Solution of a Density Problem in the Early Universe

Philipp Schöneberg* Hans-Otto Carmesin*, **, ***

*Gymnasium Athenaeum, Harsefelder Str. 40, 21680 Stade,
**Studienseminar Stade, Bahnhofstr. 5, 21682 Stade,
***Universität Bremen, 28334 Bremen
philipp.schoeneberg@athenetz.de, Hans-Otto.Carmesin@athenetz.de

Kurzfassung

In dem folgenden Artikel möchten wir ein Problem der allgemeinen Relativitätstheorie lösen. Diese Lösung verlässt den Makrokosmos und nutzt den Mikrokosmos, um zu erklären wie sie funktioniert. Um diese Lösung genauestens zu erläutern werde wir einige Formeln, Berechnungen, Modelle, Tabellenkalkulationen und Diagrammen zeigen und erklären. Zum Schluss zeigen wir die Lösung mit Ergebnissen von realen physikalischen Größen.

Abstract

In the following article we will solve a problem of the general relativity theory. This solution will leave the macrocosm and use the microcosm to explain how it works. For this we also show and explain formulas, calculations, models, spreadsheets and diagrams. At the end we will show our results in shape of real physical quantities.

1. Introduction

No density can be larger than the Planck density $\rho_P = 5{,}155 \cdot 10^{96} \frac{kg}{m^3}$. The time evolution of the actual light horizon should be traced back until the Planck length $L_P = 1.616 \cdot 10^{-35}$ m is reached. However, there arises a problem, as the framework of general relativity theory, GRT, that length L_P is only reached at the density $\rho = 6 \cdot 10^{214} \frac{kg}{m^3}$. (Carmesin 2019, Carmesin 2020). We present a solution to this model. We illustrate this solution with several model experiments. Additionally, we derive the correct solution by using EXCEL in a graphic manner. So we achieve a comprehensive understanding based on our own activity.

2. The light horizon

2.1 The evolution of the light horizon

First we will show you where and when the universe was folding up. At the blue part of the diagram you can see when the universe had unfolded. (Figure 1).

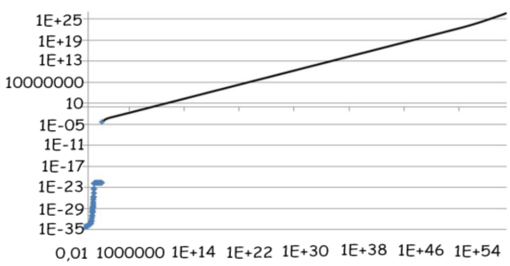

Figure 1: The time evolution of the light horizon

Here we can see the radius (r) in meters (m) to the time (t) in the Planck time (t_P) from the light horizon. If we look at this diagram the graph is the radius of the light horizon. This means we can see the time evolution of the light horizon. But if we follow the light horizon until the Planck density (ρ_P) you can see the problem that the radius isn´t the Planck length (L_P). So the universe could not become smaller because the Planck density is still reached. In the theory we use, the universe was folded up so that it could reach the Planck length. But by expanding the universe has to unfold and to change the dimension into the lowest energy needed dimension. This means it give a distance enlargement like on a folded paper which you unfold. This means that two points which were opposite of the other, now are very far away from each other. We will show you how we can calculate the distance enlargement between two dimensions.

3. Geometry of higher dimension

3.1 Hyper cubic model

Now we explain the model which we will use to calculate the distance enlargement. It´s the hyper cubic model. This model shows the light horizon not as a ball rather as a cube with the same edge length as the radius of the ball (figure 2&3). Important to say is that it isn´t a problem that we use a model of a cube, and not of a ball, because the distance enlargement is applicable at both, and it doesn´t make a different at the results.

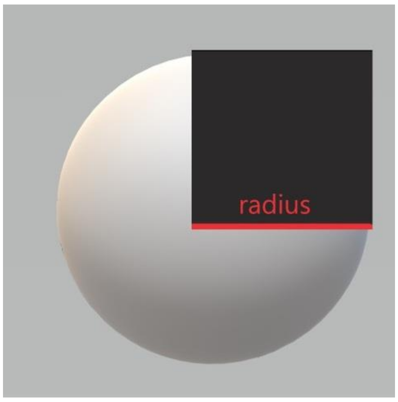

Figure 2: The model in the ball of the light horizon

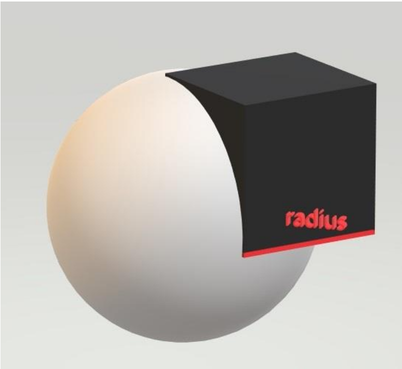

Figure 3: The model in the ball of the light horizon

In the following Picture (figure 2) we can see an example of how the cube function like.

