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A New Law of Nature

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Abstract

The rudiments of a dark energy theory are provides. This theory is developed and based on physics and mathematics and it is verificated on the basis of available data.. This correspondends to the discovery of the laws of planetary motion in elliptical planetary orbits by JOHANNES KEPLER in the past. He developed his laws from a large dataset. Later it was theoretically substantiated more thoroughly by ISAAK NEWTON. The focus is on deriving a formula for the equivalence of energy and time or equivalence of dark energy and the age of the universe. This derivation provides new theoretical insights and applications in theoreticsl terms and leads to the discovery of a new law of nature.

The theoretical result is confronted with the numerical value calculated from the available data from the MAX PLANCK Institute for Radio Astronomy. Excellent matching of numerical values of dark energy resulting in three independent paths makes the approach plausible. THOMAS GORNITZ [1] provides a theoretical basis for the equation of the equivalence of dark energy and the age of the universe. 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 fequencies of spectral lines.

The derivation of a formula for calculation dark energy is described. For the first time, this made it possible to calculate the exact value of dark energy. The dark matter of the cosmos is calculated. A balance sheet is drawn up. Conclusions are drawn.

Keywords: Dark energy, Dark matter, PLANCK time, Age of the universe, Cosmic information.

1. Introduction

Dark energy is a mysterious energy. Nobody knows what dark energy actually is. Dark energy and dark matter cannot be observed directly. It is thought to be responsible for the Dark energy is accelerated expansion of the universe. Dark energy is, by this nature, a low-energy phenomen that is dispersed. It is not found in galaxies or galaxy clusters and is unlikely to be found in laboratory studies. The repulsive dark energy that accelerated the expansion of the universe could be explained if the cosmological constant is the vacuum energy of space. Some considerations have been made; however they have not yet produced fruitful results to date. In particular, it was not possible to carry out an exact calculation of dark energy. This goal was achieved in the present article.

Applications of formula (1.2) for the equivalence of dark energy and the age of the universe could be made to answer open questions in theoretical physics, such as: dark energy is relative, dark energy is not constant, time is quantized, universe – an open system and equivalence of information and squered energy. Furthermore an possible application consists in that what Prof. Dr. Alexandre Tkatchenko from the University of Luxemburg says:

Accurate calculation the value of dark energy could be helps to bring together two of the largest fields in physics: Quantum Field Theory (QFT) and General Relativity Theory (GRT) developed by ALBERT EINSTEIN.

Research into possible interdisciplinary applications of formula (1.2) could, for example, be applied in areas outside of physics, such as in cosmology or in interdisciplinary modeling of physical systems, in future research.

Expanding the possible scope of application could up exciting avenues for further research.

It was found a new law of nature.

2. Derivation of a formula for calculating dark energy

The quotient h/t_p represent an energy that leads to the 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

$$E = h\,\nu \qquad (1.1)$$

Oscillations are fundamental oscillations of the cosmic space [1, pg.15]. 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

${}_1E_d = h / t_p^2 = 2.28 \cdot 10^{53}$ J in 1 s

$\underline{E_d = (h/t_p^2) \cdot t_u = 0.995 \cdot 10^{71}\ \text{J}}$ in 13.82 billion years for the age of the universe $t_u = 4.364 \cdot 10^{17}$ s

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

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

Physical-Mathematical and theoretical derivation of formula (1.2):

With $\nu = 1/\tau$, you get

$$E = h/\tau$$

With $\tau = t_p$, you get

$${}_pE = h/t_p \qquad \text{for energy in PLANCK time}$$

$${}_1E = (h/t_p^2) \qquad \text{for energy in 1 s}$$

$$E = (h/t_p^2) \cdot t \qquad (1.1) \qquad \text{Equivalence of Energy and Time}$$

For the age of the universe t_u , you get

$$E_d = (h/t_p^2) \cdot t_u \qquad (1.2) \qquad \text{Equivalence of Dark Energy and age of the universe}$$

THOMAS GORNITZ [1] provided in a more in-depht manner the same result 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.

3. 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 – Euclid-Mission of ESA are used as a basis. Accordingly, the mass/energy of the universe is composed as follows:

69% dark energy

26% dark matter

4-5% visible baryonic matter

0.3% neutrinos

In Grenzgebiete der Wissenschaft [2, pg. 218] 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, pg.30 at the end of 7.2]. 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) [9] $S_H = kc^3 A_H / (4\hbar G)$ 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 for the visible mass M of the universe $M^2c^2 / (4\pi R^2) = 4c^6 / (2^6 G^2 2\pi)$ and $M = 8^{1/2} c^2 R/(2^3 G)$. With the HUBBLE's relation $R = c/H_0$ yields $M = 8^{1/2} c^3 / (2^3 GH_0)$. $M = E/c^2$ is given by

