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THE IDEA OF ETERNITY AND MODERN RELATIVISTIC COSMOLOGY

Here I want to discuss some exciting aspects of modern relativistic cosmology, both classical and quantum, opening new visions of such traditionally theological problems as those of eternity and eternal life.

1. CLASSICAL RELATIVISTIC COSMOLOGY

According to the main idea of the special and general theories of relativity we live in the four-dimensional world, three dimensions of which correspond to space and the fourth dimension is time. Consequently, the Universe, being four-dimensional, consists not of space, stones, gases, particles, etc., but of space-time events. This has very important philosophical implications for our idea of time. As we know from the history of philosophy there are two opposite views on time. According to the first view, time is not so different from space. One could say with St. Augustine that there are three presents: the *present of past things*, the *present of present things*, and the *present of future things* (*Confessions*). Past and future things *exist* as well as do the present ones. The only difference between them is that we, human beings, see only the present things. From this point of view, the human condition in time is not very different from that in space. I see only the portion of space near me, but if I am in Warsaw I do not say that St. Petersburg, from which I came, does not *exist* because I do not see it: and I have no doubts that Berlin, where I will be tomorrow, exists to-day. The same is with the past and futures events.

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The opposite view (for example, *Sunyavadin* in Buddhist philosophy) is that of the *flashing Universe*. We are surrounded by *nothingness*. Only the present exists.

The past and the future do not exist. At every moment the Universe reappears in a *flash* and then goes to nothing. Past events are only an illusion in human mind. In the 19th century the English philosopher, H. Spencer said: *after the death the same thing happens with man as if he had never been born*. This also corresponds to *nothingness* (or *sunyata*, in Buddhism) point of view of past events. It is evident that relativity gives no support to such philosophy.

Past events exist as well as present events, the only difference being that we cannot influence them. This means that in our four-dimensional Universe there is no annihilating force for events. If an event — a smile of a child, a cry of a woman, etc. — has occurred, it remains in the Universe as in an *eternal memory* and cannot be annihilated. Such events have special coordinates which depend on the coordinate frame of the observer and change with the *movement in time* of this frame.

This is not very different from the change of the distance to a town when one travels in a train. From this point of view, every human life, for instance the life of Chopin, is just an *island of events* with beginning and end in the four-dimensional space-time. We, in the 20th century, are far from this island (more than 100 light years) but the *island* still *is* in the Universe. All people whom we call *dead* are alive because this life being finite nevertheless is eternal, where *eternal* means that events cannot be annihilated. The four-dimensional Universe is full of smiles, cries, deeds, and crimes which constitute overgrowing *continuum of events* which, with our movement towards the future, looks like a growing crystal.

From the relativistic point of view, human beings are four-dimensional creatures with a *jet* of past events lagging behind the moving frontier of the *present*. Every man or woman grows in the time dimension. But why we do not feel as four-dimensional creatures and see only the three dimensional projection of ourselves onto the present? First, we do have some feeling of the past — the memory. It is possible to think (as did H. Bergson in his *Matter and Memory*) that in the memory we are conscious not of some prints in our brain left by the past events but of these events themselves as they exist in four dimensions. Second, we do not *see* our past with our eyes because of special properties of the Universe: it is too large and too empty. Light rays from our past go to the sky and disappear in its *dark abyss*. In the finite Friedmann Universe, only near the Big Crunch the light rays will come back and be seen again. The Universe has every low density of matter (invisible matter included) and there are practically no *mirrors* which could reflect the rays from our past.

If the Universe is of the closed Friedmann type then in the future, near the Big Crunch, all light rays and all gravitational waves will come back, and one will be able to see (mainly through the gravitational waves because only they

can pass through the dense matter) all past events in space-time. One could truly speak of the *flash of eternal memory*.

2. QUANTUM COSMOLOGY

Classical relativity does not give a full description of the Universe if it is not unified with a quantum theory. An attempt of such a unification is quantum cosmology. There are some successes in this field as far as the so-called *minisuperspace model* is concerned. In spite of simplicity of this model it has some features which are generic for any quantum cosmological model.

The main concept of quantum cosmology is the concept of the wave function of the Universe. In the very early expanding Universe, in a neighbourhood of its beginning, there were no macrobodies — only elementary particles described by a wave function. Near the Planck time, $t_{pl} \approx 10^{-43}$ sec, even gravity must be quantized. Therefore, at that time there were no classical fields, the whole Universe was a quantum object described by a wave function. It is natural to think that even now it is described by a wave function of special type, namely by the quasiclassical wave function. Because of that the macroscopic Universe is now the classical limit of the quantum Universe. If we agree with this idea, we arrive at striking consequences having profound philosophical and theological meaning.

