SPHERE PACKINGS WITH FORBIDDEN DISTANCES

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Abstract. In this talk we will present several results on the sphere packing problem in Euclidean space with forbidden distances (inspired by some old results in coding theory under similar setting). We will construct magic functions using Viazovska's modular forms approach to show that any 48-dimensional sphere packing that avoids the interval $(\sqrt{\frac{4}{3}}, \sqrt{\frac{5}{3}})$ has center density at most $(3/2)^{24}$. This bound is sharp and attained by any of the even unimodular extremal lattices $P_{48p}, P_{48q}, P_{48m}$ and P_{48n}. This gives evidence towards the conjecture that extremal lattices are optimal unconstrained sphere packings in 48 dimensions. We also provide sharp bounds for other constrained packings up to dimension 1200, these are also attained by extremal lattices. Moreover, in the 1-dimensional case, where is not at all clear that periodic packings are among those with largest density, we nevertheless give a condition on the set of constraints that allows this to happen, and we develop an algorithm to find these periodic configurations by relating the problem to a question about dominos. This is joint work with G. Vedana: arXiv:2308.03925.

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