$$E_M = c^5 / (8^{1/2} G H_0) = 5.61 \cdot 10^{69} \text{ J} \qquad (2.1)$$

- a numerical value that STEPHEN HAWKING calculated for the entire current visible mass energy equivalent of the universe [3, pg.1355]. This theoretically calculated value, which corresponds to 10^{80} proton masses, and which 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 of the MAX PLANCK Institute for Radio Astronomy – Euclid-Mission of Esa and with $H_0 = 2.4 \cdot 10^{-18} \text{ s}^{-1}$ this results in the dark energy: $5.61 \cdot 10^{69} \text{ J} \cdot 69 / 4 = 0.968 \cdot 10^{71} \text{ J}$

$$H_0 = 74 \text{ km s}^{-1} \text{ Mpc}^{-1} \text{ according to WMAP5}$$

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 the equation (4) from Grenzgebiete der Wissenschaft [2, pg. 226]. Accordingly, the energy is equivalent to the information flow H/t with H = SHANNON's information entropy and t = time:

$$E = h \cdot \ln 2 \cdot H/t \qquad (2.2)$$

HARTMUT ISING [5] and LIENHARD PAGEL [6] also developed a corresponding formula.

The formula (2.2) should be deducted exactly here from the DE BROGLIE's formula [7]:

The DE BROGLIE's formula is: A/h = S/k; with the well-known formula

$S = k \cdot \ln 2 \cdot H$ you get $A/h = (k \cdot \ln 2 \cdot H) / k = \ln 2 \cdot H$ and $A = h \cdot \ln 2 \cdot H \rightarrow$

$E \cdot t = A$; $E = h \cdot \ln 2 \cdot H/t$.

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 Hci is given in THOMAS GORNITZ [8] as approx. 10^{122} bit for t_u = 15 billion years. From this, formula (3.2) by [8] calculates the cosmic information $H_{ci} = 0.921 \cdot 10^{122}$ bit for t_u = 13.82 billion years. $H_{ci} = 0.921 \cdot 10^{122}$ bit for the cosmic information and $t_u = 4.364 \cdot 10^{17}$s yields $\underline{E_d = 0.970 \cdot 10^{71}\ J}$ for dark energy. So here too, very good concordance is evident.

4. Derived formulas

The following relationship for cosmic information H_{ci} can be derived from the formulas (1.2) and (2.2)

$$\ln 2 \cdot H_{ci} = (t_u / t_p)^2 \qquad (2.3)$$

This formula (3.2) was also derived by THOMAS GORNITZ in a comparable form [1, pg. 30].

The maximum possible information content Hmax , which can encode the surface of a spherical universe and which corresponds to this surface in PLANCK units, is given by $A_u = 4\pi R^2 = 4\pi(R/l_p)^2$.

(see [9]).

With the HUBBLE's relation $R = c/H_0$ and $H_0 = 1/t_u$, $A_u = 4\pi\,(c\,t_u/l_p)^2$. With $l_p = (\hbar G/c^3)^{1/2}$ you get

$$H_{max} = 4\pi\, c^5\, t_u^2 / (hG) \rightarrow H_{max} \sim t_u^2 \sim A_u \qquad (2.4)$$

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

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

$$\ln 2 \cdot H_H = c^3\, A_H / (4\hbar G) \rightarrow H_H \sim A_H \qquad (2.5)$$

5. Calculation of dark matter

According to THOMAS GORNITZ, the number of AQIs (abstract quantum information) in the cosmos is $N = t_{cosmos}^2 / 2 = (t_u/t_p)^2 /2 = 0.32 \cdot 10^{122}$ [1, pg. 30]. This value corresponds to the value of dark matter in Table 1, where $H_{DM} = 0.346 \cdot 10^{122}$ is given. That`s a remarkable match!

6. Preparation of the balance sheet

If you enter the values found in a table, you get the following picture:

Table 1: Mass energy and information balance of the universe

	symbol	%	information 10^{122} [bit]	energy 10^{71} [J]	mass 10^{53} [kg]	[J/bit]
dark energy	$H_{ci} = H_{DE}$	69	0.918	1.016		
dark matter	$H_{DM} = N$	26	0.346	0.365	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 H_u)		
	H_{max}		8.21			
	M_{ctm}				4.5 [1)]	

[1)] TH. GORNITZ [1, pg.31] specifies $M_{ctm} = 5.5 \cdot 10^{53}$ kg for the "cosmic total mass", which means a useful match.

7. Applications

There are ongoing and future large-scale sky surveys and experiments specifically designet to explore the nature of dark energy and measure its properties. However, a direct , laboratory-detected particle has not yet been found.

Several „experiments" are essentially astronomical observation projects that study the universe as a whole to measure the impact of dark energy on cosmic evolution. They are not pursuing direct proof on a laboratory scale, but are collecting data to test cosmological models and gain a better understanding of this mysterious force.

Current and planned experiments include:

Dark Energy Spectroscopic Instrument (DESI)

Tis Instrument at the Kitt Deale National Observatory in Arizona maps thousends of galaxies to measure the large-scale structure of the universe. Recent data suggest that dark energy may change over time, which could call into question EINSTEIN's theory of the cosmological constant, but more data is needed.

Euclid – ESA Mission

The Euclid wide-field telescope was launched to explore the „dark universe". It is designet to make highly precise measurements of the shape and distribution of galaxies across billions of light-years in order to better understand the expansion of the universe and the role of dark energy.

