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Posted Date: 14 February 2025

doi: 10.20944/preprints202501.1995.v2

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The Symmetry Number Structure about Line-1/2

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Abstract: In this paper, we discuss the symmetry number structure about line-1/2 **.** We find that using the symmetry characters of those structures we can give proofs of the number Conjectures: Goldbach Conjecture、Twins Prime Conjecture and Polignac's conjecture and the Riemann Hypothesis. **In this paper, we also gave concise proofs of the Fermat' Last Theorem and the 3n+1 conjecture.**

Keywords: P/2n; Prime numbers Conjectures; Riemann Hypothesis

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The Symmetry of P/2n and Prime Numbers Conjectures

We have

$$\frac{P}{2n} = \begin{cases} \frac{1}{2^{N+1}} & n = 2^N P \\ \frac{3}{4} & n = 2 \quad P = 3 \\ 1 & n = 1 \quad P = 2 \end{cases}$$

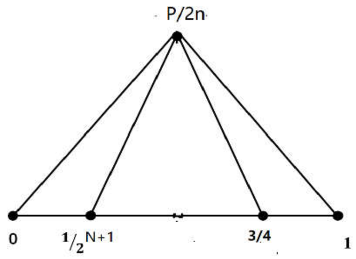

Figure 1. P/2n number structure with points [0 1/2^N+1 3/4 1].

N~(0, 1 , 2 , 3 , 4 , ……….) All natural numbers

n~(1 , 2 , 3 , 4 , ……….) All natural numbers excepted 0

P~(2 , 3 , 5 , 7 , ……….) All prime numbers

And

$$\frac{P}{2n} = \begin{cases} \frac{1}{2} - \frac{1}{2n} & P = n - 1 \ (n \geq 3) \\ \frac{1}{2} & P = n \\ \frac{1}{2} + \frac{1}{2n} & P = n + 1 \end{cases}$$

And We have

p0∈P ~(0 , n] $(n \geq 2)$

And based on Bertrand -Chebyshev Theorem： when $n \geq 2$, there are at least a prime number between n and 2n.

pn∈P ~[n , 2n) $(n \geq 2)$

So we have:

$$0 < \frac{p0}{2n} \leq \frac{1}{2}$$

$$\frac{1}{2} \leq \frac{pn}{2n} < 1$$

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So we have

$$\frac{p0}{2n} = \frac{1}{2} - \frac{1}{2n} \ (n \geq 3)$$

$$\frac{pn}{2n} = \frac{1}{2} + \frac{1}{2n}$$

So

$$(\frac{1}{2} - \frac{1}{2n}) + (\frac{1}{2} + \frac{1}{2n}) = \frac{p0}{2n} + \frac{pn}{2n}$$

$$2n = p0 + pn \quad (n \geq 3)$$

This is the proof of Goldbach conjecture.

And

$$\frac{pn}{2n} - \frac{p0}{2n} = \left(\frac{1}{2} + \frac{1}{2n}\right) - (\frac{1}{2} - \frac{1}{2n})$$

$$pn - p0 = 2$$

This is the proof of Twin Primes Conjecture

And we also have

$$0 < \frac{p0}{2n} = \frac{2k_1+1}{2n} \ll 1/2 \ (n \geq 3)$$

$$0 < 2k_1 + 1 \ll n$$

$$0 < k_1 \ll \frac{n-1}{2}$$

k_1 *is a positive integer*

so $k1 \sim 1,2,3 \cdots\cdots \left[\frac{n-1}{2}\right] \ (n \geq 3)$

And

$$\frac{1}{2} \ll \frac{pn}{2n} = \frac{2k_2+1}{2n} < 1$$

$$n \ll 2k_2 + 1 < 2n$$

$$\frac{n-1}{2} \ll k_2 < \frac{2n-1}{2} (n \geq 3)$$

k_2 *is a positive integer*

so $k_2 \sim \left[\frac{n-1}{2}\right], \left[\frac{n-1}{2}\right] + 1, \cdots\cdots \left[\frac{2n-1}{2}\right] \qquad (n \geq 3)$

we have

$$\frac{pn}{2n} - \frac{p0}{2n} = \frac{2k_2+1}{2n} - \frac{2k_1+1}{2n}$$

$$pn - p0 = 2(k2 - k1)$$

$$(pn - p0)_{max} = 2(k2_{max} - k1_{min}) = 2\left(\left[\frac{2n-1}{2}\right] - 1\right) = 2(n-2) \ (n \geq 3)$$

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This is the proof of Polignac's conjecture.

