The Antimatter Theory: a new theory of the universe.

There is no need for any mysterious dark energy to explain the expansion of the universe. Neutrons and anti-neutrons came into being in the original gluon soup. The properties of these particles explain that matter and antimatter was separated. Moreover, it explains how precursors to the galaxies arose in the gluon soup. A thin gluon soup remains between the particles after the conversion to plasma. The thin gluon soup remains today and is the cause of gravity. Expansion of the universe is explained by the formation of enormous fireballs comparable to supernovas.

What is dark energy?

The Big Bang theory has long been a recognised model for the creation of the universe. It has, however, many shortcomings. To explain the expansion of the universe, it has been necessary to introduce a theoretical construction: dark energy Λ (lambda). Λ is thought to be both evenly distributed throughout the universe and contain a quite strong repulsive energy. Λ is invisible and has never actually been observed. Dark energy can be calculated as representing 70% of the universe's energy. However, it is unnecessary to introduce Λ. The expansion of the universe can be explained by the known laws of physics. Such an explanation can be found in the Antimatter Theory.

How are nucleons created?

Nucleons (protons and neutrons) are found in atomic nuclei, and they are held together by a so-called *gluon soup*. From collision trials with high-energy particles, we have gained knowledge on particles and how they are formed. When high-energy is inducted into an atomic nucleus, new nucleons can be formed. Each nucleon consists of three specific quarks, and these quarks have to be formed prior to the nucleon. Quarks are bound to a gluon soup and can only be formed in a gluon soup. A gluon soup with high energy is also called *quark-gluon plasma.* In order for the nuclei of the universe to have been formed, there must have been a gluon soup.

What was the gluon soup like?

The Big Bang theory assumes that the universe consisted of a plasma of gluons, quarks and antiquarks at an early stage. This gluon plasma existed for only a microsecond. The temperature was high; in other words, the energy density was high, which means that the quarks and antiquarks were high-energy. Therefore, the quarks were rapidly transformed into nucleons and antinucleons, and the gluon soup was converted into a plasma of electrically charged particles and antiparticles. Here, the Big Bang theory has a problem explaining what happened to the antimatter. According to the Antimatter Theory, the gluon soup had a moderate energy density. The quarks had insufficient energy to make nucleons. But the quarks and antiquarks take part in a slow sorting of matter and antimatter already in the gluon soup. There are an even number of particles and antiparticles at the transition to plasma, but matter and antimatter are found in different areas of the universe.

The universe is perhaps unlimited

According to the Big Bang theory, Λ begins to work when the universe has a radius of approximately 10^{-27} m, creating the entire universe in the course of about 10^{-34} seconds. If we set aside the Big Bang theory and Λ, there is no indication that the universe is limited in space or that it was created at a specific time. According to Antimatter Theory, the universe is comprised of a soup of gluons, with quarks and antiquarks, and this soup may have been unlimited and may have existed for an unlimited period of time.

The gluon soup can be considered a quantum-mechanical field. I understand a quark as a vertex in the gluon soup. The gluon field will often manifest itself in many places briefly as a quark and antiquark, which have opposite electrical charges; thereby, attracting each other. They quickly annihilate each other, becoming gluons again. Occasionally, there will be more quarks of different types in the same place, and when they have opposite charge they attract each other, forming particles. The electrically-charged particles (like protons) that emerge, immediately disappear. But neutrons are neutral and, therefore, are found in great quantity in the gluon soup.

Neutrons and antineutrons roam the gluon soup

Forming a neutron in the gluon soup demands three specific quarks, which, when taken together, have an energy or mass of 12 MeV. An ordinary free neutron has a mass of 940 MeV. The energy density in the gluon soup was not immediately high enough to generate free neutrons. Still, the formed neutrons were relatively stable as they were kept together by means of the electrical attraction between the quarks.

