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*Pair correlation statistics in subsets of the integers*

Given $\mathcal{A} \subset \mathbb{N}$ and $\alpha \in \mathbb{R}$, it is often of interest to consider pair correlations of the set $\alpha\mathcal{A}$ and their distribution modulo $1$. Denote by $A_N$ the first $N$ elements of $\mathcal{A}$. We say that $\mathcal{A}$ is "metric Poissonian" if

$$\frac{1}{N}\sum_{\substack{a,b\in A_N\\ a\neq b}} 1_{[-s/N,s/N]}(\{\alpha(a-b)\}) \to 2s \quad \text{as} \quad N\to\infty,$$

for almost all $\alpha$ and for all fixed $s$, where $\{x\} = x - \lfloor x \rfloor$ denotes the fractional part of $x$. The metric Poissonian property is a stronger notion of equidistibution modulo 1, and is closely related to the additive energy of the set. Indeed, Aistleitner, Larcher, and Lewko have shown that if the additive energy satisfies $E(A_N) = O(N^{3-\varepsilon})$ then $\mathcal{A}$ is metric Poissonian. In an appendix to the same paper, Bourgain gives that $\mathcal{A}$ cannot be metric Poissonian if $\limsup_{n\to\infty} E(A_N)N^{-3} > 0$. In this talk, we will discuss ways in which density and additive energy can be used to determine whether a set $\mathcal{A} \subset \mathbb{N}$ has the metric Poissonian property. This is joint work with Thomas Bloom, Sam Chow, and Aled Walker.