So we get a symmetry structure of P/2n as Figure 2

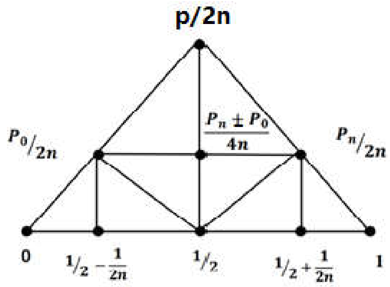


Figure 2. a symmetry structure of P/2n about line-1/2.

$$\frac{p0}{2n} = \frac{1}{2} - \frac{1}{2n} \ (n \geq 3)$$

$$\frac{pn}{2n} = \frac{1}{2} + \frac{1}{2n}$$

$$\frac{pn \pm p0}{4n} = \frac{1}{2}$$

A Concise Proof of The Fermat' Last Theorem

The Fermat' Last Theorem:

$\boldsymbol{x^n + y^n = z^n}$ $(x, y, z \in n,\ xyz \neq 0\ \ n > 2)$ has no solution.

$\boldsymbol{n}$~$(\mathbf{1, 2, 3, 4, 5, 6 \ldots\ldots\ldots})$ all the natural numbers excepted 0

The equivalent proposition of this conjecture is

$$\boldsymbol{(\frac{x}{z})^n + (\frac{y}{z})^n = 1}$$

$(x, y, z \in n,\ xyz \neq 0\ \ n > 2)$ has no solution.

We have

$$(\frac{x}{z})^n + (\frac{y}{z})^n = 1 = \sum \frac{1}{2^n}$$

n~$(1,2,3,4,5, 6 \ldots\ldots\ldots)$ all the natural numbers excepted 0

$$(\frac{x}{z})^n + (\frac{y}{z})^n = 1$$

$$= (\frac{1}{2^n} - \frac{1}{2^n}) + 1$$

$$= (\frac{1}{2} - \frac{1}{2^n}) + (\frac{1}{2} + \frac{1}{2^n})$$

$$= \frac{1}{2^n} + (1 - \frac{1}{2^n})$$

Only When $n = 1$ we have

$$\left(\frac{1}{2^n} - \frac{1}{2^n}\right) = \left(\frac{1}{2} - \frac{1}{2^n}\right) = 0$$

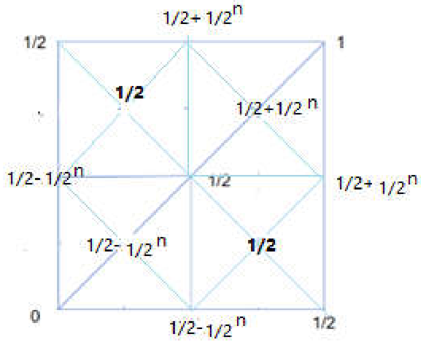
$$1 = (\frac{1}{2} + \frac{1}{2^n}) = (\frac{1}{2} + \frac{1}{2})$$

And Only When $n = 2$

$$\left(\frac{1}{2^n}\right) = \left(\frac{1}{2} - \frac{1}{2^n}\right) = \frac{1}{4}$$

$$\left(1 - \frac{1}{2^n}\right) = \left(\frac{1}{2} + \frac{1}{2^n}\right) = \frac{3}{4}$$

And We can get the figures as Figure 3.



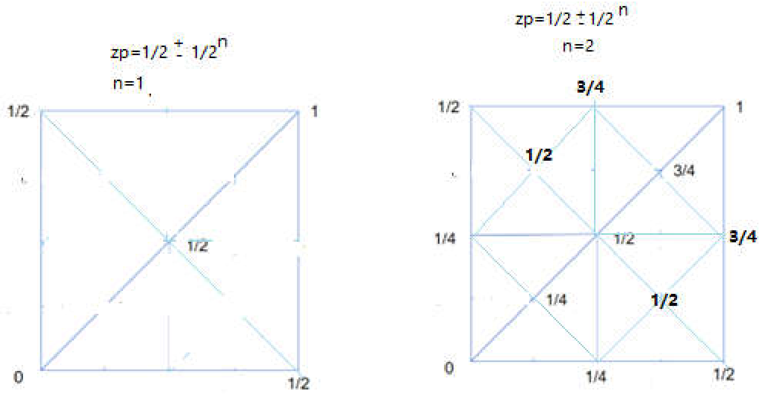


Figure 3. D1/2+1/2 with points 1/2-1/2ⁿ and 1/2-1/2ⁿ n~(1 , 2 , 3 , 4 , ……….).

$$\boldsymbol{n = 1} \ \textbf{and} \ \boldsymbol{n = 2}$$

In fact we have

$$1 = \frac{1}{2^1} + \frac{1}{2^1} = \frac{1}{2^2} + \frac{3}{2^2} = \frac{1}{2^3} + \frac{7}{2^3} \ \boldsymbol{or} \ \frac{3}{2^3} + \frac{5}{2^3}$$

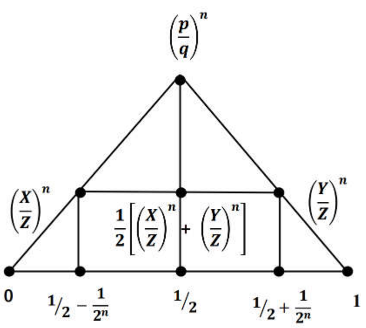


Figure 4. a symmetry structure of $\left(\frac{p}{q}\right)^n$ about line-1/2.

