(\#5) = \begin{pmatrix} 0 \\ -0 \end{pmatrix}$$

$$GM(\#6) = \left(\begin{pmatrix} +0 \\ 0 \end{pmatrix} \quad S.P. \quad \begin{pmatrix} 0 \\ -0 \end{pmatrix} \right)$$

$$GM(\#7) = \left(A\begin{pmatrix} +0 \\ +0 \end{pmatrix} B\begin{pmatrix} -0 \\ -0 \end{pmatrix} \quad S.P. \quad A\begin{pmatrix} -0 \\ -0 \end{pmatrix} B\begin{pmatrix} +0 \\ +0 \end{pmatrix} \right)$$

A note: it might be that free (subject to gravitation only) non-macroscopic massive particles, unlike macroscopic matter/antimatter and similarly to photons and antiphotons, are detached from the gravitational influence of their antimatter.

Modern Physics regards photons as the antiparticles of themselves. The principle of cosmic odyssey gives rise to a different view: The antiparticles of transition-photons are transition-antiphotons of the analogous quantum energy transition. The antiparticles of exmediation-photons are exmediation-antiphotons of the analogous emission conditions. The antiparticle of an exmediation-mixedphoton, which is emitted from a positron in a matter electromagnetic field, is an exmediation-mixedphoton which is emitted from an electron in an antimatter electromagnetic field and is of the analogous emission conditions. The antiparticles of annihilation-photons are photons which originate from the same kind of annihilation and have gravitational mass of opposite sign. The inverse process of matter-antimatter total annihilation exists; i.e. when a non-virtual photon collides with its antiphoton, a fundamental pair of lepton-antilepton is produced (the fundamental leptons are the electron, and the electron-neutrino; see Part IV). The familiar production of an electron and a positron from one photon is not the inverse process of matter-antimatter total annihilation.

5. Second Principle of Equivalence

The non-homogeneity of time generates time-effects which can be detected by **interacting with the past**. Interactions with the past are only apparently impossible. A unique property of light is that it moves along identically vanishing world-lines. Massive particles move along world-lines of positive real lengths; they move continuously into their future. Photons move along identically vanishing world-lines. The facts that the invariant distance of a photon from its emission event is identically zero and that it does not assign any individual universal function to the four-dimensional continuum make it a "frozen record" of its emission event. Absorbed light tells the value of the variant speed of light at its emission event *with respect to the absorbing matter*. An interaction between massive matter and light is an interaction with the past of the massive matter. Due to the

gradual evolution of the variant speed of light and due to Doppler effects, this fact has significant empirical consequences only for light from the remote past.

The gravitational dependent-variant evolves continuously, which implies that in the time-asymmetric description the gravitational field is not a conservative field. But since light is propagated along identically vanishing world-lines, it is not subject to the gradual evolution of the gravitational potential and preserves the potential of its emission event (in the frame of the absorbing matter). This unique property of light is the origin of the following postulate:

Second Principle of Equivalence
Exclusively for photons and only in the reference frame of their absorbing matter the time-asymmetric gravitational field is equivalent to a conservative field.

According to the second principle of equivalence, the time-effect can be correctly described in light of the assertion that the total energy of a photon (kinetic energy + gravitational potential energy) is conserved. The evaluation of the gravitational potential energy of a photon requires ascribing *pseudo* gravitational mass to that mass-less particle. For that purpose the direct result of Einstein's principle of equivalence (the first principle of equivalence) is applied. Due to this result the magnitude of the pseudo gravitational mass of a photon equals to its time-symmetric kinetic energy divided by the squared constant speed of light. The pseudo gravitational mass of non-virtual photons of gravitational mass plus zero is positive, and it is negative for non-virtual photons of minus zero gravitational mass.

Let us consider the absorption of transition-photons and of exmediation-photons from another cluster, such that any effect other than the time-effect is negligible. Let $\Phi_e^{(+0)}$ and $\Phi_a^{(+0)}$ denote the relevant emission and absorption potentials (these potentials ignore the gravitational potential due to antimatter). Let λ_a denote the absorbed wavelength from a spectrum line of which the natural wavelength is λ_e (by the principle of space, that wave length is a universal constant). For convenience the value of the variant speed of light at the absorption event is defined as numerically equal to the constant speed of light. Then by the second equivalence principle:

$$h\frac{c}{\lambda_a}\left(1+\frac{\Phi_a^{(+0)}}{c^2}\right)=h\frac{c}{\lambda_e}\left(1+\frac{\Phi_e^{(+0)}}{c^2}\right) \qquad \text{(II.4)}$$

Where h denotes the Plank constant, and c denotes the constant speed of light.

