

# Is there really a cosmic background radiation?

What is measured may be a property of the dark energy, in particular the cosmic foreground radiation!

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# Introduction

Will we ever know for sure how the universe with all its stars and planets came into being? Perhaps not, but the big bang theory currently offers the most plausible explanation for the beginning of time and space, says science.

Why is that?

[1]

Because there is additional evidence. And that evidence came from two scientists. Arno Penzias and Robert Wilson worked at Bell Labs on radio communication via reflection from balloons. They had built a huge antenna to communicate over long distances. In the signal they received with this antenna, they observed a 'disturbance' with wavelengths in the microwave range. It turned out that this signal came from all directions in the sky. They were unable to explain where the signal came from, but it seemed to come from deep in space. They found the explanation by sheer luck. Penzias called the theoretical astronomer Robert Dicke who happened to be working on calculations on the 'first light' after the big bang. Assuming a big bang, Dicke had calculated that there must still be radiation corresponding to a very low temperature. That fitted the measurements exactly. Dicke concluded that they had found convincing evidence for the big bang! That radiation was later called cosmic microwave background radiation.

The purpose of this booklet is to express my doubts about the background radiation and if there were any truth in it, this could be a start to tackle and perhaps partly solve the known problems in cosmology.

## Description of the big bang theory

[2] [3] [4] [5]

The **big bang** occurred 13.8 billion years ago and lasted only a fraction of a second, but had enormous consequences. The Belgian priest and astronomer Georges Lemaître was the founder of the big bang theory. In the 1920s, he came up with the idea that the entire universe once originated from a small particle (primeval atom). Around the same time, the American Edwin Hubble discovered that other galaxies are moving away from our galaxy, the Milky Way, in all directions. This made Lemaître's big bang theory a lot more plausible. Because if all galaxies are moving further and further apart, then they were once a lot closer together.

Extrapolation of the expansion of the universe back in time using Einstein's general theory of relativity leads to an infinite density and temperature at a finite point in the past. This is a **singularity**, a point in space-time where the laws of nature lose their validity.

According to the big bang theory, the entire universe therefore originated from a very small point that came close to a singularity. This was probably not a real singularity.

The universe originated via a big bang. The term 'big bang' was first used by Fred Hoyle in 1950 as a derogatory term to express his aversion to the theory. Hoyle himself was an advocate of the competing but now abandoned steady-state model (The steady-state theory is a cosmological theory that states that the universe has always been there and will always continue to expand).

There is much debate about how close we can extrapolate to the singularity, but certainly no closer than the end of the Planck era, about  $10^{-43}$  seconds after the universe came into being.

How far back in time can we look?

The furthest back in time that we can currently see actively is **13.798 ± 0.037 billion years – 379,000 years**. The 13.798 billion years is the current best estimate of the time to the big bang, and 379,000 years is the number of years after the big bang that the universe would have cooled down enough to become transparent. The universe was opaque during those first 379,000 years, filled with a plasma of several thousand degrees Kelvin. One property of a plasma is that it does not allow light to pass through it: every photon is captured by the plasma after a short time and converted into heat.

What happened after the big bang? [4]

Many cosmologists believe that the structure of the universe is the result of **quantum fluctuations**, fluctuations of energy in empty space, that occurred during the very beginning of the universe and its early expansion.

In the very early stages of the universe, the average energy of the universe was so high that none of the elementary particles could form (quarks, electrons, neutrinos, gluons, photons, ...). Even the four fundamental forces of nature (gravitational force, strong and weak nuclear force and electromagnetic force) were united in a combined primordial force. When this newborn universe began to expand and cool down, the fundamental forces began to separate and the universe went through a very sudden and rapid expansion of the space-time structure called **cosmic inflation**. The entire

universe was, as it were, 'inflated' at an enormous speed in an early stage of its existence, so fast that it grew many powers of ten in a tiny fraction of a second. In physical cosmology, cosmic inflation is a theory of exponential expansion of space in the early universe. The inflationary period is believed to have lasted from  $10^{-36}$  seconds to  $10^{-33}$  to  $10^{-32}$  seconds after the big bang. After the inflationary period, the universe continued to expand, but at a slower rate.

Then, in the still extremely hot plasma, quarks, gluons, high-energy photons, electrons, ... began to form and this subsequently led to the creation of baryons (such as protons and neutrons, each consisting of three quarks). In the next phase, the synthesis of nuclei of light elements (such as hydrogen, deuterium, helium, ...) took place and is called **nucleosynthesis**. Since most deuterium nuclei quickly fuse into helium-4 nuclei (two protons and two neutrons), the resulting matter of the universe at the end of this phase consisted of about 75% hydrogen nuclei and 25% helium nuclei.

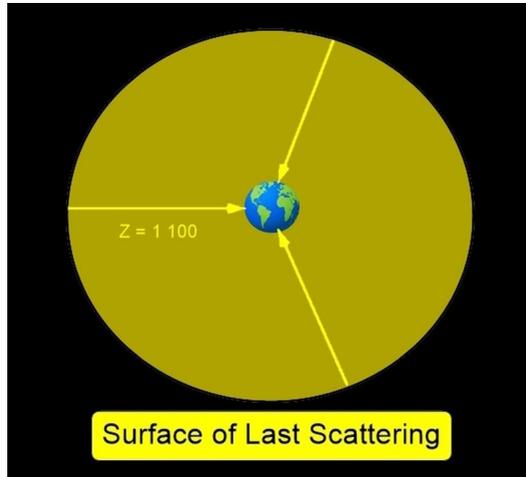
After about 380,000 years, the universe had cooled down to about 3,000 degrees Kelvin and free electrons and nuclei began to bind together to form the first neutral atoms. This is called the era of **recombination**.

