Non-Equilibrium Statistical Field Theory (M8)

Non-Examinable (Graduate Level)

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This course introduces Master Equations – an ODE for time dependent probability distributions – as a model for reaction systems on lattices. After briefly exploring its basic properties and models such as random walkers as well as branching and coagulation processes, they are transformed into a second-quantized form using bosonic ladder operators and coherent states. The meaning and properties associated with shifts of the creation and annihilation operators are explored as well as the interpretation of observables. Then, the second quantized equation is formally solved in a path integral. At this point, Doi-Peliti field theory starts and a few example models are presented: diffusion, branching, coagulation as well as coupled reactions. Feynman diagrams, loop corrections, n-point correlation functions are all concepts which are introduced and Part III students taking *SFT* will hopefully enjoy a non-equilibrium point of view on them.

Prerequisites

It will be very beneficial to take the Part III course *Statistical Field Theory* (*SFT*) alongside this course. Although both courses talk about different statistical field theories, they explore many of the same concepts.

Literature

1. N.G. van Kampen, *Stochastic Processes in Physics and Chemistry* Elsevier, 1992
2. Uwe Täuber *Critical Dynamics* 1st edition. Cambridge University Press, 2014.
3. John Cardy, *Lecture Notes on Field Theory and Nonequilibrium Statistical Mechanics*, Available at

   https://www-thphys.physics.ox.ac.uk/people/JohnCardy/

4. Gunnar Pruessner *Lecture Notes on Non-equilibrium Statistical Mechanics* Available at

   http://wwwf.imperial.ac.uk/~pruess/publications/Gunnar_Pruessner_field_theory_notes.pdf

Additional support

Lecture notes and voluntary example sheets will be provided. However, since this is a non-examinable course, there will be no example classes.