Dark Energy generated by the Evolutionpotential

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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 leads 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.

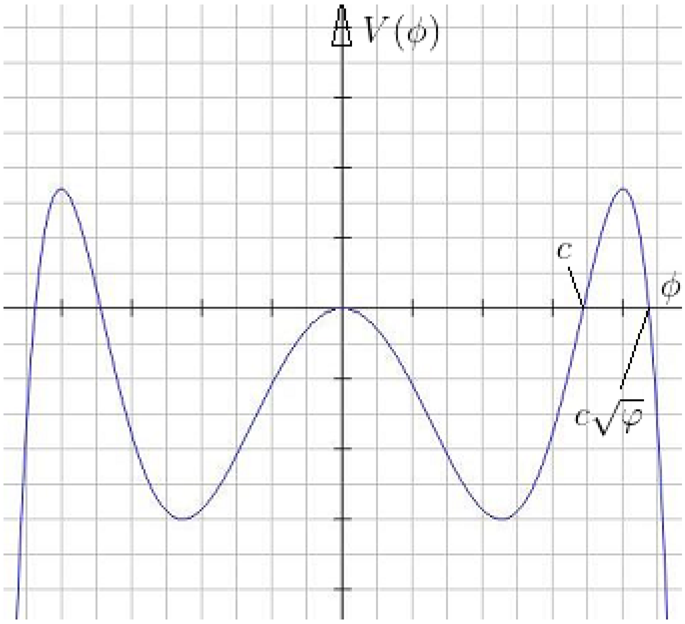
1.1. The Evolution Equation

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
$| \phi |= 0$
$| \phi |= c$
$| \phi |= c\sqrt{\varphi}$

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

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

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

and

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

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

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

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

$$V(1) = \frac{1}{N^4}.\frac{1}{(2\pi)^2}.\left(-\frac{\varphi^3}{\varphi^3+1} + 1 - \frac{1}{\varphi^3+1}\right) \tag{9}$$

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.

$$V(1) = \frac{1}{N^4}.\frac{1}{(2\pi)^2}.\left(-\frac{\varphi^3}{\varphi^3+1^3}.\frac{1^2}{1^2} + \frac{\varphi^3+1^3}{\varphi^3+1^3}.\frac{1^2}{1^2} - \frac{1^3}{\varphi^3+1^3}.\frac{1^2}{1^2}\right) = 0 \tag{11}$$

In our potential we have $densities^2$ ($massdensity^2$,...) so the third power comes from the 3 spacedimensions ($Volumne^2$).

Then we can write (11) as follow.

$$V(1) = \frac{1}{N^4}.\frac{1}{(2\pi)^2}.\left(-\frac{\Theta^2_{\sqrt{\varphi}}}{\Theta^2_{\sqrt{\varphi}}+\Theta^2_{\sqrt{1}}}.\frac{1^2}{1^2} + \frac{\Theta^2_{\sqrt{\varphi}}+\Theta^2_{\sqrt{1}}}{\Theta_{\sqrt{\varphi}}+\Theta_{\sqrt{1}}}.\frac{1^2}{1^2} - \frac{\Theta^2_{\sqrt{1}}}{\Theta^2_{\sqrt{\varphi}}+\Theta^2_{\sqrt{1}}}.\frac{1^2}{1^2}\right) = 0 \tag{12}$$

with

$$\Theta_{\sqrt{\varphi}} = (\sqrt{\varphi}.l_p)^3 = \sqrt{\varphi}^3 \quad volumne\ in\ natural\ units \tag{13}$$

and

$$\Theta_{\sqrt{1}} = (\sqrt{1}.l_p)^3 = \sqrt{1}^3 \quad volumne\ in\ natural\ units \tag{14}$$

drawing the 1^2 which is t_p^2 in (12) inside the denominator and the numerator we get

$$V(1) = \frac{1}{N^4}.\frac{1}{(2\pi)^2}.\left(-\frac{M_{\sqrt{\varphi}}^2}{M_{\sqrt{\varphi}}^2 + M_{\sqrt{1}}^2} + \frac{M_{\sqrt{\varphi}}^2 + M_{\sqrt{1}}^2}{M_{\sqrt{\varphi}} + M_{\sqrt{1}}} - \frac{M_{\sqrt{1}}^2}{M_{\sqrt{\varphi}}^2 + M_{\sqrt{1}}^2}\right) = 0 \tag{15}$$

with

$$M_{\sqrt{\varphi}} = (\sqrt{\varphi}.l_p)^3.t_p = \sqrt{\varphi}^3.1 \quad "volumne"\ of\ minkowski\ spacetime\ in\ natural\ units \tag{16}$$

and

$$M_{\sqrt{1}} = (\sqrt{1}.l_p)^3.t_p = \sqrt{1}^3.1 \quad "volumne"\ of\ minkowski\ spacetime\ in\ natural\ units \tag{17}$$

