Part III

Six-Dimensional Universe

1. Where Do Cosmic Rays Come From? [1]

"I think there should be a law of Nature to prevent a star from behaving in this absurd way!" Arthur Eddington (on black holes)

A well-known result of the Theory of Relativity is that space and time can be interchanged. This result is rather puzzling: how can the continuously flowing, one-dimensional time-coordinate be interchanged with the stationary three-dimensional space? Another strange result is that tachyons exist, particles of imaginary mass which are always faster than light. A related puzzling result is that a total gravitational collapse results in time-like space and space-like time.

The first two results tell the following: the tachyons are complementary physical substance (that will be denoted 'physical substance') for which the x-continuum (space) is macroscopically one dimensional and flows continuously and the w-continuum (time) is three dimensional and stationary. The whole universe is six-dimensional, and the two different kinds of physical substance are propagated in it in two mutually orthogonal ways. Macroscopically, the observable physical substance occupies continuum of three-dimensional x-continuum and one-dimensional ever-flowing w-coordinate, while the 'physical substance' occupies continuum of three-dimensional w-continuum and one-dimensional ever-flowing x-coordinate. All the properties of the 'physical substance' are analogous to the corresponding properties of the observable physical substance, and each of the two different kinds cannot be detected, in principle, by the other.

[1] A version of this chapter has been published in *Speculations in Science and Technology* 21 (1999), 345-346.

'Matter', 'antimatter', and the 'light' emitted by them constitute an unobservable complementary universe. The above conjecture is raised to the status of a postulate:

Principle of Cosmological Pair
The whole universe is constituted of two interchangeably orthogonal universes.

"Interchangeably orthogonal" stands for the special relations described above. That the w-coordinate is necessarily a line in a three-dimensional continuum is in fact a direct consequence of the relativity of simultaneity: The geometrical description of the relativity of simultaneity is that different world-lines are not necessarily parallel and do not necessarily lie in the same plane. That geometrical description implies that the w-coordinate lies in a three-dimensional continuum.

The Principle of Cosmological Pair, together with the prediction of time-like space and a space-like time in a total gravitational collapse, and together with the fundamental assumption that the principles of nature ***never*** break down give rise to the following conjecture. ***In total gravitational collapse physical substance/'physical substance' is converted to its interchangeably orthogonal form. 'Particles' which have been converted appear in the observable universe as cosmic rays.***

The ability of Pauli Exclusion Principle to prevent total gravitational collapse is limited to neutron stars of less than about two and a half solar masses. Conversion of matter in neutron stars of more than two and a half solar masses (black holes) is a controlled process. The ultimate anti-singularity measure is controlled gravitation (see Part II). Controlled gravitation, when used as an anti-singularity measure, prevents catastrophic events of total gravitational collapse by regulating the conversion process. The conversion process results in cosmic rays/'cosmic rays', which fuel the "furnaces" of living planets/'living planets' (see Part IV), have a role in the biological evolution, and provide observable evidence for the existence of the unobservable complementary universe. Controlled gravitation guarantees that the conversion process is always under control. The process of

conversion is coordinated by Nature in accordance with the Principle of Supreme Design (see Part II). Cosmic rays consist of protons and small amounts of heavier nuclei; converted 'electrons' are sent to the polar regions (they generate the auroras).

Thus, a black hole constitutes a "hole" in the observable universe through which observable substance leaks to the unobservable universe. And vice versa, a 'black hole' constitutes a "hole" in the unobservable universe through which 'unobservable substance' leaks to the observable universe. Particles which have been converted into 'particles' appear as 'cosmic rays' in the complementary universe. The observable substance is propagated in the six-dimensional continuum in an essentially different way from the unobservable substance; thus, no 'observable source' for those 'rays' can be identified. It remains a riddle until someone there, in the complementary universe, postulates the existence of a complementary unobservable universe. [2]

