

Journée thématique autour de la renormalisation

lundi 12 juin 2023 - lundi 12 juin 2023

école polytechnique

Programme Scientifique

Nils Berglund*Renormalisation of static and dynamic Φ^4_d models*

The static Φ^4 model on the d -dimensional torus is a well-known toy model in Euclidean quantum field theory. It is well-posed for $d = 1$, and its renormalisation is well-understood for $d = 2$ and $d = 3$, thanks to works by Glimm, Jaffe, and many others. In the dynamic case, the model becomes a stochastic PDE, motivated by the idea of stochastic quantization. It is well-posed for $d = 1$. A proof of existence of solutions to a renormalised version for $d = 2$ has been obtained by Da Prato and Debussche in 2003, while the case $d = 3$ was first solved by Martin Hairer in 2014, using his theory of regularity structures. I will provide an overview of these results, focusing on algebraic techniques of the proofs, and briefly address more general recent results on renormalisation of singular SPDEs.

The talk is partly based on the book
<https://ems.press/books/elm/232>

Jonas Lampart*Singular perturbations and renormalisation in non-relativistic quantum field theory*

I will explain the relation of ultra-violet renormalisation to the theory of singular perturbations of self-adjoint operators in some examples from non-relativistic quantum field theory. After introducing the relevant formalism, I will discuss in detail a toy model of particle creation and annihilation at a point source. I will then outline how the same approach can be extended to more interesting models in which non-relativistic particles interact with a quantum field. An example is the Bogoliubov-Fröhlich Hamiltonian, modelling the interaction of an impurity in a Bose-Einstein Condensate with the field of Bogoliubov excitations.

Slava Rychkov*Real-space renormalization of lattice models using tensor networks*

Critical points of lattice models, such as the 3d Ising model, are conjectured by Kenneth Wilson in 1970's to correspond to fixed points of renormalization group transformations. I will discuss the status of this conjecture, a novel class of renormalization group transformations using the language of tensor networks, a few results which were recently obtained using this language for the high and low-temperature phases of 2d models, and the ongoing progress towards the construction of a nontrivial 2d fixed point. Joint work with Tom Kennedy and Nikolay Ebel.