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

$$F_n = F_{n-1} + F_{n-2} \tag{18}$$

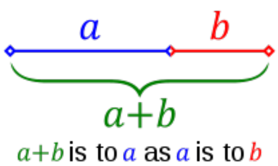
$n \geqslant 3$
$F_1 = F_2 = 1$

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

$$\varphi^n = \varphi^{n-1} + \varphi^{n-2} \tag{19}$$

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.

$$\frac{a_n}{a_{n-1}} = \varphi \tag{20}$$

Now we want to transform the golden mean series (19) to the shape of our potential (11).
With the formular

$$2\varphi^{n+2} = \varphi^{n+3} + \varphi^n \tag{21}$$

which is equvalent to (19) because of

$$\varphi^{n+3} = \varphi^{n+2} + \varphi^{n+2} - \varphi^{n} = \varphi^{n+2} + \varphi^{n+1} + \varphi^{n} - \varphi^{n} = \varphi^{n+2} + \varphi^{n+1} \tag{22}$$

divide(21) by φ^n leads to

$$2\varphi^2 = \varphi^3 + 1 \tag{23}$$

then

$$-\varphi^3 + 2\varphi^2 - 1 = 0 \tag{24}$$

divide by $2\varphi^2 = \varphi^3 + 1$ leads to

$$-\frac{\varphi^3}{\varphi^3+1} + 1 - \frac{1}{\varphi^3+1} = 0 \tag{25}$$

divide by $\frac{1}{N^4}\cdot\frac{1}{(2\pi)^2}$ leads to

$$V(1) = \frac{1}{N^4}\cdot\frac{1}{(2\pi)^2}\cdot\left(-\frac{\varphi^3}{\varphi^3+1^3}\cdot\frac{1^2}{1^2} + \frac{\varphi^3+1^3}{\varphi^3+1^3}\cdot\frac{1^2}{1^2} - \frac{1^3}{\varphi^3+1^3}\cdot\frac{1^2}{1^2}\right) = 0 \tag{26}$$

This is the formular which is the same as our potential (11) deduced by the golden mean growth.

1.5. conformity with the energy-momentum tensor

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

$$\frac{8\pi G}{c^4} T_{\mu\nu} = \Lambda.\eta_{\mu\nu} \tag{27}$$

$\eta_{\mu\nu}$*...flat spacetime metric*
Λ*... 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

$$\frac{8\pi G}{c^4} T_{\mu\nu} = \frac{8\pi G}{c^4}\begin{pmatrix} \sqrt{\varrho^2.c^4} & 0 & 0 & 0 \\ 0 & -\sqrt{\mid p^2.c^2+\sigma^2.c^8\mid} & 0 & 0 \\ 0 & 0 & -\sqrt{\mid p^2.c^2+\sigma^2.c^8\mid} & 0 \\ 0 & 0 & 0 & -\sqrt{\mid p^2.c^2+\sigma^2.c^8\mid} \end{pmatrix} \tag{28}$$

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

$$\frac{8\pi G}{c^4} T_{\mu\nu} = \frac{8\pi G}{c^4}\begin{pmatrix} \frac{\Lambda.c^4}{8\pi G} & 0 & 0 & 0 \\ 0 & -\frac{\Lambda.c^4}{8\pi G} & 0 & 0 \\ 0 & 0 & -\frac{\Lambda.c^4}{8\pi G} & 0 \\ 0 & 0 & 0 & -\frac{\Lambda.c^4}{8\pi G} \end{pmatrix} = \Lambda\begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & -1 \end{pmatrix} \tag{29}$$

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

1.6. conformity with the empirical datas

We know from observations that the universe actually is growing by ≈ 70 *km per second* on a distance of 1 megaparsec $\approx\ 30,9.10^{18}\ km$.
This observation includes the gravity of the mass,radiation,...
The Evolutionpotential is only the dark energy part of the expansion.
First i have to say that the Evolutionpotential is conform with the empirical datas by definition because we have set the second term as the massdensity which is given by the cosmological constant and the value of this constant comes from empirical measurements.
I only show in the next part that with assumption (10) we come to the same results and where we see the expansion in our Evolutionpotrential.

