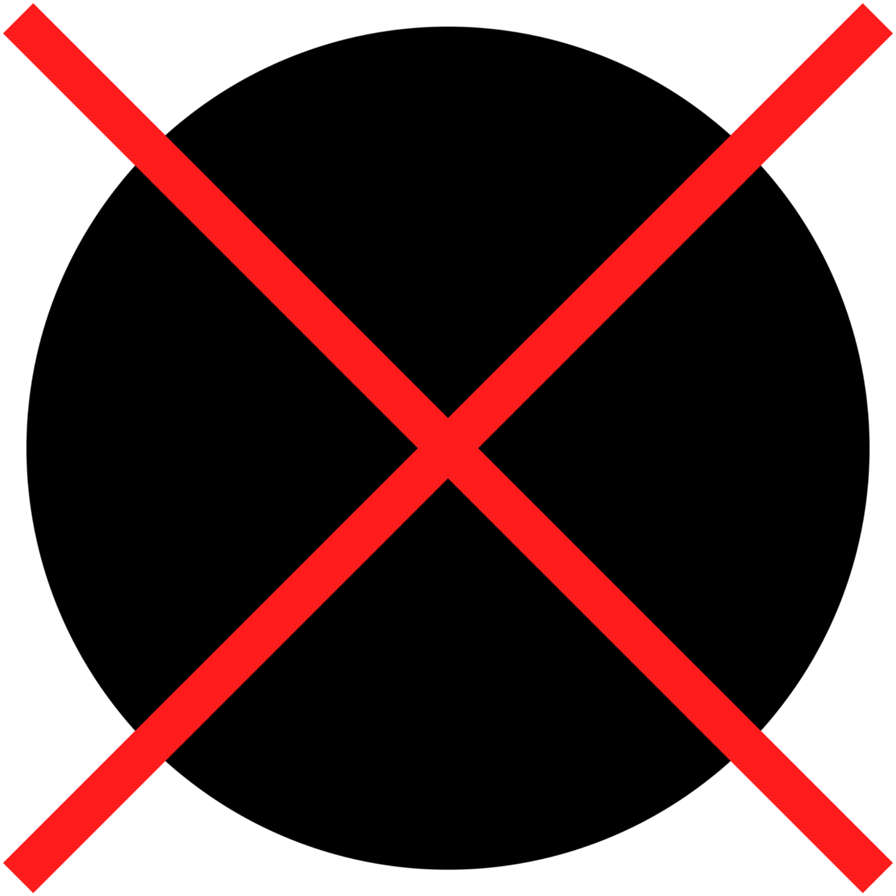
# Black holes...



# ... don’t exist!

*Peter Damen*

N Paradigm Physics

**Black holes...**

**don’t exist!**

## OTHER PUBLICATIONS

*The 2T Theory of Time (expected in 2025)*

*The Unified Theory of Inertia and Gravity (expected in 2026)*

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Peter Damen

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E-mail: info@new-paradigm-physics.com

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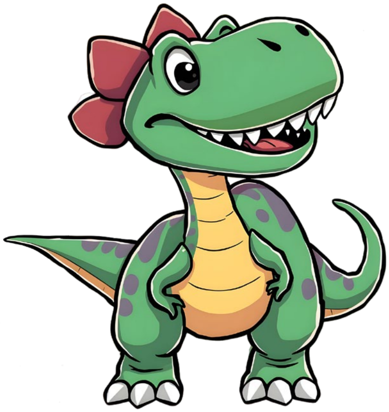
*A number of drawings and graphs in this book were made by the author. Many illustrations were generated by various AI programs, including ChatGPT, Copilot, Gemini and NightCafé.*

*For my mother and father, who always encouraged me to gain knowledge and insight, but unfortunately did not live to see this result.*

# PROLOGUE



This book is a popular scientific book for basically anyone who is interested in black holes, and who may be surprised that these fascinating celestial bodies do not exist at all. You are probably one of those people. And perhaps you, like many others, have no idea what black holes are exactly, even though they regularly appear in the media.

Then you have come to the right place. I too have been fascinated by those mysterious black holes for many decades. I consider them a bit like the dinosaurs of physics. By that I mean that I also see the attraction that dinosaurs have on people, and especially children, in their interest in black holes.

But even more than in black holes, I have been fascinated by time my whole life. And black holes are related to time, as will become clear later in this book. Because of my interest in time I have also come to the discovery that black holes cannot exist at all, and that the scientific basis for their existence is simply not correct. Why this scientific basis is not correct will also be discussed in detail later.

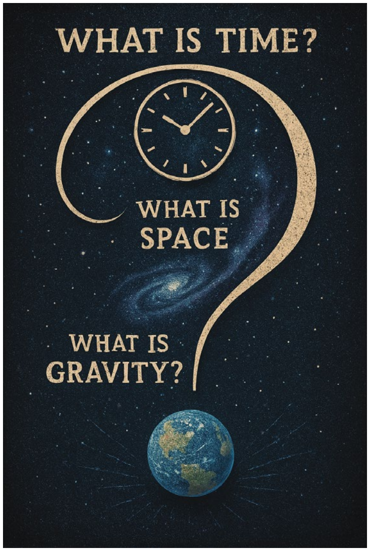
Perhaps you now have the feeling that it can all become quite complicated. In all honesty, I must admit that the subject matter is indeed quite complicated. It is therefore not without reason that all leading physicists in the field of black holes have thought for some 60 years that black holes are existing objects. And that a Nobel Prize for Physics was even awarded for it in 2020!


But let me reassure you right away. The often complicated material is explained in this book in a simple, understandable way, and without compromising the truth. In order to make this book accessible to both the interested layman and those who have a little more (basic) knowledge of physics, I have included a number of <u>red text blocks</u> in the right-hand margin for this second group of readers, in which certain matters are discussed in more depth. However, it is not necessary for the course of the story to read these text blocks. The choice of whether or not to read them is up to you. And if you do not understand a red text block, that is no problem at all.

I hope that anyone who reads this book completely will have experienced a wonderful journey into the physics of black holes at the end, that it is clear that and why black holes do not exist, and that you may have become (even) more interested in the fundamental questions of physics.

If that has happened, I will have succeeded in my intention. Because apart from the fact that I have a great interest in all kinds of fundamental questions of life, I am also always very happy when I can pass on this knowledge and also inspire other people.

I sometimes say that gaining knowledge, and really understanding this knowledge, gives me a sense of enlightenment. Whether that is true or not, gaining insight into how the world around me functions gives me peace in any case. And I hope that this book can contribute a little to this for you too, even if it is only a very small amount.



# MY ADVENTURE

For me, searching for and collecting the insights that I describe in this book has been one big adventure, which is still ongoing. When I was a child, I read a lot of adventure books. Like many others, I wanted to live an adventurous life. At first, not much came of that adventure.

