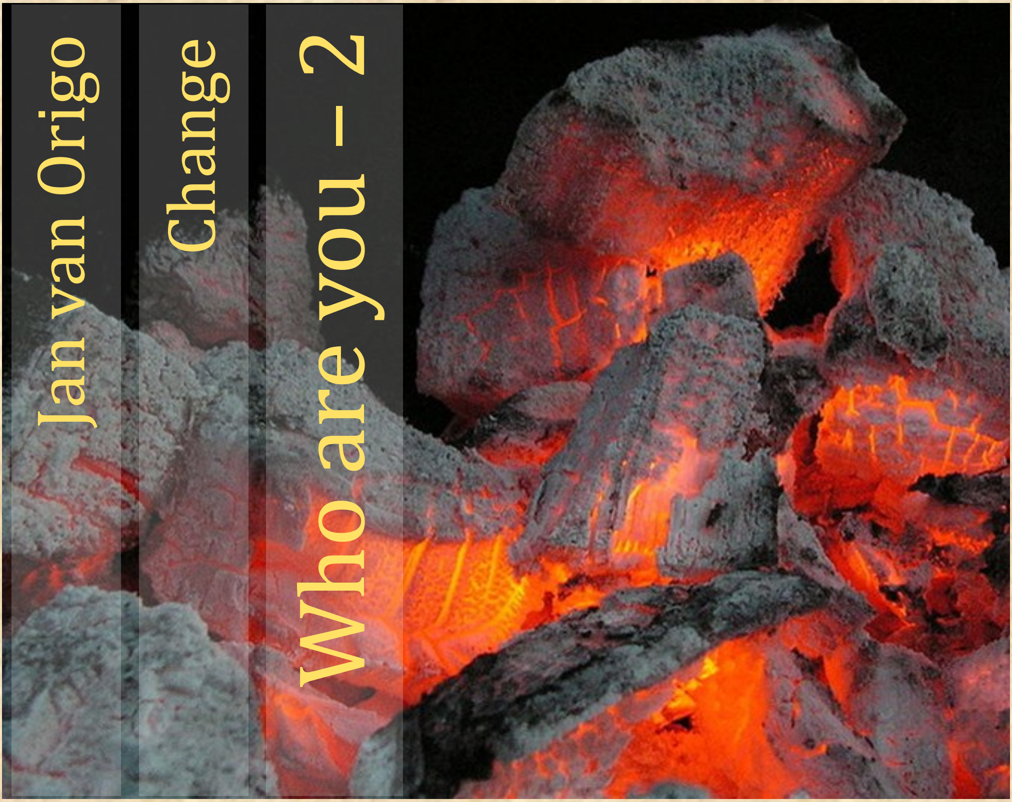

"Who are you" is about you and me and everything around us. Are you and I connected or are we separated? How are we connected? What makes you to the person who you are and who is involved in your creation? Who are you before your birth and who will you be after your death? Do you exist without an universe? What relationship do you have with the universe? How are you aware of yourself?
And how are others aware of you?

This search will be a way home. Our journey leads from the beginning of time until now. At the end, we will look back. We will see that everything is finished in one sigh.

Man Leben, Carla Drift and Narrator started the Odyssey to "Who are you". This is the part "change" from the report of the quest.

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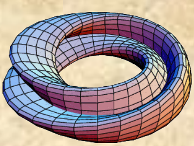

Who are you

A survey into our existence

Part 2

Five common realities

Change

Jan van Origo

Carla Drift is a fictional person. No existing human has been model for her.

Man Leben (Levi Hermann) is a fictional person. No existing human has been model for him.

All participants in this tour are fictional persons. No existing humans have been model for them.

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कालो ऽस्मि लोकक्षयकृत्प्रवृद्धो

"Time I am, awful destroyer of universe"

Bhagavad Gītā 11.32

"The empty firmament is the seat of the most violent physics"

Rendering of a statement assigned to John Archibald Wheeler

"*I wrote the book that I would have liked to learn from*."

A. Zee and Steve Weinberg

Content

Introduction

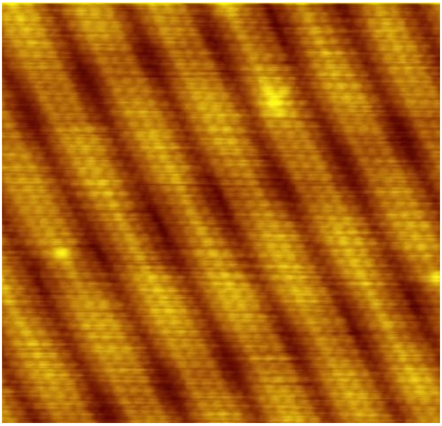
The quest for "Who are you"—in the form of a "survey into our existence"—is a contemporary Odyssey with 17 stages. At the end, we will look back on our journey. We will notice that everything is fulfilled in one sigh.

Before we resume our Odyssey by entering the world of everyday life, we will give a brief summary of the journey so far.

At the first stage, you and I have experienced the perfect oneness from where we travelled via "Solipsism", "The universe is but a dream", "Pantheism" and "Indra's net" to the second stage.

1

At the second stage, the perfect oneness was disintegrated after the initial division of air and earth[2] in innumerable particles. Also you and I had been completely disintegrated in an awful lot of minimal particles. After an initial organisation within these particles, we—the main characters Carla Drift, Man Leben and Narrator—returned in human form on our earth after an immense long time.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At the third stage, we saw how mutual trust and interconnectedness between people were realised and continued by placing “people, objects, sacrifices, and words in the middle” between people and/or between uncertainties.


4

As preparation for the continuation of our Odyssey—wherein we will enter everyday life—an interlude followed and the three main characters described each other's biographies. The report of the first part of our Odyssey and the three biographies are available on the website of the Publisher.

During the second part of our Odyssey, we will visit—as stages for everyday life—the following five common realities, because these points of view provide a good impression of the daily human experiences:

- Facts and logic
- Intensities and associations
- Void
- Change
- Interconnectedness

Do these five common realities offer everything we will need on our quest for "Who are you?"?[5]. Once we have read that:

"If you use the five common realities in a correct way, then you are completely included in the perfect universe. Do you use these accesses in a wrong way, then you will stay a mortal being." [6]

At the end of these common realities we will look back to see if we are still normal mortals or if we are included in the perfect universe.

[1] Source image: http://en.wikipedia.org/wiki/Indra's_net

[2] According to Genesis 1:1—the first book of Old Testament—God created/ separated the sky and earth at the beginning of time. The verb root "bara" in the Hebrew version of Genesis 1:1 has four meanings: "creation", "cleave", "selection" and "feed". Source: http://www.qbible.com/hebrew-old-testament/genesis/1.html

In the Western translations of the Hebrew version of the Old Testament, the word "shamayim" is translated as "Heaven". Probably "sky" or "firmament" is a better translation for the Hebrew word "shamayim". See also: http://www.qbible.com/hebrew-old-testament/genesis/1.html and http://www.ancient-hebrew.org/35_home.html and Benner, Jeff A.A. *Mechanical Translation of the Book of Genesis - The Hebrew text literally translated word for word*. 2007

[3] Source image: https://en.wikipedia.org/wiki/Atom

[4] Source image: https://fr.wikipedia.org/wiki/Charlemagne

[5] According Buddhism, the five skandhas provide everything that we need for our spiritual development. See also: Origo, Jan van, *Who are you — a survey into our existence —part 1.* Amsterdam: Omnia – Amsterdam Publisher, 2012 p. 172 - 183

[6] Source: The Sixth Patriarch's Dharma Jewel Platform Sutra. San Francisco: Buddhist Text Translation Society, 2002, p. 381 – 382. Remark: "Buddha–use" and "Store enveloping consciousness" are rendered by your Narrator as "perfect universe".

The Big Bang until now

And back?

South Kenya near Maasai Mara[1]; a few minutes after six. The sun has set and it is dark. Tonight four Maasai warriors—distant family of Narrator—keep guard at the edge of the camp. The campfire burns. Carla has set up her tent for the night: the sleeping bag lies rolled up on the camp bed, so a snake would not have a chance to crawl into it. Now she looks at the flames of the campfire and she waits for the others.

Man comes first; he has finished his daily medical check.

“Everything fine?”, asks Carla.

“Ferdinand says so. I get tired quickly and during day time I still have to get used to the heat”, says Man.

Carla nods and she says: “Fortunately, in August the difference in temperature between home and Kenya is less. This month is excellent for visiting the parks. Take care of yourself. When it is necessary, we can split ourselves from the rest of the group and stay in a luxury hotel until the others return from northern Kenya.

Anyway, I hope that we can meet Narrator's brother and sisters in two weeks in this area via his cousin: I am curious about the stories of their youth”.


2

“I think I will manage. It's nice that we met Narrator's nephews last night. Shall we go to our cook and the cooking team to see their progress with preparing our meal? Maybe they need some help”, says Man.


3

Carla and Man walk to the cooking tent where the cook and his team are preparing supper. They assist in the preparation of the meal. When the food is ready, the others—who have now set their sleeping place—arrive at the cooking tent. The entire travel group enjoys the meal and they talk about everything they have seen today. After cleaning the dishes, they sit around the campfire.

“The flames of fire are beautiful, but we should look at the starry sky instead. That way, we can—in my view—look all the way to the origin of our universe”, says Man.

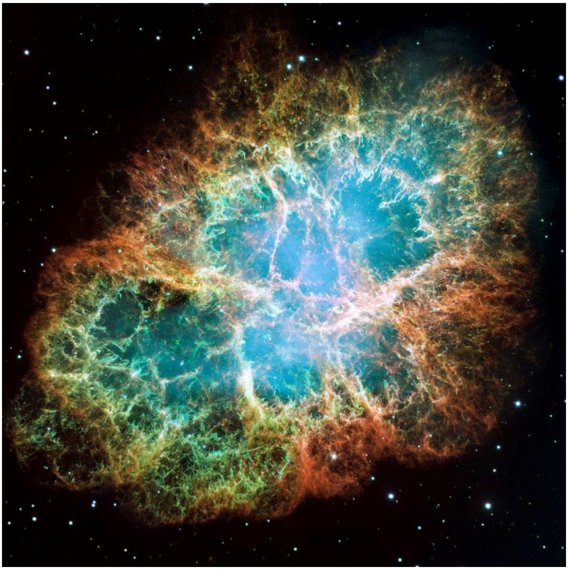
“We see the origin of the universe everywhere. A classic book on astronomy states:

“All places are alike: this cosmological principle declares that apart from local irregularities the universe is the same everywhere.” [4]

Everywhere we see the consequences of the tiny point, wherefrom—according to today's standard model for the Big Bang—today’s universe (that we can observe in our human form) has originated. What has happened before the Big Bang and what is happening outside our event horizon beyond the Big Bang, we cannot see”, says Carla.

“What do you think has been before the Big Bang?”, asks Man.

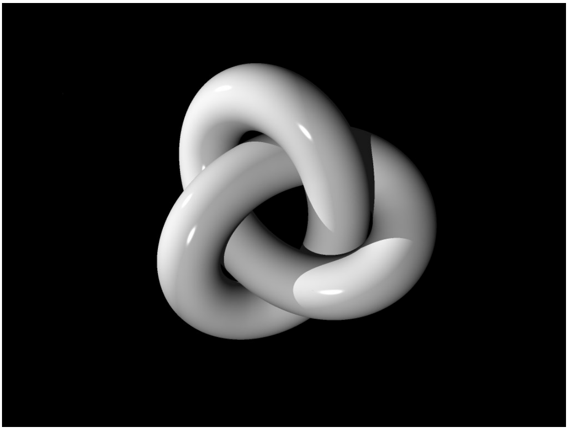
“Before I give my ideas about this question, I will explain—with omission of many, many details— the contemporary standard model for the Big Bang with its different variants. In this standard model, very small and very large meet in one and the same calculation. It is presumed that the universe—that we can perceive—has arisen at one single point, because from astronomical observations it appears that the universe is extremely uniform in general, and that it has expanded uniformly everywhere. Wherever we may look within our universe, the expansion is completely even and uniform: this means that the middle and the edges of our universe expand evenly, and so the distant parts of our universe move away faster than the nearby parts. This also means that—according to the standard model—our universe has originated within a flash at one very tiny point from an extremely large amount of energy. The enormous energy of a supernova star—released during the explosion at the end of its life—is just a tiny fraction of the energy that caused the creation of our universe and its further expansion.


[5]

Until about twenty-five years ago, the calculation of atomic physics and quantum mechanics—covering physics that is tinier than can be seen with the naked eye—were incompatible with those of astronomy and the theory of general relativity for modelling our contemporary—vast and expanding—universe: the combination of both calculations always resulted in "infinite", because this is the result of dividing by zero.

Calculation models in theoretical physics should be mathematically sound. In the event that a calculation model in physics does not correspond to the formal language of mathematics, then—most probably—a calculation error has been made; or worse, a fallacy.

Classical mathematics can easily handle ordinary numbers or fractions of numbers. Later, the concept of infinity—or the innumerable—joined, and the concept of zero appeared rather late. Recently, mathematicians started calculating with imaginary numbers and—in topology[6]—with specific shapes.



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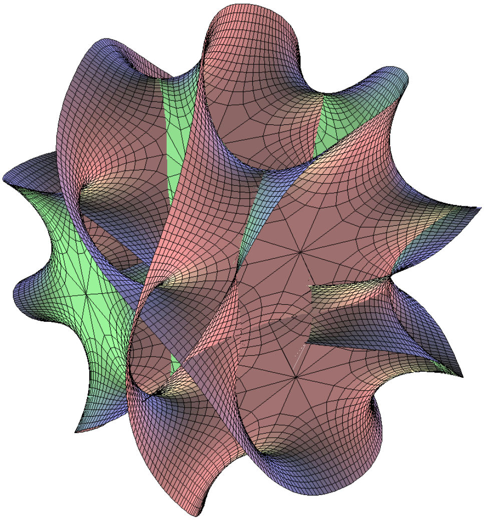
Dividing by zero is not possible in mathematics; usually an approximation of the calculation is made by dividing by a very small positive (or negative) number[8]. This approach approximates the outcome of the division: this outcome is either positive infinity or negative infinity depending on the side from which the approach is made.

As I said before, the calculation model for the Big Bang involves an extremely large number (based on astronomy) divided by virtually zero (viewed from quantum mechanics) and the outcome is steadfast plus and/or minus infinity. This infinite outcome does not fit into the cosmology we perceive, because—according to our observations in astronomy—the universe is estimated to have existed about 14 million years.

Since 1970, theoretical physicists have used for their calculations extremely tiny mathematical strings, and later manifolds—with different degrees of success—that are finite. These are much smaller than all we may observe in atomic physics, but significantly larger than zero.



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With string theory[10], the most amazing mathematical models are made sound: mathematically, other universes may easily exist parallel to our universe; particles may originate and disappear continuously from the void, which still contains a lot of energy", says Carla

"Sorry for interrupting you. Half a year ago, I started studying quantum mechanics in my own time. I have always wondered where the Big Bang had originated from. What's your idea about that?", says Peter.

"According to theoretical physics, the standard model for the Big Bang presupposes at the creation of our universe a very tiny spot that is many times smaller than an atom; from this tiny spot a number of dimensions of a manifold have been formed or—better—unfolded. This unfolding is similar to the opening of a flower from a button.

 [11]

The number of dimensions that have expanded within our universe—similar to blossom leaves, are at least the known four dimensions of spacetime: length, width, height and time. But most of the time the models take into account 10 or 11 dimensions, because it is the smallest number of dimensions, that give pretty conclusive results.

There are several models for the origin of the unimaginable energy during the Big Bang. One model assumes that the full energy within our universe has been arisen and expanded fully, simultaneously with the unfolding of the dimensions. Within this model, I think it is interesting to note that the photons at the extreme edge of the Big Bang have not gained any understanding of time and change, because no information about change—and thus time—can reach these photons anymore. These photons have not grown older after their birth at the Big Bang, because these have not received any change and new information afterwards.
A second model presupposes that the dimensions have first been unfolded and expanded to create a void wherein the full energy is arisen and expanded afterwards from one tiny spot", says Carla.

“With this second model, I am reminded of the 19th century physics framework of thought, that had presupposed a medium—or an ether—for conveying light rays, just like waves propagating in water and sound waves propagating through the sky. At the beginning of the 20th century, Michelson and Morley[12] demonstrated with an interferometry for the first time, that this medium or ether is not present. I wonder whether or not a medium or a void is necessary for the creation of our universe”, says Peter.

“Probably there is also a third model wherein the void already exists before both the dimensions and the energy originate and unfold at the same time or after each other.

I personally think that the empty space—that actually contains a lot of energy according to the standard model—has been developed together with the unfolding of the dimensions. But it is quite possible that a form of emptiness has already existed or has even been always present. How this void looks like, is outside of our universe and this emptiness is by definition beyond our reach. In case this void is uniform and completely empty, this emptiness has the highest order and thus the lowest imaginable entropy[13]; and this void corresponds to "being-whole"[14] according to Martin Heidegger's view; or this void may well be the original "All-encompassing One". Even without this original emptiness, the origin of our universe—wherefrom the universe has expanded from one point—has the highest order and thus the lowest conceivable entropy: it is—as far as we know—“being-whole" or the original "All-encompassing One".

Is "being-whole" or the original " All-encompassing One" in the form of empty space the medium or not? I do not know. I do not think there is an original ether present; I cannot prove it: it is an intuition. But I think that during the Big Bang wherefrom our universe has originated, the medium and the universe have unfolded together; I cannot prove this either.

The question why only a limited number of dimensions —whereof we can easily observe four dimensions through spacetime—have unfolded at the Big Bang, has not yet been answered unambiguously. It is true that the calculations with 10 or 11-dimensions show some sound results, and we assume a universe that matches with sound mathematical calculations. All in all, we assume an "elegant universe"[15].

When considering these 10 or 11 dimensions, I wonder about many questions, such as:

- Hasn't there been enough energy available to allow more dimensions to unfold from the tiny spot at the origin of our universe?
- Are more dimensions expanded from the origin of our universe than we know, because we cannot perceive these other dimensions?
- Have similar or other universes expanded from points outside the origin of our universe? If so, are these arisen at the same time and if so, how many other universes are there outside our universe? Mathematics allows this easily by extending the necessary dimension in the calculation model.

These questions are easily forwarded, but we cannot retrieve the unambiguous answer in our manifestation as human being", says Carla.

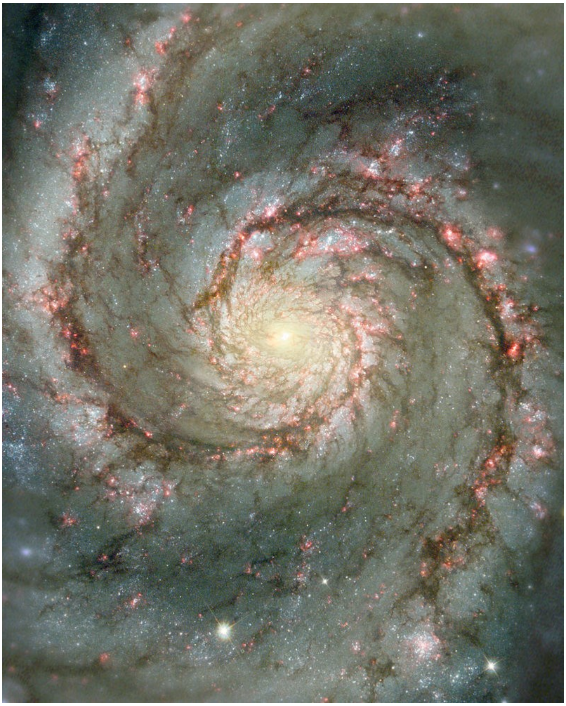
"Your description—of the standard model for the creation of our universe—closely resembles the Story of Creation in the beginning of the book Genesis in the Bible. It seems that humanity has only a limited number of myths for its creation and worldview[16]. If I understand it correctly, everything within our universe has originated in an identical way from a tiny origin, that may well be empty; nothing is privileged and everything is equivalent and uniform from the beginning. Then the question remains how the galaxy systems, our solar system, the stars and the planets have originated from this tiny point?", asks Man to Carla.

"You are right: I think there are only a limited number of myths possible within the imagination of humanity. For the explanation of the origin of our universe, we must go with our imagination beyond the existing myths.

The physicist Richard Feynman[17] has said that:

Our imagination is stretched to the utmost,
not—as in fiction—to imagine things that are not really there,
but just to comprehend those things that are there.[18]

As I have said before, our universe is uniformly expanded everywhere from an absolutely minimal point. Wherever we look at the starry sky: everywhere the universe expands at the same speed. This means that everything has arisen equally and evenly from this original spot. Or, as you said: "Nothing is in any way privileged above anything else". This is perfectly correct when we look from a distance at our universe; everything is uniformly distributed on the scale that is significantly larger than a galaxy. But when we zoom into a galaxy, or certainly to star systems and planetary systems, the uniformity of matter and radiation decreased further with every step: ever-increasing differences arise.



[19]

Where do these differences come from? In fact, we do not know, but the standard model—or the standard myth—assumes that our universe was created approximately 13.8 billion years ago at a minimum point of approximately zero. The temperature was more than 1.5 x 10^{12} K., and all matter, energy and radiation were unimaginably homogeneous. After 0.1 second the temperature fell to 10^{11} K. [20]. Not much later, due to quantum mechanical fluctuations, the first very small irregularity arose in this homogeneity.

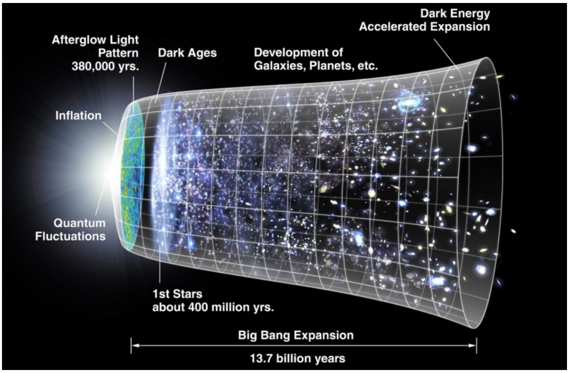
There is a variant of the standard model that assumes that matter and antimatter were created together. In matter and antimatter, the electrical charges of the particles are each other's opposites, and according to the Feynman diagrams[21] (co-developed by Richard Feynman) antimatter does not go forward in time, but goes backward in time[22]. The matter and the antimatter have merged in an unimaginable amount of energy—or, more specifically, have converted into energy—but due to a small irregularity, there was a less matter than antimatter[23]. From this matter, our universe has come into being and the energy of the merger is the major engine for the uniform and even expansion.

It is also possible that the matter of our universe has evolved along the positive axis of time, while the antimatter has unfolded along the negative axis of time: hereby, matter and antimatter—both arisen during the Big Bang—did not encounter each other, so that neither could have annihilated in energy after the Big Bang.

Around one second after the Big Bang, our universe cooled to 10^{10} K and the first particles appeared within the—still homogeneous—whole. After about 15 seconds the temperature dropped to 10^{9} K—that is 70 times the temperature of our sun—and the first chemical elements such as hydrogen and helium appeared.

The next 700,000 years atoms appeared and our universe expanded further. The small quantum mechanical irregularities that have previously occurred within homogeneity, caused that matter cluster in galaxies and stars under influence of gravity. In a metaphor: the homogeneous whipped cream slowly shifts into clots and relative empty transparent liquid.

After about 10 million years, the first living creatures arose in our universe[24].



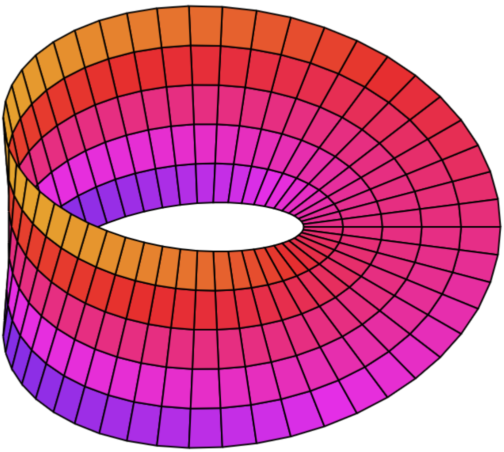
[25]

At this moment our universe is still expanding, whereby the entire universe cools further. Of course, the temperature will increase locally at the rise of new stars and during a super nova, but the total energy will be distributed over a larger space.

Depending on the total amount of mass in our universe, three scenarios are possible according to the standard model:

1. There is insufficient mass to shrink our universe again. This means that our universe will continue to expand further and everything will continue to cool down. This ultimately will result in a cold universe with a potential local temporary increase of energy, perhaps even periodically as in John Conway's "Game of Life"[26];
2. There will be just enough mass to stop the expansion of our universe at some point without any further expansion or contraction;
3. There will be enough mass to stop the expansion of our universe and then this mass will cause eventually our universe to shrink into one point again[27].

This third scenario has two variants. The first variant: after the shrinkage, our universe will return to its point of origin to annihilate (for example, by colliding with antimatter) and disappear. And the second variant: our universe will come back to the origin to start a new Big Bang in a next cycle of expansion and shrinkage [28]. These last cycles can be repeated unimaginable many times. I always think of a Möbius ring, whereby the outbound journey is the same as the return journey, with the difference that the outbound journey takes place at one side of the surface and the return journey at the other side of the surface[29].



[30]

The latest estimations of the mass present in our universe, indicate:

- a lasting expansion with finally a cold universe or
- just no permanent expansion, whereafter our universe will start to shrink again", says Carla.

“A difference in temperature from 1.5 x 10^{12} K to 10^{9}?K from the origin of our universe to the fifteenth second of existence seems small, but it is 1500° C or the difference between molten steel and steel at room temperature. This is the temperature interval wherein earthly life takes place. There are a number of scientists—often with a Christian background—who are convinced that the exact alignment of our universe is not a coincidence: it is clear to them that the universe is exactly organised in such a way, as to enable our human life on earth. Human life on earth could, according to the evolutionary theory of Darwin, have been acquired by "trial and error" and "survival of the fittest. But this does not apply to our universe; our universe has arisen from one Big Bang: it should meet exactly the conditions to make human life possible”, says Peter.

“I have my doubts whether our universe is unique in its kind; I have also doubts whether our universe was originated from just one Big Bang. People tend to consider existence from their own perspective. Every person lives in their view within only one environment, in one society, in only one age, in only one world, in one planetary system, in one system of stars, in one universe wherefrom we can now see a part of the starry sky. This perspective is so overwhelming that an existence outside of our universe—let alone beyond the Big Bang and the end of our universe—is difficult to imagine.
Of course, I can neither show nor falsify my doubts regarding the uniqueness of our universe, it is metaphysics that is outside the scope of human perception”, says Carla.

“What possibilities do you have in mind for any existence outside ours”, asks Man.

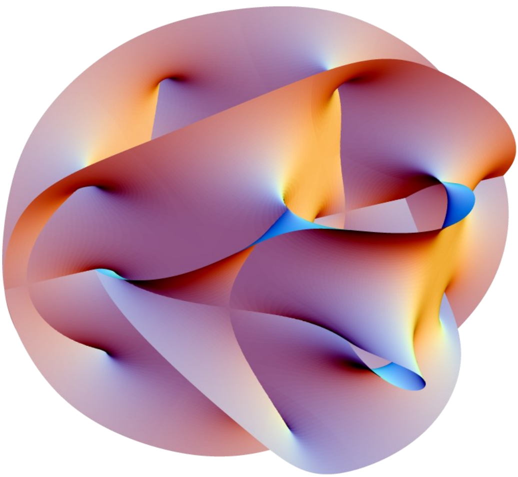
“There are possibilities sequentially and/or parallel within the space of our universe; and there are sequentially and/or parallel possibilities beyond the space of our universe.

