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Prime Numbers Among Fractional, Integer and Natural Numbers

Peter Mazurkin[1] & Peter Matveevich Mazurkin[1]
[1] Volga State University of Technology, Yoshkar-Ola, The Republic of Mari El, Russia
Correspondence: Peter Matveevich Mazurkin, Volga State University of Technology, Yoshkar-Ola, The Republic of Mari El, Russia.

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Abstract
Series of primes are considered in three levels of sets of numbers

$$(P_N \in \mathbf{N}) \subset (P_Z \in \mathbf{Z}) \subset (P_Q \in \mathbf{Q}),$$

where P_N – series of prime numbers in the set of natural numbers (PN), P_Z – a series of integer primes in the set of integers (WPN), P_Q – a series of rational primes in the set of rational (fractional) numbers (FPN). In series P_Q and P_Q the abscissa is taken as a complete series of integers $Z = \{-\infty,...,-4,-3,-2,-1,0,1,2,3,4,...,\infty\}$, and for a series of prime numbers P_N the positive right side of the x-axis is taken as a series of natural numbers $N = \{0,1,2,3,4,5,...,\infty\}$. It is proved that the FPN set contains four types in the quadrants of the Cartesian coordinate system, the WPN set includes two mirror-opposite lines (the left one in quadrants II and IV and the right one in quadrants I and III). Subtraction from the next term WPN and PN of the previous component of the series gives new series of increments. Converting from decimal to binary gives for the series WPN and PN, as well as their increments, the rational root 1/2 of the Riemann zeta function on the second vertical of the binary expansion. Such a transformation makes it possible to obtain the block structure WPN and PN of partitioning the original series into blocks, and then the groups starting from the number 2. Using the example of block No. 8168 for the series PN, we proved the decomposition of groups into separate quanta, starting from the number 2, by asymmetric wavelets in the form solitary waves (solitons) with variable amplitude and oscillation period with a maximum relative error of 0.1%.

Keywords: number series, fractional primes, integer primes, primes, increments, blocks, groups, wavelet analysis of the increment group

1. Introduction

For 2200 years and more, a number of prime numbers has been considered to be an unshakable construction of the number system in terms of uncertainty (Tsagir (Zagier) D., n.d.). However, all the same, the known series of prime numbers turned out to be only special cases. The mathematical description for integer primes is even simplified in comparison with series of primes. A clear geometric interpretation of symmetric and asymmetric series of integer primes appeared.

It is interesting to note that the 15-year-old Gauss was presented with a book on logarithms with an appendix of a series of prime numbers that began with 1 (Tsagir (Zagier) D., n.d.). This series of prime numbers, starting with one, was shown in one of the films on the history of mathematics. But as an adult, Gauss removed 1, and began to count this series already from the number 2. It is this change in the design of the series that we consider to be the reason why Gauss did not publish his results on the analysis of the number of prime numbers in decimal places of natural numbers for a long time. Gauss moved away from studies of the series and began to count the number of prime numbers in tens, hundreds, etc., that is, in the decimal number system, in order to achieve what he had planned at the age of 15. He called it the law of prime numbers. Subsequently, Riemann left this Gaussian series unchanged 2, 3, 5, 7, 11, ... The authority of Gauss is still so great that this error in the series of prime numbers is still not taken into account by mathematicians. As a result, everyone considers an asymmetric series consisting only of positive primes, but without 0 and 1 (Bayless J., Kinlaw P., & Lichtman J.D., 2022; Bayandin A.V., 1999; Bentz H.J., 1982; Cohen D.A. & Katz T.M., 1984; Chebyshev P. L., 2017; Chubarikov V.N., 2011). And the binary system of 0 and 1 has long been unconditionally accepted in computer calculations (Dunham W., n.d.). It is the conversion of prime numbers from decimal to binary that provides proof of the Riemann hypothesis. In the future, it is necessary to study further the series of prime numbers, and not the number of primes among the digits of natural numbers.

As a result, the series of primes itself was not studied in terms of structure and therefore was not brought into line with binary calculus. Mathematicians were carried away only by analyzing the power of the series and compiling series with the rapid growth of their terms.

We must also remember that Einstein did not like negative numbers and did not use them at all. This, of course, is due to the fact that many mathematical functions, except for the linear equation, do not work on the x-axis with negative numbers. As a result, the psychological barrier to resisting the acceptance of negative integers was extremely high. Therefore, all mathematicians were not concerned with the series of primes themselves, but only with the number of members of the series truncated by Gauss and supported by Riemann, starting only with the number 2.

Nature "counts" in the binary system, and man — in the decimal system. Therefore, any series of primes can be folded in binary codes (Mazurkin P.M., 2014). And only in this case does the geometry of the Gaussian ladder itself appear, as well as separately of its steps without a triangular base of this ladder (increment of prime numbers (Mazurkin P.M., 2012)).

The series of integer primes (Mazurkin P.M., 2015) is symmetric with respect to 0 and infinite-dimensional in negative and positive ends. The study of the properties of the positive part of the complete series of integer primes showed a clear geometry through the block structure of the series and gave patterns of distribution of primes in blocks and groups.

2. Theorem. Three Rows of Primes Relative to the X-Axis as Integers

For the hierarchy between sets of numbers in the existing number theory, the expression (Burdinsky I.N., 2008; Gashkov S.B., 2004) of sequential subordination is known

$$\mathbf{P} \subset \mathbf{N} \subset \mathbf{Z} \subset \mathbf{Q} \subset \mathbf{R} \subset \mathbf{C}, \qquad (1)$$

where **P** – prime numbers, **N** – natural numbers, **Z** – whole numbers, **Q** – rational numbers, **R –** real numbers, **C** – complex numbers, $\subset$ – inclusion sign.

For a direct study of series of prime numbers, we make the following assumptions:

1) $\mathbf{P} \subset \boldsymbol{R}$ and such an inclusion of prime numbers in the set of real numbers is applicable only when proving the existence of statistical regularities, revealed by modeling on various segments of a series of prime numbers by the identification method [32B 33], and then, in the limit, obtaining formulas in their final form; while the studied segment of the finite-dimensional series of primes remains without any transformation or change;

2) $\mathbf{P} \notin \mathbf{C}$, although complex numbers can and do include a set of primes according to formula (1), for example, only as natural numbers, however, we believe that elements of a series of prime numbers of a higher level cannot belong to the set of complex numbers; at the same time, the rational root 1/2 of the Riemann zeta function is easily proved when converting simple natural numbers from the decimal number system to the binary system.

Then the series of primes can be considered at three levels:

$$(P_N \in \mathbf{N}) \subset (P_Z \in \mathbf{Z}) \subset (P_Q \in \mathbf{Q}), \qquad (2)$$

where P_N – series of prime numbers in the set of natural numbers,
P_Z – a series of integer primes in the set of integers,
P_Q – series of rational primes in the set of rational numbers,
$\in$ – belonging sign.

In series P_Q and P_Z the abscissa axis is taken as a complete series of integers $Z = \{-\infty,...,-4,-3,-2,-1,0,1,2,3,4,...,\infty\}$, and for a series of prime numbers, the positive right side of the abscissa axis is taken in the form of natural numbers $N = \{0,1,2,3,4,5,...,\infty\}$. At the same time, half of the series is cut off from the full series of integers on the x-axis in the form of negative natural numbers $-N = \{-\infty,...,-5,-4,-3,-2,-1,-0\}$.

First we prove the series P_Q, then P_Z at the end of the article the series P_N.

3. Proof of a Series of Rational (Fractional) Primes

Table 1 shows fragments of four types of rational (fractional) prime numbers, and Figure 1 shows their graphs in a rectangular coordinate system.

Table 1. Four types of rational (fractional) primes

Abscissa (integer Z)	Ordinate over types of rational primes			
	Type of I	Type of II	Type of III	Type of IV
-∞	0	∞	-0	-∞
…	…	…	…	…
-6	**1/13**	13	**-1/13**	-13
-5	**1/11**	11	**-1/11**	-11
-4	**1/7**	7	**-1/7**	-7
-3	**1/5**	5	**-1/5**	-5
-2	**1/3**	3	**-1/3**	-3
-1	**1/2**	2	**-1/2**	-2
0	1	1	-1	-1
1	2	**1/2**	-2	**-1/2**
2	3	**1/3**	-3	**-1/3**
3	5	**1/5**	-5	**-1/5**
4	7	**1/7**	-7	**-1/7**
5	11	**1/11**	-11	**-1/11**
6	13	**1/13**	-13	**-1/13**
…	…	…	…	…
∞	∞	0	-∞	-0

Note: Rational (fractional) prime numbers are in bold.

Thus, the proof of the existence of rational primes is clear from the data in Table 1 and the graphs in Figure 1.

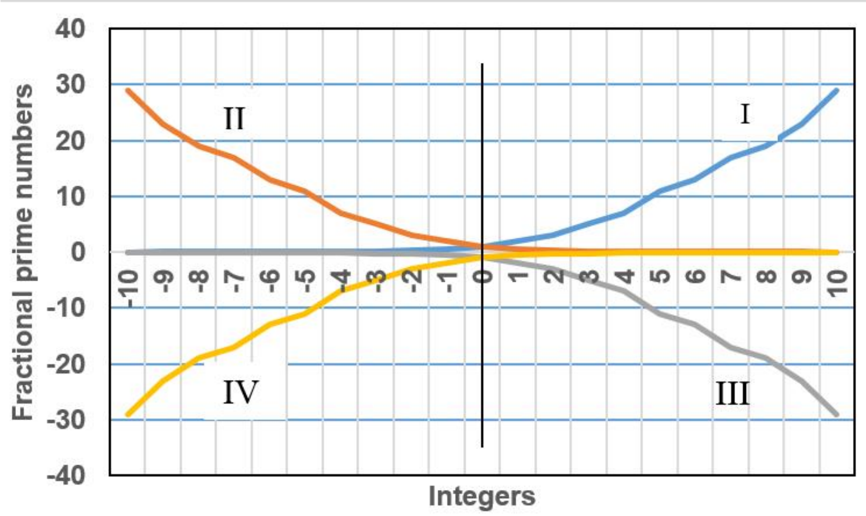


Figure 1. Graphs of four types of series of fractional primes

It seems that the physical meaning of the positive semi-axis of the abscissa for the second type of fractional primes exists. For example, one can assume the existence of a prime number $P_N^h = h^{-1}$, reciprocal of Planck's constant $h =$ 6.62607015 x 10 -34 (Joule second) – boundaries between the macrocosm and the microcosm. Apparently, it is possible to compile a series of reciprocal quantities for other fundamental physical constants.

4. Proof of a Series of Integer Primes

The set of integers was studied in (Fang J.H., 2022; Fang J.H. & Chen Y.G., 2018; Mallesham K., Prakash G. & Ramana D.S., 2022; Mallesham K., Prakash G. & D.S. Ramana D.S., 2022; Paran F., 2020). However, no one before us tried to connect them with prime numbers. Apparently, Einstein's dislike for negative numbers had an effect. Next, we will prove the integer prime numbers (WPN) in detail.

4.1 Construction of Two Mirror Series of Integer Primes

If we supplement natural numbers with the signs "+" or "-", then we get integers Z with center 0 and edges along the abscissa axis, and integer prime numbers along the ordinate axis (Table 2). Moreover, with the signs "+" (positive prime numbers) or "-" (negative WPN).

Table 2. Two subtypes of integer primes

Subspecies A of prime integers				Subspecies B of integer primes			
Z	A	Z	A	Z	B	Z	B
- ∞	- ∞	-	-	- ∞	∞	-	-
…	…	1	1	…	…	1	-1
-10	-23	2	2	-10	23	2	-2
-9	-19	3	3	-9	19	3	-3
-8	-17	4	5	-8	17	4	-5
-7	-13	5	7	-7	13	5	-7
-6	-11	6	11	-6	11	6	-11
-5	-7	7	13	-5	7	7	-13

-4	-5	8	17	-4	5	8	-17
-3	-3	9	19	-3	3	9	-19
-2	-2	10	23	-2	2	10	-23
-1	-1	…	…	-1	1	…	…
0	0	∞	∞	0	0	∞	- ∞

From Table 2 and the graphs in Figure 2, it is clear that in nature there are two sub-species of integer primes.

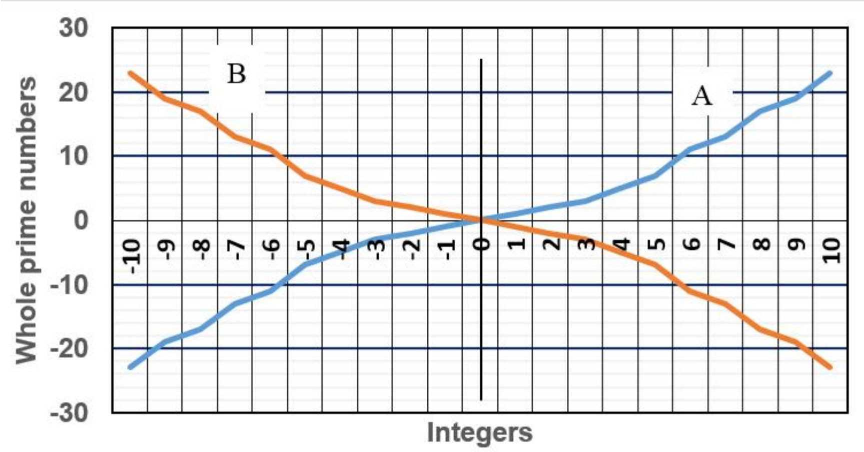


Figure 2. Graphs of two subtypes (left B and right A) of prime integers

Apparently, the chirality of the living and inert world is characteristic of the mirror reflection of subspecies among themselves, in Figure 2, for series of integer primes (http://www.akin.ru/spravka/s_fund.htm.).

4.2 Finite-Dimensional Symmetric Series WPN

Next, we will study the symmetrical right row of subspecies A from Figure 2.

Consider an example of a finite symmetric WPN series (Table 3). This example was compiled according to the computational capabilities of the CurveExpert-1.40 software environment (http://www.curveexpert.net/). It can only contain a little more than 3300 lines for the values of the x and y parameters.

Table 3. Finite-dimensional series of integer primes with cardinality of the series (fragment)

Left edge		Center of symmetry		Right edge	
Z	P_Z	Z	P_Z	Z	P_Z
-16500	-182057	-3	-3	…	…
-16499	-182047	-2	-2	16495	182011
-16498	-182041	-1	-1	16496	182027
-16497	-182029	0	0	16497	182029
-16496	-182027	1	1	16498	182041
-16495	-182011	2	2	16499	182047
…	…	3	3	16500	182057

In the full series of primes, the power n shows the total number of terms, and in the symmetric series of the

WPN, the number of pairs of integer primes. Then the power of the WPN series will be equal to $2n+1$.

With the total number in the example of Table 3, together with zero, there is $2\times 16500 + 1 = 33001$ a prime integer. A larger number of pairs of numbers Z and P_Z does not fit in the memory of the CurveExpert-1.40 software environment.

The origin of coordinates is clearly defined at the point ($Z=0$, $P_Z=0$). This is a ***point of singularity*** due to the fact that, according to the existing definition of a prime number (the second property of dividing by itself), division 0 / 0 occurs.

At the same time, according to the first property (division by 1), it turns this point into zero.

A definition is known that a prime number is a natural number $\mathrm{N}=\{0,1,2,3,4,5,6,...\}$ that has two natural divisors: one and itself (Tsagir (Zagier) D., n.d.). But, when zero is included in the series of complete primes or integer primes, division by itself has no physical meaning (it is required to mathematically reveal this uncertainty). Therefore, we exclude the second condition and leave the following definitions:

a prime integer is an integer that is only divisible by 1;

a prime number is a natural number that is only divisible by 1.

Table 3 shows that the center of symmetry is determined by seven integer prime numbers. In this case, the negative semiaxis 0(-0), -1, -2 and -3 ... is directed to the left, and the positive semiaxis 0, 1, 2 and 3 ... is directed to the right (for the full series of prime numbers).

The "+" sign gives, we believe in our Universe, Stephen Hawking's arrow of time (Hogging S., n.d.) from left to right and, apparently, both subtypes A and B for two series of integer primes determine the chirality of terrestrial biological objects. In the book (Mazurkin P.M., 2012), we proved the correspondence of the series of Fibonacci numbers to the complete series of positive primes, and in our Universe.

We also note that, according to the results of studies (Mazurkin P.M., 2012), the terms 0, 1, and 2 in the complete series of primes belong to the ***critical primes***. It was they who prevented mathematicians for more than 2200 years from finding the distribution law in the traditional Gauss series: 2, 3, 5, 7, 11, ... in the decimal number system. But Gauss nevertheless removed one critical number 1, but apparently did not dare to exclude the number 2. In a famous film on the history of mathematics, one of the mathematicians known to his contemporaries said that his favorite number is 2, since this is the only even number in the series of prime numbers. But now we can say that there are even numbers in the series 0, 1, 2, 3, 5, ... even two - zero and two. And taking into account the scale of integers, even three such even numbers appear: -2, 0, 2.

The ***non-critical series*** of primes (Mazurkin P.M., 2012) begins with the number 3 and it allows revealing highly adequate (statistical, with a correlation coefficient close to 1, that is, with some error in real values) mathematical regularities.

