

# RAIDERS OF THE LOST TIME

## On the need of a new metaphysics

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ABSTRACT: Hawking and Penrose are two leader cosmologist in the recent history of science who have proposed different models about the origin of the universe. From his earlier studies on the geometrical nature of spacetime they have extrapolated the physical laws to the own beginning of time. Trying to avoiding the outrageous singularities found in the first tick of time, they have constructed some geometrical alternatives with important metaphysical consequences. Frequently some journalists and pure non-philosophical scientists concluded that physicists can deduced a complete set of physical laws to explain the whole self-sustained universe, and therefore to wrongly demonstrate the non-existence of God. It was a white hot topic in the 1980's that strongly returns nowadays in a hardly belligerent way. In this article we support the validity of cosmology to approach the study of the primordial universe, we state that it is improbable to have self-sustained physical universe, and we claim for a new fruitful interaction between scientific speculations and metaphysical considerations.

KEY WORDS: Hawking, Penrose, God, cosmology, time, eternity, metaphysics.

### *En busca del tiempo perdido* *Sobre la necesidad de una nueva metafísica*

RESUMEN: Hawking y Penrose son dos cosmólogo líder en la historia reciente de la ciencia que se han propuesto diferentes modelos sobre el origen del universo. Desde sus primeros estudios sobre la naturaleza geométrica del espacio-tiempo se han extrapolado las leyes físicas al principio propio de los tiempos. Tratando de evitar las extrañas singularidades que se encuentran en el primer instante del tiempo, se han construido algunas de las alternativas geométricas con importantes consecuencias metafísicas. Con frecuencia algunos periodistas y los científicos puros no-filósofos llegaron a la conclusión de que los físicos pueden deducir un conjunto completo de leyes de la física para explicar la autosuficiencia del universo, y por lo tanto para demostrar incorrectamente la inexistencia de Dios. Fue un tema candente de la década de los 80 que vuelve con fuerza hoy en día en una forma casi beligerante. En este artículo se apoya la validez de la cosmología para abordar el estudio del Universo primordial, afirmando que es improbable tener universo físico auto-sostenido, y que la demanda de una nueva interacción fructífera entre las especulaciones científicas y consideraciones metafísicas.

PALABRAS CLAVE: Hawking, Penrose, God, cosmology, time, eternity, metaphysics.

Recently the old British cosmologists Roger Penrose and Stephen Hawking have published different books on the beginning of the universe. While *The grand design* of Hawking is an easy reading book, the reader must hardly strain in understanding the advanced ideas on geometry and physics proposed by Penrose in his last work *Cycles of time*. Both try to offer new answers to the ultimate questions and extraordinary new views of the early universe. But we are afraid that only one is really new.

Both authors have written speculative books based on the physical laws of non-empirical theories. On the one hand Hawking puts his confidence in multidimensional M-theory and the possibility that something can be spontaneously created from nothing. The last affirmation is carelessly used to state that it is not necessary to invoke God to set the universe going. We do not think he is wrong, we just think he is slightly careful. On the other hand Penrose focus on conformal geometry to avoid non-wished singularities in spacetime. Going back in time every classic cosmological model necessary finished in the last frontier of space and time.

Hawking's alternative for a non-boundary universe is to evoke M-theory. Penrose, who does not like theories with high number of dimensions, prefers to introduce some brilliant geometrical ideas to make time nonsense before the very beginning. Penrose's conformal geometry is one more possible hypothesis that does not need God to explain how time began ticking. In consequence, as it is commonly misunderstood, Hawking does not demonstrate the non-existence of God because he has designed a theory in which the universe will create itself from nothing. Following Penrose's model we can simply say that we do not need to evoke M-theory to switch on the first tick of time. It would be the same trick used by Hawking.