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$(\frac{p}{q})^n$ p, q is relatively prime and $n \sim \left(1 ,\ 2 ,\ 3 ,\ 4 ,\ \ldots\ldots\ldots \right)$

$$\mathbf{1/2}[(\frac{x}{z})^n + \left(\frac{y}{z}\right)^n] = \mathbf{1/2} \leftrightarrow (\frac{x}{z})^n + \left(\frac{y}{z}\right)^n = \mathbf{1}$$

$$(\frac{x}{z})^n = \frac{1}{2} - \frac{1}{2^n}$$

$$(\frac{y}{z})^n = \frac{1}{2} + \frac{1}{2^n}$$

3. a concise proof of Collatz Conjecture

Collatz Conjecture:

$$f(n) = \begin{cases} \frac{n}{2} & if n \equiv 0\ (mod2) \\ 3n + 1 & if n \equiv 1\ (mod2) \end{cases}$$

$k \in N \ \rightarrow f^k(n) = 1$

n~(1 , 2 , 3 , 4 , ……….)all the natural numbers excepted 0

$$\frac{[\frac{n+1}{2}]+[\frac{n-1}{2}]}{[\frac{n}{2}]} = \frac{2n+2}{n+1} = \frac{(n-1)+(3n+1)}{2n} = \frac{4n}{2n} = \frac{4}{2} = \frac{2}{1} = \frac{1}{\frac{1}{2}}$$

$$= \sum \frac{1}{2^N}$$

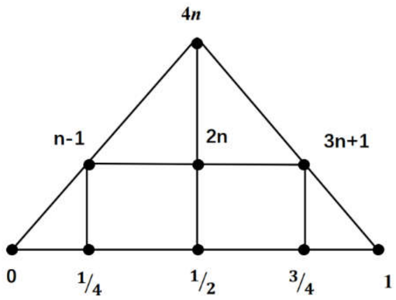

Figure 5. a symmetry structure of $4n$ about line-1/2

$$\mathbf{2n = 1/2[(n-1) + (3n+1)]}$$

$$\lim_{n\to\infty} \left(\frac{n-1}{4n}\right) = 1/4$$

$$\lim_{n\to\infty} \left(\frac{3n+1}{4n}\right) = 3/4$$

4. The symmetry of $L^{1/2\pm\varepsilon}$ (0 1/2 1) **and Riemann Hypothesis**

Riemann Zeta-Function

$$\xi\ (s) = \sum_{n=1} \frac{1}{n^s} = \prod \frac{1}{1-p^s} \qquad (s = a + bi)$$

$$S > 1 \qquad \xi\ (s) \rightarrow const$$

The trivial zero-points of Riemann Zeta-Function is -2n (n~1,2,3,…….)

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Riemann Hypothesis: all the Non-trivial zero-point of Zeta-Function $Re(s) = 1/2$.