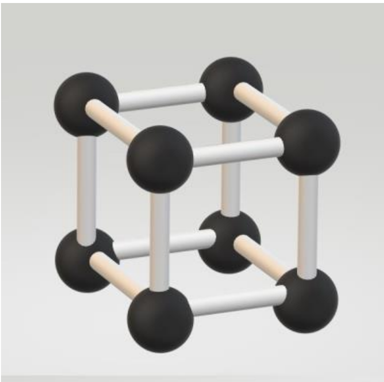

Figure 4: Example for the construction of the hyper cubic model

To use this model, we need some variables. The first variable is the dimension for which we use the symbol D. We also need a variable for the edges to determine the radius of each dimension in the model, so we use $\mathbf{n_D}$ for all balls at one edge in a dimension. All balls in the model are N, so N is the volume of the dimension. In our example we have eight balls this means that the volume is eight. We can calculate N if we use D as exponent for $\mathbf{n_D}$. So our formula is

$$\mathrm{N} = \mathrm{n_D^D} \qquad \{1\}$$

4. Enlargement factor

4.1 Calculation of the formula

Now you understand the model and some variables with which we can figure out how big the volume of a dimension in the model will be. But for figure out how big the distance enlargement between two dimensions will be, you need to know some variables more. First we will explain the new variable s we can set it free and use it to scale the dimensions (D), like we want. Also we need the factor of the distance enlargement which is our goal, it has the symbol $z_{D-s\Rightarrow D}$ This factor shows the distance enlargement (Z) from a changing dimension (D-s) to the new dimension (D). In the following calculations we will never use D rather every time D-s because we don´t will get the result for one dimension rather the for a changing dimension. We know that it is possible to calculate Z with this formula:

$$\mathrm{z_{D+s\Rightarrow D}} = \frac{\mathrm{n_D}}{\mathrm{n_{D+s}}} \qquad \{2\}$$

This is because, if we divide the edge of one dimension with the same edge of another dimension which have the same body, like in our model a cube, we get the similarity factor k which is in this situation the same like $z_{D-s\Rightarrow D}$. So it also shows the distance enlargement. But the problem is that for the formula {2} we need to know the length of the edges of two dimensions, but we only know the edge length of the 301th dimension which is the highest dimension. This is because, if we follow the light horizon backwards and the universe fold up, the highest dimension has to have an edge length of two balls because it isn´t possible that a construction of two fold up to a lower number of balls. So we can´t use this formula and have to calculate a new one.

We start by defining the term of the edge length of one dimension and the term of the edge length of the changing dimension similar because, if we set the factor s at zero it is the same.

$$\mathrm{n_D^D} = \mathrm{n_{D+s}^{D+s}} \qquad \{3\}$$

Here we add the exponent one divided by D to get the left term free from the exponent.

$$\mathrm{n_D} = \mathrm{n_{D+s}^{\frac{D+s}{D}}} \qquad \{4\}$$

Now we have the dividend of the formula {2} at the left side so we can set the new term in the equation {2}.

$$\mathrm{z_{D+s\Rightarrow D}} = \frac{\mathrm{n_{B+s}^{\frac{D+s}{D}}}}{\mathrm{n_{D+s}}} = \frac{\mathrm{n_{D+s}\cdot n_{D+s}^{\frac{s}{D}}}}{\mathrm{n_{D+s}}} \qquad \{5\}$$

Now we only have to short the break to get a new better equation. So we short the $\mathrm{n_{D+s}}$ away and get this equation which we can use with only one known edge length.

$$z_{D+s \Rightarrow D} = n_{D+s}^{\frac{s}{D}} \qquad \{6\}$$

5. Calculation of the enlargement factor

5.1 Calculation

Now we have all important variables and formulas to calculate the distance enlargement for all dimensions, but first we have to set the constants which we will use or which are important. (Figure 5).

Constants:	
D	3
D(max)	301
n(D(max))	2
s	1
LP	1,63E-35

Figure 5: The constants of the spreadsheets

So we´ve set the constant D for the current dimension because it´s the end of the tabular, the maximum dimension D_{max} which is the 301th and the edge length of D_{max}, $n_{D_{max}}$. We also set s to 1 and L_P which is the Planck length. Why we need the Planck length we will explain later. Now we could calculate the first column (Figure 6).

Dimension
D-s
301
300
299

Figure 6: The dimension spreadsheet

First we have calculated the dimensions because they scale the rest of the tabular. For this we only have s subtracted by D so the dimensions are scaled by 1. Now we can calculate the next value but first we have to decide which one. To calculate the edge length of a dimension, we need the distance enlargement of the dimension which is before and to calculate the distance enlargement of a dimension we need the edge length of the same dimension. Because we only know the edge length of the 301th dimension we can only start by calculating the distance enlargement of the same dimension (figure 7).