Nancy Grace Roman Space Telescope (formerly NASA's WFIRST)

This planned space telescope is also idented to conduct sky surveys to collect data on dark energy using supernovae and gravitational lensing effects.

The Dark Energy Survey (DES)

Although the main observation phase is complete, the DES data will continue to be analyzed the properties of dark energy.

Laboratory experiments

There are also attempts to measure the effects of dark energy or related hypothetical fields (such as quintessence) in controlled laboratory environments, often using neutron rays or searching for axions, although these often target dark matter.

The physical interpretation of dark energy remains largely unclear.

Current experiments aim to collect more data on the effects on the expansion of the universe in order to determine whether it is a constant form of energy (cosmological constant) or whether its strength changes over time.

Vera c. Rubin Observatory

These observatory in Chile will servey the entire southern sky over several years (Logistics Survey of Space and Time) to collect huge amounts of data, which will also be used for research into dark energy.

The application of the formula (2.1) as natural law for experimental research or practical applications has already been carried out and will continue to be carried out in the future. However, implementation is difficult. The reason for this is that dark energy is not yet experimentally accessible. In addition, dark energy cannot be observed directly and is diffusely distributed throughout the universe and is therefore not easy to detected.

However, the following applications of formula (1.2) could be made answer open questions in theoretical physics and give concrete examples of such applications.

In addition to the four applications previously described in the article Time is quantized [11], The Universe – an Open System [12], Dark Energy is not constant, over time [13], Energy is relative [14], Equivalence of Information and Squared Energy [15] the article, Theory of Dark Energy [16] also contains an application of formula (1.2). The statement of Prof. Dr. Alexandre Tkatchenko from the University of Luxemburg also contains a possible application of formula (1.2). The application in the article, Theory of Dark Energy“ should be highlighted.

The possible application in this case consits in that what Prof. Dr. Alexandre Tkatchenko says: Accurate calculating the value of Dark Energy could be helps bring together two of the largest fields in physics: Quantum Field Theory (QFT) and General Relativity Theory (GRT) developed by ALBERT EINSTEIN.

Since the energy is relative [14] and dark energy is not constant [13], the energy on Earth is different than the energy at the edge of the universe. What this means for the development of the universe from Big Bang ti today must be researched. That doesn't matter for the Earth , but whether the linear function of dark energy depending on the age of the universe (see diagram [13] is still valid and the exact calculating of dark energy is still correct must be reconsidered.

Research into possible interdisciplinary applications of formula (1.2) could, for example, be applied in areas outside of physics, such as in cosmology or in the interdisciplinary modeling of physical systems, in future research.

Expanding the possible scope of application could open up exciting avenues for further research.

Conclusions

My cotribution can help to better understand the nature of dark energy. This is the aim of the Euclid-ESA-Mission, which also examines whether it is a constant cosmological constant or whether it changes over time. My article contributes to this; see Reference [13]: Dark Energy is not constant. Furthermore, the following prediction is possible based on my contribution and the agreement between the value of dark matter and the number of AQIs (abstact quantum information): Dark matter does not consist of particles.

All experiments to detect dark matter particles will fail. No particles can be found.

Since the values for dark energy calculated using three independent paths agree remarkable well- according to STEPHEN HAWKING, ROGER PENROSE, and measurements from the MAX PLANCK Observatory and the HUBBLE Space Telescope – the most widely accepted value for the age of the universe is 13.82 billion years. This value is based on the standard model of cosmology and precise measurements, particularly of the cosmic microwave background radiation.

Therefore the age of the universe with 13.82 billion years is correct.

PLANCK time can be understood as the oscillation period τ. Oscillations are fundamental oscillations of the cosmic space [1, pg. 15]. The dark energy satisfies the PLANCK/EINSTEIN formula $E = h\,\nu$. 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 currently known total information content of the universe 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 1/4. Dark energy and dark matter are in a ratio 2/ln2. The ratio of dark energy to the total mass energy of the cosmos is ln2.

These statements can serve only as the beginnings of a theory on dark energy and give cause for further research.

Definition of symbols used in formulas

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 H_k

AQI = abstract quantum information (protyposis)

R = cosmic radius

c = speed of light

ν = frequency

E = energy

E_M = energy equivalent for the visible mass M of the universe

G = constant of gravitation

H_0 = HUBBLE's constant

H = SHANNON's information entropy

H_{BH} = informational equivalent of the total mass energy of the number of black holes in the cosmos

$= z_{BH} \cdot n_{BH} = (t_u/t_p)^2 / 4$

H_{DE} = informational equivalent of dark energy

H_{DM} = informational equivalent of dark matter 7

H_{ci} = cosmic information, $H_{ci} = H_{DE}$

H_{Neu} = informational equivalent of neutrinos

H_u = informational equivalent of the total mass energy of the universe

h = PLANCK's quantum of action, $\hbar = h/(2\pi)$

k = BOLTZMANN's constant

M = mass

M_{DM} = mass of dark matter

M_{ctm} = cosmic total mass

M_{bm} = 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} = nummer of black holes in the cosmos (THOMAS GORNITZ [1])

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