Quite recently, on Tuesday, October 26, 2021, at 1:33 PM to be precise (it was an epiphany, and I realized that very well, which is why I still remember it so precisely), I was lying in bed during one of my depressive periods, and suddenly had a eureka moment. I suddenly understood what time exactly is. I have been searching for that ever since I was a 7-year-old boy. How often have I not lain on the couch at night, staring at the white ceiling, wondering what it is that makes something as unreal, but at the same time frighteningly real as time passes. What is it?

But then I suddenly saw it. In retrospect, I needed several other eureka moments, which I fortunately had, before I was able to formulate a conclusive theory about what time is in physical terms. This book is not about this theory of time (but I expect to publish a book about that adventure in the foreseeable future).

What this book is about is an insight I gained about the reality of black holes, thanks to that theory of time. Because what was said about black holes, and the existence of black holes in general, did not match with my theory of time. As a trained scientist, I realized that this could mean two things: 1) My theory of time is (unfortunately) incorrect, or 2) The theory of black holes is wrong.

Fortunately, I had another eureka moment, on Friday, October 11, 2024, at 3:03 PM, again in bed (that happens more often, and shows that lying in bed can indeed be productive...), when I was thinking about the event horizon (later in this book it is explained in detail what this component of black holes is). Then I realized that my

theory about time was correct, but that black holes, with the current knowledge of physics, cannot exist.

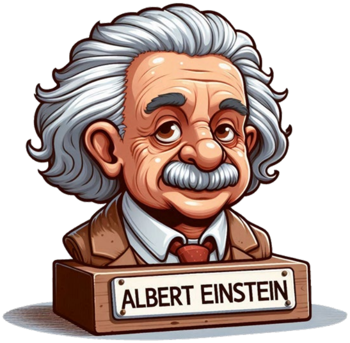
How this works is described in detail in this book. And of course it is also explained what current science means by black holes.

Let's go back to that Tuesday, October 26, 2021, at exactly 1:33 PM. I see that moment as the beginning of a real adventure in my life. Imagine what it feels like to realize that you understand something that humanity has been searching for for thousands of years. The Greek philosopher Aristotle was already searching for what time exactly is before our era. Later, famous physicists such as Galileo, Isaac Newton and Albert Einstein followed. The feeling that came over me at that moment: “could I perhaps follow in the footsteps of these greats, and make a significant contribution to our understanding of reality, and even come a step closer to a so-called theory of everything”. Yes, that felt, and still feels, like an incredibly great adventure. An adventure that I had not even dared to dream of! And now, for me, a man of almost 60, but with an absolute age (core age) of only 17, it suddenly seemed to become reality.

I would like to share my fantastic adventure with everyone who reads this book. Because this is a complicated adventure (many people had and have difficulty with physics in high school), I will explain each step of this adventure in simple, understandable language, but without violating the truth.

And now: let’s start the adventure!



# INTRODUCTION

Black holes. Fascinating. They really appeal to the imagination of many people. They are a kind of magical object. But if you ask the average person In the street what a black hole is, you generally get nothing more than something like "things that swallow everything up" and similar answers.

Before we look at why black holes do not exist at all, it is important that we know what we are talking about. Because if we do not know exactly what we are talking about, it is of course impossible to say that something would not exist. So we are first going to look at what black holes are exactly according to current physics. Then we are going to use current physics to scientifically demonstrate that these black holes cannot be formed at all. Because, something that cannot be formed, obviously cannot exist as well. And we conclude with what is formed instead, and how that fits into the picture that we have of physics today.

## Mysterious objects that stimulate the imagination

For many people, black holes are mysterious, and sometimes even magical objects. All sorts of more or less exotic properties are attributed to them. For example, space and time are said to switch roles in a black hole (whatever that may mean). It is also claimed that black holes contain so-called wormholes, a kind of space tunnels through which you could travel to a completely different universe in the blink of an eye. This also gives rise to the idea of parallel universes, universes that exist in hidden dimensions and of which we are unaware. All these universes would then be part of the so-called multiverse, a kind of overarching super-universe.

In addition to being fascinating, black holes can also be seen as somewhat scary, frightening objects. They are also called vacuum cleaners of the universe, which irrevocably swallow everything that

Parallell universes

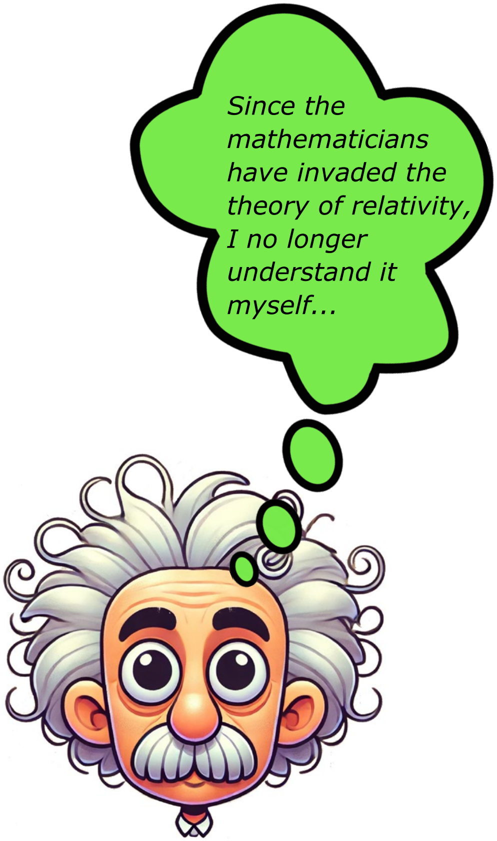
comes near them. A kind of monsters of the universe. Even light cannot escape the grasp of black holes. Well, then you know....

From this list it should become clear that black holes can strongly stimulate the imagination. And not only from laymen, but also from a great many physicists. They even suggest the existence of so-called white holes (which I will not go into here, because they also do not exist). A complete research discipline has emerged concerning black holes and related physical structures and phenomena.

## Mathematics and mathematical formulas

Before we continue, a quick word about mathematical formulas. The number of formulas in this book has been deliberately kept to a minimum. After all, wasn't it Albert Einstein himself who said in 1909 "*Since the mathematicians have invaded the theory of relativity, I no longer understand it myself*". However, in order to describe physical phenomena and processes, the use of mathematics is not only very easy and clear, it is simply necessary. Just as we do in everyday life. For example, if we want to paint a wall, we measure the length and width of that wall, then calculate the surface area using the formula "A = l x b", and thus know how many pots of paint we need (although for that you also need a simple formula).