The sign does not change the essence of the numbers themselves, but only correlates them into different "worlds" (negative or positive), therefore, 0 (-0), -1, -2, -3, ... $-\infty$, are symmetrically on the left half-axis, they are also located on the left the critical primes are 0, -1 and -2.

Therefore, a non-critical negative series $-P_Z$ begins with the number -3.

We note here that the physical analogue of the ***event horizon*** is located on the border of the sphere -1, 0, +1 from the inside (in Table 3, the core of the ***center of symmetry*** is highlighted), that is, under the condition $\pm P_Z \to 1$.

And the ***rational number*** 1/2, or the real root of the Riemann zeta function (according to the well-known Riemann hypothesis or Hilbert's 8th problem) is through for the entire series of integers. This root appears when translating prime numbers from the decimal number system to the binary system (Mazurkin P.M., 2012), and the ***critical Riemann line*** is clearly defined by the second vertical of the binary expansion.

A complete series of VPN numbers with infinity around the edges is called ***proston*** (from the Russian word "simple").

When two rows of WPN are shifted relative to each other (two protons—as counting units in the general case of a set of rows of integer primes that are offset from the center or rotated relative to each other), the ***increment*** of integer primes is determined.

The geometry and patterns of series of positive primes are given in (Hasanalizade E., Shen O. & Wong P.J., 2022; Mazurkin P.M., 2012).

4.3 Center of Symmetry of the WPN Series

Figure 3 shows a graph of the center of symmetry of the WPN series of seven points. The graph was obtained in the CurveExpert-1.40 software environment in the form of a formula

$$P_Z = Z\ ,\ \ Z = -3,-2,-1,0,1,2,3\ . \tag{3}$$

The center of symmetry of a series of integer primes has remarkable mathematical and physical properties (Mazurkin P.M., 2015).

The same proportionality $P_Z = Z$ is observed when the power of pairs of integer primes $n = 1 \vee 2 \vee 3$ or the total number of members of the WPN series is $2n+1 =$ $3 \vee 5 \vee 7$.

Thus, at the center of symmetry, prime numbers (their numbers are also prime numbers) coincide with the values of the initial elements of the scale of integers and natural numbers.

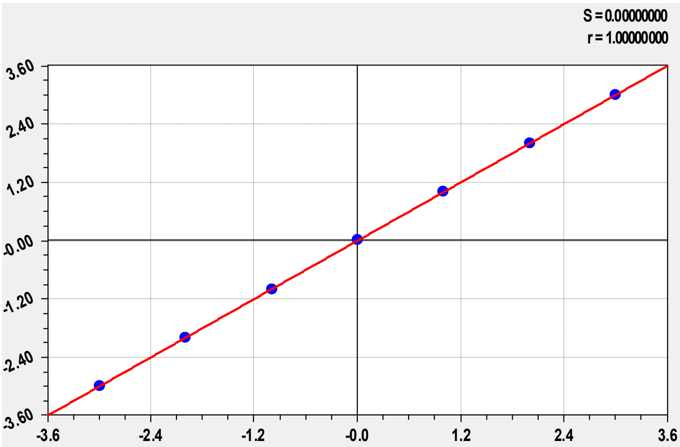


Figure 3. Center of symmetry of the WPN series

Note: in the upper right corner: S - standard deviation; r - correlation coefficient

This center of symmetry is unchanged for any cardinality of the symmetric or asymmetric (with the inclusion of the center of symmetry) WPN series, including the infinity condition $n \to \infty$ in Cantor's understanding of the types of infinity. It is a kind of start of a change in disproportion. Moreover, this start occurs from a proportionality coefficient equal to 1, and continues to infinity.

Inside the spherical ***shell of the center of symmetry*** (in Table 3, the shell is located behind the selected core of three numbers, and the sphere is formed by turning the slope of the symmetry line from an angle $\pi / 4$ up to 360 degrees) there are three fundamental constants (harmony numbers - the golden and silver proportion, time or the Napier number).

Thus, from the singularity point 0 there is a complex and yet mathematically incomprehensible extension (within the framework of rational integers) to the boundary of the kernel [-1, 0, +1]. Rational (fractional) prime numbers are at work here. Then in the spherical shell [-3, -2, …, 2, 3] there is a leap of harmony (Mazurkin P.M., 2015; Mazurkin P.M., 2012) through the number of time or the Napier number. As a result, the properties of WPN combine the achievements of physics and mathematics and therefore become an incentive for further in-depth complex physical and mathematical research.

4.4 Increments of Whole Prime Numbers

The increment of integer prime numbers is formed by two protons (Table 4, Figure 4), when the first column of a series of numbers is shifted up in Excel relative to the second column by one position, and then we get the formula

$$p_Z = P_{Z+1} - P_Z\ . \tag{4}$$

Table 4. Increment in a series of integer primes (right proston, subspecies A of the WPN series)

Negative integers	Positive integers

Z	P_{Z+1}	P_Z	p_Z	Z	P_{Z+1}	P_Z	p_Z
- ∞	- ∞	- ∞	- (?)	0	1	0	1
…	…	…	…	1	2	1	1
-10	-19	-23	4	2	3	2	1
-9	-17	-19	2	3	5	3	2
-8	-13	-17	4	4	7	5	2
-7	-11	-13	2	5	11	7	4
-6	-7	-11	4	6	13	11	2
-5	-5	-7	2	7	17	13	4
-4	-3	-5	2	8	19	17	2
-3	-2	-3	1	9	23	19	4
-2	-1	-2	1	10	29	23	6
-1	0	-1	1	…	…	…	…
				∞	∞	∞	- (?)

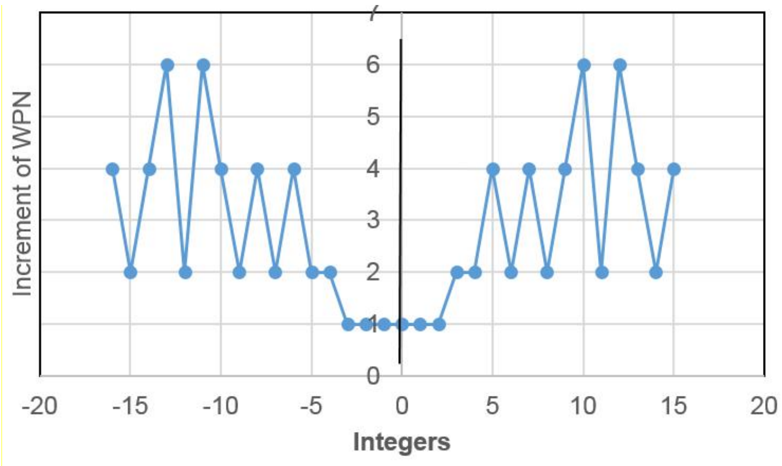


Figure 4. Scatter plot (fragment) of increments of integer prime numbers

The graph in Figure 4 shows the symmetry of both branches of the WPN series.

In the center of symmetry of integer primes, the increment is 1. On the left and right branches in the form of a non-critical series of primes, the increment receives even numbers 2, 4, 6, 8, etc. Prime number twins are always incremented by 2.

4.5 Influence of the Cardinality of Pairs of Integer Primes

Figure 5 shows graphs of symmetric finite-dimensional series WPN subspecies A for different cardinalities of pairs of prime numbers 10, 100, 1000 and 10000 pieces. Such a difference in cardinality of WPN symmetric series makes it possible to visually study the geometry of symmetric (and then asymmetric) finite-dimensional series.

Based on these indicated series of integer primes from Figure 5, the equations of the law of ***symmetric series of integer primes*** are obtained:

- for a finite-dimensional WPN series $n = 10$ of pairs of integer primes

$$P_{Z10} = 1{,}98182Z\,; \tag{4}$$

- for a finite-dimensional WPN series $n = 100$ of pairs of integer primes

$$P_{Z100} = 4{,}87381Z\,; \tag{5}$$

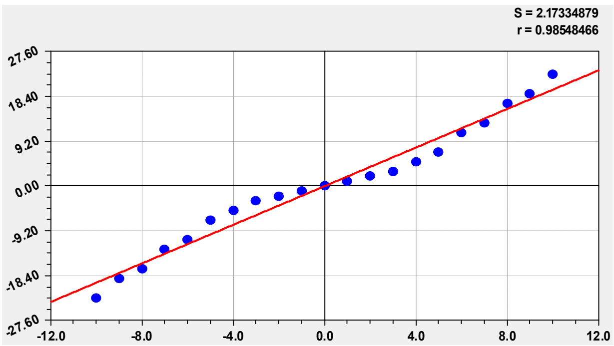
- for a finite-dimensional WPN series $n = 1000$ of pairs of integer primes

$$P_{Z1000} = 7{,}53273Z\,; \tag{6}$$

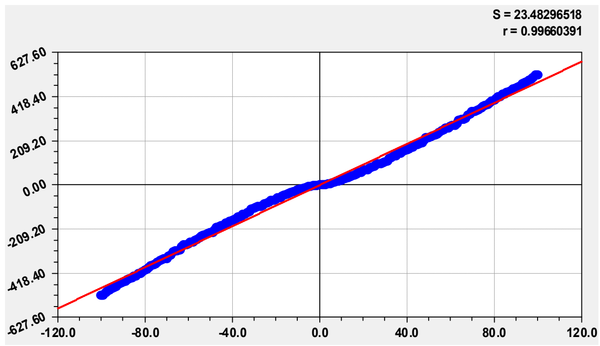
- for a finite-dimensional WPN series $n = 10000$ of pairs of integer primes

$$P_{Z10000} = 10{,}10516Z\,. \tag{7}$$

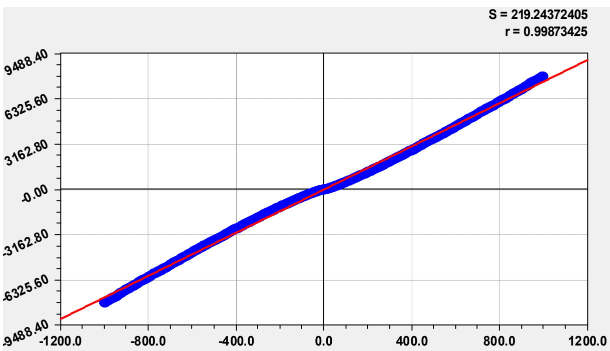
For specific symmetric WPN, all equations are of the same type and belong to the class of linear equations without a constant term.



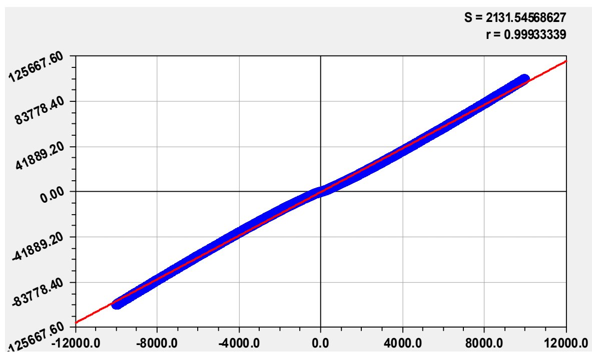
The power of the WPN series with $n = 10$ pairs



The power WPN series $n = 100$ pairs



The power WPN series $n = 1000$ pairs



The power WPN series $n = 10000$ pairs

Figure 5. Graphs of finite-dimensional series of integer primes of various cardinalities

The adequacy of linear patterns is very high in terms of the correlation coefficient (a measure of the closeness of the connection of an empirical formula, which is automatically generated). Correlation coefficients give a super strong factorial relationship (more than 0.99). With an increase in WPN power, the adequacy of the linear model increases: under the condition $n = 10$, the correlation coefficient is 0.9855; when $n = 100$ it turns out 0.9966; when $n = 1000$ adequacy is reached 0.9987; with $n = 10000$ this coefficient equal to 0.9993. At the maximum power $n = 16500$ for a number of pieces for CurveExpert-1.40, a correlation coefficient of 0.9994 was obtained. Then, when the limit is reached $n \to \infty$, as for the center of symmetry, the correlation coefficient of the linear model will approach 1.

The law of integer prime numbers is very simple in design and therefore, apparently, is also the fundamental law of the universe (in astrophysics, the so-called cosmic strings). Apparently, these cosmic strings are finite dimensional in length.

The law of prime numbers is very simple in its construction and, therefore, appears to be a fundamental law of the universe (referred to as such in astrophysics).

4.6 Basic WPN Distribution Law

The linearity of the basic law of distribution of a number of WPN of any power is geometrically interpreted as follows.

The left and right halves of the series of integer prime numbers of subspecies A form a kind of core of the entire distribution structure, bypassing the special properties of the sphere -1, 0, +1 and the abrupt transition to harmony inside the shell -3, -2, ..., 2, 3.

In the triad -1, 0, +1 there are still little known to us distinguishing features. In the spherical shell [-3, -2, …, 2, 3] there is a qualitative leap from the singularity for a harmonic distribution from a prime ± 3 to two (left and right) non-critical series $\pm P_{N=3,5,7,11,...}$.

Based on induction on a set of particular examples, it is possible to generalize the ***law of distribution of series of symmetrical WPN*** in the form of a mathematical expression

$$P_Z = \alpha(n)Z \,, \tag{8}$$

where $\alpha(n)$ - slope coefficient of the symmetrical series at the cardinality n of pairs of terms in the WPN series.

This is the main parameter of any WPN series, including the asymmetric one, which has a constant term, and has a clear geometric meaning.

The ratio of an integer prime number (ordinate) to an integer (abscissa) gives the tangent ***of the angle of inclination*** ω of the symmetric WPN axis to the abscissa axis Z according to the formula

$$tg\omega = P_Z / Z = \alpha(n) \,. \tag{9}$$

From expression (9) and the graph in Figure 5, we notice that the lower limit of the angle of inclination of the symmetry axis will be 45o or $\alpha_{\min} = \pi/4$. Then the condition $n \to \infty$ will also be $P_Z \to \infty$, therefore $\alpha_{\max} \to \pi/2$. Then the interval of the slope of the axis of the entire symmetric series of integer primes will be equal to $a(n) = \{1, \infty\}$, and the interval of the slope of the axis of the entire WPN series will change within $\alpha = \{\pi/4, \pi/2\}$.

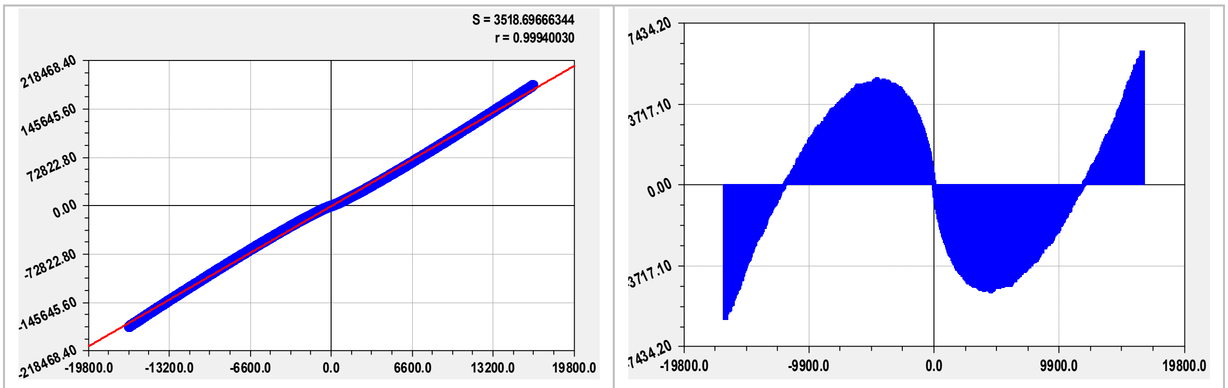
4.6 WPN Power Limit Cur4veExpert-1.40

The CurveExpert-1.40 software environment allows only a little more than 33,000 values (lines) of source data pairs to be stored. However, this turned out to be sufficient for the physical interpretation of both the line of the WPN series according to the law (8), and the physical understanding of the residuals (absolute error) of this law.

After the parametric identification of the law (8), the formula was obtained

$$P_{Z16500} = 10{,}65994Z \,. \tag{10}$$

Figure 6 shows graphs of series and residues (absolute error) from formula (10) for integer prime numbers of 16500 pairs. Residues from the basic law of integer primes show the nature of the wave change.



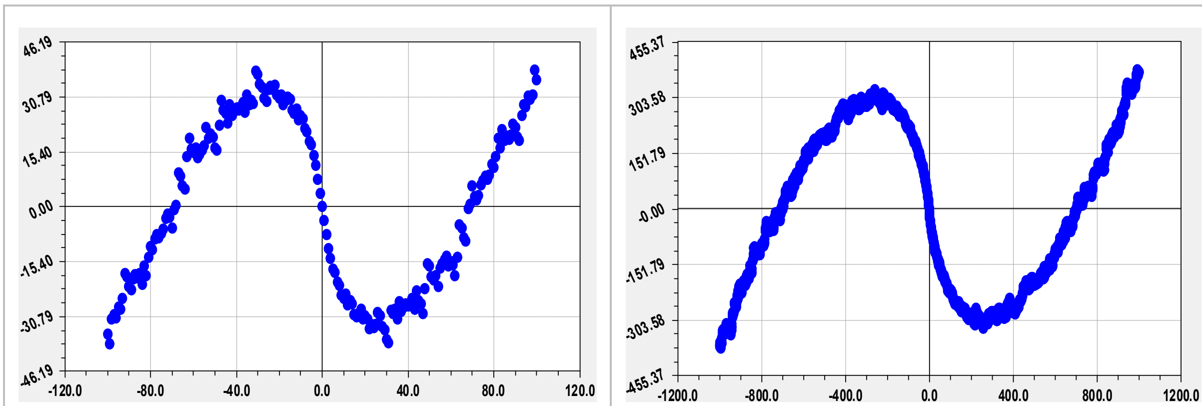
Plot of formula (10) series lines WPN	Residuals (absolute error) of the model (10)

Figure 6. Graphs of a finite-dimensional series of integer primes by the memory limit of the CurveExpert-1.40 software environment for $n = 16500$

As can be seen from the remnants in Figure 6, they form a kind of bridge near the center of symmetry, as happens in a spiral galaxy near each arm.

