Dark Energy generated by the Evolutionpotential

Mag.rer.nat. Reinhard Kronberger[1]

[1] mathematician (studied in Salzburg)

Abstract

In this paper i will give an explanation for the source of dark energy by a potential which is responsible for the expansion of the universe.I show that the gowth process is very easy to understand like the rabbit population growth described by Fibonacci. At the end of the paper i will give some hints why i have choosen this form of the potential.

Keywords: *dark energy; cosmic inflation;universe; golden mean;golden ratio*

1. Introduction

Georges Lemaître discovered Juni 1927 based on the redshift of the galaxies that the universe is expanding.In Einsteins general relativity the expansions comes from the cosmological constant Λ which is a constant factor in the equation.But until today nobody knows what is the reason for that factor.Some say the reason is the vacuumfluctuation but this leeds to the vacuum catastrophe.I want to give an answer by the Evolutionpotential which is conform to Einsteins equations and easily shows why the universe is expanding.

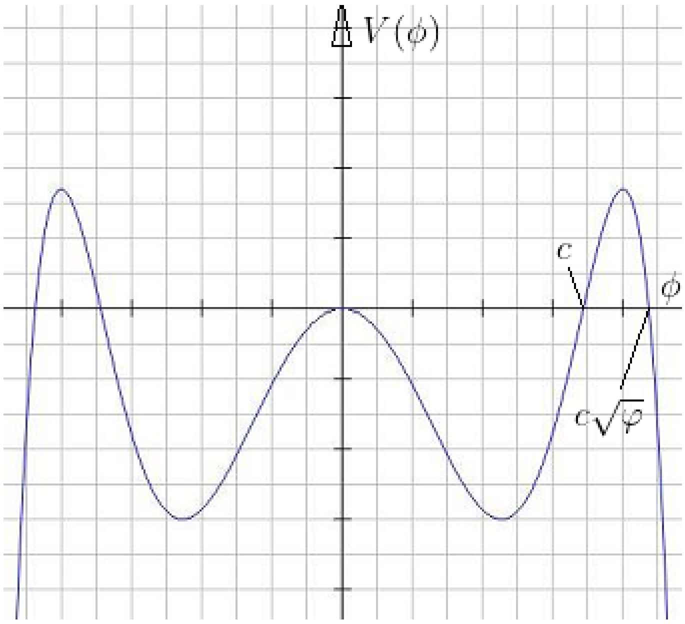
1.1. The Evolution Equation

The equation is an energydensitypotential with speed as variable.

$$V(\phi) = (\frac{\Lambda.c^4}{8\pi G})^2.\left(-\frac{\varphi^3}{\varphi^3+1}(\frac{\mid\phi\mid}{c})^2 + (\frac{\mid\phi\mid}{c})^4 - \frac{1}{\varphi^3+1}(\frac{\mid\phi\mid}{c})^8\right) \tag{1}$$

$speed\ \phi \in \mathbb{O}^5 \times \mathbb{H} \times \mathbb{H}\ = Octonions^5 \times Hamiltonians \times Hamiltonians$
and $\mid\phi\mid \leqq\ c\sqrt{\varphi}$
$c...speed\ of\ light$
$\Lambda...\ cosmological\ constant$
$G...gravitation\ constant$
$\varphi...golden\ mean\ 1,618033...$

1.2. Picture of the equation



the potential is zero on the spheres orshells
$\mid \phi \mid = 0$
$\mid \phi \mid = c$
$\mid \phi \mid = c\sqrt{\varphi}$

1.3. Understanding the 3 terms of the equation

The potential $V(\phi)$ is a $energydensity^2$ and on the zeropoint c (speed of light) we can write it as

$$E^2 = p^2.c^2 + \varrho^2.c^4 + \sigma^2.c^8 = 0 \tag{2}$$

$E ... energydensity$
$p ... (pressure/c)$
$\varrho ... massdensity$
$\sigma ... stretchdensity$

Comparing equation (2) with equation (1) on $\phi = c$ we get

$$p^2.c^2 = -\frac{\varphi^3}{\varphi^3 + 1}(\frac{\mid c \mid}{c})^2(\frac{\Lambda.c^4}{8\pi G})^2 \tag{3}$$

$$\varrho^2.c^4 = 1.(\frac{\mid c \mid}{c})^4(\frac{\Lambda.c^4}{8\pi G})^2 \tag{4}$$

and

$$\sigma^2.c^8 = -\frac{1}{\varphi^3 + 1}(\frac{\mid c \mid}{c})^8(\frac{\Lambda.c^4}{8\pi G})^2 \tag{5}$$

