

MATH-606

Statistical Field Theory

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Cursus	Sem.	Type
Mathematics		Opt.

Language of teaching	English
Credits	2
Session	
Exam	Oral
Workload	60h
Hours	34
Courses	22
TP	12
Number of positions	

Remark

Fall semester - Thursdays from 24.09.2020

Summary

The goal of this class is to teach how to look at two-dimensional field theories, how to analyse them, how to put structures on them. In the end, the student should have a good picture into what we understand for what is happening at the intersection of Quantum Field Theory and Statistical Mechanics

Content

The developments of Statistical Mechanics and Quantum Field Theory are among the major achievements of the 20th century's science. In the second half of the century, these two subjects started to converge. In two dimensions, this resulted in one of the most remarkable chapters of mathematical physics: Statistical Field Theory reveals deep structures allowing for extremely precise investigations, making such theories powerful building blocks of many subjects of mathematics and physics.

The focus of this class is on two-dimensional Conformal Field Theory (CFT) and its applications to statistical mechanics. CFT methods allow one to implement representation theory methods to study the scaling limits of various lattice models (Ising model, tri-critical Ising model, Gaussian Free Field, percolation, ...), to classify them and to obtain spectacular exact results. Special emphasis will be put on giving an intuitive understanding of the various mechanisms, and on making mathematically rigorous statements. If time allows, we will discuss massive integrable theories as well, and some connections to string theory.

While this is physics subject, much of it can now be understood rigorously thanks to recent advances in mathematical physics (in particular SLE processes and discrete complex analysis); the CFT ideas are furthermore excellent ways to gain general intuition in what happens in systems with infinitely-many degrees of freedom.

Keywords

Conformal Field Theory, Statistical Mechanics, Mathematical Physics, Lattice Models

Learning Prerequisites**Required courses**

Some familiarity with either advanced probability or with physics

Resources**Websites**

- <http://csft.epfl.ch>