During the pre-recombination phase, the universe was opaque. Photons (light) were tightly bound and in thermal equilibrium with the ionized matter, they constantly interacted with charged particles. This is comparable to light that originates in the core of the sun. It takes thousands of years to reach the surface of the sun and escape. This takes so much time because of the constant collisions with the freely moving charged particles in the sun.

During recombination, the photons were for the first time decoupled (**photon decoupling**) from matter and the universe became transparent. However, in the beginning there were still collisions between particles: photons collided with other particles, because the density of the universe was high.

The photons then started to move freely through the transparent, weakly disturbed, homogeneous and isotropic cosmos, and this is called the **cosmic microwave background (CMB)**. Originally this background radiation was ultraviolet, visible and infrared light, now it reaches the earth as radio waves.

The surface of the last scattering is a shell of the background radiation which refers to a (spherical?) surface at the right distance in space and such that photons are now collected that were originally emitted from there at the moment of decoupling. All such shells represent a series of locations in succession from which the photons that started there now reach the observers on Earth in succession.



*Source: Rik Gielen*

Soon after the era of recombination and photon decoupling, as the universe continued to expand and cool down, CMB photons were redshifted to the infrared within three million years. And because there were no stars or galaxies yet, there was no visible light in the universe from 380,000 years until the formation of the first stars around 400 million years after the big bang.

This period is therefore also called the **dark ages**. The only sources of photons during this time were neutral hydrogen atoms, which emitted weak radio waves (the 21-cm line). During the dark ages, the universe cooled down from 3,000 K to about 60 K.

From about 150 million to 1 billion years after the big bang, the first stars (also known as population III stars, a type of star with gigantic luminosity, on the order of millions of times that of the sun), dwarf galaxies and quasars (quasar: quasistellar radio source) gradually began to form. During this period of star and

galaxy formation, a second phase transition of the gas occurred, the period of **reionization**, the beginning of the cosmic dawn.

This period is so called because during that period the first stars and galaxies ionized the neutral hydrogen gas with which the universe was largely filled, via their ultraviolet light. This means that the ultraviolet rays gave the electrons enough energy to become detached from the hydrogen nuclei and ionized hydrogen gas was created. The detached electrons then collided again with the light of the cosmic background radiation, but these collisions were less numerous than in the early years of the universe.

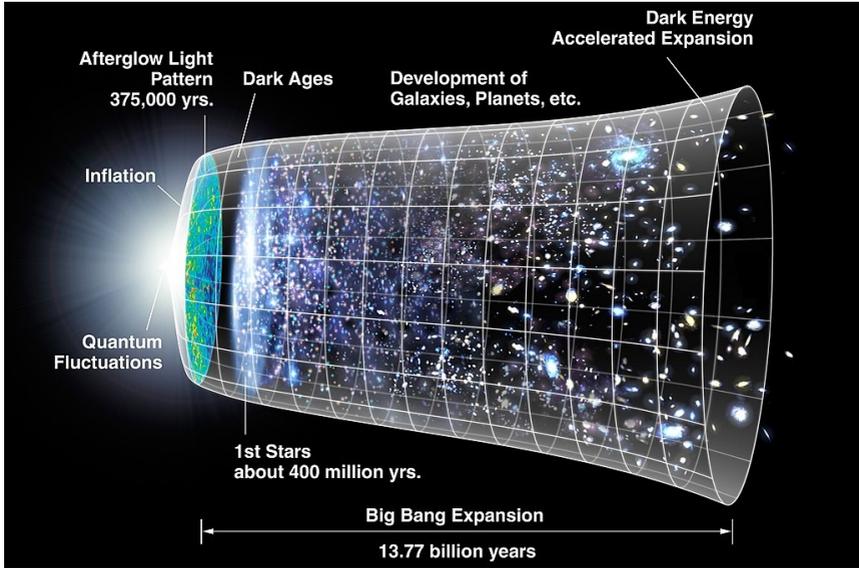
How does the story of the formation of our universe end? Further expansion of the universe has led to the formation of the universe as we know it today. It consists of planets like our Earth, orbiting a star like the Sun. This star, together with millions of other stars, orbits the center of a spiral galaxy, such as the Milky Way, which, together with other galaxies in clusters, forms part of a supercluster. A supercluster is a large group of smaller clusters of galaxies or groups of galaxies; they are among the largest known structures in the universe.

The Milky Way is part of the Local Group of galaxies (which contains more than 54 galaxies), which in turn is part of the Virgo Supercluster, which is part of the Laniakea Supercluster. The large size and low density of superclusters means that, unlike clusters, they expand at the Hubble constant rate (67.4 or 73.3 km per second per megaparsec, science has not yet figured that out!). The number of superclusters in the observable universe (radius about 46.5 billion light years) is estimated at ten million.

The part of the universe that we can see (stars, planets, galaxies and nebulae) makes up only about five percent of all matter in the

universe. The rest consists of what we call '**dark matter**' and '**dark energy**', which make up about 27 and 68 percent of all matter and energy respectively. However, no one knows what dark matter and dark energy are made of, hence their names.

Since the big bang, the universe has grown in three leaps. After the ultra-short period of explosive growth (cosmic inflation) followed a long period of about seven to nine billion years of stable growth and then followed the period in which the expansion accelerated.



Source: NASA/WMAP Science Team - Original version: NASA;  
 Theophilus Britt Griswold, modified by Cherkash  
 The evolution of the universe

## Prediction and measurement of the cosmic microwave background

[6] [7] [8]

The discovery of the cosmic microwave background has an unusual and interesting history. The basic theories and the necessary experimental techniques were available long before the experimental discovery in 1964.

