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How rigid are crystals in 2D? The hard disk model and 2D Gibbsian point processes.

Joint with Michael Fiedler

2D particle systems are believed to show some sort of crystalline phase: If the temperature is sufficiently low (or the density sufficiently high) the particles arrange themselves into a regular pattern, which is characterized by long-range correlations. So far there is no rigorous proof of this phenomenon.

Particle systems in equilibrium are usually modelled by Gibbsian point processes. We will describe this model in general and the simple special case of the hard disk model. We will give a short overview of what is known and what is expected to be true for these models. We will then describe recent results showing that the expected regular pattern within these models can not be too rigid: In a system of size n, positions of points near the center of the system fluctuate by at least a constant times $\sqrt{\log n}$. Our result holds for fairly general interaction potentials (including all interesting examples of interacting particle systems we know of) and arbitrary values of temperature and particle density.