“Unity” Formula for the Fine-structure constant

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With relative discrepancy 6.5×10^{-8} in respect to the Fine-structure constant recommended value next equality is observed

$$\mathbf{Cos}(\alpha^{-1}) = e^{-1} \qquad (1)$$

where **e** – natural logarithm base. Expression (1) yields value α^{-1} **= 137.036007939…..**

Tan ($n^2 + \pi^2$) has first local maximum at *n = 137*

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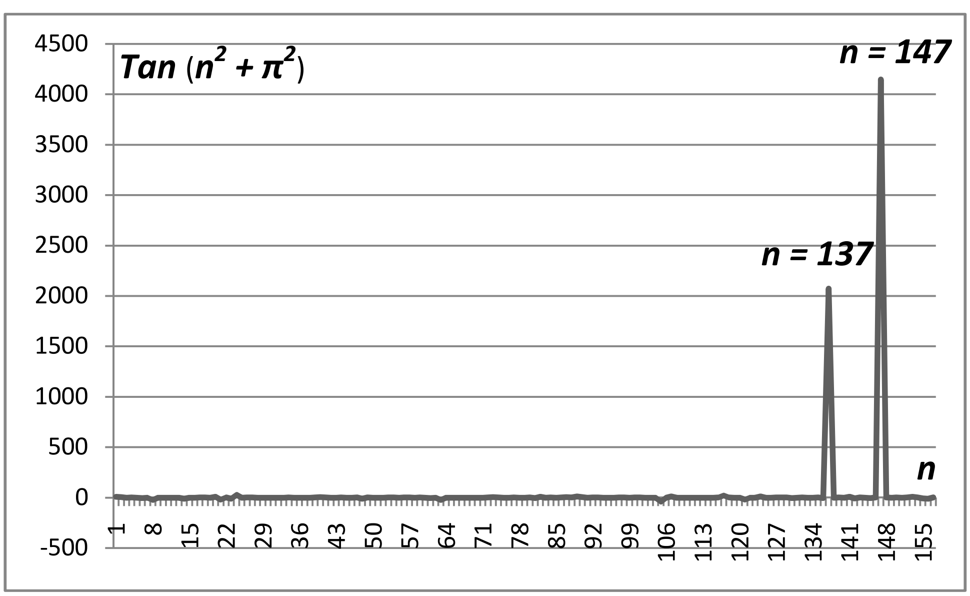
Following set has its first local maximum at ***n = 137*** and second one at ***n = 147***.

Tan ($n^2 + \pi^2$) where ***n*** is an integer number.



Fine-structure Constant depends on

Proton-to-Electron Mass Ratio

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All measurements of the Fine-structure constant are based on a behavior of electrons in atoms. Hence Fine-structure constant should depend on Proton-to-Electron mass ratio. The link can be described by following formulae

$$\boldsymbol{\alpha^{-1} = \sqrt{137^2 + (\pi - atan(\frac{4}{3 \cdot \mu}))^2} = 137.035999074536255(7)} \qquad (2)$$

where **μ** - Proton-to-electron mass ratio.

Deviation for produced value for the Fine-structure constant reciprocal is 10^{-14}. It is determined exclusively by uncertainty of measurements of the Proton-to-Electron mass ratio **μ**.

Simplified expression is also practical for the constant's value calculation

$$\boldsymbol{\alpha^{-1} = \sqrt{137^2 + \pi^2} \cdot \left(1 - \frac{4\pi}{3} \cdot \frac{1}{(137^2 + \pi^2) \cdot \mu}\right) = 137.035999073 \ldots} \qquad (3)$$

It worth to mention that number 137 belongs to recursive sets of squared and cubed natural numbers

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Number **137** belongs to sequence of squared natural numbers

$$\boldsymbol{S_n = n^2 - S_{n-1}}\,, \quad where\ \boldsymbol{n = 1, 2\ldots}\ \ and\ \boldsymbol{S_0 = 1} \tag{4}$$

$S_1=0$	$S_2=4$	$S_3=5$	$S_4=11$
$S_5=14$	$S_6=22$	$S_7=27$	$S_8=37$
$S_9=44$	$S_{10}=56$	$S_{11}=65$	$S_{12}=79$
$S_{13}=90$	$S_{14}=106$	$S_{15}=119$	$S_{16}=137$
$S_{17}=152$	$S_{18}=172$...		

Number **137** also belongs to sequence of cubed natural numbers

$$\boldsymbol{C_n = n^3 - C_{n-1}}\,, \quad where\ \boldsymbol{n = 1, 2\ldots}\ and\ \boldsymbol{C_0 = 2} \tag{5}$$

$C_1=-1$	$C_2=9$	$C_3=18$	$C_4=46$
$C_5=79$	$C_6=137$	$C_7=206$	$C_8=306$...

Respectively

$$\boldsymbol{137 = 1 + \sum_{n=1}^{16} (-1)^n \cdot n^2 = 1 + \sum_{n=1}^{16} n} \tag{6}$$

or

$$\boldsymbol{137 = 2 + \sum_{n=1}^{6} (-1)^n \cdot n^3} \tag{7}$$

There are 3 components in Fine-structure constant:

μ, π, e

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The article starts with the following question: can Fine-structure constant be measured on free electrons? Can the fine split in emission spectrum be detected on those emancipated, not bounded to atoms electrons?

General answer to the inquiry is simple: no. There is no experiment producing the constant's value where atoms are not used for the measurements.

