

MATHEMATICS, I UNDRESSED THE THEORY OF NUMBERS

MYKHAYLO KHUSID\*

Wetzlar, Germany, pensioner.

E-mail: [michusid@mail.ru](mailto:michusid@mail.ru)

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ABSTRACT

*This article is a continuation of the previous one: "Representation of an even number as the sum of four prime." Theorem the four simple and the Goldbach Euler conjecture have a series of corollary.*

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One of which is relevant problem in number theory.

**Corollary 1:** If one of the sum of three primes for any odd number, starting 9, arbitrarily set in the open interval  $[3, 2N-6]$ , then two simple variables in the sum give the required even number.

Which is evident from the proven Goldbach-Euler hypothesis.

**Corollary 2:** If one of the sum of four simple for even  $2N$ , starting with 12, arbitrarily set in the open interval  $[3, 2N-9]$ , then three simple variables in total give the necessary odd number.

Which, obviously, is from the proven Goldbach hypothesis.

**Corollary 3:** An even number, starting at 14, can be represented by a sum of four where a prime is the sum of three primes.

$$p_1 + p_2 + p_3 + p_4 = p_5 + p_6 = 2N \quad (12)$$

Suppose  $P_4 = P_5$  it is always possible (Corollary 2), the sum of the other three prime number  $P_6$ .

**Theorem:** Any even number starting from 10 can be represented by a sum not fewer than two pairs of two odd primes, 12th exception.

Let us show that the sum of four primes for all even numbers starting from 16 can be simultaneously the sum of two pairs of odd prime numbers.

$$3 + 3 + 5 + 5 = 16 = 3 + 13 = 5 + 11$$

We prove this for all even numbers greater than 16.

From the proven hypothesis of Goldbach-Euler:

$$p_1 + p_2 = 2N$$

It follows that even numbers can have several pairs of prime numbers, in the sum of  $2N$ .  $N$  is the arithmetic average, where to the left and to the right of the same distance is a pair of prime numbers.

Suppose one pair  $P_1, P_2, P_1 = P_2$

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**Corresponding Author: Mykhaylo Khusid\*, Wetzlar, Germany, pensioner.**

According to the Goldbach theorem, the sum of three simple ones can be represent any odd number, starting with 9, including prime numbers and they are represented by this sum and start with 11.

$$p_4 + p_5 + p_6 = p_1 \quad (13)$$

$$p_4 + p_5 + p_6 + p_2 = 2N \quad (14)$$

We prove that in (14) there is another pair of prime numbers.

Consider all possible options.

**Option-1:** ( $P_4 \neq P_2, P_5 \neq P_2, P_6 \neq P_2$ )

Then the opposite way we have the system:

$$2N - p_4 \neq p_7 \quad (15)$$

$$2N - p_5 = s_1 \quad (16)$$

$$2N - p_6 = s_2 \quad (17)$$

where  $s_1, s_2$  composite odd numbers and in (15) the difference is not equal to the simple odd number-  $P_7$ .

Subtract the left and right sides (16) - (15), respectively.

$$p_4 - p_5 \neq s_1 - p_7 \quad (18)$$

$$p_4 + p_5 + p_7 \neq s_1 + 2p_5 \quad (19)$$

On the right (19) is an odd number, on the left is the sum of three odd primes, which, according to Goldbach's hypothesis, since 9, is any odd number.

Is (19) inequality? Set one of three simple values.

(Corollary 1)  $P_7$ . The sum of the other two is denoted as 2K equal to the difference:

$$2K = s_1 + 2p_5 - 2N + p_4 = p_4 + p_5 \quad (20)$$

$$p_4 + p_7 = 2N \quad (21)$$

Thus we get equality. Assumption that in the system (15) - (17) All odd composite numbers are not true. At least one simple a number that creates a pair of prime numbers-  $P_4, P_7$ . Thus it is shown that with  $P_1 = 11$ , there are three simple  $P_4, P_5, P_6$  numerical values, for which (15) - (17), although they can take on the values of three composite numbers, however, there are necessarily three such values at which at least one prime number.