4.7 Physical Interpretation of Series and Remainders of WPN After the Series Line

As mentioned earlier, one “proston” shows one string of the universe. Many “prostons” from the same point with different rotations give many cosmic strings centered at one point. And the point distribution of the remnants (Figure 7) shows similarity with a symmetrical pair of arms in spiral galaxies (Mazurkin P.M., 2012; Mazurkin P.M., 2014).



Plot of residuals (5) of the WPN series at $n = 100$	Plot of residuals (6) of the WPN $n = 1000$

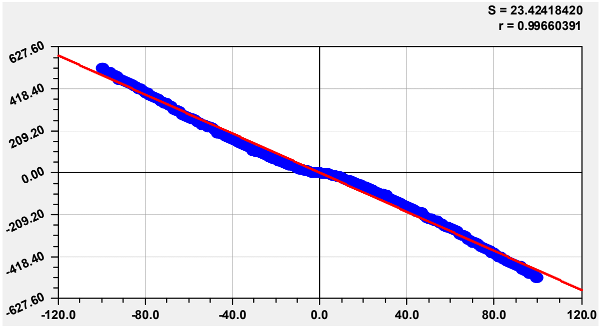
Figure 7. Graphs of residuals from the formulas of the series line according to WPN subspecies A

Then the location of the arms of residues for subspecies A will be called right-handed.

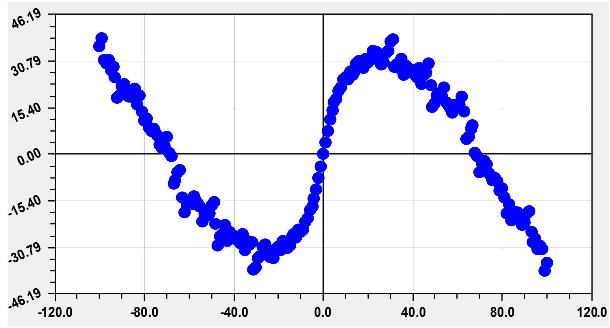
In subspecies B of the series of WPN distributions, as shown in Figure 8 for the power of the series $n = 100$, a left-hand arrangement of arms is formed according to the formula along the line “proston” (cosmic string).

$$P_{Z100} = -4{,}87381 Z \,. \qquad (11)$$

Then the right arm of the cosmic string has a positive sign before the distribution law WPN, and the left arm of the cosmic string gets a negative sign.



String line (11) of the WPN series at $n = 100$



Remains of (11) WPN series

Figure 8. Graphs of formula (11) of the law of the line of the WPN series subspecies B

Any symmetrical WPN in its residuals from the main distribution law contains a pair of opposite arms of spiral galaxies.

This property opens up wide mathematical possibilities for statistical modeling of a set of measured parameters for specific, primarily spiral, galaxies. In this case, an ideal galaxy is formed by many axes with different rotations, as well as with different offsets of the centers near the arms, in the coordinate system from the common center of the galaxy. Other types of galaxies appear to have underdeveloped string and arm systems, but they have not developed arm-like remnants of the axis.

4.8 Effect of WPN Pairs on Line Slope

Lines of axes (strings) of finite-dimensional series of prime integers change their position in the coordinate system (Z , P_Z) depending on the length in pairs n of symmetrically located two parts of the series.

Table 5 shows data on the models of the coefficient of proportionality $a(n)$ of the main law of the axis (line) of a series of integer prime numbers.

Table 5. Parameters of the basic law of a series of integer prime numbers of different cardinality

Number of pairs WPN n	Axis line options			Number of pairs WPN n	Axis line options		
	$a(n)$	Coeff. correlat. r	Standard. deviation S		$a(n)$	Coeff. correlat. r	Standard. deviation S
1	1	1	0	500	6.75059	0.99833	113.152
2	1	1	0	600	6.95023	0.99850	132.035
3	1	1	0	700	7.12861	0.99856	154.871
4	1.13333	0.99400	0.365	800	7.28206	0.99862	176.949
5	1.25455	0.99181	0.536	900	7.41296	0.99869	197.259
6	1.48352	**0.97890**	1.260	1000	7.53273	0.99873	219.244
7	1.61429	0.98242	1.372	1100	7.64459	0.99875	243.121
8	1.77451	**0.98137**	1.812	1200	7.74049	0.99880	262.806
9	1.87018	0.98471	1.916	1300	7.82581	0.99886	281.062
10	1.98182	0.98548	2.173	1400	7.91035	0.99887	303.791
11	2.13834	**0.98226**	2.834	1500	7.99258	0.99887	329.037
12	2.23692	0.98402	3.043	1600	8.06342	0.99891	348.761

Number of pairs WPN n	Axis line options			Number of pairs WPN n	Axis line options		
	$a(n)$	Coeff. correlat. r	Standard. deviation S		$a(n)$	Coeff. correlat. r	Standard. deviation S
13	2.36264	**0.98333**	3.536	1750	8.16577	0.99893	382.419
16	2.61096	0.98709	4.163	1800	8.19727	0.99894	392.899
17	2.69300	0.98746	4.477	1900	8.25455	0.99897	410.773
19	2.84534	**0.98319**	5.099	2000	8.31230	0.99899	432.613
22	3.02108	0.99004	5.707	2100	8.36645	0.99900	453.500
24	3.11714	0.99113	6.035	2400	8.51995	0.99902	522.859
25	3.16724	0.99141	6.274	2700	8.64815	0.99907	581.348
30	3.38498	0.99269	7.366	3000	8.76561	0.99910	645.497
31	3.40899	0.99321	7.377	3400	8.90713	0.99912	735.481
35	3.58270	0.99301	8.856	3800	9.03133	0.99915	818.978
36	3.62718	**0.99287**	9.306	3900	9.06049	0.99915	840.709
40	3.76567	0.99331	10.365	4000	9.08798	0.99916	860.382
50	4.04601	0.99425	12.835	5000	9.33715	0.99920	1075.856
60	4.26162	0.99517	14.801	6000	9.53923	0.99924	1285.132
70	4.44802	0.99557	17.222	7000	9.71054	0.99927	1500.382
80	4.61883	0.99584	19.772	8000	9.85942	0.99929	1715.148
90	4.76203	0.99617	21.960	9000	9.99010	0.99931	1927.779
100	4.87381	0.99660	23.483	10000	10.10516	0.99933	2131.546
125	5.14321	0.99698	29.130	11000	10.21157	0.99934	2349.802
150	5.35678	0.99725	34.691	12000	10.30853	0.99936	2565.447
200	5.68646	0.99767	45.142	13000	10.39646	0.99937	2772.652
250	5.95018	0.99782	56.969	14000	10.47778	0.99938	2980.316
300	6.15314	0.99803	67.197	15000	10.55291	0.99939	3184.371
350	6.33791	0.99809	79.424	16000	10.62554	0.99940	3409.079
400	6.49280	0.99819	90.588	16250	10.64298	0.99940	3464.959
450	6.62129	0.99832	100.073	16500	10.65994	0.99940	3518.697

It can be seen from the data in Table 5 that the correlation coefficient fluctuates at the beginning of the series up to $n = 36$, and after $n \geq 16000$, it receives a constant value of 0.99940 (within five decimal places).

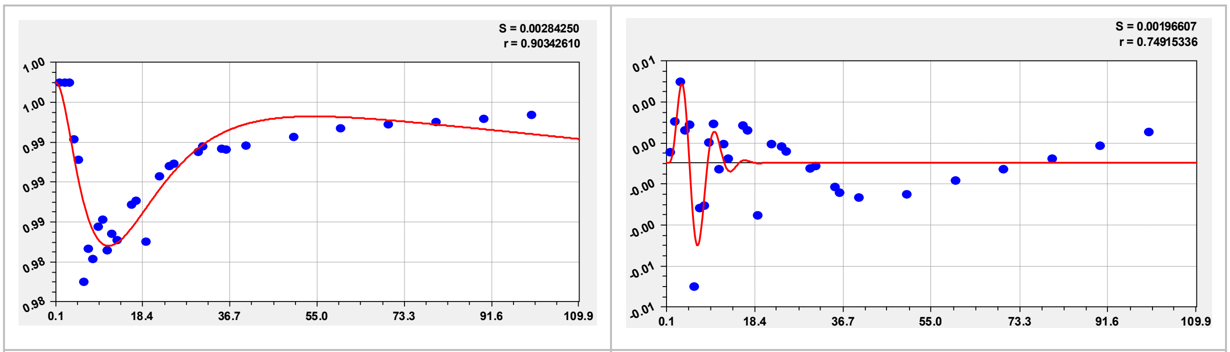
4.9 Correlation Coefficient of the Main Law of the WPN Series

It determines the tightness of the connection of the line of the main law with the WPN finite-dimensional series itself. Consider an example of 100 pairs of integer primes.

The main change in the correlation coefficient is determined (Figure 9) by the formula

$$r(n=100)=\exp(-6{,}36814\cdot 10^{-5}n^{0{,}96702})-$$

$$-0{,}0015330n^{2{,}75364}\exp(-0{,}87769n^{0{,}65473}). \quad (12)$$



Law of change of adequacy (12)	The first wave of adequacy after (12)

Figure 9. Influence of the power of the WPN series of 100 pairs on the adequacy of formula (9) of the slope of the line of the main law

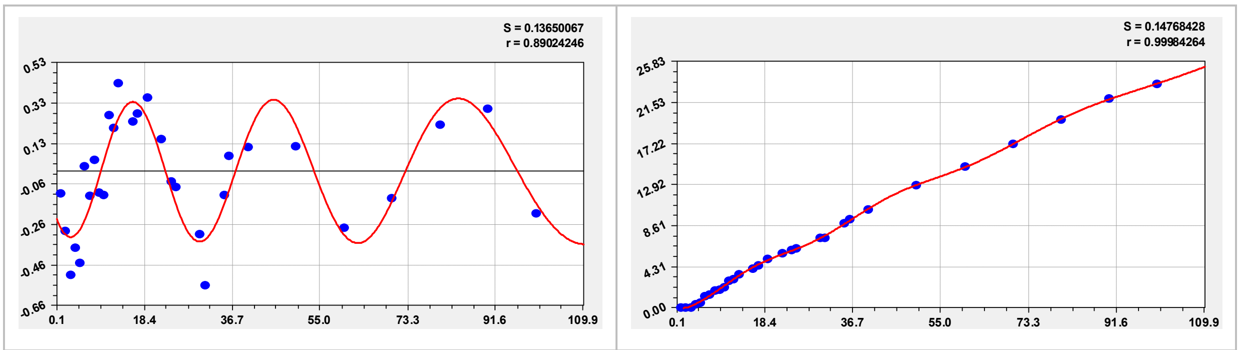
t can be seen from the plots in Figure 9 that analysis of the PN and/or WPN series requires truncated series without at least the first 100 WPN pairs. With a further increase in the power of the series, the adequacy of the model in terms of the correlation coefficient approaches unity.

4.10 Standard Deviation of Residuals from the Fundamental Law of the WPN Series

The standard deviation of the terms of the WPN series from the coefficient of proportionality (or the tangent of the slope of the line) for 100 WPN pairs is changed (Figure 10) by the

$$S(n=100)=3{,}94499\cdot 10^{7}n^{2{,}84149}\exp(-19{,}61458n^{0{,}072676})-$$

$$-0{,}033396\exp(2{,}31310n^{0{,}0019951})\cos(\pi n/(12{,}02858+0{,}011509n^{1{,}31189})-0{,}89545). \quad (13)$$



First wave of patterns (13)	Change in standard deviation (13)

Figure 10. Influence of the power of a WPN series of 100 pairs on the standard deviation of the tangent of the slope of the line (string) of the series

It is noticeable that with a change in the value of the number of pairs of primes, the parameters of a statistical model of the type (13) also change strongly.

With an increase in the power of the WPN series, the amplitude and period of the oscillatory perturbation of the standard deviation of the residuals from the law of the slope of the line of a series of 100 pairs increase.

4.11 Block Structure of a Series of Integer Primes

Blocks are allocated through the conversion of prime and integer prime numbers from the decimal system to the binary number system (Mazurkin P.M., 2015; Mazurkin P.M., 2014; Mazurkin P.M., 2015). For a series of any cardinality, various types of structure are possible, of which the left (negative) and right (positive) halves of symmetric and asymmetric series of primes of the form

Z	-7	-6	-5	-4	-3	-2	-1	-0
P_Z	-13	-11	-7	-5	-3	-2	-1	-0

0	1	2	3	4	5	6	7
0	1	2	3	5	7	11	13

For symmetrical WPN series, the construction is the same for negative and positive primes. Therefore, all patterns obtained for the positive part of the series will also be valid for the other part of the WPN series. Then we can consider the complete asymmetric series of primes (Mazurkin P.M., 2012), and apply the results of analysis and synthesis to the negative half of the series.

Table 6 shows an example of the distribution of blocks of binary reckoning of prime numbers. In total, out of 10 million natural numbers, 24 (excluding zero) blocks of positive prime numbers were identified.

Table 6. Borders, length, number, extreme points of blocks of primes and integer primes

Discharge $i = i_2$	Block $\pm 2^{i-1}$	Block boundaries		Power $n_\pm$, PCS.	Block length $\Delta P_N = P'' - P'$	Extreme points		
		$\pm P'_N$	$\pm P''_N$			P'_{ZR}	P''_{ZR}	p_{ZR}
0	0.5	0	0.5	1	0.5	0.5	0.5	0
1	1	0.5	1	1	0.5	1	1	0
2	2	1	2	1	1	2	2	0
3	4	2	3	1	1	3	5	2
4	8	5	7	2	2	7	11	4
5	16	11	13	2	2	13	17	4
6	32	17	31	5	14	31	37	6
7	64	37	61	7	24	61	67	6
8	128	67	127	13	60	127	131	4
9	256	131	251	23	120	251	257	6
10	512	257	509	43	252	509	521	12
11	1024	521	1021	75	500	1021	1031	10
12	2048	1031	2039	137	1008	2039	2053	14
13	4096	2053	4093	255	2040	4093	4099	6
14	8192	4099	8191	463	4092	8191	8209	18
15	16384	8209	16381	872	8172	16381	16411	30
16	32768	16411	32749	1612	16338	32749	32771	22
17	65536	32771	65521	3030	32750	65521	65537	16
18	131072	65537	131071	5712	65534	131071	131101	30
19	262144	131101	262139	10746	131038	262139	262147	8
20	524288	262147	524287	20390	262140	524287	524309	22
21	1048576	524309	1048573	38635	524264	1048573	1048583	10
22	2097152	1048583	2097143	73586	1048560	2097143	2097169	26

23	4194304	2097169	4194301	152937	2097132	4194301	4194319	18
24	8388608	4194319	8388593	292705	4194274	8388593	8388617	24

Note: Table 6 uses the following conventions:

$i = i_2$ - digit of numbers in the binary system;

2^{i-1} - known dividing line between the extreme points (Mazurkin P.M., 2012) of the blocks;

P'_N - left border of the block of binary partition of a number of primes;

P''_N - right border of the block of prime numbers;

$n_\pm$ - number of prime numbers in one block;

$\Delta P_N = P'' - P'$ - block length as the distance from the beginning to the end of the block;

P'_{ZR} - left extreme point at the end of the previous block;

P''_{ZR} - right extreme point at the beginning of the next block;

$p_{ZR} = P''_{ZR} - P'_{ZR}$ - increment between blocks of prime numbers.

The division into blocks occurs along the dividing line of the growth $\pm 2^{i-1}$ of the binary number system, where i is the digit of the numbers of the binary number system corresponding to the series of natural numbers 0, 1, 2, 3, 4, ... Therefore, the next block #25 ends up to the number 16777216, which is 1.68 times the power of a series of 10^7 members. Apparently, it is possible to calculate the values of the boundary primes faster if the verification of the simplicity of natural numbers begins with a known dividing line 2^{i-1}. This will allow you to quickly build up a number of prime numbers.

4.12 The Fundamental Law of the WPN Series and Its Wave Complements

From the data in Table 6, we accept in ascending order the right boundary $\pm P''_N$ of the binary decomposition blocks equal to 3, 7, 13, 31, 61, 127, 251, 509, 1021, 2039, 4093 and 8191 - up to the allowable limit of the CurveExpert-1.40 program. Then, to the model $a(n)$ of the slope coefficient of the line of the series, obtained by formula (9), we supplement the series of wave functions in the form of a sum of wavelet signals (Mazurkin P.M., 2014; Mazurkin P.M., 2015; Mazurkin P.M., 2014; Mazurkin P.M., 2014; Mazurkin P.M., 2014; Mazurkin P.M., 2015). They can be further identified up to the indivisible residues of the additive decomposition of a finite-dimensional series of primes (simultaneously also a series of integer primes).