From (II.4) we get the following description of the past-shift:

$$\frac{\lambda_a - \lambda_e}{\lambda_e} = \frac{\frac{\Phi_a^{(+0)}}{c^2} - \frac{\Phi_e^{(+0)}}{c^2}}{1 + \frac{\Phi_e^{(+0)}}{c^2}} \qquad \text{(II.5)}$$

And for light that is detached from the gravitational influence of matter (negative pseudo gravitational mass):

$$h\frac{c}{\lambda_a}\left(1 - \frac{\Phi_a^{(-0)}}{c^2}\right) = h\frac{c}{\lambda_e}\left(1 - \frac{\Phi_e^{(-0)}}{c^2}\right) \qquad \text{(II.4′)}$$

The potentials here ignore the gravitational mass of matter.

From (II.4′) we get the relevant description of this past-shift:

$$\frac{\lambda_a - \lambda_e}{\lambda_e} = \frac{\frac{\Phi_e^{(-0)}}{c^2} - \frac{\Phi_a^{(-0)}}{c^2}}{1 - \frac{\Phi_e^{(-0)}}{c^2}} \qquad \text{(II.5′)}$$

Note that when antiphotons are observed at a matter galaxy, the absorption potential is very high due to incredible distances to antimatter galaxies. This fact generates a **reinforced red-shift**; antiphotons are more red-shifted compare to photons emitted at the same absolute simultaneous space.

For approximations of the above gravitational potentials it is assumed that gravitation operates at its default choice, so we can use the customary time-symmetric description.

$$\Phi^{(+)} = -\left(\frac{\mathrm{V}}{c}\right)^{*} G\int \frac{\sigma^{(+)}}{r} dx^3 \qquad \text{(II.6}$$

$$\Phi^{(-)} = -\left(\frac{\mathrm{V}}{c}\right)^{*} G\int \frac{\sigma^{(-)}}{r} dx^3 \qquad \text{(II.6′)}$$

Where $\left(\frac{\mathrm{V}}{c}\right)^{*} \equiv \frac{\mathrm{V}}{c}\frac{[T_{VR}]}{[T_{IR}]}$ and $\sigma^{(+)}/\sigma^{(-)}$ are the densities of matter gravitational mass or antimatter gravitational mass, and the integrals are evaluated over the absolute presents of the relevant events.

6. The Hydrogen Cycle

The universe is designed such that most of the photons emitted by a cosmological body eventually return back to it. That returning light appears as cosmic background radiation—the cosmic background radiation which we observe has been emitted from our solar system. The cosmic background radiation (or odyssey-radiation) is extremely blurred, and its spectrum is extremely shifted. Due to the way that long-traveling wave-functions evolve, no image of the source, and no track of the original spectrum, can be obtained from the returning light. It is postulated that:

Third Principle of Equivalence
The spectrum of odyssey-radiation is equivalent to the spectrum of black-body radiation.

When, during the observable past, the variant speed of light decreases, the past-shift is red and the "black body" temperature is very low. And when during the observable past the variant speed of light increases, the past-shift is violet. The directional nature of the universal function is such that the evolution of the variant speed of light during the increasing phase is much faster than its evolution during the decreasing phase. Consequently, the violet-shifted returning light takes the form of mighty high-energy gamma rays, which recycle heavy nuclei back to hydrogen. The "black body" temperature in this case is incredibly high.

The red and violet past-shifts are reinforced by their corresponding nuclear processes. When the past-shift is red the region's gravitational potential continuously increases, and the dominant process in the region is the thermonuclear fusion. This process reduces the gravitational mass of the region. That reduction of gravitational mass reinforces the increase of the region's gravitational potential, and thus reinforces the cosmological red-shift. The opposite happens when the past-shift is violet. Then the region's gravitational potential continuously decreases and the dominant process in the region is the recycling of heavy nuclei back to hydrogen, this process adds gravitational mass to the region. That addition of gravitational mass reinforces the decrease of the

region's gravitational potential, and thus reinforces the cosmological violet-shift. The gravitational potential created by antimatter is always positive, but since antimatter gravitational mass and pseudo gravitational mass of antiphotons are always negative, the results are the same as described regarding matter light.

