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The boundary between the Prime Gaps and the Interchangeable between a Quantum Mechanics System & a Classical Chaos One

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ABSTRACT: *With reference to my last paper, this author found that there are always some discrete quantum constants like the Planck's one laying between the real and the imaginary parts of the Riemann function (I.e when we fix or group the Riemann Zeros one by one and make the real part to be varying.) or the quantum mechanics system. Hence, the Riemann Zeta Zeros give us the discrete quantum constants together with the given discrete quantum constants may give you the wanted Riemann Zeta Zeros. This phenomenon may be explained by Quantum Riemann Zeta Epiphancy. In the present paper, this author tries to fix or group the real part of the Riemann Zeros and make the imaginary part of the Riemann Zeros to be varying from one to the tenth one or resulting a chaos like graph. Thus, it seems that we may interchange a quantum mechanics system with the classical chaos one by just varying one variable and fix another one (such as varying real part of the Riemann function's zeors from 0.1 to 1 and fix the imaginary part of the Riemann zeros one group after one another). Certainly, the vice versa for the fix of the real part (one group after another) with different Riemann Zeros may also help. In other words, the quantum mechanics system is just the conjugate pair (varying x and fixed y variables) of the classical chaos one or the vice versa is also true (fixed x and varying y variables) & put back into the Zeta functions etc. Hence, it is a method (or transformation) for us so that we may easily to make a interchange between these two systems by only adjusting or selecting which variables to be varying or fixed. Then we may turn the classical chaos system into a quantum mechanics one or the vice versa. This implies that it may be possible to apply controllable quantum systems for the investigation of our natural aspects. Finally, this author have also shown that there is a boundary laying between the prime gap through the elementary calculation and mathematical derivation without using the computer software etc. It is thus a contradiction to the fact that there is no bound for the prime gap. This tells us that there is a need to have a shift from zero to 0.5 for the real part of the Riemann Zeta Zeros as what this author has mentioned in my last paper etc.*

KEYWORDS: boundary, prime gaps, quantum mechanics system, classical chaos one

INTRODUCTION

In my last paper, this paper has found some Planck's like discrete quantum constants exist between the real and imaginary parts of Riemann Zeta zeros. Indeed, these discrete quantum constants can be fitted well as the evidenced proof for the Quantum Riemann Zeta Epiphany. In the present paper,

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this author tries to convert such quantum system into the classical chaotics one or the vice versa. In the following content, this author applies some mathematic-a code together with the spreadsheet Excel for such kind of investigations. It is hope that through my computer simulations between the real and imaginary of the Riemann Zeta substitutions (values), we may make a further advance in the establishing quantum computer etc.

The Boundary for Prime Gaps

Consider the following equation for number theory of Riemann Zeta function ξ(1):

$\prod_{i=1}^{\infty}(z-z_i)$ = ξ(1) = $\sum_{n=1}^{\infty} 1/n$ = $\prod_{j=1}^{\infty}\left(1-1/p_j\right)^{-1}$ ------------ (*)

P_{j+1} = $\prod_{i=1}^{j+1}(z-z_j)$/ ($\prod_{i=1}^{j}(1-1/p_i)^{-1}$* $\left(1-1/p_{j+1}\right)^{-1}$)

$\left(1-1/p_{j+1}\right)$*P_{j+1} = [$\prod_{i=1}^{j}(z-z_i)$ * (z - z_{j+1})/ ($\prod_{i=1}^{j}(1-1/p_i)^{-1}$)]

P_{j+1} – 1 = $\prod_{i=1}^{j}(z-z_i)$ *(z - z_{j+1}) / P_j ------------- (by definition of P_j = $\sum_{i=1}^{j} 1/i$)

P_{j+1} = ($\prod_{i=1}^{j}(z-z_i)$ * (z - z_{j+1})/ $\sum_{i=1}^{j} 1/i$) +1

But it is well known that $ln(j+1) \leqslant \sum_{i=1}^{j+1} 1/i \leqslant 1+ln(j+1)$

($\prod_{i=1}^{j}(z-z_i)$ * (z – z_{j+1}) / $1+ln(j+1)$) +1 ≤ P_{j+1} ⩽ ($\prod_{i=1}^{j}(z-z_i)$ * (z – z_{j+1}) / $ln(j+1)$) +1

But P_j = [$\prod_{j=1}^{i}\left(z-z_j\right)$ / ($\prod_{j=1}^{i}\left(1-1/p_j\right)^{-1}$)] or P_j = ($\prod_{j=1}^{i}\left(z-z_j\right)$ / $\sum_{i=1}^{j} 1/i$)