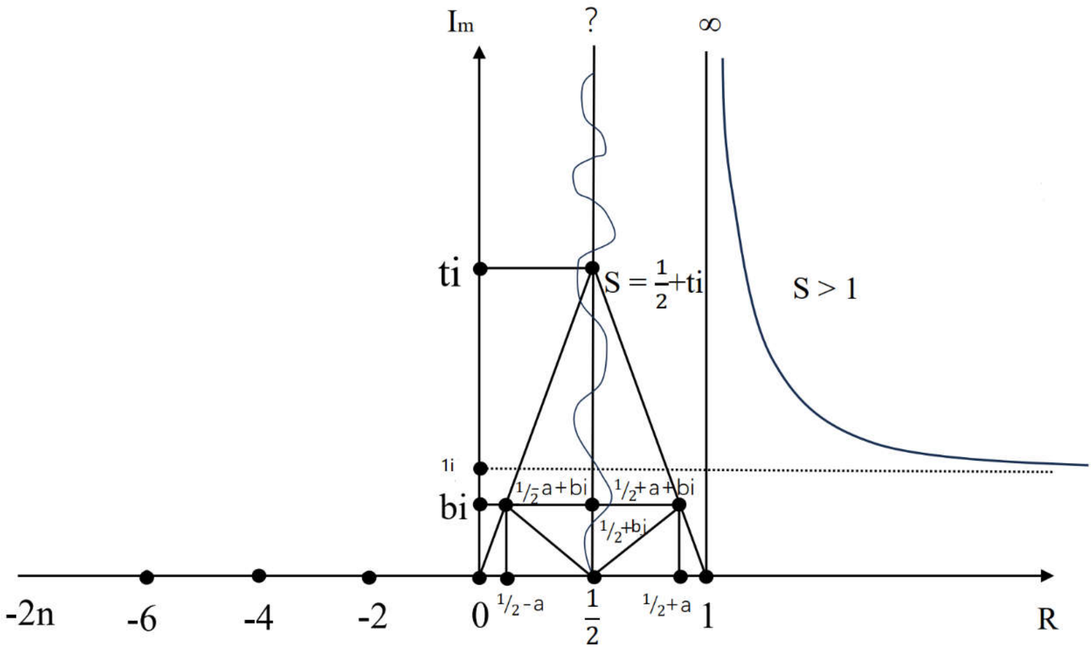

Figure 6. Riemann Hypothesis: all the non-trivial Zero points of Riemann zeta-function are on the 1/2 axis.

We can get a symmetry structure including all numbers about the line-1/2 as Figure 6

$$s = \frac{1}{2} + ti \qquad t \in R$$

$$zp1 = \frac{1}{2} - a + bi \quad zp0 = \frac{1}{2} + bi \quad zp2 = \frac{1}{2} + a + bi$$

$$zp1 + zp2 = \left(\frac{1}{2} - a + bi\right) + \left(\frac{1}{2} + a + bi\right) = 1{+}2bi$$

$$zp2 - zp1 = \left(\frac{1}{2} + a + bi\right) - \left(\frac{1}{2} - a + bi\right) = 2a$$

$$a\,,b \in R \;\; 0 \le a \le \frac{1}{2}$$

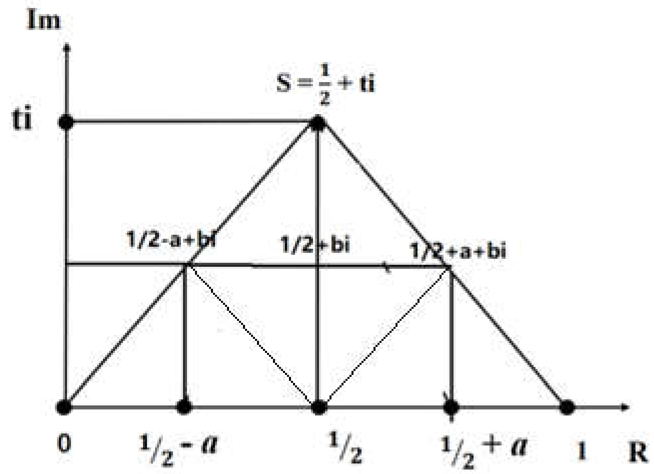

Figure 7. a symmetry structure about line1/2+/-a at the zero piont s=1/2+ti.

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As the Figure 7. If we have zero points of $\xi\ (s)$ as

$$zp1 = \frac{1}{2} - a + bi \qquad zp2 = \frac{1}{2} + a + bi$$

And $s = \frac{1}{2} + ti \quad t \in R$ **is the first zero point on line-1/2**

We can get a zero point as

$$zp0 = \frac{1}{2} + bi \quad b < t \;\; b, t \in R$$

It is contrary to that $s = \frac{1}{2} + ti \quad t \in R$ **is the first zero point on line-1/2**

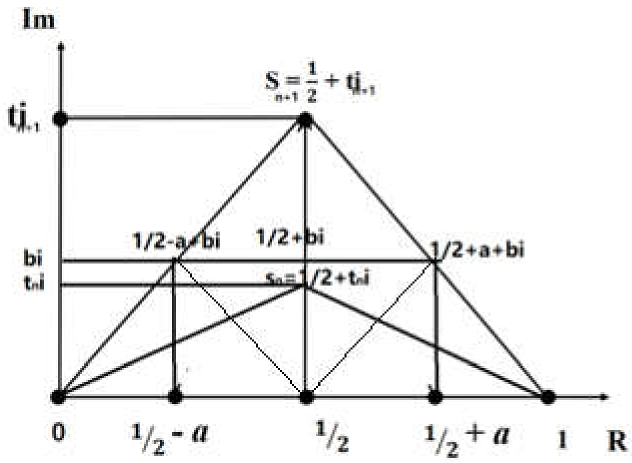

Figure 8. a symmetry structure about line1/2+/-a at the zero point s_n=1/2+t_ni and s_{n+1}=1/2+t_{n+1}i.

