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Ratio of Hyperbolic Length to Elliptic Length as Measure of Dimensionality

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Abstract: *The ratio of hyperbolic length to elliptic length as a measure of dimensionality was discussed.*

Keywords: *Double surface geometry, ratio of hyperbolic length to elliptic length, measure of dimensionality*

1. Introduction

On the double surface we have deal with the elliptic length n and the hyperbolic length h. They are implicitly related by the quadratic equation [1]:

$$3n^2 - 2nh + 4\pi^2 - h^2 = 0. \qquad (1a)$$

Or

$$h^2 + 2nh - (3n^2 + 4\pi^2) = 0. \qquad (1b)$$

Having two solutions for the elliptic length n:

$$n_{1,2} = \frac{h \mp \sqrt{4h^2 - 12\pi^2}}{3}. \qquad (2a)$$

But only one solution for the hyperbolic length h:

$$h = -n + 2\sqrt{n^2 + \pi^2}. \qquad (2b)$$

The above function (2b) has minimum hyperbolic length $h_{minimum} = \sqrt{3}\pi$ occurring at the elliptic length $n(h_{minimum}) = \frac{\sqrt{3}}{3}\pi$. (See appendix 1). The most favourable hyperbolic length is 3-times longer than the corresponding elliptic length:

$$R(h_{minimum}) = \frac{h_{minimum}}{n(h_{minimum})} = 3. \qquad (3)$$

If the ratio of hyperbolic length to elliptic length expresses a measure of the dimensionality of space, then the three spatial dimensions are the most favourable. [2]

The ratio of hyperbolic length to elliptic length R is explicitly related to the elliptic length n as follows:

$$R(n) = \frac{h}{n} = \frac{-n + 2\sqrt{n^2 + \pi^2}}{n} = 2\sqrt{1 + \frac{\pi^2}{n^2}} - 1. \qquad (4)$$

The above function (4) has minimum $R_{minimum} = 1$ occurring at the infinite elliptic length $n(R_{minimum}) = \infty$ (See appendix 2). At this occasion the elliptic length equals the hyperbolic length $n(R_{minimum}) = \infty = h(R_{minimum})$.

The maximum ratio $R_{maximum}$ is determined by the elliptic length $n = 0.546\,897\,427\,7 \ldots$ belonging to the average elliptic-hyperbolic unit $s(n) = 1$ according to the next relation [1]:

$$s(n) = n\left(2 - \frac{1}{\sqrt{1 + \frac{\pi^2}{n^2}}}\right). \qquad (5)$$

Since the unit average elliptic-hyperbolic length $s(n) = 1$ represents one Compton wavelength of the matter. After all, it is hard to imagine that matter could occupy a space that is smaller than it.

2. RESULT

The maximum ratio of hyperbolic length to elliptic length is then applying the relation (4) the next:

$$R_{maximum} = 2\sqrt{1+\frac{\pi^2}{(0.546\,897\,427\,7\,\ldots)^2}} - 1 = 10{,}66\,\ldots \quad (6)$$

3. CONCLUSION

If the ratio of hyperbolic length to elliptic length expresses spatial dimensions their maximum value is 10. The maximum ratio is also enough high to additionally offer one-way dimension of time.

REFERENCES

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APPENDIX 1

$$h = -n + 2(n^2+\pi^2)^{\frac{1}{2}}. \quad (a)$$

Derivation gives

$$h^* = -1 + 2\frac{1}{2}2n(n^2+\pi^2)^{-\frac{1}{2}}. \quad (b)$$

Being zero we have

$$-1 + \frac{2n}{\sqrt{n^2+\pi^2}} = 0. \quad (c)$$

And explicitly

$$n = \frac{\sqrt{3}\pi}{3}. \quad (d)$$

APPENDIX 2

$$R = 2\left(1+\frac{\pi^2}{n^2}\right)^{\frac{1}{2}} - 1. \quad (e)$$

Derivation gives

$$h^* = \left(1+\frac{\pi^2}{n^2}\right)^{-\frac{1}{2}}. \quad (f)$$

Being zero we have

$$\frac{1}{\sqrt{1+\frac{\pi^2}{n^2}}} = 0. \quad (g)$$

And explicitly

$$n = \infty. \quad (h)$$

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