1.4. Understanding the Evolutionpotential as growth process

To see it more clear we write equation (1) in the following shape
with

$$\frac{c^4}{G} = P_p.l_p^2 \tag{6}$$

P_p... *Planckpressure*
l_p... *Plancklength*

we get

$$V(\phi) = (\frac{1}{4}\frac{P_p.\Lambda.l_p^2}{2\pi})^2.\left(-\frac{\varphi^3}{\varphi^3+1}(\frac{\mid\phi\mid}{c})^2 + (\frac{\mid\phi\mid}{c})^4 - \frac{1}{\varphi^3+1}(\frac{\mid\phi\mid}{c})^8\right) \tag{7}$$

we write for short

$$\frac{\Lambda.l_p^2}{4} = \frac{1}{N^2} \approx \frac{0,65}{10^{122}} \approx \frac{1}{48!^2} \qquad Normalizationfactor\ dimensionless \tag{8}$$

we set G=h=c=1 (natural units) and $\phi = c = 1$ then we get

$$V(1) = \frac{1}{N^4}.\left(-\frac{\varphi^3}{\varphi^3+1} + 1 - \frac{1}{\varphi^3+1}\right) \tag{9}$$

Reading the formular:
We see for smaller N the negative pressure is bigger and getting smaller for big N.
This means in the first time of the universe N was small and therefore the expanding big (cosmic inflation).Now N is very big and therefore the expanding small.
N is the count of permutations of the definition range for the Evolutionpotential.
For example the Higgsfield have 4 degrees of freedome therefore N= 4!=24
Our Potential is defined over *speed* $\phi \in \mathbb{O}^5 \times \mathbb{H} \times \mathbb{H}$ and therefore
has $5.8 + 4 + 4 = 48$ degrees of freedome.Then $N = 48! \approx 1,24.10^{61}$.
We can see clear that the pressure which expands the universe is so small because we have a lot of degrees of freedome on the definition range.
One side result of this is see (8) that

$$\frac{\Lambda.l_p^2}{4} = \frac{1}{48!^2} \tag{10}$$

For describing the growth process we write the formular (9) as follow.

$$V(1) = \frac{1}{N^4}.\left(-\frac{\varphi^3}{\varphi^3+1^3}.1^1 + 1^3.1^1 - \frac{1^3}{\varphi^3+1^3}.1^1\right) = 0 \tag{11}$$

In our potential we have densities (massdensity,...) so the third power comes from the 3 spacedimensions.

The most important growth process in nature is the Fibonacci series.

$$F_n = F_{n-1} + F_{n-2} \tag{12}$$

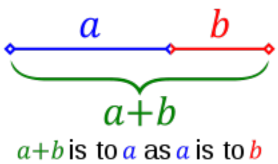
$n \geqslant 3$
$F_1 = F_2 = 1$

This leads to the golden mean growth process the golden mean series

$$\varphi^n = \varphi^{n-1} + \varphi^{n-2} \tag{13}$$

φ*...golden mean*
$\varphi = 1,618...$

The important property of the golden mean is if $a = 1$ *and* $a + b = \varphi$ that



This leads to the fact that the golden mean series is selfsimilar.

$$\frac{a_n}{a_{n-1}} = \varphi \tag{14}$$

Now we want to transform the golden mean series (13) to the shape of our potential (11).
deviding by φ^{n-2} leads to

$$\varphi^2 = \varphi + 1 \tag{15}$$

then

$$-\varphi + \varphi^2 - 1 = 0 \tag{16}$$

deviding by $\varphi^2 = \varphi + 1$ leads to

$$-\frac{\varphi}{\varphi + 1} + 1 - \frac{1}{\varphi + 1} = 0 \tag{17}$$

deviding by $\frac{1}{N^2}$ leads to

$$\frac{1}{N^2}\left(-\frac{\varphi^1}{\varphi^1 + 1^1}.1^1 + 1^1.1^1 - \frac{1^1}{\varphi^1 + 1^1}.1^1\right) = 0 \tag{18}$$

This is the formular similar to our potential (11) but for one spacedimension.
From that we can conclude that our Evolution-Potential shows the growth of 3 spacedimension.
More exact the growth of 3 spacedimensions and 1 timedimension.

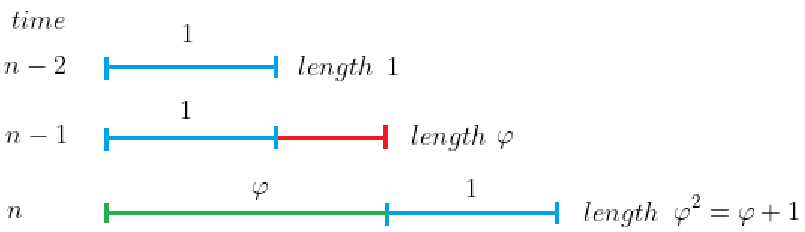
1.4.1. Explaining the two negative terms in (11)

Hereinafter we show how the negative terms expand the space.
For simplification and easier unterstanding we set N=3 and show the principe for the onedimensional space equation (18).
As timestep we take the one and only timestep $t_p = 1$ (Plancktime) which comes from nature and not from manchild.

The negative terms from (18) are.We show the 1 power only to indicate 1 spacedimension and 1 timedimension.