Let's start with sequential. If we abridge the 13.8 billion years of our universe to a few centimeters on a timeline, and imagine that our universe—as a harmonic system—cyclically expands to a certain maximum value that is determined by the total energy within our universe, and then shrinks back to almost one point, then re-expands with a huge explosion—a new Big Bang at the end of our shrunken contemporary universe—then arises again and again the same and new universe, that shrinks again to almost one point . This process can, in principle, continue infinitely when no energy is lost by damping or by energy escaping at the edges. Each consecutive universe looks from outside similar to the previous universe, but due to minor variations in the initial situation caused by quantum mechanical irregularities, differences will arise within each universe, allowing other forms of galaxies and other forms of life to origin and disappear. When this process continues into infinity, finite energy within our universe can cause precisely identical universes in the past and in the future. Infinity is so huge that our universe can try an infinite number of times to reproduce itself. Think of the monkey that types on endlessly: at times of life, this monkey will once type the entire work of Shakespeare and much later again and again….

 [31]

In addition, within the space of our universe there are sufficient possibilities for the presence of a second, a third and even an infinite number of similar universes. Within our world, four independent dimensions—length, width, height and time—have been expanded during the Big Bang. The standard model for the Big Bang is based on 8 to 11 dimensions that have expanded, because with this number of dimensions, mathematical sound results are feasible. This standard model is based on a mathematical model that is fairly cohesive, but it cannot be conclusively proven because there are still too many ambiguities.

Now imagine that from the origin of the Big Bang outside of our perception—so beyond the four dimensions that are perceptible for us—four other dimensions have unfolded: this would have caused that at the same time from the same origin of our own universe, parallel a second universe has unfolded.



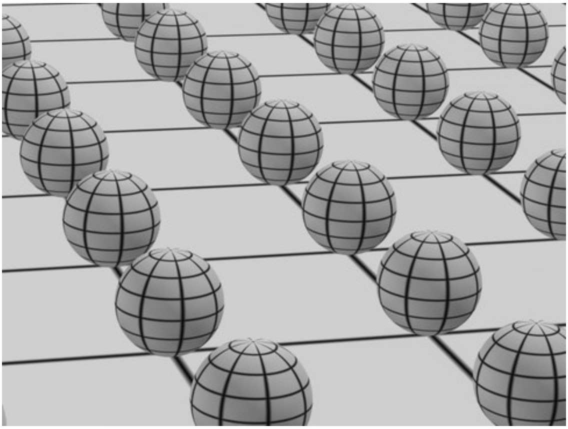
[32]

In the same way, three times as many, four times as many, as infinite times so many dimensions can be unfolded, that have caused as many parallel universes. There is no mathematical rule that prohibits extending the unit matrix/tensor from four, to 8 or 11 dimensions, and then afterwards to a multiplicity—until infinity—of this number.

$$I_1 = \begin{bmatrix}1\end{bmatrix},\ I_2 = \begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix},\ I_3 = \begin{bmatrix}1 & 0 & 0\\ 0 & 1 & 0\\ 0 & 0 & 1\end{bmatrix},\ \cdots,\ I_n = \begin{bmatrix}1 & 0 & \cdots & 0\\ 0 & 1 & \cdots & 0\\ \vdots & \vdots & \ddots & \vdots\\ 0 & 0 & \cdots & 1\end{bmatrix}$$ [33]

In addition, it is also possible that—next to the very tiny point that is the origin of our universe—at many other points in the undefined emptiness, there have unfolded (or will unfold) parallel universes. These parallel universes are—like our universe—expanded uniformly and evenly next to each other. This expansion can take place—almost identical to our universe—with small quantum mechanical fluctuations or with a different extent of expansions like balloons blown up next to each other in a more or less identical manner (or with a different size), whereby the void space will inflate identically in size, so the balloons will not hinder each other during the expansion. The quantum mechanical minor differences in origin can cause noticeable differences during the expansion.

As far as I know, there is no mathematical way to prohibit that outside of our own universe, an infinite number of other tiny point can exist, that may be the origin for an infinite number of other Big Bangs of the same kind.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When many universes can arise and disappear again—sequential and/or parallel within the origin of our universe or, sequentially and/or parallel from origins outside our universe —, there is a selection possible of "trial and error" and thus of "Survival of the fittest" within the origin and disappearance of a universe. Thus, evolution is possible within a universe that corresponds to the evolutionary theory—rediscovered by Darwin[35]—or even surpasses this evolutionary theory, because there are infinite possibilities instead of finite possibilities in our finite universe", says Carla.

"When there are infinite possibilities, I think everything will remain somewhere, sometimes, and then there will be no selection which would reduce less viable shapes of life", says Man.

"You are absolutely right, on the condition that for all infinite universes that arise, there is enough space and there is infinite energy—and therewith matter—present. But as far as I can see now, there are at least two possibilities for selection caused by small quantum mechanical fluctuations at the origin—in this model during the separate Big Bangs—that will later have major and far fetching consequences for the expansion and survival of these universes.

First of all, there might be too little space for the amount of energy to be able to expand according to plan. This creates a different form and/or composition of matter than might be expected. One form may be more sustainable or more viable for progeny of the following universe than the other form. There might also be too much space for the amount of energy, whereby the energy expands too fast and far, and this universe remains infinite as a lifeless balloon, and thus does not produce offspring and will fossilise into a lifeless cold. Even this lifeless source with a temperature at almost the absolute zero, still has many changes.

Due to quantum mechanical fluctuations, the distribution of energy across the universes can vary considerably over time, making one form more viable for offspring than another form.

In case there are infinite number of possibilities, infinitely many minor differences may arise: one form of infinity can develop much faster than the other. In this way, the distribution of energy can be significantly more applied to preferred shapes than to other shapes, whereby the preferred shapes develop faster. The other shapes can grow in infinite steps to a finite value", says Carla.

"Now that I have heard this explanation, I understand your hesitation regarding any kind of origin, better. And suddenly a question arises: "Did you wish to graduate from TU Delft on this subject"?[36]", asks Man to Carla.

"Partly: at that time I was definitely not so far. I have followed the developments on this subject. Later, a number of new insights were added, that I did not have before", says Carla.

"How do you see the law of conservation of energy during the creation of our universe?", asks Peter to Carla.

“As far as I am aware, there have never been any deviations from the law of conservation of energy. All deviations on paper have always been deduced to errors in calculation or to errors in observation. I think you ask where the enormous energy at the beginning of the Big Bang comes from?”, asks Carla to Peter.

“Yes, that is actually my question”, says Peter.

“A simple explanation for the energy that caused the Big Bang, is the merger of matter and antimatter after a shrinkage of a universe before to a minimum point by gravity. Or better: matter shrinks by gravity on one side along a positive timeline and antimatter shrinks by gravity on the other side along the negative timeline to reach a point smaller than the Planck space and then to annihilate in a fraction of a fraction of the smallest time unit; and then unfold and expand again via quantum fluctuations along the same dimensions, or perhaps unfolding other dimensions[36a].

Another explanation is assembling all matter/energy within our own universe at a minimum point that is smaller than the Planck space. Matter/energy is compressed so densely by gravity whereby all matter, energy and radiation becomes homogeneous again. Until the aggregated internal energy of the entire universe will lose all the characteristics of mass and only energy remains: this total energy causes the unfolding and inflating of a new universe. The other possibility is that the internal energy will exceed the force of gravity, and the homogeneous point will disintegrated into a Big Bang and the universe is re-created anew.

The physicist John Archibald Wheeler has said according to a quote:

“No point is more central than this, that empty space is not empty.
It is the seat of the most violent physics” [37]

The origin of the first Big Bang is shrouded in nebulae and it asks for all the imagination that we have. Maybe this event goes even well beyond our imagination. I am reminded of the following description of Dante's Purgatory:

You, imagination, that prevented us
Many times to perceive the (origin of the) world,
Although around may sound a thousand cymbals.

What moved you, outside our sense?
A flash of light, created in heaven,
By itself, or by the will of God. [38]

Maybe we should come back to it another time because it's late. I think there is also a connection with your question about quantum mechanics", says Carla.

"I will go to sleep, because I am tired. I wish you a good night", says Man.

"Sleep well", say Carla, Ferdinand, and Peter to Man.

They pour the last of the wine in their glasses.

"You are in your element tonight with your explanation of the origin of the universe", says Peter to Carla.

"I have noticed that I carry on for too long, but when I'm explaining something, I do not worry about Man. He gets tired soon and I have the impression that he is still not used to the heat. I also feel the heat during day time, but in the evening I have recovered more or less", says Carla.

"Man has consciously chosen this trip, while he knows that his health is weak. When he needs extra rest during our trip, Man and I will interrupt the tour and seek a resting place", says Ferdinand.

"Fortunately, you—as physician—will watch over his health", says Peter.

“I am pleased with that. Now I will get ready for the night, because tomorrow we have to get up early. Sleep well”, says Carla.

“Good night”, say Ferdinand and Peter.

[1] Zie ook: https://en.wikipedia.org/wiki/Maasai_Mara

[2] Source image: https://nl.wikipedia.org/wiki/Masai_%28volk%29

[3]Source image: https://en.wikipedia.org/wiki/Maasai_people

[4] Source: Harrison, Edward, *Cosmology – The Science of the Universe (2nd Edition)*. Cambridge: Cambridge University Press: 2013, p. 138.

[5] Photo of the Crab Nebula, that originated from the explosion of a supernova. A supernova is a star that is many times heavier than the sun, and it has come to the end of its life. The supernova does not have enough energy to maintain its size and implode under the influence of gravity of its own mass. This implosion takes more than a month, whereby the supernova emits just as much energy and matter until a new stable cooled state is created again. The white spots around the Crab Nebula are stars.

See also: https://nl.wikipedia.org/wiki/Supernova
Source image: https://en.wikipedia.org/wiki/Crab_Nebula

[6] See also: https://en.wikipedia.org/wiki/Topology

[7] The trefoil knot is the easiest non-trivial knot, see also: https://en.wikipedia.org/wiki/Trefoil_knot. Source image: https://en.wikipedia.org/wiki/Topology

[8] E.g.: the Planck Constant, or the Dirac Constant for the energy of a photon, see also: https://en.wikipedia.org/wiki/Planck_constant or the Dirac delta function, see also: https://en.wikipedia.org/wiki/Dirac_delta_function

[9] An example of a Calibi-Yau manifold. This type of manifolds are used in the string theory. Source image: https://de.wikipedia.org/wiki/Calabi-Yau-Mannigfaltigkeit

[10] See also: https://en.wikipedia.org/wiki/String_theory

[11] Source image: https://en.wikipedia.org/wiki/Bud

[12] See: https://en.wikipedia.org/wiki/Michelson%E2%80%93Morley_experiment

[13] See also: https://en.wikipedia.org/wiki/Entropy

[14] See also: Origo, Jan van, *Who are you – A survey of our existence – part 2.3 – Emptiness*. Amsterdam: Omnia – Amsterdam Publisher, 2015, p. 61 and 63

[15] Title of a popular scientific book about this subject: Greene", Brian, *The Elegant Universe – Superstrings, Hidden Dimensions, and the Quest for the Ultimate Theory*. New York: W.W. Norton & Company, 2003

[16] See also: Booker, Christopher, *The seven basic Plots – Why we tell stories*. London: Continuum, 2010 and Lewis-Williams, David & Pearce, David, *Inside the neolithic Mind – Conscious, Cosmos and the Realm of Gods*. London: Thames & Hudson, 2009

[17] See also: https://en.wikipedia.org/wiki/Richard_Feynman

[18] Source: Taylor, Edwin F., Wheeler, John Archibald, *Spacetime Physics – Introduction to special relativity; second edition*. New York: W.F. Freeman and Company, 1992, p. 1

[19] Source image: https://nl.wikipedia.org/wiki/Astronomie

[20] Source: Weinberg, Steven. *The First Three Minutes – A modern view of the Origin of the Universe*. New York: Basic Books, 1993, p. 101 - 121

[21] See: https://en.wikipedia.org/wiki/Feynman_diagram

[22] Source: https://en.wikipedia.org/wiki/Feynman_diagram

[23] Source: Harrison, Edward, *Cosmology – The Science of the Universe (2nd Edition)*. Cambridge: Cambridge University Press: 2013, p. 433

[24] The description of the first three seconds of our universe and the first 10 million years wherein the first living beings originated, is taken—in my own words—from: Weinberg, Steven. *The First Three Minutes – A modern view of the Origin of the Universe*. New York: Basic Books, 1993, p. 101 - 121

[25] Source image: https://en.wikipedia.org/wiki/Big_Bang

[26] See also: https://en.wikipedia.org/wiki/Conway's_Game_of_Life

[27] See also: Harrison, Edward, *Cosmology – The Science of the Universe (2nd Edition)*. Cambridge: Cambridge University Press: 2013, Chapter 18

[28] See also: Harrison, Edward, *Cosmology – The Science of the Universe (2nd Edition)*. Cambridge: Cambridge University Press: 2013, p. 370 figure 18.15

[29] See also 1963 woodcut Möbius II by M. C. Escher via: http://www.mcescher.com/gallery/recognition-success/mobius-strip-ii/

[30] Source image: https://en.wikipedia.org/wiki/M%C3%B6bius_strip

[31] Source image: http://en.wikipedia.org/wiki/File:Monkey-typing.jpg

[32] Image in dimensions: Example of 6 axes that unfold from one origin. Source image: https://simple.wikipedia.org/wiki/Calabi-Yau_manifold

[33] Source image: https://en.wikipedia.org/wiki/Identity_matrix

[34] Source image: https://www.quora.com/What-do-string-theorists-mean-when-they-say-extra-dimensions-are-rolled-up-tightly

[35] See also: https://en.wikipedia.org/wiki/On_the_Origin_of_Species

[36] See also: Narayana, Narrator, *Carla Drift – An Outlier, A Biography*. Amsterdam: Omnia – Amsterdam Publisher, 2012, p. 43 - 50

[37] According to Einstein's general theory of relativity, spacetime and energy shape each other. Spacetime has two ways of vector notation that are point-mirror-symmetrical; added together, these two forms of vector notation are zero: (1; 1; 1; -1) + (-1; -1; -1; 1) = 0. This could mean that our universe originated from a point-symmetrical spacetime: or from a total energy content of zero.

[38] John Harrison, M. *Space – A Haunting*. London: Gollancz, 2012, p. 2

[39] Dante "Purgatorio" XVII.13-18; translation from: Dante Alighieri, *De goddelijk komedie*. Amsterdam: Atheneum – Polak & Van Gennep, 2008, p. 282

End of time
In transience and imperfection

A few minutes before sunset; the sky is dark red. Carla, Man, Peter and Ferdinand are sitting around the campfire. In about fifteen minutes supper will be ready.

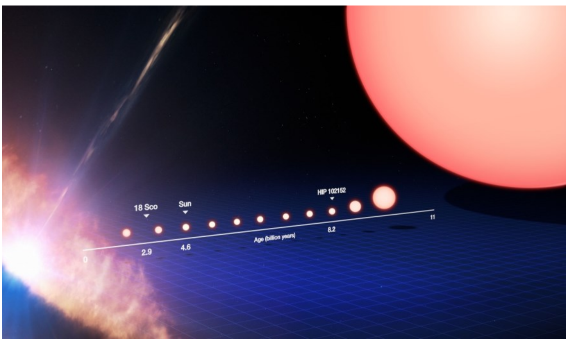
“Last night we talked about the origin of our universe. How will the sun and our earth end?”, says Ferdinand.

“In a book on cosmology, I have read that about 5 billion years ago the sun arose from a huge hydrogen nebula, that—in the course of half a billion years—was squeezed into a core under the influence of the mutual gravity of the particles. Due to this concentrated mass in the core, the pressure and temperature was raised so high that a continuous nuclear fusion started in the core of the sun, whereby Hydrogen nuclei transformed into Helium nuclei. This process of nuclear fusion in the interior of the sun will remain stable for about 10 billion years; the sun is now half way this stable phase.

During the nuclear fusion in the sun, a small part of the mass of the Hydrogen nuclei is converted into radiation, wherefrom we see and feel the light and heat radiation today on earth. By the sunlight and this heat radiation, life is possible on earth; otherwise the earth's surface would be too cold for the living humans and animals.

Due to the constant loss of mass during the nuclear fusion, gravity in the interior of the sun decreases slightly, causing the core of the sun to swell slowly, because the pressure by the nuclear fusion remains unchanged and the compression under the influence of gravity decreases slowly.

After 10 billion years, most of the Hydrogen in the core of the sun will be consumed as fuel, and therefore this way of nuclear fusion will slowly come to an end. In the interior of the sun, the radiation pressure due to the nuclear fusion will decrease, and gravity will cause the core to collapse, whereby the temperature in the core will increase dramatically. In the layer around the core, not all Hydrogen will be consumed, and the nuclear reaction will continue in the outer layers of the sun. Due to the rapid collapse of the core, the temperature in the layers around the core will be much higher than in the original core and these outer layers will swell enormously—the diameter of the sun will increase by 200 times—and thereby the solar radiation will increase several times. Due to the much larger surface of the sun, the sunlight will become red: the sun will turn into a red giant[1]. The magnitude of the sun will become so huge that the planets Mercury and Venus will be swallowed; the calculation model is uncertain about what will happen to the Earth, but the solar radiation will be so intense that life on earth will become impossible.



[2]

This enormous radiation over a period of 2.5 billion years—after 10 billion years—will cause a mass loss of a very significant part of the outer layers. After 2.5 billion years, the core will shrink further—in this period the diameter of the sun will shrink from 200 times larger to 100 times smaller than the current diameter—and the temperature in the core will increase so far that the sun will shine sharply : the sun will changed into a white dwarf [3] that will exist for 10 billion years. Hereafter the sun will probably cool off and extinguish, and the sun will turn into a black dwarf [4]", says Peter.

"This predicts a violent and scorching end of our earthly life. First we have to see if our life on earth can last for more than 5 billion years before the sun turns into a red giant. I expect that our earthy life will come across a number of other major threats within these 5 billion years, such as massive meteorites that had probably been the source of extinction of dinosaurs[5]; or humanity may well cause a world-wide nuclear war, that will destroy all life on earth", says Ferdinand.

"It is also possible that in these 5 billion years the earth will be pulled from its orbit by the gravitational force of another large passing celestial body. If this happens, then the earth will probably cool to almost absolute zero in the empty space", says Carla.

"Peter, your description of the end of our solar system reminds me of the end of in het Buddhist question "Aeonic Fire" of "Eternal/Endless Fire":

When the fire at the end of time rages through and everything is destroyed, is this destroyed or not?"
One master answered: "Destroyed, because it goes along with this".
Another master answered: "Not destroyed, because it is the same as this".
"Why is this not destroyed?"
The other master answered: "Because this is the same as our universe".[6]

Carla, yesterday you explained that our universe has expanded completely uniform from one point with small quantum mechanical irregularities in the beginning, that later led to merging of matter into planets and stars. As a result, the centre of our universe is everywhere and nowhere; or in other words, every place is the centre of our universe.

When everything changes, does the centre of our universe also change? And changes—disappears—the centre of our universe at the end of time? What do you think?", asks Man.

"A very good question with an important core. I think our supper is ready. Shall we first have supper before I let my light shine on this question?", says Carla.

"You are right: our supper is more important than questions about the origin and the decline of our universe[7]. Let us enjoy the food prepared by our cook", says Man.

Carla, Ferdinand, Peter and Man join the fellow travellers for their supper. After the meal they help with the dishes and the cleaning of the supper area; they prepare coffee for the whole group. Then they sit with fresh coffee at the still smouldering campfire, that is rekindled by Peter.

"What important core did you notice in my question about the changing centre?", asks Man to Carla.

"Before I dive into this, I think it is good to explain the end of the different types of stars.

Basically, the way whereby a star will extinguish, is determined by the mass or the energy of the star. Stars with masses up to 1.4 times the mass of the sun[8], will swell into a the red giant in the same way as the sun, shrink into a white dwarf and at last extinguish into a black dwarf, because 1.4 times the mass of the sun is the maximum where white dwarf stars are stable.

Stars with a mass that is larger than this critical mass, can—depending on their mass and composition—take different paths on their way to their end as star. I will name only three of these different paths:

1. Stars with mass around the critical mass of 1.4 times the mass of the sun, will rapidly implode at the end of their stable existence, whereby the nuclear fusion in the core will cause so much pressure and energy that the contracting gravity of the mass will be completely defied: in the beginning white dwarf will violently explode and will be seen as a supernova to the starry sky[9];
2. Stars with a mass of more than 8 times the mass of the sun can—after a huge explosion during their short life as supernova whereby the largest part of the core mass will be blown into space—end as neutron stars with a mass of between 1.4 and 3 times the mass of the sun and a diameter of about 10 kilometres[10]. The mass density of these neutron stars is very high and it consists entirely of neutrons, because the protons with the electrons fuse into the nucleus: the core of a neutron star resembles one giant atomic nucleus of neutrons, that is held together by gravity. There can still escape radiation in the form of neutrons and radio waves from gravity. Due to the radiation of high energy neutrons, a neutron star will cool from 10^{12} K to 10^{6} K within a few years. The electromagnetic radiation is usually observed as pulsating radio waves by the strong magnetic field while the neutron star rotates rapidly around her axis: this type of neutron star is being called a pulsar. A standard work on Cosmology says free rendered about these pulsating neutron stars: "*The star is dead! Long live the star! From the ashes of the old star a pulsar neutron star is born, that emits its pulselike message of matter to the end of our universe; until after a million years its rotation energy runs out*".[11]
3. Stars with a mass of about 15 to 20 times the mass of the sun, can end—after a huge explosion during their short period of time as supernova—as a so-called black hole when their residual mass after the explosion is more than 3 to 4 times the mass of the

sun[12]. The gravity of this residual mass is so large, that the core is further balled into a black hole from where nothing can escape: no radiation and no light. Around the black hole is an imaginary round surface called the event horizon. Just outside this event horizon, light can just escape the gravity of the black hole; within this horizon, everything—also light—is inescapably sucked into the black hole. Black holes are in different sizes and types, depending on the mass of the core of the black hole and the core diameter. The dimensions range from less than one millimetre to 1000 km in diameter and from 10 times to 10^9 times the mass of the sun[13]. There are also fast rotating black holes with a flat gas/matter disc outside the event horizon. This rotating disk can swing plasma perpendicular to the disk into space. The inside of the disc—of course outside of the event horizon—can be so hot that the brightness is 100 to 1000 times larger than all nearby stars and moreover, the inside of the disc just outside the event horizon of the black hole can also broadcast high energy x-rays[14].


[15]

This is a small virtual walk around the graveyard of the stars in our universe as a prelude to your question about change—and the possible end—of the centre of our universe.

Shall we first have a beer before I start herewith?", says Carla.

"With your walk on the cemetery of stars, I start to get a first impression of the meaning of a statement by a physician: "*Empty space is the seat of the most violent physics*"[16]", says Ferdinand.

Peter gets four beers and hands the bottles to Carla, Ferdinand and Man. They drink a few sips.

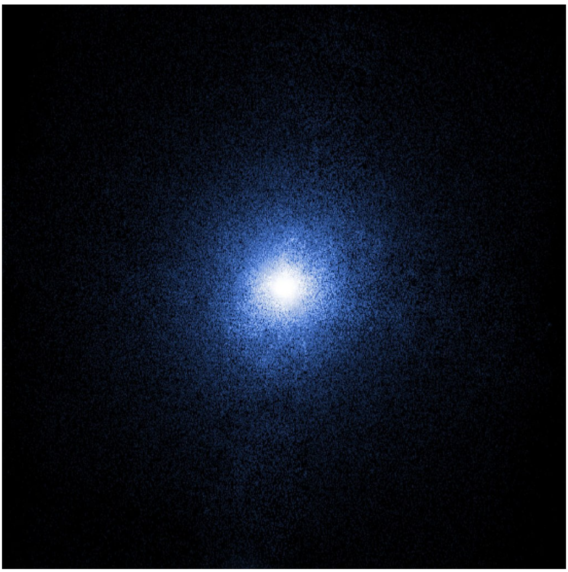
"How can we detect black holes when these holes cannot broadcast information about their existence?", asks Man to Carla.

"By the end of the eighteenth century, there were already speculations about the existence of a large number of black stars—or black holes—within our universe[17] and in 1915 the astrophysicist Karl Schwarzschild described the preconditions for non-rotating black holes based upon Einstein's general relativity theory: his calculations predicted the possibility of a gravitational field caused by a point mass with an event horizon. But Albert Einstein and Arthur Eddington—the renowned experts on general relativity and gravity in the 20s and 30s—considered intuitively that black holes did not fit within their theoretical frames of reference[18].

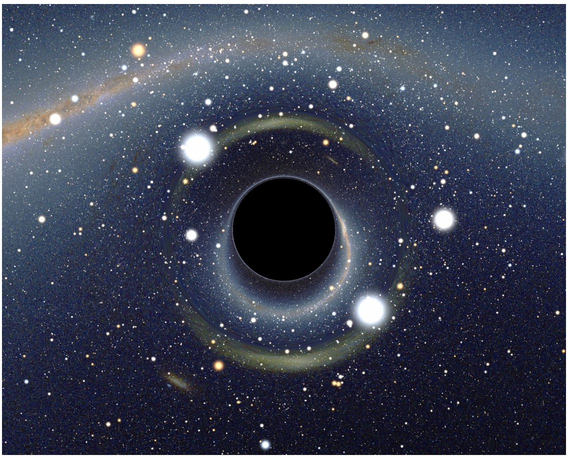
The Indian astrophysicist Subrahmanyan Chandrasekhar[19] calculated the maximum stable mass of white dwarfs as a 19-year-old young man on his boat trip to England in order to continue his studies and career[20]. In England, nobody was interested in his calculations, or his calculations were not accepted; and Arthur Eddington was an opponent of format, who in 1935 had presented his—afterwards inaccurate—view, that stars with a considerably larger mass than the sun could be saved from the fate of ending as a black hole. Until 1960, Arthur Eddington's view was common in the astronomical world. Subrahmanyan Chandrasekhar was forced to focus his attention on other areas[21].

In 1939, Robert Oppenheimer[22] and others, using the so-called "Tolman -Oppenheimer-Volkoff Limit", predicted that neutron stars—with more than 3 times the mass of the sun—could crush as ball into a black hole. The Second World War and the Nuclear Weapons Act led to an intermezzo in the theory of the life-end of stars. With the development of nuclear bombs, physicists were busy with threats of the nuclear life-end by enemies of the state.

In the 1950s, the development of the theory on the course of life of stars came back to life again; in 1967 the name Black Hole was introduced within the circle around the physicist John Archibald Wheeler[23], and this name became widely accepted. In 1964, Cygnus X-1[24] was observed for the first time and it was one of the most radiant sources of X-rays that could be seen from Earth. Around 1971, it was suspected that the core of Cygnus X-1 may contain a black hole and in 1990 this indirect evidence of the existence of a black hole was widely accepted[25].


[26]

In 1975, English physicist Stephen Hawking[27] published calculations showing that black holes emit radiation at a temperature just above the absolute zero point. Because of this radiation, the black hole will lose energy and will become lighter when more matter evaporates than new matter from outside the event horizon is attracted into the black hole. Theoretically, the black hole could completely evaporate through this radiation; but according to the calculations only a very small amount of energy will escape from the black hole throughout the entire age of our universe[28]. This so-called “Hawking radiation” is caused by the fact that at the absolute outer boundary of the event horizon, the quantum mechanical uncertainty principle involves that matter/energy within the boundary can just escape to outside the boundary horizon. This matter/energy just outside the boundary radiates with a temperature just above the absolute zero.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In 1981, there was a debate between Stephen Hawking on one side and Gerard 't Hooft and Leonard Susskind on the other side about the question if information that disappears into a black hole is lost forever[30]. Gerard 't Hooft[31] and Leonard Susskind[32] had the opinion that this information is not lost forever in a black hole. One reason why both disagree with Stephen Hawking is that losing information in our universe—that must be seen as a closed system after the Big Bang and the uniform expansion—entropy[23] will decrease: this is a gross violation of the second law of thermodynamics that states that entropy[34] of a closed system can only increase[35].

