

# Why anything rather than nothing?

The answer of quantum mechanics

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# „Why anything rather than nothing?“

Many researchers determine the question “Why anything rather than nothing?” as the most ancient and fundamental philosophical problem

❖ Indeed, that problem should be questioned first, before any other one

For example, it should underlie “What or which is the primary substance of the world?” “Spirit or matter?”, etc.

# From the being to time: Heidegger

Heidegger, in his famous “Sein und Zeit” insisted on the “question of the meaning of the Being” as the beginning of philosophy

❖ **We will try to answer it  
by means of science**

Nevertheless, we will find as Heidegger time linked to the being inherently once the question “why the being rather than nothing” is asked in the beginning

# Religion, physics, and mathematics about the Creation

In mathematics, the “empty set”, a mathematical equivalent of “nothing” is what is in the beginning

- **It generates the natural numbers, choice, sets and all mathematical objects, complexed or not, on their base**

So, mathematics gives an example how its world can be constructed on the ground of nothing rigorously

Furthermore, it is very close to the problem of Creation shared by religion, science, and philosophy, e.g. as the “Big Bang”, the doctrine of first cause or causa sui, the Creation in six days in the Bible, etc.

# Big troubles of physics about the “creation”

Its most fundamental postulate, energy conservation, can be called “no creation”:

❖ **Energy must conserve always, and thus anything physical, having nonzero energy in definition, cannot appear from nothing with zero energy: for this would violate energy conservation**

Furthermore, time is thought in two opposite ways, inconsistent to each other, in different physical theories: either reversible (classical mechanics, relativity, etc.), or irreversible (thermodynamics, etc.)

# The solution of statistical thermodynamics about time

Anyway, statistical thermodynamics managed to resolve the contradiction of reversible time in mechanics and irreversible time in thermodynamics:

❖ **Thermodynamic irreversibility is a result of the statistical averaging of mechanical reversibility:**

A huge part of information is lost after averaging, and just that loss generates irreversibility in thermodynamics

❖ The loss of information in thermodynamics can be generalized by the notion *“hidden variables”*, *hidden by and after averaging*



# New troubles of physics about quantum mechanics

Quantum mechanics was forced to introduce a thermodynamic constant, the Planck constant as fundamental to mechanical motion

- ❖ Thus, it should reconcile the reversible time of mechanics with the irreversible time of thermodynamics in its foundation

Many scientists, even Einstein, expected that its solution should be similar to that of statistical thermodynamics:

- ❖ **However, that conjecture turned out to be fundamentally wrong**

# “No hidden variables in quantum mechanics!”

Anyway, the solution of quantum mechanics is partly analogical to that of statistical thermodynamics:

- ❖ A huge part (exactly the half) of information is lost:

However, that loss is not due to averaging and human ignorance

**It is a fundamental law of nature due to the limitation imposed by the Planck constant**

That fundamental loss is caused by the course of time in the final analysis

- ❖ All rejected counterfactual alternatives represent that necessary loss of information

# Two different conjectures in physics about the “creation”

The “Big Bang” is most popular:

- ❖ It postulates a special point (“ $t=0$ ”) of the creation (“singularity”), in which physical laws do not hold yet

However, they (first of all, energy conservation and the reversible time of relativity) hold at any time thereafter

- ❖ The viewpoint of quantum mechanics is different and rather similar to that of Descartes:

The creation is permanent, at any time and due to the irreversibility of time

If one projects all irreversibility of time into a single point of the beginning, the picture of the “Big Bang” will appear

# Empirical confirmations versus the “Big Bang”

If the “Big Bang” was real, any physical objects in the universe older than the universe itself would be impossible to exist

❖ However, if the “Big Bang” is not real, but only a hypothetical projection of the irreversibility of time into a single zero point, it may be an averaging of the course of time in all points in the universe

Arbitrary deviations to that average quantity would exist in various spots of the universe

❖ The most objects might be younger than the universe, but at least a few ones should be older than it

Those objects older than the universe are confirmed

# The interpretations of the solution of quantum mechanics

Thus, the solution of quantum mechanics, being scientific in fact, can be interpreted also philosophically, and even religiously

❖ Indeed, the opposite conjecture of the “Big Bang” was elaborated by the Belgian Catholic priest Georges Lemaître, in 1927:

It was able to reconcile science (from the “Big Bang” on) with religion (the “Big Bang” itself as God’s creation)

❖ Analogically, the solution of quantum mechanics admits religious interpretations

# The philosophical interpretation of the solution of quantum mechanics

However, only the philosophical interpretation is the topic of the presentation

❖ Its essence is:

The creation is permanent and due to the irreversibility of time

❖ The creation is mathematically necessary

Thus, it is due to not one's free will (e.g. God's, the observer's, etc.)