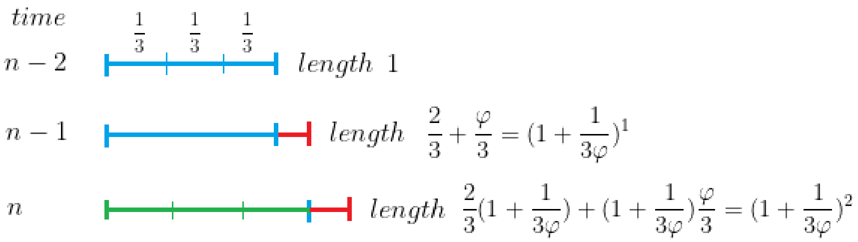
$$-\frac{1}{N^2}.\frac{\varphi^1}{\varphi^1+1^1}.1^1-\frac{1}{N^2}.\frac{1^1}{\varphi^1+1^1}.1^1=-\frac{(\frac{\varphi}{N})^1}{\varphi^1+1^1}.\frac{1^1}{N}-\frac{(\frac{1}{N})^1}{\varphi^1+1^1}.\frac{1^1}{N} \tag{19}$$

First we show the growth for N=1



The golden mean growth is a growth by the factor φ each timestep $when\ n \to n+1$.
On timestep n we have the length $\varphi + 1$. φ is the growth by the first negative term where we have $\frac{\varphi}{N}$ in the numerator and $\frac{1}{N}$ is the second negative term where we have 1 in the numerator.
The denominator $\varphi + 1$ shows the relativity of the growth.
This means 1 meter length growths in the same relation as 1 km length.

Now we show the growth for N=3 to show the influence of N.



This picture shows that by one step only $\frac{1}{3}$ of the length is streched by φ.
Therefore the growth is much slower but also exponential.

For any N we get a growth of

$$(1+\frac{1}{N\varphi})^n \tag{20}$$

The equation (11) with 3 spacedimensions is similar but instead of lengthgrowth we have volumegrowth.

1.5. conformity with the energy-momentum tensor

We show that our potential leeds to the energy-momentum equation

$$\frac{8\pi G}{c^4}T_{\mu\nu} = \Lambda.\eta_{\mu\nu} \tag{21}$$

$\eta_{\mu\nu}...flat\ spacetime\ metric$
$\Lambda...\ cosmological\ constant$
$T_{\mu\nu}...\ energy - momentum\ tensor$

For that we input the 3 terms of equation (2) in the following manner into the energy-momentum tensor

$$\frac{8\pi G}{c^4}T_{\mu\nu} = \frac{8\pi G}{c^4}\begin{pmatrix} \sqrt{\varrho^2.c^4} & 0 & 0 & 0 \\ 0 & -\sqrt{\mid p^2.c^2+\sigma^2.c^8 \mid} & 0 & 0 \\ 0 & 0 & -\sqrt{\mid p^2.c^2+\sigma^2.c^8 \mid} & 0 \\ 0 & 0 & 0 & -\sqrt{\mid p^2.c^2+\sigma^2.c^8 \mid} \end{pmatrix} \tag{22}$$

Using equation (3),(4),(5) we get what we want to show

$$\frac{8\pi G}{c^4}T_{\mu\nu} = \frac{8\pi G}{c^4}\begin{pmatrix} \frac{\Lambda.c^4}{8\pi G} & 0 & 0 & 0 \\ 0 & -\frac{\Lambda.c^4}{8\pi G} & 0 & 0 \\ 0 & 0 & -\frac{\Lambda.c^4}{8\pi G} & 0 \\ 0 & 0 & 0 & -\frac{\Lambda.c^4}{8\pi G} \end{pmatrix} = \Lambda\begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & -1 \end{pmatrix} \tag{23}$$

because $\mid p^2.c^2+\sigma^2.c^8 \mid = (\frac{\Lambda.c^4}{8\pi G})^2$

1.6. How if found the Evolutionpotential

I am not able to describe all the inspirations which leeds to the formular.Therefore i have to write a complete book.But i found it relative fast and it showed a lot of good properties which encouraged me to keep going.First i find an orientation on the Higgspotential which is of dimension GeV^4 and therefore uses the ϕ^4 theory.The Evolutionpotential is of dimension GeV^8 and therefore uses consequentely the ϕ^8 theory.
For some reasons i had to expanded the field behind it to Octonions *exact to* $\mathbb{O}^5$.
It is clear that massdensity and pressure must be a part of the formular to describe the Λ cosmos but i found out that an additional term is possible.
And what theoretical is possible is often possible in nature.
Someone want ask me why do we have the golden mean in the formular.There is a simple reason which leeds to the unique coefficients p, ϱ, σ.
The important behavior of the potential on the interval $[0, c\sqrt{\varphi}]$ is that it is stable.
This means the skewness is zero and only this coefficients leeds to this propertie.

$$\int_0^{c\sqrt{\varphi}} V(\phi)\phi^3 d\phi = 0 \tag{24}$$

2. Conclusion

I showed that the Evolutionpotential for the universe can give an answer to the unresolved question why do we have an expanding universe.It is similar but not equal to the Higgspotential with a third stretching term which acts on the spacecoordinates.
Further i showed that the universe growth is a golden mean growth which often appears in nature. One question remains open here.Why do we have the definition range with 48 degrees of freedom? An explanation for that can be found on my homepage https://standardmodell.at