International Journal of Advanced Research in Physical Science (IJARPS)
Volume 11, Issue 04, 2024, PP 1-3
ISSN (Online)-2349-7882
www.arcjournals.org

Measuring, Observing and Counting in Double Surface

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Abstract: : *Different kinds of path in the double surface were discussed.*

Keywords: *Double surface geometry, elliptic, hyperbolic, measured, observed and counted path*

1. Introduction

The path provided in the double surface mirrors the elliptic as well as hyperbolic characteristics. [1] It can be measured indirectly as the inverse path $\frac{1}{s}$ being the average of the inverse elliptic path $\frac{1}{n}$ and the inverse hyperbolic path $\frac{1}{h}$ as follows:

$$\frac{1}{s}=\frac{\frac{1}{n}+\frac{1}{h}}{2}. \tag{1}$$

On the other side the path is observed directly as the path $s_{observed}$ being the average of the elliptic path n and the hyperbolic path h as well as expressing the Euclidean path proposed as the geometric sum of the elliptic path n and rotation π as follows:

$$s_{observed}=\frac{n+h}{2}=s_{Euclidean}=\sqrt{n^2+\pi^2}. \tag{2}$$

We can mentally count different types of paths with different units. But in situ it is feasible to just count the path with a unit of the same type. The elliptic path n to treat with the elliptic unit n_{unit}. The hyperbolic path h to treat with the hyperbolic unit h_{unit}. And then to take the average of both partial results:

$$s_{counted}=\frac{\frac{n}{n_{unit}}+\frac{h}{h_{unit}}}{2}. \tag{3}$$

Comparing relations (2) and (3) we can see that the observed path $s_{observed}$ is the result of the approximate counting since it is got with the help of the average elliptic-hyperbolic unit $s_{unit}=1$:

$$s_{observed}=\frac{\frac{n}{s_{unit}}+\frac{h}{s_{unit}}}{2}=\frac{\frac{n}{1}+\frac{h}{1}}{2}=\frac{n+h}{2}\approx s_{counted}. \tag{4}$$

2. Useful Relations

Applying equations (1) and (2) some useful relations are given:

a) The hyperbolic path h is explicitly related to the elliptic path n (See appendix 1):

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

b) And vice versa the elliptic path n is explicitly related to the hyperbolic path h (See appendix 2):

$$n=\frac{2h-\sqrt{4h^2-12(4\pi^2-h^2)}}{6}. \tag{6}$$

c) The average elliptic-hyperbolic path s is explicitly related to the elliptic path n(See appendix 3):

$$s = n\left(2 - \frac{1}{\sqrt{1+\frac{\pi^2}{n^2}}}\right). \tag{7}$$

d) As well as with the help of equation (6) the average elliptic-hyperbolic path s is explicitly related to the hyperbolic path h:

$$s = \frac{2h - \sqrt{4h^2 - 12(4\pi^2 - h^2)}}{6}\left(2 - \frac{1}{\sqrt{1+\frac{\pi^2}{\left(\frac{2h - \sqrt{4h^2 - 12(4\pi^2 - h^2)}}{6}\right)^2}}}\right). \tag{8}$$

e) Rearranging the equation (7) the elliptic path n can be explicitly related to the average elliptic-hyperbolic path s as the solution of the quartic equation:

$$3n^4 - 4sn^3 + (4\pi^2 + s^2)n^2 - 4\pi^2 sn + \pi^2 s^2 = 0. \tag{9}$$

But this relation is less useful due to the abundance of terms.

3. The Path Comparison

The above equations show that the average elliptic-hyperbolic path s is longer than the elliptic path n but shorter than the hyperbolic path h:

$$n < s < h. \tag{10a}$$

For instance, the average elliptic-hyperbolic unit $s_{unit} = 1$ is longer than the elliptic unit n_{unit} but it is shorter than the hyperbolic unit h_{unit}:

$$n_{unit} = 0.546\,897\,427\,727\,... < s_{unit} = 1 < h_{unit} = 5.830\,782\,776\,729... \tag{10b}$$

Some other values are collected in Table1.

Table1. *The comparison of the elliptic, the counted, the measured, the observed and the hyperbolic path in the double surface*

Elliptic path n	Counted path $s_{counted}$	Measured path s	Observed path $s_{observed}$	Hyperbolic path h
0	0.53879432212	**0**	π	2π
0.546897427727	**1**	**1**	3.18884010223	5.83078277673
1	1.39392795057	1.68169011382	3.29690830948	5.59381661895
137	137.006176824	137.036006254	137.036015720	137.072031440
∞	∞	∞	∞	∞

It can be seen from Table1 that all five types of the path generally differ from each other. Only at infinity do they equalize. They are only two exceptions. The elliptic path n and the measured path s are identical at the zero value (See the first row). And the counted path $s_{counted}$ and the measured path s are identical at the unit value (See the second row).

4. Conclusion

The reality can be less or more than we count. But $1\ x\ 1 = 1$ and that's all we need.

Dedication

In memory of my mother Regina (1924-2007)

References

[1] Janez Špringer. " Point in Double Surface” International Journal of Advanced Research in Physical Science (IJARPS), Vol 11, issue 08, pp. 1-3., 2024.

Appendix 1

Applying the equation (2)

$$s_{observed} = \frac{n+h}{2} = s_{Euclidean} = \sqrt{n^2 + \pi^2}. \qquad (a)$$

Writing explicitly for h and rearranging:

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

Appendix 2

Applying the equation (2) again

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

Rearranging and squaring both sides of the equation:

$$n^2 + 2nh + h^2 = 4(n^2 + \pi^2). \qquad (d)$$

Rearranging again to the quadratic equation

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

Solving the quadratic equation and choosing the lower result

$$n = \frac{2h - \sqrt{4h^2 - 12(4\pi^2 - h^2)}}{6}. \qquad (f)$$

Appendix 3

Applying the equation (1)

$$\frac{1}{s} = \frac{\frac{1}{n} + \frac{1}{h}}{2}. \qquad (g)$$

And rewriting it with the help of the equation (b) from Appendix 1

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

Getting

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

Rearranging step by step to

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

Citation: *Janez Špringer. " Measuring, Observing and Counting in Double Surface" International Journal of Advanced Research in Physical Science (IJARPS), Vol 11, issue 04, pp. 1-3., 2024.*