Metaphysical arguments are involved in these two models of the origin of the existence. It is inevitably to find metaphysic topics in both books because the authors are trying to illuminate the last frontiers of physical theories. When Hawking introduces more than the four physical dimensions to explain gravitational cosmology he is doing metaphysics. There is no empirical evidence about extra dimensions. In the same way, Penrose refers to the geometrical conditions before the Big Bang, and prior to the beginning of time. There is no physical action without time. Therefore, any speculation about a previous state of the universe is metaphysical; although Penrose will insist on some possible observable consequences. By some means or another we have to deal with metaphysical concepts: nothingness, multiuniverses or eternity. In this article we present the main results of the new perspective in early cosmology and we point out some metaphysical implications.

#### THE GRAND EDITORIAL DESIGN OF STEPHEN HAWKING

What is reality? Where did the universe come from? How can we understand the world? What a beginning for a scientific book! Does not it look like a philosophy treatise? Yes it traditionally does. But now, Hawking and Leonard Mlodinow think that it is time to give new scientific answers to understand the universe at the deepest level. What a fresh attitude in the scientific community! Under the spell of the Copenhagen spirit most of the current scientists are reductionist thinkers who exclude those questions of his matters. Only matter and its observable properties do really matter in the

framework of scientific theories. Everybody knows that Hawking is a hard defender of the old positivist school as he has defined himself in his famous *A brief history of time*. What has happened? Has Hawking changed his mind?

First of all, we think that Hawking is not the principal author of the book. Indeed, we guess he did not write anything. It is only a grand editorial design to earn money quickly reprinting his old ideas and mixing them chaotically to defend that statistical physical laws rule the world. Here it is the contribution of the co-author. In the spirit of the utopian theory of everything, Mlodinow tries to answer scientifically the big questions of humanity. He completely failed. No clear ideas. No coherent argumentation. Not new at all.

### 1.1. *Spontaneously created multiuniverses and the fine-tuning conditions for life*

He spent the first fourth part of the book to poorly check some few recurrent topics in the history of philosophy and science. He finally states that his book *is rooted in the concept of scientific determinism*<sup>1</sup>. We need to read more than one half of the book to discover what he is looking for. After presenting how Feynman designed his useful diagrams to describe the microscopic quantum processes of the non-gravitational physical interactions, he applies them to the macroscopic universe —as other physicists did before him. Then, once quantum uncertainty is introduced in the early universe and it is described by Feynman sum over histories, *the net result is  $10^{500}$  universes, only one of which corresponds to the universe as we know it*<sup>2</sup>. There are so many possible universes as physical alternatives compatible with a smooth non-boundary origin. In that view, *the universe does not have just a single existence, but rather every possible version of the universe exists simultaneously*<sup>3</sup>. Although determinism is defended to avoid any divine undetermined action, after we read three fourths of the book it is stated that *the results indicate that our universe itself is also one of many, and that its apparent laws are not uniquely determined*<sup>4</sup>.

The final part of the book is the most original and outrageous. Why is there something rather than nothing? He answers the question in the view of non-boundary origin: *The universe appeared spontaneously, starting off in every possible way. Quantum fluctuations lead to the creation of tiny universes out of nothing*<sup>5</sup> because Feynman's rules are applied to the universe as whole that satisfies the non-boundary condition. If the origin of the universe is cut

<sup>1</sup> Cf. HAWKING, S., and MLODINOW, L., (2010): *The Grand Design. New answers to the ultimate questions of life*, Bantam Press, London, p. 34.

<sup>2</sup> Ibidem, p. 119.

<sup>3</sup> Ibidem, pp. 58-59.

<sup>4</sup> Ibidem, p. 143.

<sup>5</sup> Ibidem, pp. 136-137.

off, the Mlodinow's interpretation of the mathematical Feynman's methods for quantum particles give rise to a huge number of universes from nothing. The beginning itself has been removed and a vast collection of universes emerges from a non-boundary mathematical initial condition. He concluded that our physical universe has no origin and it is only one more in the multiuniverses set.

