# Calculation of dark energy and dark matter

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**ABSTRACT**

The rudiments of a theory of dark energy. The theoretical result is confronted with the numerical value calculated from the available data. Excellent matching of numerical values resulting in three independent paths makes the approach plausible. The work at hand is analogous to Kepler's laws of planetary orbits. Only Isaac Newton put Kepler's laws on a theoretical basis, which is provided here by Thomas Gornitz.

The derivation of a formula for calculating dark energy is described. The result is tested on the basis of the available data from the Max Planck Institute for Radio Astronomy. Further formulas are deducted. The dark matter of the cosmos is calculated. A balance sheet is drawn up. Conclusions are drawn.

The empirical Balmer formula for the frequencies of the spectral lines in the arc spectrum of hydrogen was also theoretically justified by Niels Bohr, who calculated the energy levels of the hydrogen atom and the frequencies of spectral lines.

**Key Words:** *Dark energy, Dark matter, Planck time, Age of the universe, Cosmic information*

## INTRODUCTION

The quotient $h/t_p$ represents an energy that leads to the derivation of a formula for calculating dark energy.

### Derivation of a formula for calculating dark energy

This requires only the assumptions that the Planck time $t_p$ is an oscillation period τ and dark energy satisfies the Planck/Einstein formula

$E=h\nu$ (1.1)

Oscillations are fundamental oscillations of cosmic space [1]. Thomas Gornitz says: “Structural quanta emerge from a quantum-theoretical description of “oscillation states” of a system around its ground state”. They produce many effects.

The AQIs of protyposis are also structural quanta and not particles. One can interpret them as the fundamental oscillations of the cosmic space.

For dark energy $E_d$ this then leads to:

${}_pE_d = h / t_p = 1.229 \cdot 10^{10}$ J in Planck time

${}_1E_d = 2.28 \cdot 10^{53}$ J in 1 s

$E_d = 0.994 \cdot 10^{71}$ J in 13.8 billion years for the age of the universe

$t_u = 4.358 \cdot 10^{17}$ s

The following formula for calculating the dark energy in the universe is then derived from these calculation steps:

$E_d = h\, t_p / t_u / t_p^2$ (1.2)

This simple three-sentence operation was found by Thomas Gornitz [1] in a more in-depth manner, resulting in very well-matched numerical values. A connection to the empirical is thus achieved. Data shows us the nature of things as well as theories.

### Verification of the result

In order to show the good concordance of the value calculated according to the formula of dark energy with the value calculated from the existing data, the data from the Max Planck Institute for

Radio Astronomy is used as a basis. Accordingly, the mass/energy of the universe is composed as follows:

70% dark energy

25% dark matter

4-5% visible baryonic matter

0.3% neutrinos

In frontiers of science [2] the energy equivalent for the visible matter in the universe is deducted as follows: For the theoretical calculation, the universe is considered to be a single black hole, just as one imagines, according to a popular theory, the final stage of the universe. Thomas Gornitz has also expressed the idea of the cosmos as a single black hole [1].

He writes: “From this point of view, it makes perfect sense to think about whether our cosmos can be interpreted under certain aspects as the interior of a gigantic black hole.”

Then, with the black hole entropy (Bekenstein-Hawking entropy)

$S_H = kc^3 A_H / (4\hbar G)$ and Hawking temperature

$T_H = \hbar c^3 / (8\pi kGM)$

one obtains the formula

$T_H S_H M / A_H = (2/G)^2 (c/2)^6 / (2\pi)$. If one sets $T_H S_H = Q_H = E = Mc^2$ and for the area of the black hole event horizon $A_H = 4\pi R^2$, which measures the information potentially contained in it, one obtains the

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visible mass M of the universe $M^2c^2 / (4\pi R^2) = 4c^6 / (2^6G^2 2\pi)$ and $M = 8^{1/2} c^2R / (2^3G)$

With the Hubble relation $R = c/H_0$ yields
$M = 8^{1/2} c^3 / (2^3GH_0)$. $M = E/c^2$ is given by
$E_M=c^5/ (8^{1/2}GH_0) = 5.61 \cdot 10^{69}$ J (2.1)
a numerical value that Stephen Hawking calculated for the entire current visible mass-energy equivalent of the universe [3]. This theoretically calculated value, which corresponds to 1080 proton masses, and makes up the major part of the cosmic energy of the matter, can be compared with the value calculated from the volume and density of the universe [4]. This value agrees well with the theoretically calculated value.

