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A new type of deterministic Salem sets and their spectrality

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(joint work with Chun-Kit Lai and Ruxi Shi)

Salem sets have equal Fourier and Hausdorff dimensions, and spectral measures admit orthonormal bases of exponential functions in their L^2 spaces. In this talk, I will present a new deterministic construction of homogeneous Moran sets that brings these two properties together.

More precisely, for every $0 < s \leq 1$, we construct a homogeneous Moran set $K_s \subset [0,1]$ of Lebesgue measure zero and Hausdorff dimension s whose natural equal-weighted Cantor–Moran measure μ_s is spectral. Moreover, for every $0 < \alpha < s/2$, there exists a constant $C_{s,\alpha} > 0$ such that

$$|\widehat{\mu_s}(\xi)| \leq C_{s,\alpha}(1+|\xi|)^{-\alpha}, \qquad \xi \in \mathbb{R}.$$

The construction uses the Weil bound over finite fields to establish Fourier decay. We found this construction with the assistance of ChatGPT. This is a joint work with Chun-Kit Lai and Ruxi Shi.