ZEROS OF THE GAMMA FUNCTION

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Summary: 160 years ago that in the complex analysis a hypothesis was raised, which was used in principle to demonstrate a theory about prime numbers, but, without any proof; with the passing Over the years, this hypothesis has become very important, since it has multiple applications to physics, to number theory, statistics, among others In this article I present a demonstration that I consider is the one that has been dodging all this time.

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Chapter 1

INTRODUCTION

Euler and Goldbach worked on an integral expression of the factorial function, giving rise to the widely used Gamma function, which has had a number of applications, applications that appeared unexpectedly. As this function is so unexpected, we can still ask ourselves, Is the whole theory of this function already raised? Can we think of zeros of this function? This function has already been proven to have no real zeros, but can these zeros (if they exist) be complex? these could be some, of a number of questions that will still be presented, questions that if they had an affirmative answer, we could be thinking about the solution of the Riemann Hypothesis.

In mathematics and in all sciences (despite the fact that 2019 years have passed after Christ), there are still some problems that have not been solved but that have provided knowledge, endless solid foundations that have allowed to create many inventions that, in the past were very needed, but due to the circumstances, it was not possible to use the elements or instruments for what is needed.

This is the case of the Riemann hypothesis, which resulted in demonstrating a exercise on the prime numbers, but its truthfulness (at the time), not was important, however, with the passage of time this statement was Acquiring greater strength.

This hypothesis says: “In pure mathematics, the hypothesis of Riemann, formulated for the first time by Bernhard Riemann in 1859, is a conjecture about the zeros distribution of the zeta function of Riemann”; this conjecture at the time did not have much importance then, it was used to talk about prime numbers, but with the passing of time has taken quite a lot of importance due to its countless applications, but it is a mathematical approach that has been 160 years without being demonstrated and that I personally expect to know your demonstration someday.

At the time that corresponded to me to do the thesis to obtain my title of graduated in mathematics, I was interested in this subject and made a general approach to what she is in reality and its applications; with the Over the years, this topic continued in my mind and I started working hard in his demonstration.

On this occasion, I propose a possible demonstration, which has already been revised by a mathematical and physical teacher, who approved it and who is now raised to those who have greater knowledge in the field of mathematics pure.

1.1 Gamma function

Leonard Euler began studying this theory influenced by Christian Goldbach, who was at the St. Petersburg Academy because they were interested in working on number theory in 1727.

Thanks to the communication that Euler and Goldbach had, they discovered the Gamma function in 1729, which has a number of applications to physics, number theory, statistics, etc.

1.2 APPLICATIONS OF THE GAMMA FUNCTION

The function Gama is a function of great importance in science and in mathematics. The development of probability theory uses the Gamma function to a large extent, mainly for the calculation of distributions, such as the Chi square distribution, student t and fisher F, as follows:

$$f(x^2, v) = \frac{1}{v/2\Gamma\left(\frac{v}{2}\right)}(x^2)^{\frac{v}{2}-1}e^{-\frac{x^2}{2}}$$

$$f(t, v) = \frac{1}{\sqrt{\pi v}}\frac{\Gamma\left(\frac{v+1}{2}\right)}{\Gamma\left(\frac{v}{2}\right)}\left(1+\frac{t^2}{v}\right)^{-\frac{v+1}{2}}$$

$$f(v_1, v_2, F) = \frac{\Gamma\left(\frac{v_1+v_2}{2}\right)}{\Gamma\left(\frac{v_1}{2}\right)\cdot\Gamma\left(\frac{v_2}{2}\right)}\left(\frac{v_1}{v_2}\right)^{\frac{v_1}{2}}\cdot\frac{F^{\frac{v_1-1}{2}}}{\left(1+\frac{v_1}{v_2}F\right)^{\frac{v_1+v_2}{2}}}$$

In addition to this, the Gamma function is the fundamental basis of the Laplace Transform, which is very important in the solution of differential equations.

The Gamma function in probability is used for the computation of the Gamma distribution, which is a probability distribution under two parameters k and λ which has the following density function, for $k > 0$

$$f(x) = \lambda e^{-\lambda x}\frac{(\lambda x)^{k-1}}{\Gamma(k)}$$

Where e is the number of Neper and Γ the Gamma function.