For the condition $n = 0$, we obtain the uncertainty ($Z = 0; P_Z = 0$) at the center of the kernel of the WPN series. For cases near $n = 1 \vee 2 \vee 3$ the center of symmetry of the WPN series, we have $a(n) = 1$. The angle of inclination of the line of a series of numbers here is uniquely determined by the value $\pi / 4$. The wave shift from the linear model of the coefficient of proportionality begins under the condition $n > 3$. Statistical modeling is best started with a small number of pairs of primes.

For example, for the border $\pm P''_N = 7$ we got (Figure 11) the main formula

$$P_Z = 1{,}25455Z\,. \tag{14}$$

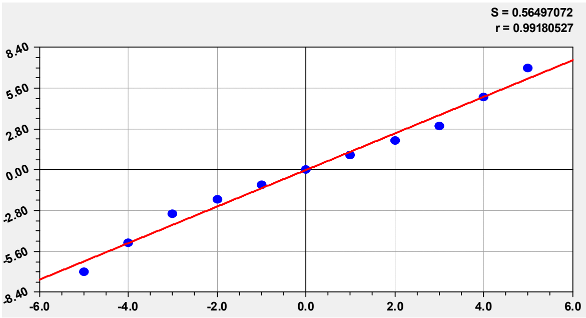
Due to the small number of points, the software environment gives a correlation coefficient equal to one, according to the general formula (Figure 11) with two additional wave functions (or asymmetric wavelet signals).

$$P_Z = 3{,}70951Z - 13{,}48069\exp(-0{,}00072644Z)\times$$

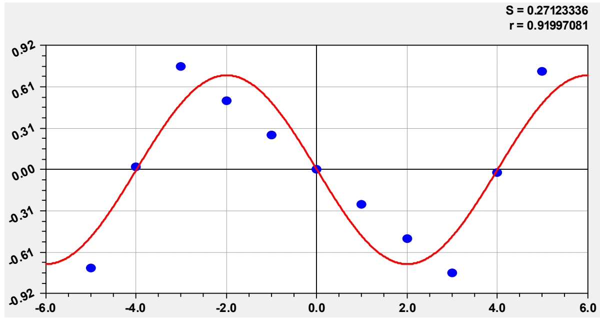
$$\times\cos(\pi Z/(15{,}05868 - 0{,}015492Z) - 1{,}57092) +$$

$$+ 0{,}15903\exp(-0{,}0041993Z)\cos(\pi Z/(1{,}82978 - 0{,}0023529Z) - 1{,}58502)\,. \tag{15}$$

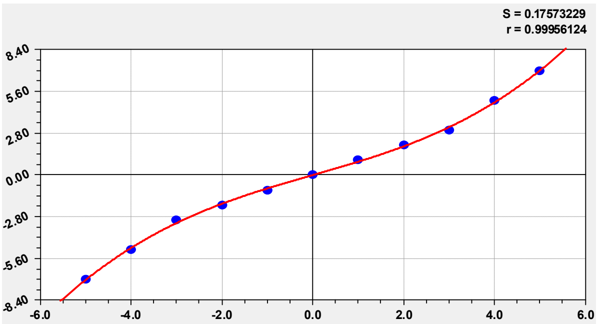
Wavelet analysis can go on and on.



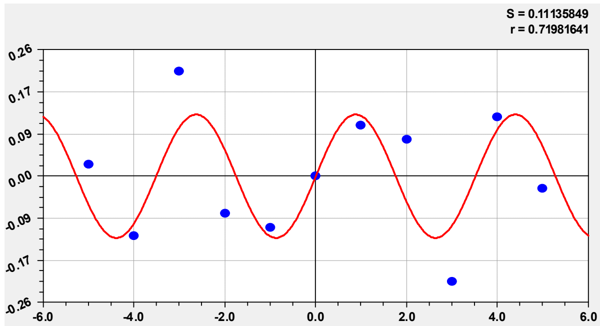
The basic Law (14)



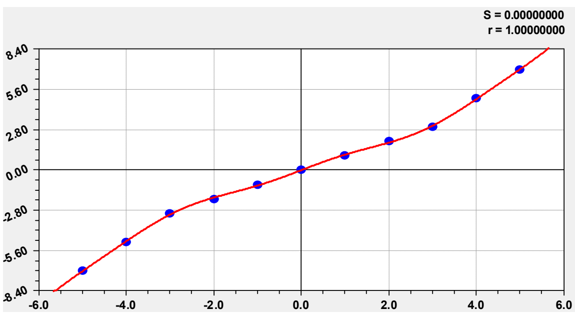
Wave function with respect to the remainders (14)



Basic law and one wave



Second wave function



Model (14) of three components

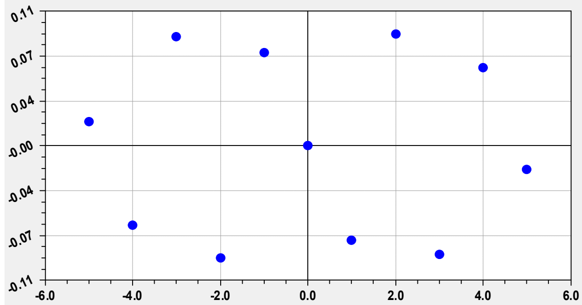

Leftovers after model (14)

Figure 11. Plots with bounds 7 for a finite-dimensional series of integer primes

In both waves of perturbation from the main law of line slope from the center of the WPN series, half the amplitude decreases according to the law of exponential death, and the half-period decreases from a constant value. At the same time, the initial value of the slope tangent increased from 1.25455 in formula (14) to 3.70951 in formula (15), that is, almost 3 times.

Thus, changing the number of members of the statistical regularity also changes the values of model parameters of the type (15). Therefore, a special software environment for a supercomputer is needed, which allows one to simultaneously identify a complex model containing more than 100 members and more than 1000 parameters on large series of prime numbers (at least up to a million lines).

For the boundary $\pm P''_N = 13$, we obtained (Figure 12) the main formula with the parameter

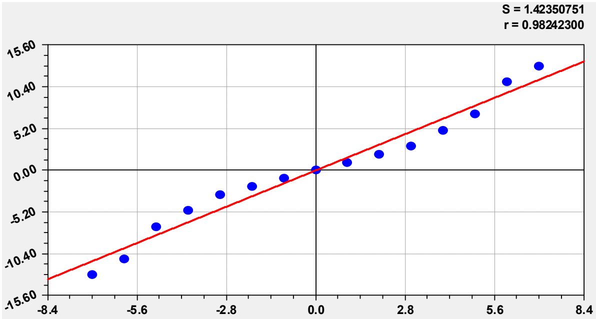
$$P_Z = 1{,}61429Z \,. \tag{16}$$

The three-term formula for this WPN finite-dimensional series is

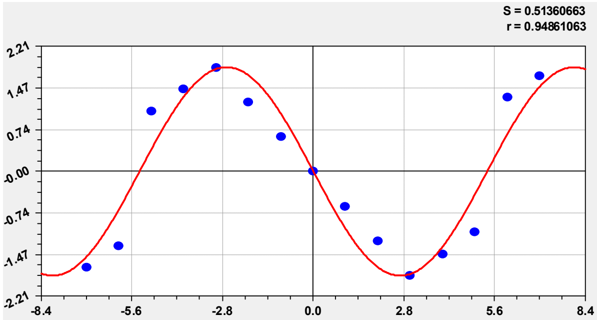
$$P_Z = -0{,}67184Z - 5{,}89992\exp(-0{,}46198Z)\times$$

$$\times\cos(\pi Z/(6{,}99980 - 0{,}71422Z) - 5{,}60767) +$$

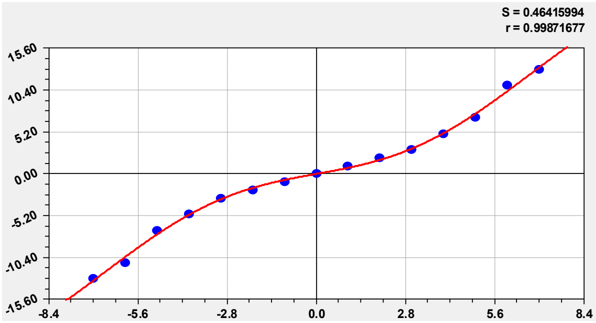
$$+5{,}89992\exp(0{,}46198Z)\cos(\pi Z/(6{,}99980+0{,}71422Z)-0{,}67552)\,. \qquad (17)$$



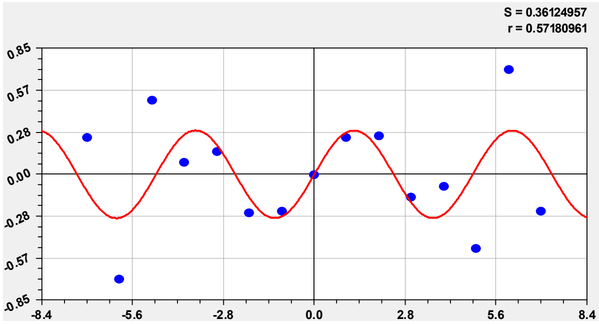
The basic Law (16)



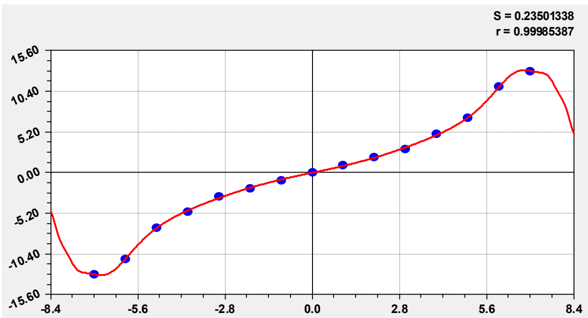
Wave function of residuals from (16)



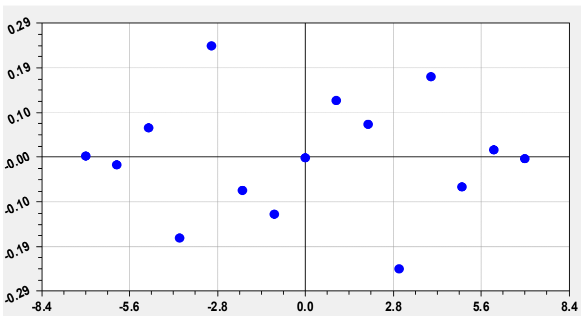
Fundamental law and wave of indignation



Second wave function



Model (17) with three components



Leftovers after model (17)

Figure 12. Graphs with block boundaries ± 13 for a finite-dimensional series of prime integers

Wavelet analysis (Mazurkin P.M., 2015) can be continued further with respect to the residuals.

However, it is clear that, in the general case, an infinite set of additional wave functions can be added to the basic linear law of the inclination of the axis of the WPN series to the abscissa axis, and to the infinite-dimensional WPN series.

But such a structural-parametric identification of a generalized wavelet requires a special software environment and a petaflop class supercomputer.

For the boundary $\pm P''_N = 31$, we obtained (Fig. 13) the main formula

$$P_Z = 2{,}23692Z\,. \qquad (18)$$

The three-term formula for this WPN finite-dimensional series is

$$P_Z = 2{,}30500Z - 4{,}22913\exp(1{,}20106\cdot 10^{-7}Z)\times$$

$$\times \cos(\pi Z / (9{,}42639 - 3{,}35462 \cdot 10^{-7} Z) - 1{,}57080) +$$

$$+ 0{,}59211 \exp(-2{,}57599 \cdot 10^{-6} Z) \times$$

$$\times \cos(\pi Z / (2{,}55443 + 7{,}50206 \cdot 10^{-7} Z) - 1{,}57077) . \quad (19)$$

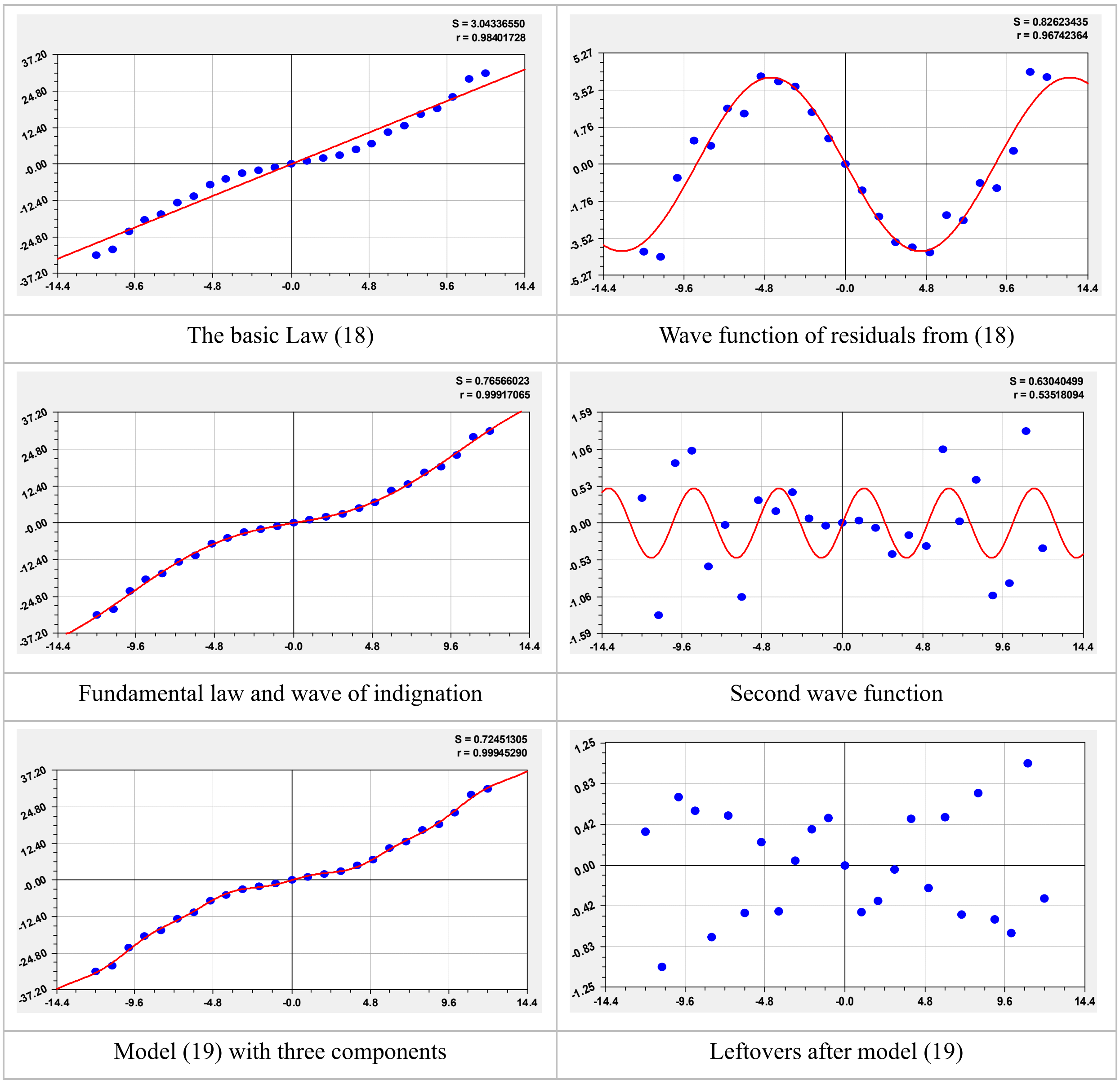


Figure 13. Graphs with block boundaries ± 31 for a finite-dimensional series of WPN

The correlation coefficient remains above 0.999. But the remnants also grow, acquiring different geometric patterns. Apparently, these patterns show something in a physical sense. However, we do not yet know how to describe these patterns of prime geometry. Therefore, one can inductively assume that for an infinite series of primes there will be an infinite set of wave functions.