Mathematics should play a similar supporting role in physics. However, over the past century, mathematics has taken a very prominent place in physics. I dare say that in a number of cases the role of mathematics has become too prominent, and that this has been at the expense of the understanding of the underlying physics. Often, mathematics does not seem to support physics, but stands more or less separate from the physics that it is supposed to describe. A good example in my opinion is the so-called string theory (see infobox on next page). I even dare to speak of the so-called overmathematicalisation of physics. I see this in several sub-areas of physics, including the aforementioned string theory, but also in Einstein's theory of relativity (which he himself also saw), and with




Albert Einstein (1879 – 1955)

regard to the supposed existence of black holes, the subject of this book.

As already mentioned, the number of formulas in this book has been limited to a minimum. And the few formulas that are included are all explained in understandable language, so that everyone can understand the essence of what these formulas describe.

## What exactly is a black hole

As already mentioned, most people have no idea what a black hole is. That is why we are going to explain it briefly but clearly below.

### Types of black holes

To start with, you have all types and kinds of black holes.

You can classify black holes according to their size or weight. For example, you have relatively small black holes, the so-called stellar black holes. These are about 5 to 10 times as heavy as our sun. They are said to have formed after heavy stars have burned up, after which they implode into a black hole. Then you have medium-sized black holes. And you have supermassive black holes. An example of this is the black hole that lies in the middle of our Milky Way, Sagittarius A*.

You can also classify black holes according to other characteristics, namely whether they rotate around their axis or not, and whether they are electrically charged or not. According to this classification, you have Schwarzschild black holes. These are the simplest black holes that exist. They do not rotate around their axis and are not electrically charged. Then you have Reissner-Nordström black holes. These do not rotate around their axis but are charged. Then you have Kerr black holes, which rotate around their axis, but have no charge. And finally, you have Kerr-Newman black holes, which both rotate around their axis and are electrically charged. In practice, it is thought that Schwarzschild and especially Kerr black holes are the most common in the universe. By the way, you can forget these

***String theory***

*String theory is a theory in physics that attempts to describe fundamental particles not as point-shaped, but as vibrating strings. The vibrational states of these strings determine the properties of particles, such as mass and charge. The theory requires additional spatial dimensions, 10 or 11 instead of the 4 we know (the three spatial dimensions, length, width and height, and the dimension of time), to describe reality as we know it and to get everything right. An important goal is to unify quantum mechanics and general relativity in a so-called theory of quantum gravity.*

*Although promising according to some, experimental evidence is lacking, and it is still unclear whether string theory actually describes the fundamental laws of nature.*

*It doesn't take much imagination to understand that if you have a lot of data (data points), you can draw a graph through it if you just add more and more dimensions to your formula. You can then ask yourself whether that final formula still says anything about reality as we experience it...*

**Infobox**

names right away, except for that of Schwarzschild, which will come up a lot in this book.

In this book, we will focus on the simplest black hole, the so-called Schwarzschild black hole. Although this type of black hole was not described or discovered by the German physicist and astronomer Karl Schwarzschild, it is thanks to him solving Einstein's mathematical formula that describes the general theory of relativity that this simple type of black hole could be described.

## What does a black hole look like

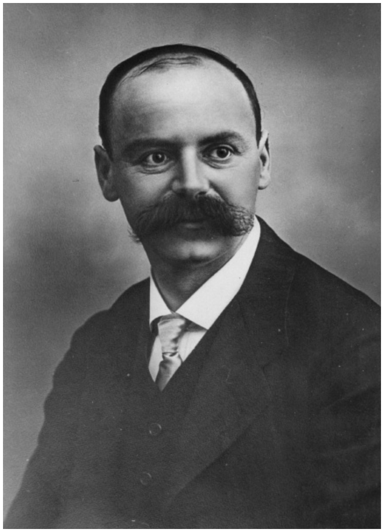
Now we are going to look at what the simplest black hole looks like. This Schwarzschild black hole appears to consist of only a few parts, as can be seen on the right.

The drawing shows the simplest black hole. This Schwarzschild black hole is a simple spherical, non-rotating, uncharged black hole. It consists of an incredibly small point in the middle (with a difficult word: singularity) (1), surrounded by an empty space (2), and enveloped by a so-called spherical event horizon (3). Outside the event horizon is the also spherical photon sphere (4). And finally, there can also be a so-called accretion disk around a black hole (not shown in the drawing).

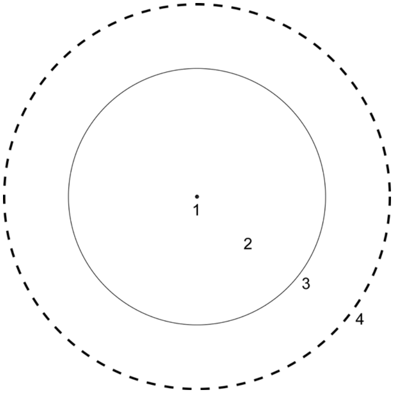
We are now going to discuss these parts separately so that everything becomes a bit clearer.

## Central point (singularity)

As mentioned above, a black hole is created when a star that has burned out (because the fuel has run out) collapses under its own weight. The gravity that matter exerts on each other pulls everything together. Obviously, because of this collapse, the mass of the burned out star comes closer together. When this mass comes closer together, the gravity becomes stronger again so that everything comes closer together even faster. The process of this implosion, because that is what it is of course, reinforces itself. So you get that the collapse of the burned out star goes faster and faster. And according to the mathematical formulas, this continues indefinitely,



Karl Schwarzschild (1873 – 1916)




Schwarzschild zwart gat

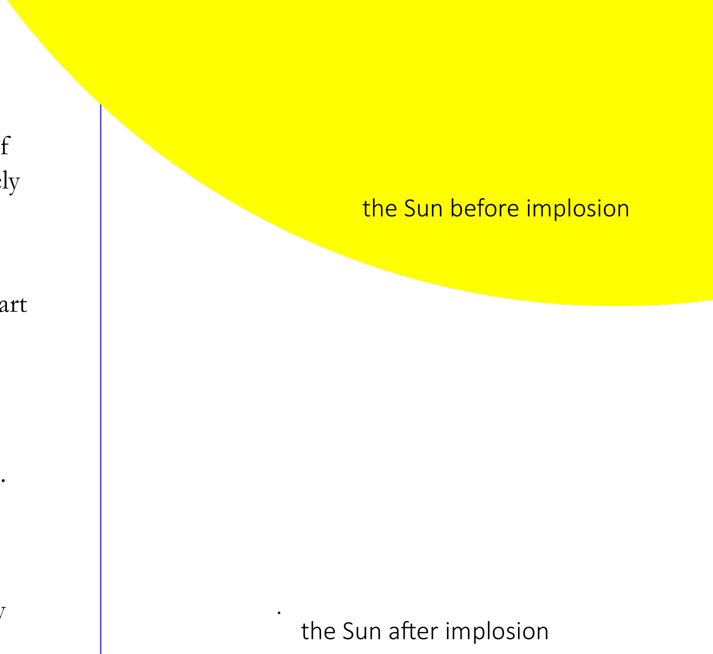
until you get a point that is infinitely small, in which all the mass of the burned out star would be located. Because this point is infinitely small according to the underlying mathematics, this point is not drawn to scale (because you simply would not be able to see it).

