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Partitions detect primes

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Abstract

This talk presents “partition theoretic” analogs of the classical work of Matiyasevich that resolved Hilbert’s Tenth Problem in the negative. The Diophantine equations we consider involve equations of MacMahon’s partition functions and their natural generalizations. Here we explicitly construct infinitely many Diophantine equations in partition functions whose solutions are precisely the prime numbers. To this end, we produce explicit additive bases of all graded weights of quasimodular forms, which is of independent interest with many further applications. This is joint work with Will Craig and Jan-Willem van Ittersum, and this work was recognized as the runner-up for the 2025 Cozzarelli Prize, which recognizes the best paper of year in the Proceedings of the National Academy of Sciences in the Physical Sciences.

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