I will explain this principle of increase of entropy by a simple metaphor. Fresh whipped cream is almost completely uniform, has a low entropy and contains little information, because the whipped cream is everywhere equal and can only be ordered in one way. Over time, the homogeneity of whipped cream will increasingly get lost, and at some point the whipped cream will separate in fluid and fat: the way wherein the separated cream can be ordered will increase and the entropy will also steadily be increasing. Or freely rendered: order changes into chaos and a clean room changes over time in a dirty dusty room. And within our universe: just after the big ban the entropy was very low, because everything was almost homogeneous and everything could be ordered in a very limited manner. Over time, the universe became organised in particles, clusters of gas clouds, galaxy systems with stars and solar systems; and after some time, graveyards of stars and solar systems arose: in short, the entropy is increasing ever more.

For these three physicists, this difference of view was of fundamental importance, comparable with the fundamental differences of view on the afterlife in the Christian faith before, during and after the Reformation[36].

According to Gerard 't Hooft and Leonard Susskind, the loss of all information after passing the event horizon of a black hole implies that all the energy involved in this information might be lost forever. Or, to put it in another way: all energy—read: $E = mc^2$—connected to the mass of this information will be forever lost when passing the event horizon. This is not permitted on the basis of the physical law of conservation of energy[37]. In case all information might be lost, according to the law of conservation of energy, all energy involved with this information/mass should be completely annihilated at the moment of passing the event horizon[38]. Such enormous energy pulses/radiation—or residues thereof—caused by the complete annihilation of information/mass, have not been observed near black holes within our universe. According to Gerard 't Hooft and Leonard Susskind, this information is not lost in the event horizon and/or within a black hole. I think this information can only be lost if our universe is not a closed system: if this is the case, this energy should leak into other dimensions, thus into a different universe[39]. To date, no increase in energy from another universe has been observed within our universe.

Stephen Hawking believes that the gravity of a black hole is so huge that nothing—no light, no radiation, no mass—can escape from the event horizon. The gravity within a black hole is so large that all matter is fully compressed into the smallest possible order and shape: a black hole that is not rotating, will take the form of a fully compressed sphere or point. This results in a completely homogeneous core that has a low entropy wherein the original information will completely disappear. Thus, according to Stephen Hawking, the information of matter entering the black hole is lost forever.

In the course of the many discussions about the differences in view, Leonard Susskind (partly on the basis of Gerard van 't Hooft's work) developed the idea—and showed with the string theory[40]—that the information of the disappearing matter remains behind as a hologram[41] at the event horizon of the black hole.

I will try to explain this idea of a hologram of information at the event horizon of a black hole. According to the theory of general relativity, time near a very heavy mass—for example on the surface of an extremely heavy planet—passes slower than in the free space[42]. Or, more accurately, an observer floating in a free space at a fixed distance from a planet will see the clock on a heavy planet, tapping slower than her/his own clock. Big black holes contain disturbingly more mass than a heavy planet. The full mass of a large black hole causes that an observer in free space will see, that changes and movements of a second observer who is approaching the event horizon of a non-rotating black hole, will come to a halt. The observer floating in the free space will see the clock of the second observer almost come to a standstill. When the second observer goes through the event horizon of the black hole, the observer floating in free space will notice that the second observer will not change anymore: this second observer will remain visible and standing still at the observational horizon forever[43]. For the floating observer in the free space, the time at the event horizon of the black hole has come to a standstill. Thus, according to Gerard 't Hooft and Leonard Susskind, the information of the mass that falls into a black hole, will remain always present on the event horizon.

This difference of view has ended with the publication of Stephen Hawking in July 2004, wherein he stated, that the information—that disappeared in a black hole—will reappear along with the vaporisation of mass/energy from the black hole.

After reading this outcome of the difference of view, I doubt whether both points of view have fundamentally come together. In addition, I have doubts about both ways of modelling. I will come back to it another time, Peter. Maybe when I give my view on your question about quantum mechanics”, says Carla.

“At the beginning of your introduction, I did not understand why you had first highlighted the end of the different types of stars, before addressing the issue conservation of “information/energy of matter/ energy” when passing the event horizon of black holes.

Also during your explanation of the search for answers to this question, I again get the impression that—for science and philosophy—humanity can only have access to limited numbers of myths for interpretation of our existence in a broad sense.

Now that the end of my life is nearing, I prepare myself on passing the doors of perception between my life on earth and a life in the hereafter. Mankind has developed only a limited number of myths to give an interpretation—or explanation—to this irrevocable change. The separate world religions use these myths, and they have arranged these religious ideas in a different manner, but the original ideas show great resemblances[44].

Thereby I recognize two ideas very clearly. After the death of my aunt, I took care of the settlement of her inheritance or—in a metaphor—for a hologram of my aunt at the doors of perception between life and death. Within her legacy, I have recognised her fully as she was in my recent memory. Many years later, I looked back at photos of her; my world had changed and she remained unchanged in the photos: she stood still in time.

Let us go on with our consideration of the universe. Carla, what will happen according to theoretical physics when an observer will pass the event horizon of a black hole?", says Man.

"That is an interesting question that we probably cannot answer with certainty, because an observer will cease to exist in the core of a black hole: the observer will fully merge with the core.
In my speculation, I will assume the simplest model[45]:

- First of all, this model is based on a non-rotating black hole, because a rotating black hole rotates almost at the speed of light due to its small diameter; as a result, the layer just outside the event horizon is very hot by friction[46].

- In addition, the observer enters perpendicularly to the event horizon of the black hole, because otherwise the observer will probably rotate faster and faster around the black hole[47].
- Let us assume a very large black hole with an event horizon at a number of kilometres from the core, so this will maximize the survival time of the observer[48].

At the moment an observer enters the event horizon of a black hole, there is a division between inside and outside the event horizon. Like in our daily lives, different observers have a different and fragmented view of our universe[49].

I have just told you that an observer who is at a safe distance from the black hole will see the second observer who approaches the event horizon come to a standstill in time and in place due to the massive gravity of the black hole. After passing this horizon, the image of the second observer remains visible on the event horizon, because the time of the second observer has stopped. Space, time and spacetime cannot be observed beyond this event horizon by observer at a safe distance[50]. Mathematically, infinity and zero are approaching each other on the event horizon in a singularity[51]. Over time, the image of the observer who had passed this boundary, fades very slowly, amongst others under the influence of new matter approaching to and circling around the black hole.

The observer who goes through the event horizon, will initially not notice that his time is slowing down, because all and everything in her/his vicinity is slowing down in the same manner. Each second is experienced by her/him in the same way as before when she/he was at a safe distance. Also, she/he will experience nothing special at the passing of the event horizon, life will continue as before. She/he is still too far away from the singularity of the core of the black hole to notice its influence. In her/his experience of time, she/he will continue to live normally for about 20 hours, but faster and faster the core of the black hole will come near. The last second before her/his final death, the observer's body is stretched in the length by the huge—almost point mass out of the black hole—and compressed in the longitudinal direction; in the last hundredths of seconds, the observer dies and she/he fully merges in the mass and singularity of the black hole.

52

Then time, space and spacetime cease to exist for her/him[53]—just like spacetime doesn't exist in the core of the black hole— : the four dimensions of spacetime are again reduced or wrapped to a point in the core of a black hole like in our universe before the Big Bang.

In my view, this is a very fast and peaceful death", says Carla.

"Definitely a quick death, but the last 20 hours are lonely", says Man.

"I think that at the same time, more matter will disappear in the black hole. It will not be much matter, because from a distance it is difficult to travel straight to a black hole. Most matter in the direction of the black hole will have a minor deviation, whereby it will continue the journey in space after passing the black hole in another direction. At an extremely small deviation, the matter has a chance to continue of circling around a black hole. Only in exactly the right direction and without any deviations in between, matter can travel exactly to the event horizon of a black hole", says Carla.

"Can matter and radiation escape from a black hole?", asks Ferdinand.

"I expect that there are black holes in sizes and kinds, just as there are stars in sizes and kinds. Let me assume a black hole, that is so compact that no movement, no nuclear fusion, and no heat development in the core is possible.

Still, I expect that this very compact black hole will shine like a black body. The energy of radiation is proportional to the frequency of radiation[54]. Because all mass—and as a consequence all energy via $E = mc^2$—is sucked into the core of the black hole, the black hole will radiate with only an extremely low surface temperature. This radiation has a very low frequency; probably this radiation—from a black hole beyond the event horizon—will have a wavelength of more than the diameter of the event horizon. Via quantum mechanical mechanisms, a small part of this radiation/mass will escape from the event horizon; as a consequence this radiation will contain very little information", says Carla.

"Is it possible that our universe will disappear into a black hole?", asks Peter.

"I don't know; I don't think so. It is already late. Shall we continue another time?", says Carla.

[1] See also: https://en.wikipedia.org/wiki/Red_giant

[2] Source image: https://en.wikipedia.org/wiki/Red_giant

[3] See also: https://en.wikipedia.org/wiki/White_dwarf

[4] Sources for the contribution by Peter:

- Harrison, Edward, *Cosmology – The Science of the Universe (2nd Edition)*. Cambridge: Cambridge University Press: 2013, p. 100 – 104,
- Thorne, Kip S., *Black Holes & Time Warps – Einstein's outrageous legacy*. New York: W.W. Norton & Company: 1994, p. 164 – 178,
- https://en.wikipedia.org/wiki/Sun

[5] See also:

- https://en.wikipedia.org/wiki/Meteorite
- https://en.wikipedia.org/wiki/Cretaceous%E2%80%93Paleogene_extinction_event

[6] Free rendering of the Zen koan Dasui's "Aeonic Fire" in: Cleary, Thomas, *Book of Serenity – One Hundred Zen Dialogues*. Bosten: Shambhala, 1998 p. 131 – 136

[7] See also: Buddhist question "Yunmen's Sesambread" in Yamada Kôun Roshi, *Hekiganroku, Die Niederschrift vom blauen Fels*. München: Kösel-Verlag, 2002, p. 236 - 243

[8] This is the so called "Chandrasekhar limit", named after the Indian astrophysicist Subrahmanyan Chandrasekhar. His first name is via Sanskrit deductible to: "Birth/ Origin from the good Brahman) and his second name to: "Summit/Crown or Best Part of the Moon". In Buddhism the "moon" is sometimes used for "belief" or the "All -encompassing One".

Sources:

- See also: https://en.wikipedia.org/wiki/Chandrasekhar_limit
- Thorne, Kip S., *Black Holes & Time Warps – Einstein's outrageous legacy*. New York: W.W. Norton & Company: 1994, p. 140 – 164,

[9] See also: https://en.wikipedia.org/wiki/Supernova

Remark: A supernova may also arise in another way, for example from a white dwarf near a red giant, where the white dwarf explodes and the red giant disappears from his orbit around the white dwarf, because the gravity of the white dwarf has spread out over a huge space with the explosion.

[10] See also: https://en.wikipedia.org/wiki/Neutron_star

[11] Source: Harrison, Edward, *Cosmology – The Science of the Universe (2nd Edition)*. Cambridge: Cambridge University Press: 2013, p. 105

[12] This is the so-called “Tolman–Oppenheimer–Volkoff limit”. See also: https://en.wikipedia.org/wiki/Tolman%E2%80%93Oppenheimer%E2%80%93Volkoff_limit

[13] Sources:

- https://en.wikipedia.org/wiki/Black_hole
- Harrison, Edward, *Cosmology – The Science of the Universe (2nd Edition)*. Cambridge: Cambridge University Press: 2013, p. 246 – 269
- Thorne, Kip S., *Black Holes & Time Warps – Einstein’s outrageous legacy.* New York: W.W. Norton & Company: 1994, p. 209 – 258

[14] Source: Thorne, Kip S., *Black Holes & Time Warps – Einstein’s outrageous legacy*. New York: W.W. Norton & Company: 1994, p. 351

[15] Impression of a rotating black hole – the event horizon is shown as a black ball – with a disc of gas/matter that is circling around the black hole and a vortex current perpendicular to the disk caused by, for example: a) hot gases caused by heat of due to friction in the inner ring of the rotating disc, or b) magnetic lines due to the rotating disk that swings plasma out of the disc outside the viewing horizon.

Sources:

- Thorne, Kip S., *Black Holes & Time Warps – Einstein’s outrageous legacy*. New York: W.W. Norton & Company: 1994, p. 346 – 354 en
- https://en.wikipedia.org/wiki/Black_hole

Source image: https://en.wikipedia.org/wiki/Black_hole

[16] Free rendering of a quote assigned to John Archibald Wheeler; See: John Harrison, M. *Empty Space – A Haunting*. London: Gollancz, 2012, p. 2

[17] Source: Thorne, Kip S., *Black Holes & Time Warps – Einstein’s outrageous legacy*. New York: W.W. Norton & Company: 1994, p. 123

[18] Source: Thorne, Kip S., *Black Holes & Time Warps – Einstein's outrageous legacy*. New York: W.W. Norton & Company: 1994, p. 124 – 134

[19] See also: https://en.wikipedia.org/wiki/Subrahmanyan_Chandrasekhar

[20] Source: https://en.wikipedia.org/wiki/Chandrasekhar_limit

[21] Source: Thorne, Kip S., *Black Holes & Time Warps – Einstein's outrageous legacy*. New York: W.W. Norton & Company: 1994, p. 140 – 163

[22] See also: https://en.wikipedia.org/wiki/J._Robert_Oppenheimer

[23] See also: https://en.wikipedia.org/wiki/John_Archibald_Wheeler

[24] See also: https://en.wikipedia.org/wiki/Cygnus_X-1

[25] Source: Thorne, Kip S., *Black Holes & Time Warps – Einstein's outrageous legacy*. New York: W.W. Norton & Company: 1994, p. 314 – 321. Remark: In 1990 Stephen Hawking has accepted his loss in the bet with Kip Thorne.

[26] Photo of X-rays by Cygnus X-1. Source image: https://en.wikipedia.org/wiki/Cygnus_X-1

[27] See also: https://en.wikipedia.org/wiki/Stephen_Hawking

[28] Source: https://en.wikipedia.org/wiki/Hawking_radiation

[29] Simulation of a black wherein a galaxy disappears. Gravity forces has an effect of a lens that distorts considerable. Source image: https://en.wikipedia.org/wiki/Hawking_radiation

[30] See also: https://en.wikipedia.org/wiki/Black_hole_information_paradox

[31] See also: https://en.wikipedia.org/wiki/Gerard_%27t_Hooft

[32] See also: https://en.wikipedia.org/wiki/Leonard_Susskind

[33] See also:

- Susskind, Leonard, *The Black Hole War: My Battle with Stephen Hawking to Make the World Safe for Quantum Mechanics*. New York: Little, Brown and Company, 2008 p. 126 - 175
- https://en.wikipedia.org/wiki/Entropy_(information_theory)

[34] Entropy is also the dimension for the number of possible ways of organizing information within a particular context. See also: Susskind, Leonard, *The Black Hole War: My Battle with Stephen Hawking to Make the World Safe for Quantum Mechanics*. New York: Little, Brown and Company, 2008 p. 131

[35] See also: https://en.wikipedia.org/wiki/Entropy

[36] See also: Origo, Jan van, *Who are you – a survey of our existence – part 2.2 – Intensities and Associations*. Amsterdam: Omnia – Amsterdam Publisher, 2014, p. 100

[37] See also: https://en.wikipedia.org/wiki/Conservation_of_energy

[38] See also: Susskind, Leonard, *The Black Hole War: My Battle with Stephen Hawking to Make the World Safe for Quantum Mechanics*. New York: Little, Brown and Company, 2008 p. 184

[39] See also: Susskind, Leonard, *The Black Hole War: My Battle with Stephen Hawking to Make the World Safe for Quantum Mechanics*. New York: Little, Brown and Company, 2008 p. 191

[40] See also: https://en.wikipedia.org/wiki/String_theory

[41] See also: Susskind, Leonard, *The Black Hole War: My Battle with Stephen Hawking to Make the World Safe for Quantum Mechanics*. New York: Little, Brown and Company, 2008 p. 290 – 308; en https://en.wikipedia.org/wiki/Holographic_principle

[42] See also:

- https://en.wikipedia.org/wiki/Time_dilation
- https://en.wikipedia.org/wiki/Gravitational_time_dilation

[43] Of course, the image of the second observer will change at the observational horizon for the observer who is floating in the free space, but this change is extremely slow because the time is (almost) standing still due to huge gravity forces from the black hole.

[44] See e.g.: Eliade, Mircea, *A History of Religious Ideas, Volume 1,2,3*. Chicago: The University of Chicago Press, 1982

[45] This is the Oppenheimer – Snyder black hole model. See: Thorne, Kip S., *Black Holes & Time Warps – Einstein's outrageous legacy*. New York: W.W. Norton & Company: 1994, p. 211 – 219 and 451

[46] See: Thorne, Kip S., *Black Holes & Time Warps – Einstein's outrageous legacy*. New York: W.W. Norton & Company: 1994, p. 294 and 346 - 347

[47] See: Thorne, Kip S., *Black Holes & Time Warps – Einstein's outrageous legacy*. New York: W.W. Norton & Company: 1994, p. 291 - 292

[48] See: Thorne, Kip S., *Black Holes & Time Warps – Einstein's outrageous legacy*. New York: W.W. Norton & Company: 1994, p. 451

[49] See: Smolin, Lee, *Three roads to Quantum Gravity*. New York: Basic Books, 2001, p. 45

[50] See: Thorne, Kip S., *Black Holes & Time Warps – Einstein's outrageous legacy*. New York: W.W. Norton & Company: 1994, p. 451

[51] See also: https://en.wikipedia.org/wiki/Gravitational_singularity

[52] Source image: https://universe-review.ca/I15-61-tidal.jpg

This image shows the elongated in a correct manner when approaching the core of the black hole, but in reality, the feet and legs will also be compressed in the direction of the core.

[53] See: Thorne, Kip S., *Black Holes & Time Warps – Einstein's outrageous legacy*. New York: W.W. Norton & Company: 1994, p. 451

[54] See also: Susskind, Leonard, *The Black Hole War: My Battle with Stephen Hawking to Make the World Safe for Quantum Mechanics*. New York: Little, Brown and Company, 2008 p. 155 – 175

Fluid time
Volatile as life

Just before the sunset, Man approaches Carla and Peter; he sits down between at the campfire.

“I noticed that you visited Ferdinand. How are you today?”, asks Carla to Man.

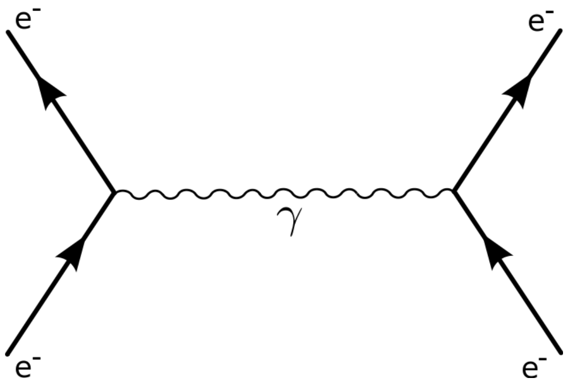
“After a week I had hoped to get used to the heat during daytime and to feel better, but that did not happen. My health remains worrisome, in a few days I will have to decide if it's necessary to travel to Nairobi and return to Amsterdam by plane”, says Man.

“If this is the case, then I will return with you”, says Carla.

“You should not do that; you should visit the family of Narrator.

Yesterday night, you said—sitting at the campfire—that entropy in our universe can only increase[1]: the order changes—without help and support from the outside—irrevocably in chaos and decay. This applies to a home and car, and I think this also applies to our body, that requires more time and rest for older people to recover from efforts. Now I notice that I don’t recover well from traveling: in past travelling it was no burden for me. I wonder, why do we only change from young to old? I would not like to go back in time—in my case from old man via young man to my birth again—like Merlin in "*The Once and Future King*" by Terence White[2]. A lot has happened in my life: I have had a rich life, rich in joy and rich in sorrow; my personal life has now been completed. But the question remains: why can’t we go back in time; why does our life go from the past to the future; why can’t we live from the future to the past?”, asks Man to Carla.

“In the world of ideal physics—a world without entropy—there is no preference for the direction of time. A capture of two crashing billiard balls on an ideal billiards table can be turned smoothly forward and backward in time without any alienation. The same applies to the exchange of a photon between two electrons. I will draw the Feynman diagram[3] for this exchange in the sand.



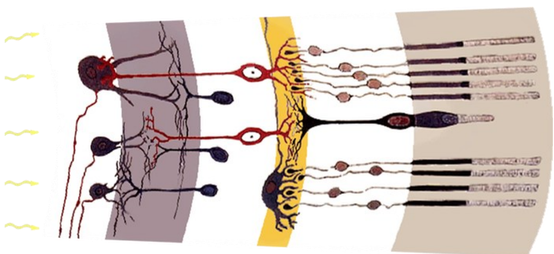
[4]

In spacetime diagrams, the progress is rendered from bottom to top. But in this Feynman diagram, the course of time can as well unfold in the opposite direction from top to bottom: in that case the arrows on the two electrons on either side of the diagram are reversed, and the photon[5]—similar to the electromagnetic energy (shown as γ in the diagram)—returns to the other electron and thus reverses in time[6].

In everyday life, the probability that a process unfolds according to a given time path, is much higher, than that it might unfold in reverse order in time. In analogy with Albert Einstein's “Gedankenexperimenten” or "Thought Experiments"[7], I will show this by the following thought experiment in two parts.

In the first part of the thought experiment a laser is placed in a dark room. This laser emits every few seconds one photon at a time to one of the eyes of a woman. The emitting of the photons is recorded on a timeline. The woman pushes a button with her finger, when she observes a photon with one of her eyes[8]. The button is connected to a counter that records on a timeline when and how often the woman presses the button. After a certain period of time, the observation timeline by the woman is compared with the timeline of emitted photons by the laser. Supposingly, 40 percent of the emitted photons are correctly recorded by the woman on the observation timeline—or better said: 40 percent of the registrations on both timelines correspond—and 10 percent of the observed photons have not been transmitted by the laser, but these are recorded wrongly by the woman on the observation timeline. This is a very good outcome of the first part of this part of the thought experiment. The two deviations in the observation of photons can be explained by:

- some part of the emitted photons is absorbed into the eye lens and parts of the retina that cannot detect photons (see illustration below) and
- a random nerve activity delivering a signal that a photon has been observed, while no photon has touched the retina. In addition, with an extremely small chance, an electron in the eye may emit a photon that is detected by the retina. On this last option I will come back later.



[9]

In the second part of the thought experiment, the woman is again in the same dark room. She is instructed to randomly transmit one photon every couple of seconds to a sensor that is located two meters away from her. As she sends a photon, she is instructed to push a button that is connected to a counter that records on a timeline when the woman presses the button.

The outcome of this second part is as expected:

- Every now and then the sensor detects the observation of a photon. The timeline of this registration by the sensor does not have any relation with the registration of the moments when the woman presses the button, because she imagines sending a photon with her eyes.

The first part of the thought experiment shows, that the first process of detecting photons by the human eye and at the same time pushing a button unfolds rather well in the course of time. The reverse process in the second part of the thought experiment—wherein the registration of photons emitted by the eye is compared with the "intention of the woman to emit a photon"— unfolds disastrous over time.

Both parts of this thought experiment show that a process unfolds well in our usual direction of time, but outright hopelessly in the reverse direction of time.

We humans are focused on survival and we pay attention to processes that are useful for our survival; while we try to avoid processes that are not useful for our survival. This means that unlikely processes in the reverse course of time do not get any attention, because these processes are not important to us.

We arrange the timelines of important processes—such as a day, the gestation period of an animal or a human child, a year cycle, a human life or the existence of humanity—by reference timelines, and thereby we experience the progress of time. The extremely minimal chance of reversing of these familiar processes, we rightly overlook in everyday life. As a result, we do not experience the possibility of an extremely small chance that a process can also be reversed, sporadically, e.g. a group of cells of a person who gets younger for a short period of time, and then simply ages again.

The astronomer, physicist and mathematician Arthur Eddington[10]—whom I had mentioned several times in relation to black holes and also as opponent of the Indian astrophysicist Subrahmanyan Chandrasekhar—described in 1928 in his book "*The Nature of the Physical World*" [11] the change over time according to the "Arrow of Time" on the timeline.

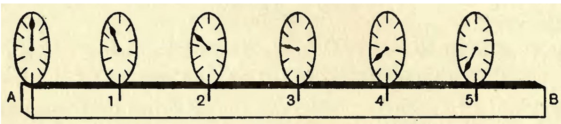


FIG. 9. [12]

Arthur Eddington wrote about this "Arrow of Time", that when we follow the arrow and we get more and more of the random element, then the "Arrow of Time" points to the future. If the random element decreases, then the arrow points to the past. This is the only known difference between future and past in physics. This is immediately clear if the basic theorem is acknowledged, that the introduction of randomness—and quantum mechanical irregularities—is the only thing that cannot be undone. Arthur Eddington uses the concept of "Arrow of Time" to express this one-way feature of time ,that does not occur in space.

After that, Eddington noted three points about the "Arrow of Time":

- The "Arrow of Time" is clearly recognisable with our consciousness;

- The "Arrow of Time" forces itself upon us through our gift for reasoning and judgment, that tells us that a reversal of the arrow of time makes our common world insane;
- The "Arrow of Time" does not occur in physics, except in the study of the organisation of a number of individuals.

According to Arthur Eddington, the "Arrow of Time" indicates the gradual progression/progress of the arbitrary elements. After a long argument about the nature of thermodynamics, he concludes that, as far as physics is concerned, the "Arrow of Time" arises only from a characteristic of entropy.

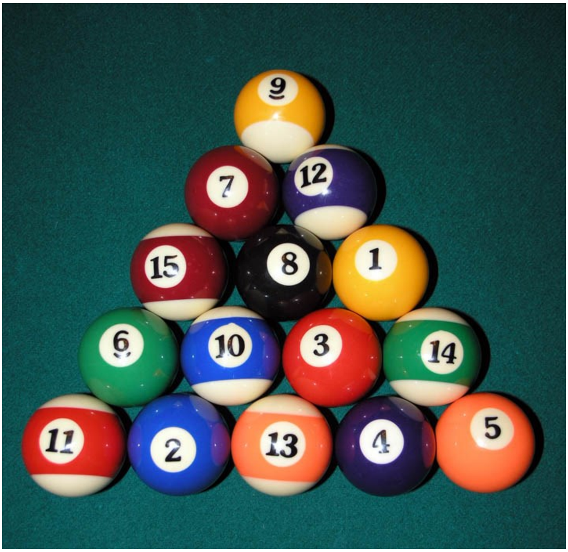
I am not completely convinced by Arthur Eddington's argumentation, because I think that the "Arrow of Time" is experienced by people in daily life, because a number of processes progress much easier in one direction. In reverse order, these processes have an extremely small chance of manifesting themselves in everyday life. I have tried to demonstrate this by the thought experiment of the perception and transmission of photons by the human eye in a thought experiment. The important changes for human—e.g. aging—consist of many processes that each have a good chance of taking place, and that must subsequently take place in a correct order. If one of these processes goes completely wrong, the person in question will die prematurely.

The chance of a person getting younger, requires many processes after each other, that each have only a very small chance of taking place.

This is the beginning of my answer. Can you still follow it?", asks Carla.

"I have to think of our gastrointestinal tract, where the normal process goes more or less by itself in the course of time. The reverse road is anything but fun, but a healthy person usually only throws up after eating spoiled food", says Ferdinand.

“True. Carla, your reasoning resembles a pocket billiards—or pool billiards—where it is easy to spread the triangle of coloured balls in a few seconds by the white ball over the billiard sheet. But it's almost impossible to re-order all the balls by fifteen separate billiard players in one move reverse in the triangle”, says Peter.