Conversion of physical substance to its complementary form is the conversion of all the physical quantities which characterize the converted particles. This includes, of course, the variant speed of light/'variant speed of light'. The close-to-singularity state occurs mainly at the end of the life-conditions phase when stars are out of nuclear fuel and collapse under their own weight. At that stage the value of the variant speed of light/'variant speed of light' is very low and the gravitational potential/'gravitational potential' is very high. Thus, many cosmic rays are at much higher gravitational potential than the current matter on our planet. A particle which is at high gravitational potential is a high-energy particle relative to matter at significantly lower gravitational potential. This time-effect is the major generator of ultra-high-energy cosmic rays. Based on the measured energies of ultra-high-energy cosmic rays an approximation of the minimal value of the variant speed of light can be evaluated, this can be added to the extrapolation of the variant speed of light, based on observations of the past, to obtain a better description of this function. Regardless of the above time-effect, the extreme conditions inside 'black holes' contribute significantly to

[2] The ultimate reason for the absence of any interaction between physical substance and 'physical substance' is introduced in the next chapter.

the high energy of cosmic rays. The 'high-accelerated fall' of 'substance' into 'black holes' and the extreme 'temperature' and extreme 'pressure' there are converted to observable extreme energies.

The binary pulsar **PSR**1913+16, is an indirect experimental demonstration of the existence of gravitational waves, and at the same time it is also an indirect experimental demonstration of energy-conversion. The observed diminution in period of this pulsar is consistent with calculated energy loss through gravitational radiation (Taylor, 1979). However, as explained in Part II, gravitational waves result of conversion of physical substance. Gravitational waves are geometric waves they do not carry energy, and the energy loss in this case is due to the conversion of kinetic energy to pairs of 'fundamental fermions' and/or to pairs of 'photons-antiphotons'. Thus, the observed diminution in the period of **PSR**1913+16 is due to conversion of kinetic energy to 'massive particles' and/or 'massless particles' at a rate that is equivalent to calculated energy loss through gravitational radiation.

Cosmological jets and relativistic jets—in some ultra-massive black holes the rapid fall of matter from their accretion disks into the black holes, results in ultra-intensive conversion of matter. The ultra-dense 'matter' generated this way is in total gravitational-collapse and is immediately reconverted and appear in the observable universe as dense jets along the polar axes of the relevant accretion disks.

The gravitational potential of Earth, as long as it is in the life-condition phase, increases continuously (due to continuous decrease of the variant speed of light). Thus, if part of the high energy of cosmic rays is due to a time-effect, a process of reduction in the average energy of these rays should be detected during long term observations.

In conclusion, a gravitational collapse never results in singularity. Cosmic rays are an indirect observable demonstration of the existence of the complementary universe. Matter does not necessarily accumulate in black holes and cosmic rays can appear anywhere anytime apparently from nowhere. It is highly desirable to put the last prediction to test with a device that can follow considerable intervals of the paths of cosmic rays. As

explained in Part IV, cosmic rays fuel the "furnace" of living planets. Thus, the device should orbit Earth in an orbit larger than the moon's orbit. Observations of cosmic rays which appear from nowhere inside such device can confirm that cosmic rays have no observable source.

2. Wave-Functions

The Principle of Cosmological Pair enables to attribute a direct physical reality to wave-functions. It can be that the phase of a wave-function describes a rotating vector in the w-continuum. Due to this line of thought, a free quantum-particle is nothing but a six-dimensional wave-function in which all the physical information about the particle is coded. A wave-function of a particle is a superposition of partial wave-functions which coexist simultaneously. At one absolute present, one of the partial wave-functions is "**full**" and the other partial wave-functions are "**empty**." The "**full" state** is distributed among the partial wave-functions according to their probability of occurrence which is proportional to the squared modulus of their rotating w-vector.

Collision of free quantum particles

When, at a certain absolute present, the x-component of a partial wave-function of a free quantum particle collides with the x-component of a partial wave-function of another free quantum particle, and the directions of the corresponding rotating vectors coincide up to certain tiny angel, $i\Delta\alpha$ – there are three possible outcomes:

1. **No interaction**: both partial wave-functions are empty.

2. **An "empty" interaction**: one of the partial wave-functions is "empty" the other is "full". The "empty" partial wave-function collapses, and the wave function of that particle, immediately after that event, is the superposition of its rest partial wave-functions; the "full" wave-function is not disturbed. "Empty" interactions account for the empirical fact that interference effects disappear when it is possible to know, even in principle, which partial wave-function has been "traveled".

3. **An interaction**: both partial wave-functions are "full". In this case the entire wave-functions, of the two particles, collapse. The observable quantities, due to this interaction, are only those coded in the two "full" partial wave-functions. The other physical information coded in the "empty" partial wave-functions is lost, and for each particle a new superposition evolves according to its state after the interaction.