1.3 HYPOTHESIS OF RIEMANN

In 1859 Riemann named the conjecture, which later received the nimbre Riemann Hypothesis, this he did in his PhD thesis called " On prime numbers less than a given magnitude, " he named it by achieving an explicit formula of the number of cousins smaller than a given number However, since this hypothesis was not primordial for its purpose, it did not focus its time on the attempt to demonstrate it, although it did know that the non-trivial zeros of the zeta function were in the complex line $s = 1/2 + it$ Also, I knew that ***these zeros were in the range*** $0 \leq Re(s) \leq 1$.

In 1896, Hadamard and de la Vallée-Poussin independently proved that non-trivial zeros do not possess $Re(s) = 1$. These and other properties of the zeros demonstrated by Riemann, allowed to show that the nontrivial zeros of the Riemann zeta function are in the critical band $0 < Re(s) < 1$, estas conclusiones fueron un paso importante en el desarrollo de teoría de números.

Chapter 2

ZEROS OF THE GAMMA FUNCTION

2.1 HYPOTHESIS

$\frac{2n+1}{2} - it$; $t \in \mathbb{R}, n \in \mathbb{N}$, evaluada en la función Gamma, es Cero:

$$\Gamma\left(\frac{2n+1}{2} - it\right) = 0 \qquad t \in \mathbb{R}, n \in \mathbb{Z}$$

2.2 *Demonstration*

We will do this demonstration by induction.
Be $n = 0$, so, we have:

$$\Gamma\left(\frac{2(0)+1}{2} - it\right) = \Gamma\left(\frac{1}{2} - it\right) = \int_0^\infty T^{-\frac{1}{2}-it} e^{-T} dT$$

By changing the variable (substitution), we have

$$\begin{array}{lll} T = x^{a+bi} & si\ T = 0 & x = 0 \\ dT = (a+bi)x^{a-1+bi}dx & si\ T = \infty & x = \infty \end{array}$$

Replacing

$$\int_0^\infty T^{-\frac{1}{2}-it} e^{-T} dT = \int_0^\infty \left(x^{a+bi}\right)^{-\frac{1}{2}-it} e^{-x^{a+bi}} (a+bi) x^{a-1+bi} dx$$

The constant $a + bi$ can leave the integral

$$\int_0^\infty \left(x^{a+bi}\right)^{-\frac{1}{2}-it} e^{-x^{a+bi}} (a+bi) x^{a-1+bi} dx = (a+bi) \int_0^\infty x^{\left(-\frac{a}{2}+bt\right)+i\left(-at-\frac{b}{2}\right)} e^{-x^{a+bi}} x^{a-1+bi} dx$$

Doing the operations presented with the constants we finally have:

$$\int_0^\infty T^{-\frac{1}{2}-it} e^{-T} dT = (a+bi) \int_0^\infty x^{\left(-\frac{a}{2}+bt+a-1\right)+i\left(-at-\frac{b}{2}+b\right)} e^{-x^{a+bi}} dx$$

Here results a system of equations of 2×2, with the variables a and b; you have:

$$\begin{aligned} a + 2bt = 2 \qquad (1) \\ -2at + b = 0 \qquad (2) \end{aligned}$$

Using the equalization method, we have:
* Multiplying $(1) * 2t$ and adding (2)

$2at + 4bt^2 = 4t$
$-2at + b = 0$

$b(4t^2 + 1) = 4t$
Clearing b , finally we have:

$$b = \frac{4t}{4t^2 + 1}$$

b replace it in (1) and clearing a,se tiene:

$$\begin{aligned} a + 2t\left(\tfrac{4t}{4t^2+1}\right) = 2 \\ a = 2 - \tfrac{8t^2}{4t^2+1} \\ a = \tfrac{8t^2+2-8t^2}{4t^2+1} \\ a = \tfrac{2}{4t^2+1} \end{aligned}$$

Replacing the obtained values, we have:

$$(a+bi)\int_0^{\infty} x^{\left(\frac{a}{2}+bt-1\right)+i\left(-at+\frac{b}{2}\right)} e^{-x^{a+bi}} dx = \left(\frac{2+4it}{4t^2+1}\right)\int_0^{\infty} x^{\left(\frac{1}{4t^2+1}+\frac{4t^2}{4t^2+1}-1\right)+i\left(-\frac{2t}{4t^2+1}+\frac{2t}{4t^2+1}\right)} e^{-x^{\frac{2+4it}{4t^2+1}}} dx$$