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“The second part of your example is good to follow, and almost everyone will find the example of spreading the billiard balls over the billiard sheet very recognizable. Almost everyone will see the spreading of the balls through the hit by the white ball as one outcome. But I expect that every single spread of the fifteen balls through the white ball is as unique - and has a chance more or less for an equal order—as the fifteen players who have to play the 15 balls back into the triangle in one move each.

Or in a metaphor: every possible distribution of the 15 balls over the billiard sheet after a billiard push, is another book in the vast “Library of

Possibilities". At the very back of the library there is a well-hidden cabinet with the "*Books of Possibilities*" to push the fifteen balls back in time within the triangle in the original order.

14

Because of the manner whereby we organize our observations, we will not regard this hidden cabinet of books in the “Library of Possibilities", about processes that went back in time as impossible options. The rest of the library is rather well known to us. These many books are about processes that in our eyes take place usually and regularly over time, although each known book is almost as unique as the limited number of unknown books in hidden cabinet of books in the back of the library.

I mentioned this metaphor of the "Library of Possibilities", because now I read a book about Sufism and Taoism, that describes that for Ibn 'Arabi—a Sufi philosopher—our tangible world of daily life is just a dream. We observe a lot of things with our senses, we distinguish them from one another, we put them in a sequential order, and ultimately we determine and conclude—on the basis of these observations—a certain reality around us. We call this reality and we do not doubt the authenticity hereof [15].

According to Ibn 'Arabi, this form of reality—based on sequential observations—is not a reality in the true sense of the word. This is not true "Being". For the reality that we experience, are only phenomena within the "Being", or in my own words: within the All-encompassing One. According to Ibn 'Arabi, the true "Being" is not perceivable to us, just as our everyday reality is also not observable to a person who is dreaming of daily life within her/his sleep[16]", says Man.

"The physicist John Archibald Wheeler[17], who has introduced the name Black Hole, once summarised with the sentence "*No phenomena is a real phenomena until it is observed*"[18] the positivistic basis[19] for an important interpretation of quantum mechanics, wherein particles have no independent properties: when particles are not observed, these particles have no properties. I do not fully agree with this interpretation of quantum mechanics, that is also called the Copenhagen interpretation[20].

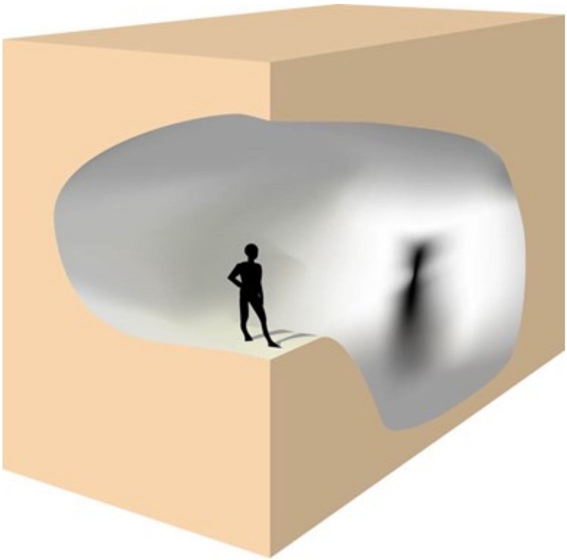
If I understand you well, Ibn 'Arabi combines the perceived tangible world—as phenomena in a dream—with the idealistic reality of the All-encompassing Being, that can usually not be perceived or perceived by humans. Do I understand you well?", asks Carla to Man.

"I think you represent Ibn 'Arabi well, because although the reality of our daily life according to Ibn' Arabi is a dream, it is not a mere illusion, but it is a certain form of rendering—and self-manifestation—of the All-encompassing Being.

Everyday world of constant changes is an imagination and at the same time also (a part of) Being[21].

According to Ibn 'Arabi, the return to the All-encompassing Being requires a dying of this representation/image of the All-encompassing Being. An arising from the dream is necessary to awaken in Being in the true sense of the word. This dying is no physical dying in the common sense of the word, but leaving the dream of Being and of the phenomena within Being.

In my opinion, Ibn 'Arabi surpasses the Platonic allegory of the cave, where the chained prisoner observes reality as shadows on the wall of the cave[22].



[23]

In the view of Ibn 'Arabi, the phenomena—or the tangible world of daily life that people feel within like a dream of the All-encompassing Being—are part of the All-encompassing Being.

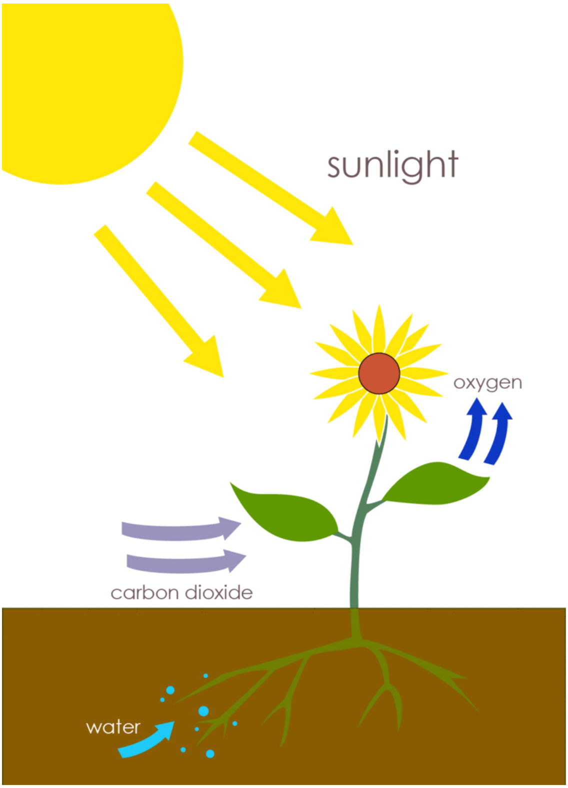
This reminds me of the haiku in "Emptiness" [24]

Way of emptiness
In everyday life,
Dream of all dreams.

Looking at our campfire, is this campfire dream or reality? I think dream and reality, and neither dream nor reality. The fire that we see, is a reflection of many complex burning processes[25]—come forth from the Big Bang—that altogether take care that wood with oxygen in a certain direction of time or "Arrow of time" according to Arthur Eddington, is converted into heat, light, ash and vapour of water. We experience these many burning processes as phenomenon "campfire", that is presented as a veil in the change of the All-encompassing Being. The burning processes are reality, the phenomenon of "campfire" is reality and the change of the All-encompassing Being is reality. The campfire and the many complex burning processes are a dream of Being; the change of the All-encompassing Being is the "Dream of All Dreams". And thereby, these dreams are all empty within the "Being-whole"[26].


[27]

In the all-encompassing emptiness of "Being-whole", the many complex burning processes and the campfire progress not only in one direction, but also in the opposite direction: ashes, light and heat are converted within the "Being-whole" into wood and oxygen by photosynthesis[28].



[29]

I come back to my original question: why can't we go back in time; why does our life go from the past to the future; why can't we live from the future to the past? While in the emptiness of "Being-whole", life continuously comes forth from dying.

The processes of photosynthesis to wood for the campfire, and the burning of wood in the campfire to ash are cyclic and sequential in time. The process of this campfire will not reverse in time, so the flames will turn smaller and the ashes will turn into good wood for the campfire. This burning process of the campfire remains irreversible: it cannot be undone, so the time will develop from the past into the present. But in the "Being-whole" of the Earth, the processes of photosynthesis and burning progress simultaneously—of course in different places—side by side. Further on, trees grow wherefrom wood will be used for campfires by other people.

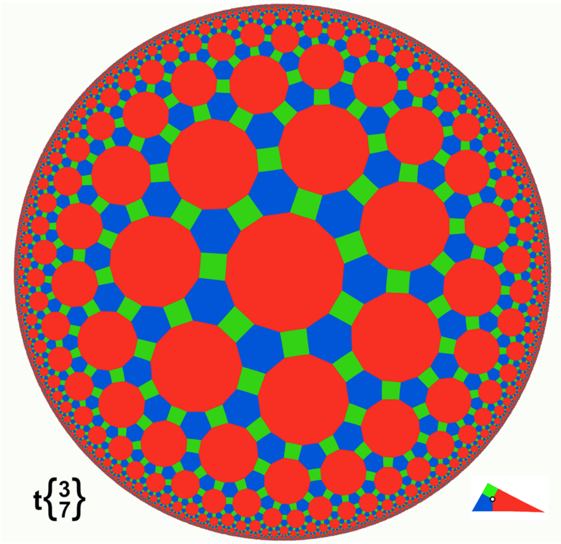
Carla, is it possible that time will stand still for us, and can we notice it[30]?” asks Man to Carla.

“Yesterday evening we showed that an observer who passes the event horizon of a black hole, will merge with the core of a black hole. Due to the enormous gravity, time will almost come to a standstill. But the observer will not be able to notice this stand still of time consciously.

I will try to find an answer to your question if we can observe a standstill of time in different ways. First, let’s look at our universe.

As far as I know, our universe is steadily expanding after the Big Bang. We observe this through an even red shift[31] in the light of all galaxies around us. This means that everything around us all expands evenly. This means that "parallel" lines will also expand in the course of spacetime; hereby is the geometry of our universe is not Euclidean[32] but hyperbolic[33].

Just after the Big Bang, the four dimensions of spacetime are unfolded; and with this progressive expansion, all the four dimensions of spacetime around us are unfolding further and further. Hereby, spacetime has not yet come to stand still. It is not yet clear, whether our universe continues to expand, or that the universe will shrink again over time.



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In my book on hyperbolic geometry there is an image depicting our expanding in a schematic fashion: all polygons are equally large: the polygons at the edges are actually equal in size and expand as much as the polygons in the middle.

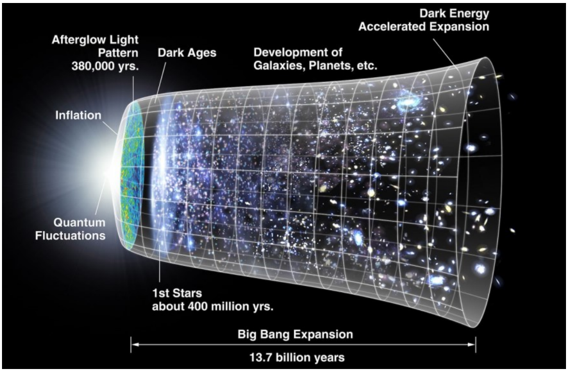
35

The woodcut Circle Limit III by Maurits Cornelis Escher gives a similar view. In an expanding universe, the squares on the edge are as large as the square in the middle, and all squares expand equally.
What is spacetime and how does spacetime expand?

In continuation of the special relativity theory by Albert Einstein from 1905, his professor mathematics Hermann Minkowski stated in 1908 at the 80th meeting of the Association of German Scientists and Physicians that:

"*The views of space and time which I wish to lay before you have sprung from the soil of experimental physics, and therein lays their strength. They are radical. Henceforth space by itself, and time by itself, are doomed to fade away into mere shadows, and only a kind of union of the two will preserve an independent reality*."[36]

Before the concept of spacetime was accepted in science, scientists usually used "fixed references with points in space" (within a coordinate system), that did not change over time. In spacetime, this "fixed reference with associated points" can change over time according to a particular timeline.



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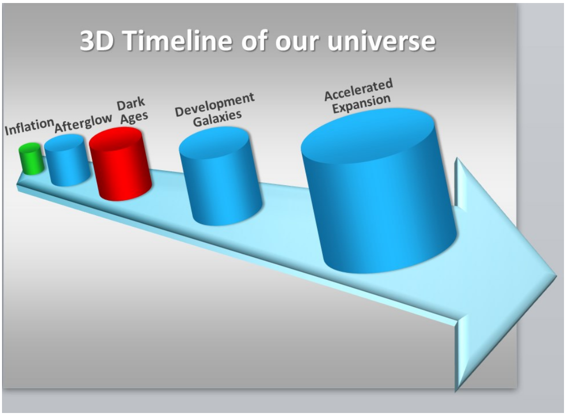
In this schematic image—from the Big Bang to the present—the reference for spacetime at the edge of the universe at "Inflation" follows the expanding timeline through "Dark Ages" and "Dark Energy Accelerated Expansion" to the reference in our time.
As a consequence, a reference circle at "Dark Ages" has expanded into a significantly larger reference circle in our time after around 13 billion years. And if we schematically render the volumes of the different periods after the Big Bang in a timeline, a four-dimensional impression in spacetime can be seen of the expansion of our universe after the Big Bang.



38

In this way, the 4 dimensions of spacetime are easy to make visible", says Carla.

"In a similar way, a human life can be shown schematically in the four dimensions of spacetime. Instead of "Inflation" the young years, "Afterglow" becomes puberty, "Dark Ages" become adolescence, "Development Galaxies" becomes the years of wisdom, and the "Accelerated Expansion" is accelerated aging after the retirement", says Man.

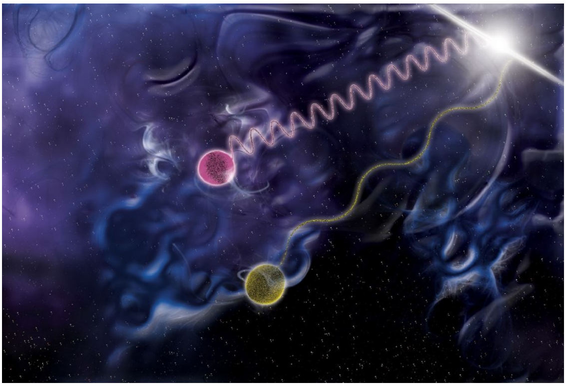
"With your background as architect, you have no trouble making this visible. Many people have trouble visualising the four dimensions of spacetime.

Not only the space of our universe changes over time, but also the time changes in the course of time. Both changes are well in line with our daily experiences, especially when speeds are well below the speed of light and acceleration within the human size.

But changes in spacetime differ considerably from our daily life, when travelling at speeds near the speed of light, when there are high accelerations or when the journey ends in a black hole. I will give a few examples hereof.

A photon[39] has no mass and it moves in free space at the speed of light[40]. In a medium, a photon will be significantly decelerated: in special cases, a photon will move in a medium at a speed of less than 10 meters per second[41].

A photon is actually energy with a momentum; the energy of photons is determined by the frequency (E is Planck's constant multiplied by the frequency of the photon). The frequency is the number of vibrations per second.

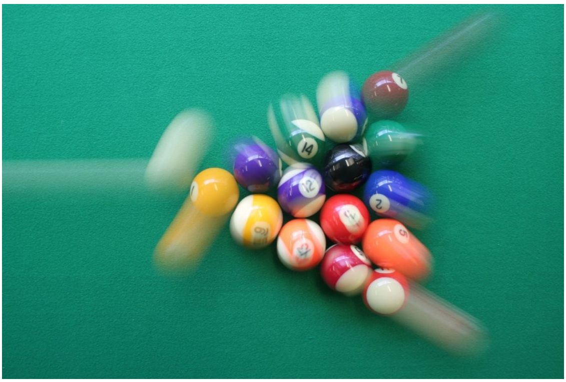

[42]

Photons manifest themselves in experiments as particles and as waves depending on the way photons are observed.

Over time, there has been a lot of discussion about whether photons should be seen as particles or as waves. Isaac Newton considered photons as particles because light—photons with a frequency of observable light—will give a momentum to an object against which light bumps. Christiaan Huijgens—and two centuries later, Thomas Young and August Fresnel—considered photons as waves, because light has the characteristics of waves like refraction and interference.

This discussion was further complicated by the uncertainty principle[43] that was formulated by Werner Heisenberg in 1927. This uncertainty principle implies that there is a fundamental limit to the accuracy with which the location and momentum of a photon can be determined. This fundamental limit is primarily determined by the characteristics of the wave character of the photon. Freely rendered into our daily experience: the fundamental limit is determined by the peaks of the waves, that will always have a certain distance. The accuracy of the location of the wave will only depend on the distance between the peaks of the waves. Due to this wave character of the light, the maximum magnification of objects under a microscope will have a certain boundary that is determined by the frequency of light.

The same is applicable for the momentum[44]: the summit of a wave causes the maximum pulse and the accuracy whereby the pulse can be observed depends on the distance between the peaks of the waves.


[45]

When the location and the momentum have to be determined more accurately, the frequency—and thus the energy—of the photon must increase. Among other things, due to this uncertainty principle—there are other reasons—fundamental accelerators need to be able to produce high energy. However, due to the golf character—with peaks and falls—the location and momentum cannot be determined accurately at the same time. When the location gets more accurate, the accuracy of the determination of the momentum decreases, and the other way around. The relationship between both is determined by Planck's constant [46] in the next formula where "Δx" is the inaccuracy in the location, "Δp" is the imprecision in the momentum and "h" is Planck's constant.

$$\Delta x \Delta p \geq \frac{h}{4\pi}$$ [47]

I think this is still good to follow with common sense. Is this correct?", says Carla.

"For me, it is easy to understand, but I also have a lot of background knowledge. Can you still follow it?", asks Peter to Man.

"If I am not mistaken, the location and momentum of a photon are two different phenomena in a dream of reality. The momentum can hit us—just like an event in a dream—and the location is an illusion in the ever-changing and slipping away manifestation of the All-encompassing Being", says Man.

"In my view, you are right, but some positivistic physicists will disagree fundamentally for a number of reasons. The results of quantum mechanical calculations do convince everyone, because of the high degree of repeatability and the very high degree of accuracy whereby the inaccuracy is determined. But the interpretation of the calculations has been discussed intensively without reaching an agreement.

At the edges of our perception, many mathematical problems—like dividing by zero and going to infinity—and interpretation problems come together. I will try to highlight a tip of this veil.

Let me start with a new “Gedankenexperimenten” or "Thought Experiments": let's travail on a photon—all of us naturally without mass—in free space towards a hydrogen atom, that is located at some distance with an electron at the lowest energy level. We take with us a reference clock, that is set at the same time as our time at home. Upon our departure, we enter the photon while it is moving slowly at a speed of 10 m/s through a transparent glassy material toward the free space. This slow speed of the photon is probably caused because the photon moves from atom to atom within the glassy material and taking some time rest at each atom.

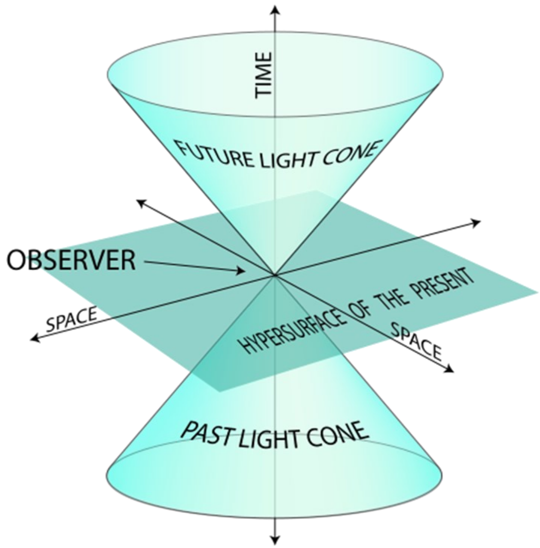
The people at home are ready to say goodbye at the edge of the material when we depart into the free space. With a camera they record a video that can be shown at an extremely slow speed.

What will the people at home see at our departure?

First, they will see us clearly on a photon moving to the edge of the glassy material at a speed of 36 km/h. When we pass the edge of the material with the photon, we will immediately accelerate to the speed of light in the free space, and we will immediately disappear; saying goodbye does not make sense. Fortunately, there is still the video recording. The people at home will show this video shot by shot at an extremely slow speed. In the recording they see us moving towards the edge of the material within the light of the photon, and then the image is black and remains black. Now they show our departure from the material at the very slowest speed. They will first see the photon with us clearly within the material. With a very small chance and some luck, the next image on the edge of the material is completely dark red, due to the decrease in frequency of the photon, because the energy of photon is moving to the free space (and by the diminishing energy, the frequency of the photon drops). The third image is black and a little vague: the energy of the photon has completely moved to free space, and upon leaving the material, the photon has given a tiny momentum to the glassy material.

What do we experience, while traveling—without mass—with the photon?

First we move to the edge of the glassy material at a speed of 36 km/h. When we travel with the photon to the edge of the material, we might see through the glass—when the photon takes some rest at an atom—the people, who stay at home, passing by. At the edge of the material to the free space, we are accelerated momentarily from 36 km/h to the speed of light of 1.08 billion km/h in the free space. We do not notice hardly anything of this acceleration, because we are without mass like the photon and therefore the force on our body is zero[48]: at departure to free space, we only observe the momentum of the photon against the glass. Hereafter we—traveling on the photon—do not observe anything, because no information from the past can reach us anymore. Also the reference clock has come to a standstill: the time axis within the photon has expanded to infinity[49].



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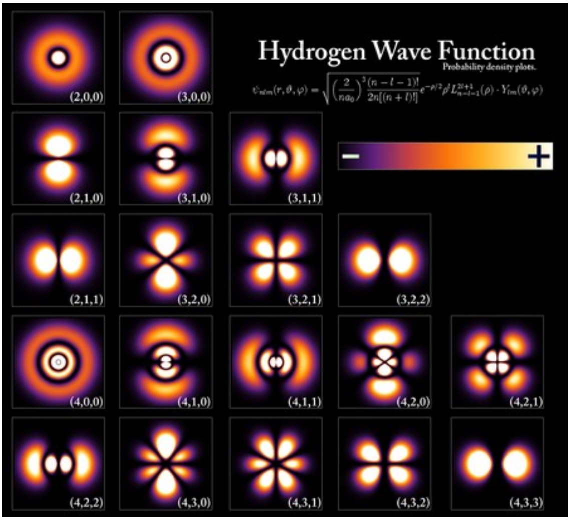
Where are we, for the people at home, after leaving the material with the photon?

That is unknown, until the position of our photon is determined by an observation. It can be said with certainty that for the people at home—"observer" in the above schematic figure—we are somewhere inside the cone "future light cone" after leaving the material. In this figure, the time is displayed in seconds and the scale for "space" is light speed times seconds. The light speed in the "past light cone" has been 36 km/h, while the speed of light in the free space applies in the “future light cone”.

Because we—with the photon—have left the material in the direction of the time axis, we will have (for the people at home) a high chance of staying on the circle of the expanding light cone “future light cone” precisely at the time that corresponds with the time “time” that passed for the “observer” after our departure. But because of the uncertainty principle, we have a small chance of manifesting ourselves during an observation somewhere else within the future light cone. In the direction of the axe within the light cone, the chances decreases further and further, but this chance is not zero. In quantum mechanics, the accuracy of this probability—in relation to other calculations and determinations in physics—is very high.

In the meanwhile, we travel—in our reference frame of the photon—timelessly (and the “oberserver” moves beyond our view “spacelike” with the speed of light from us) until we clash with the hydrogen atom, that the photon—together with us—encounters like a flat disk/wave of energy. We are lucky, because the chance that the photon—together with us—will come across a hydrogen atom is rather low: free space is very empty.

The energy and the pulse of the photon—along with us—cause that the electron of the hydrogen atom will move into a higher energy state: the ball/wave of the electron increases (according to the Compton Effect[51]) exactly in diameter, that the electron is in the next quantum state[52].

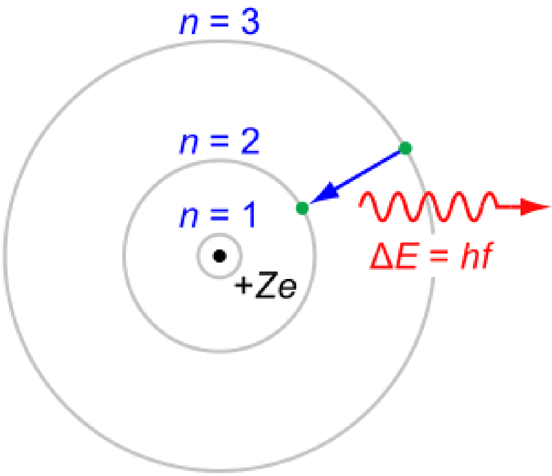


[53]

The energy and momentum of the photon that is not absorbed by the electron when the hydrogen atom increases to a higher quantum/ energy state, continues its way into the free space. We stay behind within the globe of the hydrogen atom. Due to the small mass of the electron and the atom, our time axis has decreased from endless to a very high number, and the reference clock moves slowly compared to the reference clock of the "observer".

After a very long time—also due to slowly moving reference clock —we are accelerated again to the speed of light: the reference clock has come to a standstill again. We travel again with another photon—with a slightly lower energy and momentum—with the speed of light through the free space.

For an outsider, the colour of the photon with us—after departure from the hydrogen atom—will exactly match one of the hydrogen atom's spectral lines[54]: the atom has fallen back to the lowest energy level, and a massless photon has separated from the hydrogen atom at the speed of light.



[55]

Can you follow this thoughtful experiment? If so, I suggest to continue another time with the double split experiment[56], that shows the wave and particle properties of a photon", says Carla to Peter and Man.

"The separate parts are not new to me, but you make a clear interconnection", says Peter.

"I get the impression that the manifestation of events in the world of quantum mechanics depends on the observer. Is this right?", asks Man to Carla.

"The events are universal, but the manner whereby the events are observed, depends on the observer's reference framework[57]. The universal events manifest themselves differently according to the rules of general and special relativity theory to observers[58]", says Carla.

"Can we observe events faster than the speed of light", asks Man to Carla.

"No and yes. No, because photons are the fastest particles, that let us observe an event, or that can directly affect an event: this influence or change is "timelike" and sequential in time. And yes, when we look now from one side of the starry sky to the other side, we observe faster than the speed of light, but we cannot have an influence on the events on both sides of the starry sky: this observation is "spacelike", and the observed events take more or less simultaneously place without directly affecting each other", says Carla.

"I see that the others are preparing for the night. I'm going to bed now too", says Man.

"Yes, I am also tired; good night", says Carla.

"Sleep well", says Peter.

They are getting ready for the night.

[1] See also: https://en.wikipedia.org/wiki/Entropy

[2] Source: White, Terence, *Arthur, Koning voor eens en altijd*, Utrecht: Het Spectrum, 1968, p. 38

[3] See also: https://en.wikipedia.org/wiki/Feynman_diagram

[4] Source image: https://de.wikipedia.org/wiki/Feynman-Diagramm. Remark: the time axis goes from bottom to top.

[5] See also: https://en.wikipedia.org/wiki/Photon

[6] Remark: In a Feynman diagram for the exchange of a photon between two positrons—or electrons with a positive charge—only the direction of the time axis has to be reversed from top to bottom.

