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Salem sets, equidistribution and arithmetic progressions

The decay of the Fourier-Stieltjes transform of a measure on a set of positive Fourier dimension is an indication of the uniformity of distribution of the support of the measure. Such uniformity could also indicate that the set has additive properties, such as containing arithmetic progressions, if certain density conditions are satisfied. The same phenomenon can be observed in initial segments of the integers whose discrete Fourier transform decays sufficiently quickly. By adapting a construction of Salem, we make this correspondence precise by showing that infinite subsets of the integers can be used to construct Salem sets in the continuum. Through a characterisation of Salem sets in terms of equidistribution, we further show that one can construct subsets of the integers with a given uniformity requirement from Salem sets, in such a way that arithmetic progressions are preserved.