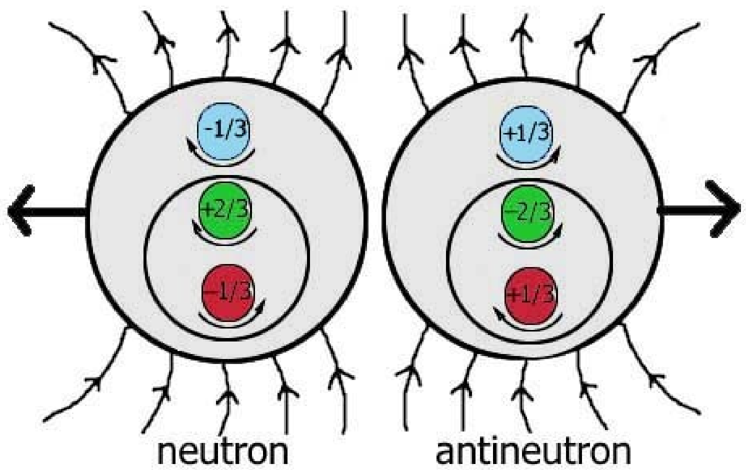

Figure 1

The figure (1) shows pair formation of a neutron and an anti-neutron. The quark's spin and charge is marked and it appears, from the figure, that the total charge for the three quarks in the neutron is zero. Two quarks in the same place cannot have the same spin and charge; thus, the three quarks in the nucleus are different, which is highlighted with colours (Quantum Chromo Dynamics). A circle in the nucleus shows where two of the quarks have formed a pair. They have opposite spins and opposite electrical charges. The pair's spin is zero and the charge is positive. We do not know where exactly the quarks are located in the neutron. One can imagine that the single, negative quark orbits the positive pair, which corresponds to electrons in an atom orbiting the atomic nucleus. The spin of the neutron is determined by the spin of the single, negative quark. Thus, the magnetic dipole moment of the neutron becomes opposite to the neutron’s spin. Researchers believed that the magnetic dipole moment of the electrically neutral neutron had to be zero, but they had to acknowledge experiments, which showed the magnetic dipole moment to be m = -9,66*10^{-27} J/T and negative.

The anti-neutron is formed at the same time as the neutron. It appears that its anti-quarks have the opposite spin and opposite charge of the quarks in the neutron. Here, the single quark is positive and, therefore, the magnetic moment of the anti-neutron gets the same direction as the spin, which is what experiments also demonstrate. The magnetic moments are marked with magnetic field lines. The neutron and anti-neutron each have a magnetic moment in the same direction and, therefore, they repel each other. The magnetic force only works while the two particles are close to each other, but it nevertheless causes the particles to move away from each other at low speed. The velocities are indicated with arrows in the figure. Due to the magnetic repulsion and the low speed, neutrons and anti-neutrons will never get close enough to annihilate each other. It is noteworthy that annihilation of free neutrons and anti-neutrons at low speeds has not been observed in laboratories.

A mechanism that can separate matter and antimatter
Collision tests indicate that gluon plasma is an ideal fluid. Therefore, neutrons and anti-neutrons can move without resistance in the gluon plasma. The neutron moves at a constant low speed until it meets three appropriate anti-quarks. The quarks and the anti-quarks then annihilate each other, becoming gluons, and the neutron dissolves into the gluon soup.

Let there now be an area A, where there is an excess of quarks, and next to it an area B, where there is an excess of anti-quarks. Pairs of neutrons and anti-neutrons are formed throughout the gluon plasma. Of the neutrons formed between A and B, almost half will move towards A, while the rest moves towards B. Those moving towards A will move a longer distance than those moving towards B, because they do not meet anti-quarks so often. The result is a transport of neutrons from B to A. When these neutrons dissolve in A, they add quarks to A, thereby increasing the excess of quarks in A. Similarly, the transport of anti-neutrons from A to B increases the excess of anti-quarks in B. With this mechanism, the Antimatter Theory explains how a large area (A) can be formed in the gluon plasma, where there is excess of quarks, and an area B with an excess of anti-quarks. We will call the areas continent A and continent B, respectively.