[7] See also: https://en.wikipedia.org/wiki/Thought_experiment

[8] The human eye is able to observe a separate photon with the correct frequency within the visible light spectrum.
Source: https://en.wikipedia.org/wiki/Human_eye

[9] The photons are displayed as yellow rays on the left side of this drawing. The "rods" and "cones" that can detect photons in black and white and in colour, are shown on the right side of the drawing in the grey/brown area. In between there is (nerve) tissue that can absorb photons.
Source image: https://en.wikipedia.org/wiki/Retina

[10] See also: https://en.wikipedia.org/wiki/Arthur_Eddington

[11] Source: Eddington, Arthur, Stanley, *The Nature of the Physical World*. New York: The Macmillan Company, 1929, p. 68 - 69

[12] The "arrow of time" goes in this drawing from A to B along the ruler. Source image: Eddington, Arthur, Stanley, *Space Time and Gravitation*. Cambridge: Cambridge University Press 1920

[13] Source image: https://en.wikipedia.org/wiki/Pool_(cue_sports)

[14] Source image: https://nl.wikipedia.org/wiki/Bibliotheca_Alexandrina

[15] Source: Izutsu, Toshihiko, *Sufism & Taoism – A comparative study of key philosophical concepts*. Berkeley: University of California Press, 1984, p. 7

[16] Source: Izutsu, Toshihiko, *Sufism & Taoism – A comparative study of key philosophical concepts*. Berkeley: University of California Press, 1984, p. 7

[17] See also: https://en.wikipedia.org/wiki/John_Archibald_Wheeler

[18] See: Kumar, Manjit, *Quantum – Einstein, Bohr and the Great Debate about the Nature of Reality*. London: Icon Books, 2014, p. 312

[19] See also: https://en.wikipedia.org/wiki/Positivism

[20] This is the so-called Copenhagen interpretation of quantum mechanics. See also: https://en.wikipedia.org/wiki/Copenhagen_interpretation

[21] Source: Izutsu, Toshihiko, *Sufism & Taoism – A comparative study of key philosophical concepts*. Berkeley: University of California Press, 1984, p. 8

[22] See also: https://en.wikipedia.org/wiki/Allegory_of_the_Cave

[23] Source image: http://nl.wikipedia.org/wiki/Allegorie_van_de_grot

[24] See also: Origo, Jan van, *Who are you – A Survey into our Existence – Part 2: Five common realities – Emptiness*. Amsterdam: Omnia – Amsterdam Publisher, 2015

[25] See also: https://en.wikipedia.org/wiki/Combustion

[26] See also: Origo, Jan van, *Who are you – A Survey into our Existence – Part 2: Five common realities – Emptiness*. Amsterdam: Omnia – Amsterdam Publisher, 2015, p. 55 et seq.

[27] Source image: https://en.wikipedia.org/wiki/Combustion

[28] See also: https://en.wikipedia.org/wiki/Photosynthesis

[29] Source image: https://en.wikipedia.org/wiki/Photosynthesis

[30] See also: Muller, Richard A. *Now – The Physics of Time*. New York: W.W. Norton & Company, 2016, p. 16

[31] See also: https://en.wikipedia.org/wiki/Redshift, and: Origo, Jan van, *Who are you – A Survey into our Existence – Part 1*. Amsterdam: Omnia – Amsterdam Publisher, 2012, p. 189 - 193

[32] See also: https://en.wikipedia.org/wiki/Euclidean_geometry

[33] See also: https://en.wikipedia.org/wiki/Hyperbolic_geometry

[34] Source image: https://en.wikipedia.org/wiki/Hyperbolic_geometry

[35] Source image: https://en.wikipedia.org/wiki/Circle_Limit_III

[36] See also: https://en.wikipedia.org/wiki/Hermann_Minkowski

[37] Source image: https://en.wikipedia.org/wiki/Metric_expansion_of_space

[38] Four-dimensional impression of the expansion in space of our universe after the Big Bang.
The image is made using a template available via:
http://www.free-power-point-templates.com/

[39] See also: https://en.wikipedia.org/wiki/Photon

[40] See also: https://en.wikipedia.org/wiki/Speed_of_light

[41] See also: https://en.wikipedia.org/wiki/Slow_light

[42] Source image: https://en.wikipedia.org/wiki/Photon

[43] See also: https://en.wikipedia.org/wiki/Uncertainty_principle

[44] See also: https://en.wikipedia.org/wiki/Momentum

[45] Source image: https://en.wikipedia.org/wiki/Momentum

[46] See also: https://en.wikipedia.org/wiki/Planck_constant and Phillips, A.C., *Introduction to Quantum Mechanics*. Chichester: Wiley, 2009, p. 11 – 17.

[47] Source image: https://nl.wikipedia.org/wiki/Kwantummechanica

[48] The force on a body that is caused by an acceleration, is equal to the mass of the body multiplied with the acceleration. When the mass is zero, then the force on a body due to acceleration is also zero.

[49] The time dilation (expansion) "gamma" when traveling with the speed of light v = c can be determined by the formula:

$$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}.$$

When v = c, the denominator is zero and the time expansion "?" is infinite. This means that time has come to a rest on a photon; and as a consequence time stops to exist as any reference source. See also: https://en.wikipedia.org/wiki/Time_dilation

[50] Source image: https://en.wikipedia.org/wiki/Minkowski_space

[51] See also: https://nl.wikipedia.org/wiki/Compton-effect

[52] See also: https://en.wikipedia.org/wiki/Quantum_state

[53] The hydrogen atom is changed from quantum state 2.0.0 to quantum state 3.0.0 due to a partly merger with this photon.
Source image: https://en.wikipedia.org/wiki/Quantum_state

[54] See also: https://en.wikipedia.org/wiki/Spectral_line

[55] Source image: https://en.wikipedia.org/wiki/Photon

[56] See also: https://en.wikipedia.org/wiki/Double-slit_experiment

[57] See also: Susskind, Leonard & Friedman, Art, *Special Relativity and Classical Field Theory – The Theoretical Minimum*. Toronto: Allen Lane, 2017, p. 48 - 53

[58] See also: https://en.wikipedia.org/wiki/Spacetime

Solidified time

Here and now—everywhere and always

After dinner Carla and Man are sitting at the campfire drinking their coffee.

“With a little luck we will meet Narrator’s family the day after tomorrow, after crossing the border with the neighbouring country. I wonder if the family still has memories of Narrator after almost forty years”, says Man.

“I think so: Narrator—as a teenager—should have been a striking appearance at that time. I expect that his family will also remember his father and mother; his father was special and his mother had a very strong will”, says Carla.

Peter and Ferdinand join Carla and Man.

“The dishes are done and the cook is satisfied”, says Ferdinand.

“It is already getting cold. Fortunately we have a big campfire tonight to keep us warm. Now, when I feel the heat radiation from the campfire and I watch the sparks from the fire rise to the starry sky, I wonder if you would now tell us your view on the two slit experiment about the wave and particle properties of a photon”, asks Peter to Carla.

“About a century ago physics struggled—and it also had mutual disagreement—about the question whether a photon has the character of a wave or of a particle. Here and now at the campfire the answer is obvious; we feel the warmth of the wave character of photons and we see the bundles of particles within the sparks. Finally, a compromise has been accepted that photons have the character of particles and of waves[2].

But it took a long way before this compromise was articulated, about 90 years ago in 1927, by Louis de Broglie and later rediscovered by David Bohm, in 1952[3]. The Northern-Irish physicist John Bell[3] wrote in 1990 about the idea that photons have the wave and particle character:

"This idea seems to me so natural and simple, to resolve the wave-particle dilemma in such a clear and ordinary way, that it is a great mystery to me that it was so generally ignored".[4]

Yet—very understandable—physics has had difficulty reaching this compromise. At that time, the necessary question marks were placed at this dual nature of photons that we observe intuitively at the campfire.

First, I will explain why physics has struggled to explain this dual nature of photons while this idea is so intuitively simple to grasp.

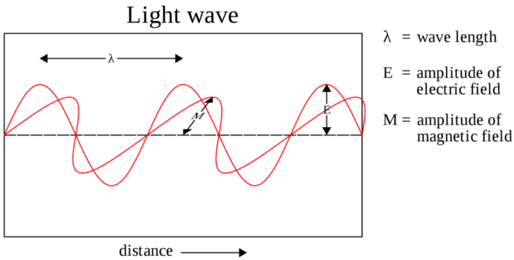
Classical physics (before quantum mechanics) has two fundamental concepts. First of all, there is the concept of the ideal (point) particle—for example, the smallest imaginable round bicycle ball as a stand-alone unit (with a specific place and moment)—moving according to the theory described by Isaac Newton[5]. The second fundamental concept is waves—such as waves in water—that within boundaries are present everywhere in space, in the ether[6] and in the field theory[7] and that exert their influence on each other and on particles. The electromagnetic vibrations and waves in space—described by Maxwell's equations—are an example of waves as the second fundamental concept.

 [9]

A pebble, that falls through a smooth water surface, will cause waves in water, that will spread over the water surface. The pebble moves—as particle—according to Newton's theory of motion; and the surface of the water follows the concept of waves, and the other way around: water surface is not seen as a particle that might follow Newton's theory of motion.

Blinded by the knowledge of classical physics, physicists could not imagine more than a century ago, that a photon could have the properties of a particle and of a wave at the same time. A photon could have only one of the two properties within the conceptual framework of classical physics: a photon should be either a particle or a wave.

Isaac Newton assumed the particle character of a photon. Christiaan Huijgens—and Thomas Young and August Fresnel in the mid-nineteenth century—have demonstrated that light behaves like a wave[10]. Maxwell's theoretical model explained many properties of light as vibrations of electromagnetic fields, but this model could certainly not explain both properties of photons.

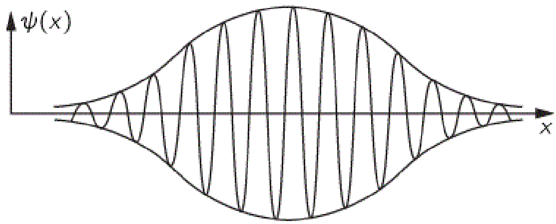


11

First of all, a photon, that is reflected by a mirror, exerts on this mirror a momentum that is equal to the momentum (or collision) of a particle (with an identical momentum) against this mirror[12]. This type of momentum cannot be explained within Maxwell's electromagnetic field theory via properties of vibrations.

In addition, research, by various researchers, into heat radiation coming from objects—that were coloured black—led to a hypothesis by Max Planck. This hypothesis states that the energy of every system—that absorbs and/or emits electromagnetic radiation (including photons) with a certain frequency—takes place in "quanta", or, in other words: in a multiple of an integer. These quanta cannot be explained by Maxwell's theoretical model for electromagnetic radiation.

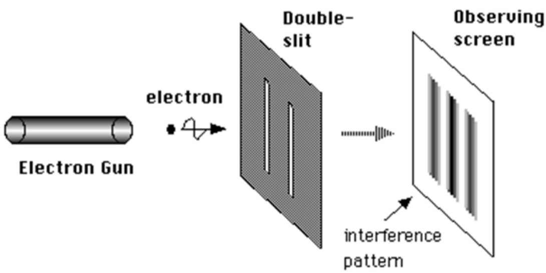
Max Planck's hypothesis implies that one single photon (with a specific frequency) is exactly one quantum of energy of this photon (at this frequency in question). According to this hypothesis, photons can only occur in whole-numbered quanta, and one individual photon cannot have a smaller energy than the energy of one quantum[13]. This hypothesis of "quantization in integers" of photons, that are capable of exerting an momentum, was described by Albert Einstein in 1905 and this assumption was conclusively confirmed in an experiment by Robert Millikan in 1914. In 1921 Albert Einstein received the Nobel Prize for this hypothesis of whole-number quantization of the energy of photons[14]. Because of this hypothesis, photons have been, for a long time, regarded as particles—with an electromagnetic energy—that can cause a momentum. Until recently, a photon has been depicted as a kind of droplet—with internal vibrations—that moves at the speed of light through the empty space.



15

This metaphor of a photon—based on Albert Einstein's hypothesis—does not include the wave character of a photon that is indicated by the "two slit" experiment.

The "two slit" experiment is connected to the "one slit" experiment. I schematically draw the setup of the two slit experiment in my notebook (see figure 16, wherein "Electron gun" must be replaced by "source of photons").



16

First, I will give my view—as metaphor—on the "one slit" experiment, that is a partial experiment of the “two slit” experiment.

In the “one slit” experiment, individual photons are sent through empty space at appropriate intervals in the direction of a plate, that is provided with two parallel very narrow slits. Each slit is just wide enough to let one photon pass. The rest of the plate is completely impermeable to light. During the “one slit” experiment, one of both slits is covered in order to make it completely light-tight. Parallel behind this plate with both slits (one slit fully covered in the “one slit” experiment), is a photographic plate located in empty space.

During this “one slit” experiment, separate photons will successively leave the source, whereby the source will experience a slight momentum—equal to the momentum of the leaving photon in question—at the departure. The photon will only be observed again when the photon has activated an electron on the photographic plate. In the meantime, an observer and/or a measuring instrument—both with retarding mass—have no possibility of following the photon, because the photon moves at the speed of light and because the photon in question cannot take a smaller shape due to the fact that one photon is a quantum in the smallest shape/form at a certain frequency.

Between 1925 and 1930, Niels Bohr and Albert Einstein exchanged views on the intermediate state of particles—like photons and electrons—about the interval between these particles have left the source and the particles are observed by a measuring instrument. This discussion has resulted in the so-called Copenhagen interpretation. Albert Einstein could not refute this interpretation.

This Copenhagen interpretation is based on:

- two positivist measurements at the source and on the photographic plate and
- the probability of the place where the particle can be observed.

The probability of a specific measurement at the source and on the photographic plate can be surprisingly accurately determined via quantum mechanical probability calculation. According to the Copenhagen interpretation, we cannot find anything useful about the status of a particle between the result of both measurements. So—following Ludwig Wittgenstein—the Copenhagen interpretation says about this intermediate state:

"*Wovon man nicht reden kann, darüber muß man schweigen."*

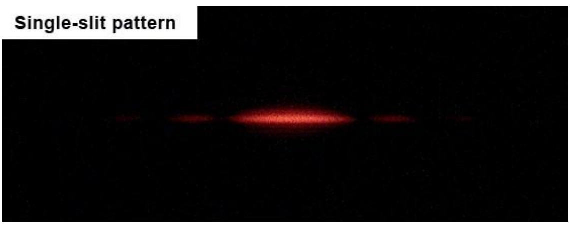
or in English:

"Whereof one cannot speak, thereof one must be silent"

At this moment I do not have the opinion of Albert Einstein on the Copenhagen interpretation available, but I have read that he was not willing to accept the remarkably accurate quantum mechanical probability calculation for measuments; he stated[18]:

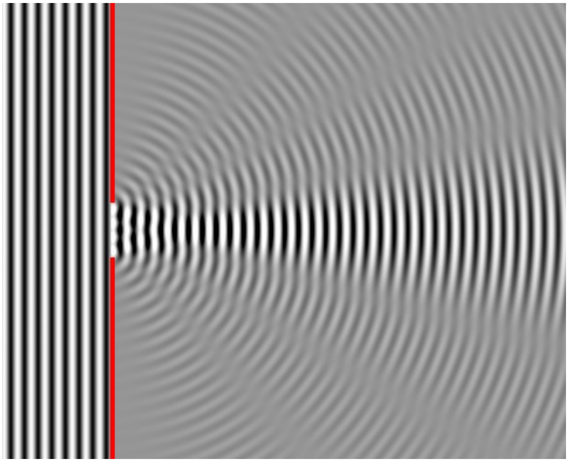
"Gott würfelt nicht" or "God does not play dice".

After the initial photons, many photons leave successively the source. These photons will activate the relevant electrons on the photographic plate through their momentum. Then the photographic plate will be developed: the photo derived from the photographic plate shows the "Single-slit pattern" on the following photo:



[19]

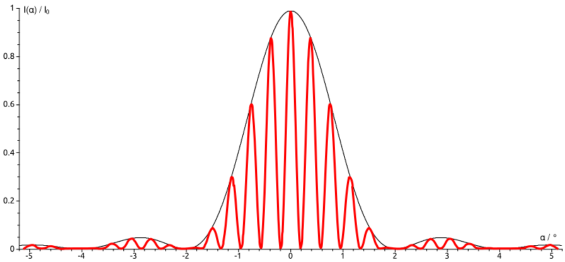
This pattern could be explained by the interference pattern that occurs after uniform waves roll through one narrow opening in a wall. The opening in the wall has the size of a few times the distance between the tops of the waves. On the other side of the wall, there is an interference pattern between the waves that—viewed from above—corresponds to the pattern in the following image:



[20]

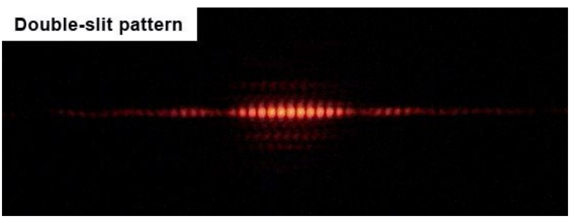
The pattern of the waves—rolling through a small opening (a few times the distance between the tops of the waves) in the wall against a second wall parallel, at some distance behind the wall, with the small opening—corresponds very well with the pattern of the many photons that activate one after the other the electrons on a photographic plate after passing through the "single slit". This pattern shows exactly the chance where a photon that passes through the slit will activate an electron on the photographic plate. The brighter the color lights up in the photo with "Single-slit pattern", the greater the chance that the photon will activate the electron at that place on the photographic plate. The graph with the solid gray line in figure 21 shows this probability. The point "0" on the horizontal line is perpendicular in line with the single slit. At this place the chance that the photon will activate the photographic plate is big; from zero, the probability decreases to both sides plus and minus

“2” on the horizontal axis in this graph. From plus and minus “2” on the horizontal axis, the probability is increased again to around plus and minus 2.9 and then is decreased again to plus and minus 4. The probability from plus and minus 4 is increased slightly again to around plus and minus 5. The dimensions on the axes in this graph depend on the experiment in question, but the pattern is reflected in every wave pattern that arises from uniform waves passing through a small opening, and then bump into a wall that is parallel to the wall with the small opening.



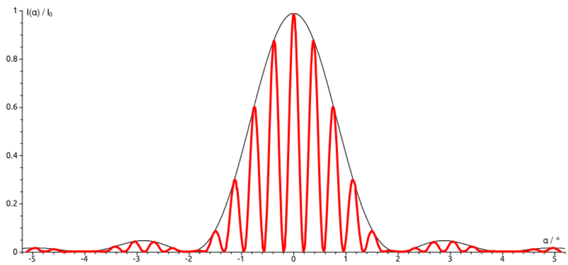
21

In the “double-slit” experiment, individual photons are sent through the free space at appropriate time intervals in the direction of the same plate that is provided with a two parallel, very narrow slits with both slits now open. Behind this plate with both slits, a (new) photographic plate is placed parallel at a certain distance in free space. After many photons have been sent in the direction of both slits, this (new) photographic plate is developed. The pattern on this second photographic plate corresponds to the "Double-slit pattern" on the following photo:



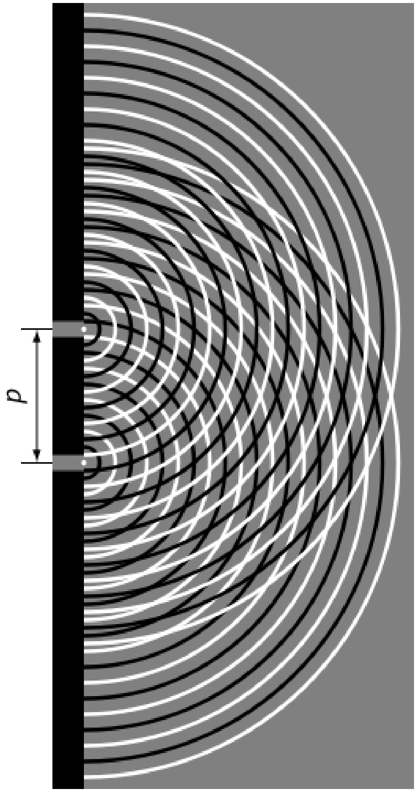
22

Again: the brighter the colours appear, the more photons have arrived at that location and therefore the greater the chance that a next photon will hit the photographic plate at that location. In figure 21, the chance that a next photon will hit the photographic plate during the "double slit" experiment is shown with the red line. The zero point is exactly perpendicular in line behind the center, between the two slits.



21

This pattern on the photographic plate—as result of the "two slit" experiment—can very well be explained by the assumption that the photon leaves the point source uniformly (and concentrically) in the direction of both slits. After passing through both gaps, two line sources are created for waves that roll in free space in the direction of the photographic plate. After a short distance the waves interfere with each other. This interference pattern of these waves—when arriving on the photographic plate—indicates the chance that a photon will activate, at that location, an electron on the photographic plate. This explanation is schematically rendered in figure 23.



23

The assumption of two line sources—both arising from one photon—is impossible in combination with Max Planck's hypothesis that a photon is the smallest possible quantum—as integer—at the frequency of the specific photon in question. This photon is therefore indivisible into two line sources at a certain frequency of the photon.

In the course of time, all kinds of experiments have been carried out to find out through which of both slits the photon might pass through during the “two-slit” experiment. All these experiments give a similar result. If one slit is covered, or if a sensor is placed behind one slit, a so-called "single-slit pattern" is created on the photographic plate. And when both slits are open or when the sensor is removed behind one of two slits, the so-called "Double-slit pattern" is created. The conclusion is: each test setup changes spacetime along with the associated total energy wherein the photon manifests itself during the two slit experiment.

Before I continue, I ask for certainty if you can still follow my explanation?", says Carla.

"I have already read about the Copenhagen interpretation. I get the impression that it has been accepted that—in the world of quantum mechanics—knowledge outside quanta is not possible.

If I am not mistaken, recently there have been developed models in line with the Copenhagen interpretation wherein the world of fundamental particles and perhaps the entire world is presented as binary. Or in other words: a world of zero and one: the particle is either present (this is 1) or the particle is absent (this is 0).

How does this binary representation of particles relate to the statement by John Bell who said that the wave/particle nature of photons is completely natural to him?", asks Peter to Carla.

"Carla, if I understand you correctly, the slumber area between the source of photons and the perception of the photons on the photographic plate is unknown and perhaps even unknowable. I also encounter, in my practice as physician, slumber areas that are unknown and that even may be unknowable. I am thinking of the birth of a child where a baby suddenly becomes a little person, narcosis and awakening again, dreams and end of life wherein a person changes from living to death", says Ferdinand.

“Ferdinand, Peter, listening to your remarks, I am reminded of a question that I have read a while ago. I will adapt this question[24] to the story by Carla.

A student came to a teacher and asked him the question:

“Existence and non-existence are like two vines that are connected to the void. If suddenly the Void disappears and the vines wither away, where does the Existence and Non-existence stay?”.

The teacher laughed in response and then he said:

“Word and thought have no road – gone are all machinations” [25].

In my opinion, the word "road" refers to Tao—a core concept in Taoism—that literally means "road” or “course of life". The word Tao probably comes from the word "Moon"[26]. The Moon is here a metaphor for rock-solid faith.

I am reminded of a haiku by the Japanese poet Rȳokan, that I will adjust to the campfire tonight:

The spark leaves behind,

the ever changing moon

at the firmament.[27]

Carla, how is the continuation of your story about the interface between light and darkness, about the existence and non-existence of a photon in the void?”, says Man.

““*Word and thought have no road*” gives a good representation of the Copenhagen interpretation about the question of the path of the photon between source and photographic plate: the supporters of this interpretation firmly believe in it. But I do not think that herewith the machinations according to the answer of the Buddhist teacher are over.

Maybe it is good that first I will show a few basic ideas for this path of the photon between the source and the photographic plate. All these basic ideas have—in my opinion—one or more flaws. Then I will present you a "gedankenexperiment".

The first basic idea is the simple idea of the photon that is shot like a bullet from the source to the photographic plate; I am so free to call this basic idea "shooting gallery at the fair".

With this idea of "shooting gallery at the fair" can—with a little goodwill—the "Single-slit pattern" be nicely explained: the photon/bullet leaves the virtual barrel of an air gun with slight inaccuracy at the source, but so accurately that the photon will pass through the single slit in more than 99% of the cases. By swirling within the slit, most photons are deflected further: this creates the middle, broad illumination on the photographic plate. A limited part of the photons interferes or "collides" with the side of the slit and these photons are therefore significantly deflected according to a certain pattern: most interfering/"colliding" photons end up in the two illuminations on either side of the middle wide illumination. An even more limited part of the interfering/"colliding" photons is deflected even significantly further to either side according to the pattern of illumination on the photographic plate.

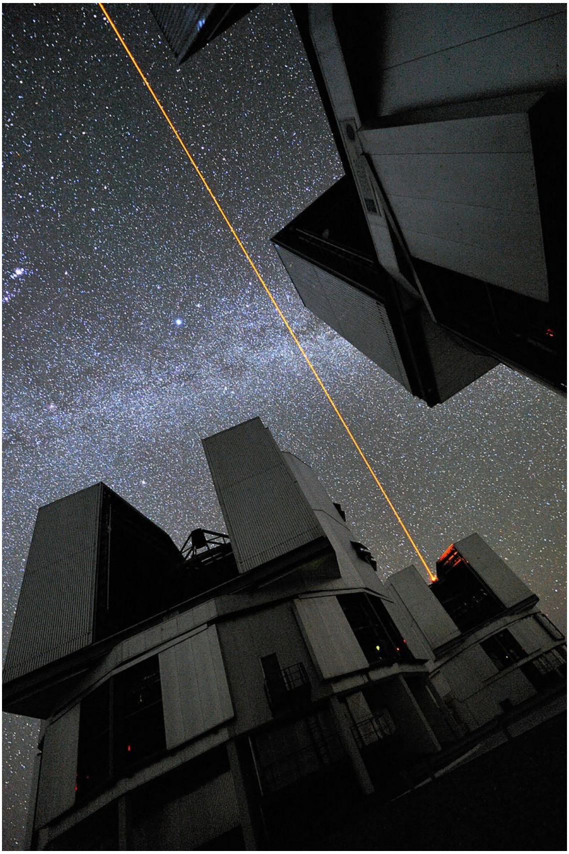
But I really would not know how I could explain the "Double-slit pattern" via the idea of "shooting gallery at the fair". The experiments that have been carried out, over the course of time, to find out through which slit the photon passes through the two slit screen, are—in my opinion—mainly the result of the idea of "shooting gallery at the fair". As I said before: all two-split experiments give the same result. When one gap is covered, or when a sensor is placed behind one of the two gaps, the "Single-slit pattern" is created; and when both gaps are opened or when the sensor is removed behind one of the gaps, the "Double-slit pattern" is created.

So the idea of "shooting gallery at the fair" is not valid for an explanation of the path of the photon from the source to the photographic plate during the two-split experiment while both slits are fully opened.

The second basic idea is a simple idea, wherein the photon manifests itself after leaving the source according to a certain pattern (and after a certain time)—as a "Deus ex machina"—on the photographic plate. The Copenhagen interpretation—and the positivist binary representation of the world as an extension of the Copenhagen interpretation—origin in my opinion from the "Deus ex machina" idea, where the photon changes after a certain time (according to the reference clocks placed at the source and/or at the photographic plate) from the source to the photographic plate in a certain pattern that perfectly matches mathematically probability calculation.

The "Deus ex machina" model offers no explanation for the transition of the photon from the source to the photographic plate during the two-split experiment with both gaps fully open.

The third basic idea is a simple idea, where the photon in the form of energy—according to the formula E is the Planck constant multiplied by the frequency of the photon—is moved as a quantum via an electromagnetic field[28] through the space from the source to the photographic plate. This model is very useful for the standing/ stationary wave of energy in the form of a bundled, constant stream of photons, that is produced by a monochromatic laser[29].



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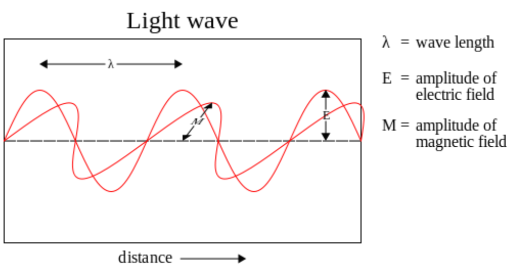
The electromagnetic wave of a laser is a standing/stationary wave where the electric wave is perpendicular to the magnetic wave in the direction of the laser light (see image below).