Based on the available data from the Max Planck Institute for Radio Astronomy and with $H_0 = 2.285 \cdot 10^{-18}$ $s^{-1}$ this results in the dark energy: $5.61 \cdot 10^{69}$ J $\cdot$ 70/4 = $0.982 \cdot 10^{71}$ J.
$H_0 = 70.5$ $kms^{-1}Mpc^{-1}$ according to WMAP5

Whilst the matching of numeric values cannot replace a theory, a good theory must nevertheless be measured according to the concordance of numerical values. In this respect, the calculation supports the assumptions (theory) made for the formula (1.2).

A further possibility of validation is given through the application of equation (4) from the frontiers of science [2].
Accordingly, the energy is equivalent to the information flow H/t with H = Shannon information entropy and t = time:
$E = h \cdot \ln2 \cdot H/t$ (2.2)
Hartmut Ising and Lienhard Pagel also developed a corresponding formula [5,6]. The formula (2.2) should be deducted exactly here from the De Broglie formula [7]:

The De Broglie formula is:
A/h = S/k.
This results in
$A = (h/k) S \rightarrow AT = (h/k) ST = (h/k) Q$. $E = h\nu = kT \rightarrow T = h\nu/ k$
$A h\nu /k = (h/k) Q \rightarrow A\nu = Q \rightarrow A/\tau = Q \rightarrow A = Q \tau \rightarrow (h/k) S$. $S = k \cdot \ln2 \cdot H$ is given by $Q = h \cdot \ln2 \cdot H/\tau$
If one then sets $\Delta t = a\tau$ (a = dimensionless factor), then
$Q = h \cdot \ln2 \cdot a \cdot H /(a\tau) = h \cdot \ln2 \cdot a \cdot H/ \Delta t$. Q/a is $Q_t$, then $Q_t = h \cdot \ln2 \cdot H/ \Delta t$
With $Q_t = E_t$ one obtains the formula (2.2). It is identical to Ising's or Pagel's formula except for the factor ln2. Thus, dark energy can also be understood as information flow.

The cosmic information $H_K$ is given in Thomas Gornitz as approx. $10^{122}$ bit for $t_u$=15 billion years [8]. From this, formula (3.2) calculates the cosmic information $H_K = 0.943\times10^{122}$ bit for $t_u$=13.8 billion years. $H_K = 0.943\times10^{122}$ bit for the cosmic information and $t_u = 4.358\times10^{17}$ s yields Ed = $0.994\times10^{71}$ J for dark energy. So here too, very good concordance is evident.

**Derived formulas**

Using equations (1.2) and (2.1) leads to the ratio of the energy equivalent of dark energy and visible matter
$E_d / E_M = 8^{1/2} Gh / (c^5 t_p^2) = 17.75$ (3.1)
For the area of astrophysics, it might be relevant to theoretically calculate this relationship.
The following relationship for cosmic information HK can be derived from the formulas (1.2) and (2.2)

$$\ln 2.H_k = (t_u / t_p)^2 \quad (3.2)$$

This formula (3.2) was also derived by Thomas Gornitz in a comparable form [1].
The maximum possible information content $H_{max}$, which can encode the surface of a spherical universe and which corresponds to this surface in Planck units, is given by $A_u = 4\pi R^2 = 4\pi (R/lp)^2$ [9]
With the Hubble relation $R = c / H_0$ and $H_0 = 1/t_u$