----- (by definition of P_j and equation (*)),

i.e. ($\prod_{i=1}^{j}(z-z_i)$ / $1+ln(j)$) ≤ P_j ⩽ ($\prod_{i=1}^{j}(z-z_i)$ / $ln(j)$), thus we have:

[(1 / $ln(j+1)$) - (1 / $ln(j)$)] ⩽ [(1 / $ln(j+1)$) - (1 / $1+ln(j)$)] ≤ P_{j+1} – P_j ⩽ [(1 / $ln(j)$) -

(1 / $1+ln(j)$)] ≤ [(1 / $1+ln(j+1)$) - (1 / $1+ln(j)$)]

Or [(1 / $ln(j+1)$) - (1 / $1+ln(j)$)] ≤ P_{j+1} – P_j ⩽ [(1 / $1+ln(j+1)$) - (1 / $ln(j)$)]

----- (Equation (**)

By applying the Taylor approximation $\frac{2(x-1)}{(x+1)}$ to both $ln(j)$ and $ln(j+1)$ for the above equation (**), we may get:

$$\left(\frac{1}{\frac{2j}{j+2}} - \frac{1}{1+\frac{2(j-1)}{j+1}}\right) . \leq . P_{j+1} - P_j . \leqslant . \left(\frac{1}{1+\frac{2j}{j+2}} - \frac{1}{\frac{2(j-1)}{j+1}}\right)$$

$$\frac{j^2+3j+2}{6j^2-2j} . \leq . P_{j+1} - P_j . \leqslant . \frac{5j^2+7j-2}{6j^2-2j-4}$$

By taking limit for j tends to infinity, we may have the boundary as below:

$$\frac{1}{6} . \leq . P_{j+1} - P_j . \leqslant . \frac{5}{6}$$

Hence, the difference (boundary) between two consective primes (or the prime gap) is bounded. But it is well known that the Harmonic series $\sum_{i=1}^{j} 1/i$ is actually divergent which is certainly a contradiction. Therefore, the equation (*) is only true for the 0.5 + I*y as shown in my past paper named "The Quantized Constants with Remmen's Scattering Amplitude to Explain Riemann Zeta Zeros". Hence, there may be a need for ordinary x equals zero line to have a shift to the line of x equals 0.5 in the Riemann Hypothesis. Hence, the Riemann Hypothesis is thus proved for its truthless as all of the roots of zeta function must lie in the line x = 0.5 but NOT all points of x = 0.5 must be the roots of the Riemann Zeta function as shown in my model of Riemann Zeros of my aforementioned paper.

This author wants to remark that if we want to solve for the polynomial P(x) like the following equation: x*P(x-1) = (x-3)*P(x).

Consider $\frac{x}{x-3} = \frac{P(x)}{P(x-1)}$,

For $x \neq 3$ & $x \neq 1$, $\frac{x}{x-3} = \frac{1}{1-\frac{3}{x}} = \frac{P(x)}{P(x-1)} = \frac{x}{x} * \frac{P\left(\frac{x}{x}\right)}{P\left(1-\frac{1}{x}\right)}$,

Now suppose P(1) = 1, then $\frac{x}{P(x-1)} = \frac{1}{1-\frac{3}{x}}$,

or $\frac{x}{P[-(1-x)]}$ = [- (1 + $\frac{3}{x}$ + $\left(\frac{3}{x}\right)^2$ + … + $\left(\frac{3}{x}\right)^{n-1}$)]

or $\frac{x}{P[-[(1-x)-1]]}$ = [- (1 + $\frac{3}{x-1}$ + $\left(\frac{3}{x-1}\right)^2$ + … + $\left(\frac{3}{x-1}\right)^{n-1}$)]

i.e. P(x) = x / [- (1 + $\frac{3}{x-1}$ + $\left(\frac{3}{x-1}\right)^2$ + … + $\left(\frac{3}{x-1}\right)^{n-1}$)]

which is obviously in a philosophical recursive geometric progression format and it is somehow similar but NOT the same to my proof of Riemann Hypothesis in the above.

