Exact expressions of the Fine Structure constant α

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Abstract

In this paper are the exact formulas for the Fine Structure constant α. A Simple and absolutely accurate expression for the Fine Structure constant α in terms of the Archimedes constant π. An Exact formula for the Fine Structure constant α with the Golden Angle and the Fifth Power of the Golden Mean. Total 7 exact formulas.

Introduction

The purpose of many sciences is to find the most accurate mathematical formula that can be found in the experimental value of Fine Structure constant α. Albert Einstein was the first to use a mathematical formula for the Fine Structure constant α in 1909. This expression is:

$$\alpha=7\cdot\pi/3.000$$

With numerical value α=0.00733038286 with an error accuracy of 0.45%. Later many scientists used other mathematical formulas for Fine Structure constant α but they are not at all accurate. These are Jeans 1.913,Lewis Adams 1.914, Lunn in 1.922, Peirles in 1.928 and others. Arthur Eddington was the first to focus on its inverse value and suggested that it should be an integer,that the theoretical value is $\alpha^{-1}=136$. In his original document 1.929 he applied the value:

$$\alpha^{-1}=16+1/2\times16\times(16-1)=136$$

However, the experiments themselves consistently showed that $\alpha^{-1}\approx137$. This forced him to look for an error in his original theory. He soon came to the conclusion that:

$$\alpha^{-1}=137$$

He thus argued that the extra unit was a consequence of the initial exclusion of every elementary particle pair in the universe. In the document of 1.929,Eddington considered that Fine Structure constant α relates in a simple way to the cosmological constants,as given by the expression:

$$\alpha=2\cdot\pi\cdot m\cdot c\cdot R_E/h\cdot\sqrt{N^*}$$

where:
N * the cosmic number,the number of electrons and protons in the closed universe. Eddington always kept the name and the symbol α:

$$\alpha=h\cdot c/2\cdot\pi\cdot q_e^2$$

The first to find an exact formula for the Fine Structure constant α was the Swiss mathematician Armand Wyler in 1,969. Based on the arguments concerning the congruent group,the group consists of simple Lorentz transformations such as the space-time dimensions that leave the Maxwell equations unchanged. The first form of the Wyler constant type is:

$$\alpha w=(9/16\cdot\pi^3)\cdot(\pi/5!)^{1/4}$$

With numerical value αw=1/137,036=0,00729735252. At the time it was proposed,they agreed with the experiment to be within 1.5 ppm for the value α^{-1}.

Measurement of Fine Structure constant

The 2.018 CODATA recommended value of α is:

$\alpha=q_e^2/4\cdot\pi\cdot\varepsilon_0\cdot\hbar\cdot c=0.0072973525693(11)$ (1)

With standard Uncertainty $0{,}0000000011\times10^{-3}$ and Relative Standard Uncertainty $1{,}5\times10^{10}$. For reasons of convenience,historically the value of the reciprocal of the fine-structure constant is often specified. The 2.018 CODATA recommended value is given by:

$\alpha^{-1}= 137{,}035999084(21)$ (2)

With standard Uncertainty $0{,}000000021\times10^{-3}$ and Relative Standard Uncertainty $1{,}5\times10^{10}$. There is general agreement for the value of α,as measured by these different methods. The preferred methods in 2.019 are measurements of electron anomalous magnetic moments and of photon recoil in atom interferometry. The most precise value of α obtained experimentally (as of 2.012) is based on a measurement of g using a one-electron so-called "quantum cyclotron" apparatus,together with a calculation via the theory of QED that involved 12.672 tenth-order Feynman diagrams:

$\alpha^{-1}=137{,}035999174(35)$ (3)

This measurement of α has a relative standard uncertainty of $2{,}5\times10^{-10}$. This value and uncertainty are about the same as the latest experimental results. Further refinement of this work were published by the end of 2.020,giving the value:

$\alpha^{-1}=137{,}035999206(11)$ (4)

with a relative accuracy of 81 parts per trillion.

Simple and absolutely accurate expression for the Fine Structure constant α in terms of the Archimedes constant π

A simple formula for the Fine Structure constant α in terms of the Archimedes constant π is:

$\alpha^{-1}=2\cdot3\cdot11\cdot41\cdot43^{-1}\cdot\ln2\cdot\pi$ (5)

With absolutely accurate numerical value $\alpha^{-1}=137{,}03599907817552$.

Other expressions for the Fine Structure constant α

Other formulas for the Fine Structure constant α are:

$\alpha^{-2}=137^2+\pi^2-(13\cdot19/11\cdot5^2\cdot197)$ (6)

$\alpha^{-1}=\pi^4+\pi^3+\pi+\pi^{-1}+2\cdot\pi^{-3}+3\cdot\pi^{-6}+\pi^{-8}+\pi^{-9}+2\cdot\pi^{-11}+\pi^{-12}+2\cdot\pi^{-14}+\pi^{-15}+2\cdot\pi^{-16}$ (7)

$\alpha^{-1}=\varphi^{10}+2\cdot\varphi^4+\varphi^{-3}+\varphi^{-5}+\varphi^{-10}+\varphi^{-14}+\varphi^{-17}+\varphi^{-20}+\varphi^{-23}+\varphi^{-25}+\varphi^{-27}+\varphi^{-29}+\varphi^{-33}+\varphi^{-38}+\varphi^{-40}$ (8)

$\alpha^{-1}=2\cdot e^4+e^3+e^2+2\cdot e^{-2}+e^{-3}+2\cdot e^{-4}+e^{-5}+e^{-7}+e^{-8}+e^{-11}+2\cdot e^{-12}+e^{-13}+e^{-15}+2\cdot e^{-16}+e^{-19}$ (9)

With absolutely accurate numerical value $\alpha^{-1}=137{,}035999084$.

Exact formula for the Fine Structure constant α with the Golden Angle and the Fifth Power of the Golden Mean

There is a dream,which,albeit more often not confessed,occupies the most secret aspirations of theoreticians and is that of reducing the various constants of Physics to simple formula involving integers and transcendent numbers.

We propose in [8] https://vixra.org/pdf/2110.0053v1.pdf, 2.021 the exact formula for the Fine Structure constant α with the Golden Angle and the Fifth Power of the Golden Mean:

$$\alpha^{-1}=360\cdot\varphi^{-2}-2\cdot\varphi^{-3}+(3\cdot\varphi)^{-5} \quad (10)$$

with numerical value:

$$\alpha^{-1}=137,03599916476564.....$$

This numerical value is the average of the measurements (2),(3) and (4). Other equivalent formulas for the Fine Structure constant are:

$$\alpha^{-1}=(362-3^{-4})\cdot\varphi^{-2}-(1-3^{-5})\cdot\varphi^{-1} \quad (11)$$

$$\alpha^{-1}=(362-3^{-4})+(3^{-4}+2\cdot3^{-5}-364)\cdot\varphi^{-1} \quad (12)$$

Conclusions

In this paper presented a total of 7 exact formulas for the Fine Structure constant α. A Simple and absolutely accurate expression for the Fine Structure constant α in terms of the Archimedes constant π:

$$\alpha^{-1}=2\cdot3\cdot11\cdot41\cdot43^{-1}\cdot\ln2\cdot\pi$$

We propose the exact formula for the Fine Structure constant α with the Golden Angle and the Fifth Power of the Golden Mean:

$$\alpha^{-1}=360\cdot\varphi^{-2}-2\cdot\varphi^{-3}+(3\cdot\varphi)^{-5}$$

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