Replacing a and b, we have:

$$\left(\frac{2+4it}{4t^2+1}\right)\int_0^{\infty} x^{\left(\frac{1}{4t^2+1}+\frac{4t^2}{4t^2+1}-1\right)+i\left(-\frac{2t}{4t^2+1}+\frac{2t}{4t^2+1}\right)} e^{-x^{\frac{2+4it}{4t^2+1}}} dx = \left(\frac{2+4it}{4t^2+1}\right)\int_0^{\infty} x^{\left(\frac{1+4t^2-4t^2-1}{4t^2+1}\right)+i0} e^{-x^{\frac{2+4it}{4t^2+1}}} dx$$

adding the complex values we have:

$$\left(\frac{2+4it}{4t^2+1}\right)\int_0^{\infty} x^{\left(\frac{1+4t^2-4t^2-1}{4t^2+1}\right)+i0} e^{-x^{\frac{2+4it}{4t^2+1}}} dx = \left(\frac{2+4it}{4t^2+1}\right)\int_0^{\infty} x^{(0)+i0} e^{-x^{\frac{2+4it}{4t^2+1}}} dx$$

Finally we have:

$$(a+bi)\int_0^{\infty} x^{\left(\frac{a}{2}+bt-1\right)+i\left(-at+\frac{b}{2}\right)} e^{-x^{a+bi}} dx = \left(\frac{2+4it}{4t^2+1}\right)\int_0^{\infty} e^{-x^{\frac{2+4it}{4t^2+1}}} dx$$

Once again changing the variable (substitution), we have:

$$\begin{aligned} x = z^{c+mi} \qquad & si\ x = 0 \quad \rightarrow \quad z = 0 \\ dx = (c+mi)z^{a-1+bi}dz \qquad & si\ x = \infty \quad \rightarrow \quad z = \infty \end{aligned}$$

$$\left(\frac{2+4it}{4t^2+1}\right)\int_0^\infty e^{-x^{\frac{2+4it}{4t^2+1}}}dx = \left(\frac{2+4it}{4t^2+1}\right)\int_0^\infty e^{-\left(z^{c+mi}\right)^{\frac{2+4it}{4t^2+1}}}(c+mi)z^{a-1+bi}dz$$
$$= \left(\frac{2+4it}{4t^2+1}\right)(c+mi)\int_0^\infty e^{-z^{\frac{2c-4mt}{4t^2+1}+i\frac{4ct+2m}{4t^2+1}}}z^{c-1+mi}dz$$

again raising a system of equations 2×2 :

$$\frac{2c-4mt}{4t^2+1}=1 \quad\rightarrow\quad 2c-4mt=4t^2+1 \qquad (1)$$
$$\frac{4ct+2m}{4t^2+1}=0 \quad\rightarrow\quad 4ct+2m=0 \qquad (2)$$

Using the substitution method:
Clearing m of (2), we have:

$4ct+2m=0$
$2m=-4ct$
$m=-2ct$

Replacing in (1)

$2c-4(-2ct)t=4t^2+1$
$2c+8ct^2=4t^2+1$
$c(2+8t^2)=4t^2+1$
$c=\frac{4t^2+1}{2+8t^2}$
$c=\frac{4t^2+1}{2(4t^2+1)}$
$c=\frac{1}{2}$

Replacing in (2)

$4\left(\frac{1}{2}\right)t+2m=0$
$2t+2m=0$
$2m=-2t$
$m=-t$

By replacing the obtained values, we have:

$$\left(\frac{2+4it}{4t^2+1}\right)(c+mi)\int_0^\infty e^{-z^{\frac{2c-4mt}{4t^2+1}+i\frac{4ct+2m}{4t^2+1}}}z^{c-1+mi}dz = \left(\frac{2+4it}{4t^2+1}\right)\left(\frac{1}{2}+(-t)i\right)\int_0^\infty e^{-z^{\frac{2\left(\frac{1}{2}\right)-4(-t)t}{4t^2+1}+i\frac{4\left(\frac{1}{2}\right)t+2(-t)}{4t^2+1}}}z^{\frac{1}{2}-1+i(-t)}dz$$

