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Local density fluctuations and hyperuniformity in quasicrystals[1]
ERDAL CELAL OĞUZ, SALVATORE TORQUATO, Department of Chemistry, Princeton University, Princeton, New Jersey 08544, USA — Local density fluctuations in many-body systems are of fundamental importance throughout various scientific disciplines, including physics, materials science, number theory and biology. In a point pattern, let the variance associated with the number of points contained in a spherical window of radius R be denoted by $\sigma^2(R)$. Hyperuniform point patterns in d dimensions do not possess infinite-wavelength fluctuations or, equivalently, possess a number variance that grows more slowly than the window volume, i.e., R^d [1]. Hyperuniform systems include all infinite periodic structures, aperiodic quasicrystals, and some special disordered systems. Previous investigations showed that the number variance for large R in hyperuniform systems serves as a useful metric to rank order systems according to the degree to which large-scale density fluctuations are suppressed. In this work, we investigate the number variance of two-dimensional quasicrystals with a variety of different rotational symmetries. We study how the number variance depends on the rotational symmetry and local isomorphism class of the quasicrystal. We compare these results to a number of different periodic systems as well as disordered hyperuniform systems.

[1] S. Torquato, F. H. Stillinger, PR E, 68 (2003)

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