The Role of Powers of 2 in Physics

The purpose of this article is to highlight the role of powers of 2 in physics.

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1. Formulas Containing Powers of 2

The following list, which is not exhaustive, contains six equations based on powers of 2. **Appendix 1** contains the nomenclature used in this paper.

1. The Titus-Bode Law

The Tutus-Bode Law predicts the distances of the planets from the sun in astronomical units.

Summary

Discovered by	Gregory, Wolff, Titus and Bode [1]
Year of discovery	1715?
Physical proof	Not known

Formulas

$$a = 0.3 \times 2^{n} + 0.4 \qquad \text{(version 1)}$$

$$a = 0.3 \times 2^{n-2} + 0.4 \qquad \text{(version 2)}$$

Author's version (2015):

$$a = 0.3 \times 2^{n} + 0.4 - 0.1\, n^{2} \times 2^{n-5.4} + 0.003\, n^{4} \qquad \text{(version 3)}$$

Note

The relative error of versions 1 and 2 (both formulas are equivalent) is less than 20% for 7 planets, while the relative error of version 3 is less than 20% for 8 planets. The following table shows the data produced by each version. The relative error corresponding to the data shown in red is greater than 20%.

Table: Predicted values of *a* from the Titus-Bode's Law and from the author's corrected law (version 3)

Planet	*n* formula (versions 1 and 3)	*n* formula (version 2)	Predicted Distance (AU) (version 1 and 2)	Predicted Distance (AU) (version 3)	Actual Average Distance (AU)
Mercury	-1	1	0.55	0.55	0.39
Venus	0	2	0.7	0.70	0.73
Earth	1	3	1.0	1.00	1.00
Mars	2	4	1.6	1.61	1.93
(Ceres)	3	5	2.8	2.87	2.77
Jupiter	4	6	5.2	5.36	5.22
Saturn	5	7	10.0	9.98	9.57
Uranus	6	8	19.6	18.3	19.26
Neptune	7	9	38.8	31.15	30.17
Pluto	8	10	77.2	50.69	39.60

2. Formula for the Electron spin g-Factor

The formula for the electron spin g-factor predicts the value of the so called electron spin g-factor, at least, to 12 decimal places and is based on four powers of the fine-structure constant inside a 4096 root, which is a power of 2: $2^{12} = 4096$

Summary

Discovered by	The author [2]
Year of discovery	2012
Physical proof	Not known

Formula

$$g_e = 2\left(\sqrt[2^{12}]{\frac{1}{\alpha} - \frac{2}{\alpha^{0.5}} + \frac{1}{\alpha^{0.1}} + \frac{0.00002}{\alpha^{0.09}}}\right)$$

3. Formula for the Fine-Structure Constant Based on the Number pi and Powers of 2

This formula predicts the value of the fine-structure constant. The accuracy of the formula is 10 decimal places.

Summary

Discovered by	The author [3]
Year of discovery	2015
Physical proof	Not known

Formula

$$\alpha = \frac{1}{\left(2^{4}+2^{-6}+2^{-8}+2^{-10}+2^{-14}+2^{-16}+2^{-17}+2^{-18}+2^{-22}\right)\pi^{\frac{15}{8}}}$$

4. Formula for the Fine-Structure Constant Based on the Number pi, Powers of 2 and Powers of 10

This formula predicts the value of the fine-structure constant. The accuracy of the formula is 6 decimal places.

Summary

Discovered by	The author
Year of discovery	2015
Physical proof	Not known

Formula

$$\alpha = \frac{2^{10}-10^{3}}{(\pi+3)\,2^{10}-3\times 10^{3}}$$

5. The Lepto-baryonic Formula for the Fine-Structure Constant

This formula predicts the value of the fine-structure constant.

Summary

Discovered by	The author [4]
Year of discovery	2011-2015
Physical proof	Not known. It is highly likely that this formula to be a true natural law

Formula

$$\alpha = 2^{-18\left(\frac{m_e - m_l}{m_n - m_p}\right)}$$

6. The Lepto-Baryonic Formula for the Mean Lifetime of the Proton

This formula predicts the value of the mean lifetime of the proton. The predicted value is 7.1236×10^{34} years

Summary

Discovered by	The author [5]
Year of discovery	2011-2015
Physical proof	Not known

Formula

$$\tau_p \approx 12 \times 2^{216} \left(\frac{m_n - m_p}{m_e - m_l} \right) \frac{\hbar}{m_p c^2}$$

2. Conclusions

The Titus-Bode law has defied physical proof for over 300 years. A modified and more accurate version of this law could, one day, be derived from a new quantum gravity theory. Should the new version prove correct, the status of the Bode's law would change from numeric to approximate law of reality.

Appendix 1
Nomenclature

The following are the symbols used in this paper

Titus-Bode's Law

a = mean predicted distance of the planet from the sun [major semi axis in astronomical units (AU)]
n = integer (this is in fact a gravitational quantum number)
AU = astronomical units

Formula for the Electron spin g-Factor

α = fine structure constant, electromagnetic coupling constant, atomic structure constant
g_e = electron spin g-factor

Formula for the Fine-Structure Constant Based on the Number pi and Powers of 2 and Formula for the Fine-Structure Constant Based on the Number pi, Powers of 2 and Powers of 10

$\alpha =$ fine structure constant, electromagnetic coupling constant, atomic structure constant

The Lepto-baryonic Formula for the Fine-Structure Constant

$\alpha =$ fine structure constant, electromagnetic coupling constant, atomic structure constant
$m_e =$ electron rest mass
$m_l =$ electrino rest mass
$m_n =$ neutron rest mass
$m_p =$ proton rest mass

The Lepto-Baryonic Formula for the Mean Lifetime of the Proton

$\hbar =$ reduced Planck's constant
$c =$ speed of light in vacuum
$\tau_p =$ mean lifetime of the proton

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