Sumando y restando se tiene

$$\left(\frac{2+4it}{4t^2+1}\right)\left(\frac{1}{2}+(-t)i\right)\int_0^\infty e^{-z^{\frac{2\left(\frac{1}{2}\right)-4(-t)t}{4t^2+1}+i\frac{4\left(\frac{1}{2}\right)t+2(-t)}{4t^2+1}}}z^{\frac{1}{2}-1+i(-t)}dz = \left(\frac{2+4it}{4t^2+1}\right)\left(\frac{1}{2}-it\right)\int_0^\infty e^{-z^{\frac{1+4t^2}{4t^2+1}+i\frac{2t-2t}{4t^2+1}}}z^{-\frac{1}{2}-it}dz$$

The complex part disappears

$$\left(\frac{2+4it}{4t^2+1}\right)\left(\frac{1}{2}-it\right)\int_0^\infty e^{-z^{\frac{1+4t^2}{4t^2+1}+i\frac{2t-2t}{4t^2+1}}}z^{-\frac{1}{2}-it}dz = \left(\frac{2+4it}{4t^2+1}\right)\left(\frac{1}{2}-it\right)\int_0^\infty e^{-z^{1+i0}}z^{-\frac{1}{2}-it}dz$$

having:

$$\left(\frac{2+4it}{4t^2+1}\right)\left(\frac{1}{2}-it\right)\int_0^\infty e^{-z^{1+i0}}z^{-\frac{1}{2}-it}dz = \left(\frac{2+4it}{4t^2+1}\right)\left(\frac{1}{2}-it\right)\int_0^\infty e^{-z}z^{\frac{1}{2}-it-1}dz$$

applying the integral definition of the Gamma function we have:

$$\left(\frac{2+4it}{4t^2+1}\right)\left(\frac{1}{2}-it\right)\int_0^\infty e^{-z}z^{\frac{1}{2}-it-1}dz = \left(\frac{2+4it}{4t^2+1}\right)\left(\frac{1}{2}-it\right)\Gamma\left(\frac{1}{2}-it\right)$$

With these results, we finally have:

$$\left(\frac{2+4it}{4t^2+1}\right)\left(\frac{1}{2}-it\right)\Gamma\left(\frac{1}{2}-it\right) = \Gamma\left(\frac{1}{2}-it\right)$$

Leaving the Gamma function to one side only:

$$\left(\frac{2+4it}{4t^2+1}\right)\left(\frac{1}{2}-it\right)\Gamma\left(\frac{1}{2}-it\right) - \Gamma\left(\frac{1}{2}-it\right) = 0$$

Factoring the Gamma function:

$$\Gamma\left(\frac{1}{2}-it\right)\left[\left(\frac{2+4it}{4t^2+1}\right)\left(\frac{1}{2}-it\right)-1\right] = 0$$

Factoring 2:

$$\Gamma\left(\frac{1}{2}-it\right)\left[\left(\frac{2(1+2it)}{4t^2+1}\right)\left(\frac{1+2it}{2}\right)-1\right] = 0$$

Realizing the product:

$$\Gamma\left(\frac{1}{2}-it\right)\left[\frac{(1+2it)^2}{4t^2+1}-1\right] = 0$$

Adding up:

$$\Gamma\left(\frac{1}{2}-it\right)\left(\frac{1+4it-4t^2-4t^2-1}{4t^2+1}\right) = 0$$

Simplifying:

$$\Gamma\left(\frac{1}{2}-it\right)\left(\frac{4it-8t^2}{4t^2+1}\right) = 0$$

Clearing the Gamma function we have:

$$\Gamma\left(\frac{1}{2}-it\right)=0\left(\frac{4t^2+1}{4t(i-2t)}\right)$$
$$\Gamma\left(\frac{1}{2}-it\right)=0$$

It is met for $n=0$, therefore we assume that it is met for $n=k(1)$; then, let's see if it is met for $n=k+1$

$$\Gamma\left(\frac{2(k+1)+1}{2}-it\right)=\int_0^\infty T^{\frac{2(k+1)+1}{2}-it}e^{-T}dT$$

As $k+1$ it's a natural, then we can do the substitution $k+1=w$, where w remains a natural; therefore, we have:

$$\int_0^\infty T^{\frac{2(k+1)+1}{2}-it}e^{-T}dT=\int_0^\infty T^{\frac{2w+1}{2}-it}e^{-T}dT$$

Making this substitution, we return to the expression (1), then:

$$\int_0^\infty T^{\frac{2w+1}{2}-it}e^{-T}dT=0$$

Returning the substitution that we made, finally we have:

$$\int_0^\infty T^{\frac{2(k+1)+1}{2}-it}e^{-T}dT=0$$

Q.E.D.