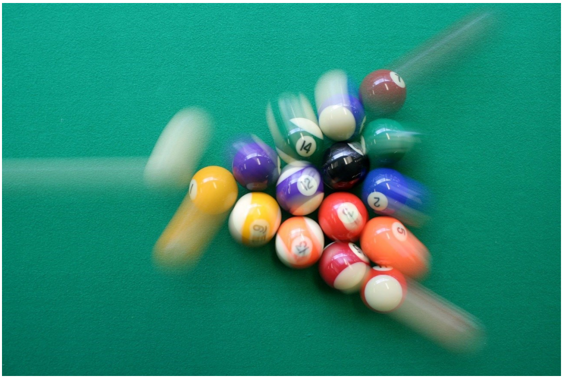
31

I doubt whether the "Electromagnetic Field" model can be used to explain the transition from just one photon from the source to the photographic plate. If we follow this model then:

- Either one indivisible photon should create the "electromagnetic field" and at the same time the photon should move itself from this source to the photographic plate via this "electromagnetic field",
- Or the "electromagnetic field" should already be present in the empty space between the source and the photographic plate for transporting the photon from the source to the photographic plate. This would mean that sufficient energy must be present in empty space to maintain—in addition to the photon—an electromagnetic field in a certain form as a kind of ether. The Michelson-Morley experiment[32] did not show any form of ether for the transport of light and photons.

Neither of the two necessary conditions is plausible for the transport of only one photon through the empty space based on the "Electromagnetic Field" model.

The fourth idea is a variant of the "Electromagnetic Field" model, where the free space is completely filled with energy. The photon at the source gives a momentum against the energy in the free space. The momentum travels through the free space—while no energy is moved, but only a momentum with the speed of light passes through the energy in free space to the photographic plate, where an electron is activated on the surface of the photographic plate by the momentum. This variant of the “Electromagnetic Field” model corresponds to pocket billiards where the white ball hits a triangle of balls: the momentum is transferred by the balls on the billiard cloth to the extreme coloured balls at the other side of the triangle; these coloured balls—ideally with no loss of energy—move away from the triangle with the same energy as the initial white ball.

 [33]

This "billiard balls" model presupposes that the empty space is not empty, but that free space is filled with a medium, "ether" or "grid" for the transfer of momentum from only one photon. The "Quantum Field Theory" implicitly presupposes a medium, field or grid for transport[34]. This model is very useful for transferring the electrical charge of one electron at the speed of almost light through the atomic grid of a conductor, but I have my doubts whether this model can be used for transferring just one photon through free empty space. Just as with the billiard cloth model, the problem of this model has also been shifted from how the photon moves through empty space to two other questions:

- How is the empty space filled and with what?
- How does the photon travel at the speed of light through space.

Are you—after explaining these models—still interested in a “gedankenexperiment” about what we know, and what we might suspect, if we do not somehow end up astray?”, says Carla.

“As you tell these models, they are fairly simple. While reading books about quantum mechanics, I quickly succumb and get drown in mathematical symbols and formulas that prevent me from seeing the modeling”, says Peter.

“Your models describe—in a lively and daily manner—a non-daily world for me”, says Ferdinand.

“Is the world of a photon, that moves at the speed of light, knowable? At this campfire we bath in the warmth and light of photons; and here during daytime in Kenya, we are blinded by the light and almost overwhelmed by the heath of the sun's photons. So close yet so far away; so direct and so distant. I am curious about your next “gedankenexperiment” about the photon in the empty space”, says Man.

“First I will give a short response to Peter's comment. In a new book I always have to find my way in the symbols and notation used, before I can fully understand the content. Many symbols in physics are fairly universal, but sometimes symbols are used specifically and—regularly—an unusual notation is chosen. This is the first challenge.

The second challenge is understanding the author's line of thought. The third challenge is to analyze the testability of the line of thought.

I have ignored these three challenges in my story about the models. Describing these models in a mathematically and physically correct way, requires a major effort. Describing the testability of these models is an additional major effort. Both descriptions will be difficult to understand for laymen.

If both descriptions are not conclusive, then misunderstandings will simply arise, such as in the anecdote wherein a wife asks a physicist to get a bread at the supermarket and if there are fresh eggs, get six! To the astonishment of the wife, the physicist—in his eyes perfectly correct—returns home with six loaves, while she has counted on one loaf and six eggs when these are in the store. My story about these models is simple at first sight, but the story may give much cause for misunderstanding; and I have told the testability of the models very briefly.

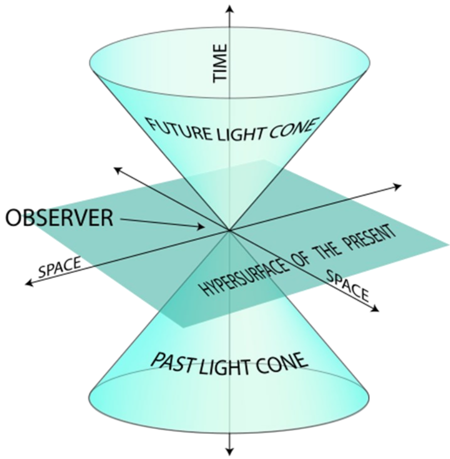
My second reaction to Peter's comment is: most physics is easy, once you understand it. Most physics can be understood with everyday knowledge from the right angle. Without the right line of approach, one remains struggling in models and in mathematical calculations. So far, for the journey of the photon from the source to the photographic plate, no correct angle has been found; the Copenhagen interpretation even assumes that it is not even possible to have any approach for understanding this journey.

My next "gedankenexperiment" about the journey of the photon from the source to the photographic plate follows the view of the photon itself instead of the point of view of the outside observers at the source and at the photographic plate. To avoid misunderstandings: it is a thought experiment for the campfire, because a rigor—or strictness—of a mathematical description is missing and it is probably not possible to test, because in this thought experiment, zero and infinity meet as singularity[35].

What we know about this journey of the photon through the empty space in our universe is:

- At the departure of the photon, a momentum and a reduction in energy are observed at the source;
- Quantum mechanics calculations can be used to predict, with great accuracy, the location on the photographic plate where the photon will arrive;
- The photon has no mass during the journey;
- The photon has no electrical charge during the journey;
- During the journey, the photon has a "polarization"—think of sunglasses with a polarization filter that filter a large part of the glare (or waves of light) using a very fine grid[36]—and a so-called "spin" that I will exclude from this ”gedankenexperiment”;

- The photon travels at the absolute speed of light relative to every frame of reference within the "future light cone" for the observer at the source;



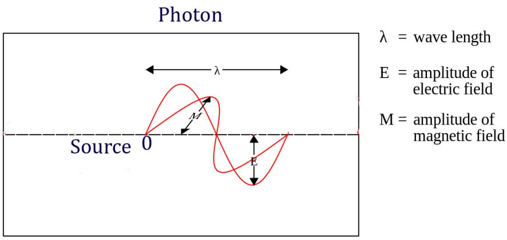
[37]

- The photon travels at the absolute speed of light relative to each frame of reference within the "past light cone" for the observer at the photographic plate, whereby the time axis between the observer at the source and the observer at the photographic plate differs exactly as the measurement of the distance between source and arrival on the photographic plate;
- The travel time can be determined with relatively simple calculations in the frame of reference of the source and in the frame of reference of the photographic plate;
- During the journey, the photon has an energy that corresponds to $E = h\nu$ [38], where "E" is the energy, "h" is Planck's constant and "ν" is the frequency of the photon;

- The momentum "p" of the photon at departure is $p = \frac{h}{\lambda}$. or $p = \frac{h\nu}{c}$ [39], where "p" is the pulse, "h" is Planck's constant again, "λ" is the wavelength of the photon, "ν" is the frequency of the photon, and "c" is the speed of light. The wavelength and the frequency relate to each other as:
    - Frequency "ν" is wavelength "λ" divided by the speed of light "c".

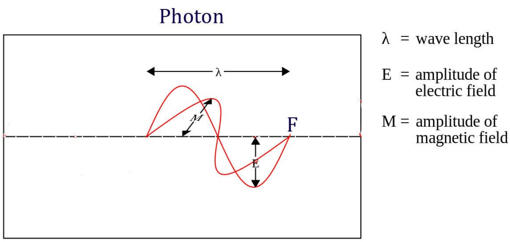
Until this point, the description of the photon's journey through empty space seems to move smoothly according to classical mechanics. But unnoticed, two singularities—these are points in space-time where the laws of physics lose their validity—have slips into this description. The first singularity is the fact that a photon travels through free space without mass: the photon has no delay, but it does have a momentum. The second singularity is the fact that the photon travels at the absolute speed of light relative to every frame of reference within the "future light cone" for the observer at the source, and within the "past light cone" for the observer at the photographic plate; and also for the frame of reference of the photon itself.

According to this "gedankenexperiment", the photon—in the frame of reference of the observer O at the source—would appear as momentum "p" and energy "E" while leaving the source.



40

And the photon is perceived by the observer F —at the photographic plate within her/his frame of reference—as momentum "p" and energy "E" of equal magnitude, in the case the momentum and energy of the photon at the beginning and at the end of the journey are similar. See the figure below:



41

Both figures show that the photon manifests itself in an identical way at the start of the journey at the source and upon arrival at the photographic plate.

Both observers at the source and at the photographic plate observe, in their stationary frame of reference, an equal wavelength of the photon, that depends on the light color of the photon. The wavelength for visible light varies between approximately 620 nm for red light to approximately 475 nm for blue light.

But in the frame of reference of the photon—that moves at the absolute speed of light in empty space—we have to convert this wavelength using the Lorentz transformation. This transformation applies for speeds that are very close to the speed of light in the empty space. This Lorentz transformation goes as follows:

$$t' = \gamma\left(t - vx/c^2\right)$$
$$x' = \gamma\left(x - vt\right)$$
$$y' = y$$
$$z' = z,$$

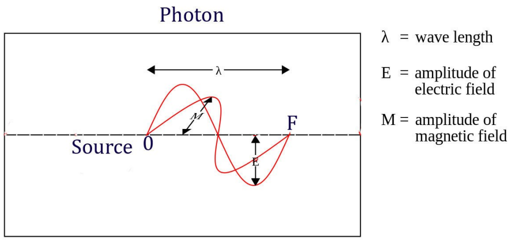
Wherein:

$$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}\,.$$ [42]

When traveling at the speed of light, the speed "v" of the photon is equal to the speed of light "c"; this means that the denominator is zero: this means that "γ" is equal to infinity, which is represented in mathematics with the symbol "∞".

I now fumble quickly and inaccurately with the numbers. In this "gedankenexperiment", I determine that the wavelength x' of the photon in the reference frame of the observers—at the source and the photographic plate—is equal to the wavelength of red light (620 nm). The value "vt" is in this experiment is the distance between the source and the photographic plate. With these assumptions:

- x'/γ is equal to zero;
- the wavelength of the photon in its own frame of reference is exactly the distance between the source (represented by O in the figure below) and the place where the photon activates the photographic plate (represented by F in the figure below).



43

How does the photon experience time interval during the transfer of energy between the source and the photographic plate?

For this, we need to apply the Lorentz transformation in the frame of reference of the photon—moving with the absolute speed of light—(in a similar way like the conversion of the perception of the wavelength by the photon) to the time unit " t' " of the observers at the source and the photographic plate to the time unit of the photon " t ". In the conversion formula, " γ " is again equal to infinity, " v " is the speed of light " c ", and " x " is the distance for the photon between the source and the photographic plate. In this formula, three units " t', c and x " are finite numbers, that are not equal to zero. As a result, the time unit of the photon " t " during the transfer of energy between the source and the photographic plate is zero, because a finite number divided by infinity is zero. This means that for the photon, this transition of energy takes place simultaneously. This time unit is zero, because units on the time axis in the frame of reference of the photon go to infinity. I will come back to this soon.

Is this results from this "gedankenexperiment"—where the wavelength of the photon in the photon's own frame of reference is equal to the distance traveled; and wherein the transfer of energy in the time unit of the photon takes place simultaneously—physically unrealistic?

Experimentally, it has been shown that cosmic rays—while entering the atmosphere around the earth—create muons. These muons travel to the Earth at almost the speed of light, but these muons are extremely unstable. Only a very small part of these muons should arrive at the Earth's surface based on the half-life of muons, but in reality a large part of the muons arrive at the earth's surface. The reason for this is: the time goes for the muons—who travel almost at the speed of light—much slower: due to this fact, the travel time to the earth becomes much shorter for the muons in its own frame of reference, and the decay of muons is also far less. The correction of the travel time to the reference framework of the muons by means of the Lorentz transformation gives a very accurate prediction of the measured number of muons that will arrive at the earth's surface[44].

Now suppose that both results for the wavelength and the simultaneous transition of energy in the photon's own frame of reference are experimentally confirmed, then these results may explain that:

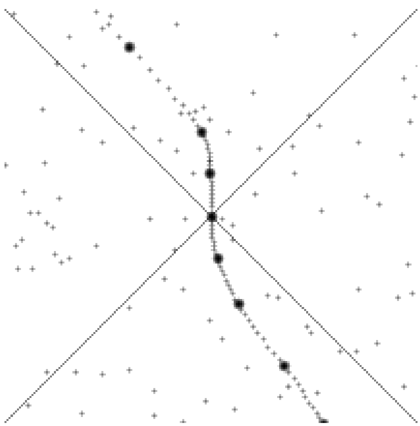
- A photon in the empty space is at the same time a particle and a wave, that moreover completely coincide with each other;
- A photon in the empty space—within its own frame of reference—fills without problem the “future light cone” as a particle and as a wave, before the photon collides with an electron around an atom;
- A photon in the empty space—along the path traveled at the speed of light—does not diverge in its own frame of reference, the entropy does not increase during travel, and the photon still has full original energy and momentum at the collision with an electron around an atom;
- A photon (in free space)—that fills the “future light cone” as a particle and wave—can easily go through both slits at the same time, and after passing through both slits can interfere as two waves from both line sources.

I think I've told you enough about quantum mechanics tonight. If you are still interested in this kind of subjects at another night, I would like to continue then", says Carla.

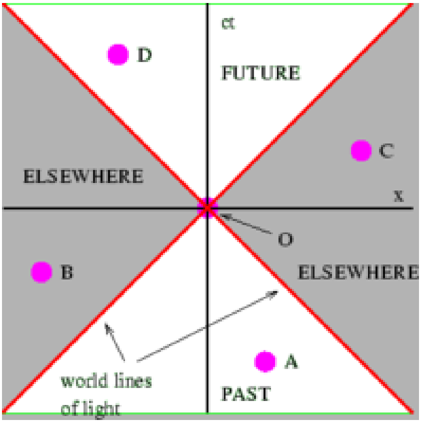
"Your explanation of the differences between the worlds of photons in the eyes of an outsider and in the perception of the photon itself, gives me food for thought. I have once read that: "The eye cannot see itself; someone else is needed to see the eye". I have some doubts, if this quote is always valid, but I will keep the explanation of my dissatisfaction about this quote for another time.

Am I correct, that according to your explanation, a photon by definition cannot perceive itself, because the photon has already left at the moment of perception by itself?", asks Man to Carla.

"Good question, with as far as I can now quickly see two answers. In spacetime, a photon is located exactly on the interface ("light like") between the time zone ("time like"), where events can directly influence each other within the same light cone (see the points on the line in the next figure)—


[45]

and the space area ("space like")—where events occur alongside and can only indirectly influence each other at a later moment when the future cones that arise from both events overlap each other in the future (see points B and C in figure below).



46

After the momentum during creation—e.g. after leaving an electron around an atom (causes the electron to move into a lower energy state)—the photon exists in free space according to its own experience in "here and now; everywhere and always ", until the photon disappears again due to a momentum, e.g. because the photon moves another electron around an atom into a higher energy state.

Maybe the author of this quote and you are both right: the photon can at the same time "perceive itself" in "here and now; everywhere and always "and “not perceive itself” at the same time.

Let me come back to this another time”, says Carla.

“In my opinion, it is fascinating how you have linked, in your introduction, metaphysics of theoretical physics with empirical experiments thereof. Does this link give rise to a clear and indisputable truth, or does "dreaming imagination"—metaphysics—and "observing without interpretation"—empiricism—both guide each other through the maze of an at times violent empty space? What do you think?”, asks Man to Carla.

“Without explanation and/or theory, measurements remain meaningless. A brilliant theoretical model without confirmation by measurable observation remains a mirage. But history shows that by "shock of the new" previously unswerving theory and observations are placed in a different perspective. For example: more than 100 years ago, classical mechanics and physics—wherein at that time only a few details needed clarification—came within a few decades in a completely different perspective due to the theory of relativity, quantum mechanics and spacetime. I think a similar revolution will soon take place again. Gravity is not described well in modern physics”, says Carla.

“I'm tired, could you explain this at another evening?” asks Man to Carla.

“Good idea. I think I can combine this with an exposure of quantum entanglement between two electrons. It's better that we will go to sleep now. It's getting late”, says Carla.

“Good idea”, says Peter.

“Sleep well”, say Ferdinand, Man, Carla and Peter to each other.

[1] See also: https://en.wikipedia.org/wiki/Photon

[2] See also: https://en.wikipedia.org/wiki/De_Broglie%E2%80%93Bohm_theory

[3] See also: https://en.wikipedia.org/wiki/John_Stewart_Bell

[4] Source: Footnote 70 in: https://en.wikipedia.org/wiki/Photon

[5] See also: https://en.wikipedia.org/wiki/Newton%27s_laws_of_motion

[6] See also: https://en.wikipedia.org/wiki/Luminiferous_aether

[7] E.g.: Gravity field Theory, Quantum Field Theory and Electromagnetic Fields. See also: https://en.wikipedia.org/wiki/Field_(physics) and https://en.wikipedia.org/wiki/Theory_of_everything

[8] See also: https://en.wikipedia.org/wiki/Maxwell%27s_equations

[9] Source image: https://nl.wikipedia.org/wiki/Superpositie_%28natuurkunde%29

[10] See also: https://en.wikipedia.org/wiki/Photon

[11] Source image: https://en.wikipedia.org/wiki/Photon

[12] Remark by Carla during editing: This momentum on the mirror—due to the reflection of one photon—consists first of all of the momentum of the photon through the collision and secondly of the momentum of the photon through the reflection of the photon in the mirror. During a complete reflection of the photon in the mirror, the mirror experiences the pulse of the photon twice, while the mirror will experience the pulse of the photon only once at a complete absorption of the photon.

[13] See also: https://en.wikipedia.org/wiki/Photon

[14] See also: https://en.wikipedia.org/wiki/Photoelectric_effect

[15] Source image: https://readingfeynman.org/2014/09/16/the-size-and-shape-of-a-photon/

[16] Source image: https://en.wikipedia.org/wiki/Double-slit_experiment

[17] See also: https://nl.wikipedia.org/wiki/Kopenhaagse_interpretatie

[18] Source: Brief aan Max Born, 4 december 1926, Einstein-Archiv 8-180 according to https://nl.wikiquote.org/wiki/Albert_Einstein

[19] Source image: https://en.wikipedia.org/wiki/Double-slit_experiment

[20] Source image: https://nl.wikipedia.org/wiki/Tweespletenexperiment

[21] Source image: https://nl.wikipedia.org/wiki/Tweespletenexperiment

[22] Source image: https://en.wikipedia.org/wiki/Double-slit_experiment

[23] Source image: https://nl.wikipedia.org/wiki/Tweespletenexperiment

[24] Free rendering of koan "*Sushan's Existence and Nonexistence*" See: Cleary, Thomas, *Book of Serenity: One Hundred Zen Dialogues*. Boston: Shambhala, 1998, p. 372 - 376

[25] Free interpretation of: "*Word and thought have no way – all machinations have disappeared*"

[26] Source: Porter, Bill, *Road to Heaven - Encounters with Chinese Hermits*. Berkeley: Counterpoint, 1993, p. 35.

[27] Source: Stevens, John, *Three Zen Masters, Ikkyū, Hakuin, Ryōkan.* Tokyo: Kodansha International, 1993, p. 131.

[28] See: https://en.wikipedia.org/wiki/Electromagnetic_field

[29] See also: https://en.wikipedia.org/wiki/Laser

[30] Source image: https://en.wikipedia.org/wiki/Laser

[31] Source image: https://en.wikipedia.org/wiki/Photon

[32] See: https://en.wikipedia.org/wiki/Michelson%E2%80%93Morley_experiment

[33] Source image: https://de.wikipedia.org/wiki/Poolbillard#/media/File:Billard.JPG

[34] See also: Zee. A., *Quantum field theory in a nutshell*. Princeton: Princeton University Press, 2010², p. 4, fig. 1.1.1.

[35] See also: https://en.wikipedia.org/wiki/Singularity_(mathematics) and for gravity: https://en.wikipedia.org/wiki/Gravitational_singularity

[36] See also: https://en.wikipedia.org/wiki/Polarizer

[37] Source image: https://en.wikipedia.org/wiki/Minkowski_space

[38] See also: https://de.wikipedia.org/wiki/Photon

[39] See also: https://nl.wikipedia.org/wiki/Foton and https://en.wikipedia.org/wiki/Photon

[40] Editing of image from: https://en.wikipedia.org/wiki/Photon

[41] Editing of image from: https://en.wikipedia.org/wiki/Photon

[42] Source of these formulas for Lorentztransformation: https://en.wikipedia.org/wiki/Lorentz_transformation

[43] Editing of image from: https://en.wikipedia.org/wiki/Photon

[44] See: Devanathan, V, *The Special Theory of Relativity*, Oxford: Alpha Series, 2015, p. 33 – 35; and Rindler, Wolfgang, *Relativity – Special, General and Cosmological*. Oxford: Oxford University Press, 2006, p. 66 - 67

[45] Source image: https://en.wikipedia.org/wiki/World_line

[46] Source image: https://en.wikipedia.org/wiki/Spacetime

Stilled time

The distance between heaven and earth

Man and Carla walk under the starry sky to the campfire.

“The food is nice. I am glad that I can still enjoy it”, says Man.

“I am worried about you. You don't look well. If you are not better the day after tomorrow, I suggest traveling together to Nairobi, to fly from there back to Amsterdam”, says Carla.

“We’ll see. I would like to meet Narrator’s family tomorrow, so back home I can tell him how they are doing. Let us sit down with Ferdinand and Peter,” says Man.

“I have already brought us a can of coffee and mugs”, says Ferdinand to Carla and Man.

“If you are going to sit, Carla, I am curious what you have to say about quantum entanglement and gravity. When I look at the firmament, I wonder how gravity ensures over such an immense distance that all stars stay in balance with each other”, says Peter to Carla.

“First some coffee, I like to have that first now. Then I can also think about how I will start”, says Carla.

“I remember that last night, with your view on quantum mechanics, you have ended with the "gedankenexperiment" entitled "Traveling with the Photon" in "Here and Now - Everywhere and Always".

During your explanation, I was reminded of the Buddhist question: "*A hair-width difference is the distance between heaven and earth*", whereby the verse—rendered freely—ends with: "*But in the end the photon returns home back to zero*"[1].

Has the photon ever been away from the source at the Big Bang?", says Man.

"You are overloading me with these questions at the same time. Let me start with my suggestion from last night: first quantum entanglement between electrons. I will see if there is enough time left for the photon and gravity during and after the Big Bang", says Carla.

"You are right; I ask too much at once. I am curious about your view on both subjects", says Man.

"Quantum entanglement is a characteristic of quantum mechanics whereby two (or more) particles—for example electrons—are and remain connected and entangled in such a way that one particle can no longer be fully described without specifically describing the other particle, although both objects are spatially separated[2]. Quantum entanglement of two electrons implies that two electrons—upon their origin—move from one another through the free space with an opposite spin—or rather with an opposite property (also referred to as "spin")[3]. By measuring the location (or certainly the "spin") of one electron, the location (or "spin") of the other electron is immediately unambiguously determined.

This quantum entanglement is the subject of a publication by Albert Einstein, Boris Podolsky, and Nathan Rosen in 1935—and not much later in various publications by Erwin Schrödinger; since that time the quantum entanglement has been known as the "EPR (this is the abbreviation for: Einstein, Podolsky and Rosen) paradox"—the latter word is not correct, because it is not a paradox. It was incomprehensible to Albert Einstein that particles can determine each other momentarily and faster than the speed of light via quantum entanglement over large distances for an observer outside the quantum entanglement[4].

This incomprehension by Albert Einstein in understandable, because in his opinion, during measurement of electron, a property of this electron is unambiguously recorded and the quantum mechanical uncertainty about this property disappears. With this measurement of the property of the first electron, at the same time the opposite property of the second electron is unambiguously determined and the quantum mechanical uncertainty about this property of the second electron also disappears. Albert Einstein could not comprehend how this measured information about the first electron is unequivocally transferred to the other electron with a speed faster than the speed of light?

This quantum entanglement has been unequivocally determined in empirical experiments based on John Bell's theorem. At present, the record for the measured distance of quantum entanglement between two electrons is 1203 km.

By quantum entanglement of electrons and photons, research teams hope to build super-fast quantum computers—where information is transmitted faster than the speed of light—for e.g. significantly improved cryptography of data.

To date, there is no clear explanation for this empirically unambiguously established quantum entanglement.

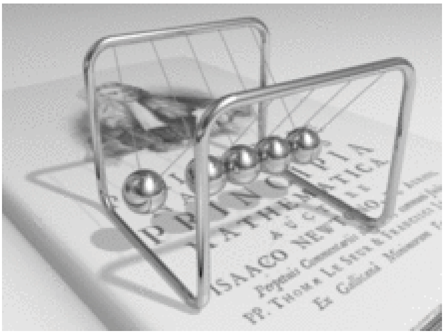
Let me try to find in a "gedankenexperiment" an explanation for the unambiguous transfer of information at a speed that is greater than the speed of light of about 3 x 10^8 m/s in our universe.

A few nights ago, I said that a photon is considerably slowed down when it moves through material[5]: in special cases a photon will move in plastic material at the speed of less than 10 meters per second[6].

In the "gedankenexperiment" I will greatly simplify physics by omitting (or bundling) many physical aspects: everything within physics will be reduced to following three aspects:

- energy,
- momentum and
- spacetime (Minkowski's).

Mass and particles are reduced to (potential) energy via $E = mc^2$; and movement is reduced to (kinetic) energy[7], and forces are reduced to momentum[8] per unit of spacetime.


[9]

Within these three aspects, energy and space-time shape each other. Two nights ago, I said, that within the core of a black hole the space has already shrunk until the dimension of the core and time have almost come to a standstill.

Let us examine the three extremes of energy and space-time in a "gedankenexperiment":

- a spacetime with a perfectly uniform energy spread evenly within the spacetime; in every point—within this spacetime—this spacetime is completely point symmetrical;
- a spacetime with the lowest possible energy;
- a spacetime with all the energy bundled in one point.

Wherever we look, our universe is expanding evenly in all directions: this means that spacetime in our universe is expanding evenly everywhere. If we now look in the dark at the starry sky, the energy of the starlight seems to be bundled in dots. But if we look at the universe in dimensions that are slightly larger than our galaxy, then according to the standard model for the Big Bang, the energy is evenly distributed everywhere as far as we can see[10]. Outside the scope of the Big Bang, we do not know how the energy is distributed.

Suppose the energy is distributed evenly over a very large spacetime far beyond the reach of the Big Bang, then the spacetime in this immense environment is also completely homogeneous", says Carla.

"Do you have any idea where this homogeneous spacetime came from and wherein this space will disappear? I have an idea, but I am curious about your view?", asks Man to Carla.

"This homogeneous immensely vast spacetime outside our expanding universe exists, as far as we know, only in our "gedankenexperiment". I do not expect that this homogeneous spacetime may have originated from a point source, unless from a completely uniform inflation, that had come to a standstill at a certain moment. If I had to give an answer, then—in my opinion—the best conceivable option is that this homogeneous spacetime "η" has arisen in the shape of a multiverse that is created together with a second parallel universe with spacetime "-η". The total energy—and therefore spacetime—of both multiverses together remains zero. This basic model complies with the law of conservation of energy.