As the Figure 8. If we have zero points of $\xi\ (s)$ as

$$zp1 = \frac{1}{2} - a + bi \qquad zp2 = \frac{1}{2} + a + bi$$

And $s_n = \frac{1}{2} + t_n i \quad t \in R$ is the No. n zero point on line-1/2

$s_{n+1} = \frac{1}{2} + t_{n+1} i \quad t \in R$ is the No. n+1 zero point on line-1/2

We can get a zero point between s_n ***and*** s_{n+1} ***on line*** $-\ 1/2$ as

$$zp0 = \frac{1}{2} + bi \quad t_n < b < t_{n+1} \;\; b, t \in R$$

It is contrary to that s_n ***and*** s_{n+1} are the adjacent zero points on line-1/2

So on complex plane, We can have the symmetry structure about the line-1/2 with zp=1/2±a ($0 \le a \le \frac{1}{2} \quad a \in R$)show as on Figure 9.

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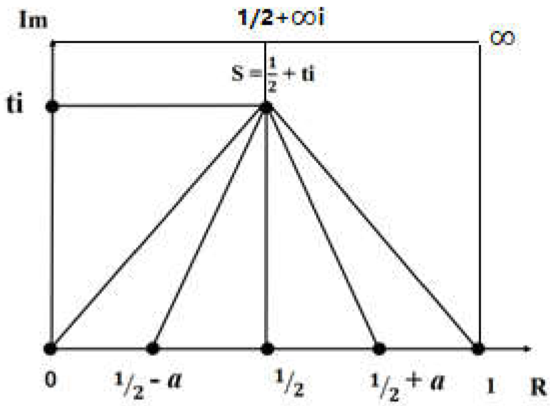

Figure 9. symmetry structure about the line-1/2 with zp=1/2±a.

$$S = \frac{1}{2} + ti \quad (t \in R)$$

$$zp = \frac{1}{2} \pm a \quad (\ 0 \le a \le \frac{1}{2} \qquad a \in R)$$

$$zp1 = \frac{1}{2} - a \quad zp0 = \frac{1}{2} \quad zp2 = \frac{1}{2} + a$$

$$zp1 + zp2 = \left(\frac{1}{2} - a\right) + \left(\frac{1}{2} + a\right) = 1$$

$$zp2 - zp1 = \left(\frac{1}{2} + a\right) - \left(\frac{1}{2} - a\right) = 2a$$

This is mean that there are no zero points on line-1/2±a ($0 \le a \le \frac{1}{2} \quad a \in R$).

Hardy and Littlewood give a proof that there are infinite zero points on line-1/2 (Hardy and Littlewood. 1914)

So we give a proof that all the non-trivial Zero points of Riemann zeta-function are on the Line-1/2. This is the proof of Riemann Hypothesis.

In fact, we have a symmetry number structure about line-1/2 as figure.10.

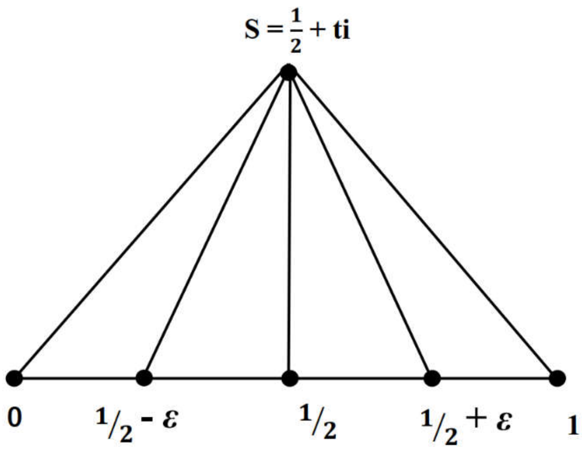

Figure 10. symmetry structure about the line-1/2 with zp=1/2±ε.

$$S = \frac{1}{2} + ti \quad (t \in R)$$

$$zp = \frac{1}{2} \pm \varepsilon \quad (\varepsilon = a + bi \quad a, b \in R \quad 0 \leq a \leq \frac{1}{2})$$

And we can get a symmetry number structure about line-1/2 as Figure 11. We should call it **Reimann dynamic space.**

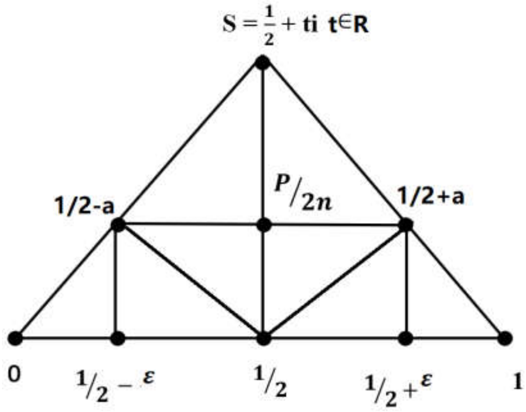

Figure 11. Reimann dynamic space.