To give you a little idea of how small that point is, you can see a part of the Sun depicted on the right (a small piece with a gentle curve) and what ultimately remains after the sun has burned up and imploded, although I must honestly admit that this is also not to scale. In reality, the Sun, which has a diameter of 1.4 million km, would implode into a black hole with a diameter of less than 6 km. And the Earth, with a diameter of a little over 12,000 km, would implode into a black hole of less than 2 cm in diameter. And note that those 6 km and 2 cm are the diameters of the much larger observation horizon. The central small point is even immeasurably smaller. It would be so small that we as humans simply cannot understand this.

Later it will become clear that it is not necessary to understand this, because these singularities (as these infinitely small points are called with a difficult word), just like black holes, do not exist at all. And by the way, for the sake of completeness I would like to mention that according to current models, neither the Sun nor the Earth would be able to implode into a black hole, because they simply do not have enough mass to do so. The process of the self-reinforcing implosion, as described above, would stop for less heavy celestial bodies (such as the Sun) before a black hole could be formed, or the process would not even start at all (as with our Earth). The self-reinforcing process of collapse would have too little mass to form a singularity in which the collapse could continue to an infinitely small point.

## Empty space

Because everything that a heavy star originally consisted of is in that one incredibly small point, there is a very large, completely empty space around that small point. According to current physical principles, a black hole consists mainly of empty space around the central point, which would contain all the mass of the black hole. Incidentally, the fact that a black hole consists mainly of empty space



is the reason why we talk about black *holes*. Black holes are literally holes in space.

## Event horizon

Now we come to perhaps the most difficult, but also the most interesting part of a black hole, namely the so-called event horizon. This is a very special physical phenomenon, which is actually (again) incomprehensible. And because this is incomprehensible, it also leads to most problems in black hole research. For example, that incredibly small central point would contain all the mass of a black hole according to physicists. Nevertheless, it is not that small point, but the event horizon that is generally seen as the boundary of a black hole.

So yes, what is the event horizon? In short, you can see the event horizon as a dead-end road where you are not allowed to turn around, or better said, you cannot turn around. This is nicely illustrated in the picture on the right. As soon as you drive into this street, which is allowed according to the signs, you will never get out again. After all, you are only allowed to drive in one direction (according to the bottom blue sign), and it is a dead-end road (according to the top blue sign)....

Another comparison concerns that of a river with a waterfall. The closer you get to the waterfall, the faster the water flows and the more difficult it becomes to turn around and row away from the waterfall. But as soon as you have crossed the edge of the waterfall, there is really no way back, and you will inevitably fall down. The edge of the waterfall can therefore be seen as a kind of event horizon, after which there is also no way back.

Finally, one more comparison. For those who know a bit more about electrical engineering, we can use the analogy of a diode. This is a semiconductor where current can only flow in one direction, which is also similar to how an event horizon is supposed to function.

In addition to the one-way path that the event horizon is supposed to form, there is another aspect of the event horizon that is essential to our story. And that is that time stands still on the event horizon,

### ***Dual nature of light***

*On the left it is described that light consists of particles, called photons. However, this is not entirely correct, as light can also be seen as a wave.*

*That's strange, because what is it now? Is light made up of particles, or of waves?*

*Well, both. Or in other words, we don't know exactly. What we do know is that in some physics experiments, light behaves as if it were made up of particles. And in other experiments, light seems to consist of waves.*

*Quantum mechanics has been set up to explain this so-called duality of light.*

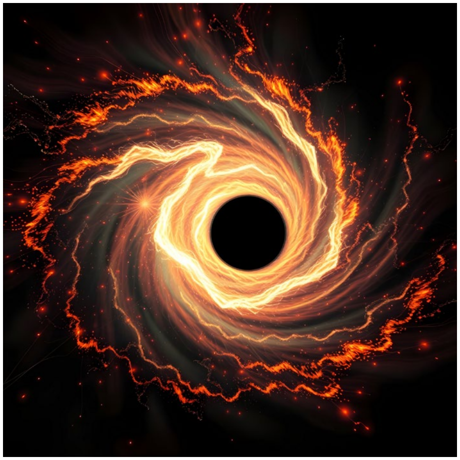
**Infobox**

because of the enormous gravitational fields that are present there. This sounds fascinating, and it is also the reason I delved into this whole black hole story. For now, it is just important to remember that time stands still on the event horizon.

### Photon sphere

The photon sphere is part of a black hole, or at least part of the physics that is supposed to describe what happens in and around black holes.

Perhaps we should first explain what a photon is. That is quite simple, because it is a so-called light particle. Without going into it in depth, you can see light as a stream of particles, just like everything around us, including ourselves, also consists of particles. We and all matter around us consist of atoms, which can form molecules. For example, water consists of particles, the so-called water molecules. And such a water molecule consists of one oxygen atom and two hydrogen atoms. And in a similar way, light also consists of particles, but not atoms that can form molecules, but photons that we perceive as light (or as heat, or as radio waves, or X-rays or microwave radiation). The big difference between atoms and molecules on the one hand, and photons on the other, is that you can build things with the first, and not with the second. It's that simple.



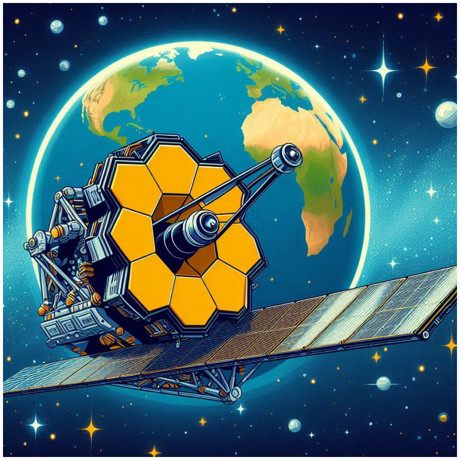
Impression of light within the photon sphere

Now, back to our photon sphere. That's the area where photons can orbit a black hole, just like satellites around the Earth. But as soon as a light particle crosses that photon sphere, it will start to orbit ever smaller circles, and eventually be irrevocably swallowed by the black hole (as can be seen nicely in the picture).