MAJOR RESULTS AND FINDINGS

In this paper together with my last one, this author has found a relationship between the quantum mechanics system and the classical chaos. Indeed, if we consider the following table and figure for the present Riemann Zeta quantum mechanics system, we may get (next page):

X is real (varied) and laying between 0.1 to 1	i*Y is the imaginary part (& fixed by group) from 1st to 10th zeros (or Y may be considered as the energy spectrum of an atom [4])
0.1	1st non-trivial zeros
0.2	1st non-trivial zeros
0.3	1st non-trivial zeros
0.4	1st non-trivial zeros
0.5	1st non-trivial zeros
0.6	1st non-trivial zeros
0.7	1st non-trivial zeros
0.8	1st non-trivial zeros
0.9	1st non-trivial zeros
1.0	1st non-trivial zeros

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X is real (varied) and laying between 0.1 to 1	i*Y is the imaginary part (& fixed by group) from 1st to 10th zeros (or Y may be considered as the energy spectrum of an atom [4])
0.1	10th non-trivial zeros
0.2	10th non-trivial zeros
0.3	10th non-trivial zeros
0.4	10th non-trivial zeros
0.5	10th non-trivial zeros
0.6	10th non-trivial zeros
0.7	10th non-trivial zeros
0.8	10th non-trivial zeros
0.9	10th non-trivial zeros
1.0	10th non-trivial zeros

Table 1: By varying the real part X and fixed the imaginary part Y for non-trivial zeros by group
Then we may get the following direct proportional graph with a discrete quantum constant K_1 = 0.16124064 for the 1st non-trivial zeros:

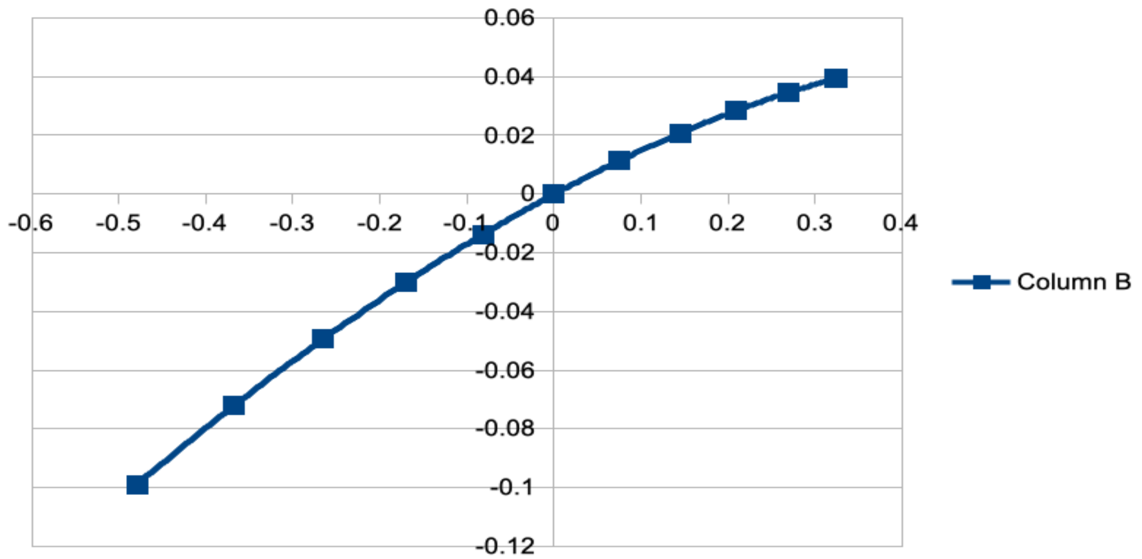

Figure 2: Quantum Riemann System with a discrete constant k_1 with previous X and Y values substitute back into the Riemann Zeta Function to obtain another set of X' and Y'.
If on the contrary, we try to fix the variable X (and group by one another) together with making the imaginary part with variable Y to be varied, then we may have the following table:

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X is real but fixed (& group by one another from 0.1 to 1.0)	I*Y is varied and laying between 1st non-trivial zeros to10th non-trivial zeros imaginary part's value (or Y may be considered as the energy spectrum of an atom [4])
0.1	1st non-trivial zero
0.1	2nd non-trivial zero
0.1	3rd non-trivial zero
0.1	4th non-trivial zero
0.1	5th non-trivial zero
0.1	6th non-trivial zero
0.1	7th non-trivial zero
0.1	8th non-trivial zero
0.1	9th non-trivial zero
0.1	10th non-trivial zero

X is real but fixed (& group by one another from 0.1 to 1.0)	I*Y is varied and laying between 1st non-trivial zeros to10th non-trivial zeros (or Y may be considered as the energy spectrum of an atom [4])
1.0	1st non-trivial zero
1.0	2nd non-trivial zero
1.0	3rd non-trivial zero
1.0	4th non-trivial zero
1.0	5th non-trivial zero
1.0	6th non-trivial zero
1.0	7th non-trivial zero
1.0	8th non-trivial zero
1.0	9th non-trivial zero
1.0	10th non-trivial zero