But  $P_4 = P_2$  a new couple is missing. If  $P_1 - P_2 = 0; 2; 4$  then  $P_4 = P_2$  does not fit  $P_1$  and there are at least two pairs sums of prime numbers.

**Lemma:** If  $2N = 2P$ , where p is a prime number except 3, is an even number, we represent several pairs of sums of primes.

For  $P = 11$  according to the above in (16)  $P = P_1, P = P_2$ . For smaller:

$$6 = 3 + 3, 10 = 5 + 5 = 7 + 3, 14 = 11 + 3 = 7 + 7.$$

**Option-2:**  $P_4 = P_2$

And similarly to option 1;

$$2p_4 + p_5 + p_6 = 2N \quad (22)$$

$$2p_4 + p_5 \neq p_8 \quad (23)$$

$$2p_4 + p_6 = s_3 \quad (24)$$

$$p_6 - p_5 \neq s_3 - p_8 \quad (25)$$

$$p_5 + p_6 + p_8 \neq s_3 + 2p_5 \quad (26)$$

$$2K_1 = 2p_4 + p_6 + 2p_5 - 2p_4 - p_5 = p_5 + p_6 \quad (27)$$

$$2p_4 + p_5 = p_8 \quad (28)$$

$$p_8 + p_5 = 2N \quad (29)$$

Again possible  $P_5 = P_2$ .

**Option-2.**  $P_4 = P_6 = P_2$

In this case, for  $2P_2$  we use the lemma and double the sum prime numbers will be displayed as the sum of two prime numbers, without  $P_2$ .

Option 3 becomes option 1.

However, this does not happen for  $P_2 = 3$ . in this case again apply corollary 1 replace with a lower value  $P_6$ . Then  $P_4$  or  $P_5$  not equal to 3. And option 3 goes to option 1 or 2.

Exception  $14 = 3 + 3 + 5 + 3$ , where  $P_6$  it is impossible to replace.

Changing  $P_4, P_5, P_6$  we find the third, fourth, etc., (if they have) a pair-sum of two simple odd numbers.

And even to 16:

$$6 = 3 + 3, 8 = 5 + 3, 10 = 7 + 3 = 5 + 5, 12 = 5 + 7, 14 = 11 + 3 = 7 + 7$$

It can be seen that only three even 6,8,12 is the sum of only one pair primes, all other sums of two or more pairs of primes odd numbers.

**Corollary 4:** If the sum of two simple of the sum of four for even  $2N$ , starting at 12, arbitrarily set to open interval  $[6, 2N - 6]$ , then the sum of the remaining two simple variables there is a necessary even number.

What can be seen from the proven Goldbach-Euler hypothesis.

**Corollary 5:** The prime numbers of twins are infinite. Any even number starting from 14 can be represented as a sum of four odd primes of which two are prime twins.

$$p_1 + p_2 + p_3 + p_4 = 2N \quad (30)$$

Let  $P_3, P_4$  - prime numbers be twins, then the difference is any even, starting at 14, and the sum of the primes of the twins is also an even number, which, according to the proved Goldbach-Euler hypothesis, is equal to the sum of two prime numbers (Corollary 4).

Next, we place the prime numbers from left to right in descending order.

And if the even number  $2N = 2P_2 + 2P_4 + 4$  then  $P_1, P_2$  inevitably also twins.

Subtract the sum from both parts (30)  $2P_2 + 2P_4$  :

$$p_1 - p_2 + p_3 - p_4 = 4 \tag{31}$$

From (31), it is obvious - inevitably twins.

Let their finite number and the last prime numbers be twins  $P_3, P_4$  .

Denote two primes greater than  $P_3, P_4$  how  $P_1, P_2$ .

Sum up all four primes and then according to the sum theorem four simple there is an even number  $2N$  at which inevitably large  $P_1, P_2$  -twins. And then substituting  $P_3, P_4$  -numeric values instead  $P_1, P_2$  - in [30] the process becomes infinite and the prime numbers are twins - infinite number.

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