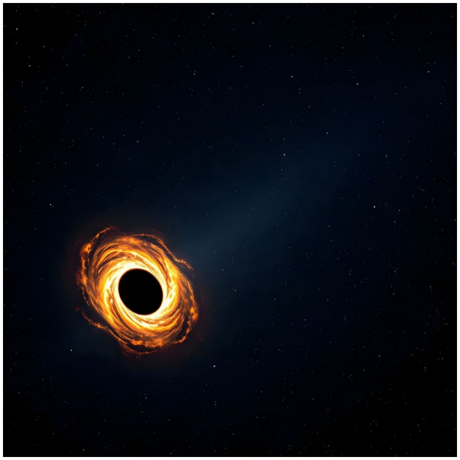
Why is this relevant, you might think. Well, that has to do with the fact that a black hole is called a *black* hole. The fact that a black hole is black is because it is assumed that a black hole does not emit any light, like a star does, for example. That is why we can see an incredible number of stars with sensitive telescopes (think for example of the recently launched James Webb telescope (the successor to the famous Hubble telescope, also a telescope that floats in space)). On the other hand, we cannot see a single black hole. Yes, you may think now, but I have actually seen that photos have been taken of black holes. I will come back to that directly below.

## Accretion disk

An accretion disk is a part of a black hole (or of another celestial body that has a very high density, such as a white dwarf or neutron star). This disk is a rotating, flat structure of gas, dust and other material that is collected around a massive object, such as a star or black hole. This happens under the influence of the gravity of the celestial body. The material in the disk moves in a spiral path towards the central object. Because the friction between the particles in the disk can make the material extremely hot, the disk can emit light. And it is that light that has been photographed. So technically speaking, no pictures have been taken of a black hole, but only of matter that is rotating around it. And finally I will explain to you that black holes do not exist at all, and that the things that have been taken of these images are therefore not black holes either.



The James Webb Space Telescope



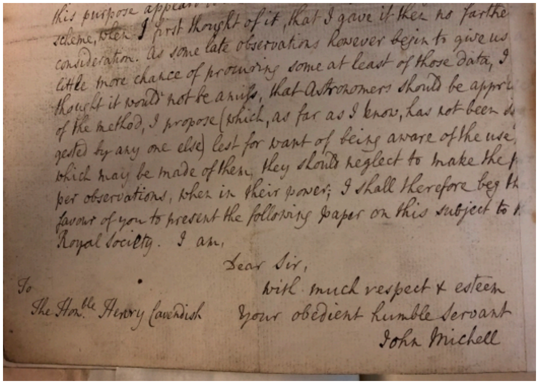
Impression of an accretion disk

# A LITTLE BIT OF HISTORY

In this chapter we will look at how scientists came to the conclusion that such a thing as black holes exist. We will do this by means of a number of pioneers who contributed to this.

## John Michell (1783) and Pierre-Simon Laplace (1796)

The first description of a black hole is generally attributed to the Englishman John Michell in his letter of May 26, 1783 to Henry Cavendish. Using classical mechanics (the mechanics of Isaac Newton), Michell described the theoretical possibility that there could be objects so massive that even light could not escape their enormous gravitational field. In 1796, the Frenchman Pierre-Simon Laplace, allegedly independent of Michell, described the same idea and called these celestial bodies "corps obsurs", translated as "dark bodies" or "dark stars". Interestingly, Laplace predicted at that time that these celestial bodies would become the most important objects of future astronomy....



this purpose
scheme, when I first thought of it, that I gave it then no farthe
consideration. As some late observations however begin to give us
little more chance of procuring some at least of those data, I
thought it would not be amiss, that Astronomers should be appri
of the method, I propose (which, as far as I know, has not been s
gested by any one else) lest for want of being aware of the use
which may be made of them, they should neglect to make the p
per observations, when in their power; I shall therefore beg th
favour of you to present the following paper on this subject to t
Royal Society. I am,
Dear Sir,
with much respect & esteem
Your obedient humble Servant
John Michell
To
The Honble Henry Cavendish

Einde van de brief van Michell aan Cavendisch

## Albert Einstein (1915)

The name Albert Einstein has already been mentioned a few times in this book. Now we are going to look at what is considered to be his most important contribution to physics, and that is of course the general theory of relativity. This is an incredibly complicated theory. But despite that, the essence of this theory can be explained in a few sentences. Together with the special theory of relativity, this theory formed a revolution in thinking about reality. Whereas previously Isaac Newton's physics was considered leading for centuries, Einstein's general theory of relativity, together with quantum mechanics, form the two pillars on which contemporary physics is based.

The general theory of relativity is primarily a theory that describes how gravity arises, and states that this is not a real force such as, for instance, the attraction between positively and negatively charged particles (which is why a compass magnet always points to the north). According to the general theory of relativity, the space around us, which consists of three dimensions (length, width and height), together with time (which is seen as a fourth dimension), forms the so-called spacetime.

That sounds complicated and you probably can't really imagine what spacetime is. Because what does that mean? And what is space, and what is time? And how can I imagine that they together form a structure called spacetime? Well, you're in good company, because no one can imagine that (yes, really). The idea was not originally conceived by Einstein, but by his mathematics professor, Hermann Minkowski (who, by the way, thought Einstein was just a lazy student). Einstein didn't want to know anything about it at first (see his statement on p. 16), precisely because it was incomprehensible. Later he had to start working with it anyway, because otherwise he couldn't get his theory of relativity right.

Impressie van de ruimtetijd

In the mathematical model that general relativity actually is, four-dimensional spacetime is distorted by heavy objects such as the Moon, the Earth, the Sun, and particularly black holes. Ultimately all mass distorts spacetime, only spacetime is hardly distorted by, for example, your mass, or the mass of your coffee mug. And that distortion creates what we experience as gravity, which causes things to fall to the ground (i.e. are attracted to the Earth), but also causes the Earth to revolve around the Sun.

For our story about black holes, a specific part of the general theory of relativity is important, and that is that heavy masses such as the Earth and the Sun, but especially black holes, slow down time. This means that the closer you are to a heavy mass, the slower your time passes. You can imagine that as a movie that is played in slow motion. That this is really the case has been demonstrated with very precise clocks, so-called atomic clocks. These atomic clocks are so precise that if you have two of the same clocks, and put them next to each other on a table, but one on a book of, say, one inch high, the

clock on the book runs faster than the other, because the clock on the book is just a little further away from the gravitational pull of the Earth than the other atomic clock. And so for someone who lives on a mountain, time also passes faster than for someone who lives in the valley. This so-called gravitational time dilation did not sound very credible at the time Einstein made this theory known to the world, but all kinds of experiments have convincingly shown that this really does happen.

Although this may all sound quite complicated, I have to add something that sounds even more unbelievable. Because gravitational time dilation always occurs together with gravitational stretching. This means that if time is slowed down by a large mass, the space in which this happens stretches. In other words, the distances become larger. And here again, no one can imagine how all this works. You have to see it more as a mathematical thing with which you can calculate physical phenomena and measurements. The general theory of relativity is therefore a so-called black box theory. You put something in (numbers), and you get something out (again numbers). The theory works great, but unfortunately it does not provide any insight into how all this works physically.