Chapter 3

GENERALIZATION OF THE RIEMANN HYPOTHESIS

When considering the functional ecution of the $p - serie$, we see that the Gamma function and the Riemanmn zeta function are closely linked; when doing study of the zeros of the $\zeta - function$, Riemann sees that this function, in addition to trivial zeros, has other zeros, but do these zeros from where they come out, if the Gamma function is supposed to have no zeros? In my study of the famous Riemann Hypothesis, I found what I consider to be the zeros of the Gamma function, and that I applied it to the functional ecution of the $p - serie$, I find a generalization of the Riemann Hypothesis, which I show below:

3.1 HYPOTHESIS

The non-trivial zeros of the Riemann zeta function have a real part $\frac{1-2n}{2}$ with $n \in \mathbb{N}$.

3.2 *Demonstration*

Replacing $s = \frac{1-2n}{2} + it,\ t \in \mathbb{R}\ n \in \mathbb{N}$; in the functional equation of the Riemann zeta function, we have:

$$\zeta\left(\frac{1-2n}{2}+it\right) = 2^{\frac{1-2n}{2}+it}\pi^{\frac{1-2n}{2}+it-1}\sin\left(\frac{\pi}{2}\left(\frac{1-2n}{2}+it\right)\right)\Gamma\left(1-\left(\frac{1-2n}{2}+it\right)\right)\zeta\left(1-\left(\frac{1-2n}{2}+it\right)\right)$$

Simplifying you get:

$$\zeta\left(\frac{1-2n}{2}+it\right) = 2^{\frac{1-2n}{2}+it}\pi^{-\frac{1+2n}{2}+it}\sin\left(\frac{\pi}{2}\left(\frac{1-2n}{2}+it\right)\right)\Gamma\left(\frac{2n+1}{2}-it\right)\zeta\left(\frac{2n+1}{2}-it\right)$$

in the previous hypothesis it was shown that:

$$\Gamma\left(\frac{2n+1}{2}-it\right) = 0,$$

as this expression is a factor of the functional equation of the Riemann zeta function evaluated in $\frac{1-2n}{2}+it$, so:

$$\zeta\left(\frac{1-2n}{2}+it\right) = 0$$

Q.E.D.

3.3 COROLLARY:*Riemann hypothesis*

The real part of all non-trivial zero of the Riemann zeta function is 1/2

3.4 Demonstration

In the generalization of the Riemann hypothesis, making $n = 0$, you have:

$$\zeta\left(\frac{1}{2}+it\right) = 2^{\frac{1}{2}+it}\pi^{-\frac{1}{2}+it}\sin\left(\frac{\pi}{2}\left(\frac{1}{2}+it\right)\right)\Gamma\left(\frac{1}{2}-it\right)\zeta\left(\frac{1}{2}-it\right),$$

and it was already shown that

$$\Gamma\left(\frac{1}{2}-it\right) = 0$$

so:

$$\zeta\left(\frac{1}{2}+it\right) = 0$$

Q.E.D.

3.5 EXAMPLE OF THE DEMONSTRATION

Over the years, they have found non-trivial zeros by means of algorithmic processes, one of them is

$$s = \frac{1}{2} \pm i14,125.$$

This zero was calculated thanks to computer algorithms, let's see if this zero satistace the Riemann hypothesis by means of the demonstration that we have proposed.