Neutrons gather in nuclei
Laboratory experiments have shown that neutrons attract each other and merge. This complex is called a *neutronium*. As mentioned, neutrons have a magnetic dipole moment. Two neutrons with oppositely directed magnetic dipoles will merge if they come close to each other. Such magnetically neutral pairs, coming in close contact will also merge because they attract each other via the same gluon forces that keep the nucleons together in an atomic nucleus. Neutrons in the neutronium nuclei are protected from dissolution as they are bound to the nucleus of the strong gluon force. The neutronium nucleus moves at a constant low velocity, because the gluon soup is an ideal fluid. This movement is only interrupted when the nucleus collides with another

nucleus and together makes a more massive nucleus.

Note that new pairs of neutrons and anti-neutrons are being continuously formed in the gluon soup. Nuclei of anti-neutrons are formed as well. When a nucleus meets an anti-nucleus, they annihilate and their quarks become gluons. Two anti-nuclei may also collide, making a more massive anti-nucleus. We look at continent A with an excess of quarks and so an excess of neutrons. Almost all anti-nuclei will annihilate with nuclei. The excess of nuclei merges, becoming more and more massive. However, a few anti-nuclei may be lucky enough to become more massive, too.

How did the galaxy nuclei arise?

Galaxy nuclei may be called black holes. It is a common assumption that galaxy nuclei had to have formed before the rest of the galaxies. Antimatter theory may explain how this happened. At a certain point in time, part of the energy of the gluon soup was concentrated in neutrons in the form of neutronium nuclei. Gradually, more nuclei were assembled in larger nuclei. The process can be compared to milk curdling. The continent A has only a small excess of matter in the first long period, according to Antimatter theory. In this period, only a few massive nuclei arise. In figure 2, three nuclei are drawn in black. At a later time, more neutrons are supplied to continent A. Then more nuclei are formed and the old nuclei grow (see figure 2).

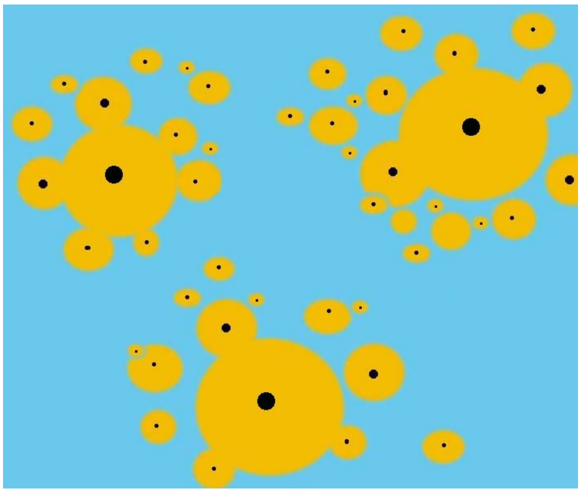

Figure 2. Gluon soup with neutronium nuclei in continent A.

We may assume that almost all the excess of neutrons is gathered in nuclei. Thus, the rest of the soup has the same amount of neutrons and anti-neutrons. In the immediate vicinity of the nucleus is a spherical shell of type A with an excess of neutrons. The reason for that may be that anti-neutrons hit the nucleus and annihilate with only one neutron of a pair, whereas the other neutron is released from the nucleus. The spherical shell A is surrounded by a spherical shell of type B with an excess of anti-neutrons. At first, the density of the excess in A is higher than that in B. Using the mechanism discussed earlier, areas A and B will slowly expand. We end up with a spherical area A near the nucleus (drawn in yellow in figure 2). Further away from the nucleus is an area B, drawn in blue. The yellow and blue areas fill up the entire volume, which later becomes the galaxy universe. The two areas have the same volume and the same density of excess.

How did the gluon soup convert to plasma?
The mass of the neutronium nuclei increased because neutrons and other neutronium nuclei were added. At this stage, gravity began to control the development of the universe. In the gluon soup, the distances between the neutronium nuclei was little and attraction made them gather in clusters around the massive nuclei (see figure 2).

