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High-density hard-core configurations on a square lattice

Abstract. The hard-core model was in the focus of attention from an early stage of the progress in the rigorous Statistical Mechanics; its popularity increased after recent successes in studying dense-packing configurations of hard spheres in $\mathbb{R}^d$, for $d = 2, 3, 8, 24$ and in view of new applications, in particular in Computer Science and Biology. A lattice version of the same problem emerges when the sphere centers are positioned at sites of a given lattice (or a graph). We will discuss two problems: (i) specification of periodic ground states (PGSs), i.e., configurations of the maximum density which cannot be 'improved' by a local change, and (ii) identification of the dominant GSs generating extreme Gibbs/DLR measures for large values of fugacity by means of the Pirogov-Sinai theory. This presentation will be focused mainly (but not exclusively) on the case of a unit square lattice $\mathbb{Z}^2$. We plan to touch upon a number of arising topics, including sliding, tesselating, counting PGSs and dominant PGSs and the Peierls condition.

This is a joint work with A. Mazel and Y. Suhov