A MATHEMATICAL EXPRESSION FOR INVERSE FINE-STRUCTURE CONSTANT

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ABSTRACT

From the golden angle to the Pell constant, a simple, elegant and concise mathematical expression of the inverse fine-structure constant is given.

***K*eywords** Fine structure constant · Golden angle · Pell constant

1 Introduction

The idea of finding mathematical expressions for dimensionless physic constants is an important topic that goes back to several physicists as Sir Arthur Eddington, Albert Einstein, Feynman, Gell-Man and Paul Dirac.

Recent years an extra effort have been done by mathematician Simon Plouffe, with their set of reasonable expressions based on simplicity and length for the mass ratios of fundamental particles.[1]

2 The fine-structure constant calculation

Following the same reasoning propose by Plouffe, we start a research for a mathematical expression of the inverse alpha constant.

The fine-structure constant has a dimensionless value experimentally determined by the most recent methods from atomic, condensed-matter[2], and have measured $\alpha = 1/137.035999046(27)$, at 2.0×10^{-10} accuracy, via the recoil frequency of cesium-133 atoms in a matter-wave interferometer.

Here is presented a concise and possibly close-form expression to obtain every digits of this important physic constant.

$$\alpha^{-1} \simeq \lfloor g \rfloor + \frac{\sqrt{\frac{P_{Pell}}{7}}}{8} \tag{1}$$

Where:
$\lfloor g \rfloor$ is floor value of the golden angle in degrees, that is 137
P_{Pell} is the Pell Constant[3], defined as $1 - \prod_{k=0}^{\infty} \left(1 - \frac{1}{2^{2n+1}}\right) \approx 0.58057755820489240229$
Then $\alpha^{-1} \simeq 137.035999056$, approximately the same value as experimentally determined[2] including the uncertainty level; this formula shows an unprecedentedly level of accuracy because with only 4 mathematical symbols give more than 7 exact digits of a physical constant.

2.1 Conclusions

The length of expression presented in this paper is simple, short, elegant, despite other speculative formulas presented before that the length is clearly longer than the output. This could be a novel approach to understand what really Fine-Structure constant is.

References

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