The gravitational force from the neutronium nucleus also attracted the neutrons and antineutrons that were formed in the soup. The particles moved closer to the nucleus and were dissolved. When they dissolved, they contributed to a rise in the energy density of the gluon soup in a spherical shell close to the nucleus. The mass of the shell increased the attraction of the particles outside of the shell, leading to an increase in the energy density of a larger area around the nucleus. The energy density rose steadily in this area. At a certain point in time, the energy density near the massive neutronium nuclei was so high that free particles were produced. These free particles formed a plasma.

A neutron and other elementary particles may be considered to be a little area where part of the energy of the gluon soup is compressed. A free neutron has an energy of 940 MeV, which is mainly caused by its content of gluons. Some scientists imagine that the quarks of the neutron rotate around each other with a velocity close to the speed of light and the gluons holding them together. This rotation implies that the free neutron is much smaller than the neutron in the original gluon soup and the energy density is much higher. Free neutrons would probably only be produced when the gluon soup had this energy density. In the plasma, some of the free neutrons break down into protons and electrons.

A considerable part of the plasma was anti-particles. They annihilated with particles and the lost mass was converted into high energy neutrinos and photons. These massless particles, moving at the speed of light, caused the temperature of the plasma to rise enormously. Fireballs came into being around the most massive neutronium nuclei. The nearby gluon soup absorbed these particles, got a high energy density and was transformed into plasma. See the blue areas on figure 2.

The high energy particles also reached other neutronium nuclei that were on the point of converting to plasma. Here, the conversion ignited, and new fireballs came into being (see the yellow areas in figure 2). The high temperature and particle density lead to a high particle pressure. There was a partial equalisation of pressure, temperature and particle density. However, for a long time there were higher temperatures in the fireballs caused by the production of high energy neutrinos and photons.

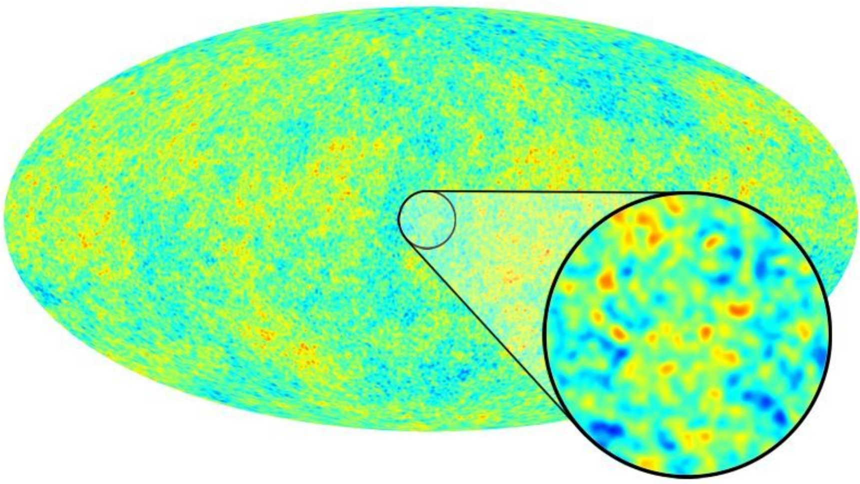

Figure 3. The Cosmic Microwave Background http://planck.cf.ac.uk/science/cmb

From the entire sky behind the stars, microwaves are received, stemming from the time when the temperature of the plasma had fallen so much that protons caught electrons and formed neutral atoms. The cosmic microwave background provides us with a picture of the state of the plasma at its end. Via the Planck satellite, it has been possible to get a high resolution image of the energy density in the plasma. The blue areas in the figure are the least dense. The red and yellow areas are the most dense and they represent fireballs. The highlighted section in the figure shows dense areas with a distance of the same magnitude as the distance between the galaxy clusters in our proximity. The galaxy clusters must have been developed from those groups of yellow areas visible in figure 2.

Does the gluon soup disappear?