$$1 + i^2 = 0$$

$$1 + 1/2 \ (i+1)(i-1) = 0$$

$$S = \frac{1}{2} + ti \ (t \in R)$$

$$zp = \frac{1}{2} \pm \varepsilon \quad (\varepsilon = a + bi \quad a, b \in R \quad 0 \leq a \leq \frac{1}{2})$$

$$\frac{P}{2n} = \begin{cases} \frac{1}{2^{N+1}} & n = 2^N P \\ \frac{3}{4} & n = 2 \quad P = 3 \\ 1 & n = 1 \quad P = 2 \end{cases}$$

N~(0, 1 , 2 , 3 , 4 , ……….) All natural numbers

n~(1 , 2 , 3 , 4 , ……….) All natural numbers excepted 0

P~(2 , 3 , 5 , 7 , ……….) All prime numbers

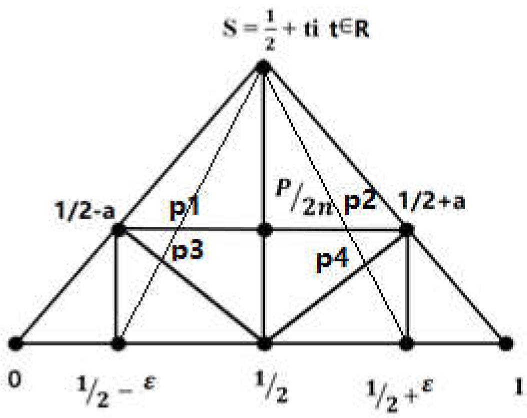

Figure 12. Reimann dynamic space with p1 p2 p3 p4.

We can have point p1 p2 p3 p4 and

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$$\boldsymbol{p1} \in \left(\frac{1}{2} - a, \frac{p}{2n}\right) \textbf{ and } \boldsymbol{p1} \in \left(\frac{1}{2} - \varepsilon, \frac{1}{2} + ti\right)$$

$$\boldsymbol{p2} \in \left(\frac{p}{2n}, \frac{1}{2} + a\right) \textbf{ and } \boldsymbol{p2} \in \left(\frac{1}{2} + \varepsilon, \frac{1}{2} + ti\right)$$

$$\boldsymbol{p3} \in \left(\frac{1}{2} - a, \frac{1}{2}\right) \textbf{ and } \boldsymbol{p3} \in \left(\frac{1}{2} - \varepsilon, \frac{1}{2} + ti\right)$$

$$\boldsymbol{p4} \in \left(\frac{1}{2}, \frac{1}{2} + a\right) \textbf{ and } \boldsymbol{p4} \in \left(\frac{1}{2} + \varepsilon, \frac{1}{2} + ti\right)$$

And we can find that

$$\left(\frac{1}{2} - \mathrm{a}, \frac{\mathrm{p}}{2\mathrm{n}}\right) \cap \left(\frac{1}{2} - \varepsilon, \frac{1}{2} + \mathrm{ti}\right) = \emptyset$$

$$\left(\frac{\mathrm{p}}{2\mathrm{n}}, \frac{1}{2} + \mathrm{a}\right) \cap \left(\frac{1}{2} + \varepsilon, \frac{1}{2} + \mathrm{ti}\right) = \emptyset$$

$$\left(\frac{1}{2} - \mathrm{a}, \frac{1}{2}\right) \cap \left(\frac{1}{2} - \varepsilon, \frac{1}{2} + \mathrm{ti}\right) = \emptyset$$

$$\left(\frac{1}{2}, \frac{1}{2} + a\right) \cap \left(\frac{1}{2} + \varepsilon, \frac{1}{2} + ti\right) = \emptyset$$

This means that there are no zero points on line -1/2$\pm\boldsymbol{\varepsilon}$.
So we can get Figure 13.

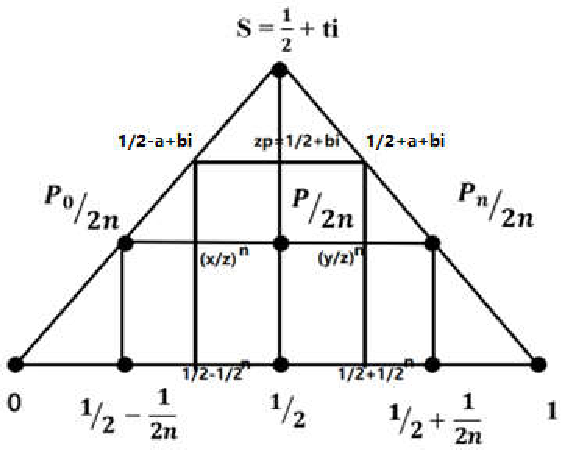

Figure 13. Reimann dynamic space and number conjectures.

