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Bounding the Regularity Radius of Delone Sets

Delone sets are uniformly discrete point sets X in Euclidean d -space that are used in the modeling of crystals. They can be characterized by parameters r and R , where (usually) $2r$ is the smallest interpoint distance of X and R is the radius of a largest "empty ball" that can be placed into the interstices of X . The local theory for Delone sets searches for local conditions on X that guarantee the emergence of a crystallographic group of symmetries producing X as an orbit set consisting of a single point orbit or finitely many point orbits, respectively. The regularity radius $\hat{\rho}_d$ is defined as the smallest positive number ρ such that each Delone set X with congruent clusters of radius ρ is a regular system, that is, a point orbit under a crystallographic group. We discuss bounds for the regularity radius in terms of R , and present conjectures that have been verified for some particularly interesting classes of Delone sets. This is joint work with Nikolai Dolbilin, Alexey Garber and Marjorie Senechal.