For the boundary $\pm P''_N = 61$, the correlation coefficient decreased, and after structural-parametric identification, the main formula for the slope angle was obtained (Figure 14)

$$P_Z = 2{,}84534Z\,. \tag{21}$$

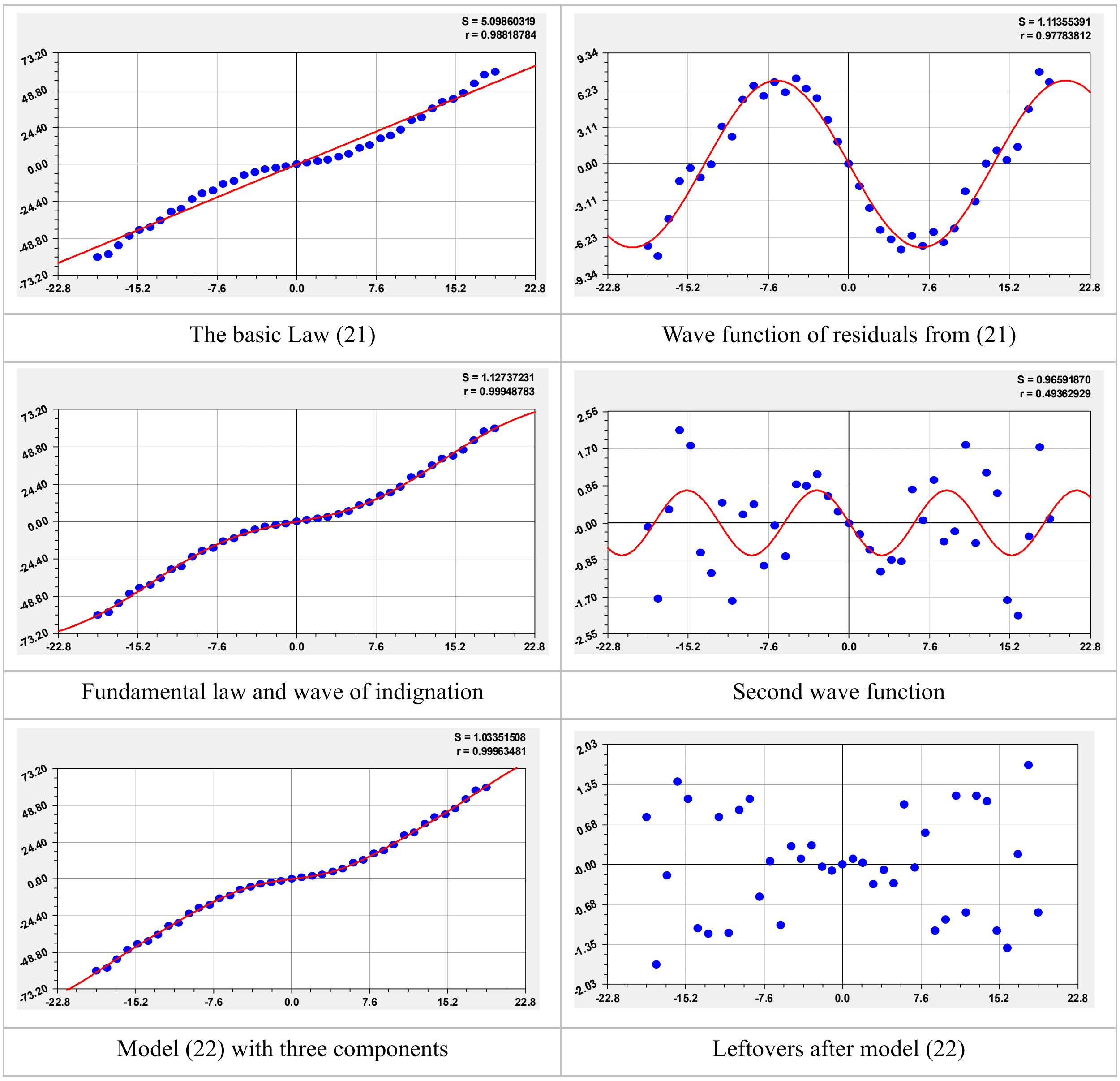
The three-term formula for this WPN finite-dimensional series is

$$P_Z = 2{,}99161Z - 7{,}97614\exp(-5{,}81847\cdot 10^{-5}Z)\times$$

$$\times\cos(\pi Z/(15{,}15307 + 0{,}00023882Z) - 1{,}57031) -$$

$$-1{,}02114\exp(-0{,}00042616Z)\cos(\pi Z/(6{,}93224 - 0{,}00038488Z) - 1{,}57472)\,. \tag{22}$$

Comparison of the main law with the formula with two waves shows that the slope tangent varies greatly for the boundaries near blocks 7 and 13.



The basic Law (21) | Wave function of residuals from (21)

Fundamental law and wave of indignation | Second wave function

Model (22) with three components | Leftovers after model (22)

Figure 14. Graphs with block boundaries ± 61 for a finite-dimensional series of WPN

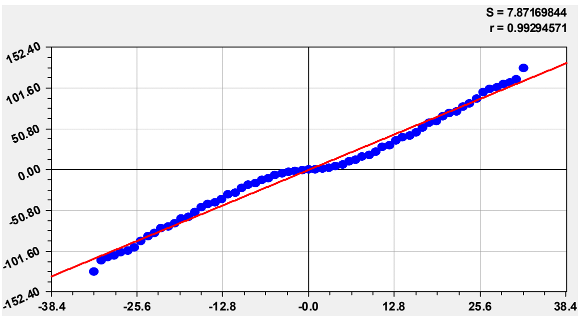
Starting from the block with the right border 31 and further, there is a small increase in the angle of inclination of the WPN series line to the abscissa axis. On a small number of primes there is a strong fluctuation.

At the same time, for the block border $\pm P''_N = 31$, the increase in the coefficient is 2.30500 / 2.23692 = 1.0304 times or 3.04%, and for the border $\pm P''_N = 61$, this increase is 5.14%. Then the indicated ratio fluctuates around 1: for $\pm P''_N = 127$ - 0.35%, and for 251 - 0.91%. But further, at the right boundary of the block $\pm P''_N = 127$, the ratio of the first parameter of the model according to the main law to the sum of the waves will be only 0.02%.

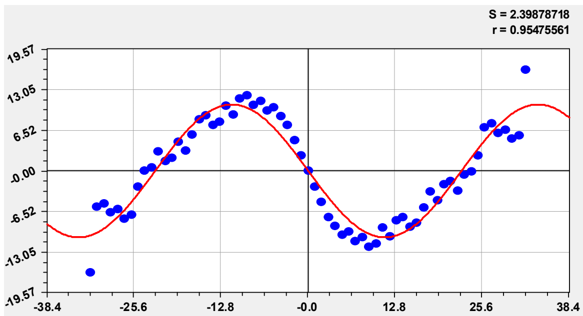
Therefore, the larger the number of blocks taken into account, the more accurately the pattern of the three components of the WPN distribution along the integer axis is determined.

Similarly, for the block boundary $\pm P''_N = 127$ (Figure 15), the main formula for the slope of the line of the CFC series takes the form

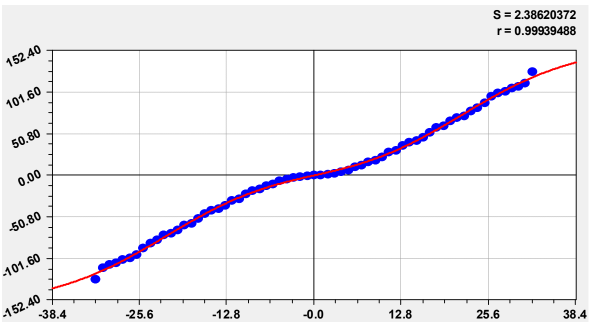
$$P_Z = 3{,}45909Z\ . \qquad (23)$$



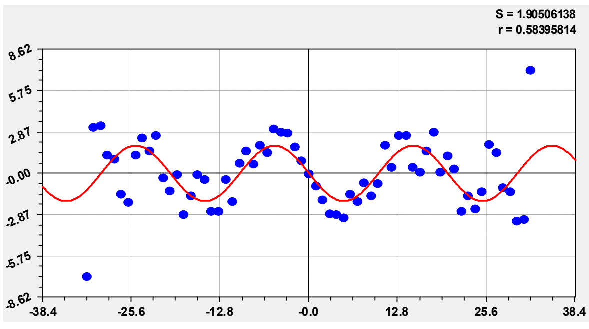
The basic Law (23)



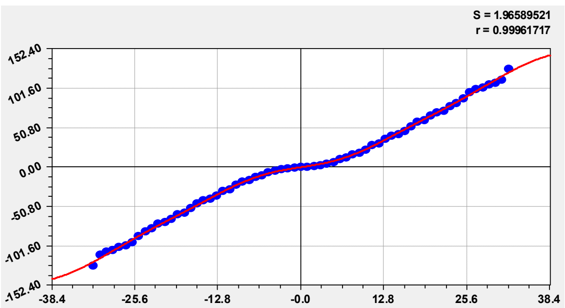
Wave function in terms of the remainders of (23)



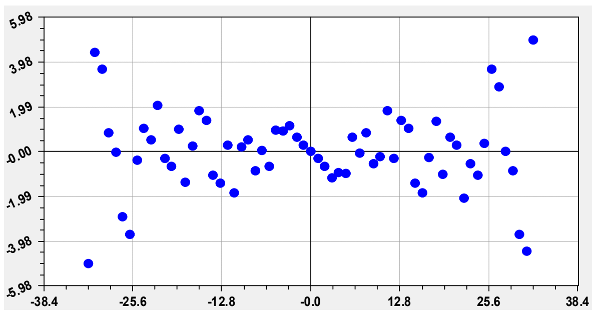
Fundamental law and wave of indignation



Second wave function



Model (24) with three components



Leftovers after model (24)

Figure 15. Graphs of a finite-dimensional series of integer primes with block boundaries ± 127

For this finite-dimensional WPN series with blocks $i = 7$, we also obtained a three-term regularity of the form

$$P_Z = 3{,}47134Z - 11{,}25285\exp(6{,}14176 \cdot 10^{-15} Z) \times$$

$$\times \cos(\pi Z/(22{,}53911 + 1{,}66693 \cdot 10^{-13} Z) - 1{,}57080) -$$

$$- 2{,}17468 \exp(-2{,}21215 \cdot 10^{-14} Z) \cos(\pi Z / 10{,}64587 - 1{,}57080). \qquad (24)$$

The design of the formula begins to change towards simplification (reduction). In the third component, the oscillation period became constant, equal to 2 × 10.64587 ≈ 21.3. The shift of the beginning of the wave in both oscillations became the same and equal to $\pi/2$. The exponential growth in the first wave and the decline in the second wave became small. Therefore, it would be possible to reduce formula (24) into a sine function with the exclusion of the oscillation shift.

4.13 Asymmetric Series of Integer Primes

Let's take the different power of the negative n_1 and positive n_2 directions on the x-axis as a series of integers. Consider subspecies A under the condition $n_1 \neq n_2$. Both branches start from zero, so the total power of the asymmetric row will be equal to

$$n = n_1 + n_2 - 1. \qquad (25)$$

To compare different types of structures, examples of symmetric and asymmetric WPN series with 20 pairs of primes are considered (Table 7).

Table 7. Decomposition of 20 pairs of integer prime numbers in binary number system

Integer Z	Prime number P_Z	Digit i in the binary system							Integer Z	Prime number P_Z	Digit i in the binary system						
		7	6	5	4	3	2	1			7	6	5	4	3	2	1
		Part $P_{iZ} = 2^\wedge(i_Z^P - 1)$									Part $P_{iZ} = 2^\wedge(i_Z^P - 1)$						
		64	32	16	8	4	2	1			64	32	16	8	4	2	1
-20	-67	-1	0	0	0	0	-1	-1	0	0							1
-19	-61		-1	-1	-1	-1	0	-1	1	1		Trivial zeros					1
-18	-59		-1	-1	-1	0	-1	-1	2	2						1	0
-17	-53		-1	-1	0	-1	0	-1	3	3						1	1
-16	-47		-1	0	-1	-1	-1	-1	4	5					1	0	1
-15	-43		-1	0	-1	0	-1	-1	5	7					1	1	1
-14	-41		-1	0	-1	0	0	-1	6	11				1	0	1	1
-13	-37		-1	0	0	-1	0	-1	7	13				1	1	0	1
-12	-31			-1	-1	-1	-1	-1	8	17			1	0	0	0	1
-11	-29			-1	-1	-1	0	-1	9	19			1	0	0	1	1
-10	-23			-1	0	-1	-1	-1	10	23			1	0	1	1	1
-9	-19			-1	0	0	-1	-1	11	29			1	1	1	0	1
-8	-17			-1	0	0	0	-1	12	31			1	1	1	1	1
-7	-13				-1	-1	0	-1	13	37		1	0	0	1	0	1
-6	-11				-1	0	-1	-1	14	41		1	0	1	0	0	1

-5	-7					-1	-1	-1	15	43		1	0	1	0	1	1
-4	-5					-1	0	-1	16	47		1	0	1	1	1	1
-3	-3						-1	-1	17	53		1	1	0	1	0	1
-2	-2						-1	0	18	59		1	1	1	0	1	1
-1	-1		Trivial zeros					-1	19	61		1	1	1	1	0	1
									20	67	1	0	0	0	0	1	1
												Non-trivial zeros					

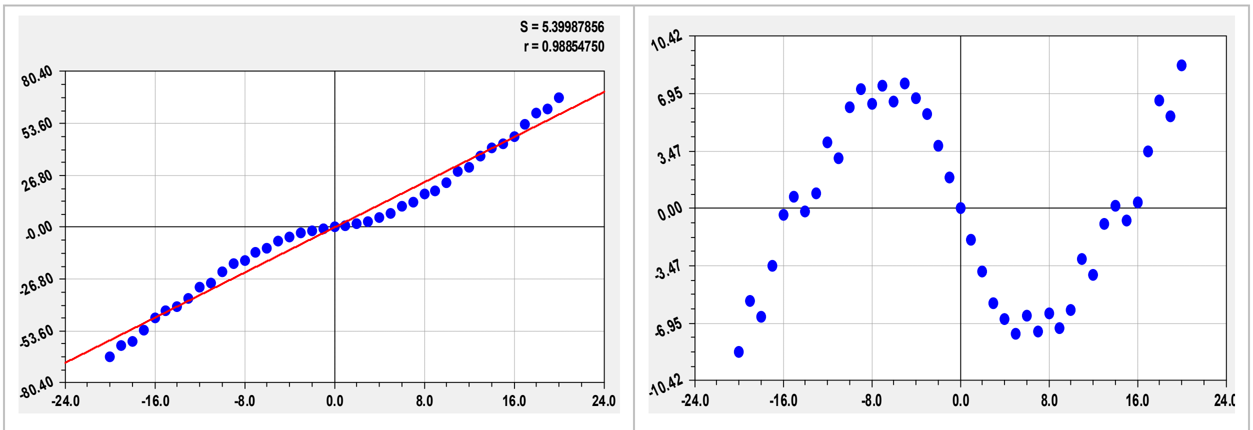
In table 7, empty cells mean trivial zeros. For WPN, the following blocks are noticeable by the number of trivial zeros: 1 – center from -1 to 1; 2 – from -3 to 3; 3 – from -7 to 7; 4 – from -13 to 13; 5 – from -31 to 31; 6 – from -61 to 61 and so on. The conversion to binary clearly shows the block structure of the WPN.

Due to the symmetry of the negative and positive parts of the WPN series, one can count the numbers of blocks along rectangles composed of 0 (nontrivial zero) and 1. In this case, the blocks increase in length and width with increasing prime numbers.

As can be seen from the data in Table 7, on the negative semi-axis of the abscissa of integers, the values of prime numbers along the ordinate receive a negative sign.

For 20 WPN pairs, according to the main law of distribution along the axis Z, the formula was obtained (Figure 16)

$$P_{Z20} = 2{,}91568Z . \quad (25)$$



Schedule of the Basic Law (25) | Remains after the model (25)

Figure 16. Graphs of formula (25) of the distribution of 20 WPN pairs along the x-axis of integers

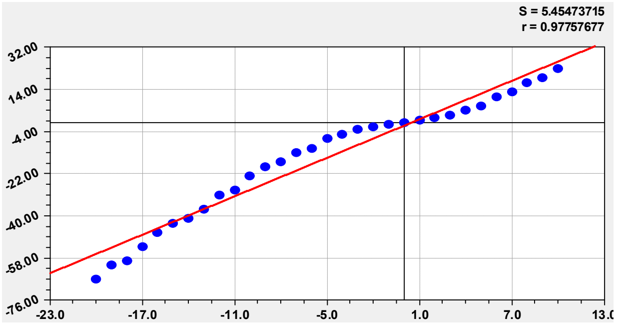
For asymmetric WPN series (Figure 17), we hypothesize that the direction of asymmetry in living matter indicates its chirality. Moreover, the difference between the ends of such a series shows the duration of the existence of such a cosmic string. The greater the asymmetry, the less likely the existence of such a cosmic string in nature (more precisely, in our Universe or in the anti-Universe).