How was the whole universe created by nothing? *It is reasonable to ask who or what created the universe, but if the answer is God, then the question has merely been deflected to that of who created God. It is possible to answer it purely within the realm of science, and without invoking any divine beings*<sup>6</sup>. Of course it is possible. He is completely right. This point has been misunderstood by many people as a demonstration of the non-existence of God. We do not think the authors believe in God, but they behave correctly and do not state in the book that God is a mere delusion. Scientists can explain properly many chemical reactions with no reference to quarks. From this fact it is not logically deduced that quarks do not exist. They are not needed to understand chemical bounds, although they do exist in other levels of the physical reality. We are not saying that God does exist. Simply, we state that God's hypothesis is as rational as other good ones like Hawking's to explain the origin of the universe. Someone uses God and Hawking-Mlodinow use a huge set of universes.

*Because there is a law like gravity, the universe can and will create itself from nothing*<sup>7</sup>. If we define *nothing* as a philosophical concept that means the absence of everything, it is logically impossible to get something from nothing. What physicists understand as *nothing* is a huge *vacuum* full of potential energy where multiuniverses could become real. Mlodinow includes gravitational potential energy to explain the emergence of our universe. He does not start from pure nothing. Following his same argumentation used before, we could ask him who created gravity. The origin of the universe has merely been deflected to who created gravity's laws. Hawking has enclosed Mlodinow in the same cell as it did before with theistic thinkers. The philosophical question about why is there something rather than nothing is still today in force, because it is in itself a frontier of the human thought. Hawking-Mlodinow arguments do not begin in nothingness but in the being. They start applying Feynman's rules to the universe itself as a matter entity. To exclude from their model the initial singularity where physical laws fail they introduce a non-boundary beginning from the future side, where the universe and all it beings do exist. In summary, they put away of the model almost all the beings but one non-boundary piece of matter.

Why are we here? *The fine-tuning in the laws of nature can be explained by the existence of multiple universes without the need for a benevolent creator who*

<sup>6</sup> Ibidem, p. 172.

<sup>7</sup> Ibidem, p. 180.

*made the universe for our benefit*<sup>8</sup>. Here Mlodinow bases his argument in probability. There are so many universes that at least one of the set has evolved under the physical conditions required for the origin of life and the emergence of consciousness. At last, we are here because of random events in the very beginning of our universe. Without invoking God and an intelligent design of his creation, we can say that maybe the initial conditions in a non-boundary universe are not so relevant to completely determine the macroscopica present state of the universe. In the end, the cosmic microwave background (CMB) radiation, the oldest empirical reminiscence of our early universe, occurred almost half-million years after the Big Bang.

Since we have remarked the intrinsic contradictions in his arguments, any conclusion can be logically formulated —included the opposite one. Then, God could create the whole universe or we can think its origin without invoking any divine beings. But this is no new at all! We already knew it. We think that *The Grand Design* is one more book that belongs to the growing collection of the belligerent new atheistic scientist. Lamentably —as indeed happens in many books about the so called *Intelligent Design*— it is poorly written and philosophically pernicious. The main purpose is reduced to fight against the God's hypothesis. We do not pretend to make an apology of theism, but we cannot agree with Hawking's hypothesis and we look for other cosmological alternatives to build a modern metaphysics. For example, Roger Penrose has developed a well-constructed model for the origin of time from a coherent geometric point of view. Again, we will find other many universes, but so geometrically linked that they constitute one whole metaphysical new entity.

#### ROGER PENROSE AND THE CYCLES OF TIME

The last century gave rise to many different cyclic cosmological models. The original Friedmann model ( $K < 0$ ) stated that our universe could be one more phase of a long series of multiuniverses that born, expand, and return to collapse in physical singularities. Tolman was the first in combining the second law of thermodynamics and cosmology to create a new cyclic model with a defined time's arrow. Hoyle was the first to describe the universe as a steady-state in which little pieces of matter were continuously created at an extremely low rate to compensate the reduction of the density of the universe due to its expansion. This is a philosophically attractive model because the universe requires neither spacetime origin nor singularity. It does exist for ever.