$$A_u = 4\pi(ct_u / l_p)^2.$$

With $l_p = (hG / c^3)^{1/2}$ you get

$$H_{max} = 4\pi c^5 t_u^2 / (hG) \rightarrow H_{max} \sim t_u^2 \sim A_u \quad (3.3)$$

$$H_{max} = 8.21\times10^{122} bit \approx 10^{123} bit$$

This value is in good agreement with the one identified by R. Penrose [10]. For comparison, the Bekenstein-Hawking entropy is cited:
$S_H = kc^3 A_H / (4hG)$; with $S_H = k.\ln 2.H_H$ follows

$$\ln2.H_H = c^3A_H/(4hG) \rightarrow H_H \sim A_H \quad (3.4)$$

**Calculation of dark matter**

According to Thomas Gornitz, the number of AQIs (Abstract Quantum Information) in the cosmos is

$$N = t_{cosmos}^{\ 2} / 2 = (t_u / t_p)^2 / 2 = 0.32\times10^{122}$$

This value corresponds to the value of the dark matter in Table 1, where $H_{DM} = 0.33\times10^{122}$is given. That`s a remarkable match!
With the formula (3.2) it follows:

$$H_K /N = 2/\ln2 \approx 2.89 \quad (4.1)$$

By comparing Table 1 the informational equivalents of the dark energy $H_{DE} = H_K$ and the total mass-energy of the universe Hu, one obtains the relation

$$H_{DE} = \ln2.H_u \quad (4.2)$$

And $E_d = (\ln 2)^2.h.H_u / t_u.\ln 2.H_{DE} = (t_u / t_p)^2 \sim A_k$
The formulas (3.2), (4.1), and (4.9) lead to

$$H_{BH} =_{ZBH} \cdot_{nBH} = (t_u / t_p)^2 / 4 \quad (4.3)$$

By combining the different informational equivalents of the energies in Table 1, a number of formulas of the ratios of the informational equivalents can be derived. Here are examples:

$$H_{max} / H_{DE} = 4\pi c^5 t_p^{\ 2} / (\ln 2.hG) \quad (4.4)$$

$$H_{max} / H_M = 8^{3/2}.\pi^2.\ln 2 \quad (4.5)$$

The formulas (3.2) and (4.3) lead to

$$H_{BH} = H_{DE}.\ln 2 / 4 \quad (4.6)$$

$$H_{DE} / \ln 2 \sim A_k \sim (t_u / t_p)^2$$

Formula (4.2) results in

$$4H_{BH} = H_{DE}^{\ 2} / H_u \quad (4.7)$$

and

$$H_{BH} = [(\ln 2)^2 / 4] H_u \quad (4.8)$$

According to Thomas Gornitz, the informational equivalent of the total black holes in the universe is

$$H_{BH} =_{ZBH} \cdot_{nBH} = N / 2 \quad (4.9)$$

The number of AQIs that make up all black holes in the universe is therefore $N/2 = 0.3268 \times 10^{122}/2 = 0.1634 \times 10^{122}$. The entropy for black holes as objects in the cosmos is always smaller than the number of AQIs that form the black hole (Thomas Gornitz) (Table 2 and Figure 1) [11-14].

**Preparation of the balance sheet**

**Table 1**

**Mass energy and information balance of the universe**

| | Symbol | % | Information 10122 [bit] | Energy 1071 [J] | Mass 1053[kg] | [J/bit] |
|---|---|---|---|---|---|---|
| **Dark energy** | $H_K=H_{DE}$ | 70 | 0.943 | 0.994 | | |
| **Dark matter** | $H_{DM}$=N | 25 | 0.337 | 0.355 | 3.9 | |
| **Visible baryonic matter** | $H_M$ | 4-5 | 0.054 | 0.056 | 0.625 | $10^{-51}$ |
| **Neutrinos** | $H_{neu}$ | 0.3 | 0.004 | 0.0043 | | |
| Σ | $H_u$ | 100 | 1.338 | 1.4093 | | |
| | $H_{BH}$ | | 0.1634 | (contained in Hu) | | |
| | $H_{max}$ | | 8.21 | | | |
| | $M_{KG}$ | | | | 4.5* | |