Asymmetry to the left for $n^- = 20$ and $n^+ = 10$ forms (Figure 17) the formula

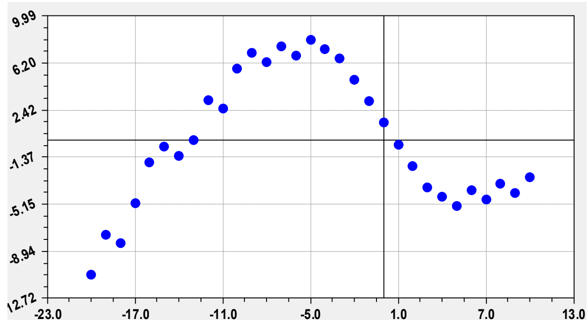
$$P_{Z20Л,10П} = -1{,}40524 + 2{,}73831Z . \quad (26)$$

Asymmetry to the right $n^- = 10$ and $n^+ = 20$ receives (Figure 17) the expression

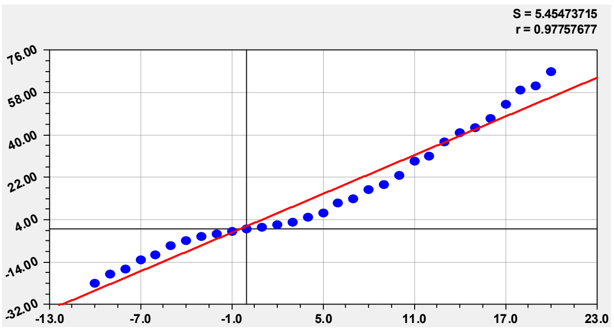
$$P_{Z10Л,20П} = 1{,}40524 + 2{,}73831Z . \quad (27)$$



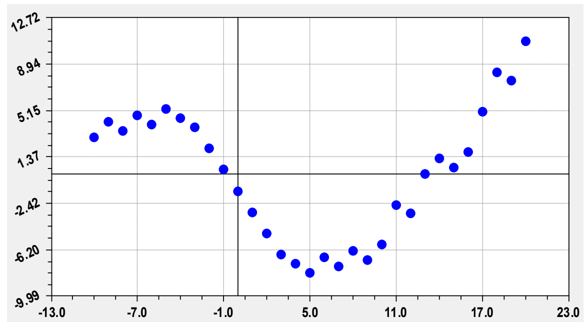
Graph of the model (26) asymmetry on the left



Remains after the model (26)



Graph of the model (27) asymmetry on the right



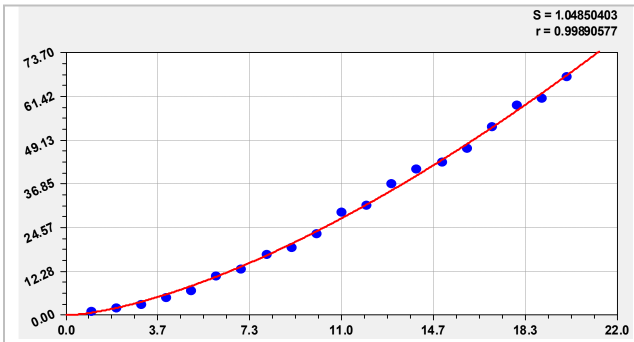
Remains after the model (27)

Figure 17. Graphs of the distribution of asymmetric WPN pairs along the abscissa of integers

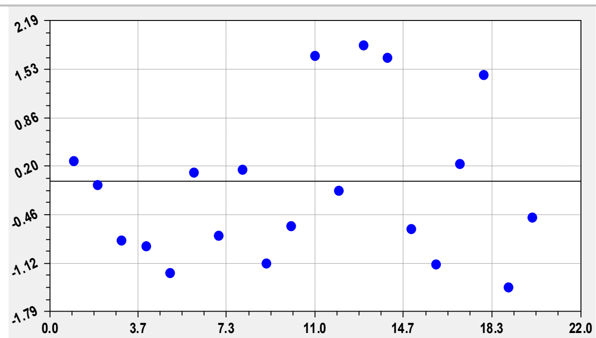
Comparison of formulas (26) and (27) shows that the left and right asymmetries differ from each other only in the signs of the first component, which appears as a constant term in front of the law of distribution of members of the symmetric series of integer primes. Let's push the skewness to the limit where the start (positive PN) or end (for negative PN) is determined by the origin of the integer axis.

For prime numbers (complete series (Mazurkin P.M., 2012)) 0, 1, 2, 3, 5, 7, 11, … (Figure 18) we get

$$P_{+Z} = 0{,}720694 Z_{+}^{1{,}515400} . \qquad (28)$$



Model plot (28) of the full PN series



Remains after the model (28)

Figure 18. Distribution of positive primes along the right abscissa of integers

The residuals show an additional possibility of wave adaptation to (28).

4.14 Binary Number of Symmetrical Series of Numbers WPN

Data for identifying patterns are given in Table 7.

The influence of integer prime numbers P_{Z20} on a binary number along the vertical $i_Z^P = 2$ goes in accordance with an equation of the form

$$z_2 = -0{,}5\sin(\pi P_{Z20-3}/2)\,. \tag{29}$$

Here, three WPN (-1, 0, 1) nuclei of the center of symmetry were excluded due to the fact that only trivial zeros are found in the second vertical $i = 2$ in these cells.

The correlation coefficient of formula (29) is slightly more than 0.7 due to the fact that the beginning with a prime number 2 interferes with a series of Gauss-Riemann primes (2, 3, 5, 7, 11, 13, ...).

After excluding the center of symmetry from WPN, on two non-critical halves of the series $\pm$ (3, 5, 7, 11, ...) symmetrical with respect to the origin of the axis Z, a formula of the form

$$z_2 = \cos(\pi P_{Z20-5}/2 + 0{,}58903)\,. \tag{30}$$

The correlation coefficient became equal to 0.7454. Then it turns out that trivial zeros always divide the verticals of the binary decomposition matrix of prime numbers into separate parts, dividing the series of prime numbers into blocks according to binary representations.

Therefore, it is necessary to model immediately in parts the non-critical halves of the series, for example, a series of prime and negative prime numbers $P_{Z=\pm(3,5,7,11,...)}$ (Figure 19):

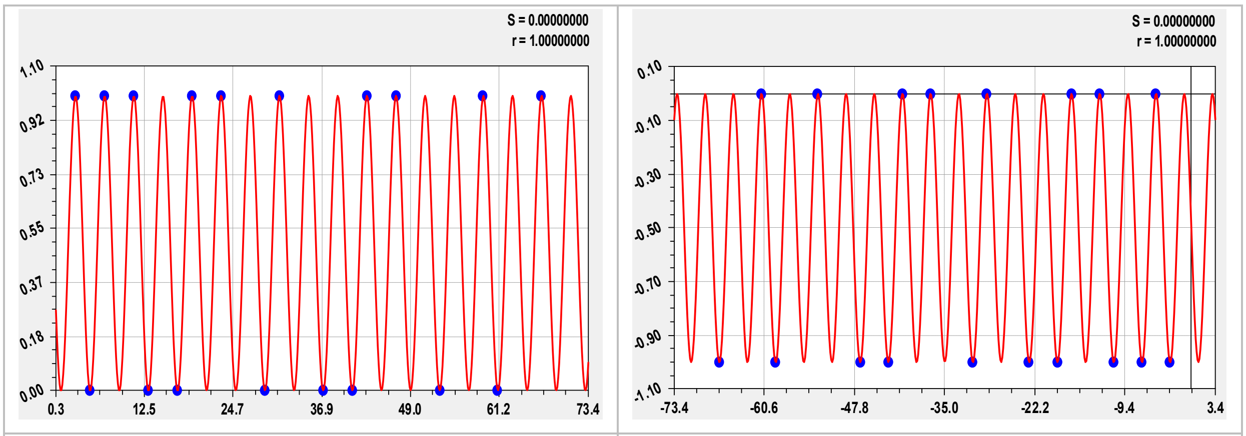
– for positive non-critical primes

$$z_2 = \frac{1}{2} - \frac{1}{2}\sin(\frac{\pi}{2}P_{Z=3,...})\,; \tag{31}$$

– for negative non-critical primes

$$z_2 = -\frac{1}{2} - \frac{1}{2}\sin(\frac{\pi}{2}P_{Z=-3,...})\,. \tag{32}$$

Thus, the Riemann conjecture about the root 1/2 is also proved on the WPN series.



Model plot (31) of positive PN	Plot of the model (32) negative PN

Figure 19. Distribution of a binary number along the right and left halves of the x-axis of the series integer non-critical primes

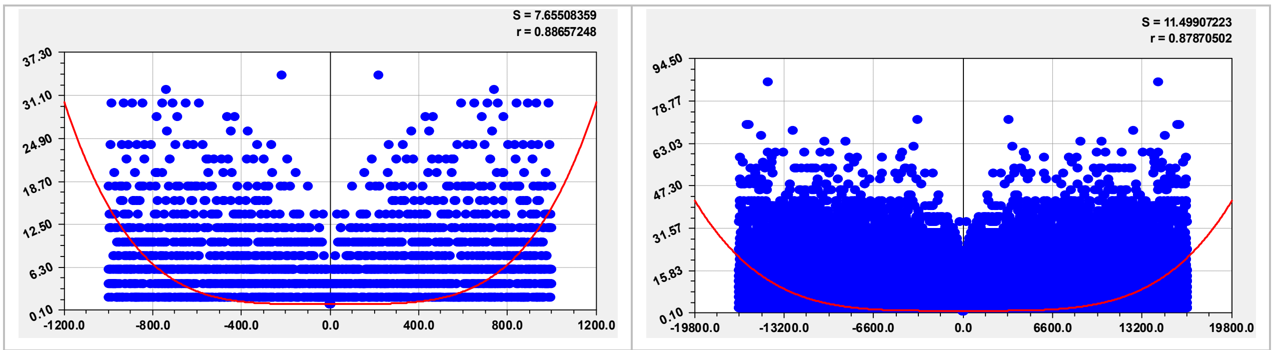
With an increase in the digit of the number π more than 18 (for the CurveExpert-1.40 software environment) (http://www.curveexpert.net/), the remainders will be much less than the number 1.0e-12.

4.15 Features of the Increment of Integer Prime Numbers

This indicator turned out to be visual and at the same time mathematically simpler for studying a number of integer prime numbers. The increment changes in the same digits of the binary number system, therefore, further we accept the designation $i = i_j^P = i_j^p$.

For example, the pattern of increments is shown for the power of a series of WPNs of 1000 pairs, as well as 16500 WPN pairs, (Figure 20) according to the general formula

$$y=1+a*x^4. \tag{33}$$



1000 steam, a = 1.40298187660E-011	16500 steam, a = 2.65597688884E-016

Figure 20. Distribution patterns of 1000 and 16500 pairs of WPN increments

The correlation coefficient of model (33) is 0.8866 and 0.8787, respectively.

As can be seen from Figure 20, all horizontal even rows of numbers are gradually filled with increments of numbers. The pictures show the complex structure of the distributions of the WPN increments, as well as PN. Noticeably stand out for 16500 pairs of four maximum increments.

For an example of a rational Riemann root, we take the WPN series with the right block boundary $P_Z'' = 61$ from Table 7 and give only the binary expansion of increments (Table 8).

The second vertical of the binary decomposition of the increment of WPN numbers according to Table 8 receives the following distinguishing features:

1) The center of symmetry on the second vertical has trivial zeros, therefore the increment of numbers of the WPN series has a central break, which allows us to consider separately the negative and positive branches of the increment of numbers;

2) While the increments in both directions (negative and positive) along the x-axis of integers are positive, which makes it possible to analyze only one right side in the form of a semi-axis of positive natural numbers, starting from 3;

3) Positive increments of numbers make it possible to analyze along the entire axis of integers, since both branches of the increment change symmetrically with respect to the negative and positive sides of the x-axis of integers.

Table 8. Decomposition of 20 pairs of increments of integer prime numbers in binary number system

Integer Z	WPN P_Z	Incre-ment p_Z	Discharge i_Z^p			Integer Z	WPN P_Z	Incre-ment p_Z	Discharge i_Z^p		
			3	2	1				3	2	1
			$p_{iZ} = 2^\wedge(i_Z^p - 1)$						$p_{iZ} = 2^\wedge(i_Z^p - 1)$		
			4	**2**	1				4	**2**	1
-19	-61	2		1	0	0	0	1			1
-18	-59	6	1	1	0	1	1	1			1
-17	-53	6	1	1	0	2	2	1			1
-16	-47	4	1	0	0	3	3	2		1	0
-15	-43	2		1	0	4	5	2		1	0

-14	-41	4	1	0	0	5	7	4	1	0	0
-13	-37	6	1	1	0	6	11	2		1	0
-12	-31	2		1	0	7	13	4	1	0	0
-11	-29	6	1	1	0	8	17	2		1	0
-10	-23	4	1	0	0	9	19	4	1	0	0
-9	-19	2		1	0	10	23	6	1	1	0
-8	-17	4	1	0	0	11	29	2		1	0
-7	-13	2		1	0	12	31	6	1	1	0
-6	-11	4	1	0	0	13	37	4	1	0	0
-5	-7	2		1	0	14	41	2		1	0
-4	-5	2		1	0	15	43	4	1	0	0
-3	-3	1			1	16	47	6	1	1	0
-2	-2	1			1	17	53	6	1	1	0
-1	-1	1			1	18	59	2		1	0
						19	61	6	1	1	0

The binary number on the second vertical (Figure 21) is determined for any cardinality of the WPN series by a formula of the form

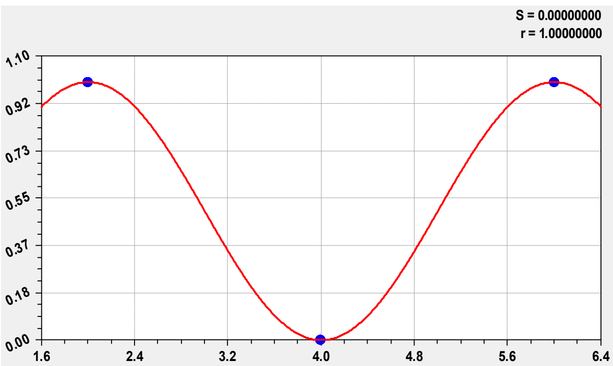
$$z_2^p = \frac{1}{2} - \frac{1}{2}\cos(\frac{\pi}{2} p_Z) \quad (34)$$

for series of both types - prime numbers and integer prime numbers.

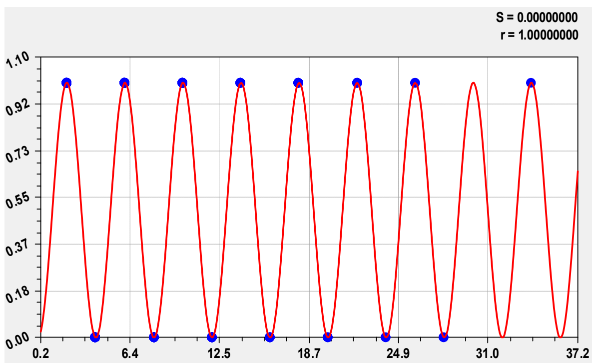
As a result, formula (34) has three rational Riemann roots 1/2 and the ***fundamental law of growth*** is valid for any series of prime numbers in the form PN or WPN.

The infinity of a series of prime numbers was proved more than 2200 years ago by Euclid. Therefore, the increment series for prime numbers is also infinite.

Then it becomes obvious that the number of extreme numbers and some of them in the form of twin primes also tend to infinity.



Binary increment for 19 WPN pairs without center of symmetry



Binary increment numberfor 500 primes

Figure 21. Graphs of a binary number along the second vertical of the WPN and PN binary expansion

As a special case of formula (34), the increment of the twins is always equal $p_P(n)_{\min} = 2$, and therefore the increments of the twins are on the Riemann critical line, that is, on the second vertical of the binary decomposition of prime numbers.

If there are rows with a constant increase of 2, then there must be rows with constant other even numbers 4, 6, 8, ... etc.

Then the Riemann hypothesis is also proved for a series of increments of integer primes.

4.16 Fractional Part of the Root of the Riemann Hypothesis

It is known from the Internet (Tsagir (Zagier) D., n.d.): "But the famous Riemann conjecture that the real part of the root is always exactly equal to 1/2 has not yet been proven by anyone, although its proof would be extremely important for the theory of prime numbers." Equations (31) and (34) prove that not only the real part of the real root of the Riemann zeta function is equal to 1/2.

There are other interesting mathematical results.

For example, in formula (34), the expression in front of the cosine function is also exactly 1/2. The appearance of the space number (Archimedes number) π transforms Eq. (34) into a signal in the form of a symmetric wavelet with a constant amplitude 1/2 (Mazurkin P.M., 2018; Mazurkin P.M., 2023; Mazurkin P.M., 2014).

The Riemann zeta function has zeros in negative multiples of 2. But the data in Table 8 show that the multiplicity in binary digits is 2^{i_2-1}. Then, according to Riemann, it turns $2^{i_2-1} = 2$ out that only under the condition $i_2 = 2$. This is the binary vertical of the binary expansion of WPN and PN, as well as their increments (Mazurkin P.M., 2015; 2014)

Note also that in the Riemann zeta function in complex variables the sine function is adopted, but the cosine is better for real numbers, as it allows you to ignore the signs in the expression under the trigonometric function. The cosine works in both quadrants on the natural number series $(0,1,2,...,\infty)$. Therefore, this trigonometric function will continue to be successful in the study of series of primes and integer primes.

5. Proof of a Series of Primes

The history of the development of mathematics is described in the book (Kolmogorov A.N., 1991).

In the 1940s, there were attempts to develop models with the inclusion of a number of primes (Vinogradov I.M., 1937). Attempts to improve the Riemann hypothesis were made in (Kim T., 2009; Kim T., 2003; Kim T., Hwang K.W., & Lee B., 2009). The papers (Sarnak P., 2004; Sarnak P., 2010) consider the so-called L -functions.

Trigonometric functions (Leverson A.A., 2013) turned out to be closer to reality, and we used them in the form of a cosine to prove the patterns of WPN and PN. The article (Zhang M. & Li J., 2019) came even closer to the binary expansion, when it was proposed to take a function with base 2. Gauss proposed a function with the base of the natural logarithm, which completely confused the study of the series of prime numbers directly.

We do not consider attempts to prove simplified versions of the Riemann hypothesis. This is a road to nowhere, since the Riemann hypothesis itself is expressed in complex numbers. Earlier in this article, we showed that the real (more precisely, fractional) root of the Riemann hypothesis is easily proved on the second vertical of the binary representation of prime integers. This also applies to a number of prime numbers.