Dimension	Edge length	Distance enlargement
D-s	n(D-s)	Z(D-s->D)
301	2	1,002313162

Figure 7: The spreadsheets to calculate the rest

To calculate $z_{D-s \Rightarrow D}$ we only have to set the correct numbers in the formula {6}. Now because we know the distance enlargement, we be able to calculate the edge length of the next dimension and with this we can repeat the method to calculate the distance enlargement. Because with this method we every time have one quantity to calculate the other, we be able to calculate the values for every dimension. Here in the following pictures you can see some sectors (figure 8, 9, 10).

Dimension	Edge length	Distance enlargement
D-s	n(D-s)	Z(D-s->D)
301	2	1,002313162
300	2,004626324	1,002328652
299	2,009294402	1,002344299

Figure 8: Sectors of the spreadsheets solution

Dimension	Edge length	Distance enlargement
D-s	n(D-s)	Z(D-s->D)
151	3,981680564	1,009253915
150	4,018526698	1,009378709
149	4,056215291	1,009506049

Figure 9: Sectors of the spreadsheets solution

Dimension	Edge length	Distance enlargement
D-s	n(D-s)	Z(D-s->D)
5	1,32436E+18	33923,56102
4	4,4927E+22	35549682,36
3	1,59714E+30	1,26378E+15

Figure 10: Sectors of the spreadsheets solution

Here in the following diagram (figure 11) you can see how big the edge length in which dimension is, so you can assess how big the distance enlargement will be.

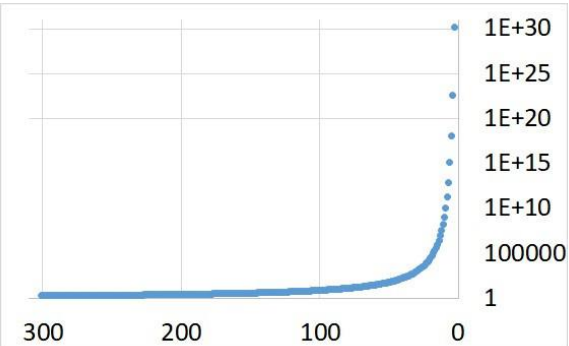

Figure 11: The dimensional distance enlargement

Now we know the distance enlargement and the edge length of every dimension. So we had calculated the solution of the problem.

6. Critical radii

6.1 Comparing

Now we are finished with getting the solution of the Problem, but we also will show you a proof that the theory we use function and can be used at a sensible extension of the three dimensional macrocosm, so we also will calculate the radius in meters to each dimension. For this we only have to multiply the edge length which is the number of balls in one dimension with the Planck length (figure 12) to get the critical radii of each dimensions. Critical radii are the radii of a dimension in which the dimension will be change in another.

Dimension	Light horizon
D-s	r in m
301	3,26E-35
300	3,26754E-35
299	3,27515E-35

Figure 12: A sector of the spreadsheets of the critical radii

If we compare the critical radius of the third dimension which we have calculated in our theory (figure 13) with them of L. Heeren, P. Sawitzki and H.-O. Carmesin (figure 14).

Dimension	Light horizon
D-s	r in m
5	3,26E-35
4	3,26754E-35
3	3,27515E-35

Figure 13: The spreadsheets of the critical radius of the third dimension

t	a
2,54E-61	2,91E-05

Figure 14: The radius result from L. Heeren, P. Sawitzki and H.-O. Carmesin

We see that they are nearly the same so we can connect the theory of the macrocosm with the by us used theory of the microcosm. To explain a solution for a problem of the general relativity theory.

7. Discussion

The expansion of space according to the general relativity theory cannot explain the whole expansion of the light horizon ranging from the Planck length to the light horizon. This is shown in a parallel report by Heeren, Sawitzki and Carmesin. Instead, a different dynamics caused a rapid increase of the distances by a factor of approximately 10^{28} (Guth 1981). Here we model this enlargement by dimensional transitions ranging from D = 301 to D = 3.

This project was elaborated in a research club with classes ranging from 9 to 12. The results can directly be used in classes or courses.

8. Literature

Carmesin, Hans-Otto (2019): Die Grundschwingungen des Universums - The Cosmic Unification - With 8 fundamental Solutions based on G, c and h - With Answers to 42 Frequently Asked Questions. Berlin: Verlag Dr. Köster.

Guth, Alan (1981): Inflationary Universe: A possible to the horizon and flatness problem. Phys. Rev. D 23, 347-356.

Carmesin, Hans-Otto (Mar 2020): Wir entdecken die Geschichte des Universums mit eigenen Fotos und Experimenten. Berlin: Verlag Dr. Köster.