**Th. Gornitz specifies $M_{KG}$= $5.5 \times 10^{53}$kg for the "cosmic total mass", which means a useful match*

**Compilation of the formulas**

**Table 2**

**Compilation of the most important formulas**

| Author | Formula | Determined | Deducted further formulas |
|---|---|---|---|
| Ising, H.and Pagel,L. | $_IE = hH/t_u$ | $H_u$ | $E_d = ht_u/t_p^2$ |
| Joge, F. | $_JE$=h·ln2·H/$t_u$ | $H_{DE}$ | ln2·$H_{DE}$=$(t_u/t_p)^2$ |
| Sedlacek, | -$D._GE = (\ln 2/12\pi^2)$ h H/$t_u$* | $H_{Neu}$ | $H_{DE}$ = (2/ln2) N |
| Görnitz, Th. | | | $H_{DM}^2 = (H_{BH} \cdot H_u)/2$ |
| | $E_M=c^5/(8^{1/2}GH_0)$ | $H_M$ | $H_{DE} = \ln 2 H_u$ |
| | $H_{DM}=(t_u/t_p)^2 /2 = H_u/4$ | $H_{DM}$ = N | $H_{max}/H_M \approx 8^{3/2} \pi^2 \ln 2$ |
| | $H_{max} = 4\pi c^5 t_u^2/(\hbar G)$ | $H_{max}$ | $H_{BH} = (\ln 2/4) H_{DE}$ |
| | $H_{BH} =(t_u/t_p)^2/4$ | $H_{BH}$ | $H_{BH} = H_u/8 = [(\ln 2)^2/4]$ Hu |
| | | | $H_{BH} = N/2 = H_{DM}/2$ |

** The difference between the calculations according to this formula and formula (2.2) lies in the factor $12\pi^2$= 118.8435. It comes about due to the fact that during the expansion of the cosmos –especially during the period of inflation (see Standard Model of Cosmology) –the volume work pdV has to be considered (see the first law of thermodynamics: dU + pdV = 0*

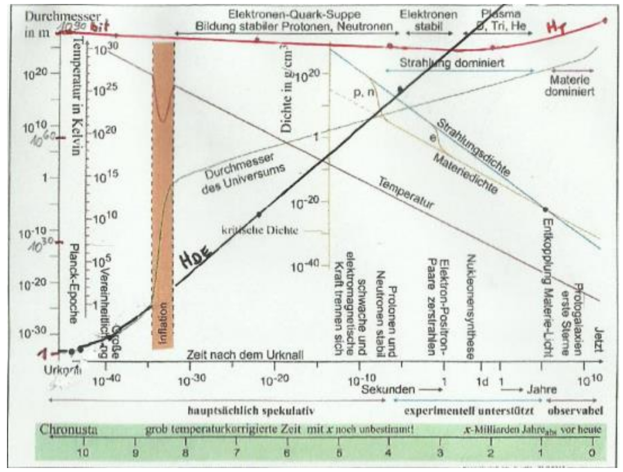


**Figure 1)** *Schematic sequence of the world evolution from Big Bang theory*

## CONCLUSIONS

Planck time can be understood as the oscillation period τ. Oscillations are fundamental oscillations of cosmic space. The dark energy satisfies the Planck/Einstein formula E = hν. Dark energy can be interpreted as information flow.

According to formula (3.2), the cosmic information multiplied by ln2 is nothing more than the age of the universe in Planck time units squared. The approximately fivefold amount of the universe's currently known total information content would still have space on the surface of a spherical universe.