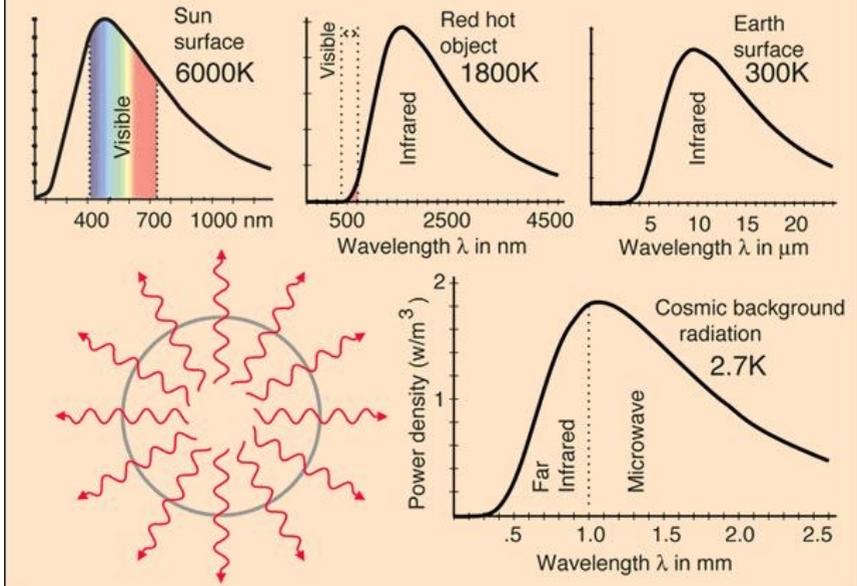
Around 1960, a few years before the discovery, two scenarios for the universe were under discussion. Was it expanding according to the big bang model, or was it in a stable state? Both models had their supporters, and among the scientists who argued for the latter were Hannes Alfvén, Fred Hoyle, and Dennis Sciama.

If the big bang model was correct, there must still be an imprint, a trace of the radiation-dominated early universe, and several groups were looking for it. This radiation had to be thermal, of the shape of a blackbody, and isotropic.

The discovery of the cosmic microwave background radiation by **Penzias and Wilson in 1964** came as a complete surprise to them as they were trying to understand the source of unexpected noise in their radio receiver. The radiation caused unexpected noise in their radio receivers. They shared the 1978 Nobel Prize in Physics for the discovery.

Some sixteen years earlier (1948), Alpher and Herman had predicted that there should be a **relic radiation field** that would penetrate the universe. Tolman had already shown in 1934 that the cooling blackbody radiation in an expanding universe retains its blackbody shape.

## The 3K Cosmic Background Radiation



Source: <http://hyperphysics.phy-astr.gsu.edu/hbase/bkg3k.html>;

Carl Rodney Nave

Examples of blackbody radiation curves

It seems that neither Alpher, Herman, nor Alpher's supervisor Gamov have succeeded in convincing experimentalists to use the characteristic blackbody shape of the radiation to find it. In 1964, however, Doroshkevich and Novikov published a paper explicitly suggesting a search for the radiation, focusing on the characteristics of a blackbody.

But what causes this radiation? Because the universe is expanding, we know that the deeper we look into the universe, the further back in time we look. The further away a galaxy is, the

longer it has taken for the light to reach us and therefore the longer ago it was emitted. The signal that Penzias and Wilson picked up was light that had been emitted billions of years earlier. It had originated about 380,000 years after the big bang, millions of years before the first stars were formed. Dicke concluded that they had found convincing evidence for the big bang!

After the discovery of the cosmic microwave background in 1964, many, but not all, proponents of the steady-state model gave up and accepted the hot big bang model.

After the discovery, several independent measurements of the radiation were made by Wilkinson and others, mainly using balloon-, rocket-, and ground-based instruments. The intensity of the radiation peaks at a **wavelength of about 1 mm**. Although most results supported the blackbody form, few measurements were available on the high-frequency (low-wavelength) side of the peak. Some measurements yielded results that showed significant deviations from the blackbody form (Matsumoto et al. 1988).

For example, because of atmospheric absorption, it had long been recognized that measurements of the high-frequency part of the cosmic background radiation (wavelengths shorter than about 1 mm) had to be performed from space. A satellite instrument also provides full coverage of the sky and a long observation time. This last point is important for reducing systematic errors in the radiation measurements.

On November 18, 1989, the **COBE satellite (COsmic Background Explorer)** was successfully launched into orbit around the Earth. More than 1,000 scientists, engineers, and administrators were involved in the mission. COBE carried three instruments covering the wavelength range from 1  $\mu\text{m}$  to 1 cm to

measure the anisotropy and spectrum of the cosmic background radiation, as well as the diffuse infrared background radiation.

COBE was a success. All instruments worked very well. The predictions of the big bang model were confirmed: temperature fluctuations of the order of  $10^{-5}$  were observed and the background radiation with a temperature of 2.725 K followed the spectrum of a blackbody very closely.

The discovery of the cosmic microwave background radiation in 1964 had a major impact on cosmology. The COBE results of **1992**, which strongly supported the big bang model, gave a much more detailed picture, and cosmology turned into a precision science. New ambitious experiments were started and the number of published papers increased by an order of magnitude.

On June 30, 2001, the **Wilkinson Microwave Anisotropy Probe (WMAP)** was launched. This satellite was tasked with mapping the temperature fluctuations of the cosmic background radiation. WMAP reached its observation position at Lagrange point L2 on October 1, 2001 (At Lagrange points of the Earth, the gravitational pull of the Earth, the Moon and the Sun cancel each other out, so that a satellite can easily be kept in the same position). This point is located 1.5 million kilometers away on the night side of the Earth.

WMAP has a much higher resolution than the previous COBE satellite and can therefore produce sharper images. The image of this shows the 'oldest light' of the universe, 380,000 years after the big bang. The map shows the very small temperature differences in the young universe. The resolution of the observations is 1 millionth of a degree.

