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Abundance of 3APs in sparse subsets of integers, finite fields, and Euclidean spaces

Motivated by the study of patterns in the prime numbers, in 1936 Erdős and Turán conjectured that any dense subset of the natural numbers must contain arbitrarily long arithmetic progressions. In 1953, Roth proved the 3-term case of this conjecture (later resolved in full by Szemerédi in '75) by Fourier analytic means. In 2008, Laba and Pramanik showed that an analog of the pseudorandom half of Roth's approach could be made to work in the fractal setting. As the field of additive combinatorics has come into its own in the past two decades, the study of arithmetic progressions within various sets, and, centrally, Roth's and Szemerédi's theorems, have continued to grow in significance. In this talk we will focus on the tri-directional interplay between harmonic analysis, geometric measure theory, and discrete additive combinatorics through the lens of recent work of the speaker (partially joint with Steven Senger).