The casual discover of the microwave background radiation by Penzias and Wilson refused the Hoyle model. Black-body cosmic radiation means that the

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<sup>8</sup> Ibid., p. 165.

universe expands from a hot dense state or a Big Bang as it was named by Hoyle in a pejorative way. Cyclic cosmological models propose that the universe will collapse in a future Big Crunch and restart again in new big bang. In 1998 Perlmutter and Schimdt's groups observed that the universe is expanding faster and faster. The accelerating universe does not allow a re-collapsing state and the universe will expand forever. Geometrically, we say that the universe is opened and it is described by hyperbolic geometry. Once we avoid the final singularity we have to deal with the origin of the Big Bang. Ashtekar and Bojowald have been successfully working on it, but they do not include gravitational degrees of freedom. New Penrose's model takes account of them and offers new interesting perspectives on spacetime singularities.

Penrose has recently published a new book on speculative physics in the frontier between science and metaphysics. He introduces an interesting geometrical model about the origin of the universe without singularities. His mathematics goes beyond the last frontier of time and goes deeply into the metaphysics before the Big Bang. *Cycles of time*<sup>9</sup> is a first-class intellectual work that contributes to answer some fundamental questions: *Which is the origin of complex systems? What was before the Big Bang? How it will be the future of the universe?*

### 2.1. *The Second Law: The origin of complex living systems*

Classical Mechanics, General Relativity and Quantum Mechanics are local theories reversible in time. Past and futures are symmetric because they do not admit a privileged time direction. Time does not flow from the past to the future as it does in our psychological experience. Modern cosmological models have a complete set of local physical laws to describe the history of the universe up to its origin in the Big Bang. As a singularity the Big Bang does not belong itself to the spacetime framework. Physical laws cannot predict what happened in the Big Bang.

Second Law of Thermodynamic states that every irreversible process in the universe increases the entropy, i.e. a magnitude to quantify disorder or randomness in a thermodynamic system. The increase in entropy allows us to distinguish a time's arrow in each irreversible process. Later states have more entropy than the more ordered previous ones. Due to this asymmetry we conclude that the Second Law cannot directly be deduced as a consequence of the dynamical laws. According to Thermodynamic every isolated thermodynamic system reaches a maximum in entropy. But, as it is empirically observed the universe began in an equilibrium state with huge entropy—if we do not take into account the gravitational degrees of freedom.

<sup>9</sup> PENROSE, R. (2010), *Cycles of Time. An extraordinary new view of the universe*, Bodley Head, London.

In consequence, it is not possible explain how complex material structures emerges from a disordered universe in thermodynamic equilibrium. Independently of the power of the Big Bang, all the energy in thermodynamic equilibrium is completely useless. The thermal energy of oceans is useless because a gradient of energy is needed to get physical work. Thus, the Big Bang could not be an original state in thermodynamic equilibrium. The dominant gravitational interaction must play an important role in the Big Bang to allow the Second Law and the emergence of life<sup>10</sup>. Including gravity the emergence of life does not represent a contradiction with the Second Law.

Life on Earth depends on the Sun as a powerful low-entropy source. The Sun continuously radiates on Earth's surface, which send solar radiation back to space. The solar power received on Earth is almost the power re-emitted to the outer space. The Sun-Earth system has reached such equilibrium. But there is an importance difference in the entropy levels. The incoming photons have more energy that the outgoing reflected ones. The energy of the solar photon is reduced by scattering process once it impacts on Earth's surface. In consequence there must be more reflected photons to keep solar radiation equilibrium. The increase of outgoing photons carries more potential disorder and therefore a positive increment in the entropy of the energy sent back to the cosmos. Life depends upon the low-entropy energy of the Sun. Life on Earth requires organization, and therefore to keep entropy at a low level.

Living beings use this thermodynamic process via photosynthesis. They take the ordered energy from Sun and they return back with more entropy. Plants are producing order and transforming CO<sub>2</sub> into O<sub>2</sub>. Plants-eating animals and animals that eat them use the oxygen to control its life and regulate its own vital entropy. The Sun energy that make possible life on Earth proceeds of nuclear reactions in its core, which ultimately depends on the gravitational interaction. Once again gravity gets tangled in the Second Law, which produces the origin of complexity, conformational structures of life, sensibility and consciousness. According to Penrose the activation of the gravitational degree of freedom, latent in the beginning of the universe, explain the evolution of matter to complexity.