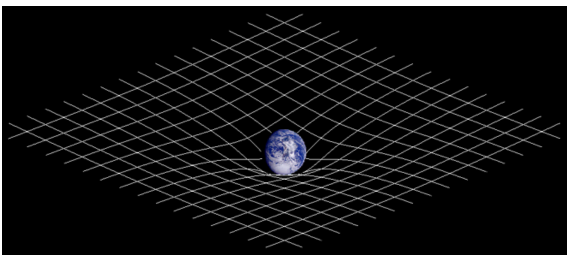
$$\eta = \pm \begin{bmatrix} -1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

The possible existence of such a multiverse and the cause of a possible origin and disappearance of multiverses are shrouded in mist. In short: I actually have no idea about the origin and possible disappearance of this homogeneous spacetime in our "gedankenexperiment"", says Carla.

"I had to think of "A day without yesterday - a day without tomorrow"[12], says Man.

"You are right to some extent. Viewed from a great distance, there is no change in this homogeneously immensely extended spacetime: the perfectly homogeneous energy does not allow change within spacetime. But locally spacetime is constantly changing—or rather "vibrating"—by the rule of quantum mechanics. A test probe will also have a local influence on spacetime.

If we place our earth—as a test probe—somewhere in a point within this immense homogenous area, then the energy will greatly increase at this point through the energy of the earth[3]. As a result of this increase in energy, the dimensions of spacetime around the earth change: the time unit and the measurement for length become smaller relative to the environment, but the spacetime at some distance from the earth remains homogeneous causing the earth to not change its place. Or in our daily speech, everywhere around the earth, the energy of the environment exerts an equal gravity on the earth: these forces cancel each other out and the ultimate force on the earth due to gravity is zero.


[14]

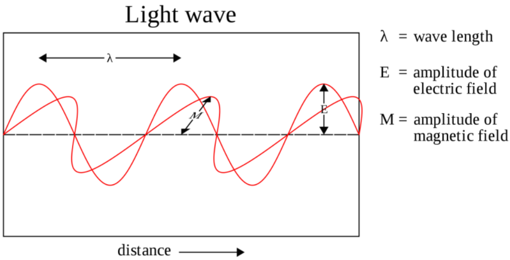
This is also the case on earth in our universe: due to the uniform distribution and expansion of the energy at a great distance around the earth, the distant environment outside our galaxy does not exert gravity on our solar system and therefore on our earth. The unified energy of the sun and planets in our solar system do distort the spacetime within our solar system; in our speech, this distortion of spacetime causes the gravity between the sun and the planets.

Let us first have a drink before we continue with our "gedankenexperiment". Can I get you something to drink from the cooking space", says Carla.

Ferdinand and Peter tell Carla, that they would like to have an IPA beer; Man asks for a glass of water. Carla stands up and heads towards the cooking space. After a few minutes, she returns with the requested drinks and holding also her notebook.

While drinking water and beer, they talk about the miracle of spacetime and gravity that ensures that the drink ends up neatly in the glass and afterwards in their mouth. After a few minutes, Peter asks Carla to continue with the "gedankenexperiment.".

"When I got the drinks, I thought that a photon might also be seen as a multiverse of two identical parallel universes of an electric field and a magnetic field, whereby the phase rotation in space—and not in time—results in a total energy—and therefore spacetime—of the photon equal to $E = h\nu$ [15]. I remember reading somewhere that the speed of light is determined by the speed whereby the electric and magnetic field of the photon can be constructed; in a space, that is filled with a lot of energy or with photon with a high frequency[16], this construction takes more time so that the speed of light is slower than in a room with a low energy density. This thought seems a nice prelude to the next step in our "gedankenexperiment": within a moment I will come back to the total energy of one photon that oscillates in a limited space.

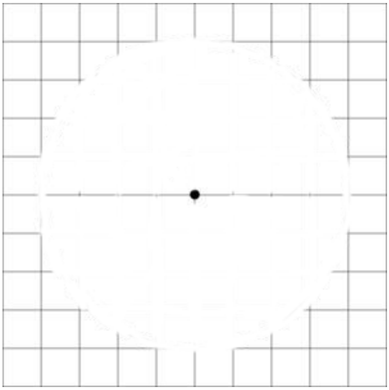


[17]

The second step in this "gedankenexperiment" is a volatile and superficial investigation of a spacetime of a black hole that contains many times the energy of our own expanding universe. This black hole is placed in the same homogeneous, immensely vast spacetime outside of our expanding universe. Three nights ago, we saw that around a black hole, within our expanding universe, is a spherical event horizon wherein almost all energy is sucked into the black hole. This is also the case within this black hole in our "gedankenexperiments": the core point contains all energy within the event horizon. Due to this bundled energy, the spacetime in the core of the black hole has shrunk to the dimensions of a point core: in this core the space is practically zero, and change has virtually come to a standstill: this means that the time unit is incredibly large compared to the time on earth, which means one second lasts (almost) endlessly long, and the speed of light within the black hole is (almost) zero.

In my notebook, I have sketched a cross-section using some Tipp-Ex[18]. In this sketch, I have neglected local distortion of the background spacetime just outside the event horizon through the black hole", says Carla.

Carla opens her notebook and she shows Ferdinand, Man and Peter this sketch.



“Why did you leave a horizontal line in graph paper through the black hole in the middle?”, asks Man to Carla.

“This horizontal line represents a photon. I have left one photon within the event horizon to meet quantum mechanics. Suppose we could measure the wavelength of this single photon within the event limit of the black hole, this photon has an average wavelength of the diameter of the event horizon at many measurements. Quantum mechanics states that for measurements of the photon occasionally the wavelength of the photon is much smaller than the diameter of the event horizon; very rarely the wavelength is almost zero. And sometimes the wavelength of the photon is much larger than the event horizon: energy will then escape from the black hole, as Stephen Hawking has suggested in a publication that I have told you three nights before.

Oh yes, I almost forgot. In this sketch the energy balance is correct: the black hole contains all energy within the event horizon minus the one photon in question; the black hole has not distorted the homogeneous immensely extended spacetime outside of the event horizon; and the energy within the black hole was derived exclusively from the original homogeneous, immensely extended spacetime within the event horizon before the black hole was created.

Can you still follow my explanation?", asks Carla.

"I don't seem to recall your mention of this publication by Stephen Hawking a few nights ago. But that is not important: I can very well understand that energy can escape from the black hole by a photon", says Man.

"I have read about Stephen Hawking's discussions with fellow physicists, I cannot remember all details. It is clear that energy via a photon—however very little energy, because the energy of a photon is "h" multiplied by "c" divided by "λ" (where "h" is Planck's constant; "c" is the light speed and "λ" is the wavelength that in this case is incredibly large)—disappears from the black hole", says Peter.

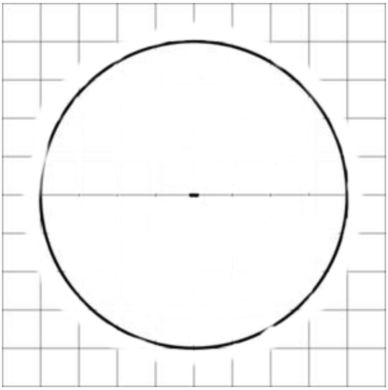
"I can follow the "gedankenexperiment" on main lines and that is good. Go on with your story", says Ferdinand while he looks first at Man and then at Carla.

"Two additional steps follow—or rather: two and a half steps—in our "gedankenexperiment".

The third step is a cursory examination of a vast, much larger spacetime than our universe that emerged from the Big Bang with the lowest possible energy. This empty spacetime is surrounded by a thin spacetime with very high energy. It is not a black hole, but a black sphere that is completely empty inside—again with the exception of a photon to satisfy quantum mechanics. Outside of this sphere is an event horizon just like around a black hole. I made a sketch hereof with Tipp-Ex and a pencil. This sketch is probably not in proportion. Perhaps the event horizon around the globe should be larger.

Oh yes, the energy balance is sound again: all energy from the original, homogeneous, immensely extended spacetime within the event horizon is bundled in the surface of the black sphere; and the energy within the event horizon outside the sphere is also included in the black sphere", says Carla.

She shows the sketch in her notebook while she says: "I was a bit sloppy with Tipp-Ex, which is why the dark circle is not uniformly black".



"Is the horizontal line again a photon with a wavelength that is equal to the diameter of the sphere?", asks Peter to Carla.

"For the sake of clarity in our "gedankenexperiment", I propose lowering the energy of this photon by half. This means that the sphere contains one photon with only a single wave moving in this space. Within the sphere the potential energy is zero and the kinetic energy is the energy of the moving photon according to the formula in the spacetime of our daily life should be equal to "E = hc/2d"[18a], where "h" is Planck's constant , "c" the speed of light in vacuum within our daily spacetime and "d" the diameter of the sphere. But the spacetime within the sphere is most likely not equal to the spacetime in our daily lives.

The spacetime within this black sphere in our "gedankenexperiment" is—in my opinion—considerably different from the spacetime on earth. The unit for spacetime within the black sphere completely coincides with the inside diameter of the black sphere; no other spacetime is possible within this empty sphere. The unit of distance within the sphere can only be the diameter of the inside of the sphere: no other size is possible within the sphere. The dimension for the Planck constant within the universe of this sphere is twice the diameter of the inside of the sphere, because within this sphere only one reciprocating wave—with the lowest energy—can exist with a wavelength of "λ/2" . The time unit within the black sphere can only be deduced from the periodic frequency of the photon, because there is no other periodic change within this sphere. The frequency might be derived from the formula: $f = c/\lambda$[19], but I do not know the speed of light within the black sphere. It would surprise me if the speed of the photon within this black sphere is equal to the speed of light within our expanding universe. I expect that the speed of light near the inner surface of the black sphere will approach zero, because the spacetime on the inside of the black sphere is also zero due to the extremely high energy density. Very close to the inner surface of the black sphere, the speed of light will be significantly lower than in vacuum within our universe, because the spacetime here will be strongly curved due to the very high energy density nearby. I expect that the speed of light in the middle of the black sphere will be instantaneous because—in the absence of any energy (except the photon with a very low frequency)—the spacetime here will be extremely high and the time—read the measurement for change—is virtually absent. I still have to think carefully about this.

However, the energy of a possible wave with a shorter wavelength will be immediately absorbed by skin of the black sphere. Only one unit for periodic change—with the lowest energy—is possible within the empty sphere: the inside of the sphere acts as an ideal mirror in optics[20]. This means that we must assume that the photon is perfectly reflected by the inner side of the black sphere; we will never be able to measure this, because this empty spacetime is unreachable for measurements due to the black exterior. Moreover, inserting a measuring probe for measurements will greatly increase the lowest possible energy within the black empty sphere.

In theory, there is room for energy right in the center of the black empty sphere, but the photon ensures that this energy is taken out of the metastable equilibrium precisely in the middle by the very small pulse of the photon, so that the energy is irrevocably moved to the nearest inner side of the sphere", says Carla.

"Does this photon have the same effect as the butterfly here in Kenya which—by flying back and forth—directly influences the weather in South America a week later[21]? If I remember correctly, you would like to graduate on a similar subject in Delft", says Man to Carla.

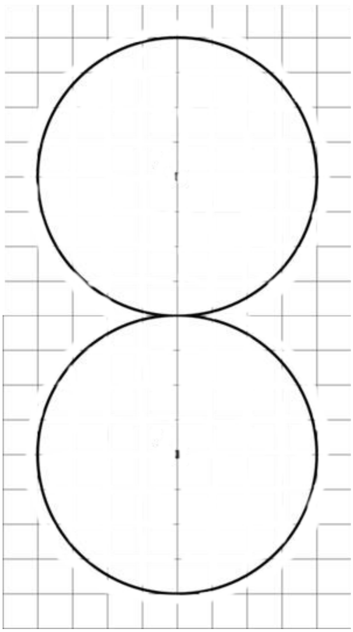
"Yes, I did wanted to investigate chaos theory in physics many years ago, but there was no good opportunity for support at that time. Even then, I was interested in the combination of almost zero and almost infinite: this coherence is reflected in the last half-step of our "gedankenexperiment". Let me continue with this third step.

On the outside, around the very large black sphere is an almost completely empty space with an event horizon just like a black hole. In this empty space around the black sphere, there is again a photon with a wavelength that on average is twice the thickness of the empty outer shell during many measurements. Via this photon, energy can be moved from the black outer surface of the sphere to the space with uniform energy.

This exterior of the black sphere acts for the photon within the event horizon also like an ideal mirror in optics[22]. Because the shell of the black sphere acts as an ideal mirror inside and outside, it is easy to demonstrate via symmetry that this black sphere is in balance with itself and with the homogeneous immensely extended spacetime outside the event horizon of the black sphere, provided that the energy balance is correct and the diameter of the sphere is large enough and it has the correct vast dimensions. A black sphere that is too small has too little energy in relation with spacetime to remain stable within the homogeneous immensely extended spacetime outside the event horizon.

In the fourth step in our "gedankenexperiment" we let two black spheres touch each other at one point: this tangent point between the two black spheres is by definition a black hole, but the event horizon looks different than a black hole in our everyday universe.

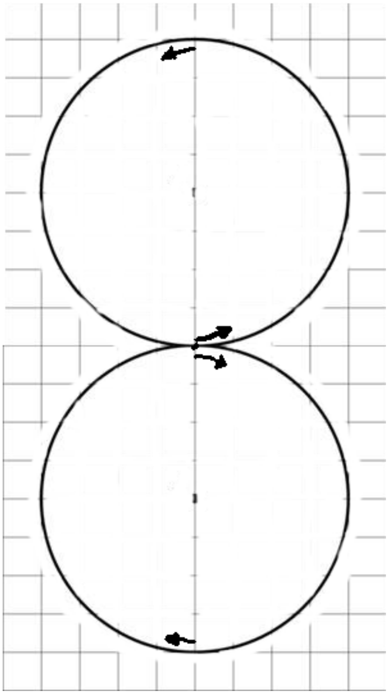
I have drawn with Tipp-ex in my notebook the cross-section of two black spheres that touch each other. Look, here is the sketch", says Carla.



“When I look at this sketch, I have two questions. The first question is: what about the stability of both black spheres? Will both spheres not start to implode, while creating a tiny black hole containing all energy of both spheres on the interface between the two spheres. The second question is: does the vertical line represent again a photon within the void of both black spheres?”, asks Peter to Carla.

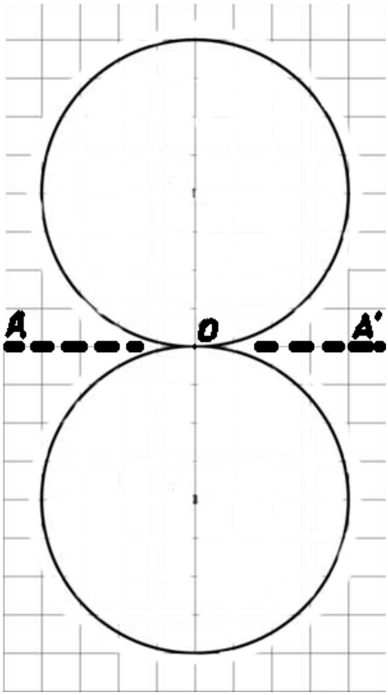
“Good questions. The stability of both black spheres depends, in the first instance, on the "compelling" symmetry—around the “touch point” of both spheres—that keeps the assembly in balance. This assembly remains in balance when the energy distribution of both black spheres within the homogeneous immensely extended spacetime is and remains in balance: among other things, the symmetry of the assembly—around this “touch point”— provides this balance. This sketch is symmetrical with respect to a y-axis through the centers of both spheres and for each x-axis—perpendicular to the y-axis—via the tangent point of both black spheres.

Your answer to the second question is correct. The vertical line is a stylised representation of a photon—the wavelength of λ/2 is the diameter of the relevant black sphere—that is present in both black globes. Let us assume that the "rotation/vibration[23]" of both photons are linked. The two photons rotate in the opposite direction within the two spheres, so that both black spheres roll over each other extremely slow under the influence of the momentum of both photons, while the tangent black hole does not move. I will draw it in the sketch”, says Carla. She shows the arrows in the sketch to Peter, Man and Ferdinand.

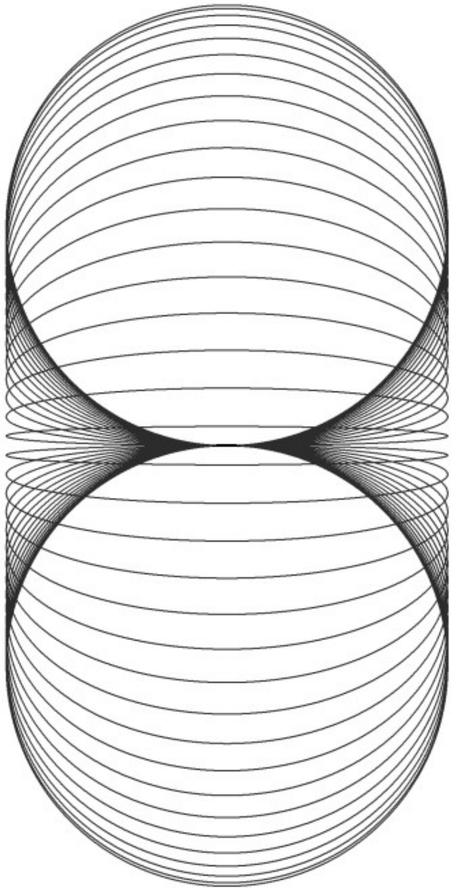


“The momentum of both photons causes both black spheres to rotate extremely slowly over the tangent point, just as two gears rotate over each other.

Now we arrive at step four and a half of our "gedankenexperiment". We change both black spheres with almost complete emptiness into a different shape, by rotating the cross section of both spheres around the axis A-A’ in this sketch that I have already made.



The rotation around this axis results in a black torus with the almost complete void inside the torus. This torus has no hole in the middle, but the middle is a black hole. In English this type of cone is called a "horn"-torus[24]. See the two following drawings.



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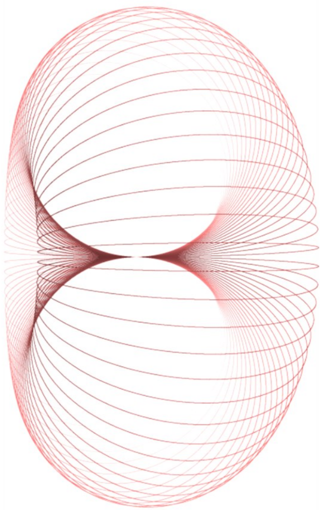
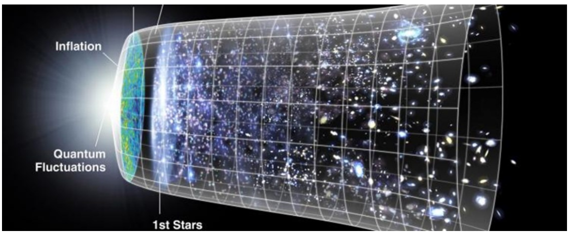


The outer surface of this “horn”-torus is equal to the shell of both black spheres: all energy—originally from the homogeneous immensely extended space-time—within the event horizon of this torus is like black body—hole—uniformly distributed over the surface of the torus. Only the center of this “horn”-torus has twice the energy content of the shell in this model. The interior of the “horn”-torus is completely empty with the exception of a photon with a wavelength of the diameter of this torus, where the lines in my drawing represent the rotation of the photon: on the outer diameter of the torus the photon rotates either to the left or to the right.

Now comes a surprise: a fifth step in our “gedankenexperiment”: This direction of rotation of the photon in the inside of the torus along the outer surface arises—or, as you wish, determines—the slow expansion of the black hole in the center point either to the right or to the left from the center.

Now comes a second surprise: the sixth step in our "gedankenexperiment". If we allow the Big Bang of our universe to take place precisely in the black hole in the middle of this “horn”-torus and the direction of rotation of the outer shell of this torus—together with a compelling symmetry—causes the inflation of the energy in our daily universe, then our universe from the Big Bang until now constitutes one or two horizontal millimeters in the core of this "horn" torus in this sketch. The beginning of the horn of this torus works due to the high density of potential energy as a mirror for our universe. In these drawings, each point—stylised—represents a 4-dimensional Minkowski spacetime: a point in the sketch, that lies a part of a millimeters from the core of the torus, corresponds to a point in the diagram below of our universe from the Big Bang until now.



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In this rendering, the first inflation takes place extremely quickly: I think this is correct seen from our spacetime on earth, but during the Big Bang, the unit of time was solidified in such a way, that this first Big Bang took place very slowly in one's own spacetime: see the schematically rendering of the funnel of the "horn" torus.

If our universe will continue to expand constantly, the outer shell of the torus will continue to turn in one direction in our "gedankenexperiment". If our universe stops expanding in the future, and it will start to shrink, then the rotation of the outer shell of the torus will come to a halt and then—like an oscillator—it will turns in the other way; hereby the direction of time revolves and our universe will irrevocably shrink back again into the interior of the black hole.

Now—at the seventh step—our "gedankenexperiment" is complete: time for rest", says Carla.

"I am deeply impressed by this "gedankenexperiment": you have outlined a model in six steps for the origin of all energy in our universe. I have to let that settle down.

In your notebook, I just briefly saw a passage from Kierkegaard about looking back on life. Would you like to share this passage with us, or would you prefer to keep this to yourself?", says Man to Carla.

"Certainly, I have used this passage from Kierkegaard's work in the development of our "gedankenexperiment". This passage reads:

It is perfectly true, as the philosophers say, that life must be understood backwards. But they forget the other proposition, that it must be lived forwards. A proposition which, the more it is subjected to careful thought, the more it ends up concluding precisely that life, at any given moment, cannot really ever be fully understood. [27]

I have contrasted this passage with a passage by Albert Einstein and a passage by Samuel Taylor Coleridge.

Albert Einstein has written the following sentence in *Physics and Reality*:

One may say, that "the eternal mystery of the world is its comprehensibility".

In his work *Life and Fate*, Vasily Grossman cites the English poet Samuel Taylor Coleridge with:

Imagination is the power to disimprison the soul of facts.

Let us come back to this tomorrow, it is already late: I am going to get ready for the night", says Carla.

"These three statements are true. It is incomprehensible that our universe fits like a speck in a sea of space within a notebook; and it is incomprehensible that the future will cleanse the iniquities of my past, as expressed by a verse in the book of Leviticus from the Old Testament, either returning into the void, or back within the oneness of the black hole wherefrom our universe—or better: our being—has originated.

Leviticus 26 verse 39 goes as follows:

And they, that are left of you, shall pine away in their iniquity in your enemies' lands; and also in the iniquities of their fathers shall they pine away with them.

I have been in exile all my life, but not a refugee. An exile is a refugee with the luxury of a library. Everything I have done in my adult life is always surrounded by the loss of those I have had to leave behind.

Carla, you are still the primary school girl, who can put a whole universe in a matchbox and make a building out of these boxes[28].

You are right: I should have been in bed a long time ago. Thank you for this evening!", says Man.

Carla and Man stand up and go to bed.

Peter and Ferdinand join another group at the campfire to drink a second glass of beer.

[1] Free rendering of "*Fayan's Hairsbreadth*" in: Cleary, Thomas, *Book of Serenity: One Hundred Zen Dialogues.* Boston: Shambhala, 1998, p. 72 - 75

[2] Sources: https://en.wikipedia.org/wiki/Quantum_entanglement and https://nl.wikipedia.org/wiki/Kwantumverstrengeling

[3] See also: https://en.wikipedia.org/wiki/Angular_momentum under the heading "in Quantum mechanics"

[4] See also: Pais, Abraham, *Subtle is the Lord – The Science and the Life of Albert Einstein*. Oxford: Oxford University Press, 1982, p. 456 – 457; and https://en.wikipedia.org/wiki/Quantum_entanglement and https://nl.wikipedia.org/wiki/Kwantumverstrengeling

[5] See also: https://en.wikipedia.org/wiki/Speed_of_light

[6] See also: https://en.wikipedia.org/wiki/Slow_light

[7] See also: https://nl.wikipedia.org/wiki/Energie

[8] See also: https://nl.wikipedia.org/wiki/Impuls_(natuurkunde)

[9] Source image: https://nl.wikipedia.org/wiki/Energie

[10] See for a further description: Schneider, Peter, *Extragalactic Astronomy and Cosmology*. Berlin Heidelberg: Springer - Verlag, 2015[2], Chapter. 4.

[11] See for a hypothesis about multiverse in quantum mechanics: https://de.wikipedia.org/wiki/Parallelwelt

[12] See also: Origo, Jan van, Who are you – a survey of our existence. Part 1, Amsterdam: Omnia – Amsterdam Publisher, 2012, p. 176 – 180

[13] The energy of the earth is the total energy of the earth, that is determined by the heat of the earth, the kinetic energy of the earth, and the potential energy of the earth by its mass via $E = mc^2$.

[14] Source image: https://nl.wikipedia.org/wiki/Ruimtetijd

[15] See also: https://en.wikipedia.org/wiki/Photon

[16] See for the speed of a high frequency photon: https://en.wikipedia.org/wiki/Speed_of_light

[17] Source image: https://en.wikipedia.org/wiki/Photon

[18] See: https://en.wikipedia.org/wiki/Tipp-Ex

[18a] Within this sphere, there may also temporarily exist a photon with a higher energy equal to "E = n/2 times hc/d", where n = 2, 3, 4, 5, etc ..

[19] See: https://en.wikipedia.org/wiki/Wavelength

[20] See also: Gutzwiller, Martin C., Chaos in Classica and Quantum Mechanics, New York: Springer Verlag, 1990, p. 196. Explanation: the outer shell has a potential energy that is very large, and inside the sphere the potential energy is virtually zero: at the interface of the outer shell and the inside, the wave function of the Schrödinger equation is $\psi = 0$.

[21] See also: https://en.wikipedia.org/wiki/Butterfly_effect

[22] See also: Gutzwiller, Martin C., Chaos in Classica and Quantum Mechanics, New York: Springer Verlag, 1990, p. 196

[23] The term "spin" seems to be appropriate here, but it is confusing, because "spin" in an electron indicates another aspect of an electron. A photon has always a "spin"—in the sense of an electron—of 1, while "photon spin" is associated with the polarization of a photon. See further for "spin" at an electron: https://en.wikipedia.org/wiki/Spin_(physics)

[24] See also: https://en.wikipedia.org/wiki/Torus and http://mathworld.wolfram.com/HornTorus.html

[25] Image: Torus with a hole, that has the size of a point in the middle.

[26] Source image: https://en.wikipedia.org/wiki/Big_Bang

[27] Kierkegaard, Søren, Journals IV A 164 (1843). See also: Staube, Detlef & Ruschmann, Eckart, ed., Understanding the Other and Oneself. Newcastle upon Tyne: Cambridge Scholars Publishing, 2018, p. 82

[28] Nārāyana, Narrator, Carla Drift – An Outlier, A biography. Omnia – Amsterdam Publisher, 2012, p. 154

Sparks of life
A hair-width difference

The sun has just set; the camp is ready for the night. Eight family members of Narrator keep watch on the edge of the camp, because there is dangerous wildlife in the area.

Carla and Peter are standing by the newly lit campfire. They look at the tiny sparks that rise from the fire to the starry sky.

“I am worried about Man; his health condition is not good. If the problems with his heart get worse, we will not be able to help him, since we are very far from civilization for any medical help. When Man joins us in a moment, I will walk to Ferdinand to hear his professional opinion about Man”, says Carla.

“Of course I also have concerns about Man either. But he has deliberately chosen, for this detour in the neighbouring country, to meet the family members of Narrator. Here comes Man”, says Peter.

“I have to get something out of the tent", says Carla while walking past Man. Via the backside, she enters Ferdinand's tent. Ferdinand stores the medical equipment in his suitcase.

“Ferdinand, I know that as a doctor you have to keep medical confidentiality, so I won't ask you to violate it. But as a fellow travel companion, what do you think of Man? What can we do if Man's health condition worsens the next days? The nearest medical post with some facilities is more than a day's travel and the hospital in Nairobi is at least two or three days away”, says Carla.