Many and various glowing nebulas are observed in the Milky Way and in neighboring galaxies. [13] It is beyond the current power of observation to directly confirm the existence of nebulas in very remote galaxies, but according to the assumption that the local cluster of galaxies does not differ significantly from other clusters, nebulas are common in the universe, no matter what epoch is considered. Nebulas are constituted of defused matter; they are several light-years across to about a hundred light-years across and they glow light which can be observed easily (in some cases by the unaided eye) from distances of thousands of light-years. Nebulas are often stellar nurseries; young stars are generated there.

Contemporary astronomers use only time-symmetric effects to explain the nebulas. A typical example is the Rosette Nebula, NGC 2237, which spans about 100 light-years, lies approximately 5,000 light-years away, and can be seen with a small telescope (Nemiroff/Bonnell, 2003). The time-symmetric explanation of the tremendous emission of red light from that large defused object is the following: "…an open cluster of bright young stars, NGC 2244, which lies at a hole in the nebula's center, emits ultraviolet light which causes the surrounding nebula (hydrogen) to glow." What a fantastic illumination of ultraviolet light is required to penetrate a huge cloud of tens light-years and to excite hydrogen molecules so intensively that it can be seen 5,000 light-years away with a small telescope!

It is possible, in principle, that the universal function with respect to two different particles is different (see Part I p. 17). It seems that this is not the case for particles at the same astronomical body. The observations of the glowing nebulas, however, can be explained in light of the idea that nebulas experience a violet past-shift. *The universal function is a function of the common time-coordinate, such that all matter of the same astronomical body experiences the same past-shift, and at any absolute present there are parts of the cosmos which experience a red past-shift, while other parts experience a violet past-shift.* In any absolute present, all the various different phases of the universal function appear in different regions of the universe and also in different regions of a galaxy. A certain value of the variant speed of light with respect to a certain frame at a certain event implies that with respect to this

[13] When first observed, galaxies were called nebulas. In this book, however, the meaning of "nebula" is distinguishably different from the meaning of "galaxy".

frame at this event the value of the variant speed of light in the absolute present of the above event is the above certain value. Note that with respect to different frames the value of the variant speed of light in a certain absolute present can be different and even entirely different. Light from the same emission event which is observed in a certain absolute present can be red-shifted in one frame and violet-shifted in the other.

A **cosmological region** is defined as the largest vicinity such that with respect to the matter in it, the universal function is the same. A galaxy is not one cosmological region. In a galaxy, at the same absolute present, there intermittently appear regions which experience red past-shift and regions which experience violet past-shift. The assumption that the universal function is a function of the w-coordinate can be put to test. Due to the rotation of Earth about its axis for several billion years, the world-lines of equator matter slightly shrink relatively to the world-lines of polar matter. The length of Equator matter's world-line between an absolute present of a certain emission event and its absorption event is shorter than the length of the corresponding polar matter's world-line. Thus, it might be that an apparatus constructed of equator materials would detect a slightly different cosmological background radiation (and even more slightly different cosmological red-shift) than an apparatus constructed of polar materials.

A null result of such experiments can indicate that the universal function is a function of the **common coordinate.** In each absolute present, each cosmological region has a gravitational center of mass (the position of which is absolute since absolute present and gravitational mass are invariants). The w-coordinate in the gravitational center of mass of a cosmological region is the common coordinate of this region. This results in a common universal function for all the members of one cosmological region (different regions can differ in their individual phases).

Nature continuously governs all the gravitational distances according to the supreme design such that an eternally stable universal structure is guaranteed. Danger of a universal gravitational collapse never exist, and also, as explained in Part III, each individual star, no matter how big is its mass, is never in a state of singularity. The flow of time never and nowhere stops.

Modern cosmology, due to misleading assumptions, is preoccupied with "the beginning of time." But in fact, as mentioned before, this issue is outside the domain of physics; physics is concerned with the way the universe functions.

Physics can say nothing about "the beginning of the universe" or about "the beginning of time".

