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FB Mathematik

FB Physik, Mathematik und Informatik  
Institut für Mathematik

FB Informatik und Mathematik  
Institut für Mathematik  
Schwerpunkt Stochastik

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## Rhein-Main-Kolloquium Stochastik

TU Darmstadt, Goethe-Universität Frankfurt und Gutenberg-Universität Mainz

Friday, 17 January, 2025

3:15 pm: [Christian Mönch \(JGU\)](#)

### “Strict inequalities for percolation thresholds without essential enhancements”

Consider translation invariant independent long-range percolation on the  $d$ -dimensional lattice with coupling constants  $F(x,y)=F(0,y-x)=f(y-x)$ , where  $f$  is an integrable function. If  $f'$  is another coupling function which is coordinate-wise dominated by  $f$ , then the percolation threshold for  $f'$  is at least as great as that for  $f$ . I will discuss a new proof for the fact that this inequality is strict. The argument completely avoids the use of differential inequalities which are needed to implement the classical ‘essential enhancement’-technique of Aizenmann and Grimmett (1991). Instead, we couple the clusters of the ‘smaller’  $f'$ -configuration with a dependent percolation process on the original model parametrised by  $f$ . As a corollary, we obtain that the critical value for nearest neighbour percolation is strictly decreasing in the dimension, a result due to Kesten (1982). The equivalent statement for the contact process was, perhaps surprisingly, never explicitly proven. This is the main motivation for our approach -- our technique is transferable without much technical effort to the contact process/oriented percolation in continuous time. If time permits, I will also explain how a variation of the construction can be used to show that the critical value of loop percolation is strictly larger than the critical value of nearest neighbour percolation on any Galton-Watson tree with finite branching number larger than 1, and for any ensemble of finite graphs that converges locally to such a tree. These results generalise work of Mühlbacher (2021) for bounded degree graphs. The talk is based upon several joint works in progress with S. A. Bethuelsen (Bergen), and with A. Klippel (Darmstadt) and B. Lees (Leeds).

4:15 pm: Coffee break

4:45 pm: [David Belius \(UniDistance Suisse\)](#)

### “The TAP approach to mean field spin glasses”

Mean-field spin glass models like the Sherrington-Kirkpatrick model and its generalizations are paradigmatic examples of complex systems, and exhibit exotic and fascinating phenomena. Recently the Thouless-Andersson-Palmer (TAP) approach to these models has enjoyed renewed interest in the mathematics literature. This talk will give an overview of spin glasses and the TAP approach. Time permitting it will also present an upper bound for the free energy of these models in terms of the so-called TAP free energy. The proof elegantly relates the partition function of the model to the TAP free energy, by uses a microcanonical geometric method arising from a partition of the configuration space. The latter result is from the preprint <https://arxiv.org/abs/2204.00681>.

<https://www.stochastik.mathematik.uni-mainz.de/rhein-main-kolloquium-stochastik/>

Venue:

Johannes Gutenberg-Universität Mainz  
Building 2413, 5<sup>th</sup> floor | Room 05-432 (Hilbertraum)  
Staudingerweg 9, 55128 Mainz

Any interested parties are welcome.

Yours, Lisa Hartung and Matthias Birkner