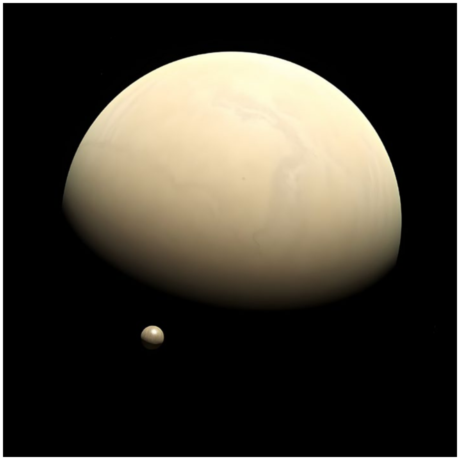
The foundation of the general theory of relativity is formed by the so-called field equations of Einstein, formulas that underlie Einstein's general theory of relativity. These are incredibly complicated formulas that even Einstein himself could not solve exactly. He therefore thought that they could not be solved exactly.

He could certainly not have imagined at the time that the scientific search for the possible existence of black holes, which had indeed already begun at the end of the 18th century, would only receive a serious boost through the discovery of the general theory of relativity. In fact, he himself did not believe in black holes at all, as you can read below.

## Karl Schwarzschild (1915)

Einstein thought that his complicated field equations could not be solved exactly, but he had not counted on the extremely skilled mathematical and physical qualities of the German physicist and astronomer Karl Schwarzschild. At the time, Schwarzschild was director of the astronomical observatory in Potsdam, and at the same time served with the German artillery during World War I, where he calculated artillery trajectories. And only a few weeks after Einstein published his field equations, Schwarzschild had already found an exact solution in his sparse free time on the Russian front.

Schwarzschild solved the Einstein field equations for a relatively simple situation, namely for a non-rotating, uncharged, spherical celestial body that is approached by an object. This solution would prove to be extremely important for the rest of the history of black holes, but also for that of general relativity, as will become clear later in this story.



## Albert Einstein (1939)

In 1939, Einstein published a paper specifically investigating whether Schwarzschild's solution could lead to gravitational collapse and the concept of singularities. Gravitational collapse refers to the fact that a star that has burned out is increasingly compressed by the gravity of the mass that the star possesses, until an infinitely small point remains. Yes, that is the same point that would form the centre of a black hole (as explained above). And with a fancy word that small point is called a 'singularity'.

Remarkably, Einstein concluded in his paper that Schwarzschild singularities (those infinitely small points) and therefore black holes cannot actually arise, and therefore cannot exist. A central part of this conclusion was his argument that time stops at the event horizon, which essentially prevents total collapse from occurring, because the event horizon cannot be reached. After all, at a place where time stands still, no movement can take place. And if something moves, time cannot stand still, of course.

understand well (so I do not have to explain this term here)). But the further away the spaceship flies, the smaller the influence of the Earth becomes. So the greater the distance, the smaller the force of gravity.

## What are coordinate systems

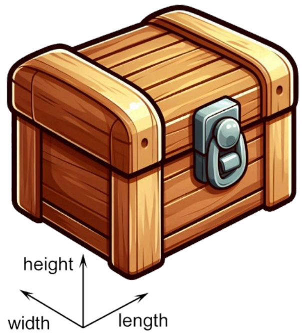
Coordinate systems. That sounds complicated. However, it is less complicated than it sounds, and everyone uses coordinate systems in one way or another, often without even realizing it.

Simply put, a coordinate system is a mathematical way to indicate positions of objects in a space, so that you can determine the distance to such an object and, for example, its dimensions.


Think, for example, of a treasure map. And that this treasure map describes where a treasure is located (obviously!). It says, for example, that you have to walk 100 paces from the jetty to the waterfall, and then turn right just before the palm tree, then 30 paces further to the left and look up in front of the rock that looks like a skull. There in a niche in the rock face, at a height of three men, lies the treasure. What is described here is a cumbersome way to indicate a certain position. Nowadays, fortunately, that is a lot easier with GPS coordinates of your navigation system on your phone.

The coordinate system used on the treasure map is rather unclear, and not the same for everyone, because your stride length will not be exactly the same as mine, for example. That is why scientists have come up with ways to clearly indicate a position in space. Two of these systems are actually familiar to everyone, and these are briefly discussed below because they are important for understanding the story that follows.

<u>The Cartesian coordinate system</u>




To understand this coordinate system, think of a box. It has a length, width and height. This is called the Cartesian coordinate system in a fancy word. It is named after the Frenchman <u>René Descartes</u>, who invented this system. Descartes (Cartesius in Latin, that was common in science at the time) was a mathematician and philosopher from France, who lived in the Netherlands for a long time, and is also known as the father of modern philosophy. You may know one of his famous statements: "*I think, therefore I am*".

The Cartesian coordinate system is based on three axes that are perpendicular to each other, with a measurement next to them (for example centimeters, meters, or inches). These three axes represent the length, width and height of the aforementioned box. With these three coordinates, which start from a so-called origin (the starting point of measurements), you can indicate all positions in space. And that is not limited to Earth, but in this way you can also indicate where the Moon is, or the Sun. The attentive reader will probably think that the Moon and the Sun move (and of course the Earth too), which means that you need a fourth coordinate, time. In this way you finally have a complete coordinate system, of the so-called spacetime of Einstein (but which was actually invented in 1908 by his mathematics professor, the rather underrated Hermann Minkowski).

Hermann Minkowski (1864 – 1909)

The polar coordinate system

To understand this coordinate system, think of a globe. A globe has so-called longitudes and latitudes. In the past, explorers could use this to determine their position and thus know where they were, even when they were on the high seas. This coordinate system is based on the prime meridian, the longitude that runs across the observatory in the village of Greenwich in England. If you walk north across this prime meridian, the meridian at the North Pole suddenly changes from 0 degrees to 180 degrees (see picture on next page showing a bird's-eye view of the North pole), and you simply continue walking across the 180 degree meridian on the "back" of the Earth. Incidentally, you do not notice this transition yourself. You simply continue walking along the "back" of the Earth to Siberia. This is therefore purely a theoretical transition; a transition in the system that we humans have devised to indicate positions on Earth (so that, among other things, our navigation systems work properly).


Globe with longitudes and latitudes

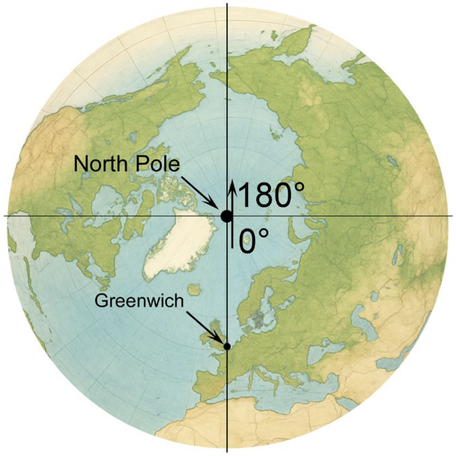
In addition to longitudes that run from the North to the South Pole, there are also latitudes that are perpendicular to them and therefore run from west to east. The best-known latitude is undoubtedly the equator, which runs across the middle of the Earth. And some of you may remember the Tropics of Cancer and Capricorn from geography lessons, the extreme latitudes where the Sun is exactly above the Earth's surface once a year.