Forming the free neutrons uses energy, which is taken from the gluon soup. Thereby, lowering the energy density of the soup. When the energy density is less than the energy density of free neutrons, the formation of particles ceases. That means the conversion of gluon soup into plasma stops. A thin gluon soup, which gets much thinner as the universe expands remains between the particles. Note the following remarkable statement:

Gluon soup survives everywhere in the universe any-time!!!

This statement implies an entirely new theory of the universe, which I can only outline here. Quarks and other particles may be understood as eddies of gluon soup. It means that the universe is composed of gluon soup only. Gluon soup has an attracting force, for instance in atomic nuclei. So we can describe the gluon field with a field strength equal to the attracting force per area. This can be called negative pressure. The gluon field is composed of fields moving in all directions at the speed of light, and permeating each other. Therefore, the field strength is continues and without direction. It equalises immediately, and equilibrium means that the field strength everywhere is constant in time. The field presents no resistance to the movement of particles. Field strength is very high inside a nucleon and falls continuously outside of the nucleon. That field strength is inverse proportional to the square of the distance to the centre of the nucleon can be demonstrated from the claim of equilibrium.

These properties of the gluon field imply that the gluon field is the cause of gravity. We examine two bodies with a distance. The gluon field will, with the speed of light, move to such a position, that the field strength between the bodies is higher than elsewhere. This high field strength leads to an attractive force between the two masses. The size of the force is in agreement with Newton's law of gravitation. Neither Newton nor Einstein explained how gravity came into being. And what about the other three forces of nature? The strong nuclear forces are already explained with the help of gluons. The electromagnetic forces and the weak nuclear forces may be explained in a similar way as gravitation. In these cases a positive and a negative part of the gluon field have to be involved. I hope someone will do that.

Traditional science reckons that gravitational forces and electromagnetic forces act on a distance. That is not possibble in the soup theory, because only local forces act in the gluon soup. The balance may be disturbed, when the energy density changes some place in the soup. Then the change will spread out as a wave with velocity of light. In this way we may explain electromagnetic radiation, neutrino radiation and gravitational waves.

Particles move in the thin gluon soup without resistance. The front of the particle come upon soup and absorbs it. The backside get rid of an equivalent amount of soup. These processes occur with speed of light. The particle velocity can never be that high, because the absorbed gluon soup can only have the speed of light. The gluon soup in front of the particle holds part of the momentum of the particle, and this part will increase when energy is added to the particle.

The expansion of the universe can be explained without dark energy Λ

According to the Antimatter Theory, the expansion of the universe begins in the plasma phase. The plasma of the fireballs contained an enormous amount of heat energy owing to the high nucleon density and the high temperature. The nucleon density originated from gravitation from the neutronium nuclei and the temperature originated from the annihilation of nucleons. The temperature of a single fireball rises until expansion starts. Experiments involving the bombardment of nuclei demonstrate how much energy is required to generate new nucleons in a gluon plasma. Thus, we can estimate the temperature reached by the fireballs.

According to the Antimatter Theory, neutron density was less in those part of the continents, which later became outer parts of the galaxy universe. Therefore, in the plasma, the nucleon density was less in the outer parts than in the central parts, and the relative decrease in neutron density can be estimated. In the plasma, the pressure of nucleons, thus, declined out towards the outer areas. By giving a value to the temperature of the fireballs and a value to the relative decrease in nucleon density, the expansion rate of the universe can be calculated. The calculated speed has the correct magnitude, relative to the expansion rate we know today. The expansion of the universe may be compared with the expansion of a supernova.

How does the universe expand?
The Big Bang model regards the expansion as a confirmation of the existence of Λ. Temperatures fall in line with expansion. Thus, it is possible to explain which nuclear processes occur in the plasma phase and, for example, why Helium is formed. How the cosmic microwave background occurred at the end of the plasma phase can also be explained. The Antimatter Theory has exactly the same temperature drop and, therefore, assumes the same processes in the plasma phase.