Take the Riemann zeta function given by:

$$\zeta(s) = 2^s\pi^{s-1}\sin\left(\frac{\pi s}{2}\right)\Gamma\left(1-s\right)\zeta(1-s),$$

now, let's see if one of the non-trivial zeros already calculated, satisfies the demonstration presented here; let's replace now, let's see if one of the non-trivial zeros already calculated, satisfies the demonstration presented here; let's replace $s = 0.5 + i14.135$

$$\zeta(0.5+i14.135) = 2^{0.5+i14.135}\pi^{0.5+i14.135-1}\sin\left(\frac{\pi(0.5+i14.135)}{2}\right)\Gamma(1-(0.5+i14.135))\zeta(1-(0.5+i14.135))$$

here we see that effectively

$$2^{0.5+i14.135}\pi^{0.5+i14.135-1}\sin\left(\frac{\pi(0.5+i14.135)}{2}\right)\zeta(0.5-i14.135) \neq 0$$

since, the exponential functions are different from zero, the value that is in the function $\sin(x)$ it's different from $\pm k\pi$; we just have to see $\Gamma(0.5 - i14.135)$,let's see

$$\Gamma\left(0.5 - i14.135\right) = \int_0^\infty t^{0.5-i14.135-1}e^{-t}dt$$

simplifying we have

$$\Gamma\left(0.5 - i14.135\right) = \int_0^\infty t^{-0.5-i14.135}e^{-t}dt$$

doing the substitution

$$\begin{array}{rl} t = x^{a+bi} & \text{si } t = 0 \text{ ent } x = 0 \\ dt = (a+bi)x^{a-1+bi}dx & \text{si } t = \infty \text{ ent } x = \infty \end{array}$$

replacing

$$\int_0^\infty t^{-0.5-i14.135}e^{-t}dt = \int_0^\infty \left(x^{a+bi}\right)^{-0.5-i14.135} e^{-x^{a+bi}}(a+bi)x^{a-1+bi}dx$$

By doing the operations presented with the constants we finally have:

$$\int_0^\infty t^{-0.5-i14.135}e^{-t}dt = (a+bi)\int_0^\infty x^{0.5a+14.135b-1+i(-14.135a+0.5b)}e^{-x^{a+bi}}dx$$

Here results a system of equations of 2×2,(The solution of this system can be seen in the demonstration of the zeros of the Gamma function); having

$$\begin{aligned} b &= \frac{4(14.135)}{4(14.135)^2+1} = 0,070657963 \\ a &= \frac{2}{4(14.135)^2+1} = 0,002499397 \end{aligned}$$

Replacing the obtained values, we have:

$$\begin{aligned} & (a+bi)\int_0^\infty x^{0.5a+14.135b-1+i(-14.135a+0.5b)}e^{-x^{a+bi}}dx \\ = \; & (0,002499397 + 0,070657963i) \\ & \int_0^\infty x^{0.5(0,002499397)+14.135(0,070657963)-1+i(-14.135(0,002499397)+0.5(0,070657963))}e^{-x^{0,002499397+i0,070657963}}dx \end{aligned}$$

Simplifying:

$$(a+bi)\int_0^\infty x^{0.5a+14.135b-1+i(-14.135a+0.5b)}dx = (0,002499397+0,070657963i)\int_0^\infty x^{0+i0}e^{-x^{0,002499397+i0,070657963}}dx$$

In these accounts it should be noted that this value of t, calculated by means of computational approaches, manages a margin of error of 1×10^{-9}, approximately; So, we have:

$$(a+bi)\int_0^\infty x^{0.5a+14.135b-1+i(-14.135a+0.5b)}dx = (0,002499397+0,070657963i)\int_0^\infty e^{-x^{0,002499397+i0,070657963}}dx$$

Applying substitution again, we have:

$$\begin{array}{cc} x = z^{c+mi} & \text{si } x = 0 \text{ ent } z = 0 \\ dx = (c+mi)z^{c-1+mi}dz & \text{si } x = \infty \text{ ent } z = \infty \end{array}$$

$$\begin{aligned} & (0,002499397 + 0,070657963i)\int_0^\infty e^{-x^{0,002499397+i0,070657963}}dx \\ = \; & (0,002499397 + 0,070657963i)\int_0^\infty e^{-\left(z^{c+mi}\right)^{0,002499397+i0,070657963}}(c+mi)z^{c-1+mi}dz \end{aligned}$$

simplifying

$$\begin{aligned} & (0,002499397 + 0,070657963i)\int_0^\infty e^{-x^{0,002499397+i0,070657963}}dx \\ = \; & (0,002499397 + 0,070657963i)(c+mi)\int_0^\infty e^{-\left(z^{(0,002499397c-0,070657963m)+i(0,070657963c+0,002499397m)}\right)}z^{c-1+mi}dz \end{aligned}$$