Obviously, Fine-structure split is caused by interaction of an electron and an atomic nucleus because atom does not contain anything else besides electron cloud around the core. As consequence, the constant should depend on Proton-to-electron mass ratio **μ**.

Next expressions are suggested:

$$\boldsymbol{\alpha^{-1} = 137 \cdot \left(1 + e^{-1} \cdot \frac{\mu + 0.5}{137^3}\right) = 137.035999082\ \ldots} \qquad (8)$$

or similar form

$$\boldsymbol{\alpha^{-1} = 137 / \left(1 - e^{-1} \cdot \frac{\mu + 0.018}{137^3}\right) = 137.035999091\ \ldots} \qquad (9)$$

where

μ = 1836.1527… is Proton-to-electron mass ratio,

e = 2.71828… is natural logarithm base.

Small shifts **0.5** and **0.018** in reduced mass ratios in expressions (8) and (9) are not accidental because **0.018 / 0.5 = 0.036**.

The prime number **137** (which is the main participant in formula (8) and (9)) is itself produced from Proton to-electron mass ratio **μ** by rounding as follows:

$$137 = round_{to_{prime}}\left(\pi \cdot \sqrt{\mu}\right) \tag{10}$$

or

$$137 = round\left(\frac{2 \cdot \mu}{e \cdot \pi^2}\right) \tag{11}$$

Another intriguing equality for the Fine-structure constant

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Another intriguing and the most promising equality can be written retroactively for the number ***137*** being expressed as a function (Taylor series) of the fine-structure constant **α**. Please, see the equality **(12)**:

$$(\pi \cdot \alpha)^2 + (\pi \cdot \alpha)^4 + \frac{1}{8} \cdot (\pi \cdot \alpha)^6 + \ldots = \left(\frac{\pi}{137}\right)^2 \tag{12}$$

Please, note, that in the above series the coefficients for the subsequent terms (for the powers $(\pi \cdot \alpha)^8$ and above) could be all zeros as one extreme. As the other extreme, these coefficients cannot be greater than the coefficient for the term $(\pi \cdot \alpha)^6$ which is ***1/8***.

By using these two border cases we can retroactively calculate the range for the possible values for the Fine-structure constant. The range for the values of the fine-structure constant reciprocal satisfying the expression **(12)** is very narrow: $137.0359991669 < \alpha^{-1} < 137.0359991682$.

The middle point of the above range for the fine-structure constant reciprocal is shown in the expression **(13)**:

$$\alpha^{-1} = 137.0359991676 \pm 0.0000000007 \tag{13}$$

It is also worth to mention that number ***137*** is the best choice among the prime numbers to generate its $(\pi/137)^2$ value to be closest to the reciprocal of the proton-to-electron mass ratio $1/\mu_p = 1/1836.1527\ldots$ or the neutron-to-electron mass ratio $1/\mu_n = 1/1838.683662\ldots$. This could be the reason why the electromagnetic interactions are based on the coupling constant **α** (the fine-structure constant) which can be retroactively derived from numbers ***137*** and ***π***, as we saw it in **(12)**.

For direct expression of the fine-structure constant **α** as a function (Taylor series) of the ***π/137*** ratio, please, see the equality **(14)**:

$$(\pi \cdot \alpha)^2 = \left(\frac{\pi}{137}\right)^2 - \left(\frac{\pi}{137}\right)^4 + \frac{15}{8} \cdot \left(\frac{\pi}{137}\right)^6 - \frac{35}{8} \cdot \left(\frac{\pi}{137}\right)^8 + \cdots \qquad (14)$$

There is also a converging set for the fine-structure constant **α**. Please, see the equality **(15)**:

$$(\pi \cdot \alpha)^2 = \frac{\pi^2}{137^2+\pi^2} \cdot \left(1 + \frac{7}{8} \cdot \left(\frac{\pi^2}{137^2+\pi^2}\right)^2 + \cdots\right) \qquad (15)$$

Connection between ratio *π/137* and proton-to-electron mass ratio μ_p and neutron-to-electron mass ratio μ_n

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The equality **(16)** connects the proton-to-electron mass ratio μ_p to the ***π / 137*** ratio:

$$\left(\frac{\pi}{137}\right)^2 \Big/ \left(1 - \frac{3}{2}\cdot\frac{\pi}{137} - \frac{1}{8}\cdot\left(\frac{\pi}{137}\right)^2 - \cdots\right) = \frac{1}{1836.1596\ldots} \approx \frac{1}{\mu_p} \qquad \textbf{(16)}$$

The equality **(17)** connects the neutron-to-electron mass ratio μ_n to the ***π / 137*** ratio:

$$\left(\frac{\pi}{137}\right)^2 \cdot \left(1 + \frac{3}{2}\cdot\frac{\pi}{137} - \frac{1}{4}\cdot\left(\frac{\pi}{137}\right)^2 + \cdots\right) = \frac{1}{1838.6935\ldots} \approx \frac{1}{\mu_n} \qquad \textbf{(17)}$$

Therefore, expression **(10)** can be extended with the neutron-to-electron mass ratio μ_n in addition to the proton-to-electron mass ratio μ_p providing some reasoning behind the number ***137*** origin and appearance in nature's laws. Please, see the expression **(18)**:

$$137 = round_{to_{prime}}\left(\pi \cdot \sqrt{\mu_p}\right) = round_{to_{prime}}\left(\pi \cdot \sqrt{\mu_n}\right) \qquad \textbf{(18)}$$

where

μ_p **-** is the proton-to-electron mass ratio,

μ_n **-** is the neutron-to-electron mass ratio.