## 2.2. *Before the beginning: The oddly special nature of the Big Bang*

The issue of the special geometrical conditions in the Big Bang is central to the cyclic cosmology. Such an extraordinarily special state characterized by its initial low-entropy originated the Second Law, which is an essential prerequisite for the emergence of complex living systems.

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<sup>10</sup> PENROSE, R. (2005): *The Road to Reality. A complete guide to the laws of the universe*, chapters 27 and 28, New York, Knopf.

The CMB radiation is in thermal equilibrium. The sources of photons that actually constitute the cosmic radiation come to us from a surface formed almost 400.000 years after the Big Bang. According to the Second Law thermal cosmic radiation is associated with a state of maximum entropy. Just the opposite to what is rationally expected: A special order first state which evolve in time developing complex structures and increasing the whole entropy. Including gravitational degrees of freedom Penrose's picture of the entropy of the Big Bang is completely changed. Almost half a million years after the Big Bang matter was uniformly distributed in thermal equilibrium. The gravitational influence was then small but with great potential entropy, because the gravitational degrees of freedom were indeed not yet activated.

Gravitational interaction increases the entropy of the initially uniform matter when high-density fluctuations appear. Gravity was a secondary interaction while the universe was dominated by radiation. As the gravity clusters were formed gravitational degrees of freedom were liberated and entropy increase. Strong gravitational systems like black holes produce more entropy than the CMB radiation. It is estimated that there is one huge black hole in the core of each galaxy and, therefore the gravitational Bekenstein-Hawking entropy is much higher than all the entropy of the cosmic radiation. From this point of view the universe today has more entropy than it had in earlier phases. Consequently, the Second Law can be applied to explain emergent complex system as it was expected by Penrose.

Penrose's cosmological model includes gravitational degrees of freedom<sup>11</sup>. In his model the singularity of the Big Bang is characterized by its enormously low entropy, because all the gravitational degrees of freedom were then frozen. A singularity like the Big Bang is a rupture of the continuum spacetime. The Big Bang is a physical spacetime singularity where time and energy are originated. On the contrary, every singularity associated to black holes represents the end of time. Black holes are the temporal symmetry problem of the Big Bang. All the physical trajectories began in the Big Bang. Analogy, the spacetime singularity of black holes is the end point for any body that crosses its gravitational frontier. Black holes are described geometrically by high levels in the conformal Weyl tensor, which diverges to infinity in the singularity. Opposed to what happens in the final-type singularities, Penrose propose that the Weyl tensor vanishes in the extraordinary special nature of the Big Bang singularity. The nullity of the conformal Weyl tensor may us to explain the origin of the Second Law and the evolving universe.

In very beginning the universe was so extremely hot that the kinetic energy of the particles was much higher than their rest energy. Thus, particles could be effectively considered massless. When it rose sufficient the temperature to provided energies much higher than the rest mass of the Higgs boson —which

<sup>11</sup> PENROSE, R. (2006): «Before the Big Bang: An outrageous new perspective and its implications for Particle physics», *Proceedings of EPAC*, 2006, 2.759-2.762.



is the origin of the rest mass of all the particles except itself— all the particles became effectively massless, like photons. As photons moves constantly at the speed of light its world-line lies along the null cone at any point of the crossed spacetime. Massless particles do not feel the spacetime metric either. Time does not tick for photons and there is no distance at all for them. In a sense photons experience eternity. Photons do only need spacetime to have null-cone geometry. Massless particles are not concerned with the full geometry of spacetime. They merely respect its conformal structure that is invariant under metric changes. All the massless matter is then dominated by conformally invariant laws and blind to a scale factor.

Conformal geometry is the dominant structure in the early universe. Spacetime conformal rescalings, which preserves angles and infinitesimally small shapes, are changes in the metric that do not affect the light cones, and therefore causal relations keep unaffected. The universe erases the metric when the energy is much higher than the rest energy of the particles. The full metric of spacetime is condensed into conformal geometry and all time and length reference disappear. Thus, matter is unable to make clocks. Matter does not tick. No time at all because rest-mass is an indispensable ingredient to build a clock<sup>12</sup>. Photons are insensitive to conformal rescalings, because electromagnetism is conformally invariant —unlike gravitation that does need the full metric. In conclusion, conformal geometry provides the causal structure of spacetime.