❖ It is not an addition, but taking away due to the rejection of the reverse "half" of time

The being is less than nothing

# Quantum mechanics about that creation

The essence of the answer of quantum mechanics is in physical terms rather than in philosophical notion is:

(1) The CPT-theorem is fundamental: it manages the transformation of the discrete charge (electric and color charge, weak isospin) into a space-time position

(2) Thus it manages how the discrete transformation of elementary particles is equivalent to continuous space-time trajectory

(3) Weak interaction manages the mechanism how the discrete charges can be transformed into space-time trajectories

# Quantum mechanics about that creation

(4) Weak interaction implies the Higgs mechanism generating mass (energy) at rest by cutting the opposite direction of time

(5) So, mass (energy) at rest represents the total probability of all cut alternatives after the unavoidable choice in the course of time

(6) The antiparticles (with opposite charges) represent the “difference” of the particles to the physical “nothing” (which is not a vacuum, but the result after their annihilation)

(7) Thus, the particles identical to their antiparticle (such as photons,  $Z^0$  bosons,  $\pi^0$  mesons) represents the physical nothing from the viewpoint of the physical being (with mass at rest)



# An approach to the the mathematical necessity of creation

The creation is necessary in a rigorous sense after one has represented mathematically the physical creation by taking away as follows:

- ❖ The operation  $A \rightarrow \{A\}$  (i.e. the generation of a set from a class) means “taking away” and it is possible always, including to  $\emptyset$  (the empty set) or to another set:  $\{A\} \rightarrow \{\{A\}\}$

This implies all natural numbers by the construction described in the “axiom of infinity” in set theory

- ❖ The set of all natural numbers is infinite, though all natural numbers are finite according to the axiom of induction in Peano arithmetic

# About the secondarity of choice

Any set may be enumerated (the well-ordering principle), which means that it may be mapped one-to-one into some subset of the set of all natural numbers

- ❖ The empty set can be enumerated by the special natural number “zero”

The well-ordering principle implies the axiom of choice (the secondarity of choice)

- ❖ Thus, the being does not need any choice, free will, subject, God, observer, etc. to appear for it appears in virtue of mathematical necessity

# The creation as a mathematical truth

The world exists in virtue of mathematical necessity, e.g. as any mathematical truth such as  $2+2=4$

❖ However, that fact requires the completeness of the being, which is not demonstrated yet, e.g. as follows:

The operation  $A \rightarrow \{A\}$  can be interpreted as a “primary choice”, and thus a vicious circle appear

❖ The vicious circle being equivalent of a contradiction generates an empty set, to which it is a characteristic property

That empty set can underlie the successive genesis:

“ $A \rightarrow \{A\}$ ” as a choice means an alternative “ $A \rightarrow \{B\}$ ” to exist, e.g.  $\{B\}=\emptyset$ : that choice would be necessary only if

$f(A) \neq f(B) = \emptyset$  i.e. “nothing  $\neq \emptyset$ ” is necessary

# The being as less than nothing

The being is less than nothing rather than more than nothing

❖ The creation does not add, but takes away

This seems to be paradoxical to common sense:

❖ It may be explained particularly by an example

Any contradiction (such as  $A \wedge \neg A$ ) as a characteristic property define the empty set

❖ If one removes either  $A$  or  $\neg A$ , an non-empty set in general can be defined by means of  $\neg A$  or  $A$  correspondingly as two separated characteristic properties

# The consistency of the mathematical necessity of the being to the “Big Bang”

We discuss the gradual physical creation at any time, due to the irreversibility of time as mathematically necessary

❖ However, the mathematical necessity of the being underlies the Big Bang, too, here is how:

As a few slides ago, the empty set generates the well-ordering of the natural sets by taking away, or physically, time, but the time has not “started” yet

❖ The time implies energy in virtue of Emmy Noether's theorems

The well-ordering generates the axiom of choice and thus the choice itself

# The “Big Bang” in virtue of mathematical reasons

Now, all is ready for the “Big Bang”:

- ❖ There are time and energy, though they are not “activated” physically yet

This will be done by the choice, which exists, too:

- ❖ The choice means zero entropy and thus infinite temperature at any finite energy and even possibly, at zero energy

The infinite temperature generates symmetry breakings (such as the Higgs mechanism), and particularly breaks the symmetry of the two directions of time

- ❖ The latter symmetry breaking starts the time:  $t=0$ !