1. $\boldsymbol{zp = \frac{1}{2} + bi \quad 0 < b < t \quad b, t \in R}$ **(the proof of RH)**

2. $$\left(\frac{x}{z}\right)^n + \left(\frac{y}{z}\right)^n = 1$$

$$\left(\frac{x}{z}\right)^n \leftrightarrow \frac{1}{2} - \frac{1}{2^n}$$

$$\left(\frac{y}{z}\right)^n \leftrightarrow \frac{1}{2} + \frac{1}{2^n}$$ **(the proof of F.L.T)**

3. $$\frac{\mathrm{p}0}{2\mathrm{n}} \leftrightarrow \frac{1}{2} - \frac{1}{2\mathrm{n}}$$

$$\frac{\mathrm{pn}}{2\mathrm{n}} \leftrightarrow \frac{1}{2} + \frac{1}{2\mathrm{n}}$$ **(the proof of GC/BC/TPC)**

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The Symmetry Number Structure about Line-1/2 including all numbers

And we have

$$1/2 = 1/2 \quad 0 = 1/2\text{-}1/2 \quad 1 = 1/2 + 1/2$$

$$1+(\pm\ i)^2 = 0$$

$$1+1/2(i+1)(i-1) = 0$$

$$\infty = 1+1+1+1+\cdots$$

We called it $L^{1/2\pm\varepsilon}$ 【0 1/2 1】 and analytic continuation to $\begin{bmatrix} +\infty & -\infty \\ -\infty & +\infty \end{bmatrix}$ we can get Figure 14.

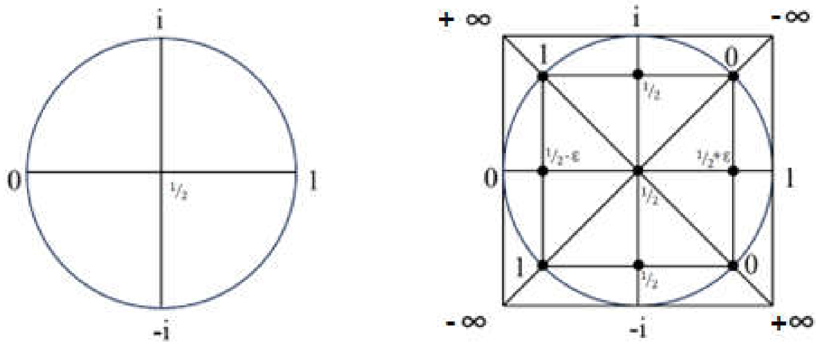

Figure 14. The Symmetry of $L^{1/2\pm\varepsilon}$ 【0 1/2 1】 with $\boldsymbol{zp} = \frac{1}{2} \pm \boldsymbol{\varepsilon}$.

So we have:

$$1+\begin{bmatrix} +\infty & \text{i} & -\infty \\ 0 & 1/2 & 1 \\ -\infty & \text{-i} & +\infty \end{bmatrix} \begin{bmatrix} 1 & 1/2 & 0 \\ \frac{1}{2}-\varepsilon & 1/2 & \frac{1}{2}+\varepsilon \\ 1 & 1/2 & 0 \end{bmatrix}^{-1} = 0$$

$$\boldsymbol{zp} = \frac{\mathbf{1}}{\mathbf{2}} \pm \boldsymbol{\varepsilon}$$

$$\boldsymbol{\varepsilon} = \boldsymbol{a} + \boldsymbol{bi}\ (\boldsymbol{a}, \boldsymbol{b} \in \boldsymbol{R} \quad \mathbf{0} \le \boldsymbol{a} \le \tfrac{1}{2})$$

$$\boldsymbol{zp1} = \frac{\mathbf{1}}{\mathbf{2}} - \boldsymbol{\varepsilon} \quad \boldsymbol{zp2} = \frac{\mathbf{1}}{\mathbf{2}} + \boldsymbol{\varepsilon}$$

We have

$$\boldsymbol{zp1} + \boldsymbol{zp2} = \left(\frac{1}{2} - \boldsymbol{\varepsilon}\right) + \left(\frac{1}{2} + \boldsymbol{\varepsilon}\right) = \mathbf{1}$$

$$\boldsymbol{zp2} - \boldsymbol{zp1} = \left(\frac{1}{2} + \boldsymbol{\varepsilon}\right) - \left(\frac{1}{2} - \boldsymbol{\varepsilon}\right) = \mathbf{2}\boldsymbol{\varepsilon} = \mathbf{2}(\boldsymbol{a} + \boldsymbol{bi})$$