Table 3: Fix the real part X by group and varies the imaginary part Y by those non-trivial zeros
Then we may have the following chaos graph for the value 0.1:

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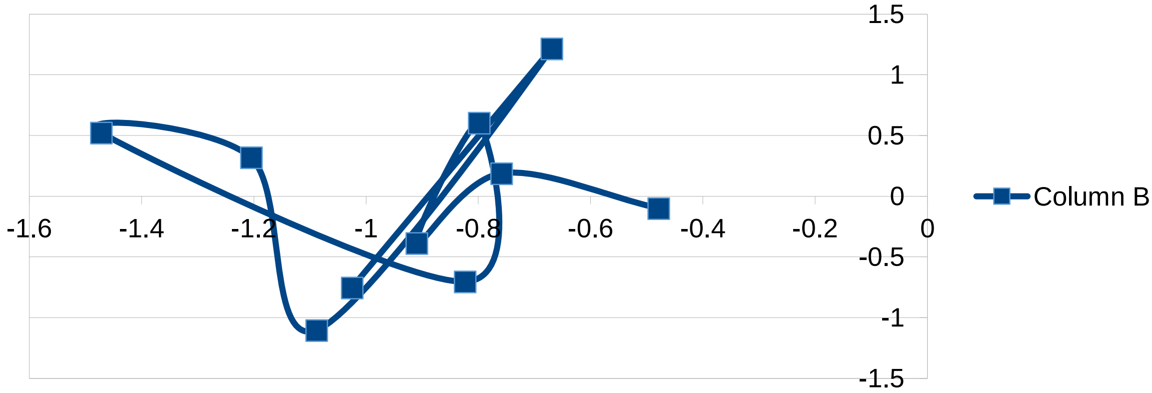

Figure 4: Classical Chaos with previous X and Y values substitute back into the Riemann Zeta Function to obtain another set of X'' and Y''

By the comparing the above two sets of table (1 & 3) and figure (2 & 4), we may observe that there is a method for the interchangeable relationship between the Quantum Riemann System and the classical chaos or the vice versa. The key is just to select which variables to be varying and the other one variable to be fixed by group.

DISCUSSIONS & SIGNIFICANCES

In my previous paper [1], this author has found that there are some discrete quantum constants corresponding to each Riemann Zeta non-trivial zeros given (Table 1 & Fig 2). Certainly, it is also true that if we may know any of these discrete quantum constants in advance from experiment, then we may find the wanted Riemann Zeta non-trivial zeros. Hence, from such numerical evidence (Table 1 & Fig 2) and relationships, we may prove that the Riemann Zeta function is indeed a kind of quantum system or the so called "Quantum Riemann Zeta Epiphany". In the present paper, this author has also found that we may turn the above classical chaos one into the Riemann Zeta Epiphany system if we can collect all of the nth entry (say all of the 1^{st} non-trivial zeros in different groups with varying real part -- X) that is spread among the Table 3, substitute back into the Riemann Zeta function and form the set values X' and Y'. In a vice versa way, we may also turn the Quantum Riemann Zeta Epiphany system into the Chaotics one by a collection of nth entry (say all of the 1^{st} fixed real values with varying non-trivial zeros in different groups – Y), subsitute back the just obtained X and Y into the Riemann Zeta function and get the set values X'' and Y'' (has been tested by using commercial software Mathematic-a 13.1 Home Edition: this author has downloaded from the U.S.A. official website with full payment. In addition, this author may provide the details of the coding source together with the Excel file for checking whenever requested).

In reality, it is well known that there is a strong relationship/correlation [2] between the quantum entanglement and the classical chaos. According to [3], thermalization may be the things connect the chaos and the entanglement. Indeed, what the chaos theory study is the behavior in those highly sensitive and unpredictable systems. Or the superposition theory that suggests a particle may be located in several places at a time. For the entanglement, one may refer to the particles that a deeply linked behave as such despite the physical distance from one another. Therefore, if (we can find a method or transformation for the interchanging between the quantum system and the chaos one and in a vice versa way), we may convert the chaos (a particle that may be located in several places at a time) in the superposition theory into a quantum system, then we may apply those found quantum results (or even have some forecasted values in the locations of the particle by the Quantum Field Theory) so that we may get some further advancements in developing the ordinary type of quantum computers for our common people in the future just like our present everyday using desktop computers. Or just in the worst case, we may still have the chance to have an in-depth investigation of our nature aspects in the superposition theory through the application of such resulted controllable quantum systems.