The longitudes and latitudes are expressed in degrees. If you walk around the Earth on the equator, you have covered 360 degrees (one whole circle), just like if you walk from the North to the South Pole, for example by walking over the previously mentioned prime meridian, and back via the 180 degree meridian.

As mentioned, if you move around the Earth by walking over the prime meridian ($0^0$), you will notice that it suddenly changes into the $180^0$ meridian at the North and South Poles. These kinds of sudden transitions often cause problems in mathematical formulas. Such a sudden transition is also called a singularity or infinity. For example, the famous physicist Stephen Hawking is said to have once asked "What is north of the North Pole?". We all know that this is a nonsense question, but it does illustrate a bit of how mathematics deals with these problems (or not...).

Problems in these kinds of situations have led to ambiguities about the question of whether or not black holes really exist, as will be explained later in this book.

In order to be able to indicate all positions in the three-dimensional space in the polar coordinate system, you also need the radius in addition to latitudes and longitudes (see picture on the next page). The radius of a sphere is the distance from the centre of the sphere to the surface (which is half the diameter of a sphere). Realize that with only the latitude and longitude, so without the radius, you can indicate all positions on the surface of a sphere, but nothing inside or outside of it. And if you add a radius to your coordinates, you can make spheres of any size. For example, by taking the radius of the Moon, you can indicate all positions on the surface of the Moon. And of course you can also indicate positions that are not on an

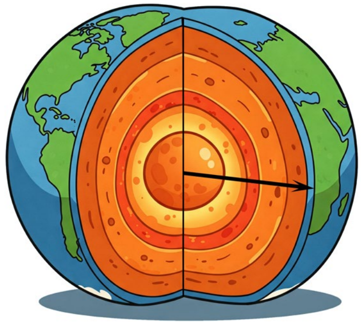



Transition from $0^0$ to $180^0$ meridian

Stephen Hawking (1942 – 2018)

actual surface, such as the surface of the Earth or Moon, by choosing a radius larger or smaller than the radius of the Earth or the Moon. In this way, you can indicate all positions in our three-dimensional space with this polar coordinate system, just like with the Cartesian coordinate system.

Now you might wonder why we use the polar coordinate system if it has disadvantages in mathematics, and not just always use the Cartesian coordinate system. Well, because the polar coordinate system also has certain advantages in mathematics. A very important advantage occurs if you want to study physical processes or phenomena that take place around a symmetrical sphere. It does not matter from which position you approach this sphere, the only thing that matters is the distance to this sphere. This means that instead of needing three coordinates in the Cartesian coordinate system (length, width, and height), but also in the full polar coordinate system (latitude and longitude, and also the radius), you can leave out two coordinates (the latitude and longitude in the polar coordinate system), and only need the distance to the sphere (the coordinate "r" of radius)) to describe and investigate certain processes that occur in a spherical symmetrical way.



Globe with radius (arrow)

Take for example a lamp that emits the same amount of light in all directions (for example as a model to imitate a star emitting light). Then it does not matter from which position you approach the lamp. The only thing that matters is the distance to the lamp. Whether you approach the lamp from the front, the side, the top, the bottom (of course not in the picture, because the lamp holder at the bottom is blocking the light) or from the back, the light intensity you measure is the same everywhere, and only depends on the distance, and not on the direction. If you get closer to the lamp, regardless of the direction from which you come, you will measure a higher light intensity. The light intensity of a lamp that emits the same amount of light in all directions therefore only depends on the distance to the lamp (the radius "r"). You will understand that by using only one coordinate instead of three, the mathematics to describe a process becomes much simpler (and besides, many mathematical calculations are not even possible with all the coordinates).

## Infinities

Another vague concept, you might think. But just like with coordinate systems, you will have heard of this in practice.

Simply put, infinity means, yes indeed, that something is infinite, so it never ends. When you were sitting in the dentist's chair, you may have thought that it lasted forever. Fortunately, that turned out not to be the case.

In mathematics and physics, infinities exist in various forms. The best known is undoubtedly that if you start counting, 1, 2, 3, 4, 5, 6, etc., you can continue counting indefinitely. There is simply no largest number. We also have a symbol for that, the infinity symbol ∞, which people sometimes have tattooed on their bodies.

In addition to this simple infinity, there are all kinds of other infinities. For our story, there are two infinities that are important, the so-called progressive infinity, and the regressive infinity. Let me explain these difficult terms using simple everyday examples that you may have heard of before, so that you can get an idea of what they mean..

### Progressive infinities

A progressive infinity can be compared to when you eat something and each subsequent bite is twice as big as the previous one. Before you know it, you would have a bite that not only does not fit in your mouth, but also does not fit in a truck, for example, or even in a swimming pool. One of the most famous examples of a progressive infinity is described in the story of King Midas. He wanted to reward an inventor. The inventor asked for the number of grains of rice that were needed to double the number of grains of rice that he wanted to give to the inventor on each subsequent square of a chessboard (the series: 1, 2, 4, 8, 16, 32 etc.). If you calculate this, you will see that this meant that he would have to fill more than half a million (!) football stadiums such as the Wembley Stadium with grains of rice, an impossible task that nicely demonstrates the power of the progressive infinity, also known as exponential growth.

In mathematical terms, a progressive infinity is a self-reinforcing infinity, meaning that an increase causes an even greater increase, which in turn causes an even greater increase, or exponential increase. Many may remember this concept from the corona pandemic, where 1 virus becomes 2 viruses, which then become 4 viruses, which then become 8, which then become 16, which then become 32, 64, 128, 256, 512, 1024, et cetera.

Regressive infinities

A regressive infinity is the exact opposite of a progressive infinity. When eating bites, this would mean that each subsequent bite is half the size of the previous bite. Before you know it, your next bite has become so small that you can't even see it anymore. And realize that if you do this, you will never take in more than the amount of two original bites. You won't even take in two bites, because 1 + 1/2 + 1/4 + 1/8 + 1/16... is always (just) a little smaller than 2 (do the math)! The most famous example of a regressive infinity is undoubtedly the story of the tortoise and the hare, in which the hare could never catch up with the tortoise in one of the most famous paradoxes of Zeno, an ancient Greek philosopher. This story of Zeno, also known as Zen's paradox of Achilles and the Tortoise, is explained in the infobox.