From my own point of view conformal geometry is a great physical strategy to avoid the initial singularity. It looks like the universe becomes eternal when we go back on time towards its own born, and therefore the singularity itself becomes inaccessible. It is just the opposite of black holes singularities where time dies. Unlike the Hawking's unbound primordial universe, Penrose's model offers a new cosmological horizon closer to an emergent metaphysics. He does not merely suppress the origin of time, but it does make time emerges from an *eternal* era dominated by conformal geometry. Time's beginning is not simply excluded but integrated in the whole physical system. In Penrose's model is easier to find a coherent metaphysical interpretation of the first tick of time. Time is no solely a mathematical coordinate; it is no longer a physical parameter without plausible origin; it is indeed a physical reality that emerges with matter from the whole ontology.

### 2.3. *The future of the universe: Conformal Cyclic Cosmology*

The rest-mass of a particle is not an absolute constant. As it is in fact in the very early universe, it might indeed fade away in the very remote future.

<sup>12</sup> Penrose, R. (2008): «Causality, quantum theory and cosmology», in *On space and time*, Cambridge, University Press.

According to the latest cosmological observations the universe appears to be expanding at an increasing rate. The density of matter in the universe is therefore decreasing. Matter is increasingly diluted in the evolving universe. In consequence, de Sitter cosmological model for an empty universe is even nowadays a good approximation.

Observational evidences favour the existence of black holes in the core of galaxies. Near the centre of our galaxy the stars orbit rapidly around an invisible and enormous massive compact entity about four millions solar masses. According to Hawking's quantum field theory in curved space-time backgrounds, a black hole ought to have a very tiny temperature. Large black holes in the core of the galaxies, which are likely to form one of the main contributions to the total mass of the universe in its very late stages, are extremely cold in comparison with the 2.7K temperature of the cosmic background radiation. Due to Hawking's quantum evaporation large black holes radiate away its mass-energy until it shrinks away completely. Even the largest black holes will evaporate into radiation. Over time, a large percentage of the mass will be consumed by black holes. The remnant stars will go out and the remote future the universe will consist mainly of photons coming from the CMB radiation, the red-shifted starlight and Hawking evaporation. Probably, there will also be gravitons coming from black holes interactions. The gravitational interactions will die and, in effect, gravity becomes ultimately conformally invariant like electromagnetism. When the universe enters this final stage it will be dominated by massless particles that cannot be used to make a clock.

At the ultimate time scale, we have an exponentially expanding de Sitter-like universe, cooled down to zero temperature, expands out to null density, and inhabited by mass-less particles. If time does not tick away, then distances cannot be determined. In this sense, the last border of the universe is as physical as any other one. The universe will have reached eternity. As we know, massless particles are only concerned with the conformal geometry of spacetime, ignoring its metric nature that assigns a notion of length from time measurements. Therefore, the physical laws of the universe will be conformally invariant in the remote future, which looks like the remote past. In absence of geometrical singularities the universe can flow through different aeons. The remote future of one aeon links smoothly with the remote past of the next because they share the same conformal geometry. According to the Conformal Cyclic Cosmology (CCC) the universe as a whole is understood as the extension of a conformal geometry made of an unlimited succession of aeons.

The CCC model offers new perspectives on the physical nature of singularities. According to Penrose, every big bang is very different from the singularities within black holes. In CCC we find that the conformal Weyl tensor is null, whereas the black holes singularities are described by a divergent Weyl tensor. This severe constrain in the conformal geometry explains how the gravitational degrees of freedom were not activated in the big bangs, and how

gravity could be ignored as a first approximation. It provides a clear but unconventional perspective on how quantum gravity would affect the classical space-time singularities in a grossly time-asymmetric way. In keeping with the Second Law, gravitational degrees of freedom would have to be suppressed in the big bangs, though not at their remote futures. Some form of quantum gravity determines the kind of geometry that we find close to the two extremes of time.

