

Advanced Topics in Stochastic Analysis

- Introduction to Lattice Models

Tuesdays 10–12 and Thursdays 10–12

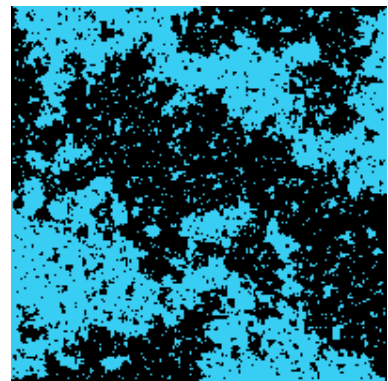
online course: for zoom-link, see eCampus or contact me via [firstname.lastname @ hcm.uni-bonn.de]

We present examples in the zoo of critical lattice models, originating from statistical physics, now very popular also in mathematics. No physics background is needed – this serves only as motivation.

We discuss the meaning of phase transitions, via example models such as variants of percolation, Ising model, polymers, and $O(n)$ -models. We outline some recent results on the mathematical understanding of critical phenomena. We will see examples of applications of discrete complex analysis, which has lead to recent breakthrough results, and renormalization group techniques, originating from physics ideas but now finding their use in mathematics as well. Some Gaussian fields will be discussed towards the end of the course.

The goal of the course is to provide an introduction and overview to mathematical formulation of statistical physics without relying on any physics background. Mathematically, in this area the main techniques are probability theory and clever combinatorics.

The precise plan can also depend on the participants' wishes.



Prerequisites:

Basic probability theory. The aim is to develop theory as the course proceeds, so no advanced prerequisites will be needed.

Literature:

- H. Duminil-Copin. Parafermionic observables and their applications to planar statistical physics models. <http://www.ihes.fr/~duminil/publi/parafermion.pdf>
- G. Grimmett. Probability on Graphs. <http://www.statslab.cam.ac.uk/~grg/books/pgs2e-draft.pdf>
- R. Bauerschmidt, H. Duminil-Copin, J. Goodman, and G. Slade. Lectures on Self-Avoiding Walks. http://www.ihes.fr/~duminil/publi/saw_lecture_notes.pdf
- R. Bauerschmidt, D. Brydges, and G. Slade. Introduction to a renormalisation group method. <http://arxiv.org/pdf/1907.05474.pdf>
- S. Friedli and Y. Velenik. Statistical Mechanics of Lattice Systems. <http://www.unige.ch/math/folks/velenik/smbook/>