With reference to [4], this author wants to remark that there is also classical mechanics in physics. In practice, there are always some links among the classical mechanics, quantum system and the chaos one. We may well connect the classic, simple system with the quantum one by Bohr's correspondence principle. Indeed, the connection is the limit of objects become larger than than the size of an atom. At the same time, the linking between the classic simple systems and the chaotic systems is the Kolmogorov-Arnold-Moser (KAM) theorem. Hence, one may calculate the survivebility of the sturcture of the regular system when we introduce a small perturbation, then we may identify those perturbations that lead a regular system to undergo such chaotic behavior. However, there is no theorem to connect the quantum system with the chaotic one. One is just well known that they are strongly correlated. In the present paper, this author discovers an interchangeable way or transformation between the quantum system and the chaotic one.

Lastly, if my finding of an interchangeable method between the quantum system and the chaotic one is correct, then when one relates both of the Bohr's correspondence principle and the Kolmogorov-Arnold-Moser (KAM) theorem, we may construct a three way philosophy that includes the classical mechanics system, chaotics system and the quantum system just like the Roger Penrose one or in [5].

CONCLUSIONS AND LIMITATIONS

Last but not least, in the present paper, this author has shown there is an interchangeable way (or transformation) for the conversion between the Quantum Riemann Zeta Epiphany system and the classical chaotics one. Hence, we may finally establish a better everyday usable quantum computer or at least one may make some essential progresses in the advancement of it. In other words, we may build a new type of Quantum Riemann Epiphany computer system by the present interchangeable result together with tools like quantum tunneling, quantum fourier transform, quantum filtering and convolution neural network etc for computing but NOT using the ion trapping system etc to compute an accurate Riemann Zeta zeros values. Certainly, in my last paper [1], this author has found some quantum constants between the real part and the imaginary part of the Riemann zeros after their substitution into the zeta function. Hence, these quantum constants may imply the Riemann zeros or we may find the quantum constants from those Riemann zeros. These discrete quantum constants are just like the case of Planck's constant or give us the evidence of proving the feasibility of Quantum Riemann Zeta Epiphany etc. **Indeed, the most Harry Potter's JEG ER VOLDEMORT is how one may find the more accurate values of Riemann zeros and then use the vice versa of my HKLam Theory to approximate/compute the S-matrix together with the final process getting the classical (or quantum) chaos paths. Hence, we may predict the highest quantum entanglement path and seek for the control of a higher quantum computing power as most of the quantum algorithms are always employing quantum entanglements.** This author also notes that there may be a need for the shift of zero line to 0.5 line as there is a contradiction for the boundary of the prime gap. Certainly, there are still defects in my present results (or mathematical computation values) as they are just obtained from the computer simulation and more laboratory experiments should be done for any further scientific advancements. This author summarizes the (machine learning) algorithm for computing the discrete quantum constant as follow:

1. Obtain the fixed nth non-trivial zeros' values each time -- Y;
2. Varying the real part from 0.1 to 1 -- X;
3. Substitute the varying real parts with the fixed nth non-trivial zeros into the Zeta function again;
4. Get the real and imaginary parts' values – X' and Y';
5. Plot the imaginary part Y' against X' by using spreadsheet software like Excel;

Similarly, we may obtain the Chaos by:

1. Fixed the real part by nth value from 0.1 to 1 – X;
2. Varying the imaginary parts with 1st to nth non-trivial zeros – Y;
3. Substitute back the above real part X and imaginary part Y back into the Zeta function;
4. Get the another set of values X" and Y";
5. Plot the imaginary part value Y" against X" by using spreadsheet software;

(Note: Alternatively, one may obtain the same result by just selecting all of the (say the 1^{st} set value of X' and Y' from the 1^{st} non-trivial zeros until the 1^{st} set value of X' and Y' for the n^{th} non-trivial zeros in different groups or a collection of all nth set of X' and Y' from (1 to nth non-trivial zeros in different groups) – another set of X" and Y" is thus formed. In a vice versa way, a collection of all nth set of X" and Y"from 1 to nth real values in different groups to form the X' and Y', as this author has just mentioned similar idea in the discussion section. It is only the interchange or the conversion method between Quantum System and the Chaos one or turns the Chaos to a Quantum system. Plot the graph by using a spreadsheet software).

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