CSCanada
**Studies in Mathematical Sciences**
Vol. 8, No. 1, 2014, pp. 21-26
**DOI:**10.3968/4014

ISSN 1923-8444 [Print]
ISSN 1923-8452 [Online]
www.cscanada.net
www.cscanada.org

# Proving the Twin Prime Conjecture

LIU Dan[a]; and LIU Jingfu[b]

[a]Department of Mathematics, Neijiang Normal University, Neijiang, China.
[b]Department of Mathematics, Sichuan Normal University, Chengdu, China.
* Corresponding author.

Address: Department of Mathematics, Neijiang Normal University, Neijiang, China;
E-mail: zxc576672568@qq.com

Received: November 11, 2013/ Accepted: January 5, 2014/ Published online: February 26, 2014

**Abstract:** Presented and proved symmetry primes theorem, parallelism proving the twin primes conjecture, Goldbach conjecture. Give part of the calculation.

**Key words**: Integer; Primes; Composite number; Theorem

Liu, D., & Liu, J. F. (2014). Proving the Twin Prime Conjecture. *Studies in Mathematical Sciences, 8*(1), 21-26. Available from URL: http://www.cscanada.net/index.php/sms/article/view/4014 DOI: http://dx.doi.org/10.3968/4014

## 1. INTRODUCTION

Mathematicians found that primes of distance 2, there are infinitely many numbers known as twin primes conjecture [1-3], for example, (11, 13), (59, 61). In 1742, the German mathematician Goldbach found even greater than 4 are each equal to two prime numbers and. known as Goldbach conjecture, For example, 6 = 3+3, 8 = 3+5, Here proved:

$$L(x) \sim \frac{\pi^2(x)}{x}, \quad (x \to \infty) . \tag{1}$$

Here (1) known as *twin primes conjecture*. Wherein $L$ ($x$) is the numbers of twin primes. And proved:

$$G(N) \sim \frac{\pi^2(N)}{N}, \quad (N \to \infty). \tag{2}$$

Here (2) known as *Goldbach conjecture*. Wherein $G$ ($x$) is the numbers of two primes and.

## 2. DISTRIBUTION DENSITY OF SYMMETRY PRIMES

Set the Integer $x = 16$, we have:

$k$ is 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14,

$k+2$ is 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16,

Wherein $k+2$ is the primes have: 2, 3, 5, 7, 11, 13,

Set $k+2$ is the primes, the quantity as $\pi(x)$, we get [5-6]:

$$\frac{\pi(x)}{x}\ . \tag{3}$$

Here (3) as *distribution density of symmetry primes*.

Set the composite number $h$, here let 0 and 1 is the composite number, we have:

$h$ is 0, 1, 4, 6, 8, 9, 10, 12, 14,

$h+2$ is 2, 3, 6, 8, 10, 11, 12, 14, 16,

Wherein $h+2$ is primes have: 2, 3, 11. Set the $h$ quantity as $F$, $h$+2 is the primes, the quantity as $F(x)$, we get:

$$\frac{F(x)}{F}\ . \tag{4}$$

Here (4) also as *distribution density of symmetry primes*. Wherein $F = x - \pi(x) - 1$, for example, Let $x = 16$, $\pi(16) = 6$, and $F = 9$, $F(16) = 3$, by (3) and (4) get:

$\frac{\pi(16)}{16} = \frac{6}{16}$ and $\frac{F(16)}{9} = \frac{3}{9}$.

Calculate:

| $x$, | $\pi(x)/x$, | $F(x)/F$, |
|---|---|---|
| $10^1$, | 0.4, | 0.4, |
| $10^2$, | 0.25, | 0.23, |
| $10^3$, | 0.168, | 0.162, |
| $10^4$, | 0.1229, | 0.1168, |
| $10^5$, | 0.09592, | 0.09256, |
| $10^6$, | 0.078498, | 0.076321, |
| $10^7$, | 0.0664579, | 0.0648711, |
| $10^8$, | 0.05761455, | 0.05646461, |

## 3. THE TWIN PRIMES

Set primes $p$, we have:

$p$ is 2, 3, 5, 7, 11, 13,

$p+2$ is 4, 5, 7, 9, 13, 15,

Wherein $p+2$ is the primes have: 5, 7, 13, the twin primes (3, 5), (5, 7), (11, 13). Set $p$+2 is the primes, the quantity as $L(x)$, we can get [1]:

$$\pi(x) = F(x) + L(x). \tag{5}$$

By (5) we can prove the twin primes conjecture.

## 4. SYMMETRY PRIMES THEOREM

The *T* theorem:

$$F(x) \sim \frac{F\pi(x)}{x}, \quad (x \to \infty). \tag{6}$$

Here (6) known as *symmetry primes theorem* [5].

Proof: by (4) we get:

$$F = x - \pi(x) - 1 = x\left(1 - \frac{\pi(x)+1}{x}\right). \tag{7}$$

By (7) can get:

$$\lim_{x \to \infty} \frac{x}{F} = 1.$$

If $F \sim x$, then $F(x) \sim \pi(x)$, by (3), (4) we can get:

$$\lim_{x \to \infty} \frac{x}{F} \Big/ \frac{\pi(x)}{F(x)} = 1. \tag{8}$$

By (8) can get:

$$\frac{F(x)}{F} \sim \frac{\pi(x)}{x}, \quad (x \to \infty). \tag{9}$$

By (9) The T theorem proved.