In February **2003**, the first results were available in the form of extremely detailed and accurate observations of the background radiation. The temperature of the radiation that has since cooled was determined to be 2.73 Kelvin.

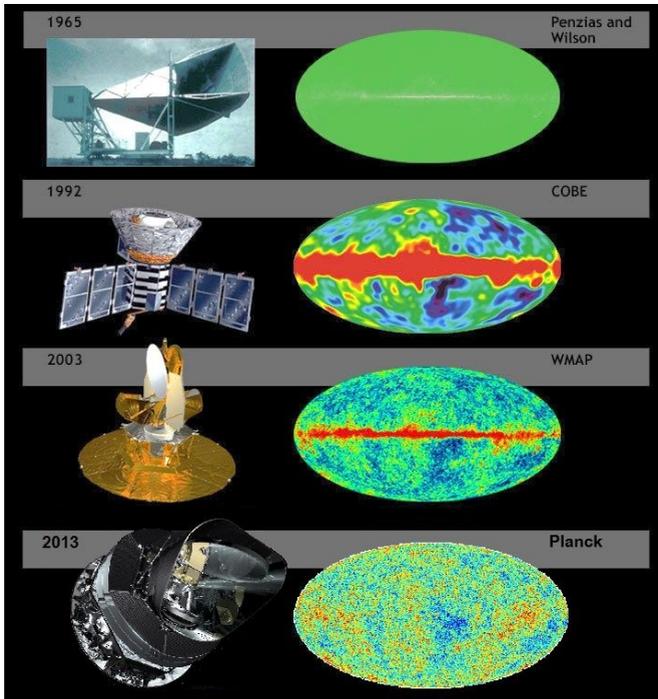
The Planck Observatory was a (sub)millimeter- and radio-telescope that was successfully launched on 14 May 2009 together with the Herschel Space Telescope by the European Space Agency (ESA) with an Ariane 5 rocket from the Centre Spatial Guyanais launch site in Kourou in French Guiana.

Between 2009 and 2013, the **Planck space telescope** accurately measured the cosmic microwave background radiation in nine different frequency bands between thirty and 857 GHz.

Planck measured the temperature variations with a much higher sensitivity, angular resolution and frequency range than any previous satellite, giving astronomers an unprecedented view of our universe when it was still extremely young. We now know that the CMB has an average temperature of  $2.72548 \pm 0.00057$  K. The radiation is very isotropic: the average variation in temperature is only eighteen  $\mu$ K.

Because the satellite was no longer able to observe due to the exhaustion of the helium cooling, it was switched off on 23 October 2013.

The most accurate measurements of the cosmic microwave background were made with the Planck Observatory between 2009 and **2013**.



Source: Taken from: [Quantumuniverse.nl](http://Quantumuniverse.nl) > Donkere materie: "Licht in de duisternis"

The most important measurements of the background radiation

Source top three images: NASA/WMAP Science Team

Source bottom image, part 1: ESA (Image by AOES Medialab)

part 2: ESA and the Planck collaboration

1965 Penzias and Wilson \*\*\* 1992 COBE \*\*\* 2003 WMAP \*\*\* 2013 Planck

## Interesting research regarding the cosmic microwave background

[9] [10] [11] [12]

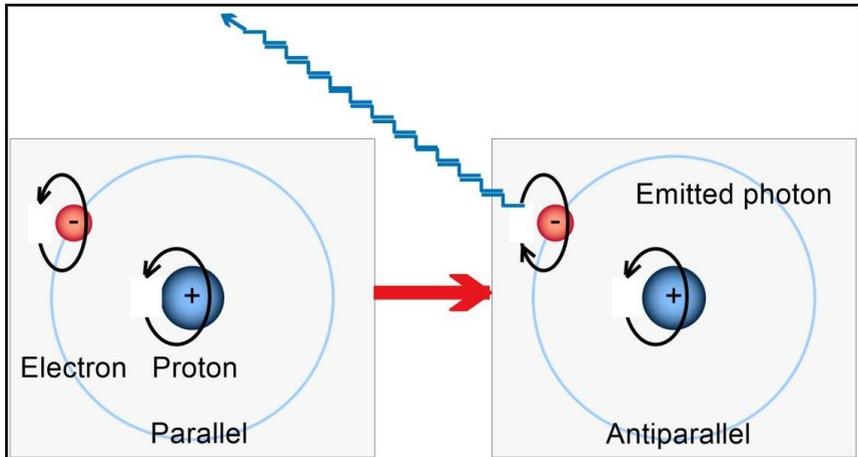
During the **reionization** period, the free electrons collided with the light of the cosmic microwave background and this caused a subtle polarization of that light, which scientists have mapped thanks to the Planck telescope.

When the universe began to reionize, the free electrons affected the polarization of the light. A free electron can interact with a photon by a process called Thomson scattering: the electron is accelerated and the associated light is polarized according to the direction of motion of the electron. This effect was most pronounced during and just after reionization. Afterwards, as the universe continued to expand, the density of the free electrons and also their polarizing effect decreased.

Astronomers consider the reionization period to be very important because it was then that the young universe with its galaxies became visible for the first time. There are two ways to try to find out more about that period.

The first way is that one wants to study the radiation that comes from the neutral hydrogen gas itself. The way to do that was discovered in 1944 by the then 25-year-old student Hendrik C. van de Hulst in Leiden, namely the 21-cm line (1,420 MHz). This is created when the spin of an electron in a hydrogen atom flips, reverses with respect to the spin of the atomic nucleus. The wavelength of this radiation from the reionization era has become dozens of times as large due to the expansion of the universe and has been stretched to a few meters upon arrival at Earth. That is the radio wave range that can be viewed by radio telescopes such

as LOFAR and that is why it is used to observe the reionization era (LOFAR, Low Frequency Array, is a radio telescope that is composed of thousands of radio antennas).