The total mass of the galaxies can be estimated and, thus, the gravitational force exerted by the total mass at the outermost regions of the galaxy world can be calculated. These outermost parts are exposed to a braking force, so the decrease in their kinetic energy can be calculated. Movement is slowed, but the calculation shows that the movement cannot be completely stopped. The expansion of the universe continues without end.

How were spiral galaxies formed?
In the Big Bang model, dark energy Λ is the only force controlling the movement of the universe. Therefore, the plasma is uniform and without structure. But this is also precisely why the Big Bang theory has been unable to explain how galaxies were formed. According to Antimatter Theory, the material of the galaxies was already gathered in the gluon soup. Many neutronium nuclei survived, and the active galactic nuclei of the contemporary galaxies are some of them (see figure 2). The yellow areas of the plasma around the neutronium nuclei became fireballs during the plasma phase, and the fireballs were precursors of the galaxies. The blue areas, between the fireballs, contained antimatter, which was the precursor of intergalactic gas.

At first, in the plasma phase, fireballs exploded at different times. The larger fireballs exploded first, along with their closest neighbours. They were found around the large neutronium nuclei, shown, for example, in figure 2. Today, they exist as galaxy clusters, and are also visible as warm areas in the highlighted section of the cosmic microwave background in figure 3. The pressure of the fireballs affected the movement of other fireballs and intergalactic matter. Thus, the rotation of the galaxies can be explained.

The magnetic forces are crucial for the plasma with electrically-charged particles. On the border between the plasma-galaxy and the intergalactic plasma, the particles on both sides will take part in the rotation. The movement of the protons in the galaxy and the movement of the anti-protons in the intergalactic plasma are two oppositely directed electrical currents. A magnetic repulsion will keep the two currents separate. Thus, magnetism offers an explanation as to why matter and antimatter were kept separate.

The magnetic forces also provide an explanation for why spiral galaxies are flat. In the interior of the Sun are tube-like currents of protons, in the direction of falling proton-density. In the plasma-galaxy, the direction of currents was perpendicular to the symmetric plane of the galaxy. Therefore, matter was mixed in this direction and the expansion of the galaxy stopped in this direction.

Where is the universe’s antimatter?
The Antimatter Theory explains how the separation of matter and antimatter was brought about. In interstellar space, there is now a gas of hydrogen and helium molecules, and the gas rotates with the stars of the spiral galaxy. Close outside, in intergalactic space, there is an equivalent gas of antimatter rotating at the same rate. The two gas volumes are separated by a narrow void. The concentration of anti-gas is greatest near the galaxy due to gravity. None of the gases are visible, but antimatter reveals its existence in different ways. The existence of this antimatter is confirmed by observations of high-energy positrons, which come from intergalactic space. These positrons must have been released from anti-hydrogen molecules. Antiprotons, which seem to originate from intergalactic space, are also observed.

Antimatter is detected by its gravity. It has not been possible to explain the rapid rotation of the spiral arms due to gravity from the galaxy’s stars. Gravity must come from another substance of the galaxy – known as *dark matter* – but what it consists of is a mystery. It is estimated that dark matter has 6 times as much mass as visible matter in the galaxy.

The Antimatter Theory offers a solution to this mystery. If we consider the sphere that circumscribes the galaxy, then the gravitational effect on a spiral arm will be the same as if the entire mass of the sphere was placed at the centre of the galaxy. If antimatter was evenly distributed throughout intergalactic space, then antimatter in the sphere would have roughly the same mass as the galaxy. However, as the galaxy attracts antimatter, the mass of antimatter in the sphere will be multiple times that of the galaxy. Interstellar gas, which is also invisible, has a significant amount, too. The bulk of dark matter must be antimatter in the sphere, and a smaller portion, interstellar gas.

The concentration of antimatter is particularly high around a galaxy cluster. Here, the speed of light decreases, as it wanes with greater matter density. This explains the *gravitational lenses* that result from light deflecting at the galaxy cluster. The cause of the light bending is antimatter – the gravitational field from the galaxy cluster affects it only indirectly.