a) The Universe was *created* from *nothing* through a *quantum jump*, due to the act of observing by the Ultimate Observer of an observable chosen by Him from the set of noncommuting observables. It is erroneous to say (as it is sometimes expressed in the popular literature) that the Universe *spontaneously* originated from nothing, like it happens in the radioactive decay. The radioactive decay occurs because an observer measures the particular observable (momentum) which does not commute with the total Hamiltonian. In quantum cosmology non-commuting observables are super-Hamiltonian and quasiclassical ones, the eigenstate of which is a quasiclassical wave function. Therefore, it is the Observer who creates the Universe.

b) Quasiclassical wave function, being complex, leads to the possibility of defining *time*. This *time* is also created by the Observer. The Hartle-Hawking wave function, being real, does not lead to the creation of time, and it must be *collapsed* into a complex valued function, and only then time appears. The *collapse* is due to the observation.

c) It is natural to think that near the Big Crunch, in the closed Friedmann space-time, the wave function must again be changed or collapsed to something else, possibly to the Hartle-Hawking wave function with its Euclidean time. From this point of view, past and future singularities are the frontiers of the quasiclassical description.

But what could the future collapse mean of the wave function of the Universe? It could mean that all events in the four-dimensional Universe will be *reorganized* after the Big Crunch; they will reappear, from our point of view, and be put into a new order. In the Euclidean regime there will be no difference between time and the usual space. But we, human beings, are just set of events. So our earthly life will reappear and *stand without movement in time*. This can be thought of as a modern version of the Resurrection of the Dead idea. As Scripture says, in the Last Judgement all the dead will stand with their *books of life*. Resurrection corresponds to reappearing of all combinations of atoms and fields constituting the human body during the earthly life. Surely, a difficult question remains concerning all emotions and thoughts in the situation when usual time order is changed into a new order, for instance into the Euclidean time. This is the question related to a reorganization of our consciousness, and it cannot be answered from the point of view of physics.

Resurrection takes place not due to the usual macroscopic physical processes (in such a case it is impossible) but due to a discrete change of the wave function of the Universe: in a sense it is the *new Creation*. The wave

function is now something like $\Psi(a, \varphi) = \rho e^{iS(a, \varphi)}$, where a is the scale factor, and φ denotes all particles and fields. In quantum cosmology, unlike in the usual quantum mechanics, the wave function is defined on the whole history of the Universe, on the set of all events. That is why its collapse influences the whole history and consequently also the *past events* of the Universe. Therefore, $\Psi(a, \varphi) = \rho e^{iS(a, \varphi)}$ implies $\Psi(a, \varphi)$, where (a, φ) can be the same as now but ordered differently due to the absence of the usual time. This can be called the *Resurrection of Events*.

Our last question concerns the Observer in the Copenhagen interpretation of quantum cosmology. The famous „Wigner friend” paradox — why different observers see the same quantum event? — shows that this observer must be the Ultimate Observer who corresponds to the idea of God. An observer in quantum cosmology is not a part of the Universe. Nevertheless we, human beings, as observers are also co-creators of the quantum Universe. We observe the Universe through the mediation of our bodies, and this leads to the choice of a quasiclassical observable of the Universe to be measured. This also explains the choice of time, which must be long enough, to organize our body from quantum elementary particles through physical processes occurring in the Universe. This is the basis of the *anthropic principle* in cosmology.

We can observe the quantum Universe only by *moving in time*. The reason for this is that we cannot measure simultaneously two non-commuting (complementary) observables. One must *move* in time in order to observe at this moment this and the other moment that complementary observable. This is connected with the difference in the logical structure of the human consciousness which is Boolean (distributive) and the non-Boolean (non-distributive) structure

of the quantum Universe. Therefore, the *movement in time* and the irreversibility of time, arising because of quantum measurement, are purely human in their origin.

3. CONCLUDING REMARKS

In conclusion let us give a summary of our ideas.

A) The theory of relativity leads to the existence of past events as well as present ones; this in turn leads to a *finite eternity* of our earthly life.

B) Quantum cosmology makes speculations possible concerning the Creation of the Universe due to the act of measurement by the Ultimate Observer, and the Resurrection of the Dead as reappearing of events, which constitute the present life, in a new time order after the Big Crunch. The last possibility is due to the collapse of the wave function of the Universe.

C) A special property of the human consciousness, its Boolean logic, can explain our movement in time from the present to the future, and irreversibility of time.

Surely, the basic question is the one concerning the problem of consciousness. Speaking about the *finite relativistic eternity* the question arises: what does happen to the consciousness in the moment of death when the future ceases to exist for a man? Does it mean that there appears a consciousness of all past events of this life, and it remains in an eternal contemplation of them? According to Bergson, we *forget* our past in order to be active in the future, and this activity is due to our body. But if the body is ruined then the consciousness of the fourth dimension must be changed. The question remains: if the same combinations of atoms will form our body as they were forming it during our *earthly life*, but the order in time will be different and some events could have different probabilities, what will happen to the soul? These questions cannot be answered by physics.