We know from the Friedmann equation that the Hubble-Parameter for the dark energy is

$$H^2 = \frac{\Lambda}{3}.c^2 \tag{30}$$

with the assumption in (10) we can write it

$$H^2 = \frac{4.c^2}{3.l_p^2.48!^2} = \frac{4}{3.48!^2} \quad \textit{in natural units} \tag{31}$$

Then 2 objects (galaxies) with a distance of D walk away by the velocity of

$$v = H.D \tag{32}$$

Then the distance is growing by a $\triangle$ in a Plancktime

$$\triangle = v.t_p = H.D_0.t_p = D_0.\frac{1}{\sqrt{3}}\frac{2}{48!} \quad \textit{in natural units} \tag{33}$$

Then the new distance after a Plancktime is

$$D_1 = D_0 + D_0.\frac{1}{\sqrt{3}}\frac{2}{48!} = D_0(1 + \frac{1}{\sqrt{3}}\frac{2}{48!}) \quad \textit{in natural units} \tag{34}$$

Then the new distance after another Plancktime is

$$D_2 = D_1 + D_1.\frac{1}{\sqrt{3}}\frac{2}{48!} = D_1(1 + \frac{1}{\sqrt{3}}\frac{2}{48!}) = D_0(1 + \frac{1}{\sqrt{3}}\frac{2}{48!})^2 \quad \textit{and so on} \tag{35}$$

Then in general the distance after n Plancktimes is

$$D_n = D_0(1 + \frac{1}{\sqrt{3}}\frac{2}{48!})^n \tag{36}$$

On a distance of D_0 =1 Megaparsec $\approx 30,9.10^{18} km$ we have a growth after 1 second $\approx 0,1855.10^{44}\ t_p$

$$D_n = D_0(1+\frac{1}{\sqrt{3}}\frac{2}{48!})^{0,1855.10^{44}} = D_0(1+\frac{1}{\sqrt{3}}\frac{2}{48!})^{\frac{0,1855.10^{44}}{\frac{1}{\sqrt{3}}\frac{2}{48!}}\frac{1}{\sqrt{3}}\frac{2}{48!}} = \tag{37}$$

$$D_n = D_0((1+\frac{1}{\sqrt{3}}\frac{2}{48!})^{\frac{\sqrt{3}48!}{2}})^{0,1855.10^{44}\frac{1}{\sqrt{3}}\frac{2}{48!}} \approx D_0 e^{0,1855.10^{44}\frac{1}{\sqrt{3}}\frac{2}{48!}} \tag{38}$$

$$\approx D_0.(1+0,1855.10^{44}\frac{1}{\sqrt{3}}\frac{2}{48!}) \tag{39}$$

because $(1+\frac{1}{k})^k \to e\ for\ k \to \infty$ and $e^x \approx 1+x$ for very small x.

Then with $48! \approx 1,24139.10^{61}$ we get finally

$$D_n \approx D_0(1+\frac{1,7254}{10^{18}}) \tag{40}$$

with $n = 0,1855.10^{44} \widehat{=} 1 second$

The empirical expansion today is $\approx$ 70 km per 30,9 megapersec

$$D_n \approx D_0(1+\frac{70}{30,9.10^{18}}) \approx D_0(1+\frac{2,26}{10^{18}}) \tag{41}$$

The reason why our expansion is smaller is because we only have took into account the dark energy and not the mass,radiation,... in the universe.
Now we want to show that our Evolutionpotential leads to the same result.

For that we split the pressurecoefficient in equation (1) into two parts.

$$V(\phi) = (\frac{\Lambda.c^4}{8\pi G})^2.(...) = (\frac{\Lambda.c^2}{3})^2 \times \left(\frac{3.c^2}{8\pi G}\right)^2 (...) = H^4 \times \left(\frac{3.c^2}{8\pi G}\right)^2 (...) = \tag{42}$$

In natural units and with assumption (31) then it can be written as

$$V(\phi) = H^4 \times \left(\frac{3}{8\pi}\right)^2 = (\frac{4}{48!^2}\frac{1}{3})^2 \times \left(\frac{3}{8\pi}\right)^2 (...) = \frac{1}{48!^4}.\frac{1}{(2\pi)^2}(...) \tag{43}$$

so it is easy to sea how the Hubbleparameter appears in the Evolutionpotential.
We keep in mind that it is the Hubbleparameter just for the dark energy!

