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On the moments of the number of representations as sums of two prime squares

The solutions to the system of equations $x_1^2 + x_2^2 = x_3^2 + x_4^2$ with $x_i \leq R$ in integers come in two pairs, the diagonal ones and the off-diagonal ones. The number of off-diagonal solutions is more than that of diagonal solutions. If we instead focus our attention to the case x_i are prime, then the diagonal solutions overtake the off-diagonal solutions; this effect is called "paucity". This phenomenon also continues in the case of the system of three equations. For more equations, we expect off-diagonal solutions to be the main contribution.

In this talk, we will give ideas on how to get an upper bound for the off-diagonal solutions in the two equations case. The approach we present is generalizable to many equations. If time permits, we will also see how to get lower bounds conditional on some quadratic extension of the Green-Tao theorem.