Neutral hydrogen and anti-hydrogen absorb ultraviolet radiation of a certain wavelength, which is emitted from quasars. Such radiation from distant quasars is seen to be absorbed in different places along the radiation’s way to us. An entire forest of absorption lines with different wavelengths can be seen.

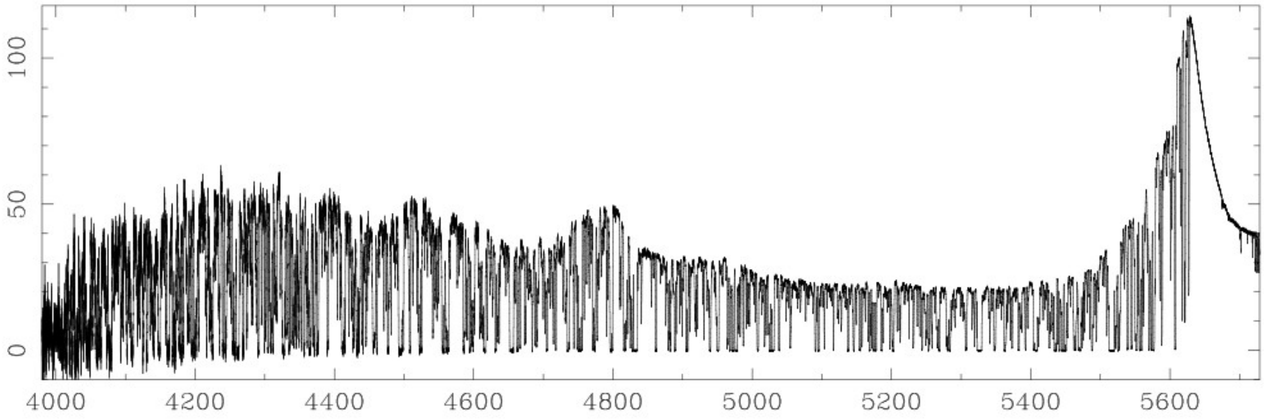

Figure 4. Lyman-Alpha-forest: http://arxiv.org/abs/astro-ph/9806286

To the right is the emission line from the quasar of ultraviolet radiation, which, due to the expansion of the universe, is received as redshifted. The forest of absorption lines to the left of this should probably be explained by absorption from antimatter in intergalactic space. This absorption has occurred at different places on the radiation's way to us. The light from such a place has moved for a shorter time than the light from the quasar. The universe has expanded less during this shorter period, than since the quasar emitted light. Therefore, the absorption lines are less redshifted, i.e., have a smaller wavelength.

What becomes of the universe?

The cosmic microwave background is the furthest from where we can receive light signals. Figure 3 shows blue areas, with fewer fireballs. They are outer areas, and further out may be areas completely devoid of fireballs. It is presumably the fireballs, which create the high temperature that makes the gluon soup evaporate. Therefore, we can assume that the original gluon soup still exists out there where no fireballs have existed. According to the Antimatter Theory, the original gluon soup may be unlimited. We may try to figure out what happens far out, but it would be speculation. From laboratories we only know gluon soup in microscopic size and with a very high energy density.

An extinguished and cooled fireball consists of gas and anti-gas and a neutronium nucleus, which all moves towards the distant gluon soup at high-speed. Gas and anti-gas will presumably be quickly absorbed and dissolved in the gluon soup. The gas particles transfer momentum to the soup, but they hardly prevent the soup from penetrating into our particle universe. The reason for this is that the gluon soup has a higher energy density than the particle universe. The original gluon soup will return and fill up our universe. However, what will happen to the massive neutronium nuclei (black holes) is more doubtful. The neutronium nucleus will possibly move through the gluon soup for a very long time, but will gradually dissolve. A second possibility is, that the nucleus will create a new fireball and start a new particle universe. A third possibility is that the nucleus meet an anti-nucleus and annihilates into radiation, which in turn dissolves in the gluon soup.

A more thorough description of the "Antimatter Theory" can be found in the dissertation at http://www.finse.dk/antistof.pdf, including values and calculations.

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