Researches (Diamond H.G., 1969; Hasanalizade E., Shen O. & Wong P.J., 2022; Hughes C. & Pearce-Crump A., 2022; Karatsuba A.A., n.d.; Khale T., O'Kuhn C., Panidapu A., Sun A. & Zhang S., 2021; Kolossváry I.B., Kolossváry I.T., 2022) were carried out in the Gauss (Delaunay B.N., 1959) and Riemann doctrines. Articles (Sachpazis S., 2022; Sedunova A., 2022; Song Y., 2021; Vindas J., 2012; Wang V., 2013) also refer to the paradigm (concept) of Gauss. Elementary methods in number theory are shown in the book (Zenkin V.I., 2008). As a result, a strong and deep psychological barrier has developed among mathematicians in the 153 years since the publication of the Riemann hypothesis.

5.1 Complete Series of Prime Numbers

Going beyond the existing concepts of prime numbers to integer primes corresponds to the Galois incompleteness theorem.

Previously (Mazurkin P.M., 2012) we omitted the abscissa in the form of integers Z, due to the rejection of negative numbers by mathematicians, but now the ***full series of primes*** is accepted $\mathrm{P} = \{0,1,2,3,5,7,11,13,17,...\}$. Therefore, in statistical analysis (Mazurkin P.M., 2014) from prime numbers $\mathrm{P} \subset \mathrm{N}$ in (Mazurkin P.M., 2012) there was a jump to real numbers according to the scheme

$\mathrm{P} \subset \mathrm{N} \subset R \not\subset C$. Moreover, regularities are revealed without taking into account complex numbers C (we give a fair attitude to them by the Russian mathematician Chebyshev P.L. (Chebyshev P. L., 2017; Laptev V.N., Sergeev A.E. & Sergeev E.A., 2015)), but necessarily with irrational numbers of the type $e = 2{,}71...$ (time number or Napier number) and $\pi = 3{,}14...$ (space number or Archimedes number).

As a result, we have a physical interpretation of space research using examples from a series of integer primes.

In the CurveExpert-1.40 software environment, these fundamental physical constants are accepted (http://www.curveexpert.net/) with 18 decimal places. This makes it possible to compare the regularities of the complete series of prime numbers with other fundamental physical constants (Mazurkin P.M., 2014).

Natural numbers $\mathrm{N} = \{1,2,3,...,\infty\}$, obtained by natural counting since the time of Euclid, but now from the main one they become only an auxiliary means. Then the series of primes known before Gauss has the form and therefore $\mathrm{P} = \{1,2,3,5,7,11,13,17,...,\infty\}$, in the absence of 0, it is a truncated series. In the future, we completely abandon the Gaussian series of the form 2, 3, 5, 7, 11, ...

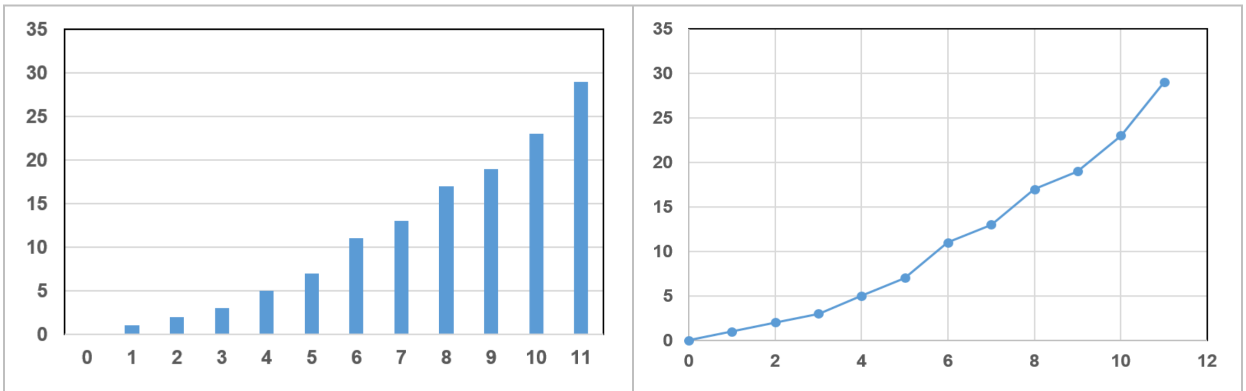
Physically, according to Gauss, the complete series of prime numbers is physically represented by us as a staircase (Table 9, Figure 21), containing a support and separate steps.

Table 9. A series of 20 PNs and their increments (blocks in decimal and binary notation)

i_{10}	$10^{i_{10}}$	i_2	2^{i_2}	j	P_{j+1}	P_j	p_j
$-\infty$	0	$-\infty$	0	0	1	0	1
0	1	0	1	1	2	1	1
		1	2	2	3	2	1
		2	4	3	5	3	2
				4	7	5	2
		3	8	5	11	7	4
				6	13	11	2
		4	16	7	17	13	4
				8	19	17	2
				9	23	19	4
1	10			10	29	23	6
				11	31	29	2
		5	32	12	37	31	6
				13	41	37	4
				14	43	41	2
				15	47	43	4
				16	53	47	6
				17	59	53	6
				18	61	59	2
		6	64	19	67	61	6
				20	71	67	4

Physically, the increments of prime numbers (Figure 22) are represented as separate steps when the base of the Gauss-Riemann ladder is removed from them. Then these unsupported steps can be considered separate from the body of the stairs. Regardless of the value of a prime number, its increment will vary from 2 to some value in groups of primes.

Then the number 2 will divide the series of increments into groups of primes.



Gauss ladder (steps with base) | Separate steps at the Gauss ladder

Figure 22. Physical dual representation of a series of primes

For example, among a million natural numbers, the last increment $p_j = 2$ occurs at the serial number $j = 78497$ for a prime number $P_j = 999959$. The number of the group of prime numbers of the initial increment 2 is 8169. This group moves on to the next block.

5.2 Asymmetric Wavelet for Pattern Identification

We adhere to the concept of Rene Descartes on the need for direct application of the general algebraic (trigonometric) additive equation as the final mathematical solution of unknown integral equations. Generalizing many examples, including in the form of a list (space) of objects located in the same time section, we proposed a new class of wave functions (Mazurkin P.M., 2018; Mazurkin P.M., 2015; Mazurkin P.M., 2012; Mazurkin P.M., 2014).

An asymmetric wavelet signal, as a rule, of any nature (object of study) is mathematically written according to the wave formula (Mazurkin P.M., 2014) of the form:

$$y = \sum_{i=1}^{m} y_i \,, \quad y_i = A_i \cos(\pi x / p_i - a_{8i}) \,, \quad A_i = a_{1i} x^{a_{2i}} \exp(-a_{3i} x^{a_{4i}}) \,, \quad p_i = a_{5i} + a_{6i} x^{a_{7i}} \,, \qquad (35)$$

where y – is the indicator (dependent factor), i – is the number of the component in the model (35), m – is the number of members in the model (35), x – is the explanatory variable (influencing factor), $a_1 ... a_8$ – are the parameters of the model that takes numerical values in the process of structural-parametric identification in the software environment CurveExpert-1.40 (URL: http://www.curveexpert.net/), A_i – is the amplitude (half) of the asymmetric wavelet (axis y), p_i – is the half-period of oscillation (axis x).

By successively increasing the dynamic series (the serial number j of a prime number or its increment is a kind of conditional time scale), it was noticed that the structure of the wavelet functions changes within the framework of the general formula (35). However, all components had the structure of a finite-dimensional wavelet. And infinite-dimensional wavelets under the condition $a_{2i} = 0$, characteristic for the dynamics of temperature, climate and weather (Mazurkin P.M., 2022; Mazurkin P.M., 2022; Mazurkin P.M., 2021; Mazurkin P.M., 2022), were not detected for a series and groups of prime numbers.

5.3 Groups of Prime Numbers and Their Increments

Groups of primes always start with an increment of 2.

For example, the previous group from the end in the series of one million natural numbers with an increment of numbers $p_j = 2$ begins with $j = 78475$ a prime number $P_j = 999611$. The ordinal number of this group is $k = 8168$. The maximum increment for this group of primes is 44. The power of group No. 8168 in terms of the number of members is 22 (Table 10).

Table 10. Group №8168 of prime numbers, their absolute and relative increments

4 j	P_j	p_j	j_1	q_{j_1}	ε	Δ , %
78475	999611	2	0	2	0	0
78476	999613	10	1	10.00	0.000238387	0.002
78477	999623	8	2	8.00	-0.000251055	-0.003
78478	999631	22	3	22.00	-0.00105463	-0.005
78479	999653	14	4	14.00	-0.00330241	-0.024
78480	999667	4	5	4.00	-0.00309775	-0.077
78481	999671	12	6	12.00	-0.00304154	-0.025
78482	999683	38	7	38.00	0.00290464	0.008
78483	999721	6	8	6.00	-0.000516526	-0.009
78484	999727	22	9	22.00	0.00132449	0.006
78485	999749	14	10	14.00	0.00490127	0.035
78486	999763	6	11	6.00	-0.00241468	-0.040
78487	999769	4	12	4.00	0.00395688	**0.099**
78488	999773	36	13	36.01	-0.0061264	-0.017
78489	999809	44	14	44.00	-3.68236e-005	0.000
78490	999853	10	15	10.00	-0.000582175	-0.006
78491	999863	20	16	20.00	0.00395562	0.020
78492	999883	24	17	24.00	0.00265646	0.011
78493	999907	10	18	10.00	0.00161829	0.016
78494	999917	14	19	14.01	-0.0053499	-0.038
78495	999931	22	20	22.00	-0.00175524	-0.008
78496	999953	6	21	6.00	-0.00128052	-0.021

The calculated value of the increment q_{j_1} (real numbers) makes it possible to calculate the relative error Δ of modeling by the identification method (Mazurkin P.M., 2012) using the formula

$$\Delta = 100\varepsilon / p_{j_1} , \qquad (36)$$

where ε – is the absolute error (residuals) after the 17th wave function.

Then the serial number j_1 of the increment of prime numbers in the indicated group 8168 begins with the number 0 (while the initial increment is 2, which means: a pair is always needed first for the emergence and then the continuation of life) and this makes it possible to identify in the CurveEx-peret-1.40 software environment the patterns of each group using a common model (35).

Based on the capabilities of the CurveExpert-1.40 software environment, the following formula was obtained

(Figure 23):

User-Defined Model:

y=2+a*x^b*exp(-c*x^2.96020)+d*x^49.43084*exp(-e*x^0.70660)*cos(pi*x/(f-g*x^0.39587)+h)-i*x^78.74017 *exp(-j*x^0.50750)*cos(pi*x/(k+l*x^1.84801)-m). (37)

Coefficient Data:

a =	6.40099539638E+000	b =	5.02357701678E-001	c =	1.16545291130E-004
d =	3.70711382938E-024	e =	1.13506169336E+001	f =	2.09382901827E+001
g =	5.73094634718E+000	h =	3.59139580149E+000	i =	1.29266967184E+009
j =	6.23601435037E+001	k =	1.00438109684E+000	l =	2.37423795039E-005
m =	4.62114720638E+000.				

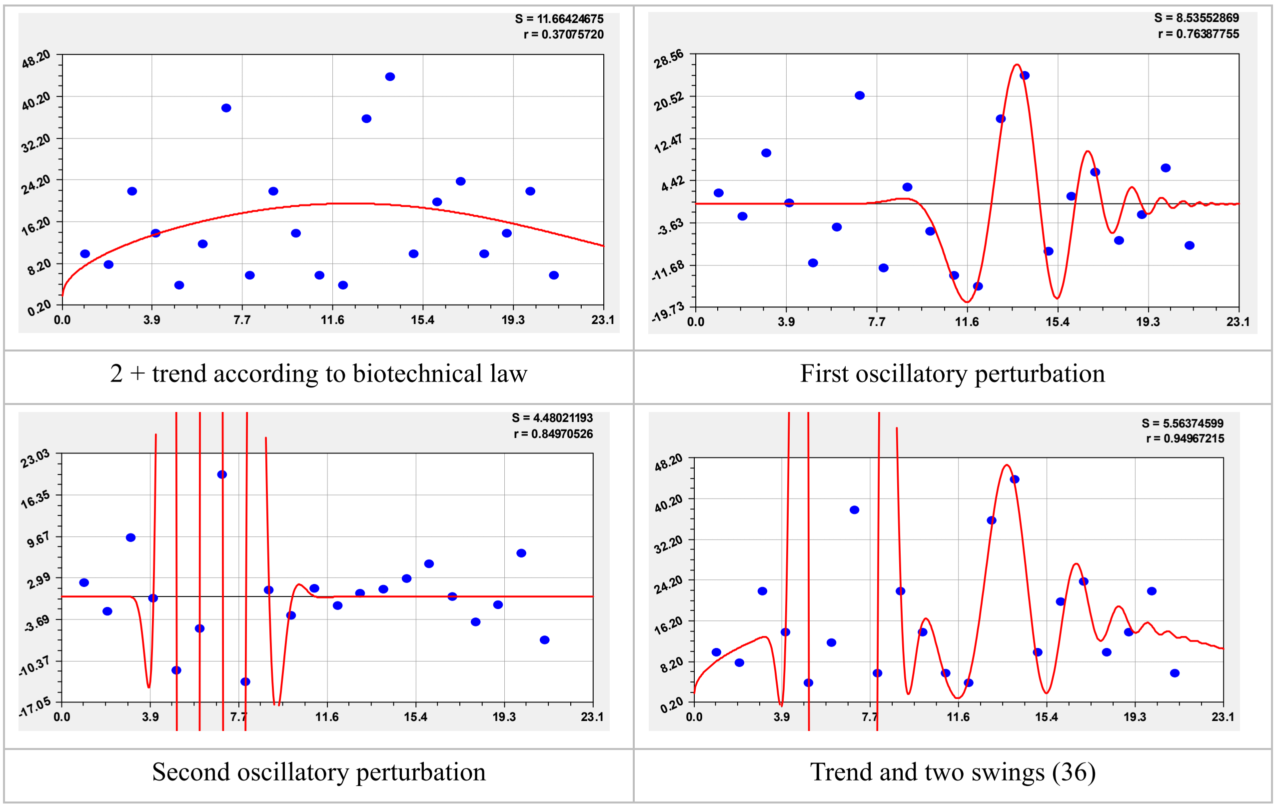


Figure 23. Graphs of the model (36) of the distribution of increments in the group No. 8168 of prime numbers

Model (37), containing four components with the inclusion of the number 2, receives adequacy according to the data in Table 10 by a correlation coefficient of 0.9497. This value is closer to 0.95, that is, to a super strong level of adequacy of the revealed pattern.

However, new components to model (37) appear additionally. And this fact indicates that in nature there is a process of oscillatory adaptation.

5.4 General Information About Behavior Quanta

Many time series, for example, the annual surface air temperature at points on the Earth (Mazurkin P.M., 2022; Mazurkin P.M., 2022; Mazurkin P.M., 2021; Mazurkin P.M., 2022), make it possible to carry out a full wavelet analysis when the residuals after the last wavelet are less than the measurement error. Consistent identification of the members of the general model (35) is tantamount to decomposing the process under study into separate actions. Then the overall process is divided into separate quanta of behavior. Let’s represent group No. 8168 as the dynamics of increments of prime numbers in a natural process unknown to us.

We distinguish two types of behavioral quanta:

Firstly, in dynamics, each factor is divided into a sum of wavelets, that is, in time, the factor is represented as a bundle of solitary waves (solitons) and this process is characterized as quantum certainty;

Secondly, in pair relations, the mutual influence of factors with a uniform (in Table 10) or non-uniform periodicity of measurements, for example, annual temperature, additionally receives quantum uncertainty (entanglement in the quantum mechanics of macroobjects).

Thus, any phenomenon or process can be assessed by the level of adequacy (correlation coefficient) of the decomposition of the functional connectivity of the system (in the example, group No. 8168) into quantum certainty and quantum uncertainty.

For air temperature, it turns out that the time series have a quantum certainty of up to 188 wavelets, and the pair ratios give only trends, so there is a quantum uncertainty between the factors. As we shall show further, groups of increments of prime numbers also have quantum certainty.

5.5 Behavior Quanta of Increments in the Group of Primes

In contrast to the well-known approximation method, when a formula is selected from a large set of equations in Excel that barks the maximum approximation to the experimental values. However, a physically incorrect equation is obtained, in which the model parameters have no physical meaning.

For example, in a polynomial, only a linear model has a physical sense for a short distance along the abscissa axis (this made it possible to introduce the so-called spline functions). And in a quadratic equation and a polynomial, even from the second degree, even the components themselves do not have a meaningful meaning. That is why biologists do not like the approximation method (Hogging S., n.d.), since biological processes are clearly non-linear and, at the same time, wave processes of oscillatory adaptation.

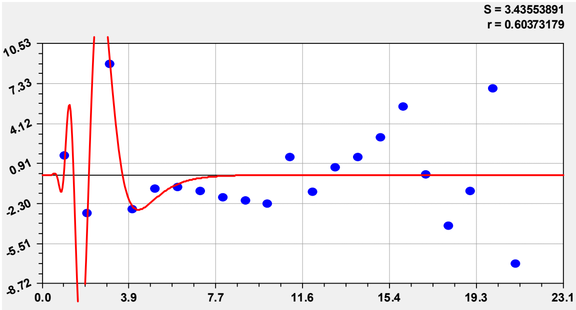
In the identification method, the stage of choosing an equation is excluded, since for any phenomena and processes in nature, a general wavelet (35) is initially given.