“As fellow travel companion: your questions and comments are my answer. Last night and this morning you advised him not to travel with us, at the day trips in the neighbouring country. He did not follow your urgent advice. You know that he has explicitly chosen to come along with us and he is very happy that he could meet Narrator's family today. Just like all of us, if something serious happens, then we will have to act according to the circumstances. I know that my words are not reassuring, but life has no more to offer at the moment”, says Ferdinand.

“I am not good at letting life run its course, but we cannot do anything else now. I am going to get something out of my tent. I will see you soon at the campfire”, says Carla.

Carla walks to her own tent and shines several times with her flashlight. Then she goes to the kitchen and she takes a few mugs and a can of coffee to the campfire.

“I could not find what I was looking for in my tent using my flashlight”, says Carla to Peter. "I brought coffee from the kitchen," says Carla to Ferdinand, Man and Peter.

“Nice”, they say.

“How are you?”, asks Carla to Man.

“Still the same as the days before. I cannot get used to the heat and I get tired very quickly. I'm going to sleep early tonight. I am very happy that Carla and I have met the two brothers and the oldest sister of Narrator today in a more permanent settlement of the Maasai. With the help of our guide, I spoke with them for half an hour”, says Man.

 [1]

“What did you talk about with his sister and brothers?”, asks Peter.

“Of course about Narrator: he was here over 40 years ago a striking person in many respects. They wanted to know how he is doing now. Man and I said that now he has followed in his father's footsteps and he is traveling through Europe as a storyteller; of course we didn’t talk about the dark side of Narrator. They have good memories of him: as a boy he was cheerful, wise and special. They also showed us the postcard that their mother received from Narrator, a few months after he had arrived from Kenya to Amsterdam. The postcard shows a cow in a meadow with barbed wire as a fence. On the postcard Narrator wrote to his mother that Amsterdam is the upside-down world. There is an abundance of water that is higher than the meadow; the water must be constantly pumped away: otherwise the water will be in the meadow. The cows have more than enough grass; they stand in a very small meadow that is surrounded by barbed wire so that they cannot roam in a big herd. The young people are in charge of the old people; Narrator was doing well, but his mother would not be welcomed with her herd and his father would be mocked and laughed at by the young people”, says Carla.

“Do you know why he did not send an usual postcard from Amsterdam at that time?”, asks Ferdinand.

“I once heard Narrator say that he did not dare asking his mother to visit him in Amsterdam, because she could not leave her flock behind. He did not dare asking his father, because he was afraid that he would not go back to his mother: he could not do that to her. I think that for this reason he has chosen the cow in the meadow as an image and he has written this text that is on the back”, says Man.

“I am almost certain that this is the reason. The sister and brothers are still well aware that he was away for a few years as a young 15-year-old man. He came back with the dark eyes of the God Engaï in the night”, says Carla.

“Who is the God Engaï?”, asks Ferdinand.

“Engaï or Ngai is the most important God for the Masaï. According to a Maasai myth, the God Engaï gives cattle to the people, he brings the people to life after death and he lets the moon die every day. After a sin wherein an opponent was wished to die, Engaï had let the people die and he brought the moon back to life every night[2]”, says Man to Ferdinand and Peter.

“On the day that Narrator returned to his mother, their mother had Narrator first welcomed as her lost son, until she had seen his eyes; dark and cold as the night. He had been given food and he had stayed one night, but the next morning she had sent him away with the words: “You have taken from the world, you have to give back to the world. After that, you are welcome as a guest”. After three years he came back with a white man who he had named Arjuna[3].

The sister and brothers knew exactly why Narrator had named the white young man Arjuna. Arjuna is one of the main characters in the Mahābhārata. He is one of five brothers who all live together with a woman Draupadi—the most beautiful and influential woman of her time—in polyandry. The five brothers are fighting for their rightful part of the kingdom, for the restoration of Draupadi's honour and for the preservation of the world order. The name Arjuna means amongst others "white, clear"; in the name one may also recognise "arh" meaning "worthy, capable of".

His mother had immediately seen that Narrator and Arjuna were special and different. To protect him, she had sent him away the next day to live in a city in a distant country: they gave the name Amsterdam as the name of this city. After that, they never heard from Narrator again. His sister and brothers were very happy to hear that he is doing well", says Carla.

"And the mother and father of Narrator? Are they still alive?", asks Peter.

"Narrator's father fell unexpectedly ill more than twenty years ago during a dry period while he was with their mother. She wanted to take care of him, but he didn't want to drink anything anymore and he died on the third night of his illness at the first light of dawn. The next morning, their mother had her sons collect all the wood, that they were able to find, to make a pyre for his cremation. While they were busy with that, their mother and her daughter anointed the dead body of Narrator's father and wrapped him in a white cloth. Then they placed the body—face down—on the pyre and the pyre was lit by noon. They let the fire burn all night so that no wild animals could touch their father. Narrator's sister said that their mother wanted to reunite their father with India—the country where he was born and raised—so that he can again start a new life there in a better shape. Their father was a good man, because the next morning he had traveled completely with fire to his ancestors in South India. In the course of that day, they scattered all ashes from the fire on the earth, so that the traces of the stake had gone.

After a mourning period of one week—according to their father, common in India—their mother and her herd of cattle moved on to fresh grassland and they followed her.

Half a year later, Narrator's youngest brother traveled to South India to see if Narrator's father was reborn there in a better shape. After an adventurous journey, with the necessary intervals of labour in rich Arab States to pay for the outward and return journey, the youngest son returned to his mother to tell her that his father had come back to life in many forms in South India. After spending two nights with his mother, he left for Nairobi to settle there as teacher; during school holidays he regularly stayed with his mother for a few nights: he always returned with stories and his mother was happy to see that he was happy", says Carla.

"Is Narrator's mother still alive?", asks Peter to Carla and Man.

"The mother of Narrator unexpectedly died five years ago at daytime about the time that Narrator had felt it intuitively; while at the Leidseplein in Amsterdam he sang the stanza "*From a country where it doesn't rain*" from the chanson "*Ne me quitte pas*" by Jacques Brel.

I asked her children where she was buried. They said that the Masaï do not break the earth and no Masaï will break the ground to bury the dead in a grave. The earth is sacred, and breaking the ground is harmful to the grass and to the cattle, because the soil produces grass for feeding the cattle that belongs to the God Engaï[5].

In preparation for the funeral for Narrator's mother, one of her sons slaughtered an ox. The children covered their mother with fat and blood from this ox. Then they left her for scavengers[6] and they moved two hours away with her herd. One of her sons went back the next day and he saw that she had disappeared completely. According to her children, she was a good woman, because the scavengers had not rejected her[7]", says Carla.

"They have completely adapted their way of life to nature in this environment. Carla and Peter, what I will say to you now, I have already let Ferdinand and the expedition leader know on paper. We are now far away from civilisation and from any medical aid. You have already been well acclimatised, but I noticed that I cannot get used to the heat during the daytime. If I should pass away unexpectedly, do not put much effort into my funeral: it is my wish that you send me off according to the local funeral ceremony of the Masaï. This prevents a lot of hassle for everyone and I am at peace with their habits: "When you are with the Masaï, live like the Masaï; and when you die with the Masaï follow the funeral ceremony of the Masaï". I would like a glass of wine now. Carla, would you be so kind to get a bottle of wine from my tent?", says Man.

"Within a few days we are back in the neighbourhood of all usual facilities. If you still don't feel well tomorrow morning, I suggest that you and I travel with Ferdinand to the nearest first aid post. I will go and get a bottle of wine", says Carla.

Carla walk to the tents and she returns with two bottles of wine and a few glasses.

"You got two bottles of your own?", says Man.

"I still had these in my luggage; this heat does not do any good to the wine. It's better to enjoy it, while it is still good. Who wants a glass of wine?", asks Carla.

She pours the wine in the glasses and everyone cheers on the beautiful journey and the impressive nature that they have seen today.

 [8]

Man wishes prosperity for the Narrator family in the future: everyone cheers on this. They are silent for a few minutes while they enjoy their wine.

“Now that I am here looking at the starry sky in the dark at the light of the campfire, I am thinking of the Buddhist question *“A hair's width is the difference between heaven and earth”*[9]”, says Man.

“How do you see here—at the campfire under the starry sky—emptiness and "being whole" of our sailing trip on the Wadden Sea[10] together with "all-encompassing one" of the first part of our search for "Who are you”?”, asks Carla to Man.

“The supreme road is not difficult, this road simply does not like making choices. If there is even a hair’s width difference, then this is the difference between heaven and earth”, says Man.

“One and two, two and one: how do they go together?”, asks Carla to Man.

“It is the same way and the same wind as ever—when you meet someone and talk about it, a hair's breadth of difference arises. In the end, there are no two winds: there is only one wind. This wind causes a myriad of manifestations likes waves on the sea: a flat sea with windlessness, rippling waves in a breeze and huge waves hunted by a storm”, says Man.

“I have to come back to it: how can One together with all manifestations arise from "creation and doom", and "being and emptiness"?”, asks Carla to Man.

“In "creation and destruction" as "being and emptiness", the universe—in the form of this starry night—shows its face: young without traces in the sparks of the campfire, and old with the furrows of life in the glowing logs: all like sparks and emptiness within the firmament. We see with eyes of the universe; one and two, two and one: both eyes one in duality. Young and old are also "one and two, two and one: both one in duality." Now that I am old in the eyes of others, I feel myself younger and more carefree than ever. So I also have to go early to bed again: it is now child's bedtime”, says Man.


11

“Man, before going to sleep, I have a “little song of desire” for you. I am aware of interconnectedness of everything around me with myself. Seeing with my eyes, everything that I perceive, shapes each other simultaneously like subject and object shape each other at the same time. But I don't know how I can see with the eyes of the universe. Is the universe able to see itself? What do you think?”, asks Peter to Man.

“Your question comes down to the question: "Who are you?" If you are the universe in all its manifestations, then the universe sees with your eyes. Or maybe better, let me use the metaphor "The ocean and the wave". In our eyes, the ocean and the wave are two—in my view artificial—manifestations of One in duality. Wave and ocean are indivisibly linked together. Their interconnection is complete: without the ocean there is no wave and without the wave, the ocean is a completely different manifestation for us. The wave and the ocean are one together: if the wave hits the rocks of the coast, then the wave and the ocean take on a different shape together.


[12]

When you see, then the universe sees; your seeing and the universe are one: herewith the universe sees itself. If you see this, then there is no difference between you and the universe. If there is a hair width difference between your view of the universe and the universe, then both are clearly separated as duality in One. Or in other words: both are two manifestations of One and the same. This is my contribution to the "little song of desire". More will follow tomorrow. I wish you all good night", says Man to Peter, Carla and Ferdinand.

"I'm also going to bed. We have to make a long journey tomorrow. Good night", says Carla to Ferdinand and Peter.

"I think Ferdinand and I drink what is left in this bottle", says Peter.

“Good idea. Let us quietly enjoy the starry sky and the remains of the campfire”, says Ferdinand.

The next morning Carla, Ferdinand and Peter have their breakfast.

“Man is usually awake on the late side, but now he stays away for a very long time. I'm going to see if he's already awake”, says Carla.

Carla walks to Man's tent and asks outside the tent if he is already awake. No answer. She enters the tent and apparently he is still asleep. She says softly: "Man, it's time to wake up." No reaction. She touches him: he is cold and stiff. She sits down next to him and she notices how peacefully he lies on his sleeping bag.

“Carla is has been away for a half an hour now, shall we look where she is? I also have to see how Man is doing before we break up. If you walk to Carla's tent, I'll see where Man is now”, says Ferdinand to Peter.

Ferdinand and Peter walk to the tents. At the opening of Man's tent, Ferdinand asks: “Man, how are you doing, did you got up yet?” Carla answers: “Man is lying here peacefully on his sleeping bag with his clothes from yesterday still on”. Ferdinand enters Man's tent and he sees and feels that Man is deceased. Peter hears Carla's answer; he quickly walks to Man's tent and he opens the tent.

“Peter, can you get the leader of the tour. As a doctor, I have to fulfill a few formalities and our tour leader must immediately make some considerations for the continuation of our tour. If I have finished the formalities, we have to discuss and decide what to do”, says Ferdinand to Peter. Peter walks to the leader of the tour.

“Carla, would you please sit at the other side of the tent so that I will be able to examine Man in a few minutes? I am now going to get my doctor's case and I'll be right back”, says Ferdinand.

A few minutes later, Ferdinand and Peter are back in Man's tent with the tour leader. Carla is at the other end of the tent. Ferdinand says to the tour leader: “Man died more than a few hours ago. I will now check him for the possible cause of death. "

Ferdinand examines Man on the front and sides. With the help of Peter and Carla, he turns Man to also examine his back. Then they put Man on his back again.

“I have not seen any traces that could indicate an unnatural cause of death. As the physician in charge, I will fill out the death certificate and state "probably heart failure" as cause of death. I cannot accurately determine the time of death. Based on the available data, the nomogram says that 8 hours have elapsed since his heart failure: I will conclude 11 o’clock last night as time of death.

I propose that we discuss how to continue outside the tent", says Ferdinand.

"I would like to stay here with Man," says Carla. Ferdinand, Peter and the leader of the tour go to the breakfast place. Ferdinand takes the last cup of coffee. Peter is leaving to make a new pot of coffee. After ten minutes, he is back and he gives everyone a cup and pours the coffee.

“I think it is not possible to transfer Man's body to the Netherlands in this heat. Is there another option than to have his funeral in this area?”, asks Peter to Ferdinand and the tour leader.

“The tour leader has already told me that there is a similar second problem. Dealing with the cause of death and obtaining a certificate of Man's death from the local government—which is located approximately 50 km from us—is rather dangerous. The local government is corrupt; there is a high risk of being arrested and receiving our freedom of movement back is likely to involve significant bribes. During a previous tour, the foreign participants prepared and signed a statement of my findings. With this statement, the official death certificate was issued later in the civilized world. I propose that Carla, you and I prepare this statement of findings and that we submit this statement of findings together with my statement of cause of death as physician to the civil registry in Amsterdam in the Netherlands”, says Ferdinand.

“I am not good at drawing up such a statement. Shall we ask Carla in a few minutes if she is willing to prepare this kind of statement?”, says Peter.

“Let’s wait and see what Carla thinks. A many days transport of Man’s body to Nairobi is not justified in this hot weather. I think we have no choice but to let Man's funeral take place in this area. The tour leader just said that a deceased foreign participant was cremated during an earlier tour”, says Ferdinand.

“I think this is the best option”, says Peter.

“I will immediately ask a part of the cooking team to help you collect enough wood for a funeral pyre. I suggest that the other members of the group move on for a few hours to look at wildlife there. We will spend the night several hours driving from here. Tonight we will meet you there again or else tomorrow morning”, says the leader of the tour.

“I have no other options and with the local government in mind, I think this proposal is better for the safety of the other group members than to continue mourning here”, says Ferdinand to the leader of the tour.

“Let’s now inform the others about Man's death. If you, as a physician, will report Man's death, then I will explain you the travel scheme for the next two days. I will call everyone together for this message”, says the leader of the tour to Ferdinand.

When everyone—except Carla who wishes to stay with Man—is gathered at the cooking tent, Ferdinand says that Man Leben had died peacefully around 11 o'clock last night in his sleep due to heart failure. He asks for one minutes of silence for the memory of Man.

At the end of these two minutes, Ferdinand says that—before the tour in the Netherlands – Man and he had spoken several times about the health status of his heart. He was aware that this tour would be a burden on his heart and he knew that he might have to stop this tour prematurely. At the start of the tour, Man had given him a letter in a sealed envelope with his requests in case he would become a burden on our tour. "I have opened the envelope a few minutes ago. In his letter, Man has written that he did not want to stop the tour in case he would have problems with his health; he wanted the journey to continue as usual and he wished to be left behind with minimal support or as alternative to follow a shortened route. Yesterday evening at the campfire, Man had told Carla, Peter and me, that in case he should die unexpectedly, we should not have to do much trouble for his funeral: it was his wish to be buried according to the local funeral ceremony of the Maasai. Our tour leader will present the daily schedule for the next two days. If you have any questions for me, I will answer these after the explanation by the leader of our tour", says Ferdinand.

"It is not possible in our situation to transport Man's body to the civilised area. I believe that the funeral of Man will have to take place here. Five years ago, another participant died unexpectedly in a remote place during one of my tours. We cremated his body there during the next night. I propose that Man Leben should be cremated here starting this evening. I have asked the cooking team to gather additional wood for the funeral pyre. I think it would be wise for us to move on a few hours in order to avoid unnecessary problems with the local government. It has happened that the local government arrests foreigners in the event of an accident or an unexpected natural death; only after paying a large ransom, foreigners are released on probation. A few volunteers can stay behind to guide Man's cremation. These volunteers should arrive tomorrow at the end of the day at our next camp, so that we may again continue the journey together. Who wishes to be present as volunteer at the cremation of Man?", says the tour guide.

"I propose that I am the only volunteer", says Ferdinand.

"If Carla stays behind, I will also stay for the funeral", says Peter.

"Let's ask in a few moment what Carla's wishes are", says Peter.

One of the fellow travelers says: "It is prudent to follow the advice of our tour guide in this area. Is it possible for us to bring a last farewell to Man before we leave?"

"The last fifteen minutes before your departure, anyone who wishes can say goodbye to Man. I will make sure that you will have the opportunity to do so. When is the departure planned?", asks Ferdinand to the tour guide.

"I propose we leave around 10 a.m. We can say goodbye to Man from a quarter to ten to ten. Let's now prepare for departure", says the leader of the tour.

Almost everyone goes to their tents to prepare for the departure. Marlies—fellow traveler—walks to Ferdinand and she says: "I was working at a funeral home until last year. I already packed my luggage early this morning. I offer to help you prepare Man for the cremation".

"I am happy with your offer. Please, let's walk to Man's tent", says Ferdinand.

They gently enter the tent. Carla looks around at Ferdinand. He says: “Marlies is going to prepare Man for cremation. Maybe it's better if you go outside, so Marlies can quietly do her job”.

“I would like to help Marlies. You and I can speak afterwards”, says Carla.

“You may remain seated quietly with Man, Ferdinand and I will get water, towel, soap and other supplies”, says Marlies.

Outside the tent, Marlies says to Ferdinand: “When we are ready, we will look for you. Where can we find you in less than half an hour?" “Probably I will be helping with the preparation for the pyre”, says Ferdinand.

When Marlies is back in Man's tent, she washes Man's body with the help of Carla. While Marlies prepares Man's body for the funeral, Carla chooses white light cotton clothing for him. After they have dressed him, Carla combs his hair. Man is beautiful and peaceful; as final blessing Marlies puts her hand on his forehead. Marlies says: “Shall we go to Ferdinand to prepare the funeral? Afterwards you can say goodbye to Man". They walk silently to the place where the pyre is prepared.

“Man is doing well. I will leave you alone now. I will return shortly before the departure to see if you may need my help”, says Marlies to Ferdinand.

Ferdinand tells Carla the schedule for the next two days. Carla immediately says that she will stay with Ferdinand for the cremation. She asks if the cremation will start around the last daylight, so that she has more time to say farewell and have time to prepare for the cremation. Carla indicates that she wants to return to the Netherlands immediately after the cremation, also to complete the formal obligations in the Netherlands. "Do you have mobile coverage here?", asks Carla. "Yes, I have a satellite connection," says Ferdinand. "May I use your mobile to notify Man’s family," asks Carla. "Of course. Do you have their mobile phone numbers?”, says Ferdinand. "Yes, a few. Let’s compare what we have", says Carla. They walk to Ferdinand's tent to get his mobile phone. Upon finding a quiet place, she calls the family of Man; Ferdinand is discussing Carla’s wishes with Peter and the tour guide.

When Carla has had three short telephone conversations with the ex-wife and his two children, she walks to Ferdinand and Peter who are now helping to build up the funeral pyre.

“Ferdinand, Peter, the conversation with Man's ex-wife was aloof: she has thanked me for conveying this sad news and she hopes that this will be the last message she hears about Man. Their daughter was cold: she had listened to my message and then she has disconnected as quickly as possible. Their son spoke in a business-like way about avoiding the inheritance; I said that I am not a party to this matter. None of them had a specific wish for the funeral”, says Carla.

“Sorry to interrupt you briefly. I have read the letter in a closed envelope that Man had given me before this tour in case of. In this letter, Man asks that in case he died in Africa, he wishes you to contact a notary in Amsterdam. He had also written that no additional effort has to be made for his funeral: he expressed in writing his wish at the campfire last night”, says Ferdinand.

“I wish to give him here a decent funeral at the end of the day. Tomorrow during the day I hope to be able to travel back to Amsterdam”, says Carla.

“Ferdinand, a cook, a driver and I will stay for the funeral. The others will leave around 10 a.m. for the remaining of the tour”, says Peter.

Marlies joins them. “A few moments ago all of us said goodbye to Man. Is there anything else I can do. If so, then I can stay behind and join the others together with you next day, at the end of the day. Otherwise I will say goodbye here. In the Netherlands we will have contact again”, says Marlies.

“Thank you very much for your help and support. I am happy that you have given other group members the opportunity for a last farewell to Man. The practical preparation for the cremation will be soon finished. After you leave, I will prepare the funeral service. I know that this journey is one of your greatest wishes. We will manage: I think it will be better for you to continue traveling with the group”, says Carla.

They say goodbye to Marlies. The rest of the group is ready for departure: they say goodbye. Ferdinand and the tour leader agree to keep in touch via satellite telephone. The other members of the group and Carla, Ferdinand and Peter say goodbye.

Carla, Ferdinand and Peter start preparing coffee in the shade. Carla reads the letter that Man had given to Ferdinand. Ferdinand asks Carla when she will prepare her statement about the death of Man. Carla proposes to put all statements on paper in the Netherlands: she says that it may be dangerous to go through customs in Kenya and the Netherlands with official death declarations from a neighbouring country. If, during the search of the luggage, these unfinished papers without official stamps and signatures are found, it will raise many questions by authorities with a possible arrest and suspicion as a result. They drink their coffee. Then Ferdinand and Peter decide to ask the driver to take them to the temporary settlement of the brothers and sister of Narrator. Carla stays with Man. After lunch she will plan the funeral. Halfway through the afternoon, Ferdinand and Peter return with the two brothers of Narrator. They wish to keep watch during the next night; they notice that there is enough wood and they will keep the fire burning until the next morning.

Half an hour before sunset, the men carry the body of Man from the tent to his place on the funeral pyre. They cover him with enough wood. When they are done with this, Carla wishes to speak a few words for farewell.

First she says a word of thanks for Man. She starts calling him by his birth name: Levi Hermann, the only son of Lea and Jacob Hermann. She tells how halfway through his youth his name was changed to Herman—named Man—Leben in order to survive. His parents did not survive this oppression. Halfway through his adult life, she met Man as a friend: a Jewish spiritual leader with attention for everyone he met by:

1. Sacrifice
2. Involvement,
3. Inspiration
4. Servitude
5. Overview
6. Unselfishness
7. Respect for predecessors
8. Aversion of authority
9. Practise what she/he preaches
10. Leadership without structure[13].

Hereafter Ferdinand and Peter say a few words of thanks.

Carla proposes to sing after lighting the fire with a slightly adapted text "*Thine be the glory*", first in Dutch and then in English:

U zij de glorie, opgestane Man!
U zij de victorie, nu en immermeer.
Uit een vonken stromen, stijgt Zijn leven op,
Naar de sterrenhemel in dez' flonk'rend nacht:
U zij de glorie, opgestane Man!
U zij de victorie, nu en immermeer.

Thine be the glory, Oh resurrected Man!
Thine be the victory, for eternity!
From all these sparks, his life is rising,
To the starry sky in this luminous night.
Thine be the glory, Oh resurrected Man!
Thine be the victory, for eternity!


[14]

The expedition leader had prepared a small campfire about 100 meters away. Peter lights this campfire. Carla, Ferdinand and Peter discuss how they will organize the next morning before travelling to Nairobi airport around noon.

Through the whole night, the two brothers of Narrator let the pile burn as a bonfire for the life of Man. A life won in time against the stream—even with a headwind, his name carried far over the fields—and now he has returned in the stream of sparks, changing fires and ashes.

At the breaking of dawn the fire was put out by the brothers of Narrator. After the ashes had been cooled with water, Carla searched for the remains of Man's body[15] in the ashes of the pyre; she had crushed and scattered some small bone residues together with the ashes from the pile. The brothers of Narrator had said that Man had been a good person, because the fire did not reject him.

They let Narrator's brothers choose a number of things, that are useful to them, from our luggage to share with their families. The camp is quickly broken up. As a farewell, they had coffee with the brothers of Narrator.

They left for Nairobi around noon. Three days later they arrived by plane in Amsterdam. The next day, Carla visited the notary.

[1] Source image: https://en.wikipedia.org/wiki/Maasai_people

[2] Source: https://nl.wikipedia.org/wiki/Masai_(volk)

[3] Arjuna is one of the main characters in the Mahābhārata. He is one of five brothers, who all live together with a woman Draupadi—the most beautiful and influential woman of her time—in polyandry. The five brothers are fighting for their rightful part of the kingdom, for the restoration of Draupadi's honour and for the preservation of the world order. The name Arjuna means, among other things, "white, clear"; in the name also may be recognises "arh" meaning "worthy, capable of".

[4] Source: elektronic version of the dictionary Monier-Williams – MWDDS V1.5 Beta

[5] Source: Okiya, Denis Odinga, The Centrality of Marriage in African Religio-Culture with reference to the Maasai of Kajiado County, Kenya, 2016, p. 99 See: http://ir-library.ku.ac.ke/bitstream/handle/123456789/14947/The%20centrality%20of%20marriage%20in%20african%20religio%20culture%20with.pdf?sequence=1

[6] See also: https://en.wikipedia.org/wiki/Maasai_people

[7] See also: https://en.wikipedia.org/wiki/Maasai_people

[8] Source image: https://en.wikipedia.org/wiki/Maasai_people

[9] This is koan "Fayan's Hairbreadth" in: Cleary, Thomas, Book of Serenity – One Hundred Zen Dialogues. Bosten: Shambhala, 1998 p. 72 – 75

[10] See: Origo, Jan van, Who are you – Emptiness. Amsterdam: Omnia – Amsterdam Publisher, 2015

[11] Source image: https://nl.wikipedia.org/wiki/Vuur

[12] The Great Wave off Kanagawa, by Hokusai. Soure image: https://en.wikipedia.org/wiki/Hokusai

[13] Source: Maleachi 3:10 (book and prophet from the Tanakh (Hebrew bible; see also: http://en.wikipedia.org/wiki/Tanakh). See also: http://www.nik.nl/2010/01/parsja-simchat-tora-wezot-haberacha/

[14] Source image: https://nl.wikipedia.org/wiki/Vuur

[15] See also the movie "Why has Bodhidharma left for the East" produced by door Bae Yong-kyun – see hyperlink: http://en.wikipedia.org/wiki/Why_Has_Bodhi-Dharma_Left_for_the_East%3F and the movie "Spring, Summer, Autumn, Winter", directed by Kim Kiduk – see hyperlink: http://en.wikipedia.org/wiki/Spring,_Summer,_Fall,_Winter..._and_Spring

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Jan van Origo is my writer's name. During his youth Jan lived in the middle of South Limburg – the Netherlands. After finishing his study of Industrial Design at Delft University of Technology, Jan lived in Amsterdam where he met his wife Marieke. Now, Marieke and Jan live for almost 30 years in a village near Rotterdam.
His work is related to the safety of consumer products. Nine years ago he started the essay on the quest "Who are you – a survey of our existence".

The progress of the Odyssey can be followed on the website of the publisher.

"Our imagination is stretched to the utmost,
not—as in fiction—to imagine
things that are not really there,
but just to comprehend those things that are there"

- Richard Feynman

On may say that
"the eternal mystery of the world is its
comprehensibility"

- Albert Einstein

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