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## COLLOQUIUM MATHEMATICUM

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ON THE DIOPHANTINE EQUATION  $F_n - F_m = 2^p$ 

BY

ZAFER ŞİAR (Bingöl) and REFIK KESKİN (Sakarya)

**Abstract.** We solve the Diophantine equation in the title in nonnegative integers  $m, n$ , and  $a$ . In order to prove our result, we use lower bounds for linear forms in logarithms and a version of the Baker–Davenport reduction method in Diophantine approximation.

**1. Introduction.** The Fibonacci sequence  $(F_n)$  is defined as  $F_0 = 0$ ,  $F_1 = 1$ , and  $F_n = F_{n-1} + F_{n-2}$  for  $n \geq 2$ . The Lucas sequence  $(L_n)$ , which is similar to the Fibonacci sequence, is defined by the same recursive pattern with initial conditions  $L_0 = 2$ ,  $L_1 = 1$ . The terms of the Fibonacci and Lucas sequences are called Fibonacci and Lucas numbers, respectively. The Fibonacci and Lucas numbers for negative indices are defined by  $F_{-n} = (-1)^{n+1}F_n$  and  $L_{-n} = (-1)^nL_n$  for  $n \geq 1$ . The Fibonacci and Lucas sequences have many interesting properties and have been studied by many researchers. For a brief history of Fibonacci and Lucas sequences one can consult [6]. Firstly, square terms and later perfect powers in the Fibonacci and Lucas sequences have attracted the attention of the researchers. The perfect powers in the Fibonacci and Lucas sequences have been determined in 2006 by Bugeaud, Mignotte and Siksek [5]. The Diophantine equation  $L_n + L_m = 2^p$  has been tackled by Bravo and Luca [2]. Two years later, the same authors solved the Diophantine equation  $F_n + F_m = 2^p$  in [3]. Moreover, Luca and Patel [8] found that all solutions of the Diophantine equation

$$(1.1) \quad F_n \pm F_m = y^p, \quad p \geq 2,$$

in integers  $(n, m, y, p)$  with  $n \equiv m \pmod{2}$  satisfy either  $\max\{|n|, |m|\} \leq 36$ , or  $y = 0$  and  $|n| = |m|$ . But the case  $n \not\equiv m \pmod{2}$  is still an open problem. Motivated by the studies of Bravo and Luca, we consider the Diophantine equation

$$(1.2) \quad F_n - F_m = 2^a$$

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