*Source: Rik Gielen*

### The 21-cm hyperfine transition of neutral hydrogen

The second way is to study the ultraviolet light of those very first stars and galaxies. The ultraviolet photons that are responsible for the reionization of the neutral hydrogen gas are called Lyman Continuum photons, or LyC photons for short, and they have a wavelength of 91.2 nm (3.29 million GHz). No galaxies have yet been found that emitted the LyC photons during the start of the era of reionization. It is hoped that the James Webb Space Telescope (JWST) will yield some results in the future.

In the meantime, the JWST is delivering great results. Astronomers have found six gigantic galaxies in the early universe with the JWST. They have discovered the seemingly impossible.

Specifically, these are six galaxies that existed some 500 to 700 million years after the big bang, or some thirteen billion years ago. And that defies current ideas about the origin of galaxies and our understanding of the universe. The galaxies are so massive so early in the universe that according to current cosmological theories they should not exist.

There is the galaxy GLASS-z12 (formerly known as GLASS-z13). This is a Lyman break galaxy that was discovered in July 2022 by the Grism Lens-Amplified Survey from Space (GLASS) observing program using the NIRCam (Near Infrared Camera) on the James Webb Space Telescope. Spectroscopic observations of GLASS-z12 by the Atacama Large Millimeter Array (ALMA) in August 2022 confirmed that the galaxy has a spectroscopic redshift of  $12.117 \pm 0.012$ , making it one of the earliest and most distant galaxies ever discovered, dating back only 350 million years after the big bang.

The JWST broke its own record in 2024 by observing two exceptionally distant galaxies. The most distant, called JADES-GS-z14-0, dates from 290 million years after the big bang.

We can certainly expect great results from the James Webb Space Telescope in the future.

# The cosmic microwave background examined in detail

## A first observation.

The predictions of the cosmic microwave background and the measurements by Penzias and Wilson were enthusiastically linked together, which implies a redshift of  $z = 1,100$ .

### Calculation of redshift, $z$

Based on wavelength	Based on frequency
$z = \frac{\lambda_{\text{obsv}} - \lambda_{\text{emit}}}{\lambda_{\text{emit}}}$	$z = \frac{f_{\text{emit}} - f_{\text{obsv}}}{f_{\text{obsv}}}$
$1 + z = \frac{\lambda_{\text{obsv}}}{\lambda_{\text{emit}}}$	$1 + z = \frac{f_{\text{emit}}}{f_{\text{obsv}}}$

The intensity of a radiation source at 3,000 K (beginning of recombination after about 380,000 years after the big bang) has its maximum at a wavelength of about 1.29 micrometers (0.9 - 1.7). The intensity of the measured cosmic background radiation has its maximum at a wavelength of about 1.42 millimeters (1.0 - 1.9). This gives a redshift of 1,100.

Let us compare this redshift with that of the galaxy GLASS-z12: this has a redshift of 12.117. **That is quite a huge difference**, especially since the redshifts of most galaxies and stars are smaller than 14.

There are several types of redshift (more about that later): [13] [14]

1. Doppler effect: the radiation source and the observer move relative to each other;
2. relativistic Doppler effect: Doppler plus effects described by special relativity;
3. cosmological redshift: when radiation travels through an expanding space;
4. gravitational redshift: when radiation travels towards a weaker gravitational field.

Because the redshift of the CMB turned out to be 1,100, a new type of redshift was introduced, the cosmological redshift. In the early part of the twentieth century, Slipher, Hubble and others made the first measurements of redshifts and blueshifts of galaxies beyond our Milky Way. They first interpreted these as due to the Doppler effect alone, but later Hubble discovered a correlation between the increasing redshift and the increasing distance of galaxies.

Theorists immediately realized that these observations could be explained by **introducing a different mechanism for redshift, the cosmological redshift** (also called Hubble redshift). This is caused by the expansion of the space through which the photons travel.

### **Analysis of the red shift of the CMB.**

Let us start from the era of recombination and photon decoupling. After about 380,000 years after the big bang, the universe had cooled down to about 3,000 degrees Kelvin and free electrons and

nuclei began to combine to form the first neutral atoms. This gradually uncoupled the photons from matter and made the universe transparent. These photons began to move freely through the transparent cosmos, creating the CMB. And all this happened while the universe continued to expand.

Or expressed differently, when did the photons of the CMB come into being?

The light source of the CMB was the gas everywhere in the universe that was cooling and deionizing while still radiating glowing light. The light that was emitted was gradually able to move more and more freely until it could eventually move freely throughout the entire universe. The transition phase of the universe from opaque to transparent was relatively short (in terms of cosmological timescales) and occurred everywhere at the same time. The end result was therefore a universe filled with neutral transparent gas, mainly hydrogen, and a lot of residual light, which had been created everywhere and radiated in various directions.

Let us examine this situation more closely. The entire universe was therefore filled with mainly neutral hydrogen, and flashes of light (photons) were shooting everywhere and in various directions through the cosmos. The cosmos continued to expand, but no new flashes of light were generated, which means that the photons did not expand with the cosmos either. The hydrogen-filled cosmos expanded, but the photons did not expand with it. They continued to follow their flash directions undisturbed.

**We can make the following interesting observations:**

1. 380,000 years after the big bang, the universe became transparent;
2. the universe was then filled with decoupled photons that radiated in various directions;
3. the decoupled photons were decoupled from their light sources (ions and electrons);
4. the universe expanded further, the neutral atoms moved further away from each other;
5. the decoupled photons did not expand with it, they continued on their started path.

What does this mean for the redshift of the cosmic background radiation CMB?

1. Doppler effect: the Doppler effect describes how the frequency of a wave depends on the relative motion between **source** and observer; light from objects that move away from us shows a redshift (spectral lines are shifted towards the red side of the spectrum).