Let us crudely describe the evolution of a cosmological region through the different phases of the universal function it experiences. At the end of the phase of decreasing variant speed of light, the activity level of the region is very low. The region is out of nuclear fuel, the stars are at various stages of gravitational collapse and most of their emission is long-wave electromagnetic radiation. [14] Then the variant speed of light turns to its increasing phase. Meanwhile, by means of controlled gravitation, dense stars are defused to red giants which are defused to nebulas. Gradually the past-shift turns to a violet shift. The process starts with the light from the close galaxies and finally the cosmological background radiation turns to extremely high-energy gamma rays. The slope of the universal function at the increasing phase is much steeper than its slope at the decreasing phase. Therefore, the time-effect at that phase is so intensive that originally emitted infrared radiation is converted to mighty gamma rays background radiation. The wave-function of a returning-home photon is a huge ellipsoid far bigger than any nebula, which explains the incredible penetration ability of the Odyssey radiation. This wave-function converges at the emitting system where the photon is certainly absorbed. Those rays provide the binding energy to nuclei, and the inverse process of nuclear fusion occurs—*heavy nuclei are disintegrated back to hydrogen—light from the past is converted to rest-mass*. Light from other galaxies is less violet-shifted than the background radiation. The light which is not energetic enough to disintegrate nuclei excites them, and that process results in intensive emission of observable light, x-rays, and gamma rays. Most of that radiation, however, returns back to its emitting matter and, when absorbed by it, reinforces the disintegrating process. The same returning-home light, when absorbed by regions for which the observable past is at the decreasing phase of the variant speed of light, is long waves radiation.

When the universal function starts to decrease the bombardment by gamma rays gradually stops and gradually the past-shift turns to red-shift. The region is very rich in hydrogen and that hydrogen, by means of controlled gravitation, is driven to create young stars, a process which begins already at the phase of increasing variant speed of light. Some of the young stars are very massive; they consume their nuclear fuel rapidly, and their rapid gravitational collapses trigger supernovas. Supernovas create and distribute a variety of heavy chemical

[14] As explained in Part III, no gravitational collapse ends up in singularity.

elements, and thus prepare the chemical ground for the creation of planets, in particular living planets.

The phase of decreasing variant speed of light is the phase of life-conditions. In addition to the abundance of nuclear fuel, the night sky at that phase is dark—two crucially necessary conditions for life. Life gradually appears on numerous planets in the region. It does not result from a rare blind chance; it is supremely designed inspected and controlled.

A **closed cosmological system** is a region in the cosmos, together with the radiation emitted from it, such that the universal function with respect to all the parts of that region is practically the same. The system's radiation which is absorbed by other systems is negligible compared with the systems' total energy. In addition, that loss of energy is compensated for by absorption of radiation from other systems, so the system is practically closed. During the phase of decreasing variant speed of light, mass is converted to photons and the wave-lengths of those photons, when absorbed as odyssey-radiation, is red-shifted; these processes increase the entropy of the system. During the phase of increasing variant speed of light the wave-lengths of odyssey-radiation are dramatically short and photons are converted to mass—the entropy of the system decreases. Independently of the universal phase, there always exist local processes of conversion of energy to higher entropy forms. In a time-homogeneous universe the time-symmetric second law of thermodynamics is universally true and the entropy of that universe never decreases. Fortunately, and not accidentally, time is directionally periodic, and any cosmological system experiences also a phase of decrease in its entropy due to a violet past-shift which is incredibly more intensive than any local increase in entropy.

Time-Asymmetric Second Law of Thermodynamics
The entropy of a closed cosmological system increases during the decrease of the variant speed of light, and decreases during the increase of the variant speed of light. States of infinite entropy are fictions. The total entropy of a closed cosmological system always lies within a certain finite interval.

The universe is *eternally active* either in processes of thermonuclear fusion and biological processes or in processes of recycling heavy elements back to hydrogen and in creation of newborn systems. All the large-scale physical details are carefully designed and continuously inspected and controlled. Entropy never increases without a limit nor decreases without a limit. It is a marvelous universe designed for eternal life.

Relativistic plasma

Particle accelerators which generate highly dense beams (plasma beams) might enable a test of the principle of gravitational mass. According to Einstein's Relativity, the gravitational mass of a particle, like its inertial mass, depends on its energy content. Contrary to this view, the principle of gravitational mass asserts that the gravitational mass of a particle is proportional to its time-symmetric rest-mass and does not depend at all on its energy content. It might be possible to create relativistic plasma such that its gravity according to Einstein's Relativity could be detected by a highly sensitive Cavendish device. If gravitational mass does not depend on energy content, the gravity of the relativistic beam would be smaller than the error of measurement.

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