University of Cologne
Department of Mathematics & Computer Science
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SS 2026:
Gaussian free field and related topics

The Gaussian free field is a fundamental model in probability theory and statistical physics. It plays the role of Brownian motion with a multidimensional index set and hence is a (conjectured) universal scaling limit. We will investigate the (mostly two-dimensional) Gaussian free field and then look into related ideas such as Liouville measures, Gaussian multiplicative chaos and planar maps.

We are planning to mostly use [1] as a reference.

The course is aimed at MSc students in mathematics and business mathematics, and forms part of the area stochastics and insurance mathematics.

Prerequisites: Probability theory I & II (the relevant parts of probability theory II could also be studied individually whenever necessary)

Literatur:

- N. Berestycki, E. Powell. Gaussian free field and Liouville quantum gravity (available at through USB or at `https://arxiv.org/abs/2404.16642`).
- W. Werner, E. Powell. Lecture notes on the Gaussian Free Field (available at `https://arxiv.org/abs/2004.04720`).
- R. Rhodes, V. Vargas. Gaussian multiplicative chaos and applications: a review (available at `https://arxiv.org/abs/1305.6221`)
- A.-S. Sznitman. Topics in Occupation Times and Gaussian Free Fields (available at `https://ethz.ch/content/dam/ethz/special-interest/math/department/Research/Rese`

Lectures:	Mondays 2:00 pm – 3:30 pm (Seminarraum 1) Thursdays, noon – 1:30 pm (Seminarraum 1)
Start of lectures:	Monday, April 13, 2026
Exercise classes:	tba

Literaturliste

[1] Nathanaël Berestycki and Ellen Powell. *Gaussian Free Field and Liouville Quantum Gravity*. Cambridge Studies in Advanced Mathematics. Cambridge University Press, 2025.