After carrying out the structural-parametric identification of the formula for the set of asymmetric wavelet signals (35), the parameters of the obtained components of the dynamics of the current speed (average rates of increment of values according to table 10) for prime numbers are shown in table 11 (Figure 24-27).

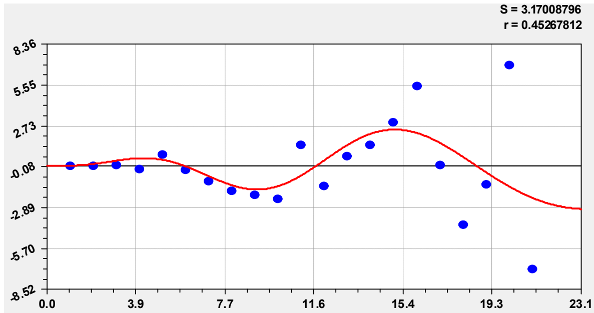
Table 11. Parameters of increment rate models in group #8168 of prime numbers

# i	Asymmetric wavelet $y_i = a_{1i} x^{a_{2i}} \exp(-a_{3i} x^{a_{4i}}) \cos(\pi x / (a_{5i} + a_{6i} x^{a_{7i}}) - a_{8i})$								Coeff. correlat. r
	amplitude (half) oscillation				half cycle			shift	
	a_{1i}	a_{2i}	a_{3i}	a_{4i}	a_{5i}	a_{6i}	a_{7i}	a_{8i}	
1	2	0	0	0	0	0	0	0	0.9497
2	6.40100	0.50236	0.00011655	2.96020	0	0	0	0	
3	3.70711e-24	49.43084	11.35062	0.70660	20.93829	-5.73095	0.39587	-3.59140	
4	-1.29267e9	78.74017	62.36014	0.50750	1.00438	2.37424e-5	1.84801	4.62115	
5	-2.05532e10	13.02759	22.52472	0.42458	0.17818	0.070737	1.23775	4.25654	0.6037
6	0.45169	2.99850	2.33278	0.37310	5.30588	0.00047705	2.47662	1.92008	0.4527
7	-4.47235e-6	4.82408	0	0	3.75095	-0.00058210	2.42169	-0.65490	0.9598
8	-2.19011e7	98.88405	102.35638	0.37172	1.00635	-0.0032216	0.081884	1.46921	0.8589
9	4.75987e-26	46.64421	4.93660	0.99959	15.03614	-0.89177	0.98308	-5.83853	0.2426
10	-0.00052947	32.98319	9.11033	0.98864	1.05305	-0.0017582	0.95356	4.22596	0.4791
11	-0.24771	0.027529	0	0	862.9093	-57.24781	0.46715	1.46888	0.5447
12	5.13440e-6	4.36217	0.00032467	3.02882	2.42667	-0.0064409	1.50224	-2.48753	0.7037
13	0.0025564	3.93503	0.59205	0.92966	3.01688	-9.06562e-5	2.72661	-2.72212	0.7206
14	-5.91740e-7	15.33019	2.26447	0.99998	1.05286	-0.0011423	1.00255	0.76983	0.8769
15	-2.48013	11.46911	5.53727	0.99908	1.68050	0.012173	1.24332	-2.20024	0.7259
16	-5.96344e-5	4.12290	0.35411	0.96481	31.17484	-1.20194	0.99830	-1.90357	0.8569
17	6.48993e-9	10.12394	0.80545	1.01250	1.91631	-0.0028984	1.12121	1.05503	0.9607

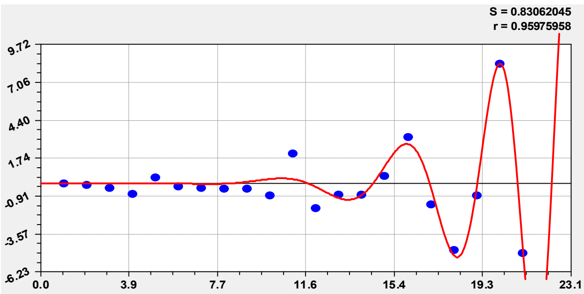
From the data in Table 10, it can be seen that the residuals after the 17th component become small, and the maximum relative error is only 0.099%.



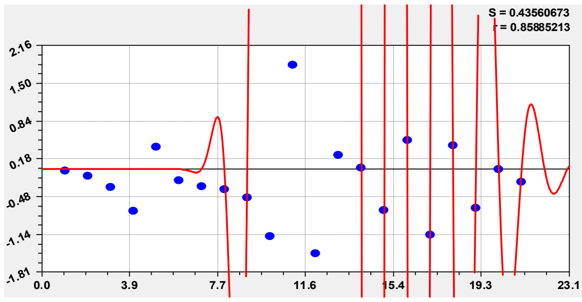
Asymmetric wavelet №5



Asymmetric wavelet №6

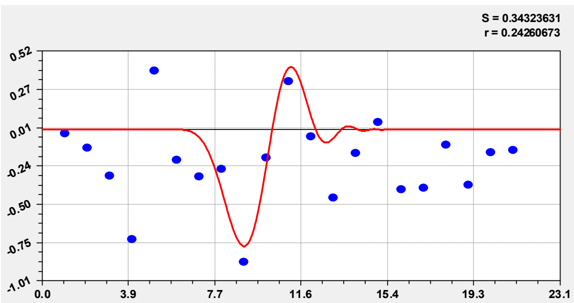


Asymmetric wavelet №7

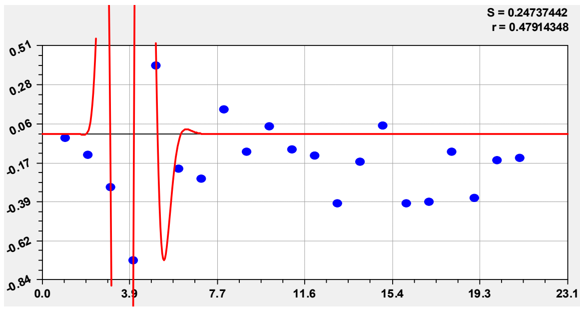


Asymmetric wavelet №8

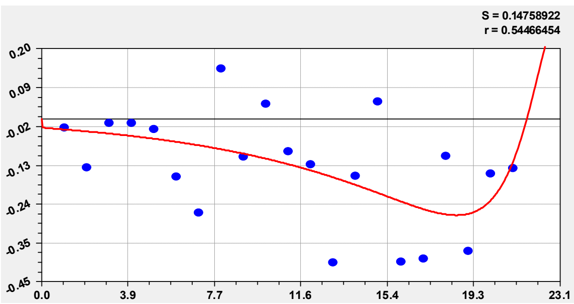
Figure 24. Graphs of the components of the model (35) increments in group No. 8168 according to table 11



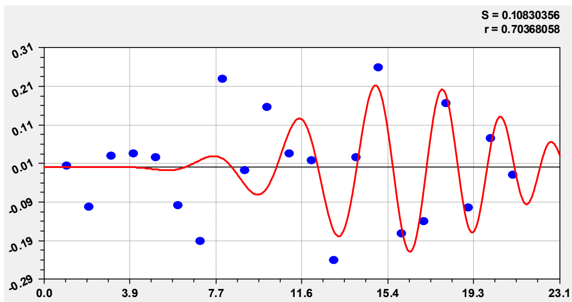
Asymmetric wavelet №9



Asymmetric wavelet №10

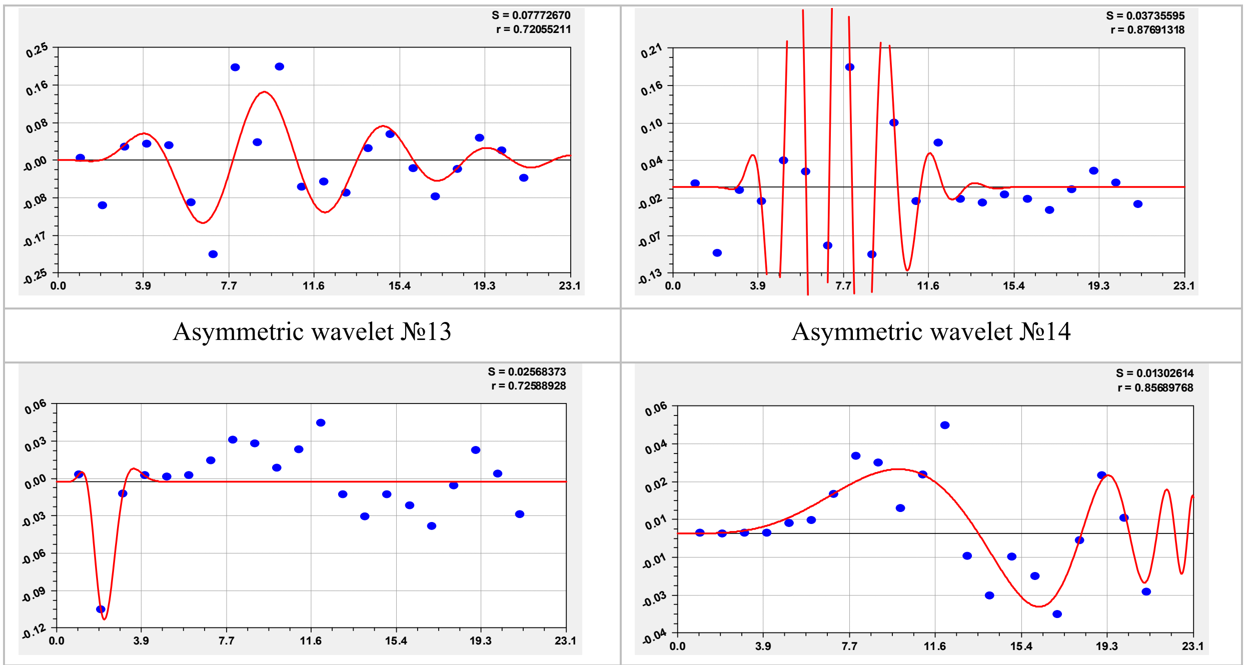


Asymmetric wavelet №11



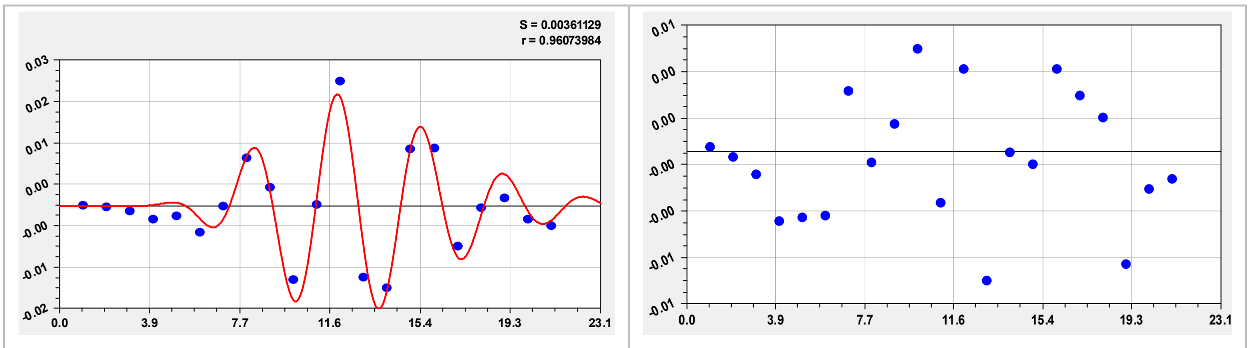
Asymmetric wavelet №12

Figure 25. Graphs of the components of the model (35) increments in group No. 8168 according to table 11



Asymmetric wavelet №13	Asymmetric wavelet №14
Asymmetric wavelet №15	Asymmetric wavelet №16

Figure 26. Graphs of the components of the model (35) increments in group No. 8168 according to table 11



Asymmetric wavelet №17	Remains after the 17th component

Figure 27. Graphs of the components of the model (35) increments in group No. 8168 according to table 11

The residuals after the 17th component became less than 0.01. However, they continue to receive wave oscillations and therefore the wavelet analysis can be continued further.

According to the computational capabilities of the CurveExpert-1.40 software environment, only the first four components were combined and identified together. The remaining additional 13 wave equations for the current rate of change of increments of prime numbers in one group 8168 increase the overall coefficient of the model (35) to a correlation coefficient of 1.7

5.6 Initial Surge of Growth in the Sequence of Prime Numbers

We suggested (Mazurkin P.M., 2012; Mazurkin P.M., 2014) that prime numbers (and especially integer prime numbers) are functionally related to complexes of fundamental physical constants and harmony numbers (golden and silver proportions).

Types of increments and their geometry are shown in the book (Mazurkin P.M., 2012). You can take instead of the serial number of a prime number, in particular for increments, the series of prime numbers itself as the abscissa axis. But then the series will accelerate. Next, consider the beginning of a complete series of prime numbers and their increments.

Table 12. Increment PN

Prime number P_j	Increment PN p_j
0	1
1	1
2	1
2.41421	1.35914
2.71828	1.61873
3	2
5	2

Let us introduce fundamental physical constants as real numbers among prime numbers at the beginning of the series:

– number for time (Napier number)

$$e = 2{,}71828...;$$

– harmony number (golden ratio)

$$\varphi = (1+\sqrt{5})/2 = 1{,}61803...$$

– beauty harmony number (silver section)

$$1+\sqrt{2} = 2{,}41421...;$$

– half the number of time (Napier numbers)

$$e/2 = 1{,}35914...$$

After parametric identification of the ***law of reaching the limit*** or the known law of the Weibull distribution, a regularity was obtained in the form of the formula

$$y = y_{\max} - a\exp(-bx^c) \quad (38)$$

A bivariate statistical regularity was obtained (Figure 27)

$$p_{j\min} = 2 - 1{,}02402\exp(-0{,}00025750 P_{0,1,2,3,5}{}^{8{,}39705}). \quad (39)$$

These formulas are generally valid, taking into account the “-” sign and repeated parametric identification, for the negative semiaxis of a number of integer prime numbers.

Then the harmony of any series of integer primes begins with ± 3.

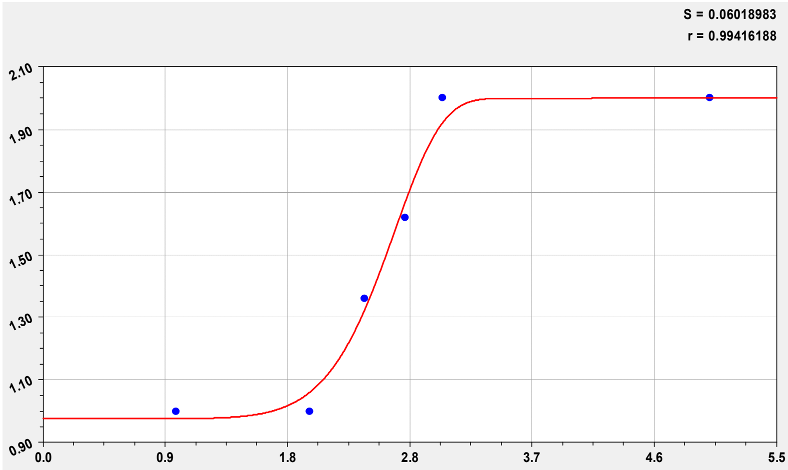


Figure 28. Number increment jump from 1 to 2 in the full PN series

This abrupt transition gives an anomaly in the mathematical equations of the law of distribution of prime numbers.

Deviations of the graph from the points in Figure 28 according to formula (39), as well as in other examples of modeling by identifying stable laws, occur due to the accuracy of accepting an irrational number $e = 2{,}71828...$ (18 digits in the CurveExpert-1.40 mathematical environment) and other fundamental physical constants. For illustration, in formula (39) and others, it is sufficient to indicate the parameters of the model with 5 significant figures (Table 11).

Due to the difficulty of formalizing the core and periphery of the center of symmetry, Gauss, and after him Riemann and other mathematicians, abandoned the analysis of the series themselves.

All mathematicians took the path of revealing the law of change in the number of prime numbers within the digits of numbers in the decimal number system. To do this, they switched to a number system with the base of the natural logarithm, and the process of studying prime numbers finally reached a dead end of scientific progress in number theory. Riemann's transition to complex numbers turned out to be a redundant process. As we proved, it was enough to convert prime numbers from the decimal system to the binary number system.

In mathematical modeling, there was a linearization of clearly non-linear series of statistical data. Only linear equations are obtained with specific solutions of differential and integral equations. The latter work only in the first quadrant of the rectangular coordinate system. Therefore, Hilbert's 23rd problem arose, which has not been solved so far, when mathematical statistics was created on the basis of the so-called "normal" distribution law with the "light" hand of Gauss.

And Gauss's law turned out to be a clearly abnormal distribution. In the general case, an asymmetric wavelet becomes normal, the action of which is confirmed by the wave nature of the behavior of any objects in the Universe according to the principle of oscillatory adaptation. Analysis of a number of primes, especially integer primes, strongly supports this principle.

A number of integer prime numbers easily overcomes the mathematical obstacles of two jumps (chaos from the number 0 to 1 and then harmony from the number 2 to 3) by the fact that as the power of pairs of prime numbers grows, the adequacy of identification by stable laws first decreases (Figure 9), then the correlation coefficient increases, approaching the condition $n \to \infty$ again to the value 1.

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