The nothing explodes (or “Nothing explodes”) by itself by taking away as the History of the Being

# The creation: decrease versus increase

The common viewpoint to the creation or to the being is the opposite one:

Creation should **add** rather than take away

The being should be **more** than nothing

**So, the creation is not an increase of nothing, but the decrease of nothing: it is a deficiency in relation of nothing**

**You may figure a sculptor who takes away from the stone by the chisel**

# Time and its „arrow“, which takes away...

Time and its “arrow” are the way of that  
diminishing or incompleteness to nothing:

- ❖ One may represent the nothing as the  
unification of both directions of time

However, only the one, forward in time, is real

- ❖ The other one, backward in time, is taken away  
from the nothing

After the one direction of time has been taken  
away from nothing, what remains is right the being

- ❖ If one could add the reverse direction of time to  
the being, what would obtain is just the nothing



# Transformation into nothing in physics: annihilation

“Annihilation” in physics means the fusion of a particle and its antiparticle into ... light

❖ **So, the light (electromagnetic radiation) is the way for us to see the nothing from our viewpoint of the being (i.e. less than nothing):**

This is the reason for the nothing to be watched as something: namely light, but only from our viewpoint of “less than nothing”

“And God said,  
“Let there be light,”  
and there was light.  
And God saw that  
the light was good.  
And God separated  
the light from the  
darkness”.

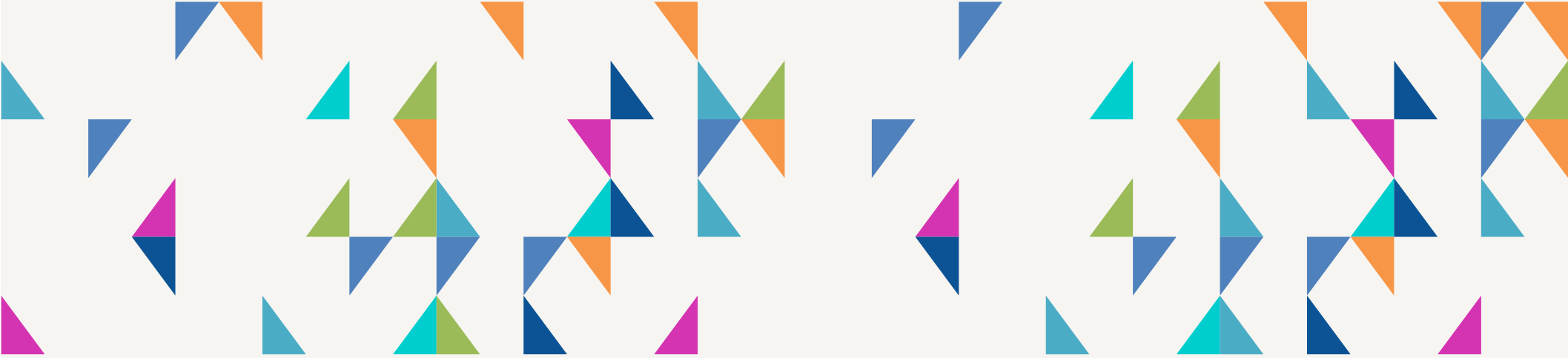
The Bible

# Our reading of the “light” in both Bible and theory of relativity

We see the nothing as light because we ourselves are less than nothing

❖ **Indeed, the light is an absolute upper border or limit for all being just as the theory of relativity states**

To be nothing an upper bound is only another way to say that the being is “negative”, i.e. less than nothing



“In the beginning was the Word, and the Word was with God, and the Word was God. He was in the beginning with God. All things were made through him, and without him was not any thing made that was made”.

The Bible,  
John 1:1-4



# Our reading of the “Word” in both Bible and theory of quantum information

The “Word” is information, particularly quantum information

❖ **Onologically, information, being measured in units of bits, is the quantity of “taking away” from the nothing for the being to be created**

Indeed, a bit is the elementary choice between two equally probable alternatives, and the thus, right “taking away” the one of them: the other is the chosen one

# Time and information

Information is the quantity of choices measured in units of elementary choices, i.e. bits

❖ Time in turn is the result of choices:  
the successive series of all chosen alternatives

The first, crucial, and mathematically necessary choice is the choice of the time itself, or in other words, that of the direction of time, or the “arrow of time”

❖ Information (the quantity of choices), and time (the series of all results of those choices) are closely linked

# Conclusions as negations:

The state of “nothing” is not stable

- ❖ The physical nothing is not a general vacuum

The being is less than nothing

- ❖ The creation is taking away from the nothing

Time is the destruction of symmetry

- ❖ The creation need not any (external) cause

# Conclusions as statements:

The state of nothing passes spontaneously (by itself) into the state of being

❖ This represents the “creation”

The transition of nothing into being is mathematically necessary

❖ The choice (which can be interpreted philosophically as “free will”) appears necessary in mathematical reasons

The choice generates asymmetry, which is the beginning of time and thus, of the physical world

❖ Information is the quantity of choices and linked to time intimately



Thank for your patience  
and kind attention!

Your turn is now:  
for criticism, comments, or  
questions!