# Theory of Dark Energy

*Friedhelm M. Jöge*

## ABSTRACT

The presented article provides a theory of dark energy that appears to have been developed in two complementary ways. On the one hand, this theory is based on physics and mathematics and, on the other hand, it is developed on the basis of available data. This corresponds 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 amount of data. Later it was theoretically substantiated more thoroughly by ISAAK NEWTON. The focus is on deriving a formula for the equivalence of energy and time (1), page 2. Precursors to the presented „Theory of Dark Energy" were published in the articles [1-11].

The derivation of the formula for the equivalence of energy and time provides new theoretical insights and applications in theoretical terms. These are listed in the "Application" and „Future research fields" sectors; five applications are listed in the „Application" sector.

This derivation leads to the discovery of a new law of nature. This is explained in section „Conclusion".

A formula for calculating dark energy was developed in a previous article published in the International Journal of Physics and Astronomy [1].

*Keywords:* dark energy, planck time, law of nature, age of the universe, fundamental oscillations of a cosmic space, cosmology, theoretical physics.

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*A formula for calculating dark energy was developed in a previous article published in the International Journal of Physics and Astronomy [1].*
*It is:*

$$E_d = (h/t_p^2) \cdot t_u \tag{1.2}$$

*The „The Foundations of a Dark Energy Theory" was first mentioned in my previous work "Commentary about Calculation of Dark Energy and Dark Matter", published in the Journal of Physics and Astronomy [2]. The presented article „Theory of Dark Energy" is now completed and a physical-mathematical and theoretical derivation of the formula (1.2) is provided.*

*Keywords:* dark energy, planck time, law of nature, age of the universe, fundamental oscillations of a cosmic space, cosmology, theoretical physics.

*First way*

## I. PHYSICAL-MATHEMATICAL AND THEORETICAL DERIVATION

The derivation of the formula (1), page 2 for the „Equivalence of Energy and Time" [3] requires only the assumptions that the PLANCK time $t_p$ is an oscillation period $\tau$ and dark energy satisfies the PLANCK / EINSTEIN formula

$$E = h\,\nu \tag{1.1}$$

Oscillations are fundamental oscillations of a cosmic space [4 pg.15]. THOMAS GÖRNITZ says: „Structural quanta emerge from a quantum-theoretical description of „oscillation states" of a system

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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“.

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for the equivalence of energy and time then this leads to:

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

$$E = h/\tau$$

With $\tau = t_p$ , you get

$$_pE = h/t_p \quad \text{for Energy in PLANCK time}$$

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

$$E = (h/t_p^2) \cdot t \quad (1) \; \textit{Equivalence of Energy and Time}$$

For the age of the universe $t_u$ , you get

$$E_d = (h/t_p^2) \cdot t_u \quad (2) \; \textit{Equivalence of dark Energy and age of the universe}$$

*Second way*

## II. DERIVATION WITH DATA

In my article „Calculation of Dark Energy and Dark Matter“ [1] you can find on page 2 the derived formula:

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

This formula did emerge from the BECKENSTEIN HAWKING entropy and the HAWKING temperature, see my article [1], pg.2.

In formula (1.2): $(h/t_p^2)$ is $= 2.2802 \cdot 10^{53}\ Js^{-1}$ (a)

$$E_d = 5.61 \cdot 10^{69}\ J \cdot 70 / 4 = 0.982 \cdot 10^{71}\ J$$

With $t_u = 4.3056 \cdot 10^{17}\ s$ , you get

$$E_d/t_u = 0.982 \cdot 10^{71}\ J / 4.3056 \cdot 10^{17}\ s = 2.2807 \cdot 10^{53}\ Js^{-1} \qquad (b)$$

The numerical values calculated using formulas (a) and (b) correspond to a high degree.

This means that formula (1.2) is validated and correct. It should be acknowledged as a law of nature, so as KEPLER's laws of planetary orbit descriptions have been confirmed and acknowledged as correct from the large amounts of data available.

The available data has been published by the MAX PLANCK Institute for Radio Astronomy.

## III. APPLICATION

Applications of the formula (1.2) as natural law for experimental research or practical applications have not yet been carried out. The reasons for this are explained in „Future research fields“ in the next section. However, applications to answer open questions in Theoretical Physics can be made.

The following publications show how formula (1.2) can be used to answer open questions and give concrete examples of such applications.

In addition to the four applications previously described in the article „Time is quantized“ [5], „The Universe – an Open System“ [6], „Dak Energy is not constant“ [7], „Equivalence of Information and Squared Energy“ [8] the present article “Theory of Dark Energy” 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 present article „Theory of Dark Energy“ should be highlighted.

The possible application in this case consists 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 the General Theory of Relativity (ART) developed by ALBERT EINSTEIN.

*Future research fields*

Future experimental applications of formula (1.2) are hardly to be expected, as 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, applications of formula (1.2) could be made to answer open questions in Theoretical Physics: Since the dark energy is relative [9] and dark energy is not constant [7], 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 to 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 [7]) is still valid and the exact calculating of dark energy is still correct must be reconsidered.

Another application of the formula (1.2), which was already mentioned in the „Application“ section, is given by Prof. Dr. Alexandre Tkatchenko.

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.

## IV. CONCLUSION

The formula (1.2) is theoretically justified and validated based on available data.

It should be acknowledged as a natural law. „KEPLER's“ laws of planetary motion were theoretically founded by ISAAK NEWTON („NEWTON's“ law of gravitation), which he discovered and which represents a law of nature. The situation is similar when generalizing the formula for the „Equivalence of Dark Energy to the age of the universe“ to the „Equivalence of Energy and Time“ [3]. That is, when I say in all modesty: „This formula also represents a law of nature“.

The article „Calculation of Dark Energy and Dark Matter“ [1] was the first to accurately calculate the value of Dark Energy. Accurate calculating of this value could help bring together two of the largest fields in physics: Quantum Field Theory (QFT) and the General Theory of Relativity (ART), developed by ALBERT EINSTEIN. That's what Prof. Dr. Alexandre Tkatchenko says. This is also a possible application.

*Definition of symbols used in formulas*

E = Energy
$E_d$ = dark Energy
$E_M$ = Energy that corresponds to the visible baryonic matter
$t_u$ = age of the universe = 13.75 billion years with 1 year = 365, 2422 days (Google).
$t_u$ = 4,30557 • $10^{17}$ s [12]
$t_p$ = PLANCK time
h = PLANCK constant of action $\hbar = h/(2\pi)$
G = constant of gravitation
Ho = HUBBLE constant
ν = frequency
τ = period of oscillation

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12. This is the result of a new detailed study. Researchers from the University of Bonn evaluated images from the HUBBLE Space Telescope together with colleagues from the US- universities of Stanford and California.


*The highlight:*

your calculation takes more factors into account than previous studies. Their value for the age of the universe is therefore particularly close to reality. The results will soon be published in the trade magazine „Astrophysical Journal“.