1.7. direct connection between Evolutionpotential and Kepler triangle

We start with some basics.For two positive numbers a and b we can calculate the three Pythagorean means:

$$\bar{A} = \frac{a+b}{2} \qquad arithmetic\ mean \tag{44}$$

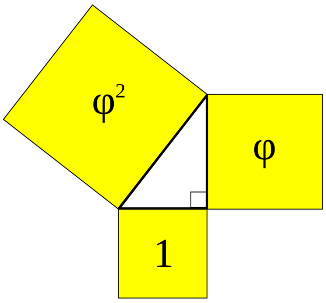
$$\bar{G} = \sqrt{a.b} \qquad \textit{geometric mean} \tag{45}$$

$$\bar{H} = 2\frac{a.b}{a+b} \qquad \textit{harmonic mean} \tag{46}$$

with

$$\bar{H} \leq \bar{G} \leq \bar{A} \tag{47}$$

The Kepler triangle with sides $\varphi, \sqrt{\varphi}$ *and* 1 where φ...golden mean.

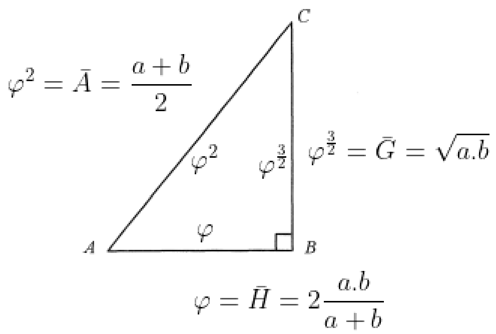


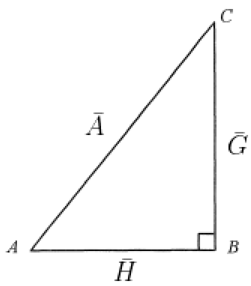
But this is not the only Kepler triangle.Every streching of all three sides by a factor x is also a Kepler triangle. We set our focus to the Kepler triangle with sides $\varphi, \varphi^{\frac{3}{2}}$ *and* φ^2 which is a stretching of the above triangle by the factor φ.

It is a known theorem that the Pythagorean means can be assigned to a right triangle $\iff$ if it is a Kepler triangle and then a and b are in the relation (see references).

$$a = b.\varphi^3 \tag{48}$$

We choose $b = 1$ and then $a = \varphi^3$





$a = \varphi^3 \quad b = 1$

Then it is easy to see that we can write our Evolutionpotential (1) in the following shape:

$$V(\phi) = (\frac{\Lambda.c^4}{8\pi G})^2.\frac{1}{2}\left(-\bar{H}(\frac{\mid\phi\mid}{c})^2 + (\bar{H} + \frac{1}{\bar{A}})(\frac{\mid\phi\mid}{c})^4 - \frac{1}{\bar{A}}(\frac{\mid\phi\mid}{c})^8\right) \tag{49}$$

and with the known relation of the reciprocal dual (see references)

$$\bar{H}^{-1} := \bar{H}(\frac{1}{a}, \frac{1}{b}) = \frac{1}{\bar{A}(a,b)} \tag{50}$$

$b = 1$ and $a = \varphi^3$

we get our potential in terms of the harmonic mean

$$V(\phi) = (\frac{\Lambda.c^4}{8\pi G})^2.\frac{1}{2}\left(-\bar{H}(\frac{\mid\phi\mid}{c})^2 + (\bar{H}+\bar{H}^{-1})(\frac{\mid\phi\mid}{c})^4 - \bar{H}^{-1}(\frac{\mid\phi\mid}{c})^8\right) \tag{51}$$

it is easy to proof that

$$(\bar{H}^{-1})^{-1} = \bar{H} \quad and \quad \bar{H}+\bar{H}^{-1} = 1 \tag{52}$$

1.8. How if found the Evolutionpotential

I am not able to describe all the inspirations which leads 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* $\mathbb{O}^5 \times \mathbb{H} \times \mathbb{H}$.
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 leads 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 leads to this propertie.

$$\int_0^{c\sqrt{\varphi}} V(\phi)\phi^3 d\phi = 0 \tag{53}$$

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 growth of the universe is splitted into the two components of the golden mean growth.
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

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