On The Prime Equations: $P_1 = P+2$ and $P_2 = 2P+1$

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Abstract: Using Jiang function we prove that there exist infinitely many primes P such that P_1 and P_2 are all prime.

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Theorem

$$P_1 = P+2 \text{ and } P_2 = 2P+1 \tag{1}$$

There exist infinitely many primes P such that P_1 and P_2 are all prime.

Proof. We have Jiang function [1]

$$J_2(\omega) = \prod_P [P-1-\chi(P)], \tag{2}$$

where

$$\omega = \prod_P P.$$

$\chi(P)$ is the number of solutions of congruence

$$(q+2)(2q+1) \equiv 0 \pmod P \tag{3}$$

where $q = 1, \cdots, P-1$.

From (3) we have $\chi(2) = 0$, $\chi(3) = 1$, $\chi(P) = 2$ otherwise.

From (3) and (2) we have

$$J_2(\omega) = \prod_{5 \le P} (P-3) \ne 0 \tag{4}$$

We prove that there exist infinitely many primes P such that P_1 and P_2 are all prime.

we have the best asymptotic formula

$$\pi_3(N,2) = \left|\{P \le N : P+2 = prime, 2P+1 = prime\}\right| \sim \frac{J_2(\omega)\omega^2}{\phi^3(\omega)} \frac{N}{\log^3 N} \tag{5}$$

where $\phi(\omega) = \prod_P (P-1)$.

Reference

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