An Equation Relating Planck Length, Planck's Constant and the Golden Ratio

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Abstract

Planck's constant, Planck length and the golden ratio can all be written as a simple equation. It is not yet clear if this is simply a mathematical coincidence or rather something with a deeper fundamental meaning. A few ideas will be suggested that might be physical in nature.

1   Discussion

First start with the uncertainty princple at its limit to be an equality.

$$\Delta x \Delta p = \frac{\hbar}{2} \tag{1}$$

Next look logarithmic spiral equation. Here the growth factor is $b = \frac{\ln \phi}{\pi/2}$ where ϕ is the golden ratio [1].

$$\frac{dr}{d\theta} = br \tag{2}$$

From the above two equations l_p could be thought of as the incremental radius change in the cross section of a growing sphere, namely $\frac{dr}{d\theta}$, while the momentum is set to unity; $|\hat{p}| = 1$. Therefore, the following can be correlated to Planck length, Planck's constant and the growth factor.

$$\frac{l_p}{b} \cdot |\hat{p}| = \frac{\hbar}{2} \tag{3}$$

$$l_p \cdot |\hat{p}| = b\frac{\hbar}{2} \tag{4}$$

A potential physical connection might be that the maximum entropy per generator for a braid with three strands is $\ln \phi$. [3] [2] Additionally, the growth factor b might be correlated to a factor of cosmic expansion. Due to fairly strong convergence, further investigation appears essential to see if this equation does indeed have a physical meaning.

Table 1: Convergence Table

Equation	Error %
$l_p \cdot |\hat{p}| = b\frac{\hbar}{2}$	0.06

References

[1] Logarithmic spiral. `https://mathworld.wolfram.com/LogarithmicSpiral.html`.

[2] J. Baez. The golden ratio and the entropy of braids. `https://johncarlosbaez.wordpress.com/2017/11/22/the-golden-ratio-and-the-entropy-of-braids/`, Nov. 2017.

[3] D. D'Alessandro, M. Dahleh, and I. Mezic. Control of mixing in fluid flow: a maximum entropy approach. *IEEE Transactions on Automatic Control*, 44:1852–1863, 1997.