This holds for $p = 7$ and $g = 3$. The remaining two cases $-g^2 \pm g + 1 = 0$ are equivalent because $-g^2 + g + 1 = 0$ if and only if $-g^{-2} - g^{-1} + 1 = 0$. In other words, we only need to consider the equality $g^2 = g + 1$ over $\mathbb{F}_p$. Such a primitive root g is called a *Fibonacci primitive root* modulo p, as the *golden ratio* φ_{gr} satisfying $\varphi_{gr}^2 = \varphi_{gr} + 1$. The primes p such that $\mathbb{F}_p$ has a Fibonacci primitive root is the sequence A003147: $5, 11, 19, 31, 41, 59, 61, 71, 79, 109, \ldots$ on OEIS [Slo]. Consequently, we have $N(p,(p-1)/2) > 0$ if and only if $\mathbb{F}_p$ has a Fibonacci primitive root. On the other hand, the order $|H|$ of the subgroup $H = \langle -1, 2\rangle$ is an even integer. It follows that $\ell_0 = \frac{p-1}{|H|}$ must divide $\frac{p-1}{2}$. By Proposition 5.3, we see that Equation (2) is solvable over $\mathbb{F}_p$ if $\mathbb{F}_p$ has a Fibonacci primitive root. In this case, there exists a solution $(x,y) \in \mathbb{F}_p^2$ such that $xy \neq 0$ and thus Conjecture C holds.

Proposition 5.4. *If $\mathbb{F}_p$ has a Fibonacci primitive root, then* Conjecture C *holds for this p.*

On a related issue, for the valid cases in Conjecture C established above we would like to know how many prime numbers p are there such that the subgroup H generated by -1 and 2 has the given index ℓ_0 in $\mathbb{F}_p^\times$. This question can be viewed as a generalization of the Artin's primitive root conjecture. It is shown in [Mur91, Theorem 1] that there are infinitely many primes p such that the index $[\mathbb{F}_p^\times : H] = \ell_0$ under the *Generalized Riemann Hypothesis* (GRH). Assuming GRH, we conclude from Corollary B that there are infinitely many prime numbers p with ℓ_0 satisfying conditions in Theorem 5.2 and therefore, the size of optimal CACs of prime lengths is equal to $M(p,\ell_0)$ for *infinitely many* primes p.

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