A wave-function is of a certain x-volume and of a certain w-volume. The smaller is the x-volume, the lesser is the uncertainty in position and the bigger is the uncertainty in linear momentum (of the relevant particle). The smaller is the w-volume, the lesser is the uncertainty in the w-coordinate and the bigger is the uncertainty in energy (of the relevant particle). The product of each complementary pair of uncertainties is never less than the limit given by the Heisenberg Uncertainty Principle.

"Empty" partial wave-functions pass each other entirely undisturbed. In macroscopic matter, "full" wave-functions with rotating vectors at any direction in the w-continuum are highly frequent. Particles in macroscopic matter very frequently undergo interactions, and their wave functions collapse before any significant superposition is developed.

Let us discuss a simple example: a photon splits up when incidents on a half-silvered mirror. The photon, after splitting, is two spatially-separated wave-functions between which the "full" state alternates evenly. When a detector is put on one of the two routes and the corresponding wave-function, when arriving at the detector, is "full", the photon is absorbed by the detector and immediately from that absolute present will not be found on the other route. But when an "empty" wave-function arrives at the detector it instantaneously collapses and the photon, from that absolute present on, is certainly on the other route. The two spatially separated partial wave-functions can be brought together to the same event (under Pauli exclusion principle, an event is not point-like but is of some non-zero six-dimensional volume). This situation of two partial wave-functions approaching one event from two different directions results in a transformation of the photon's wave-function from a superposition of two partial wave-functions

to a superposition of many partial wave-functions arranged in a conic structure. In each of the partial wave-functions, there rotate two w-vectors; their resultants are of periodically evolving magnitudes. The "full" state is distributed among the partial wave-functions in proportion to the squared magnitudes of their resultant rotating w-vectors; this results in an observable interference pattern. Note: it is not interference between electromagnetic fields, it is interference between rotating w-vectors.

Wave-functions of observable substance are of rotating w-vectors. Wave functions of 'physical substance' are of rotating x-vectors. This is the ultimate reason that interactions between physical substance and 'physical substance' are impossible in principle.

3. Contact Interactions—the Gold Foil Experiment

All the x-components of the wave-functions of the constituents of an atom/subatomic particle occupy ***a common quantum of space***; they differ in their quantum numbers, in their masses, in their electric charges, and in their ***three-dimensional w-components***. Spatial structure is significant at the molecular level and upward. But at the atomic level and downward phenomena which apparently result from spatial substructure actually result from w-substructure. For example: polarization of atoms, which results in Vander Waals forces between them, are not due to any sub-position of electrons in the spatial quanta of atoms, but due to the positions of electrons' wave-functions in the w-continuum.

When alpha particles incident on a gold foil, the x-components of the gold atoms' wave-functions (each occupies one flexible quantum of the three-dimensional x-continuum) deform and let the wave-functions of the energetic alpha particles pass among them. With respect to interactions with external particles, the electrons of a gold atom do not create a unified wave-function, while the nucleons of the atom do create a unified wave-function (it is definitely not a matter of position in space). The rotating w-vectors of the nuclei of the gold atoms have a spatial wavy pattern such that when the

rotating w-vector of an alpha particle coincides with the rotating w-vector of a nucleus of a gold atom with which it is in a direct spatial-contact, it does not at the same absolute present coincide with the rotating w-vectors of the nuclei of its other direct neighbors (a reaction can occur only with direct neighbors, not with any other atoms of the gold foil). When and only when the above rotating vectors coincide, a reaction takes place—the outcome depends on the w-components of the two wave-functions involved. Rutherford's description of the atom actually describes the w-component of the atom's wave-function. The w-component of the wave-function of an atom occupies a volume of about 10^-30 cube additional-meter. In this volume the w-component of the nucleus occupies a volume of about 10^-45 cube additional-meter. Orbiting the w-component of the nucleus are the point-like w-components of the electrons. The w-component of the wave-function of an alpha particle occupies some volume which is typical for nuclei, order of 10^-45 cube additional-meter, its x-component, like all the x-components of the other constituents of the atom, occupies a volume of the order of 10^-30 cube meter. When the rotating w-vectors of an alpha particle and of a direct neighbor nucleus coincide, the outcome reaction is determined by the relative position in the w-continuum between the corresponding w-components.