Dark matter corresponds to the number of AQIs in the cosmos. The informational equivalents of dark matter and the total mass energy of the cosmos are in a ratio of 1/4. Dark energy and dark matter are in a ratio of 2/ln2. The dark energy ratio to the cosmos's total mass energy is ln2.

According to the formula (4.5), the ratio $H_{max}/ H_M$ is equal to $8^{3/2}.\pi^2.\ln 2$. The informational equivalent of the black holes in the cosmos is equal to $H_{DM} / 2 = Hu / 8 = [(\ln 2)^2 / 4] H_u$.

Half of the hypothetical particles of dark matter are distributed over the black holes in the universe and can be made accessible after the experimental production of small black holes in a particle accelerator. These statements can serve only as the beginnings of a theory on dark energy and give cause for further research.

**Definition of the symbols used in the formulae**

A = Effect, action

$A_H$ = Area of the black hole event horizon measures the information potentially contained in it

$A_u$ = Surface of the spherical universe, corresponding to Hu

$A_k$ = Surface of the spherical universe, corresponding to Hk

AQI = Abstract quantum information (protyposis)

R = Cosmic radius

c = Speed of light

ν = Frequency

E = Energy

G = Constant of gravitation

$H_0$ = Hubble constant

H = Shannon information entropy

$H_{BH}$ = Informational equivalent of the total mass-energy of the number of black holes in the cosmos
$H_{DE}$ = Informational equivalent of dark energy
$H_{DM}$ = Informational equivalent of dark matter
$H_K$ = Cosmic information, HK = HDE
$H_{Neu}$ = Informational equivalent of neutrinos
$H_u$ = Informational equivalent of the total mass-energy of the universe
h = Planck quantum of action, ħ = h/(2π)
k = Boltzmann constant
M = Mass
$M_{DM}$ = Mass of dark matter
$M_{KG}$ = Cosmic total mass
$M_M$ = Mass of visible baryonic matter
N = Number of AQIs in the cosmos
$n_{BH}$ = Number of AQIs for a black hole
p = Pressure
Q = Thermal energy
S = Thermodynamic entropy
$S_H$ = Bekenstein Hawking entropy
T = Absolute temperature
τ = Period of oscillation
t = Time
$t_u$ = Age of the universe
$t_p$ = Planck time
$l_p$ = Planck length
U = Internal energy
V = Volume
$z_{BH}$= Number of black holes in the cosmos

**REFERENCES**


1. Gornitz, Th. Quantum Cosmology Explains “Dark Matter” and the structure of the interactions and makes the "dark energy" superfluous.
2. Jöge F. Information and Effect. Contribution to the introduction of the concept of immanence as a physical quantity. Frontiers of science. 2015; 64(3):215-28.
3. Eigen M. From entropy to information—the physical chemistry of living matter. Rep. Bunsen Soc. Phys. Chem. 1994; 98(11):1351-64.
4. Jöge FM. Calculation of Dark Energy and Dark Matter. Int. J. Phys. 2019; 7(1):1-7.
5. Ising, H. Information and energy. 2016.
6. Pagel L. Information is energy. Springer; 2013
7. Broglie LD. The thermodynamics of the isolated particle, or, Hidden thermodynamics of particles. 1964.
8. Gornitz TB. The creative cosmos, spirit and matter from information. Spectrum, Heidelberg. 2002; 10: 247ff.
9. Bekenstein JD. Information in the holographic universe. Scientific American. 2003; 289(2):58-65.
10. Penrose R. The Emperor’s New Mind. Oxf. Univ. Press. 1989.
11. SEDLACEK K. Equivalence of information and energy. Norderstedt. 2010
12. Tribus M, McIrvine EC. Energy and information. Scientific American. 1971; 225(3):179-90.
13. Volz, H. This is information. 2017.
14. Völz H. As we have come to know: not everything is information. Shaker Publishing; 2018