For the CMB we can simply ignore this kind of redshift, for the simple reason that there was no longer a source of the decoupled photons. See point 3.

2. Relativistic Doppler effect: light waves from **objects** moving at a speed close to the speed of light experience deviations from the normal Doppler redshift due to the time dilation of special relativity.

For the CMB we can also simply ignore this redshift, for the same reason as above. See point 3.

3. Cosmological redshift: redshift that arises because the space of the universe expands and everything in it (like stars and galaxies) moves along with that expansion; photons that travel through the **expanding space** are stretched, their wavelength is increased.

Here we must ask ourselves: does space exist (and does time exist)? If space does not exist, then there is no expanding space and we can ignore this redshift as well [15]

Proving that space and time do not exist is another matter, but what can be said is that space and time do not have a physical reality that is independent of matter and energy. Space and time are about events that involve matter fields. One does not measure space and time; one measures distances between material objects and time intervals between events.

More philosophically, is space physical or abstract? It is a bit of both. It is physical in the sense that it is part of the structure of the universe, influenced by and affecting matter and energy. And it is abstract in the sense that it is a concept that we use to understand our reality and to navigate through it.

In that sense, I think this redshift, which would be the most pertinent, can also be ignored. See points 4 and 5.

4. Gravitational redshift: this follows from general relativity. In general relativity there is a time dilation within a **gravitational well**. The wavelength of electromagnetic radiation will become longer as it climbs out of a gravitational well. Photons must expend energy to escape, but at the same time must always travel at the speed of light, so this energy must be lost through a change in frequency rather than through a change in speed. If the energy

of the photon decreases, the frequency also decreases. This corresponds to an increase in the wavelength of the photon.

The universe expanded, the neutral atoms moved further away from each other after recombination and decoupling. The photons did not expand with it, they continued on their started path. The result of this is that the photons ended up in an increasingly weaker gravitational field and therefore experienced an increase in their wavelength.

Note that the cosmic inflation does not play a role here, as it occurred within less than a second after the big bang.

Did this lead to that large redshift of the photons arriving on earth? Hard to say, but I think this effect is relatively small. If we compare the CMB photons with the photons that reach us from distant galaxies, then I would say, these latter photons have to generate much more energy to escape their parent star. And the measured redshifts of distant galaxies are all smaller than 14.

I think this redshift has not made a very big contribution, has not played a big role the first 300 million years after the big bang. See points 4 and 5.

Furthermore, look at it this way. The CMB started 380,000 years after the big bang, when the universe became transparent. 300 million years after the big bang, we are interested in some of the CMB radiation near the galaxy JADES-GS-z14-0. From that moment on, we want to see how the two types of radiation behave. The redshift of the CMB 300 million years after the big bang is about 75 (?) according to the scientific literature. From that moment on, the CMB and the light from JADES-GS-z14-0 travel towards us together. I cannot accept that the CMB arrives at  $z = 1,100$  (from about 75 to 1,100) while JADES has a redshift of

only 14.32 (from 0 to 14.32). To explain the large redshift of the CMB, a fourth redshift was introduced: the cosmological redshift (as space expands, the wavelength of the radiation increases proportionally). When the CMB undergoes this cosmological redshift, so should the light from JADES. But it doesn't!

**Therefore I would dare to conclude:**

**the CMB redshift cannot be 1,100.**

**Or even more striking, there was no cosmic background radiation!**

**Further observations.**

*No dark times?*

Now let us consider the dark ages. Soon after the era of recombination and photon decoupling, as the universe continued to expand and cool down, CMB photons were **redshifted to the infrared** within three million years. And because there were no stars or galaxies, there was no visible light in the universe from 380,000 years until the formation of the first stars around 300 million years after the big bang. This period is therefore called the dark ages.

For this redshift to the infrared, we can use the same analysis as for the total redshift of the CMB above.

The Doppler effect (no source), the relativistic Doppler effect (no source), and the cosmological redshift (space does not expand) can simply be ignored.

The gravitational redshift would therefore be solely responsible for the shift to the infrared. I think that this redshift did not make a very big contribution, given the short time period of a few million years to a few hundred million years, until reionization.

After all, we compare this redshift to the infrared with the redshift of the photons that reach us from distant galaxies. These take several billion years and only reach us in the infrared.

Moreover, these galaxies are moving away from us while the CMB photons do not!

I would dare to say that this redshift did not completely leave the visible spectrum and that there were therefore **no dark times!**

That then poses a major problem and this entails a revision of the evolution of the universe.

*A neutralization of all CMB photons?*

Another possibility that is certainly worth considering is that in the beginning after the recombination there were still collisions between the randomly moving photons and the neutral mainly hydrogen atoms, because the density of the universe was high.

Did these collisions lead to the neutralization of the light flashes, whereby the energy of the photons was absorbed by the hydrogen gas, which therefore cooled down less quickly?

After all: light is absorbed when a photon interacts with an atom and transfers its energy to the atom. This causes the atom to go to a higher energy state. The photon is then 'destroyed' and its energy is converted into another form of energy, in this case heat.

But a total neutralization of all light flashes, of all CMB photons?  
This is very unlikely.

But if there is any truth to it, we can make two observations:

1. there were no dark times;
2. there was **no cosmic background radiation!**

*What will future research yield?*

Astronomers consider the reionization period to be very important because it can provide information about the first galaxies of the very young universe, and that is why they want to study this period intensively.

LOFAR is used to study the 21-cm line of neutral hydrogen gas, with which the universe was largely filled during this period.

And with the James Webb Space Telescope, they hope to obtain some results from the ultraviolet light of those very first stars (galaxies) that caused the neutral hydrogen gas to ionize.

What will the future bring?

# The measurements of Penzias and Wilson, COBE, WMAP and Planck

## **What phenomenon produces this radiation?**

The measurements of Penzias and Wilson, COBE, WMAP and Planck are impressive, that is a fact.