Here results a system of equations of 2×2, (The solution of this system can be seen in the demonstration of the zeros of the Gamma function); having

$$\begin{aligned} c &= \frac{(14.135)^2 + 1}{2(14.135)^2 + 1} = \frac{1}{2} \\ m &= -14.135 \end{aligned}$$

Replacing

$$\begin{aligned} & (0,002499397 + 0,070657963i)(c+mi)\int_0^\infty e^{-\left(z^{(0,002499397c-0,070657963m)+i(0,070657963c+0,002499397m)}\right)}z^{c-1+mi}dz \\ = \; & (0,002499397 + 0,070657963i)(0,5 - 14.135i)\int_0^\infty e^{-\left(z^{1+i(0)}\right)}z^{-0,5-14,135i}dz \end{aligned}$$

In these accounts it should be noted that this value of t, calculated by means of computational approaches, manages a margin of error of 1×10^{-9},approximately; So, we have:

$$\begin{aligned} & (0,002499397 + 0,070657963i)(c+mi)\int_0^\infty e^{-\left(z^{(0,002499397c-0,070657963m)+i(0,070657963c+0,002499397m)}\right)}z^{c-1+mi}dz \\ = \; & (0,002499397 + 0,070657963i)(0,5 - 14.135i)\int_0^\infty e^{-z}z^{-0,5-14,135i}dz \end{aligned}$$

With these results, we finally have:

$$(0,002499397 + 0,070657963i)(0,5 - 14.135i)\Gamma(0.5 - i14.135) = \Gamma(0.5 - i14.135)$$

Leaving the Gamma function to one side only we have:

$$(0,002499397 + 0,070657963i)(0,5 - 14.135i)\Gamma(0.5 - i14.135) - \Gamma(0.5 - i14.135) = 0$$

Factoring the Gamma function:

$$\Gamma\left(0.5 - i14.135\right)\left[(0,002499397 + 0,070657963i)(0,5 - 14.135i) - 1\right] = 0$$

simplifying:

$$\Gamma\left(0.5 - i14.135\right)\left[(0,001249699 - 0,035328977i + 0,035328982i + 0,998750307) - 1\right] = 0$$

In these accounts it is worth noting that this value of t, calculated by means of computational approaches, a margin of error of 1×10^{-9}, approximately; So, we have:

$$\Gamma\left(0.5 - i14.135\right)\left[1 + 5E - 09i\right] = 0$$

Clearing:

$$\Gamma\left(0.5 - i14.135\right) = 0 * \frac{1}{1 + 5E - 09i}$$

Thus:

$$\Gamma\left(0.5 - i14.135\right) = 0$$

Finally having

$$\zeta(0.5 + i14.135) = 0$$

doing $z = 0.5 - i14.125$ In the functional equation of the zeta function, we have:

$$\zeta(0.5 - i14.125) = 2^{0.5 - i14.125}\pi^{0.5 - i14.125 - .1}\sin\left(\frac{\pi(0.5 - i14.125)}{2}\right)\Gamma(1 - (0.5 - i14.125))\zeta(1 - (0.5 - i14.125))$$

simplifying you have:

$$\zeta(0.5 - i14.125) = 2^{0.5 - i14.125}\pi^{-0.5 - i14.125}\sin\left(\frac{\pi(0.5 - i14.125)}{2}\right)\Gamma(0.5 + i14.125)\zeta(0.5 + i14.125)$$

here, we just saw that

$$\zeta(0.5 + i14.125) = 0$$

then how $\zeta(0.5 + i14.125)$ es uni de los factores, se tiene que

$$\zeta(0.5 - i14.125) = 0$$

so $0.5 \pm i14.125$ is a non-trivial zero of the Riemann zeta function.
Also, in the Gamma function we saw that

$$\Gamma\left(0.5 - i14.135\right) = 0$$

applying the property of the Gamma function

$$\Gamma(z + 1) = z\Gamma(z)$$

and doing $z = 0.5 - i14.135$ se tiene

$$\Gamma((0.5 - i14.135) + 1) = (0.5 - i14.135)\Gamma(0.5 - i14.135)$$

we just saw that

$$\Gamma(0.5 - i14.135) = 0$$

so

$$\Gamma(1.5 - i14.135) = 0$$

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