In this paradox, the essence of a regressive infinity becomes clearly visible, namely that despite the fact that you take innumerable or infinite steps (which are always halved), you can never reach your goal. The infinity of the regressive infinity is therefore not in the end point that seems infinitely far away (but is not), but in the number of steps needed to get to that end point. That number of steps is infinitely large, after which you still have not reached the goal because your step length keeps getting smaller and smaller and smaller.

In reality, of course, you don't take smaller steps, so you can never take two whole steps. You have (approximately) the same step length every time. And in reality, the hare quickly overtakes the tortoise. The fallacy in the paradox is that it zooms in on an increasingly

***Zeno's paradox***

*Suppose a fast hare is racing a slow tortoise. Because the hare is much faster, the tortoise gets a head start, say 10 meters.*

*The philosopher Zeno reasons as follows:*

*1. When the hare starts running, it must first cover the 10 meters to the tortoise's place.*

*2. By the time it gets there, however, the tortoise has crawled a little further.*

*3. Now the hare must catch up with that new distance, but again the tortoise will advance a little bit in the meantime.*

*4. This process keeps repeating itself: every time the hare reaches a previous position of the tortoise, the tortoise has already advanced a little bit.*

*According to this reasoning, which nicely captures the essence of a regressive infinity, the hare never seems to catch up with the tortoise completely, because there is always a new bit of distance to cover, no matter how small..*

**Infobox**

smaller part of the movement, and therefore also on an increasingly smaller part of time. You can see this clearly in the example of the increasingly smaller bites, so you never arrive at two original bites. In the case of Zeno's paradox, you zoom in on increasingly smaller pieces of distance, with the associated increasingly shorter time period. In reality, of course, time simply continues.

You may not see the relationship between these stories and black holes at this moment. But what all this means for black holes will be explained later on.

# BOOK TIPS

Below are some book tips for each level of difficulty (although that is of course subjective) for people who have become interested and would like to read more about these kinds of subjects.

Realize that the books listed below all (still) assume the existence of black holes. Although you are presented with various arguments in these books that would confirm the supposed existence of black holes, you have been able to read in this book that some inaccuracies have crept in, and that there are very convincing arguments that show that these enchanting celestial bodies, which defy the laws of nature, really belong in the realm of fables.

Finally, this is only a very small, and certainly not objective selection. So dive into the bookstore yourself and scour the shelves for interesting books!

Easy

Hart-Davis, Adam. *The book of time*, London, UK: Octopus Publishing Group Ltd, 2011

Hawking, Stephen. *Brief answers to the big questions*. Cambridge, UK: Spacetime Publications Ltd, 2018

Smethurst, Becky. *A brief history of black holes and why nearly everything you know about them is wrong*. London, UK: Pan Books, 2022

Gubser, Steven S. and Pretorius, Frans. *The Little Book of Black Holes*. Princeton (NJ), US: Princeton University Press, 2017

Average

Cox, Brian and Forshaw, Jeff. *Black holes*. London, UK: William Collins, 2022

Darling, David. *Gravity's Arc. The story of gravity, from Aristotle to Einstein and beyond*. Hoboken (NJ), US: John Wiley & Sons, Inc., 2006

Harrison, Edward Robert. *Cosmology. The science of the universe*. 2nd ed. Cambridge, UK: Cambridge University Press, 2012

Hawking, Stephen and Mlodinow, Leonard. *A briefer history of time*. New York (NY), US: Bantam Dell, 2005

Rezzolla, Luciano. *The Irresistible Attraction of Gravity: A Journey to Discover Black Holes*. Cambridge, UK: Cambridge University Press, 2023

<u>Challenging</u>

Carroll, Sean M. *Spacetime and geometry: An introduction to general relativity*. Cambridge, UK: Cambridge University Press, 2019

Carroll, Sean M. *The biggest ideas in the universe. Space, time, and motion*. New York, NY, US: DUTTON (Penguin Random House LLC), 2022

Davies, Paul. *About time. Einstein's unfinished revolution*. New York, NY, US: Simon & Schuster Paperbacks, 1995

D'Iverno, Ray, Vickers, James. *Introducing Einsteins relativity - A Deeper Understanding*. 2nd ed. Oxford, UK: Oxford University Press, 2022

Greene, Brian. *The elegant universe. Superstrings, hidden dimensions, and the quest for the ultimate theory*. London, UK: Vintage, 1999

Misner, Charles W., Thorne, Kip S., Wheeler, John A. *Gravitation*. Princeton, NJ, US: Princeton University Press, 2017

# ABOUT THE AUTHOR

Peter Damen (13-6-1965; subjective age: 17 years) was born in Goirle, near Tilburg (The Netherlands), where he has lived (almost) his entire life.

After completing primary school, he started VWO (atheneum B) at the St. Odulphuslyceum in Tilburg in 1977. After completing this cum laude, he started studying biology, specializing in medical biology, at Utrecht University (The Netherlands). He also completed this study cum laude, after which he conducted PhD research at the same university in the field of developmental biology. This resulted in the dissertation entitled "*Cell-lineage, and specification of developmental fate and dorsoventral organization in the mollusc Patella vulgata*" in 1994, in which Damen describes aspects of the early development of a snail species. He then briefly went to the United Kingdom, where he conducted research at University College London on the development of Schwann cells (a specific type of cell found in the nervous system).

Damen has a broad range of interests, which has led to various career paths, including in pharmaceutical services (IPC-Holland), karate (Enso Karate-do), photography (Red Eye Photography) and as a tutor (Exact op weg).

Since the end of 2021, Damen has been passionately, and according to some even somewhat obsessively, trying to understand the physics of time and everything that goes with it (see also the chapter "My challenges"). In this book, the first result of this is explained in simple language for interested readers who do not have specific knowledge of physics.

Damen has felt 17 years old all his life and thinks that this young absolute age has contributed significantly to his drive to investigate and understand all this.

Black holes capture the imagination — mysterious cosmic phenomena that supposedly devour everything in their vicinity like an insatiable galactic vortex. Or perhaps even portals to an unknown reality, where time and space are distorted in unimaginable ways, as often suggested in films such as Interstellar. But what if everything we think we know about black holes is wrong?

In this richly illustrated and accessible book, the author takes you on a surprising scientific journey of discovery. Based on ground-breaking research from 2024, he shows why black holes — as we know them — cannot exist. Step into the world of modern physics and discover how the limits of our understanding of space and time are really formed.

Are you ready to change the way you see the universe forever?

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*My name is Peter Damen (1965) and I have been fascinated by time and its mysteries all my life. Black holes have long been considered exotic celestial bodies that freeze time — an idea that intrigued me, but also raised questions. How could this be consistent with Einstein's special and general theories of relativity?*

*Driven by this paradox, I delved deeply into the physics behind black holes. What I discovered was both unexpected and disconcerting: black holes simply cannot form and therefore do not exist.*

*In this book, I take you along on my scientific quest — a journey full of surprises that challenges not only our view of black holes, but also the foundations of space and time.*