But as explained above, we think that the measured radiations cannot come from the cosmic background radiation.

Then the question is: what phenomenon does produce this radiation?

I think I can give an answer to that.

The measured spectrum that corresponds almost perfectly with that of a blackbody of 2.7 K, is a **property of the dark, or rather, cosmic energy**. The radiation of this energy caused the unexpected noise in the radio receivers of Penzias and Wilson in 1964.

And that cosmic energy is more specifically the **3C energy**.

## **3C energy, what kind of energy is that?**

3C stands for: **Cosmic, Creative, Conscious**.

I would like to refer here to the trilogy that I wrote, in Dutch, a few years ago:

1. ‘Een revolutionaire theorie van de kosmos’  
**(A Revolutionary Theory of the Cosmos)**;
2. ‘Leven in een LEM-Mobiel’  
**(Living in a BEM Mobile)**  
(Body Emotions Mental abilities);
3. ‘Een revolutionaire theorie van de deeltjesfysica’  
**(A revolutionary theory of particle physics)**.

And I have summarized this trilogy clearly in a fourth book:

‘Het schitterende Heelal’  
**(The magnificent Universe)**.

**What are the properties of that 3C energy?**

**3C is Cosmic.**

3C includes all matter and all energy present in the universe.

3C includes everything, the entire universe: the sun, the moon, the stars, all galaxies, all clusters of galaxies and therefore also our earth with all plants, animals and people.

The 3C energy **is** everything, 3C animates the universe with its **cosmic animation**. 3C is extensive, all-encompassing.

**3C is Creative.**

3C creates and sustains the entire universe.

3C eliminates old and creates new galaxies with a supermassive black hole in their center. 3C tears apart clusters of galaxies and creates new clusters.

The 3C energy **can do** everything, 3C rules the universe with its **cosmic energy**. 3C is almighty, omnipotent.

### ***3C is Conscious.***

3C possesses, controls all knowledge that is present in the universe.

3C knows everything, he knows every change in the universe immediately. 3C foresees all events.

The 3C energy **knows** everything, 3C is aware of the entire universe with his **cosmic consciousness**. 3C is aware of everything, is omniscient.

### **What does the 3C energy look like?**

The 3C energy consists of energy particles: **3C-bits** and **3C-bytes**.  
The **very, very smallest particle of the universe is a 3C-bit**.

It is a quantum bit, the smallest and most elementary packet of energy that exists in the universe.

A 3C-bit is under normal circumstances, when the bit is not included in the material part of the universe or when the bit is not participating in some process, in an undetermined state, in a quantum state of which it is not known what that state exactly is, until an action takes place.

One can also say that a 3C-bit is the smallest information packet that exists and that information packet contains within it the blueprint of all creations that are possible in the universe.

A 3C-bit has no charge.

As for the shape and size of a 3C-bit, not much can be said. Only that the shape and size must be described as belonging to a diffuse quantum cloud (is: unclear, vague, scattered, without a certain boundary, not well-defined). After all, the 3C-bits have an undetermined intrinsic spin and can move a lot, violently and unpredictably. The quantum cloud of the 3C-bit is in superposition, it is in all its possible quantum states.

The 3C-bit quantum clouds have dimensions that are even much smaller than the Planck length ( $l_p = 1.616199 \times 10^{-35}$  m), hence invisible and undetectable.

And the 3C-byte?

All elementary particles, both the bosons and the fermions (quarks and leptons), which form the building blocks of our universe, consist of 3C-bytes.

**Each 3C-byte consists of eight 3C-bits.**

When a 3C-bit is switched on to form a 3C-byte, it can take two states: up or down, + or -, 1 or 0, spin up or spin down.

In a 3C-byte, the 3C-bits have specific functions.

Bit 1 determines whether the byte is a particle (up) or an antiparticle (down).

Bit 8 determines whether the particle is a matter particle, with spin  $\frac{1}{2}$  (up) or a force-carrying particle, also called a messenger particle, with spin 1 (down).

Bits 6 and 7 determine what charge the particle has.

Bits 2, 3, 4 and 5 tell what mass the particle has.

As for the shape and size of the 3C-bytes, not much can be said either. Are the 3C-bytes rods, certainly not. Are they vibrating

strings, I don't think so. The most logical thing seems to me that their shape can also be described as three-dimensional diffuse quantum clouds in superposition.

The 3C-bits in the 3C-bytes are going wild and therefore take up much more space than when they are calmly together. These 3C-byte quantum clouds probably have dimensions that are much larger than the Planck length, because of the unpredictable behavior of the 3C-bits that compose them.

For a deeper analysis I refer to my books mentioned above.

### **How can the 3C energy be a blackbody of 2.7 K?**

In describing the big bang theory, we briefly mentioned that many cosmologists believe that the structure of the universe is the result of quantum fluctuations that occurred during the very beginning of the universe and its early expansion.

Let's take a closer look at quantum fluctuations.

According to Wikipedia, a **quantum fluctuation** is the temporary change in the amount of energy in a point in empty space (vacuum), according to Heisenberg's uncertainty principle.

Energy and time are related quantities according to Heisenberg's uncertainty principle. This means that it is possible for a system to have extra energy, provided that this energy is 'returned' after a short period of time, shorter as the extra energy is greater.

So vacuum itself has a certain energy. From that energy, virtual particles can appear and disappear out of nowhere, with each particle being coupled to an antiparticle.

A **virtual particle is a theoretical, temporary particle** that exhibits some of the characteristics of an ordinary particle.