Although CCC is a highly speculative cosmological model, Penrose proposes that there might be some correlations in the CMB radiation due to the extended conformal geometry shared by bounds eons. Matter distributions in the very early universe could be a consequence of the physical dynamics in the remote future of the last aeon. In this sense, the inflationary phase would be placed before the big bang, identifying it with the exponential expansion of the remote future of the previous aeon. Accordingly, each aeon is not sensitive at which moment the big bang took place, because the only relevant geometry is conformal and non-metric. Mass density and temperature have clearly different values in the hot dense state of the past and in the diluted cooled state of the future. Nevertheless, they both depend exclusively on the metric geometry, and it is conformal geometry that is indeed matched between aeons. Thus, the state of the big bang is geometrically identical to the state in the remote future, because matter is blind to the metric under those extreme physical conditions. In the transition from one aeon to the next there would be a conformal factor named the  $\phi$ -field that produces the changeover from the different metric conditions of the remote past and the remote future of the previous.

Information within black holes has puzzled physicists. What happens to the information that falls down into a black hole after it evaporates? Hawking radiation is supposed to be completely thermal and therefore information-free. For Hawking information must be conserved due to the unitary evolution of quantum processes. On the opposite side, Penrose thinks that there must be information loss similar to the quantum reduction in the measurement process. What information dropping means is a loss of degrees of freedom. Once the black holes have all evaporated away, there will be a great loss of degrees of freedom, and the zero of the entropy will be restored as it was in the prior big bang. Thus, there is an exact matching of the information, both gravitational and electromagnetic, between consecutive aeons. The zero of entropy does characterize the big bangs, and squares the Second Law with cosmology evolution. However, the gravitational information is carried by the variation of the  $\phi$ -field in the big bangs.

The classical ultimate behaviour of matter distribution in the form of massless radiation could leave its signature on the aeon's crossover, and perhaps be observable in subtle spikes correlations in the CMB. Gravitational waves due to black hole interactions in the remote future of the last aeon, virtually instantaneous originated in the conformal geometry could have

influenced the conformal geometry of the crossover with slight irregularities and kick the field material in a new big bang. Those subtle local unhomogeneities will evolve increasing the entropy in perfect agreement with the Second Law.

Penrose's unlimited aeon's series is not completely convincing. We do prefer to follow other metaphysical possibilities as matching the beginning and ending of the universe to a whole eternal ontology. Penrose does use aeons because he wants to avoid outrageous causal violations in time loops, which would appear putting together the remote past and the ultimate future of the universe. Maybe the violation of causality in non-boundary models that match and identify the past with the future is a mathematical consequence due to the physical impossibility of having a self-sustained universe. From a metaphysical point of view an ontological basis is always needed for a finite physical universe. According to Penrose's main cosmological philosophy, we think that the universe could be ontologically anchored in eternity, where from matter emerges and time begins ticking in some way.

#### CONCLUSION: TOWARDS A NEW METAPHYSICS

Historically, there are two main metaphysical positions to understand the origin of the existence. On the one hand we have the philosophers who support that the self is eternal and, therefore there is no need to explain how matter begins to exist. The self exists by itself and it cannot stop existing. Simply, it evolves in time. But how does time start running? According to the last cosmological scientific observations the universe as a whole began thirteen billion years ago and there will necessarily die in the future. Thus, the physical time has a beginning; although it is not so clear there will be an end. Time is a parameter of matter and classically matter will last indefinitely. In this sense, the universe is everlasting in the future, except that it is a process to annihilate time. How will time end? The principal difficulty to support the eternity of the self is to resolve the problem of time. Some thinkers would say that time is only an illusion, but they cannot convincingly argue why we experience the flow of time. The problem is still unresolved.