## 5. PROVE THE TWIN PRIMES CONJECTURE

By (5) we get:

$$L(x) = \pi(x) - F(x). \tag{10}$$

By (6), (10) can get:

$$L(x) \sim \pi(x) - \frac{F\pi(x)}{x}, \quad (x \to \infty). \tag{11}$$

By (11) we get:

$$L(x) \sim \frac{\pi^2(x)}{x}, \quad (x \to \infty).$$

The twin primes conjecture proved. The number of twin primes. By (10) we get [6-7]:

$$\pi(x) \sim \sum_{n=2}^{x} \frac{1}{\ln(n)} \text{ and } F(x) \sim \frac{x}{\ln x}.$$

Can get:

$$L(x) \sim \sum_{n=2}^{x} \frac{1}{\ln(n)} - \frac{x}{\ln x}, \quad (x \to \infty).$$

Generally speaking:

$$L(x) \sim c\sum_{n=2}^{x}\frac{1}{\ln(n)} - c\frac{x}{\ln x}, \quad c = 1.32\cdots\cdots$$

# 6. PROVE GOLDBACH CONJECTURE

Set even $N$ =16, $k < N$, we have:

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $k$ | is 1, | 2, | 3, | 4, | 5, | 6, | 7, | 8, | 9, | 10, | 11, | 12, | 13, | 14, | 15, |
| $N$-$k$ | is 15, | 14, | 13, | 12, | 11, | 10, | 9, | 8, | 7, | 6, | 5, | 4, | 3, | 2, | 1. |

Set $N$-$k$ is the numbers of primes as $\pi$ ($N$), we get [4]:

$$\frac{\pi(N)}{N}. \tag{12}$$

Set composite number $h$, the numbers of composite number as $F$, we have:

$h$ is 4, 6, 8, 9, 10, 12, 14, 15,

$N$-$h$ is 12, 10, 8, 7, 6, 4, 2, 1.

Set $N$ -$h$ is the numbers of primes as $F$ ($N$), we get [5]26,[6]:

$$\frac{F(N)}{F}. \tag{13}$$

Set the primes $p$, we have [4]:

$p$ is 2, 3, 5, 7, 11, 13,

$N$-$p$ is 14, 13, 11, 9, 5, 3,

Set $N$ -$p$ is the numbers of primes as $G$ ($N$), we can get:

$$\pi(N) = F(N) + G(N). \tag{14}$$

By (12), (13) can prove:

$$F(N) \sim \frac{F\pi(N)}{N}, \quad (N \to \infty). \tag{15}$$

The proof and the twin primes conjecture are the same. by (14), (15) we can get [8]:

$$G(N) \sim \frac{\pi^2(N)}{N}, \quad (x \to \infty).$$

The Goldbach conjecture proved.

# 7. GOLDBACH'S CONJECTURE CALCULATION

Formulas are [3]:

$$G(N) \sim \frac{2c(N)\,N}{\ln^2(N)}. \tag{16}$$

Here (16) known as *Hardy formula*. Which *Laman Niu Yang factor*:

$$c(N)=\prod_{P\le N}\frac{p(P-2)}{(P-1)^2}\prod_{P|N}\frac{P-1}{P-2}.$$

## 8. WANG XINYU DOUBLE SIEVE TRANSFORM

Set $p>2$, have:

$$G(N)\sim\frac{N}{2}\prod_{P|N}\left(1-\frac{1}{P}\right)\prod_{P\perp N}\left(1-\frac{2}{P}\right),\quad p\le N^{1/2}. \tag{17}$$

Here (17) known as *double sieve transform formula*. qingdao china Wang Xinyu transform:

$$\frac{N}{2}\prod_{P|N}\frac{P-1}{P}\prod_{P\perp N}\frac{P-2}{P}=\frac{N}{2}\frac{\prod_{P|N}\frac{P-1}{P}}{\prod_{P|N}\frac{P-2}{P}}\prod_{P|N}\frac{P-2}{P}\prod_{P\perp N}\frac{P-2}{P}$$

$$=\frac{N}{2}\prod_{P|N}\frac{P-1}{P-2}\prod_{P\le\sqrt{N}}\frac{P-2}{P}$$

$$=\frac{N}{2}\prod_{P|N}\frac{P-1}{P-2}\prod_{P\le\sqrt{N}}\frac{P-2}{P}\frac{P^2}{(P-1)^2}\frac{(P-1)^2}{P^2}$$

$$=\frac{N}{2}\prod_{P|N}\frac{P-1}{P-2}\prod_{P\le\sqrt{N}}\frac{P(P-2)}{(P-1)^2}\prod_{P\le\sqrt{N}}\frac{(P-1)^2}{P^2}$$

Can get [2]:

$$\prod_{P\le\sqrt{N}}\frac{(P-1)^2}{P^2}\sim\frac{4\pi^2(N)}{N^2}.$$

Get:

$$G(N)\sim 2\prod_{P|N}\frac{P-1}{P-2}\prod_{P\le\sqrt{N}}\frac{P(P-2)}{(P-1)^2}\frac{N}{\ln^2 N}. \tag{18}$$

Here (18) also double sieve transform formula. And Hardy formulas are the same.

## REFERENCES


[01] Manin (Russian) et al. (2006). *Modern number theory guided*. Science Press.
[02] Hua, L. G. (1979). *Number theory guide*. Science Press.
[03] Neukirch, J.(2007). *Algebraic number theory*. Science Press.
[04] Wang, Y. (Ed.). (1987). *Goldbach conjecture research*. Heilongjiang Community Education.
[05] Liu, D. (2005). Goldbach conjectureelementary discussion. *Neijiang Science and Technology*, (2).

[06] Liu, D. (2013). Elementary discussion of the distribution of prime numbers. *Progress in Applied Mathematics*, *5*(2).
[07] Liu, D., & Liu, J. F. (2013). Riemann hypothesis elementary discussion. *Progress in Applied Mathematics*, *6*(3).
[08] Liu, D. (2013). The proof of the jie bove conjecture. *Studies in Mathematical Sciences*, *7*(2).