And we have

$$n^2 = \frac{1}{2} \cdot n \cdot 2n = \sum^{N} \frac{1}{2} \sum^{N} \frac{1}{2^N} [\left(\frac{\mathbf{1}}{\mathbf{2}} - \boldsymbol{\varepsilon}\right) + \left(\frac{\mathbf{1}}{\mathbf{2}} + \boldsymbol{\varepsilon}\right)]$$

N~(0, 1 , 2 , 3 , 4 , ……….) All natural numbers

n~(1 , 2 , 3 , 4 , ……….) All natural numbers excepted 0

We can get a matrix $(n \times n)$

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$$\begin{bmatrix} 1/2 & \ldots\ldots & \frac{1}{2^n}(1/2+\boldsymbol{\varepsilon}) \\ \ldots\ldots & 1/2 & \ldots\ldots\ldots \\ \frac{1}{2^n}(1/2-\boldsymbol{\varepsilon}) & \ldots\ldots & 1/2 \end{bmatrix} (n \times n)$$

The **tr(A)=1/2*n**

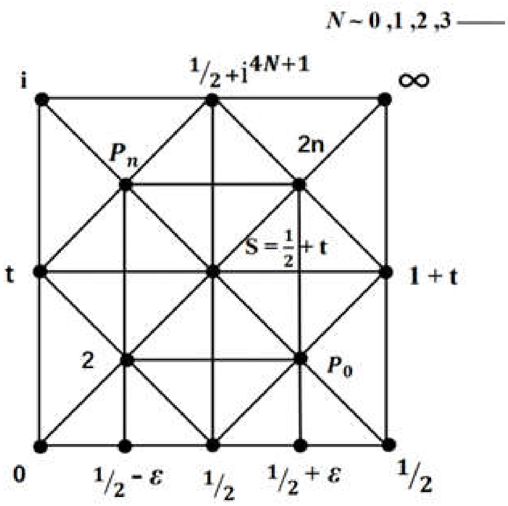

Figure 15. The Symmetry of S∞+i.

We have

$$0 = \frac{1}{2} - \frac{1}{2} \quad 1 = \frac{1}{2} + \frac{1}{2} \quad 2 = 1 + 1$$

$$1 + i^2 = 0 \qquad \boldsymbol{1/2 + i^{4N+1} = 1/2 + i}$$

$$\infty = 1 + 1 + 1 + 1 + \cdots$$

p0∈P **≤2n** **pn∈**P **≥2n**

$N\sim(0\ ,\ 1\ ,\ 2\ ,\ 3\ ,\ 4\ ,\ \ldots\ldots\ldots)$ all the natural numbers.

$n\sim\left(1\ ,\ 2\ ,\ 3\ ,\ 4\ ,\ \ldots\ldots\ldots\right)$ All natural numbers excepted 0

P~$\left(2\ ,\ 3\ ,\ 5\ ,\ 7\ ,\ \ldots\ldots\ldots\right)$ All odd prime number

$$\boldsymbol{S = \frac{1}{2} + t\ (\ t\ \in R)}$$

$$\boldsymbol{zp = \frac{1}{2} \pm \varepsilon\ \ (\varepsilon = a + bi\quad a\,,b\ \in R\ \ 0 \le a \le \frac{1}{2})}$$

And we find that

1. **$1 + e^{\pi i}$ =0 (Euler's Formula)**

$$1{+}i^2{=}0 \qquad 1 + \frac{1}{2}(i+1)(i-1) = 0 \qquad (1{+}i)(1{-}i) = \sum \frac{1}{2^N}$$

$$\boldsymbol{1 + e^{\pi i} = 0} \qquad \boldsymbol{1 + \frac{1}{2}(e^{ip\pi} - e^{i2N\pi}) = 0}$$

$N\sim(0\ ,\ 1\ ,\ 2\ ,\ 3\ ,\ 4\ ,\ \ldots\ldots\ldots)$ all the natural numbers.

 doi:10.20944/preprints202501.1995.v2

p~(3 , 5 , 7 , ……….) All odd prime number

2. $\mathbf{2(n \pm 1) = pn \pm p0}$

$$\mathbf{pn - 2n + p0 = 2}$$

And

$$\mathbf{2n - pn + p0 = 2}$$

It is like the **Euler's Polyhedron Formula**

We can get Figure 15. This is a symmetry number structure about line-1/2 including all numbers.

Competing Interests statement: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data Availability statement: No datasets were generated or analyzed during the current study.

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