On the other hand the alternative to the eternity of the self is creation. Matter and time were created. They came into existence some finite time ago. Most of the modern scientists believe that the entire universe was created in the Big Bang as it is supported by the CMB radiation. As matter and time were both non-separately created it must follow that creation happened out of time. How could the universe arise? No answer can be found in science, because *creation*, *nothingness* and *out of time* are concepts that do not belong to science. Creation in itself is not a scientific task because no physics is possible without time. The problem of creation is metaphysical and overlaps with the problem of time and eternity.

We have two different answers from metaphysics. First, God creates the universe out of nothing. Only an infinite being could make something appears from nothing, because logically nothing arises from nothingness. Mathematically, only infinite multiplied by zero give something non-zero. But thus, the problem of creation is moved to the problem of God. Who created God? The common answer is that God need not a creator because God always existed by itself. In this sense, we return back to the eternity of the self, and to the question about how does God make time ticking. Secondly, the universe emerged out of nothing. This is the one preferred by belligerent atheist scientists and quantum string theory supporters like Hawking. The universe is self-sustained. But we must be cautious because the physical background reality is a full-energy sea namely quantum vacuum. *Vacuum* and *nothingness* are very different concept. While the first a stated physical reality, the last one is completely out of science because the absence of everything cannot be measured not even observed. Thus, as in the theistic case the ultimate question is the problem of the nature of the physical vacuum. Who created the vacuum? If the vacuum is eternal, then how does it make time clicking? Once more time we finished our argumentation in eternity, as Penrose did.

In one way or another eternity is a crucial concept to understand the origin of the universe. *Cycles of time* is an explanatory physical model of the universe based on eternity as a metaphysical concept. In Penrose's new model eternity is represented in the unlimited series of aeons. The master point of his proposal is the link between the origin and end of each aeon in the same conformal geometry. He avoids the initial singularity because the set of all aeons is unlimited and he manages to explain the origin of time from an energy flow through aeons. Metaphysically, Penrose states that matter-energy is an eternal flux that makes time starts and stops in each aeon. Although he introduces infinite aeons to avoid the causal violations that would be present in one only universe that is continuously collapsing and restoring, it is a good metaphysical argument to keep explaining the universe from eternity. Indeed eternity is the result of the unlimited series of pseudo-eternities in each aeon. But once again, the problem is how does the first flow of energy begin to rule the self in the eternity?

It looks like we are not able to design a self-sustained cosmological model. Time and eternity are interlinked concepts that prevent us to explain definitely our own origin. Time is necessary for physics and eternity seems unavoidable for metaphysics. But we are truly far for understanding the physical/metaphysical connection between both. For this reason some theistic authors prefers to evaluate the God hypothesis as the most rational and coherent. It is a bit disappointed from the point of view of science and philosophy. God hypothesis is only valid when the contingency of the universe has been proven. Once it would be known that the whole universe is not self-sustained, the logical consequence would be to introduce the non-contingent being, namely God. Opposite to the temporal, dynamic, and finite universe,

God must be characterized by infiniteness, changelessness and eternity. Provided of those divine attributes God could create the world out of time from nothingness. What about changelessness? How could God decide to create the world if it is supposed to be eternally unchanged? In this sense the idea of creation was always in the mind of God. Thus, to use God to answer metaphysical problems does indeed lead us to new difficulties that make the whole explanation uncompleted. The answer now is not only who created God but rather how the idea of creation was put in God's mind? In this sense, from a non-theological point of view, the metaphysical translation is again: What is the spark that starts the flow of time?

Due to the actual impossibility to verify the completeness of the whole universe, it is also impossible to decide the plausibility of God's hypothesis. Therefore, under the assumption of the impossibility to acknowledge if the universe in itself self-sustained it is truly plausible to support an atheistic or theistic intellectual position. From the first we find unresolved metaphysical problems, and from the last we run up with new theological mysteries. In conclusion, if we want to avoid getting isolated in one of those orthogonal and belligerent theistic/atheistic alternatives, it is necessary to establish new metaphysical bridges between the God's hypothesis and the Hawking's hypothesis. The key of the success will be to investigate on the metaphysical nature of time and eternity. How does the dynamical physical activity of matter emerge from the ontological eternal being?

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