Like normal matter and antimatter, virtual, theoretical electrons and positrons annihilate each other. Unlike normal matter, however, they do not create energy when they annihilate each other, but instead create an imaginary, virtual photon. In low-energy annihilation, the production of photons is favored, because these particles have no mass. Normal photons can interact with matter, but theoretical photons cannot. The existence of these virtual particles ensures that the vacuum in quantum mechanics still has energy.

In quantum mechanics, there is no zero-energy state in the vacuum. There is only **the lowest possible energy state of a system, the ground state**. If there is an inherent uncertainty in the energy of a system, the energy of the ground state can fluctuate. If we call this ground state a **quantum vacuum**, it follows that the quantum vacuum always has a certain structure.

There is no such thing as a true vacuum in the sense of complete emptiness. Quantum mechanics prohibits nothingness. A quantum vacuum is full of quantum energy and particles and antiparticles that appear for a very short time and then disappear again. They give off strange signals, and **these signals are called quantum fluctuations or vacuum fluctuations**.

Also, it should be noted that the temperature in space is about 2.7 K.

## **Research of quantum fluctuations.**

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Researchers at the University of Konstanz in Germany, led by Alfred Leitenstorfer, have been studying quantum fluctuations since 2015. They said they had manipulated “pure nothing” and found that this manipulation had an effect on the quantum fluctuations.

Instead of looking at the changes in the quantum fluctuations by absorbing and amplifying photons, the team had studied the light in the time field. This may sound strange, but in a vacuum, time and space behave in the same way, so it is possible to study one to learn about the other.

In this way, the team found that when they squeezed the vacuum, it acted a bit like squeezing a balloon, redistributing the strange quantum fluctuations in the vacuum. At some points, the fluctuations became much louder than the background noise of a vacuum with no pressure applied, and at other points, they became quieter.

“Since the new measurement technique does not need to absorb or amplify the photons in order to measure them, it is possible to directly observe the electromagnetic background noise of the vacuum, and therefore also the controlled deviations from this ground state, which are created by the researchers,” the team said.

Several researchers are setting up experiments to detect quantum fluctuations of the vacuum in order to explore the limits of physics.

Experts are currently preparing a laser experiment that aims to verify these vacuum fluctuations in a new way, which could provide clues to new laws of physics.

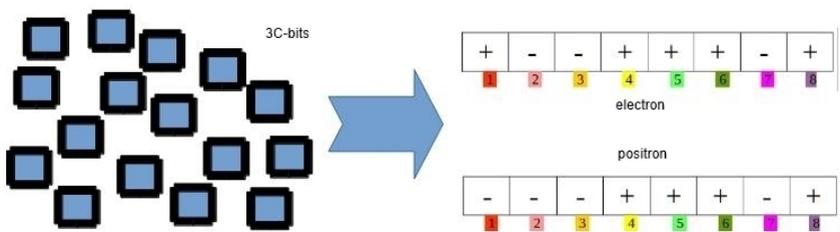
### How does the 3C energy behave in space?

As mentioned, the all-encompassing 3C energy consists of 3C-bits and the matter that makes up our visible universe consists of 3C-bytes.

The quantum fluctuations in a quantum vacuum, as described above, actually tell us how the 3C energy behaves.

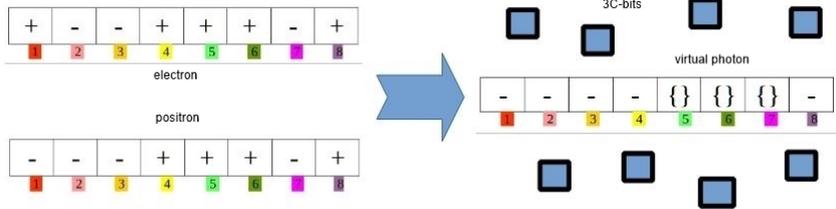
The 3C energy is everywhere, also here on earth, in its ground state. But the inherent uncertainty of that quantum state means that there are continuous fluctuations.

Some sixteen 3C-bits shoot into action and degenerate into a particle and an antiparticle, an electron and a positron for example.



Source: Rik Gielen

But these particles only last for a very short time. They annihilate each other and transform into a virtual photon, surrounded by the eight 3C-bits that are reabsorbed into the sea of 3C-bits of the 3C energy.



Source: Rik Gielen

A virtual photon is its own antiparticle (bit 1 down), is a force-carrying particle with spin 1 (bit 8 down), and has no charge and no mass (all other bits down). Bits 5, 6, and 7, however, are running wild, they are oscillating to give the photon its proper velocity.

This photon together with similar photons causes a commotion in the mass of 3C-bits and sixteen of them are then stimulated to form two particles. These two short-lived particles with opposite signs annihilate each other again and we get another virtual photon. And so it goes on and on. This does not happen in one place but everywhere, in the entire universe.

The strange signals that are emitted here, the quantum fluctuations, can be picked up as electromagnetic background noise.

And these are the signals that the researchers call the cosmic background radiation.

We would rather call that radiation the **Cosmic Foreground Radiation. Cosmic Microwave Foreground (CMF)** instead of Cosmic Microwave Background (CMB).

If we were really dealing with the CMF instead of the CMB, then the laws of physics would need a thorough revision. Then the scientific world would be turned upside down. It is not difficult to deposit generally accepted positions in physics to the wastepaper basket based on this. First of all, the big bang! But we are not there yet.

The scientists who investigate the quantum fluctuations do not question the CMB and therefore do not directly link the cosmic background radiation to their research. But perhaps they are the ones who could introduce the cosmic foreground radiation which then would become generally accepted. Who knows?

## Conclusion

In the first part of this document we have shown in detail that it is **highly unlikely that the measured radiation is the cosmic background radiation!**

In the second part we have given a possible explanation of what the measurements performed by Penzias and Wilson, COBE, WMAP and Planck could actually be.

We want to introduce here the **cosmic foreground radiation (CMF)**, the quantum fluctuations of the 3C energy (the dark energy)!

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